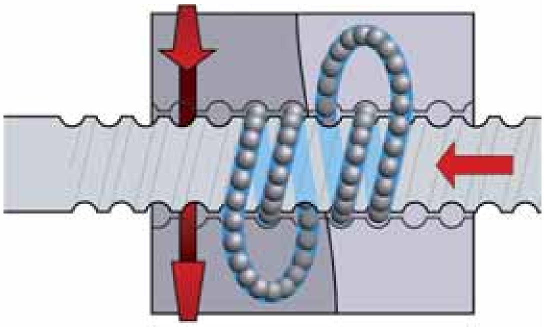
Self-Study Program 990303



The 2012 Audi A7 Running Gear and Suspension Systems

Audi Academy

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

Table of Contents

Table of Contents

The Self-Study Program provides introductory information regarding the design and function of new models, automotive components, or technologies.

The Self-Study Program is not a Repair Manual!
All values given are intended as a guideline only.

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

Reference

Note

!

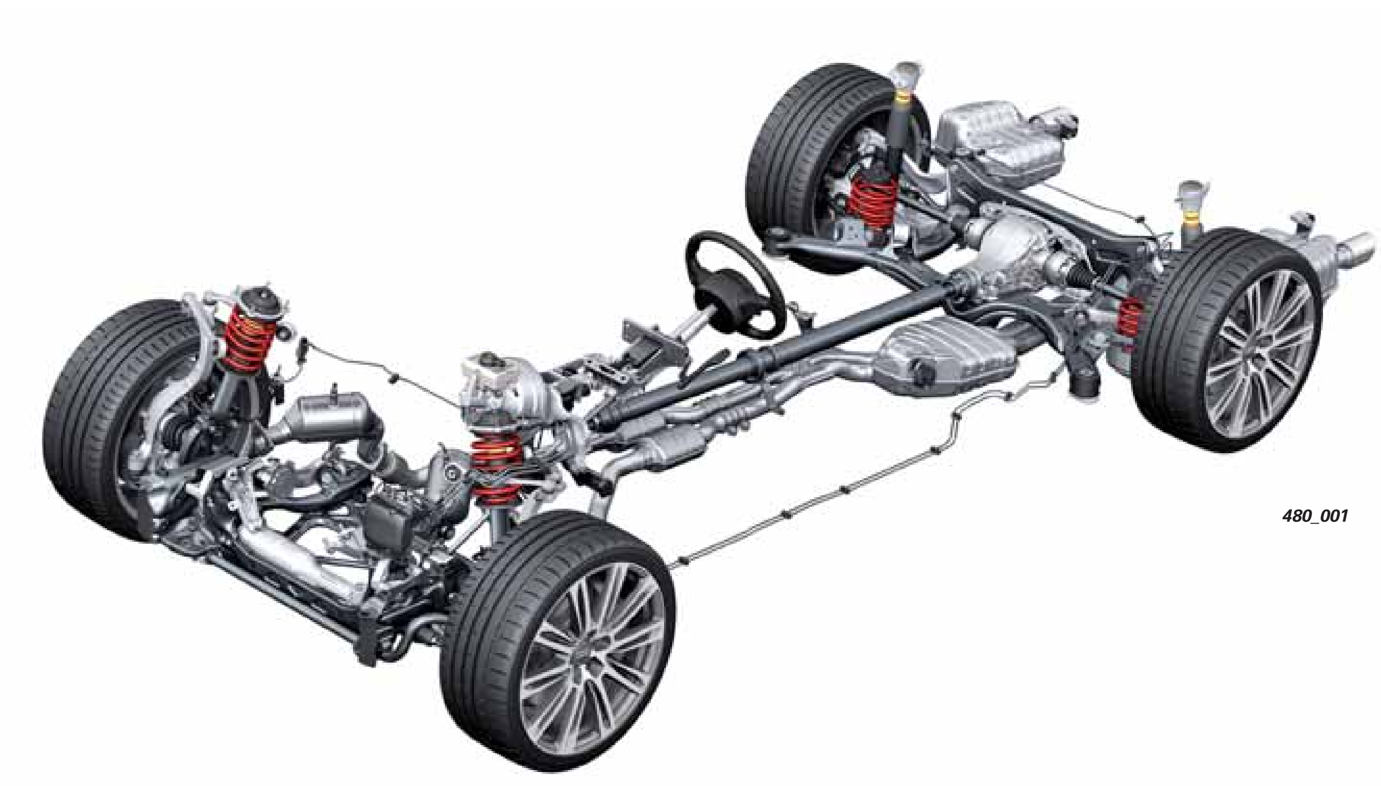
The major development goals for the running gear and suspension of the 2012 Audi A7 were to achieve great agility, precise handling, a high level of safety, and refined driving comfort.

These goals have been accomplished with the use of Audi's proven five-link front axle in conjunction with a trapezoidal link rear axle. This is the same suspension configuration used on the 2011 Audi A8.

Other design features, such as mounting the front final drive ahead of the differential, resulted in a larger wheelbase, which increased ride comfort and shortened the front overhang.

As in other Audi models, the steering gear is mounted forward of the front axle which helps ensure exact steering response and a precise steering feel in every driving situation.

The implementation of electromechanical power steering has not only reduced fuel consumption but also enabled additional functions that contribute to driver safety.



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Axles and Wheel Alignment

Overview

The following running gear and suspension variants are available for the 2012 A7 in North America:

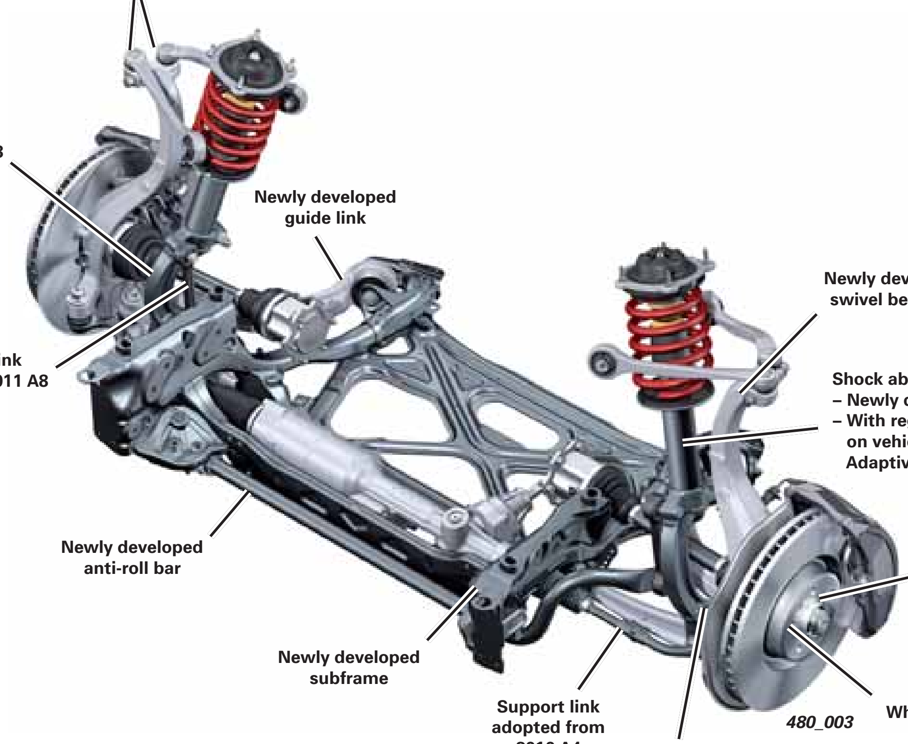
Production Control Number (PR)	Description	Technical Implementation	Offer
1BA	Standard running gear /suspension	Steel suspension	Series standard
1BE	Sports running gear /suspension	Steel suspension	Option
1BV	Sports running gear /suspension S line (offered from quattro GmbH)	Steel suspension	Option
1BK	Adaptive air suspension (delayed introduction)	Air suspension	Option

480_002

Front Axle

As stated earlier, the design of the front axle was based on the five-link front axle used in the 2011 A8. The bearing bracket to support the upper axle link has also been integrated into the body of the A7.

In addition to reducing weight and increasing rigidity, this has also meant that the installation tolerances of the upper axle link have been reduced. As a result, the stabilizers and shock absorbers were then reconfigured.



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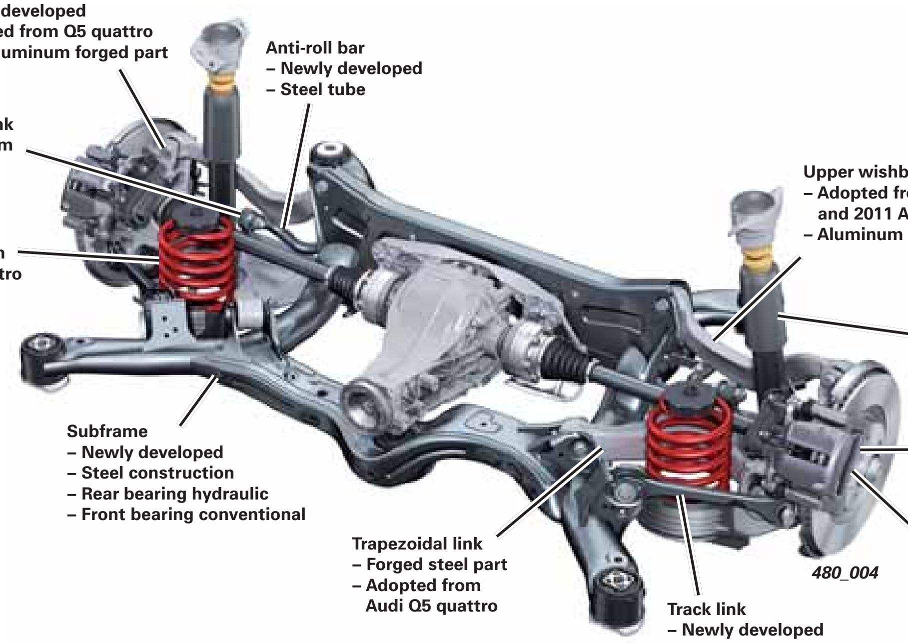
Rear Axle

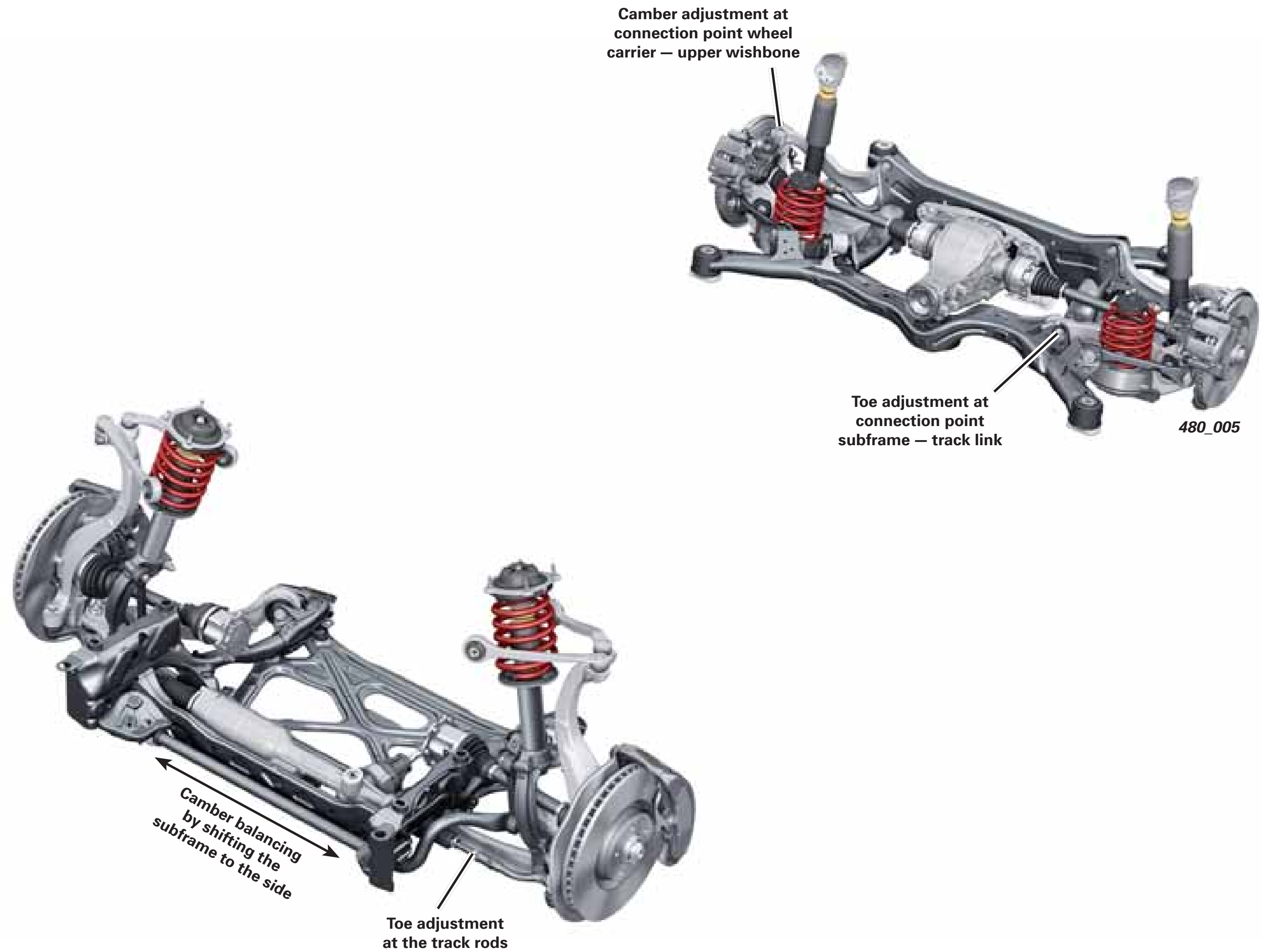
The rear axle is based on the trapezoidal link rear axle already used in the Audi Q5 quattro. The springs and shock absorbers are arranged separately from one another.

This design increases pass through loading capability when the floor is level.



Running Gear / Alignment

The alignment of the front and rear axles is the same as on the 2011 A8. The adjustment points are identical for steel suspension vehicles and those with Adaptive Air Suspension.



