

Audi Q7 - New Driver Assistance Systems

- Audi side assist
- Optical parking system (OPS)
- Reversing camera

Self-study programme 375

Driver assistance systems

The continuous improvement of vehicle safety is one of the foremost objectives in the development of new vehicles. New driver assistance systems that have been introduced into series production for the first time on board the Audi Q7 make a considerable contribution in this regard. On request, a number of innovative driver assistance systems are also available in the Q7, for example the radar-based Audi side assist, the optical parking system with audible and visual information and the reversing camera.

A frequent cause of accidents when changing lanes is that other vehicles are overlooked.

By continuously monitoring the adjacent lanes, in particular the area to the rear of the vehicle, the Audi side assist supports the driver during overtaking and lane-change manoeuvres and thus makes a contribution to active safety. The driver is alerted if one of the adjacent lanes is occupied by one or more road users. Despite the system's capability, the driver must always be aware that the system serves as an aid, but cannot take the responsibility away from the driver for his/her own decisions. Despite the Audi side assist, it is still necessary for the driver to turn his/her head, look in the side mirror and observe the traffic.

The electronic parking aid system has been further improved. Two new functions are now available to the customer. The familiar acoustic parking aid system has been expanded by a graphic screen display in the MMI. Using bar diagrams this provides the customer with a detailed depiction of the point at which a collision may occur. The bar diagrams permit the distance from the obstacle to be estimated with precision. The familiar acoustic feedback is retained.

Drivers who would prefer to get a picture of the situation behind the rear of the vehicle for themselves, can have the image from a reversing camera displayed on the MMI screen. The camera which has been integrated into the tailgate handle provides an ideal overview of the situation behind the vehicle. The camera image appears automatically when reverse gear is engaged.

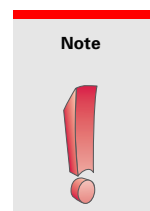
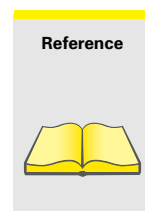
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The self-study programme provides basic information on the design and function of new vehicle models, new vehicle components or new technologies.

**The self-study programme is not intended as a workshop manual.
The specified values only serve for better understanding and relate to
the software versions applicable at the time the SSP was compiled.**

For maintenance and repair operations it is essential that you refer to the current technical literature.



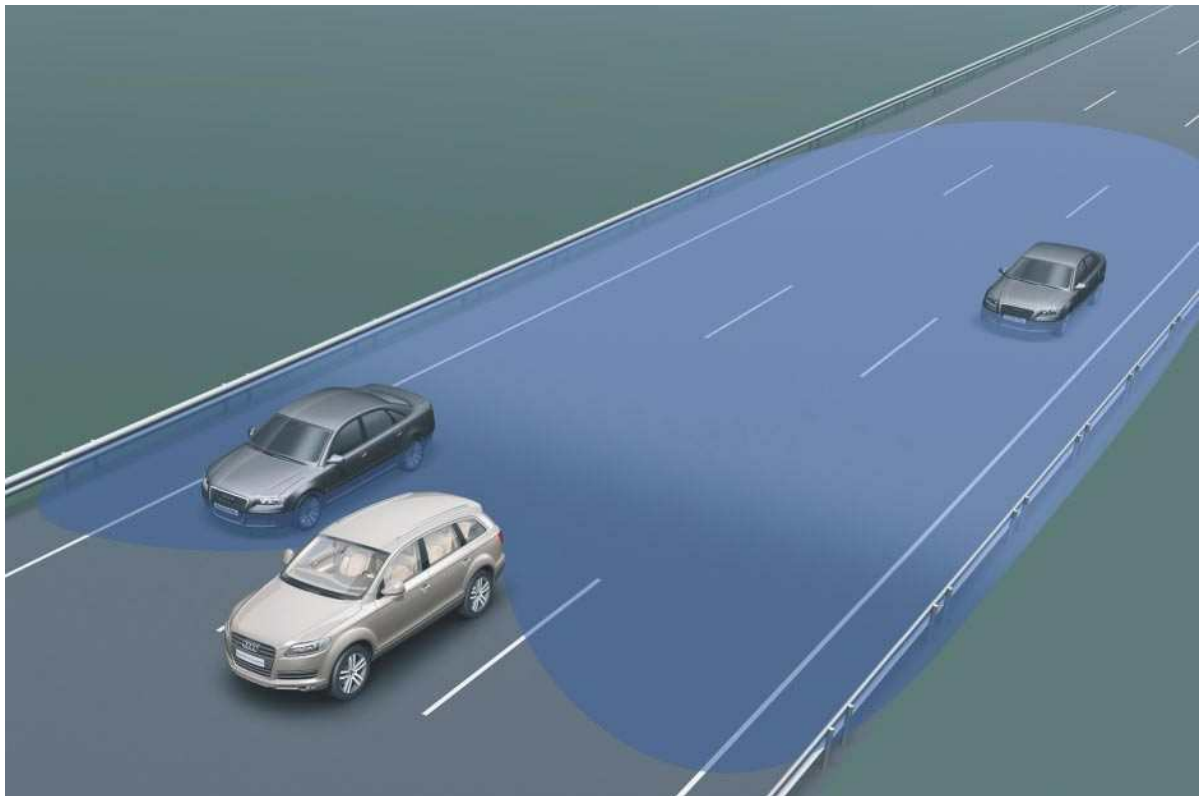
Audi side assist

Audi side assist in the Audi Q7

Introduction

The purpose of the Audi side assist is to monitor the area behind and to the side the vehicle using radar sensors and assist the driver when changing lanes. The area monitored also includes the so-called "blind spot" on the driver side and the front passenger side. Each vehicle side is fitted with a radar sensor for this purpose.

If the Audi side assist detects a critical situation that could cause an accident during a lane change, the system alerts and warns the driver. The driver is alerted through activation of the warning lamps in the relevant exterior mirror and warned through the warning lamps flashing rapidly.

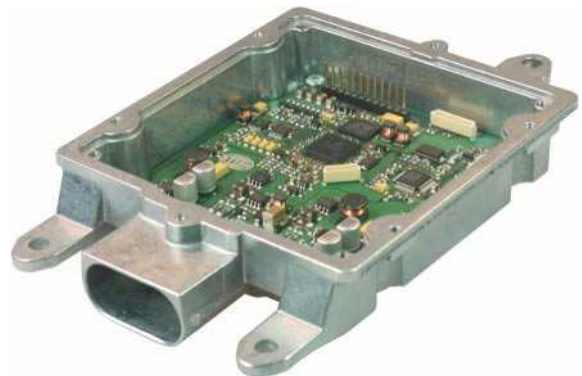


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Radar sensors and control units

The Audi side assist is equipped with two control units, the side assist control unit J769 (master control unit) and the side assist control unit 2 J770 (slave control unit). The master control unit forms a single module with the right radar sensor, while the slave control unit forms a single module with the left radar sensor.

The master and slave control units are identical in design. The main component is an electronic circuit board with a digital signal processor as the central processing unit. Among other functions, it is used to record and track objects detected by means of the radar sensors. The system is manufactured by Hella.

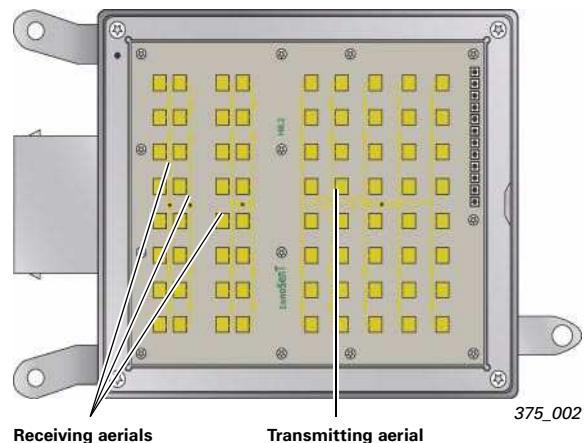


375_001

The aerial circuit board with integrated transmitting and receiving aerials is connected to the electronic circuit board via a connector console.

The transmitting aerial comprises 40 copper squares, whereas the 3 receiving aerials comprise 8 or 16 copper squares. The technical term for the copper squares is "patch".

The physical properties of the reflected beams picked up by the receiving aerials are evaluated by the digital signal processor. Based on these properties, the size, position and speed of the object reflecting the beams is calculated.



375_002

A plastic cover, referred to as the "radom", is fitted on the control unit.

This is made from a special plastic which is ideal for allowing the radar beams to pass through, without causing any significant losses.



375_003

Audi side assist

Fitting locations

In the Audi Q7, the two control unit modules are located in the area of the rear bumper and fastened to the end plate. The end plate is clipped to the bumper cover and bolted to the body. The bumper conceals the modules, making them invisible from the outside, unlike the parking aid sensors. Because the bumper cover is made of plastic, it does not represent an obstacle to radar beams.

The modules are installed at an angle of 22 degrees with respect to the vehicle transversal axis, providing better coverage for scanning the side areas. They are inclined upwards at an angle of approx. 3 degrees. Once fastened to the vehicle, precise calibration is conducted using the diagnostic tester and special calibration tools.

Calibration and the tools required are described in more detail in a later chapter.