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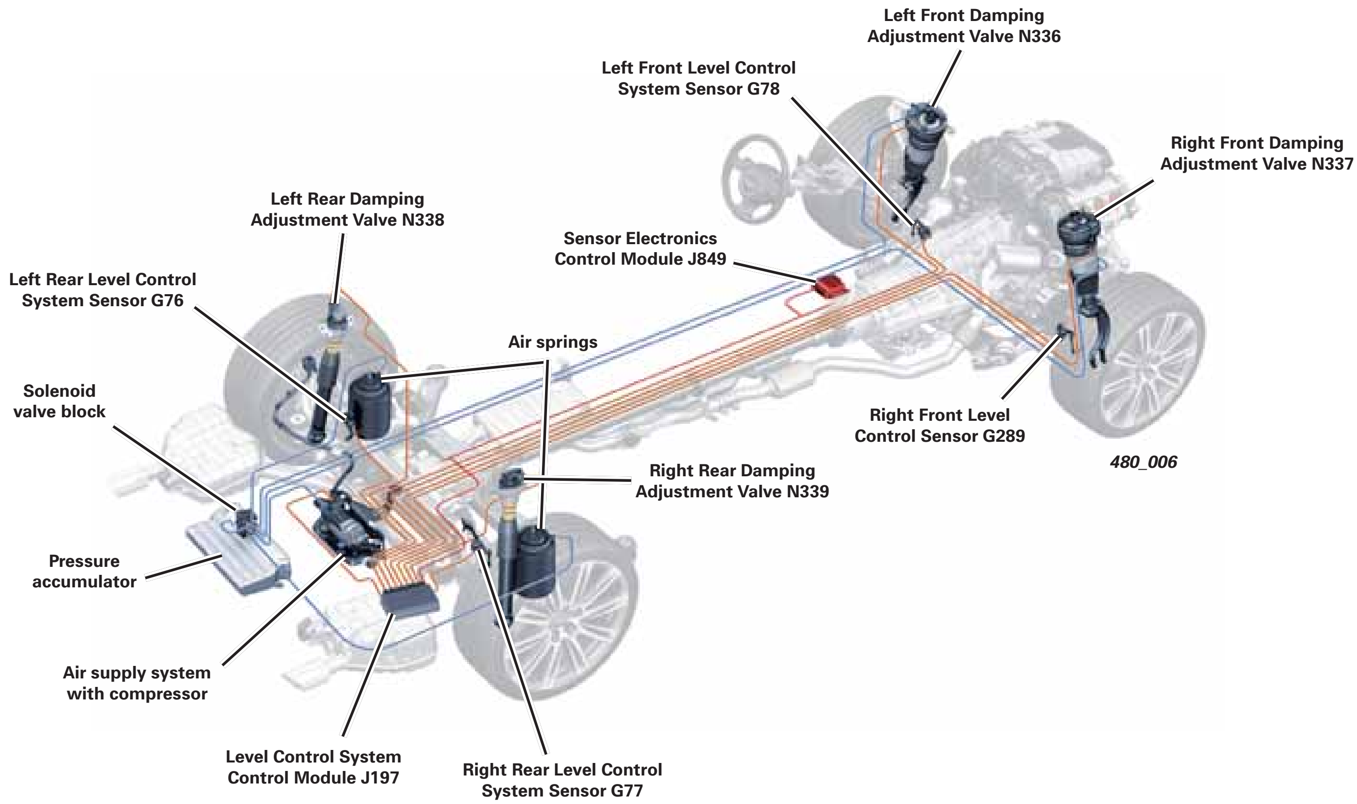
Adaptive Air Suspension

Overview

The design and operation of the Adaptive Air Suspension system of the Audi A7 are the same as those of the 2011 A8. However, Adaptive Air Suspension will not be available at vehicle launch.



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System Components

Level Control System Control Module J197

J197 communicates over the FlexRay data bus. It receives relevant acceleration signals from Sensor Electronics Control Module J849.

J197 actuates the solenoid valves and air compressor for leveling the vehicle and adjusting the dampers. Damper valves are only operated while the vehicle is being driven and a road speed signal is being received from ABS Control Module J104.

Actuating current to the dampers is in a range of approximately 0.0A to 1.8A. Maximum damping force is achieved at approximately 0.0A, while a current of 1.8A is required for minimum damping force.

To achieve the greatest possible driving comfort, the base current applied to the valves is approximately 1.8A. If the driver has selected dynamic mode, the greatest comfort is achieved when 1.6A current is applied.

J197 is located in the right rear of the luggage compartment, behind the trim panel.

480_007

Solenoid Valve Block

The design of the solenoid block and its electric and pneumatic functions is identical to the 2011 Audi A8. The connection assignment and color coding of the lines are identical, too.

However, the solenoid valve block differs from the 2011 A8, in that it is not part of the air supply unit. Instead, it is located separately in a recess of the foam cover above the pressure accumulator.

When removing the vehicle battery, the solenoid block can be moved from its position together with the foam cover without removing the air lines.

480_008

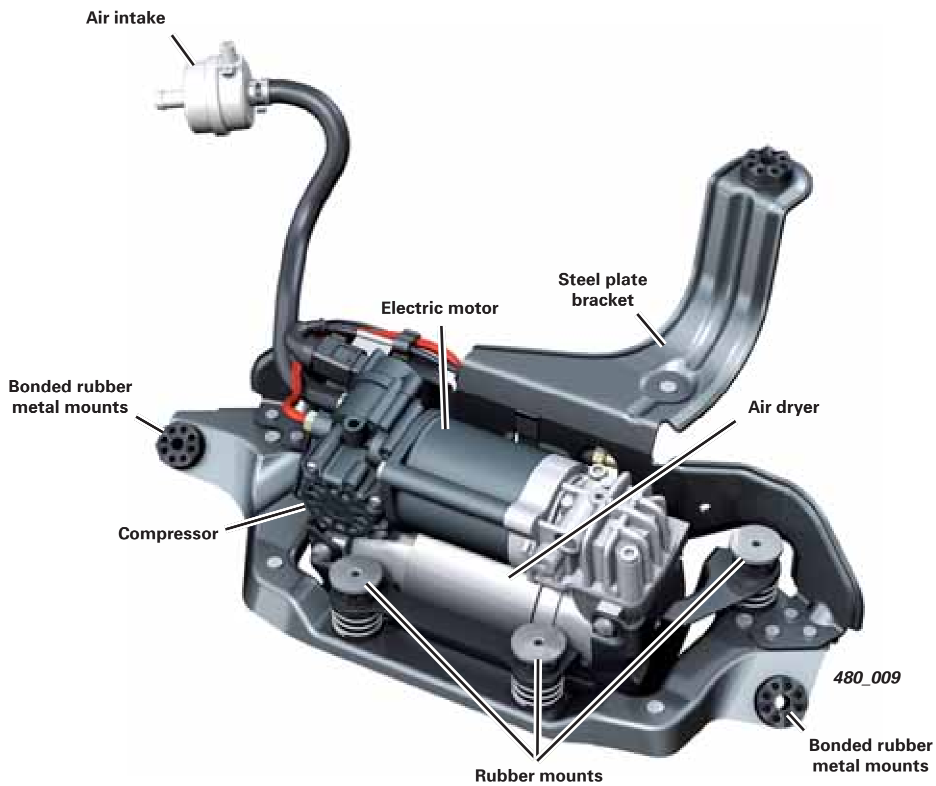
Air Supply System

The air supply system consists of the dry running, electric motor driven compressor, an air dryer, intake dampers, and corresponding air lines. The air supply system unit is installed under the spare tire well. Its components are attached to a steel plate bracket by springs and rubber mounts.

The complete unit is attached to the vehicle body with rubber/metal mounts. These mounts help insulate the body acoustically from the unit. An outer cover with stone chip protective material is bolted onto the bracket.

A single stage compressor generates up to 261.0 psi (18 bar) pressure to operate the system. A pressure limiting valve in the compressor protects the system from over pressure. Air is drawn in via intake dampers and the air dryer from the left rear wheel housing. The air dryer is self-regenerating and requires no maintenance.

To protect against mechanical damage from overheating, the compressor temperature is “model calculated” by measuring the change of resistance in the magnetic coil of the drain valve.



Pressure Accumulator

The task of the pressure accumulator is to maintain system availability. When the vehicle is stationary or moving at slow speeds, all control pressure changes are carried out through the accumulator if there is sufficient pressure. This means that it is not necessary to run the compressor at all times, which makes for a quieter passenger compartment.

There can be upward control operations (raising the vehicle) if the pressure in the accumulator is at least 43.5 psi (3 bar) higher than the pressure in the air spring to be controlled.

The volume of the accumulator is 1.5 gal (5.8 liters). Air lines from the pressure accumulator to the solenoid valve block, as well as from the compressor to the solenoid block, have large cross sections which allow the accumulator to fill quickly.

The accumulator is located in the spare tire well, directly behind the vehicle battery. It is made of aluminum.

480_010

Vehicle Level Sensors G76-78 and G289

Four vehicle level sensors are used in the A7. They have been adopted from the 2011 A8.

480_011

Sensor Electronics Control Module J849

Introduced on the 2011 A8, J849 is also used on the A7. The body acceleration sensors used on previous versions of the Adaptive Air Suspension system have been eliminated.

J849 sends the vehicle acceleration values in x, y, and z direction, as well as the corresponding yaw rates to the adaptive suspension control module. Communication between the two control modules takes place on the FlexRay data bus.

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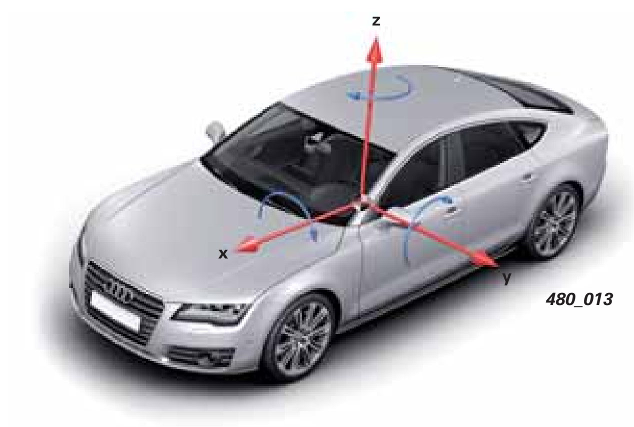


480_013

Air Strut, Front Axle

The air struts are newly developed, but their design is the same as the components already used in the 2011 A8.

Infinitely variable twin tube shock absorbers are used. The controlled valve is located in the damper piston. The electrical wiring 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 flexible boot protects the air spring seal from dirt. There are residual pressure retaining valves on the air line connections, ensuring a minimum air pressure of 43.5 psi (3 bar).

480_014

Air Spring, Rear Axle

The air springs and shock absorber are mounted separately on the rear axle.

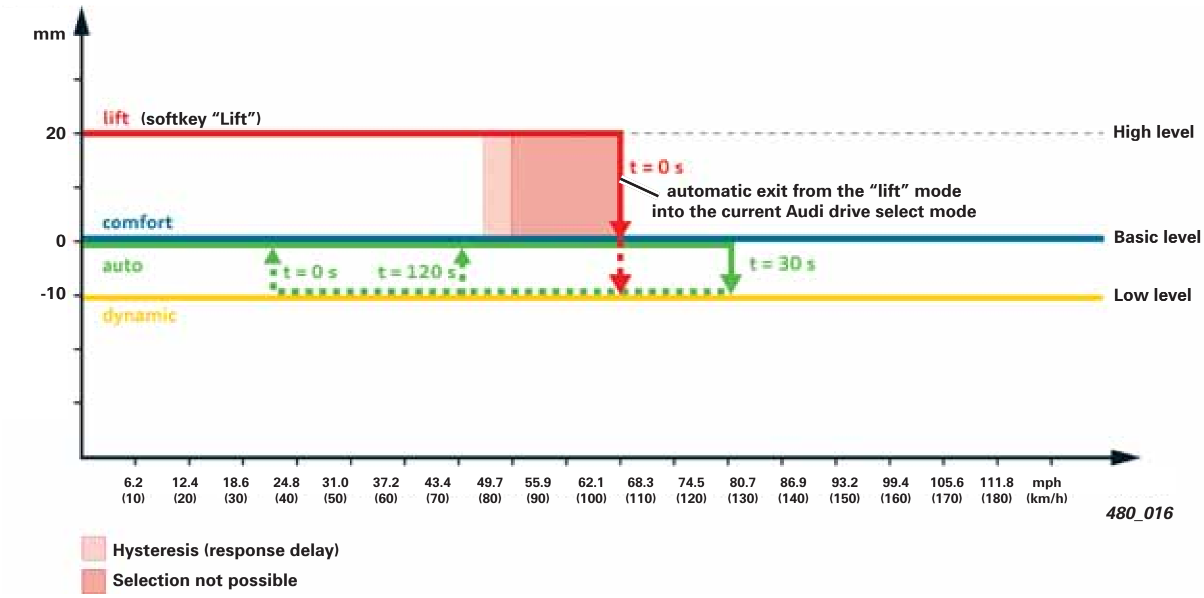
480_015

Control Strategy

1BK Adaptive Air Suspension

Control algorithms generally differ depending on the running gear and suspension variant.

The characteristics and control strategy for the Audi A7 are the same as those for the 2011 A8.



480_016

The control system implements three different vehicle heights. Starting from the basic level, the "lift" mode can be set by raising the vehicle .78" (20mm).

This mode is automatically deactivated upon reaching or exceeding a vehicle speed of 62.1 mph (100 km/h). This mode can be selected up to 49.7 mph (80 km/h).