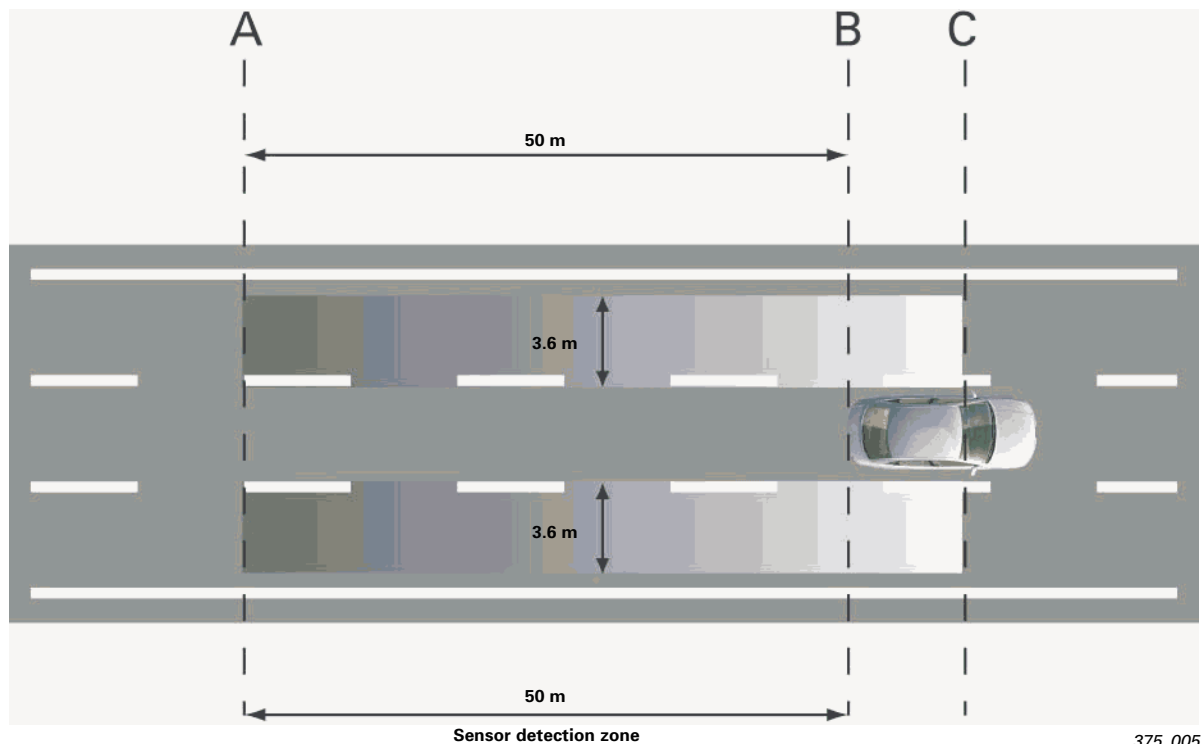
A mechanical fine adjustment, as familiar from the ACC, is not possible for the side assist sensors.



375_004

Radar sensor detection zone

The detection zone consists of areas to the rear and to both sides of the vehicle. The rear detection area extends from the rear edge of the vehicle to approx. 50 metres rearwards. This corresponds to the grey area between lines A and B. The side area extends from the rear edge of the vehicle to approximately the line of the B-pillar, which corresponds to the grey area between lines B and C. The width of the grey areas measures approximately 3.60 metres.



The illustration of the sensor detection zone shows a straight stretch of road. On curved road sections, the Audi side assist operates above a minimum curve radius of approx. 170 metres. If the radius of the curve drops below the 170 m limit, the Audi side assist is deactivated because the emitted radar beams can no longer monitor the full 50 metres of the rear detection zone. This deactivation threshold is provided with a hysteresis of 30 metres. This means that if the Audi side assist has been deactivated due to the radius of the curve, it is reactivated when the radius of a curve exceeds 200 m.

The course of the road is calculated by the side assist control unit by means of the yaw rate and the individual wheel speeds from the ABS control unit J104. The curved detection zone during cornering is represented as a straight road section by the software. This ensures that the basis of the assessment for the warning algorithm used to determine whether or not the driver needs to be alerted is the same for straight roads and bends.

Warning lamps in the exterior mirrors

The Audi side assist warns or alerts the driver, as appropriate, of potential hazards during a lane change by means of warning lamps integrated into the two exterior mirrors.

The usual service designations for these are: Side assist warning lamp in driver side exterior mirror K233 and side assist warning lamp in front passenger side exterior mirror K234.

The two warning lamps K233 and K234 can be replaced individually, without having to remove the mirror housing. This procedure is described in the Workshop Manual.

The warning lamps are activated directly by the side assist slave control unit J770. They comprise four yellow LEDs.



375_006

If the Audi side assist recognises a critical situation in one of the two lanes, and no imminent lane change is indicated, the driver is informed of this situation through illumination of the warning lamp in the relevant exterior mirror. If an intended change of lane is indicated through actuation of a turn signal and the adjacent lane is occupied, the driver is warned by the warning lamp flashing on and off four times.

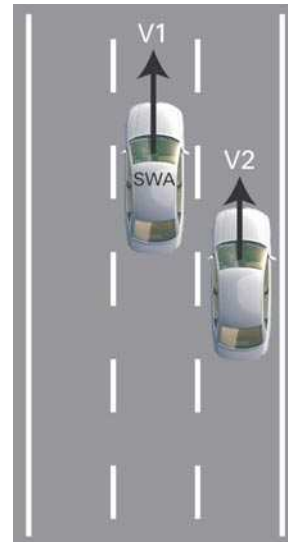
The customer can adjust the brightness of the warning lamps to 5 different levels via the MMI. The current ambient brightness measured by the rain and light sensor G397 is also used for determining the brightness of the warning lamps.

Two specific traffic situations

By way of an example, two typical traffic situations resulting in a warning being provided by the Audi side assist are described below:

Scenario 1

The vehicle with the Audi side assist is being driven in the centre lane of a three-lane motorway and is currently overtaking the vehicle on the right-hand side. The speed difference between the vehicle with Audi side assist (SWA) and the vehicle being overtaken is less than **15 km/h**. This small difference in speed means that the overtaking manoeuvre will take some time and that the vehicle being overtaken will disappear into the "blind spot" at a certain point. In this situation, the warning lamp in the right exterior mirror must alert the driver that the right-hand lane is occupied. If the driver of the vehicle equipped with Audi side assist then activates the right turn signal, the driver is warned by four flashes in the right exterior mirror.

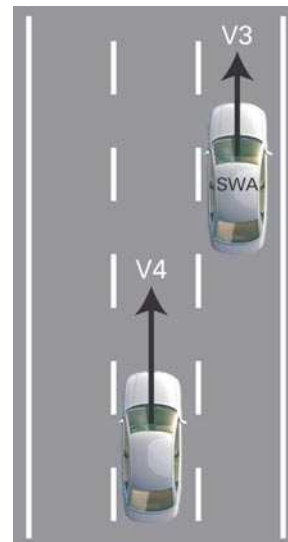


375_007

Scenario 2

The vehicle with the Audi side assist (SWA) is being driven at a moderate speed in the right-hand lane of the three-lane motorway. A vehicle in the centre lane approaches from behind at a much faster speed. The approaching vehicle is detected by the Audi side assist, which activates the warning lamp in the left exterior mirror. If the left turn signal is now actuated nonetheless, the driver is warned of a potential collision before changing lanes by means of a flashing warning lamp.

The maximum distance between the two vehicles at which the warning lamps are activated depends on the speed difference between the two vehicles. The greater the difference in speed, the greater the maximum distance between the two vehicles at which the driver is alerted to the imminent collision. At the earliest, however, a warning can be issued from a distance of 50 m, as 50 m is the upper limit of the detection range of the radar sensors.



375_008

Audi side assist

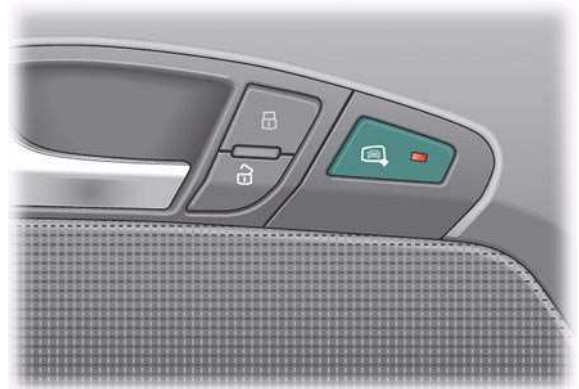
Operating the system

The side assist button E530 is located in the driver door, to the right of the central locking switch. The button is used for switching the Audi side assist on and off. A red LED in the button indicates its current status. If the LED is illuminated, this means that the Audi side assist is switched on. If the LED is not illuminated, the system is either switched off or faulty. Every time the system is restarted it readopts the last valid system status.

When switched on, the Audi side assist may be either active or inactive.

Two conditions must be met in order for the system to be activated: the road speed must exceed a minimum speed of 60 km/h **and** the current curve radius must not be less than 170 metres during cornering. If one of the two conditions is no longer met, the Audi side assist switches to the inactive mode.

It should be noted, however, that the driver is not provided with any indication as to whether the system is in the active or inactive state.

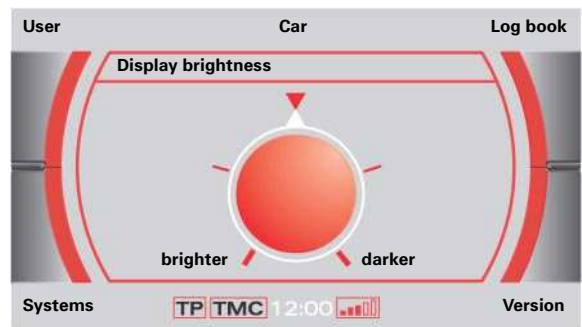


375_009

Adjusting the brightness of the warning lamps

Using the MMI, the customer can individually adjust the brightness of the warning lamps in the exterior mirrors. For this purpose, the "Audi side assist" menu item in the Car menu of the MMI must be selected and activated by pressing the rotary control.

The brightness of the warning lamp can be set to 5 different levels. The third level is the factory default. Having completed the selection, the warning lamps are switched on for 2 s at the selected brightness.



375_010

Personalisation

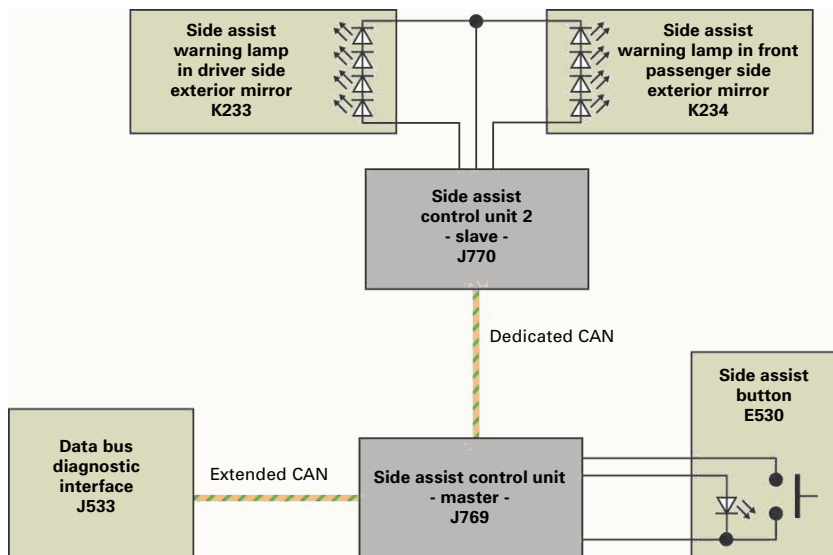
At the end of a journey, the brightness setting selected by the driver is stored in the side assist control unit J769 (master control unit) under the vehicle key last used. This setting is reactivated for the next journey made with this vehicle key.

Audi side assist

Implementation of function in hardware and software

System circuit diagram

The master and slave control units exchange data via a dedicated high-speed CAN bus. The master control unit is connected to the extended CAN, enabling data exchange with other bus modules via the data bus diagnostic interface J533. The master control unit is also responsible for reading in the side assist button E530, while the slave control unit actuates the two warning lamps K233 and K234 in the exterior mirrors.



375_011

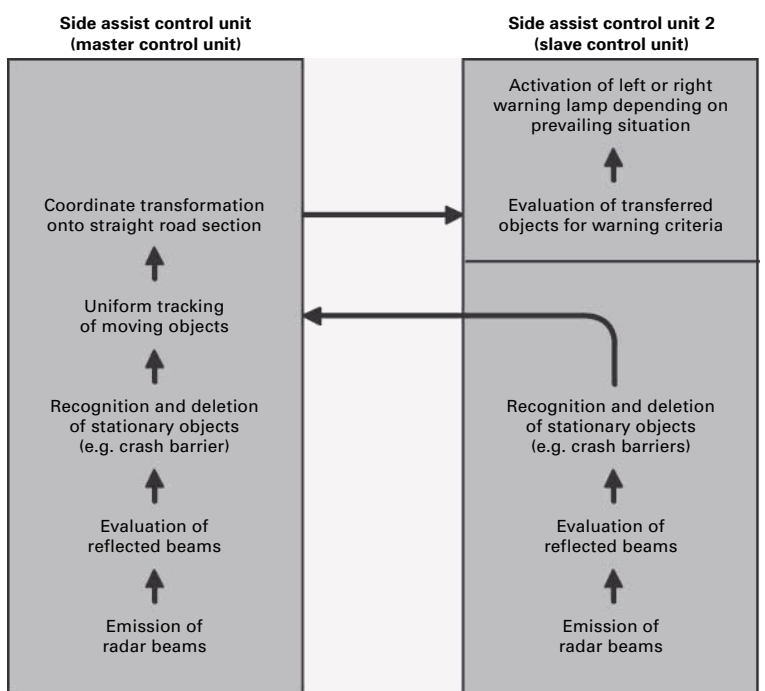
Allocation of tasks between master and slave control units

The two control units emit radar beams using the transmitting aerials. The emitted radar beams are reflected by objects. Depending on the nature of the object, many, few or no beams at all are reflected.

The reflected beams are measured in the two control units by means of three receiving aerials. Based on the physical properties of the reflected beams, the control units are able to obtain a variety of information regarding the reflection objects. These physical properties include, for example, the time delay between transmitting and receiving the radar signal, the frequency shift between the transmitted and received signal and also the different phase position at the receiving aerials. Based on these, the current position, the speed and also the direction of travel of different objects can be calculated.

Each control unit is independently able to detect fixed reflection objects, such as the crash barrier, structures at the edge of the road or stationary vehicles. As these objects must not result in a warning, they are not tracked further by the control units.

Objects that have been recognised as moving vehicles are tracked in the master control unit. Curved road sections are also transformed into a straight road section in this control unit. This makes it easier for the warning algorithm to assess the prevailing situation.



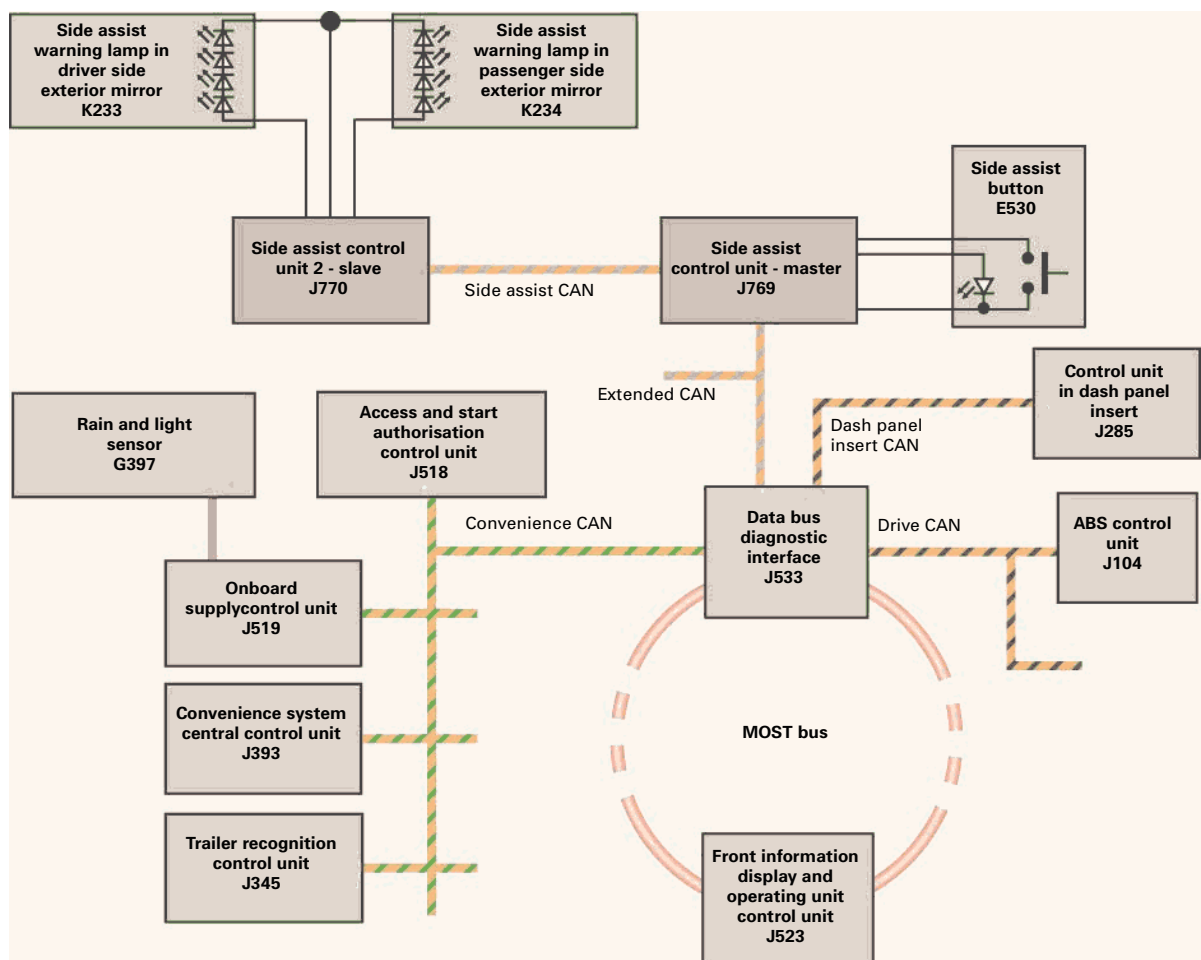
375_012

The data processed in this manner is supplied via the dedicated CAN to the slave control unit J770 where the warning algorithm is implemented. If the slave control unit recognises a collision hazard based on the predetermined warning criteria if lanes were to be changed, it activates the warning lamp on the relevant side. If despite this the driver actuates the turn signal on the critical side, the lower intensity continuous light changes to a flashing light at an increased intensity.

Audi side assist

Communication structure of the Audi side assist

The Audi side assist requires a large amount of information from a number of different control units which are in turn connected to the various bus systems. Below is a description of the control units that exchange data with the Audi side assist via bus systems and the information and variables in question.



375_013

Rain and light sensor G397

Supplies the Audi side assist with the instantaneously measured ambient brightness via its LIN master, the onboard supply control unit J519. This enables the brightness of the warning lamp to be perfectly adapted to the ambient conditions.

Control unit in dash panel insert J285

Informs the driver by means of error messages in the event of faults in the Audi side assist and also outputs an acoustic signal to this effect.