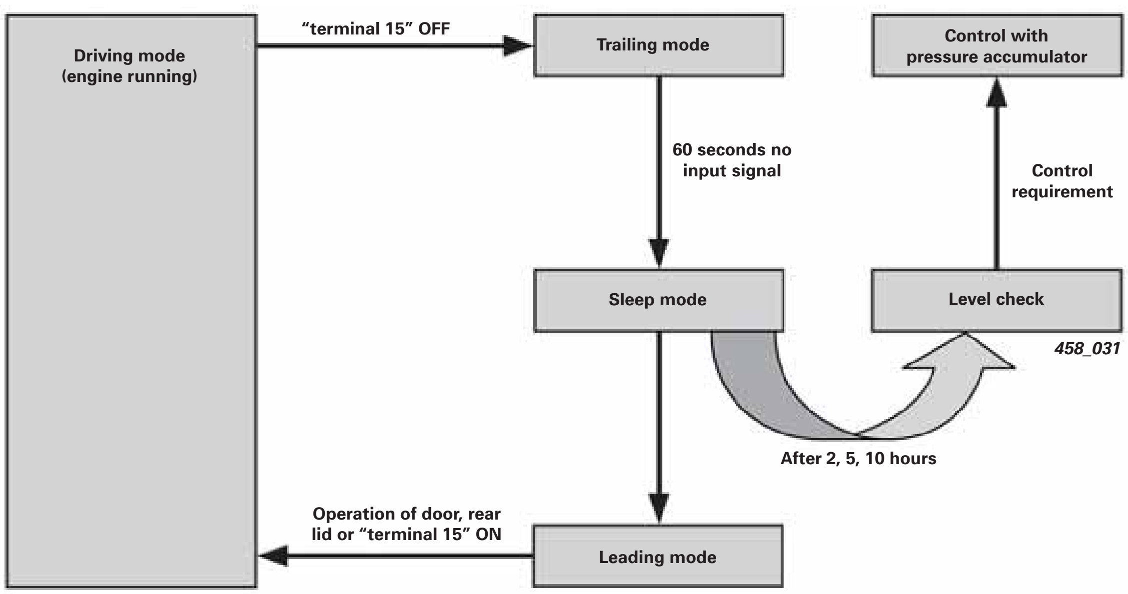
The level is lowered 0.39 in (10 mm) by activating "dynamic" mode. If a road speed of 74.5 mph (120 km/h) is maintained for 30 seconds in "auto" mode, the vehicle is automatically lowered 0.39 in (10 mm) below the basic level.

The vehicle is not lowered to highway level in "comfort" mode. Highway level is deactivated automatically when vehicle speed drops below 43.4 mph (70 km/h) for 120 seconds or immediately when the speed drops below 21.7 mph (35 km/h).

When activating "comfort" mode, the basic level is set, along with comfort-orientated damper control.

Control Strategy Characteristics

- When control procedures (changing the vehicle level) are made while driving, the left and right front dampers are moved the same amount. Dimensional changes to the left and right rear dampers are made individually.
- When changes to the level are made for adaptations or when learning control positions during service work, the dimensional changes are done individually at each damper. This helps ensure system accuracy.
- After the ignition has been switched OFF, the control module remains active for 60 seconds awaiting further input signals. If no signals are received, energy-saving sleep mode is activated.
- In sleep mode, the vehicle level is checked by Level Control System Control Module J197 after two, five, and 10 hours. J197 supplies operating voltage to the vehicle level sensors and reads their measured values.
- If J197 recognizes that control intervention is required, the system checks to see if there is sufficient accumulator pressure for this purpose, which would need to be a minimum of 43.5 psi (3 bar) higher than the pressure in the air spring to be regulated. If this is the case, the vehicle level is then corrected.
- No further control procedures take place if accumulator pressure is too low. When the anti-theft alarm system is activated, the level is raised to ensure the difference in level does not exceed 0.3°.



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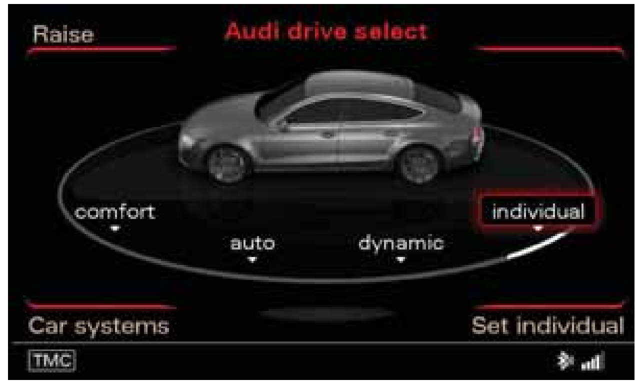
- The door/trunk lid signals are no longer sent via discrete lines to J197 but rather via the bus systems
- Vehicle level can drop greatly during prolonged vehicle downtimes. To ensure the vehicle is set to a defined minimum level when starting, compressor operation starts immediately after the ignition is switched ON. This occurs even before the engine starts running, as long as there is a sufficient charge level in the vehicle battery.

Operation and Driver Information

The settings of the Adaptive Air Suspension system are integrated into 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 comfort and sport systems.

In vehicles with 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.



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By selecting “comfort”, “auto”, or “dynamic”, various modes are activated in connection with the corresponding settings of other systems (engine, transmission, etc.).

Different system settings (for example, the “dynamic” setting of the Adaptive Air Suspension and the “comfort” engine and transmission setting) can be combined by selecting “individual” mode.

Lift mode is activated by selecting “lift”. The lifting and lowering procedure is indicated in the display by flashing arrows on the front and rear axle. The arrow indicator becomes static when the lift level is reached.

Messages / Warnings

Text messages relating to the Adaptive Air Suspension are shown in the central display to inform the driver.

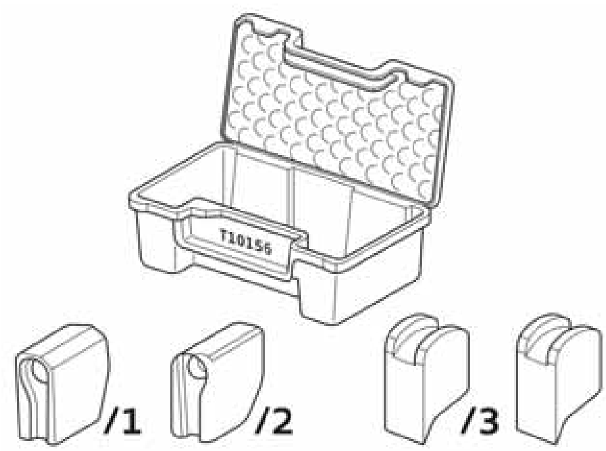
Driver information/warning messages are always prioritized according to urgency.

There are three priority levels: driver information in white, warnings in yellow, and highest priority warnings in red.

Service Work

1. Vehicle Transport

If the vehicle is to be raised with the spring blocker set T10156 for transport purposes, the engine should be turned OFF. Steering movements must be restricted to a maximum of one-half turn of the steering wheel.



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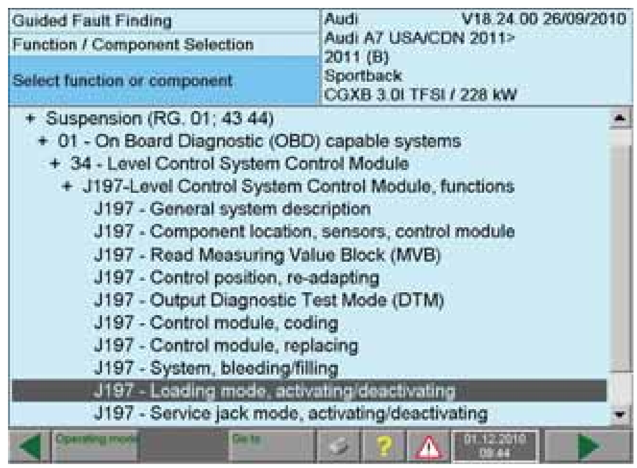
Loading Mode

Loading mode is used to ensure sufficient ground clearance and the greatest possible ramp angle for loading operations. When this mode is activated, the vehicle is set to and then maintained at a level of 1.9 in (50 mm) above the standard level.

Other levels cannot be set as long as this mode is active. Loading mode is activated/deactivated with the VAS Scan Tool. For safety reasons, the mode is deactivated automatically when exceeding a vehicle speed of 62.1 mph (100 km/h) or after covering a distance of 31.0 mi (50 km).



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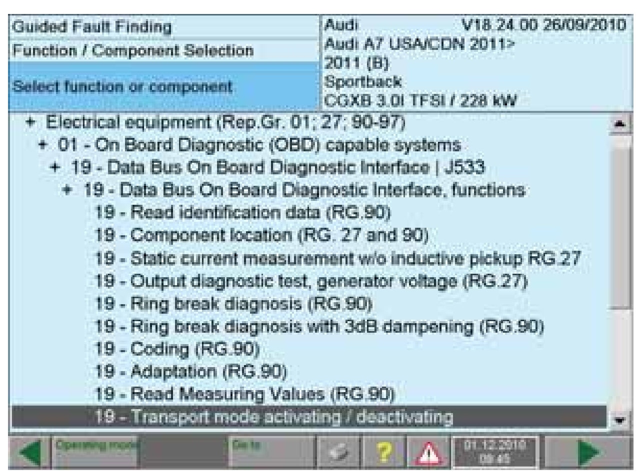
Transport Mode

Data Bus On Board Diagnostic Interface J533 sets shutdown level 4 when transport mode is activated. The Adaptive Air Suspension control module responds by preventing/deactivating leading and trailing mode, and switches OFF the power supply to the damper valves.

The control module remains in sleep mode even when input signals are received (operation of door/trunk lid, change in “terminal 15” status). Transport mode is automatically deactivated when the engine is started.

If both transport and loading mode are to be activated, loading mode must always be activated before transport mode.



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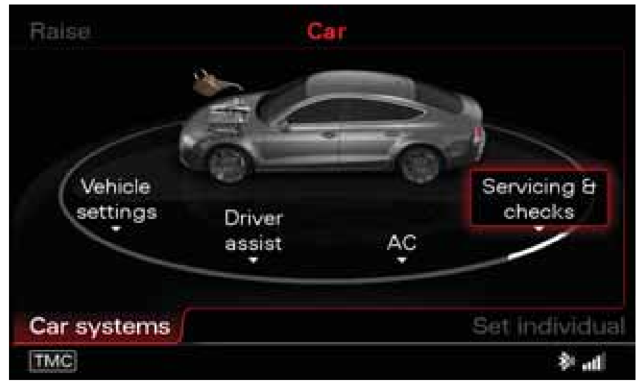
2. Removing and Installing/Replacing System Components and Added Service Work

The system recognizes when the vehicle is raised on a hoist or at the wheel, and therefore prevents all control procedures. Air is released for a short time prior to automatic detection.

For safety reasons, it is recommended to always switch the control system OFF manually before starting any service work. The system is switched OFF by selecting the "Jack mode" setting in the MMI.

The deactivated function is automatically activated again at a driving speed in excess of 6.2 mph (10 km/h).



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480_027

Level Control System Control Module J197

After installation, a new control module must be encoded online. The software parameters for this specific control module and vehicle are defined and activated by writing data sets as part of the encoding procedure. The coding defines whether the vehicle is equipped with Adaptive Cruise Control (ACC), and/or dynamic steering.

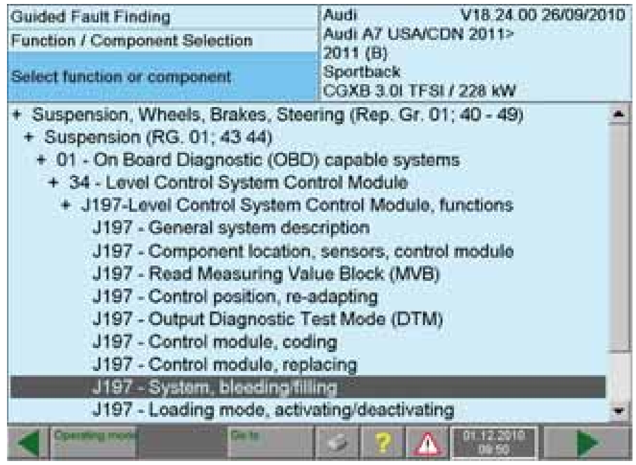
Since the adaptation values of the level sender signals have not yet been stored in this new control module, it is additionally necessary to perform the "Learn control position" function.


480_007

Air Spring Strut, Solenoid Salve Block, Compressor, Pressure Accumulator

The air system must be opened to remove these components. Therefore, the system must first be vented. 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. The “Learn control position” function must be performed using the VAS Scan Tool before reinstalling the air springs.



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Vehicle Level Sensor

The “Learn control position” function must also be carried out after replacing a sensor. Since, for tolerance reasons, the new sensor returns different measured values for the same vehicle level, the measured value/vehicle ride height allocation must be sent to and is stored in the control module.

The control module “recognizes” the characteristic curve of the sensors and their vehicle level change to measured value change mechanical ratio when installed.

Once the known measured value for all level positions is assigned through the “Learn control position” function, the control module can determine the assigned level for all other measured values.

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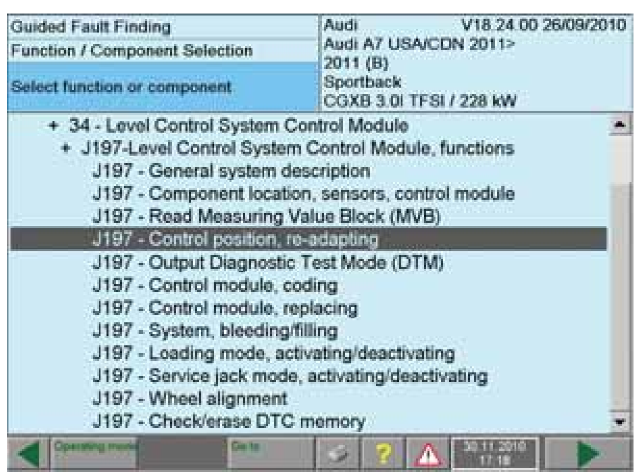


480_028b

Air Lines

Leaking and/or damaged air lines and their connections can be replaced. Sometimes, air lines can be repaired. The air system must be vented before it is opened.

Particular care must be taken when connecting the air lines, especially at the solenoid valve block, to ensure the connections are not interchanged. When replacing the lines, the line from the solenoid valve block to the pressure accumulator must always be replaced as a shaped line.

The specifications for repairs to air lines are the same as those used on other current Audi vehicles. The same applies to determining the causes of leaks.

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

3. Special System Status

Low Level

After prolonged vehicle down periods or when carrying heavy loads, it is possible that the vehicle level may drop below a level suitable for driving. This behavior is consistent with the system and does not constitute a fault, as air line connections and air spring seals are naturally subject to slight air loss.

After the ignition is switched ON, a warning appears in the Driver Information System, drawing the driver's attention to this situation. The compressor is already activated, although the engine has not yet been started. This raises the vehicle as quickly as possible to an operational level.

If the low level is caused by a major leak in the system, it will not be possible to raise the vehicle to the required level within a defined period of time. The control module recognizes that there is a fault in the system and issues a yellow warning in the instrument cluster.