ABS control unit J104

Supplies the Audi side assist with the yaw rate and the current wheel speeds. These variables are used to calculate the current vehicle speed and the curve radius during cornering, etc.

Trailer recognition control unit J345

Informs the Audi side assist whether a trailer is attached to the vehicle or not. If a trailer is attached to the vehicle, the function is deactivated because there is a risk of the scanning range of the sensor being impaired. A corresponding message is displayed in the dash panel insert.

Convenience system central control unit J393

Transmits the information as to whether the right or left turn signal has been actuated. The Audi side assist infers from this that a lane change is intended. The convenience control unit also informs the Audi side assist whether or not the reversing lights are currently switched on. The Audi side assist is deactivated during reversing.

Access and start authorisation control unit J518

Transmits the key number of the vehicle key currently being used. This ensures that the personalised brightness setting is adopted for the warning lamps after "ignition ON".

Front information display and operating unit control unit J523

The customer is able to use this to set the desired brightness for the warning lamps. The value is stored in the side assist control unit J769 together with the corresponding key.

Diagnostics

In the diagnostics tester, the address word 3C is assigned to the side assist control unit (master) J769. The side assist slave control unit J770 is not addressable separately using the diagnostics tester and thus does not have its own address word. The fault memory, the measured value blocks, the code and the adaption channels of the Audi side assist are all to be found in the side assist master control unit J769.

The following variables can be found in the measured value blocks:

- Supply voltage and internal temperature of master and slave
- Communication status of dedicated CAN bus between master and slave
- Current system status (on / off)
- Input variables of the function, which are transmitted by other control units via the CAN bus
- Calculated current radius of curve
- Status of side assist button and its LED
- Status of both warning lamps in the exterior mirrors
- X and Y coordinates of the nearest object in the left, centre and right lane
- Relative speed of the nearest object in the left, centre and right lane
- Current status of auto-calibration; calibration information
- Status of communication with the control units involved in the overall function

The following information is encoded into the code:

- Vehicle model equipped with Audi side assist
- Country in which the vehicle is operated
- Left or right-hand drive
- Whether or not a trailer control unit is installed in the vehicle

The following variables can be adapted in the adaption channels:

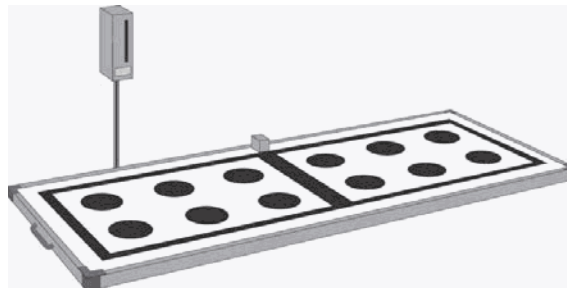
- The brightness of the warning lamps

It is possible to actuate the following components via final control diagnosis:

- LED in side assist button
- Side assist warning lamp in driver side exterior mirror
- Side assist warning lamp in front passenger side exterior mirror

Special tools for system calibration

Special tools have been developed for calibrating the radar sensors. These are a calibration board with a Doppler generator VAS 6350, wheel centre markers VAS 6350/1 and a distance measuring device VAS 6350/2 featuring laser measuring technology. The calibration board is used for calibrating the radar sensors of the Audi side assist and also for calibrating the reversing camera.



375_014

The first step is to correctly position the calibration board, which is described in detail in the calibration instructions. This document is available as a Workshop Manual. First, the calibration board is aligned at a defined distance from the two rear wheels. For this purpose, the wheel centre markers, also referred to as "paddles", are attached to the wheel nuts using a special device. Gravity aligns the movable paddles perpendicular to the ground. Using an electronic distance meter, the calibration board is then adjusted to the specified distance on both sides.



375_015

Using a laser liner located centrally on the calibration board, the calibration board is then centred along the longitudinal axis of the vehicle, without the distance already set being altered. The laser projects a vertical line onto the rear of the vehicle, which when aligned correctly divides, for example, the Audi emblem on the rear end into two equal halves.

Once the alignment is complete, the calibration procedure can be started using the diagnostics tester. The rest of the procedure is fully automatic. The black circles on the calibration board are only required for calibrating the reversing camera. The so-called "Doppler generator" is used for calibrating the radar sensors. Using a rotating fan wheel, it simulates a moving object, the nominal position of which is known to the control unit. Based on the difference between the actual position and the nominal position, the control unit learns the correction values required to make the subsequent adjustments to the measured positions.

Applied radar technology

Radar sensor system

The word RADAR is an acronym and stands for **RA**dio **D**etection **A**nd **R**anging.

The technology is used in stationary objects for determining positions as a function of distance and angle. In moving objects, the movement is detected as a function of current position, speed and direction of travel.

This occurs through the emission of high-frequency electromagnetic radiation, i.e. "microwaves", and evaluation the radiation reflected by objects. The reflection characteristics of the objects is of crucial importance. Metallic objects reflect the radiation very well, whereas plastic materials, for example, are almost entirely permeable to it.

Consequently, motor vehicles are very well-suited for detection by radar sensors.

Advantages of radar sensors over other sensor systems

When selecting the sensors, it was decided to use radar technology rather than rival technologies such as video, ultrasound or infrared technology.

Ultrasonic sensors have the disadvantage of a very limited range and are highly sensitive to environmental effects. Moreover, ultrasonic sensors always need to have direct contact with the propagation medium, i.e. air, which means they would have to be positioned in a visible location.

Infrared sensors, in contrast, are particularly well-suited for detecting lateral movements but are very poor at detecting movements towards or away from the sensor. It is this direction of movement in particular, however, that is crucial for the Audi side assist. Moreover, infrared sensors are also very sensitive to environmental effects such as rain.

The sensitivity to environmental effects is also the reason why video sensors were not chosen for this application. Other reasons against video sensors are their range and inaccuracy. The inaccuracy stems from the fact that the video image has to be interpreted in order to determine a distance. It is an indirect measurement process compared to the direct measurement method of radar sensors.

Radar sensors lend themselves to this type of task because they are insensitive to environmental effects and penetrate non-metallic materials, enabling the sensors to be concealed by the bumper cover. Radar applications have also become much more reasonably priced in recent years, making it feasible to use them on a large scale.



Optical parking system (OPS)

Optical parking system (OPS) in the Audi Q7

Introduction

The optical parking system (OPS) is an innovative extension of previous Audi parking aid systems. The 4-channel (rear only parking aid) and the 8-channel (front and rear parking aid) systems are already familiar. In these systems, an acoustic signal provides the customer with information about the distance of the vehicle from an obstacle.

The new optical parking system (OPS) is only available as an 8-channel system. In addition to the existing acoustic sensor evaluation, it provides the customer with an image in the MMI display which schematically depicts the current distance value of each individual parking aid sensor from an obstacle. Additional hardware is not required for this extended function. The optical parking system can be ordered with or without a reversing camera.

One major advantage to the customer over the purely acoustic system is that he/she can now accurately ascertain the point at which the vehicle is approaching an obstacle. In the purely acoustic version, based on the signal frequency, it is only possible to distinguish whether an obstacle has been detected by the front 4 parking aid sensors or the rear 4 parking aid sensors.

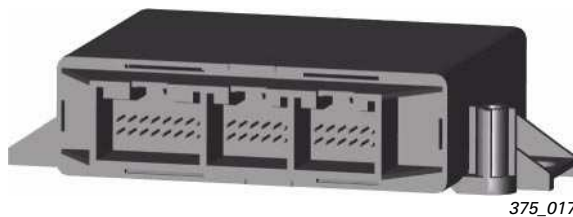


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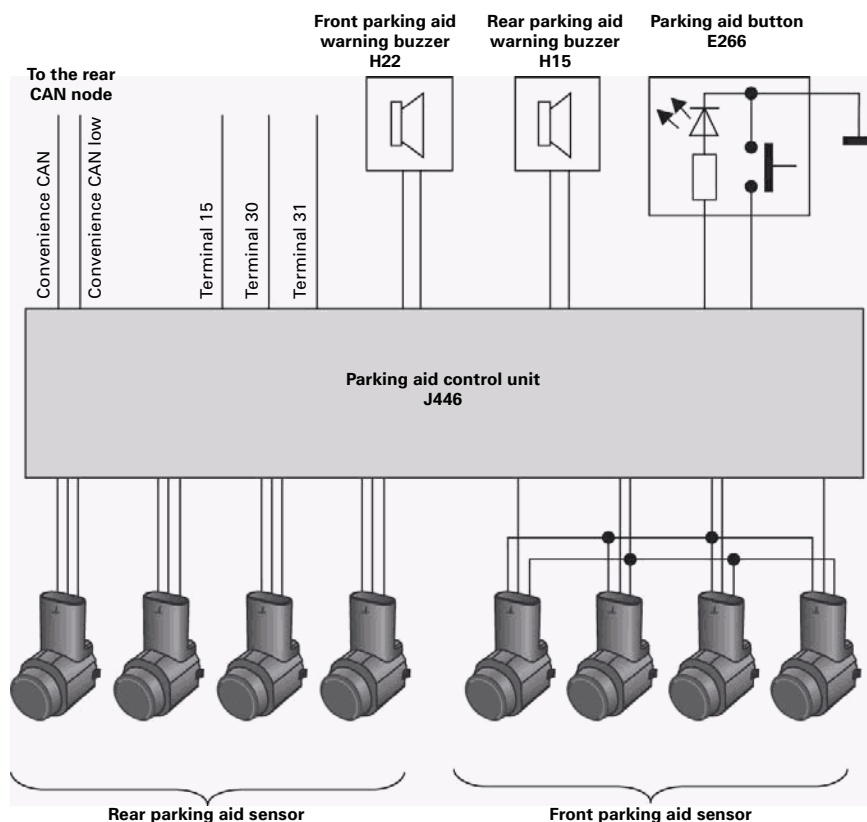
Parking aid control unit J446

The purpose of the parking aid control unit is to:

- Provide the supply voltage for the parking aid sensors
- Evaluate and process the signals from the parking aid sensors
- Activate the two parking aid warning buzzers H15 and H22
- Transmit the information required for displaying the OPS image on the MMI screen to the front information display and operating unit control unit J523
- Store the settings with respect to the remote control key when locking the vehicle (rear/front volume, rear/front frequency)
- Diagnose the system; manage the fault memory
- Read in the parking aid button E266
- Control the LED in the parking aid button E266
- Communicate with other control units for transmitting and receiving messages



Schematic circuit diagram of the parking aid control unit J446



375_018

Optical parking system (OPS)

Fitting location

The parking aid control unit J446 is fitted at the rear right, underneath the load floor.

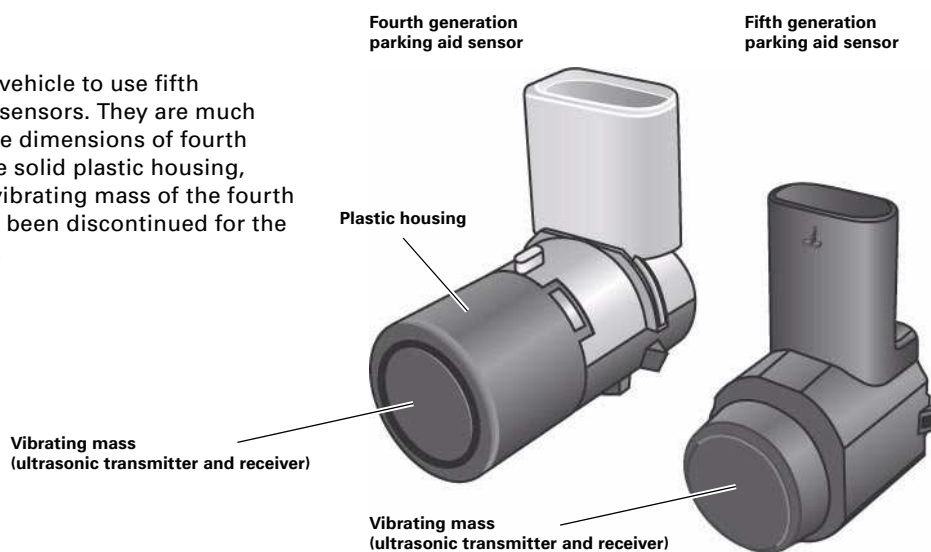
It can be addressed using the diagnostics tester under address word 76.



375_019

Parking aid sensors

The Audi Q7 is the first vehicle to use fifth generation parking aid sensors. They are much smaller compared to the dimensions of fourth generation sensors. The solid plastic housing, which surrounded the vibrating mass of the fourth generation sensors has been discontinued for the new sensor generation.



375_020

The function of the optical parking system (OPS)

Parking system detection zone

Like the previous 8-channel systems, the optical parking system (OPS) monitors the area around the vehicle using 4 parking aid sensors integrated in the front bumper and 4 in the rear bumper. The acoustic warning is given by one warning buzzer in the front section of the vehicle and one in the rear. The visual display is provided in the MMI display, with both the Basic and the High version supporting OPS.

Depending on their fitting location, the parking aid sensors recognise distinct obstacles as follows:

- Rear side parking aid sensor: from approx. 60 cm
- Front side parking aid sensor: from approx. 90 cm
- Rear centre parking aid sensor: from approx. 160 cm
- Front centre parking aid sensor: from approx. 120 cm

On reaching the following distances, the signal changes to a continuous tone:

- Front: from approx. 25 cm
- Rear without trailer hitch: from approx. 30 cm
- Rear with trailer hitch: from approx. 35 cm

Operation of the parking aid system

The driver is only given audible and visual information if the parking system is activated. Activation is automatic when reverse gear is engaged.

During forward parking or when moving forwards towards an obstacle, the parking system must be activated manually by pressing the parking aid button. Activation of the system is always signalled to the driver by a confirmation tone. It is also possible to recognise that the parking system is activated from the illuminated LED in the parking aid button.

Activating the system automatically switches the MMI to the optical parking system display. If the vehicle is also equipped with the reversing camera system, it is possible to select which of the two displays is to appear on the screen in the Car menu of the MMI under the item "Audi parking system". The setting options available to the customer in the MMI are explained in greater detail in the chapter on the reversing camera system.



375_021

An activated parking aid system is deactivated when

- a speed of approx. 15 km/h is exceeded (forwards),
- the ignition is switched off,
- the parking aid button is pressed.

Following deactivation, the LED in the button extinguishes and the MMI switches back to the image source set before the system was activated.

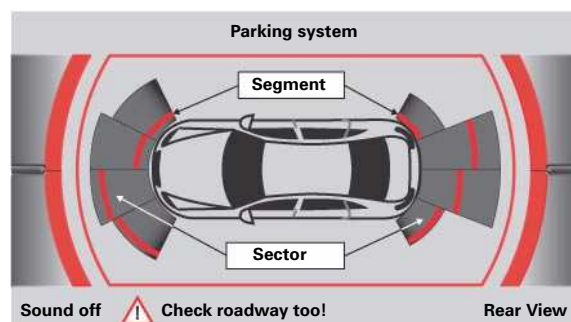
Optical parking system (OPS)

Information to the driver

If an obstacle has been detected inside the warning zone while the parking aid system is activated, the distance warning is triggered. As the distance to the obstacle decreases, the time between the sound pulses also diminishes until it becomes a continuous tone when a critical distance is reached.

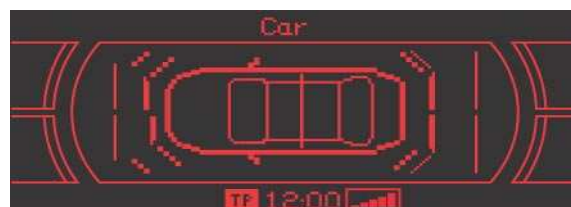
In the case of the optical parking system (OPS), the current distance measurement values for the parking aid sensors are shown in the MMI display in addition to the audible warning. For this purpose, a sector is assigned to each sensor, with the 8-channel system this corresponds to 4 sectors at the front and 4 at the rear. A red segment within a sector represents the current distance between an obstacle and the vehicle, i.e. the sensor making the measurement. If an obstacle moves towards the vehicle, the red segment also moves towards the vehicle in the diagram.

OPS display in the MMI High



375_022

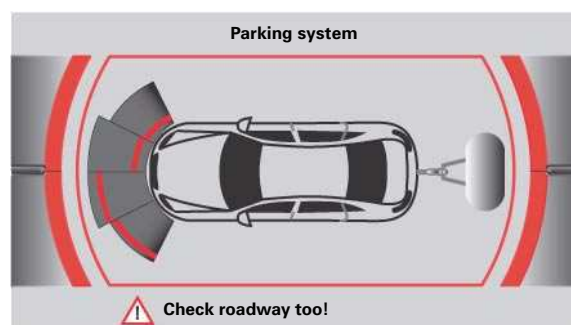
OPS display in the MMI Basic



375_023

Trailer operation

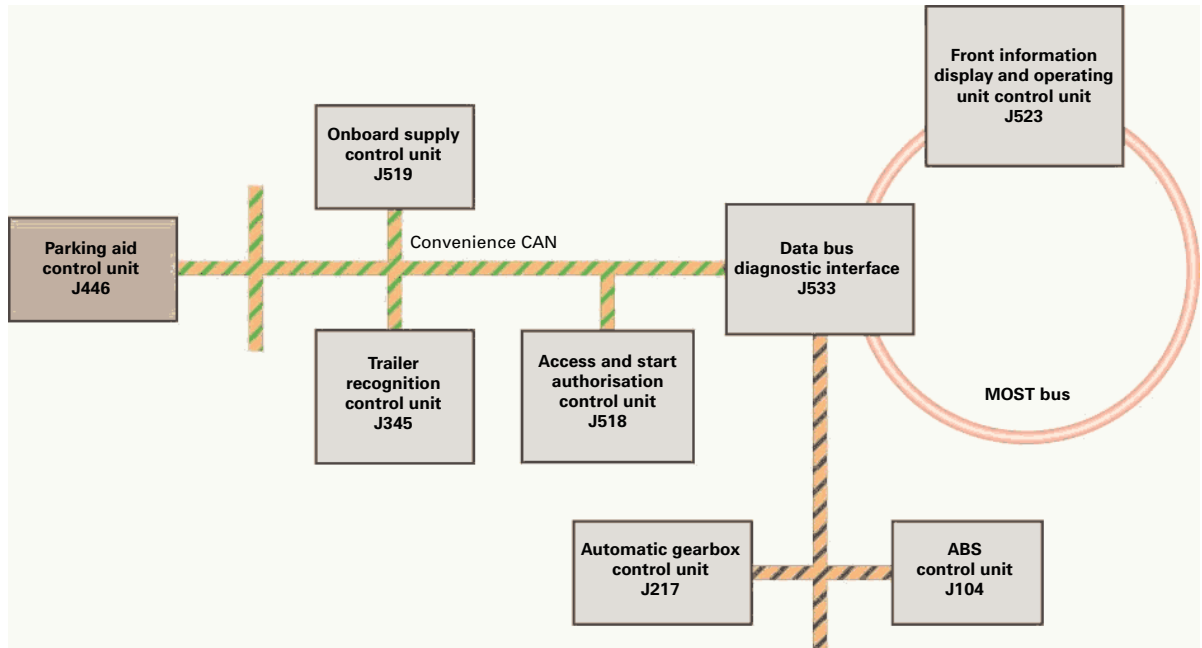
If, based on the code, the parking aid control unit recognises that a trailer hitch is installed, the range for the continuous tone is extended by 5 cm to 35 cm. This is necessary because the trailer hitch increases the vehicle length at the rear.