Extreme High Level

In rare cases, it is possible that the vehicle may assume an extreme high level. This can briefly occur when very heavy loads are removed rapidly from the vehicle. If this situation persists, a system fault will be registered, with a high priority red warning shown in the Driver Information System.

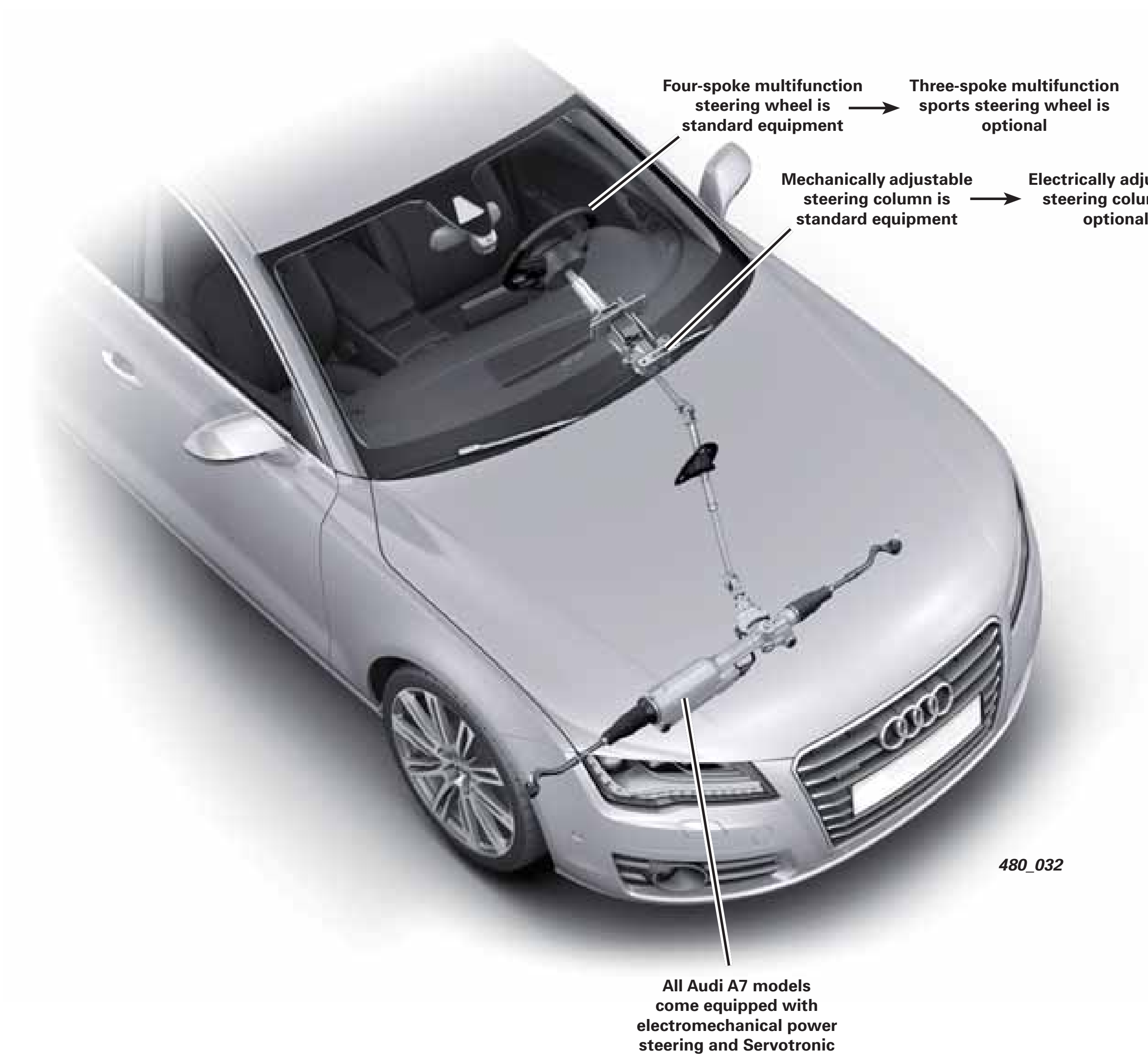
!

Warning!
Because 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! Placing the vehicle on its wheels when the system is vented will damage the air springs.

Overview

The major innovation on the steering system of the 2012 A7 is the use of electromechanical steering. The Servotronic function is standard on the A7, as is a manually adjustable steering column.

An electrically adjustable steering column is optional, depending on vehicle trim level. The standard steering wheel is a four-spoke multifunction wheel. A three-spoke multifunction sports steering wheel is available depending on vehicle trim level.



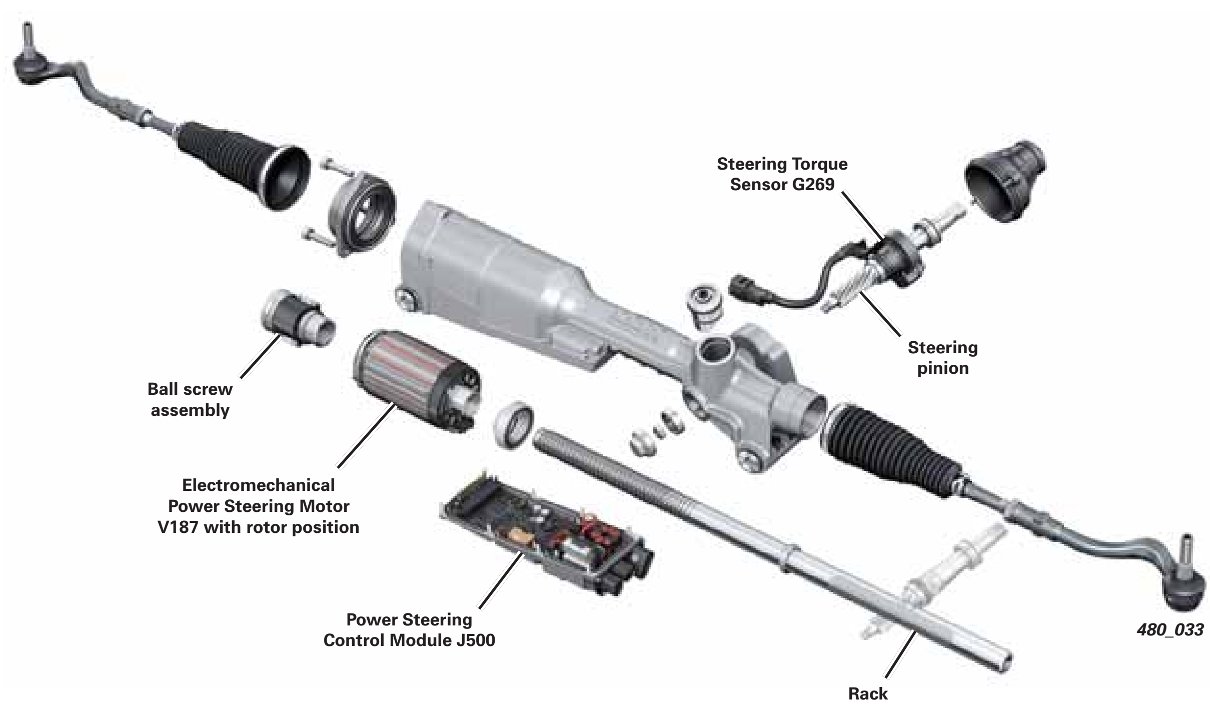
Electromechanical Steering

Overview

A new generation of electromechanical power steering is used on the 2012 A7. The power assist is accomplished via an electric motor arranged concentrically in relation to the steering rack. This design was selected because it enables high performance capability with relatively small space requirements.

The rack, electric motor, ball screw assembly, control module and necessary sensors are integrated into a compact unit.

This complete steering system is approximately 35.2 lb (16 kg) lighter than earlier versions. The weight reduction means better fuel consumption and increased functionality with other vehicle safety and handling systems.



System Components

Power Steering Control Module J500

Based on input information, rotor position and steering torque, J500 determines the pattern for the phase voltages. The phase currents this creates generate the torque of the electric motor. The torque depends on current intensity.

The output stage for electric motor activation is integrated into J500, which communicates over the FlexRay data bus.

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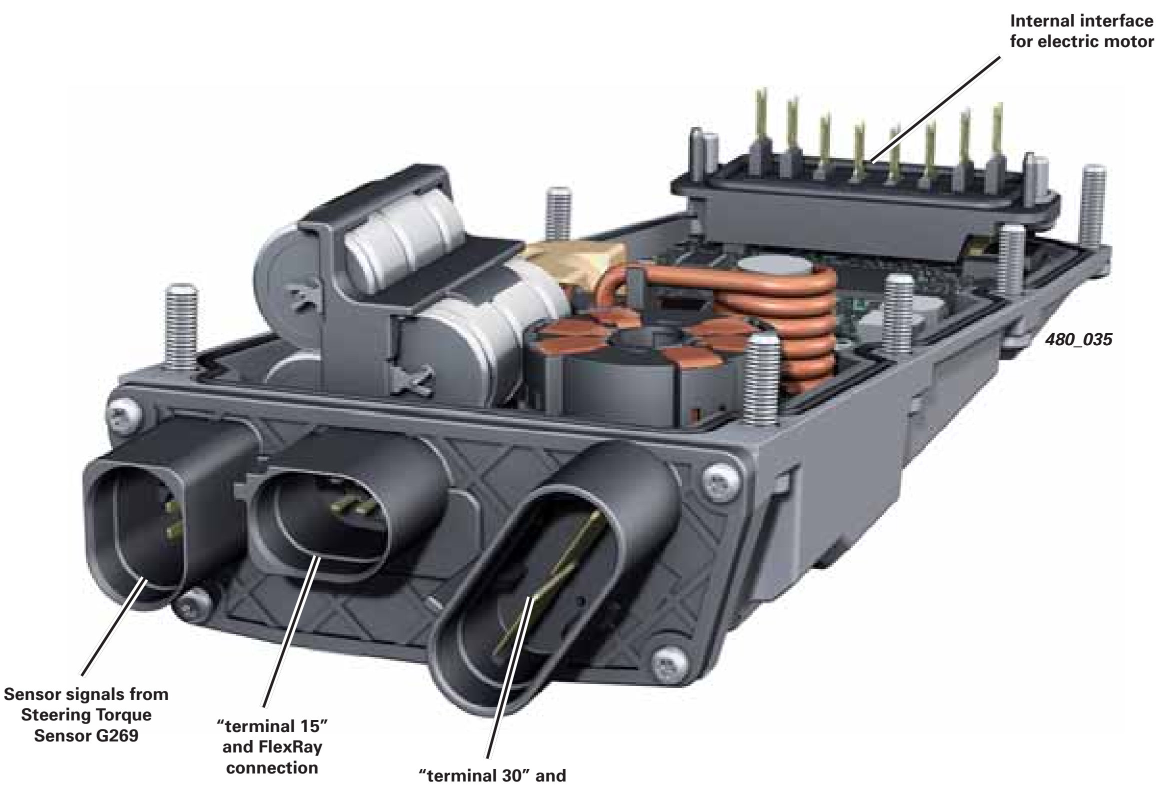

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Electromechanical Power Steering Motor V187

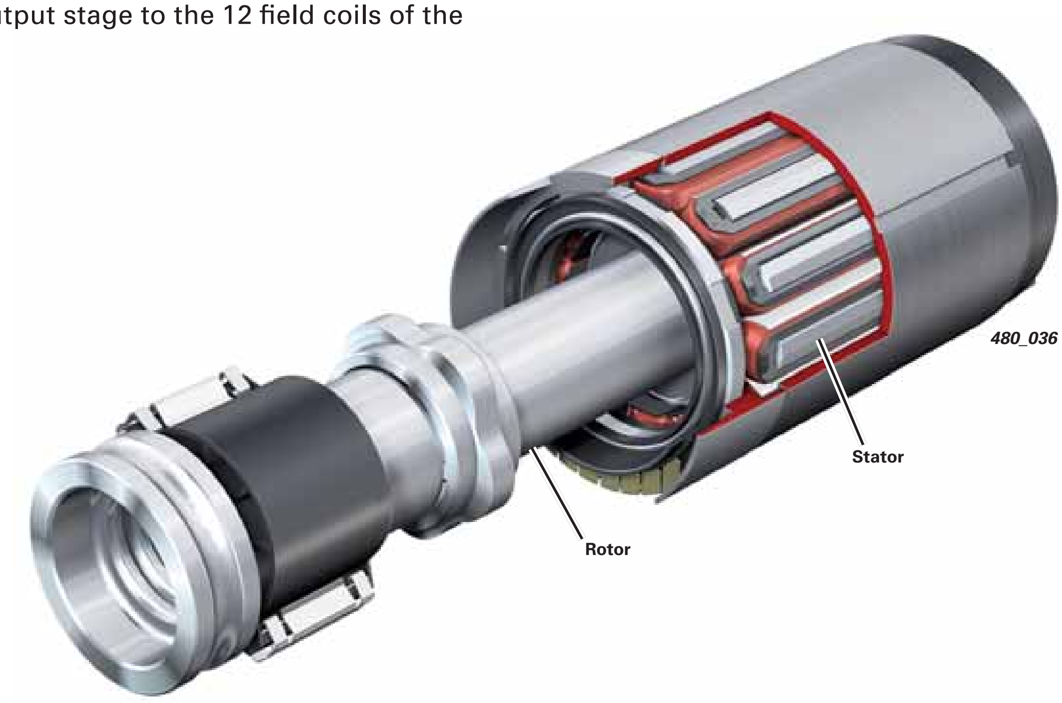
This electric motor delivers the steering torque required for power assist.

A permanently excited three-phase current synchronous motor is used. Synchronous motors are compact and capable of high power output. The permanent excitation eliminates the need for slip rings to transfer the excitation current to the rotor.

Power Steering Control Module J500 calculates the necessary phase voltages and applies them via the output stage to the 12 field coils of the stator.

Three groups of four coils are connected in series and energized 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 hollow shaft rotor is mounted on the rack. It has 10 permanent magnets arranged in an alternating north/south pattern.



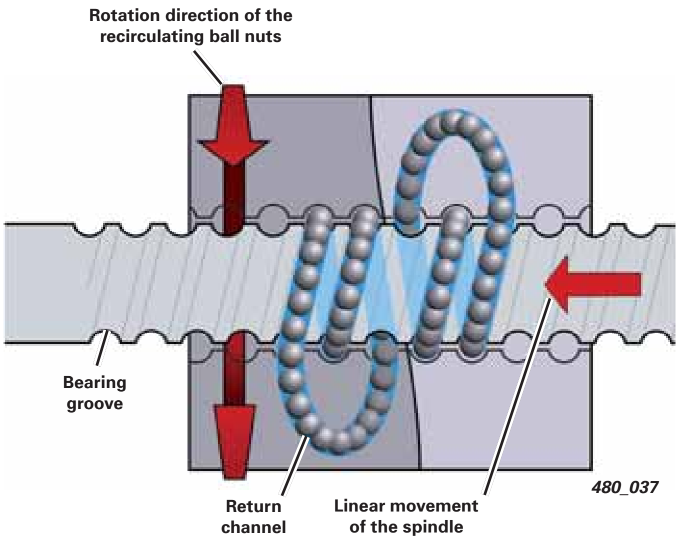
Ball Screw Assembly Function

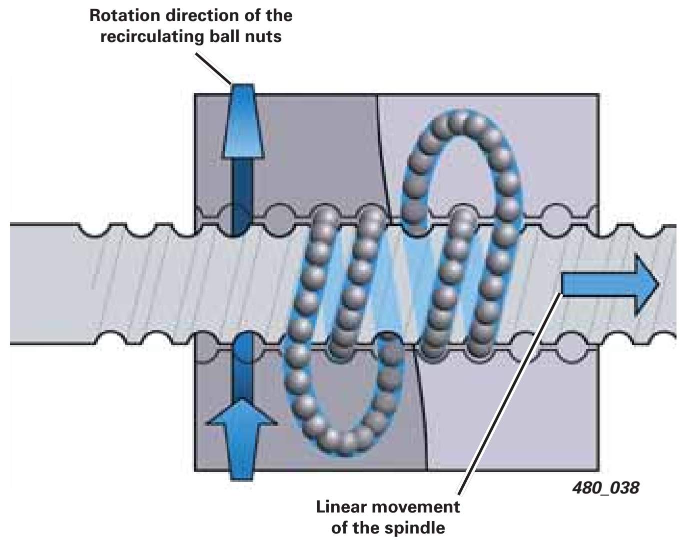
The turning motion of the electric motor is converted to the rack's linear motion by a ball screw. The conventional ball screw assembly consists of a screw and a nut, each with matching helical grooves, and balls which roll between these grooves when the nut or spindle is rotating.

The balls are deflected into the ball return system of the ball nut, whereupon they travel through the return system to the opposite end of the ball nut in a continuous path. The balls then exit from the ball return system into ball screw and nut thread raceways continuously to recirculate in a closed circuit.

When the direction of movement of the recirculating ball nut and ball bearing is reversed, the spindle also changes its direction of movement.

Compared to a conventional screw assembly, the conversion of turning motion into linear movement requires only one-third of the drive output. The reduced drive output is realized through the lower friction of the ball bearings with the bearing grooves. The system has a low level of wear and high position accuracy because of close manufacturing tolerances.





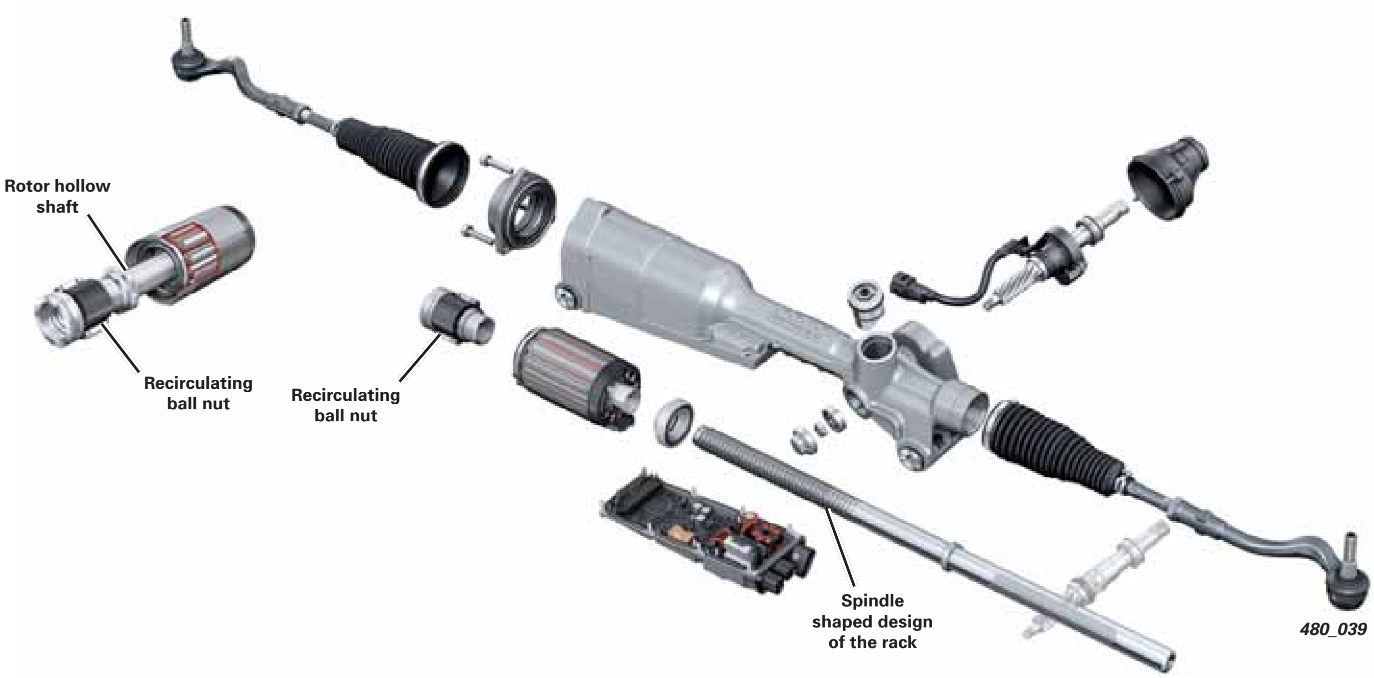
The recirculating ball nut is fixed in a longitudinal direction. If it is turned, there is a linear movement of the spindle in the direction of the arrow.

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

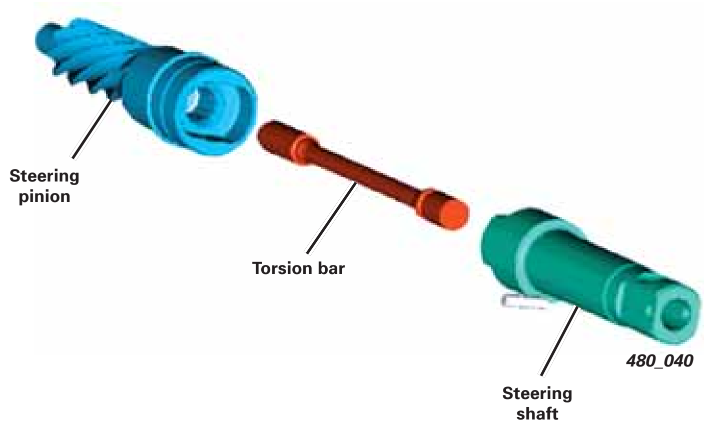
In the 2012 A7, the recirculating ball nut is connected firmly to the rotor hollow shaft. The rack is designed as a spindle at one end. On activation of the electric motor, the rotor hollow shaft and the recirculating ball nut are turned.

As shown above, this causes a linear movement of the rack. Depending on the rotation direction 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 torque.



Steering Torque Sensor G269

When the driver turns the steering wheel, the steering shaft and torsion bar are turned relative to the steering pinion. The amount the components turn depends on the steering torque applied by the driver. This torque is measured by G269.



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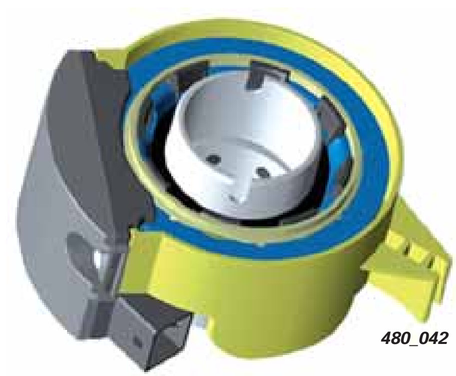
Design

A ring magnet with eight pairs of poles is 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 offset in such a way that when viewed from above, toward the axis of rotation, the teeth of one sender disc are located in the tooth gaps of the other sender disc.

Centered between the two sender discs and attached to the housing are two Hall sensors.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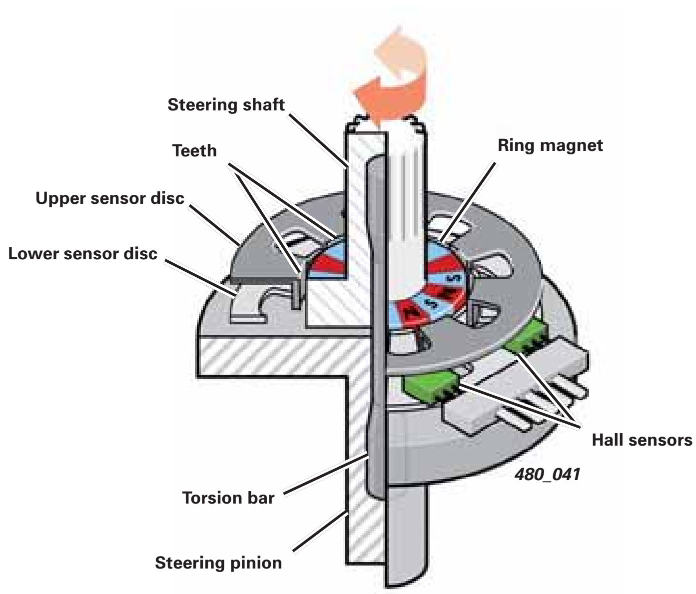

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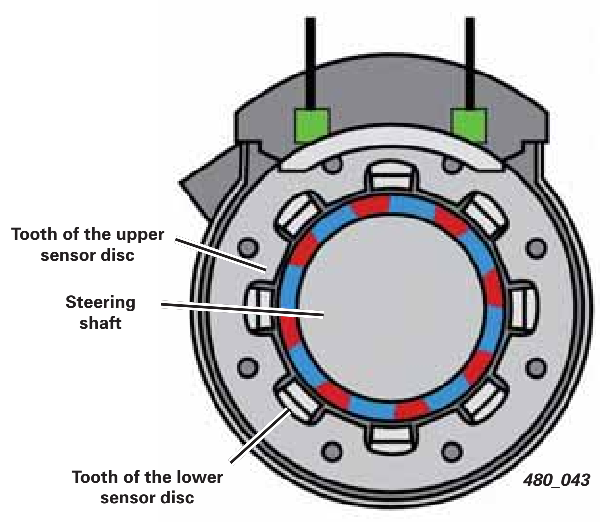
Function

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.

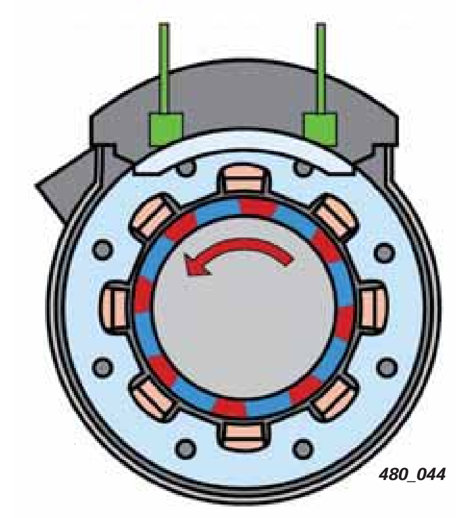


View from above in direction of the steering shaft

When the steering wheel is turned, the torsion bar and magnetic ring are moved relative to the position of the sender discs. The teeth of the sender discs move from 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, while those of the other sender disc are proportionally more opposite the south poles. This unsettles the magnetic field.

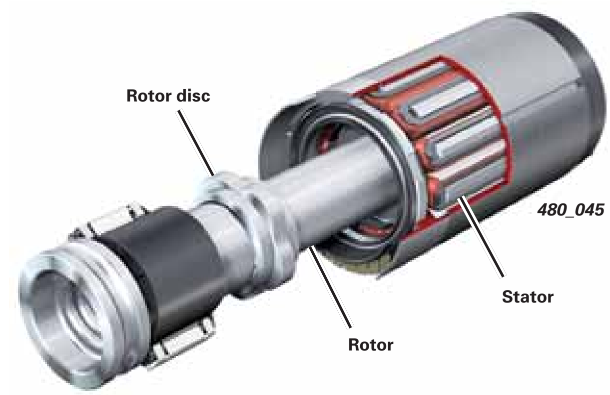
The magnetic flow is measured by the Hall sensors.



Rotor Position Sensor

A sensor detects the position of the rotor. Power Steering Control Module J500 must know the exact position of the rotor to calculate the required 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. To avoid hard mechanical stops, the electromechanical steering implements “soft” end limit stops.



480_045

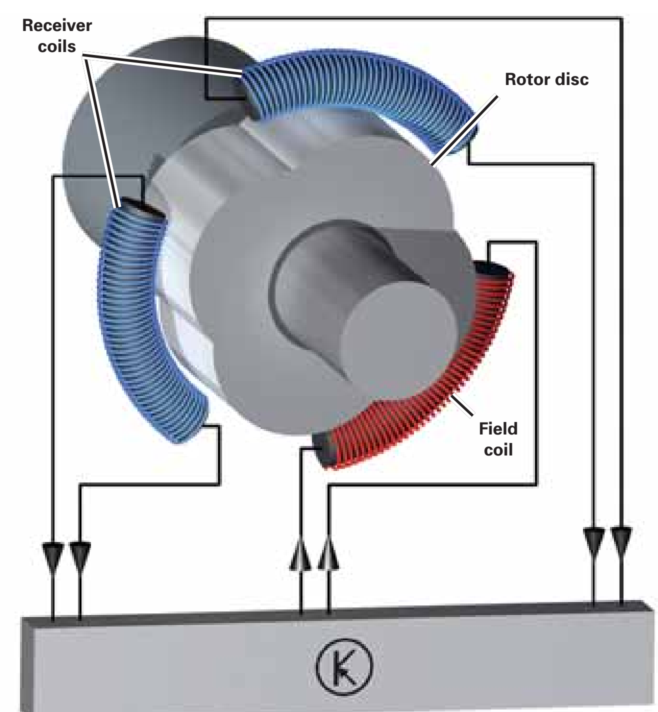
Design

A disc made of flow conducting metal is attached to the rotor. The rotor disc has a special shape similar to that of a curved disc. It is surrounded by a magnetic coil ring attached to the housing that functions as the stator. The coil ring consists of three individual coils. One acts as the field coil while the other two act as receiver coils.