375_024

Communication structure of the optical parking system

In order to operate correctly, the parking aid control unit also requires information from other control units. The control unit receives this information via the convenience CAN. Information required from the modules of other bus systems is made available on the convenience CAN by the data bus diagnostic interface and is thus accessible to the parking aid control unit.



375_025

Optical parking system (OPS)

The following information is supplied to the parking aid control unit J446 by the control units listed below:

Onboard supply control unit J519

The reversing lights are on. It can be deduced from this that reverse gear is engaged and that the parking aid system needs to be activated. (CAN-message is only evaluated in vehicles with manual gearbox.)

Trailer recognition control unit J345

Trailer is currently recognised or not recognised. If a trailer is currently recognised, the rear parking system is deactivated.

Access and start authorisation control unit J518

The current terminal status and the number of the key currently being used are transmitted. The number of the current key is used to activate driver-specific settings, such as the volume and frequency of the audible warning.

ABS control unit J104

Transmits the current vehicle speed. This is needed because the front parking aid system is only available up to a speed threshold of $v=15$ km/h when the parking aid system is activated. If this threshold is exceeded, the system is deactivated. As the vehicle speed is only required for the front parking aid system, the message from the ABS control unit J104 is only evaluated in the case of an 8-channel system.

Front information display and operating unit control unit J523

Transmits the driver-specific settings to the parking aid control unit, which stores the settings under the current vehicle key. Moreover, the J523 serves as a driver display unit for showing the distances determined by the parking aid sensors in the form of a segment diagram.

Automatic gearbox control unit J217

Transmits the information as to whether the selector lever is in the "R" position. If this is the case, the parking aid system is activated.

Diagnostics

In the diagnostics tester, the address word 76 is assigned to the parking aid control unit.

The following variables can be found in the measured value blocks:

- Distance of the individual rear sensors from an obstacle
- Distance of the individual front sensors from an obstacle
- Minimum distance for the 4 rear sensors
- Minimum distance for the 4 front sensors
- Vehicle speed
- Voltage supply for parking aid sensors
- Reverse gear engaged yes / no
- Trailer attached yes / no
- Operation of function key
- Set volume and frequency, rear
- Set volume and frequency, front
- Decay times of the individual rear sensors
- Decay times of the individual front sensors
- Applicable vehicle key number
- Setting stored for the current vehicle key

The following information is encoded into the code:

- Vehicle derivative (saloon, Avant, coupe, etc.)
- USA or Rest of world
- Type of gearbox installed (manual gearbox / automatic gearbox)
- Installation of a reversing camera in the vehicle
- Installation of a trailer hitch in the vehicle
- Optical parking system (OPS) or only 8-channel acoustic parking system

The following variables can be adapted in the adaption channels:

- Confirmation tone for activation of parking aid system on / off
- Resetting volume and frequency to factory default

It is possible to actuate the following components via final control diagnosis:

- Rear parking aid warning buzzer H15
- Front parking aid warning buzzer H22
- Parking aid warning lamp K136

Reversing camera (rear-view)

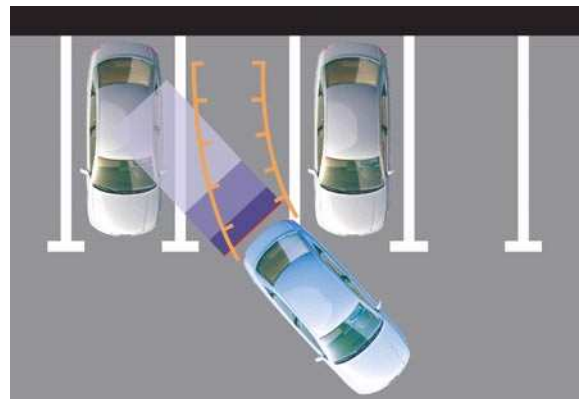
Reversing camera (rear-view) in the Audi Q7

Introduction

The AUDI reversing camera provides the customer with an improved view to the rear by capturing the area behind the vehicle and depicting this on the MMI screen. This makes it much easier for customers to reverse and reverse park.

The reversing camera makes it possible to get much closer to obstacles. The customer can direct his/her line of vision forwards for the most part and does not need to keep turning his/her head all the time. Static and dynamic reference lines that are superimposed on the video image further simplify reverse parking.

In principle, the reversing camera can be ordered as a separate parking system, together with the acoustic rear parking system or with the optical parking system (OPS). The order options available depend largely on the particular market.



375_032

Reversing camera

The Audi reversing camera is a PANASONIC camera. It weighs 40 g and measures 27 mm x 24.5 mm x 35 mm. Due to its compact design, it was possible to integrate the camera into the tailgate handle.



375_026

It is a wide-angle camera with a horizontal detection angle of 130° and a vertical detection angle of 95°. Owing to the wide-angle lens used, the camera image is greatly distorted and this distortion must be eliminated before the image is displayed on the MMI display. The distorted image is corrected in the reversing camera system control unit J772.



375_027

The chip used for capturing the image has a horizontal resolution of 510 pixels and a vertical resolution of 492 pixels, which results in an overall resolution of 250K pixels

The camera lens has a dirt-repellent coating. Dirt on the camera lens is not detected by the reversing camera system control unit, but is identified by the driver due to the quality of the image on the MMI screen. The driver is responsible for cleaning the dirty lens. The recommended method is to moisten the lens using a commercially available alcohol-based glass cleaner and clean it with a dry cloth.



375_028

Reversing camera (rear-view)

Reversing camera system control unit J772

Tasks of the control unit

The reversing camera system control unit J772 is connected to the convenience CAN.

The purpose of the reversing camera system control unit is to:

- Supply the reversing camera with voltage
- Remove distortion from the camera's wide-angle image
- Superimpose static and dynamic reference lines onto the camera image
- Provide a video input for the camera signal
- Provide a video input for the TV tuner
- Switch to the desired video signal using an integrated video switch
- Supply a video output for the incoming video signal
- Perform a self-diagnosis of the control unit
- Diagnose the incoming camera signals
- Perform the system calibration using VAS tester and calibration board

The TV tuner is available as special equipment. If there is no TV tuner in the vehicle, then the second video input of the reversing camera system control unit remains unused.



375_029

Fitting location

The reversing camera system control unit is located in the rear of the vehicle, on the right near the wheel housing. For transferring the image, the reversing camera is connected to the control unit via a screened wire. This wire is used for transmitting the entire video signal including colour, brightness, blanking and synchronising information.

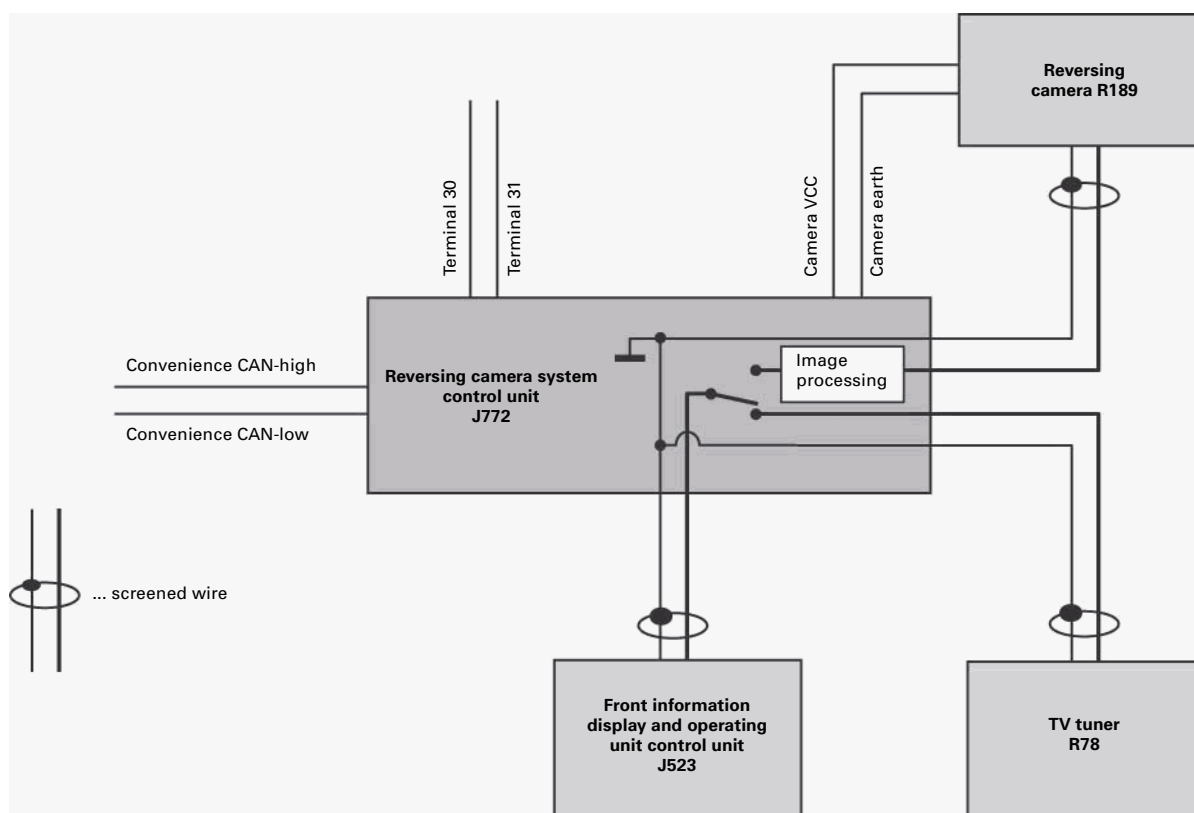


375_030

System circuit diagram

The reversing camera and the corresponding control unit are connected together by 4 wires. These are the wire for the camera's power supply and the corresponding earth wire, a screened wire for the video signal and the screening of the video signal connected to earth.