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

Operation

1. Opening the Driver's Door

Opening the door wakes up the FlexRay data bus and communication of the control modules is started. Initialization routines are started by J500 and a self test of the system is performed.

2. Switching ON the Ignition ("terminal 15" ON)

The power steering MIL is checked by Instrument Cluster Control Module J285 via short activation. If no system error is found, the light goes out.

3. Engine Start ("terminal 50" ON)

If engine speed exceeds 500 rpm, the power assisted steering is active. As soon as the torsion bar is turned by the effect of force on the steering wheel (recognition by means of Steering Torque Sensor G269), the signals of Steering Angle Sensor G85 are synchronized with those of the rotor position sensor.

The dependency of the two measured values on one another is stored as a map in Power Steering Control Module 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 module to determine the corresponding map of the power assisted steering for regulation.

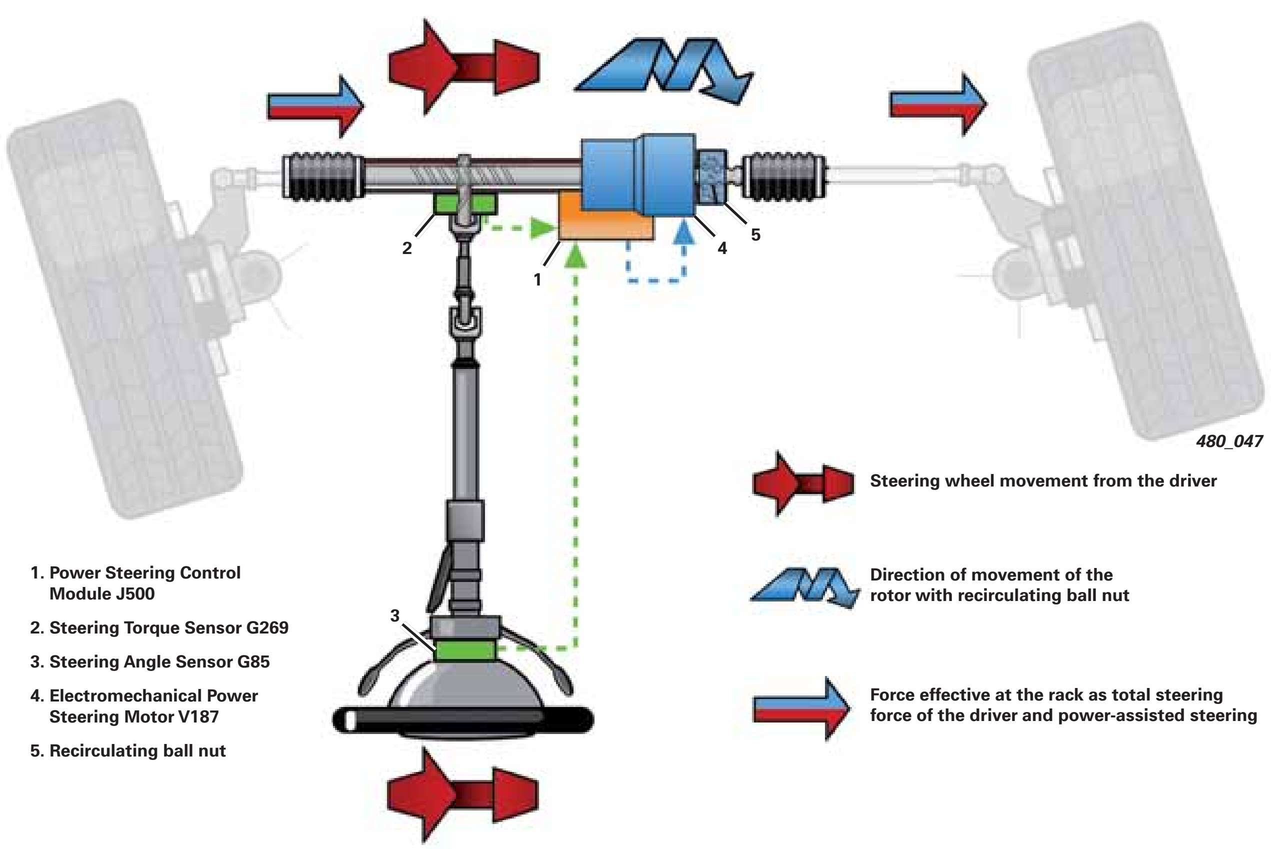
4. Vehicle Operation

During vehicle operation, the amount of power assisted steering is defined by steering torque, wheel angle, and road speed.

The activation currents for the electric motor are calculated by the control module, while the stator coils are energized by the output stage with corresponding currents. The force exerted by the electric motor with the ball screw assembly on the rack supplements the steering force applied by the driver.

5. Shut Down of the Power Assisted Steering

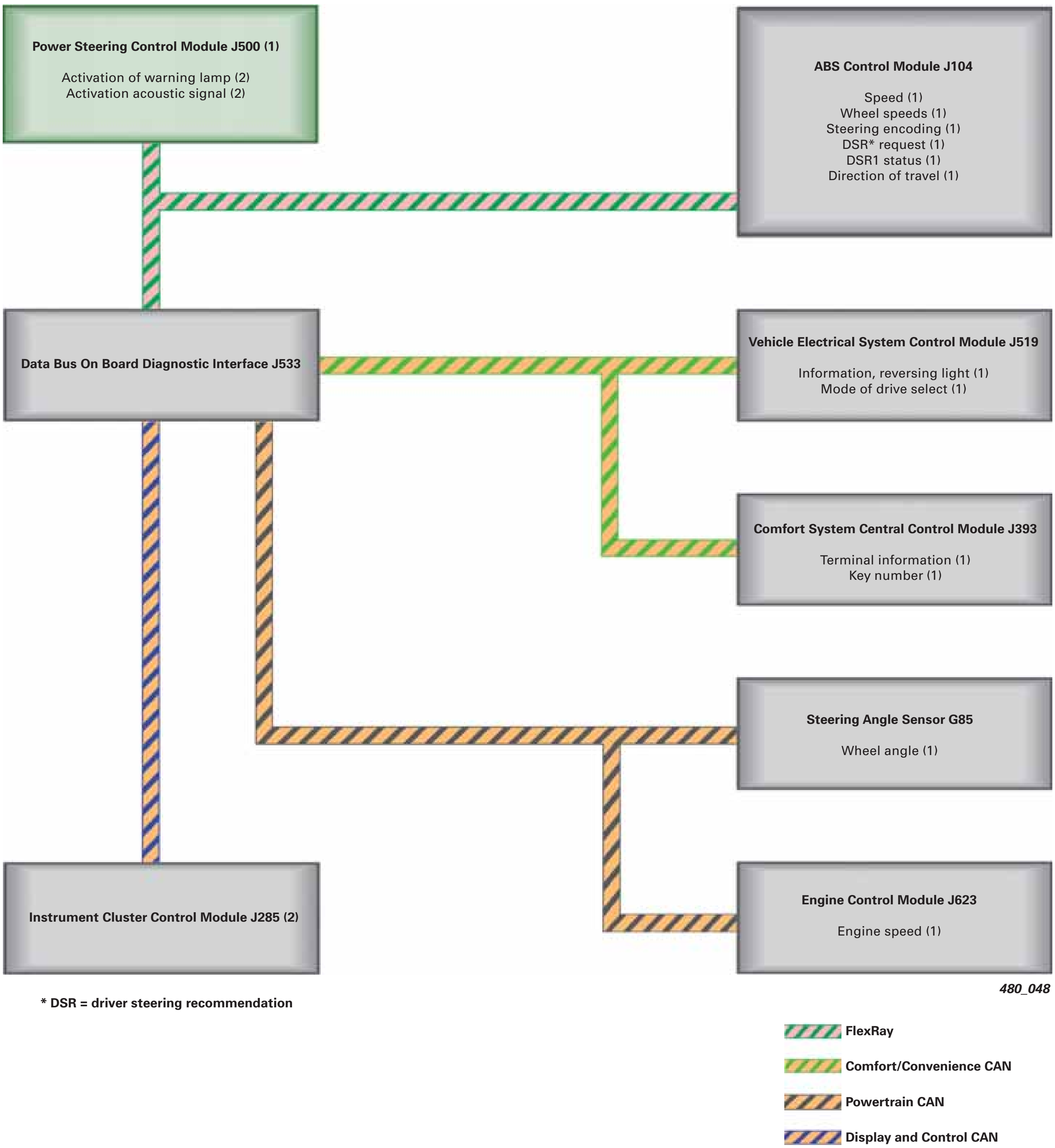
If the ignition is switched OFF while the vehicle is still moving, the power steering is switched OFF when vehicle speed falls below 4.3 mph (7 km/h).



Data Interchange

This diagram shows the information received and transmitted by Power Steering Control Module J500.

The number in parentheses following the information indicates which control module requires this information.



*** DSR = driver steering recommendation**

Operation and Driver Information

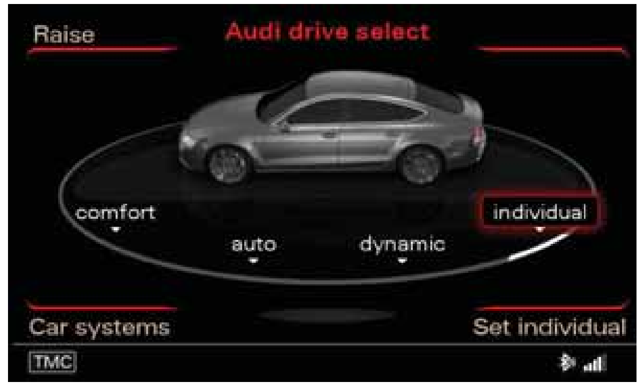
A major advantage when comparing electromechanical steering assist to conventional hydraulic assist systems is the possibility of implementing additional functions with other vehicle systems.

For example, straight ahead driving correction can be implemented with an electromechanical system.

In the future, on vehicles equipped with Audi active lane assist, the power assisted steering will be actuated to prevent the driver from inadvertently allowing the vehicle to leave the driving lane.

The driver can choose a setting in Audi drive select, and set the steering characteristics anywhere between comfort and sport modes.

Steering system status information is displayed by a two-color indicator lamp in the instrument cluster. Additional text details are shown in the Driver Information System display.



480_020

480_049

Service / Diagnosis Functions

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

1. Special System Statuses

Yellow Indicator Lamp Active:

The yellow indicator lamp is activated in the following cases:

- End limit stops have not been adapted. In this case, an entry is made in the DTC memory and power assisted steering is reduced to 60%. Additional details in text form are provided in the Driver Information System (DIS) display. When the end limit stops are adapted, the indicator lamp is deactivated again and the DTC is automatically deleted.
- System malfunction. Text information will appear in the DIS, and a DTC is set. It is possible to continue driving to the nearest service facility, but with reduced power assisted steering.

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”. Instrument Cluster Control Module 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 illuminates continuously, there is a system error. In such cases, text information appears in the DIS and a DTC is recorded. It is no longer possible to continue driving, because the power assisted steering has been reduced to a value of less than 20% or has failed completely.

480_050

480_051

2. Removing and Installing/Replacing System Components and Additional Service Work

Protective boots and track rods are the only individual components that can be replaced at this time. In the event of other component failures, the entire steering unit must always be replaced.

Power Steering Control Module J500 must be encoded online if it is replaced. Once the “encode control module” Test Plan has been initiated, the vehicle data record is downloaded. The software for the particular vehicle is loaded from a central database.

Within the encoding framework, the vehicle’s equipment level is downloaded to the module. Since the steering limit stops have not yet been stored in this new control module, coding must be followed by running the “Learn steering limit stops” Test Plan.

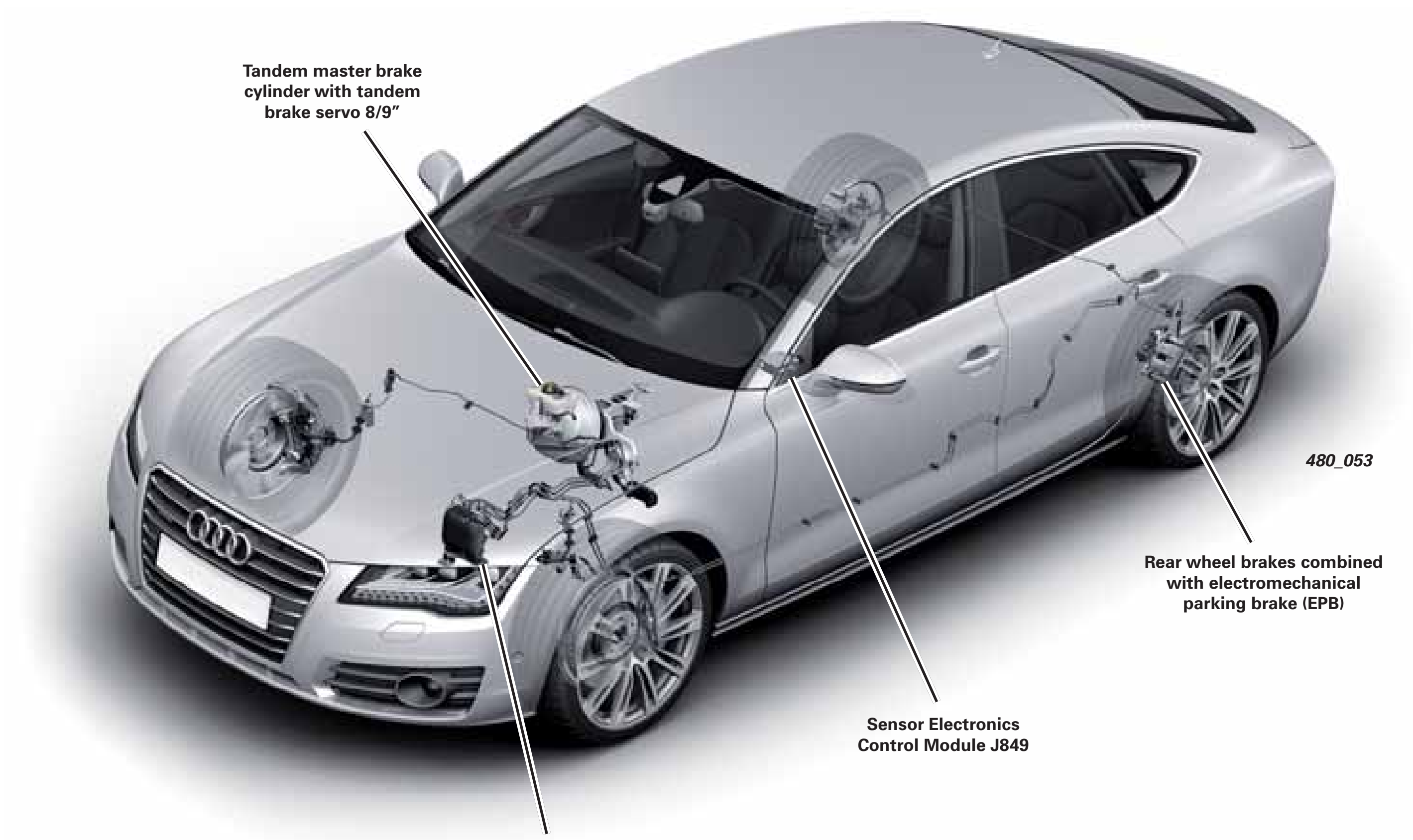
480_052

Brake System

Overview

The 2012 A7 brake system is similar in design and operation to that of the 2011 A8. An electromechanical parking brake is used at the rear.

A high performance ESP by Bosch with an extended range of functions provides a high standard of safety. As on the 2011 A8, Sensor Electronics Control Module J849 supplies vehicle dynamics information to calculate desired control operations.



System Components

Wheel Brakes, Front Axle

Engine Performance	V6 3.0L TFSI
Minimum wheel size	18″
Brake type	Teves 2FNR 42 AL
Number of pistons	2
Piston diameter	1.65 in (42 mm)
Brake disc diameter	14.0 in (356 mm)

The wear indicators are located on the left side of the front and rear axles. The contacts are inserted on the inner brake pad.

480_054

Wheel Brakes, Rear Axle

Engine Performance	V6 3.0L TFSI
Minimum wheel size	18″
Brake type	CII 43, EPB 17″
Number of pistons	1
Piston diameter	1.69 in (43 mm)
Brake disc diameter	12.9 in (330 mm)

The design and function of the electromechanical parking brake is identical to that of the 2011 A8.

480_055

Brake Servo, Master Brake Cylinder, Foot Controls

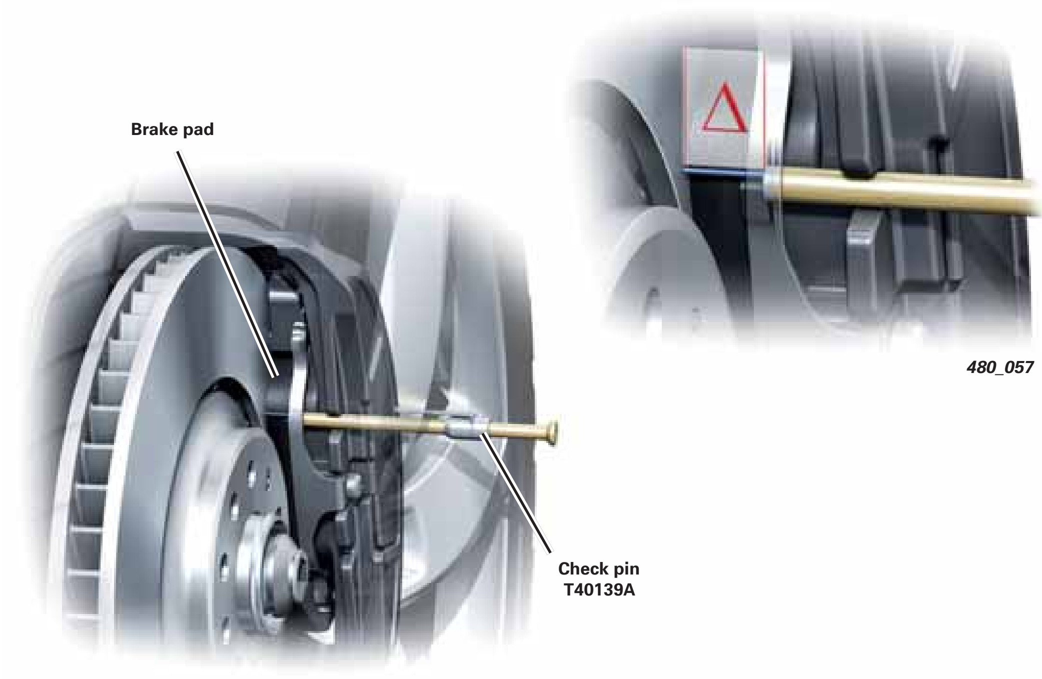
A tandem 8/9” brake servo is used on the 2012 A7. It is similar in design and function to that of 2011 Audi A8. The housing has been optimized for production and now uses two metal plates rather than three. Brake pressure is built up with single rate characteristics.

The tandem master brake cylinder is the same as that of the 2011 A8, though the locations of the hydraulic connections have been modified.

480_056

Service Work

The pad thickness of each outer brake lining, on each wheel, can be checked using check pin T40139A.



480_057

Overview

A 9th generation ESP Premium system by Bosch is used on the 2012 A7. It is the same unit used on the 2011 A8.

While the hydraulic module is unchanged, performance enhancements have been made to ABS Control Module J104. As a result, it was possible to integrate the new DSR (driver steering recommendation) function.

The module is installed on the left side member of the engine compartment.

480_058

System Components

ABS Control Module J104

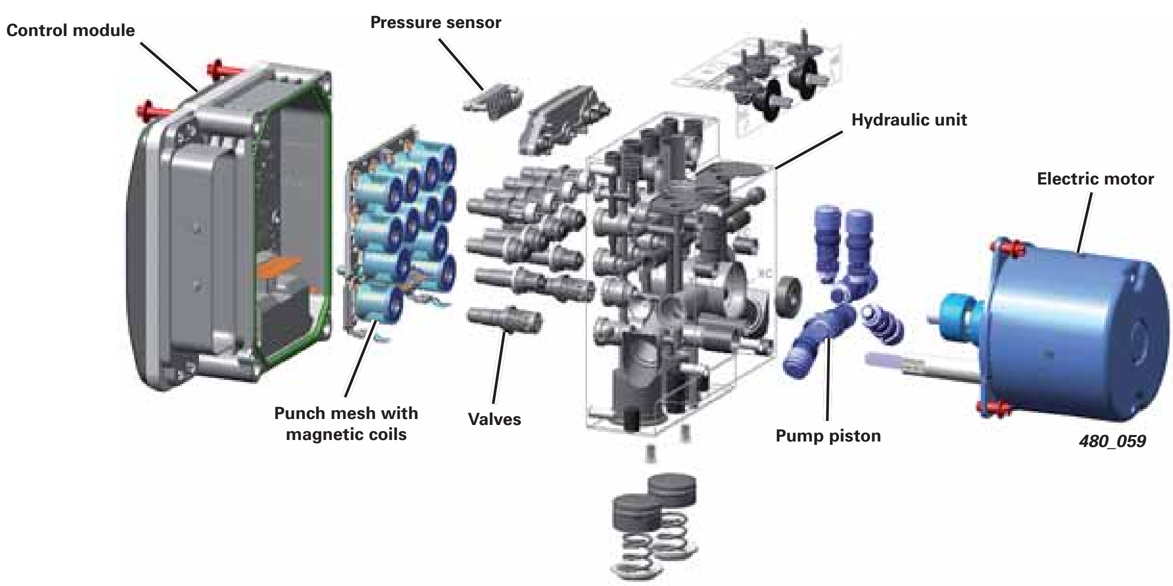
J104 enhancements include new electronic components and a new software design. The use of a newly developed pressure compensation element increases the service life of the system.

Communication takes place over the FlexRay bus. This also includes, for the first time, communication with the VAS Scan Tool.

Hydraulic Unit

There are two hydraulic unit variants used on the A7, one with ACC and one without. The ESP hydraulic units for ACC operation have six pumps to ensure continuous, harmonious pressure build-up during control operation.

To precisely regulate brake pressures in the brake circuit during ACC operation, two additional pressure sensors are located in the brake circuits.



480_059

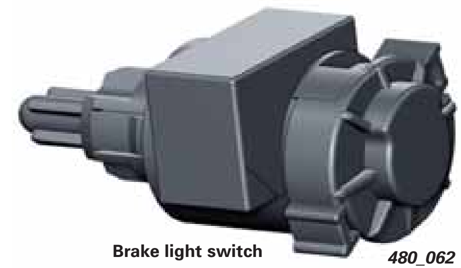
Wheel Speed Sensors G44-G47, Steering Angle Sensor G85, Brake Light Switch F

The design and function of the active wheel speed sensors, the steering angle sensor, and the brake light switches have been adopted from the 2010 Audi A4.

Sensor Electronics Control Module J849 is also used in the 2012 A7. ABS Control Module J104 receives information regarding the vehicle movements across the FlexRay data bus from this control module.

480_060

480_061

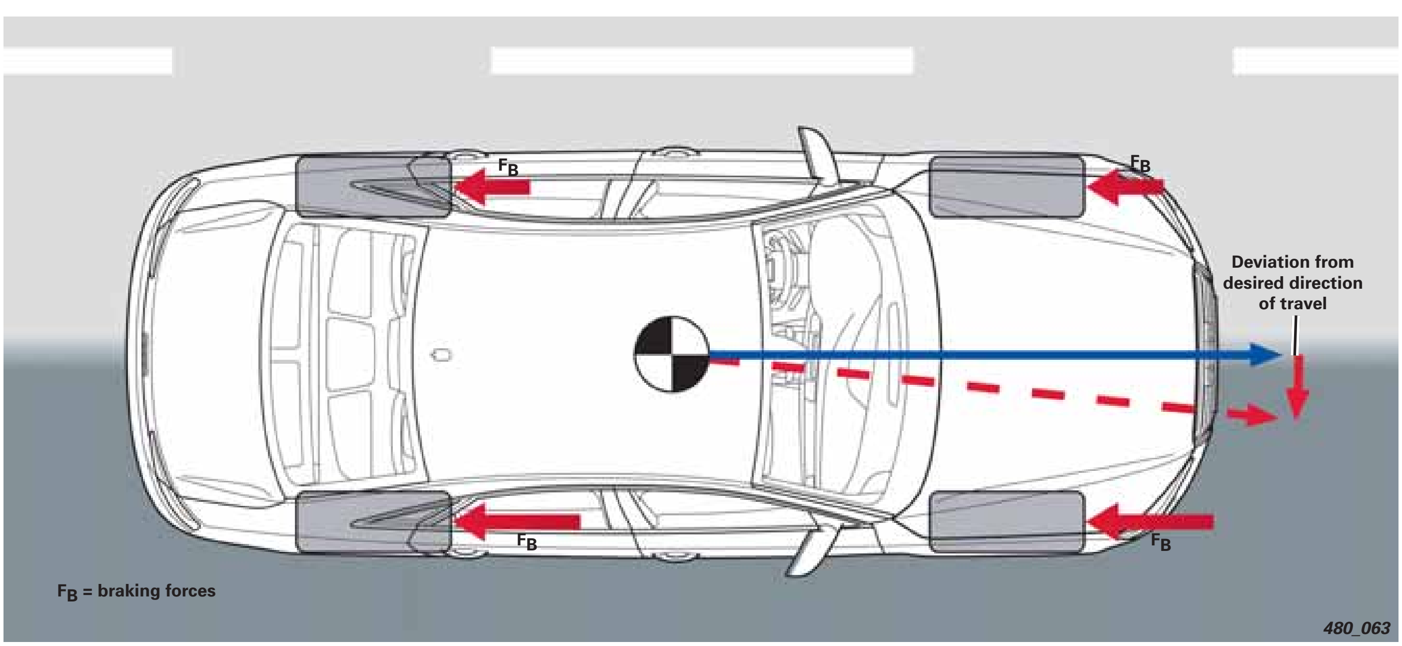


480_062

DSR (Driver Steering Recommendation)

This function supports the driver during braking operations on roads with different coefficients of friction between the wheels of the right and left 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 and left wheels.

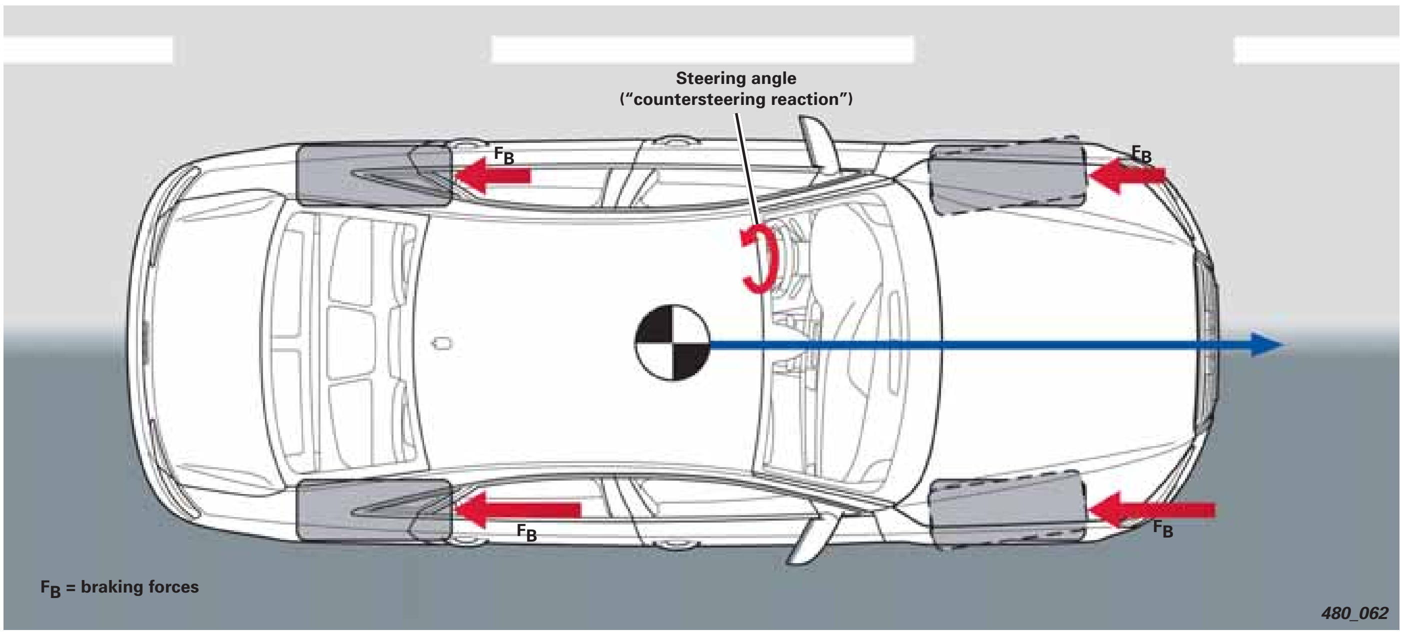
In the example shown below, the left side wheels of the vehicle are on an icy road surface, while the right side wheels are on a dry road surface. This means that higher braking forces can be applied to the right wheels. When braking, torque is created around the vehicle vertical axis towards the higher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



480_063

To keep the vehicle on course, the driver has to compensate for this yaw moment by countersteering (in the example, steering to the left). The DSR function provides support here. It employs the electromechanical steering in the yaw moment regulation. Given vehicle road speed and the yaw velocity, ABS Control Module J104 determines the necessary steering impulse.