The camera is switched on and off via the voltage supply. The camera voltage supply is 6.5 V and is generated in the reversing camera system control unit by means of a switching power supply. When in operation, it requires an output of approx. 500 mW. The camera's power supply is switched off at speeds above 25 km/h, as the function is not active at speeds higher than this.



375_031

The front information display and operating unit control unit J523 has only one video input, even though there may be two video signal sources present in the vehicle: the TV tuner R78 and the reversing camera R189. For this reason, the reversing camera system control unit J772 has 2 video inputs and a video switch which patches through the image from the TV tuner or the image from the reversing camera to its video output, as required. The video output of the reversing camera system control unit J772 is connected to the video input of the front information display and operating unit control unit J523.

The illustration above depicts the off-position of the video switch in J772: this transmits the video signal of the TV tuner to the video output. The video splitter only switches to the reversing camera if the reversing image is needed in the MMI. The image from the reversing camera must first be processed in the reversing camera system control unit before it reaches the front information display and operating unit control unit J523 via the video switch and video output.

Reversing camera (rear-view)

Parking modes

With the Audi reversing camera, there are two different parking modes - the "transverse parking" mode and the "parallel parking" mode. Depending on the parking situation, the customer can opt for one of the two modes. The "transverse parking" mode is defined as the standard mode. To change the mode that is currently active, in the MMI control panel the softkey assigned to the displayed term "Mode" must be pressed.

If the vehicle is also equipped with the optical parking system (OPS), the OPS diagram can also be selected using the softkey assigned to the term "Diagram".

Parking mode 1: transverse parking

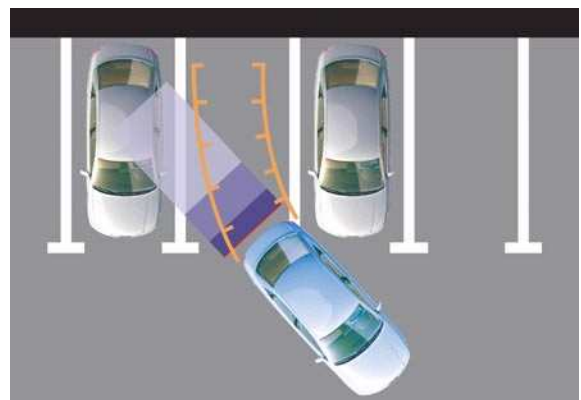
Parking mode 1, "transverse parking", is, as shown in the adjacent illustration, particularly suitable for reverse parking. It is also particularly suitable for reversing up narrow paths, such as relatively long driveways, for example. The blue area represents a vehicle contour that has been lengthened by 5 m. The vehicle would drive over the blue area shown, if it was reversed a further 5 m without turning the steering wheel.

The different shades of blue make it easier for the driver to estimate the distance from obstacles. The first transition from the dark-blue to the mid-blue area is around 1 m from the rear bumper, the next transition is at about 2 m. The following light-blue area extends to a distance of about 5 m.

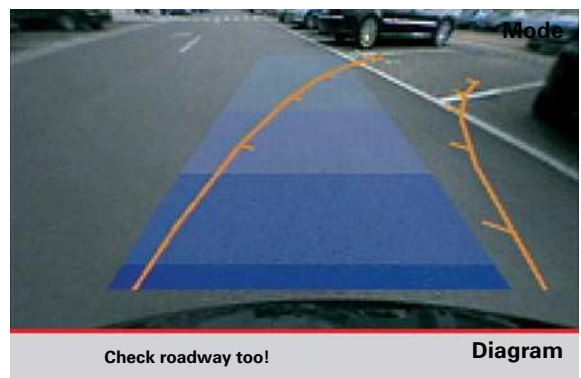
The red line which delimits the dark blue area is about 40 cm away from the rear of the vehicle. If this line touches an obstacle, then the driver should not reverse any further.

As the alignment of the reference field does not depend on the steering angle and only depends on the instantaneous vehicle position, this is known as a static reference field.

In contrast, the orange reference lines indicate the path the vehicle will follow for the next 5 m if the steering angle remains the same. As the radius of the line is dependent on the steering angle, these are known as "dynamic reference lines". The side markings along the dynamic reference lines are provided at approx. 1 m intervals.



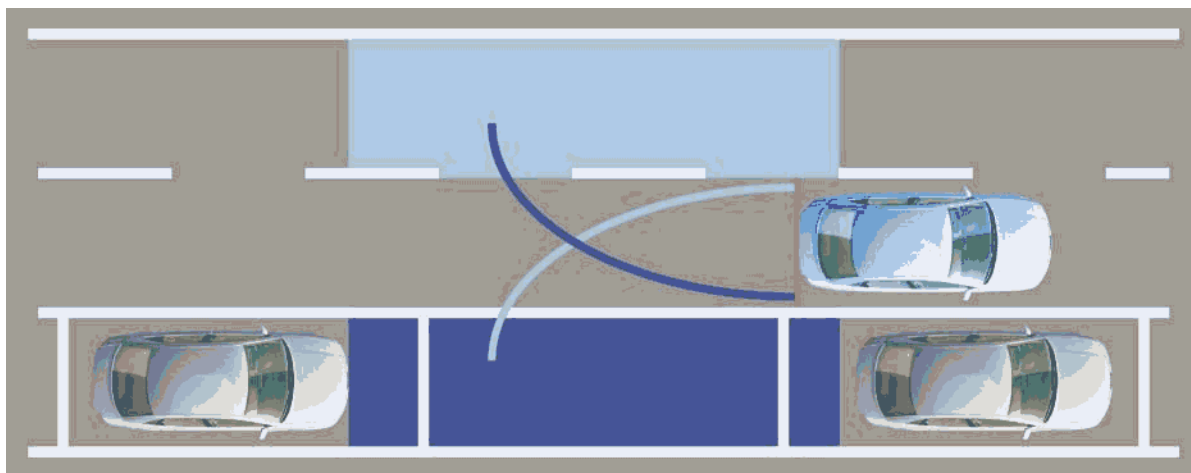
375_032



375_033

Parking mode 2: parallel parking

Parking mode 2, "parallel parking", makes it easier for the driver to reverse park alongside the kerb. Two blue fields are depicted - a light-blue field for reverse parking on the right-hand side and a dark-blue field for reverse parking on the left. The static blue lines shown, indicate the ideal point at which the driver should adjust the steering angle.



375_034

Procedure for reverse parking

If the dark-blue area fits between the two vehicles, between which the driver intends to park, then the space is large enough. Now reverse in a straight line until the end of the dark-blue area touches the rear of the vehicle (see the upper of the two illustrations). Then reverse with the steering wheel turned to left full lock. The driver must ensure that he/she does not touch the vehicle he/she is parking behind. When the dark-blue line touches the kerb (see the lower of the two illustrations), the steering wheel must be turned to right full lock and reversing continued until the vehicle is parallel to the kerb. The vehicle should then be driven forward slightly and the vehicle will be parked perfectly.



375_035



375_036

Reversing camera (rear-view)

Operating the system

Activating the reversing camera

The display of the reversing camera image on the MMI screen is activated automatically as soon as terminal 15 is active and reverse gear has been engaged.

On vehicles with the optical parking system (OPS), the reversing camera display may also be activated using the parking aid button in the centre console. This is possible when driving forwards at speeds < 10 km/h.



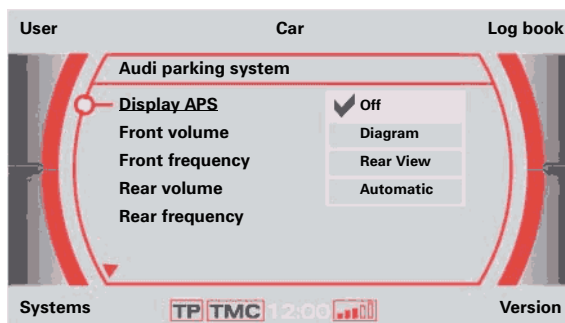
375_021

Deactivating the reversing camera

The display of the reversing camera in the MMI is switched off when terminal 15 is switched off, if another hardkey in the MMI is operated or the vehicle is travelling forwards at a speed > 10 km/h. In vehicles with OPS, pressing the parking aid button also terminates display of the reversing camera on the screen.

Setting options in the MMI

As is already familiar from other Audi models with a parking aid system, the customer has the option of storing individual settings for the frequency and volume of the front and rear warning tone. For this purpose, the "Audi parking system" menu item in the Car menu of the MMI must be selected.