J104 transmits a "steering request" to Power Steering Control Module J500. Activation of the electric motor moves the rack with a maximum force at the steering wheel of approximately 1.4 to 2.2 lb ft (2–3 Nm) in the prescribed direction. This steering impulse indicates to the driver which direction the steering wheel must be turned.



480_062

Operation and Driver Information

Single level actuation of the ESP button disables the ASR function on vehicles with quattro drive. Furthermore, stabilizing ESP corrective intervention only occurs when there are 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, automatically reactivates full ESP function.

480_065

480_066

Service Work

Online encoding is necessary after replacing the ABS Control Module. The pressure sensors are calibrated automatically during the encoding process. Actuator diagnosis is required after replacing the hydraulic unit.

480_058

Steering Angle Sensor G85 is calibrated in Guided Fault Finding by the corresponding function of Steering Column Electronics Control Module J527.

480_067

Longitudinal Acceleration Sensor G251 and Transverse Acceleration Sensor G200 are calibrated through Guided Fault Finding by the corresponding function of Sensor Electronics Control Module J849.

480_068

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Note

Whether or not the control module can be replaced separately was not determined at the time of printing. Refer to the latest repair literature for more information.

Sensor Electronics Control Module J849

Overview

J849 has sensors that measure vehicle acceleration in the x, y, and z axes, as well as vehicle rotation around these axes. It replaces ESP Sensor Unit G419 and the body acceleration sensors for the Adaptive Air Suspension system.

This control module exists worldwide in the four variants described below. Depending upon vehicle equipment, the minimum number of sensors are defined in the chart.

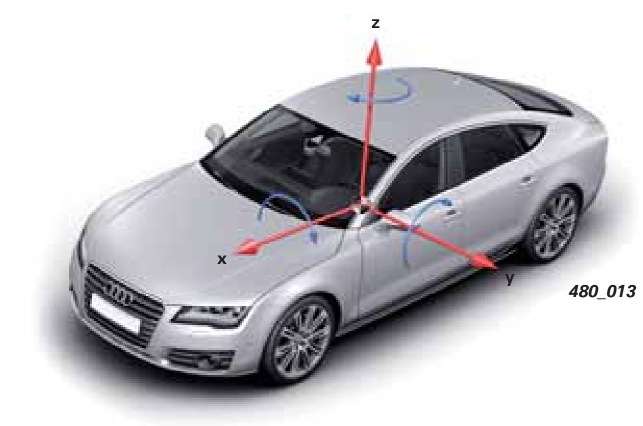
480_068

Variant	Number x sensors for measurement	Minimum requirement
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 seatbelt tensioners

[1]Torque around the z axis (vehicle vertical axis)

[2]Torque around the y axis

[3]Torque around the x axis



480_013

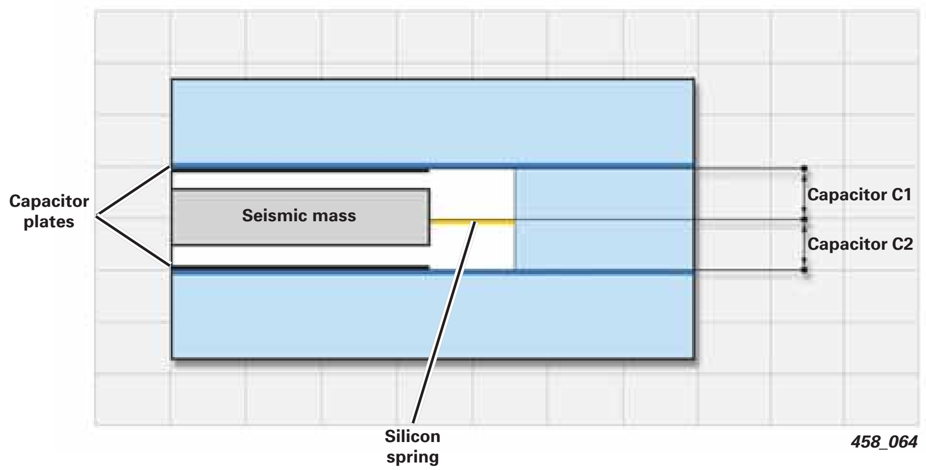
Function of Sensors for Registering Movements in x, y, and z Axes

The sensors for registering the movements in x, y, and z axes, operate in accordance with the "seismic mass" principle. The sensors are part of a spring-mounted mass (seismic mass) located between two electrodes acting as capacitor plates. The mass plate also has two electrodes that form two capacitors together with the electrode of the "housing."

During acceleration, the position of the seismic mass changes relative to the housing. The resulting change in the capacitance (stored energy) of the capacitors is evaluated by electronic logic circuitry.

Rest State:

The seismic mass is centered between two outer capacitor plates. The capacitance of both capacitors C1 and C2 is identical.

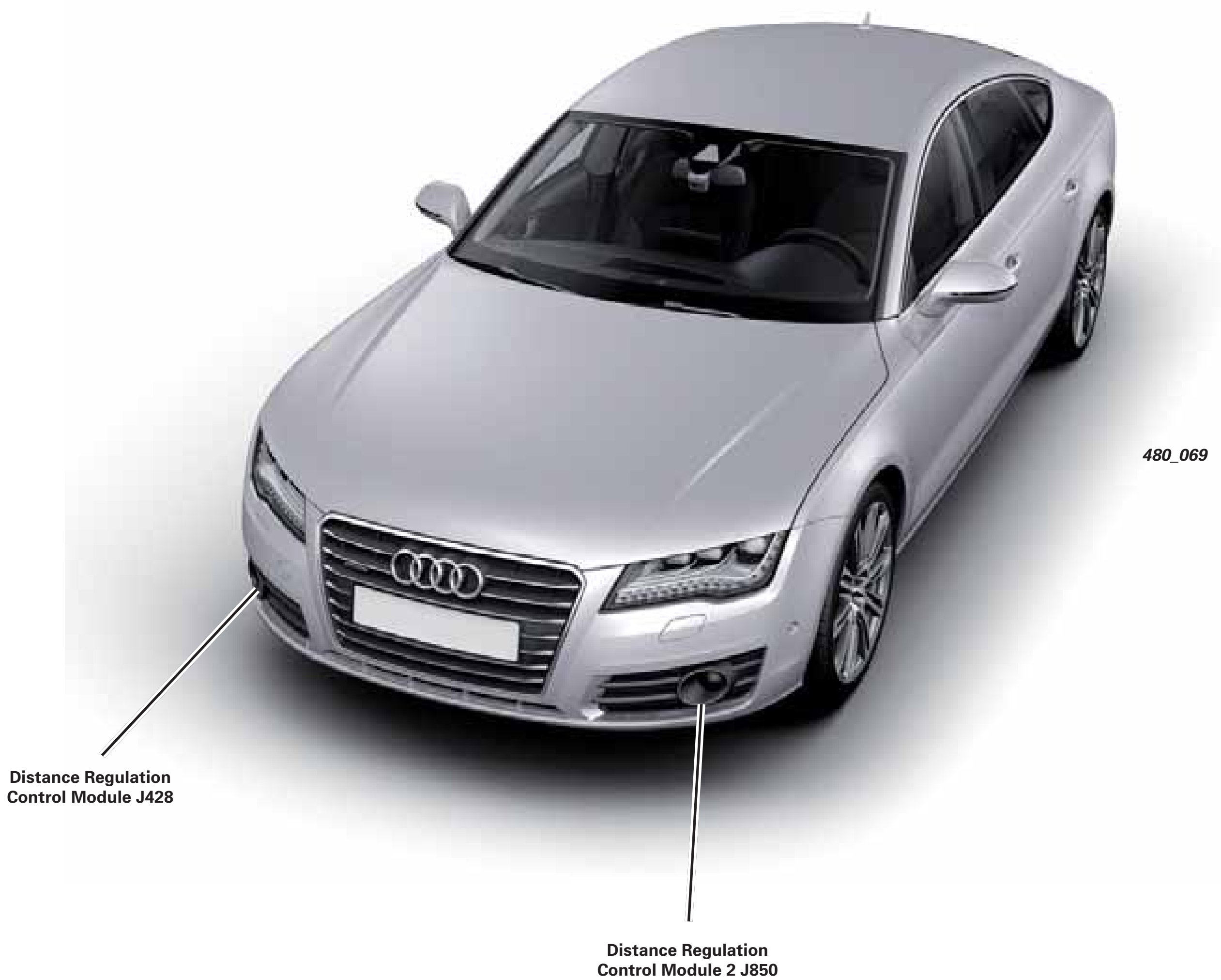


458_064

Adaptive Cruise Control (ACC)

Overview

ACC is also offered as an option for the 2012 A7. As already introduced on the 2011 A8, two radar sensors are used in the A7.



480_069

Reference

For more information about the ACC system, please refer to SSP 960103, *The 2011 Audi A8 Running Gear and Suspension Systems*.

Tire Pressure Monitoring (TPMS)

Overview

The 2012 A7 is equipped with the second generation Tire Pressure Monitoring System (TPMS.)

By evaluating the vibration characteristics of each wheel/tire, the new TPMS system is capable of determining and indicating which tire is experiencing pressure loss.

The system can also detect slow (gradual) pressure loss, as well as simultaneous pressure loss at several wheels.

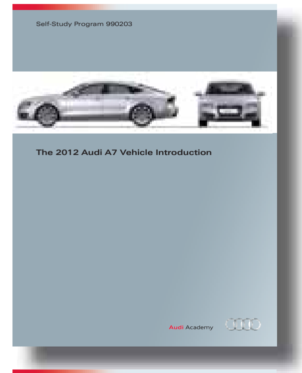
480_071

Reference

You will find detailed information on the second generation Tire Pressure Monitoring System in SSP 990193, *Audi New Technology 2009 – 2010*.

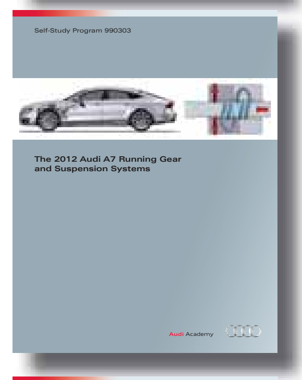
Self-Study Programs for the 2012 Audi A7

SSP 990203 The 2012 Audi A7 Vehicle Introduction



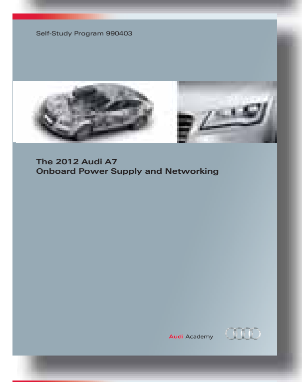
- Body
- Occupant Protection
- Engine
- Power Transmission
- Suspension System
- Electrical System
- Climate Control
- Infotainment

SSP 990303 The 2012 Audi A7 Running Gear and Suspension Systems



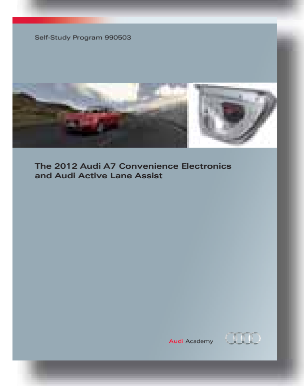
- Axles and Wheel Alignment
- Adaptive Air Suspension
- Steering System
- Electromechanical Steering
- Brake System
- ESP
- Sensor Electronics Control Module J849
- Adaptive Cruise Control (ACC)
- Wheels and Tires
- Tire Pressure Monitoring (TPMS)

SSP 990403 The 2012 Audi A7 Onboard Power Supply and Networking



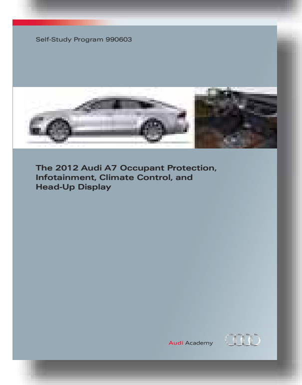
- Power Supply
- Networking
- Control Modules
- Exterior Lighting

SSP 990503 The 2012 Audi A7 Convenience Electronics and Audi Active Lane Assist



- Topology
- Convenience Electronics
- Audi Active Lane Assist

SSP 990603 The 2012 Audi A7 Occupant Protection, Infotainment, Climate Control, and Head-Up Display



- Occupant Protection
- Audi pre sense
- Infotainment
- Air Conditioning
- Seat System
- Head-Up Display

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The Knowledge Assessment is required for Certification.

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- Click on the "ACADEMY" tab
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- Click on the "CRC/Certification" link
- Click on Course Catalog and select "990303 — The 2012 Audi A7 Running Gear and Suspension Systems"

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Or you may send an email to:

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Notes

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990303

Audi of America, LLC
2200 Ferdinand Porsche Drive
Herndon, VA 20171