375_038

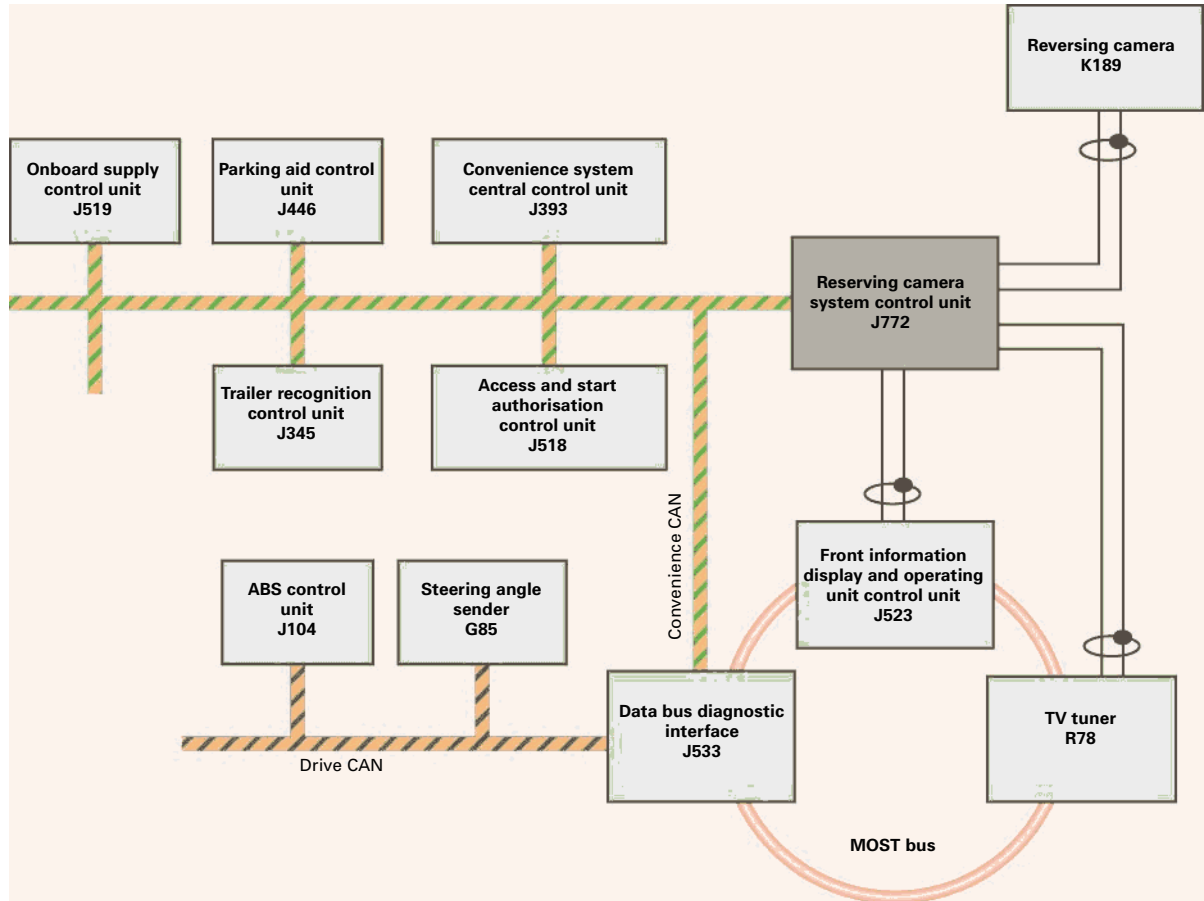
As there are two possible parking aid systems available in vehicles with optical parking system (OPS) and reversing camera, the settings listed in the adjacent table for the MMI display when a parking cycle begins can be selected under the item "Display APS".

The settings are active for the next parking cycle.

Settings of MMI display			
1	Off	there is no display of the parking system function in the MMI display	
2	Diagram	the diagram of the optical parking system (OPS) is displayed in the MMI display	
3	Rear View	the image of the reversing camera is shown in the MMI display	
4	Automatic	when reversing, the image from the reversing camera is displayed in the MMI display, when driving forwards the OPS diagram is shown	

Communication structure of the reversing camera system

The reversing camera system control unit exchanges information with various control units. This information is required for the correct operation of the overall function and is described below:



375_039

Reversing camera (rear-view)

Steering angle sender G85

Supplies the current steering angle, which is needed for calculating the dynamic reference lines in the camera image.

Parking aid control unit J446

Supplies information as to whether the parking aid system is currently active based on the button or based on the reverse gear being engaged and whether the parking aid control unit is defective.

Trailer recognition control unit J345

Informs the reversing camera system whether or not a trailer is currently attached to the vehicle. If a trailer is attached to the vehicle, then the reference lines and the reference field are disabled.

Convenience system central control unit J393

Transmits the information as to whether the tailgate is open or closed. If the tailgate is open, the reference lines and the reference field are deactivated.

Access and start authorisation control unit J518

Transmits the current status of terminal 15 to the reversing camera.

Front information display and operating unit control unit J523

It depicts the reversing camera image on its display. In addition, system settings for the reversing camera can also be made.

Onboard supply control unit J519

This transmits the information as to whether the reversing light is currently actuated. In vehicles without a parking aid control unit, it can be deduced from this that the reverse gear is currently engaged and that the camera image must be displayed on the MMI screen accordingly.

ABS control unit J104

The “current vehicle speed” information is required by the J104 for detecting the conditions for switching the reversing camera on and off.

Data bus diagnostic interface J533

This directs the required CAN messages from other bus systems onto the convenience CAN. Transmits freeze-frame information if an entry is made in the fault memory of the reversing camera system control unit.

Remarks

The following control units are optional and therefore not installed in every Audi Q7:

- Parking aid control unit J446
- Trailer recognition control unit J345
- TV tuner R78

Diagnostics

In the diagnostics tester, the address word 6C is assigned to the reversing camera control unit.

The following variables can be read out in the measured value blocks:

- S-contact status and terminal 15 status
- Reverse gear engaged yes / no
- Voltage supply for control unit
- Voltage supply for camera
- Tailgate open / closed
- Current vehicle speed
- Calibration active / not active
- Status of last calibration
- Cause of a failed calibration

The following characteristics are encoded in the code:

- Vehicle manufacturer VW / Audi
- Country version
- OPS (optical parking system) installed - yes / no
- Trailer hitch installed - yes/no
- Steering installed
- Camera height above ground (dependent on chassis and tyres)
- Vehicle model

The following variables can be adapted in the adaption channels:

- Start of calibration
- Coordinate information for calibrating the camera
- Brightness, contrast and colour settings for video image

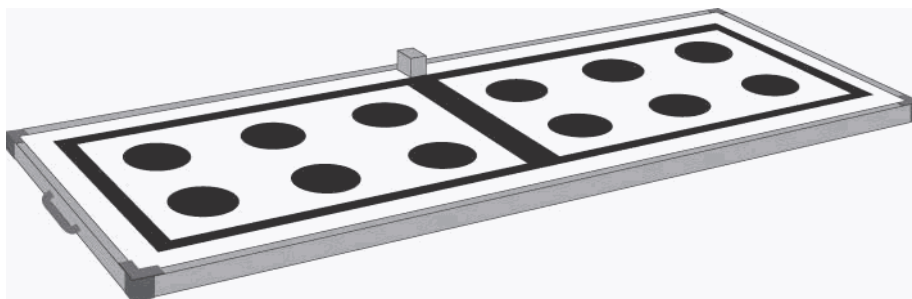
Reversing camera (rear-view)

Special tool for system calibration

The same calibration board is used for calibrating the reversing camera as is also used for calibrating the Audi side assist. The Doppler generator is however not required.

The way in which the calibration board must be aligned to the vehicle is described in detail in the corresponding Workshop Manual and is also briefly outlined in the chapter on calibrating the Audi side assist. It should also be noted that the board must be perfectly level, which is achieved via the three adjustable feet under the calibration board. A built-in spirit level on the calibration board indicates whether the required position has been achieved.

The distance of the surface of the calibration board from the ground must be determined using a tape measure and entered into the tester before starting the calibration procedure. A bore has been provided next to the spirit level to measure the distance.



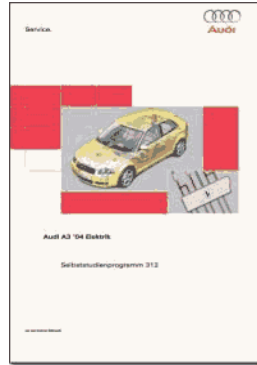
375_037

The calibration must be carried out according to the calibration instructions available in the guided fault-finding.

Once the calibration device has been aligned correctly, the calibration program can be started in the guided fault-finding.

The purpose of calibrating the reversing camera is to correct the distortion of the camera image. For this purpose, the system first searches for the two rectangles on the calibration board outlined in black. Once these have been found, the system then finds the 6 black circles in each of these rectangles and determines their centre points. Then the actual position of the centre of the circle that has been determined is compared with the specified position stored in the control unit. From this information the correction parameters can be calculated, which are used to continuously correct the distortion of the camera image.

Self-study programme for the Audi Q7

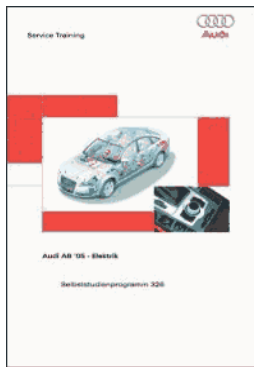


375_041

SSP 312 Audi A3 '04

- Control units
- Distributed functions
- Infotainment
- Passenger protection

Order number: A03.5S00.03.20



375_042

SSP 326 Audi A6 '05 Electrical system

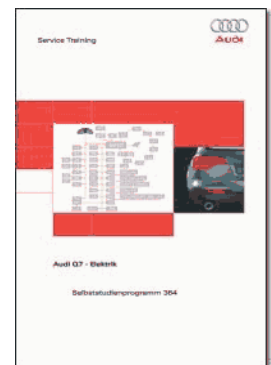
- Networking
- Bus topologies
- Convenience electrics
- Infotainment

Order number: A04.5S00.09.20

SSP 364 Audi Q7 Electrical system

- Networking
- Fitting locations
- Convenience control units
- Vehicle electrical system

Order number: A05.5S00.17.20



375_043

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