

Workshop Manual

Audi A4 2008 ➤

Audi A5 Cabriolet 2009 ➤

Audi A5 Coupé 2008 ➤

System description - adaptive cruise control

Edition 10.2011



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List of Workshop Manual Repair Groups

Repair Group

01 - Self-diagnosis, electrical checks

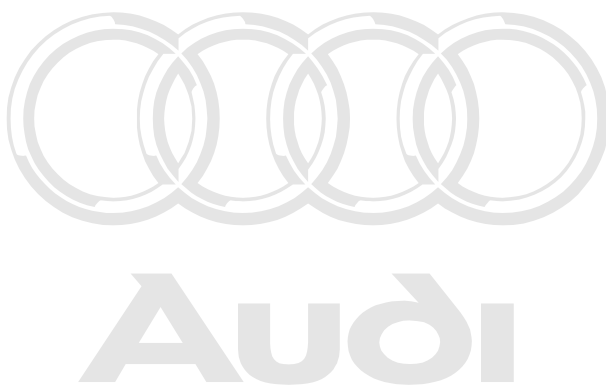


Technical information should always be available to the foremen and mechanics, because their careful and constant adherence to the instructions is essential to ensure vehicle road-worthiness and safety. In addition, the normal basic safety precautions for working on motor vehicles must, as a matter of course, be observed.

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01 – Self-diagnosis, electrical checks

1 General notes on „adaptive cruise control“ (ACC)

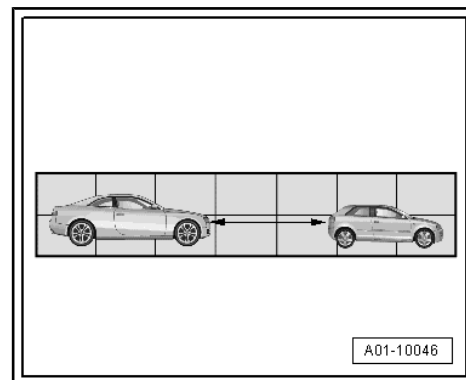
Requirements for adaptive cruise control

The following information is required for the control:

Distance to vehicle in front

The time span between the transmission of the signal and the receipt of the reflected signal components depends on the distance to the object.

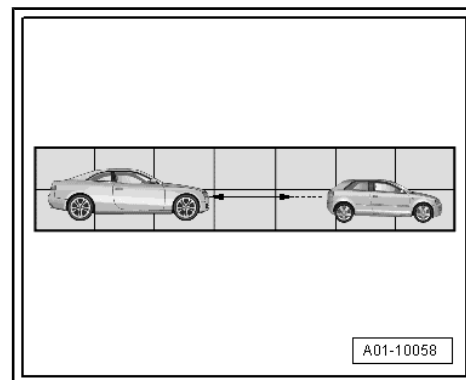
In other words, the further away an object or vehicle is, the longer it takes to receive the signal echo.



Speed of vehicle in front

If the distance to the vehicle in front is reduced, the frequency of the reflected beam is increased.

If the distance to the vehicle in front is increased, the frequency of the reflected beam is reduced.



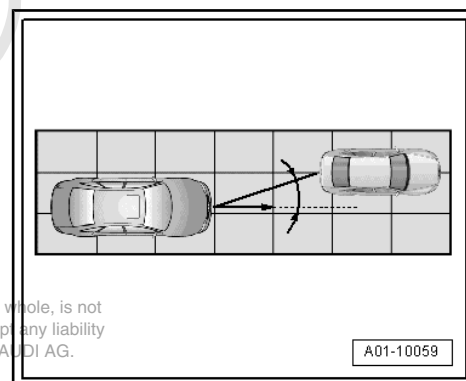
Distance to vehicle in front	Time span between transmitted and received signal	Frequency
Remains constant	Time remains constant	Remains constant
Is increased	Time is increased	Is reduced
Is reduced	Time is reduced	Is increased

This frequency shift is evaluated by the electronics and is used to calculate the speed.

Position of vehicle in front

The radar signal propagates outwards in the shape of a cone.

The intensity of the signal decreases as it gets further away from the transmitter in the longitudinal and transverse directions.

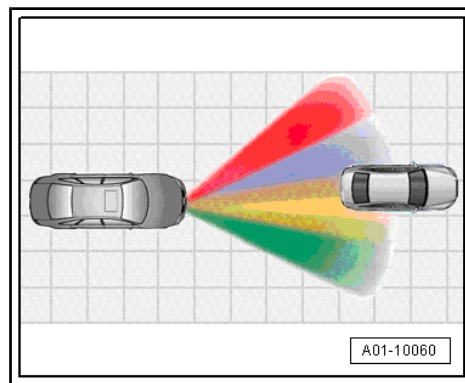


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In order to determine the position, it is also necessary to know the angle at which the vehicle in front is moving in relation to the host vehicle.

A radar with four beams is used for this purpose.

The angle information is provided by the ratio between the amplitudes (= signal strength) of the received (i.e. reflected) signals from the individual radar beams.



1.1 Technical data

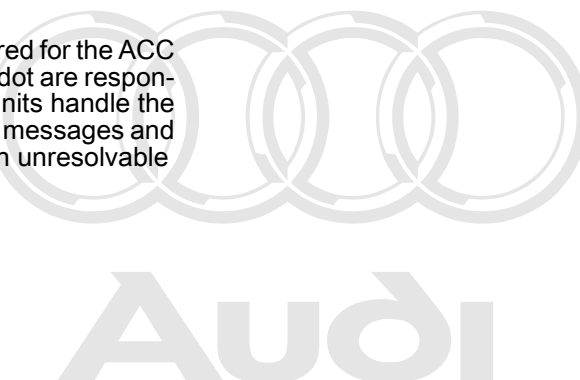
Range of the ACC	approx. 200m
ACC speed control range	20 ... 200 km/h
Frequency of ACC carrier signal	76.5 Gigahertz
Maximum brake effect by ACC in relation to maximum overall brake effect	25 %

1.2 Components used

As the individual vehicle systems are networked, the ACC uses a large number of different control units.

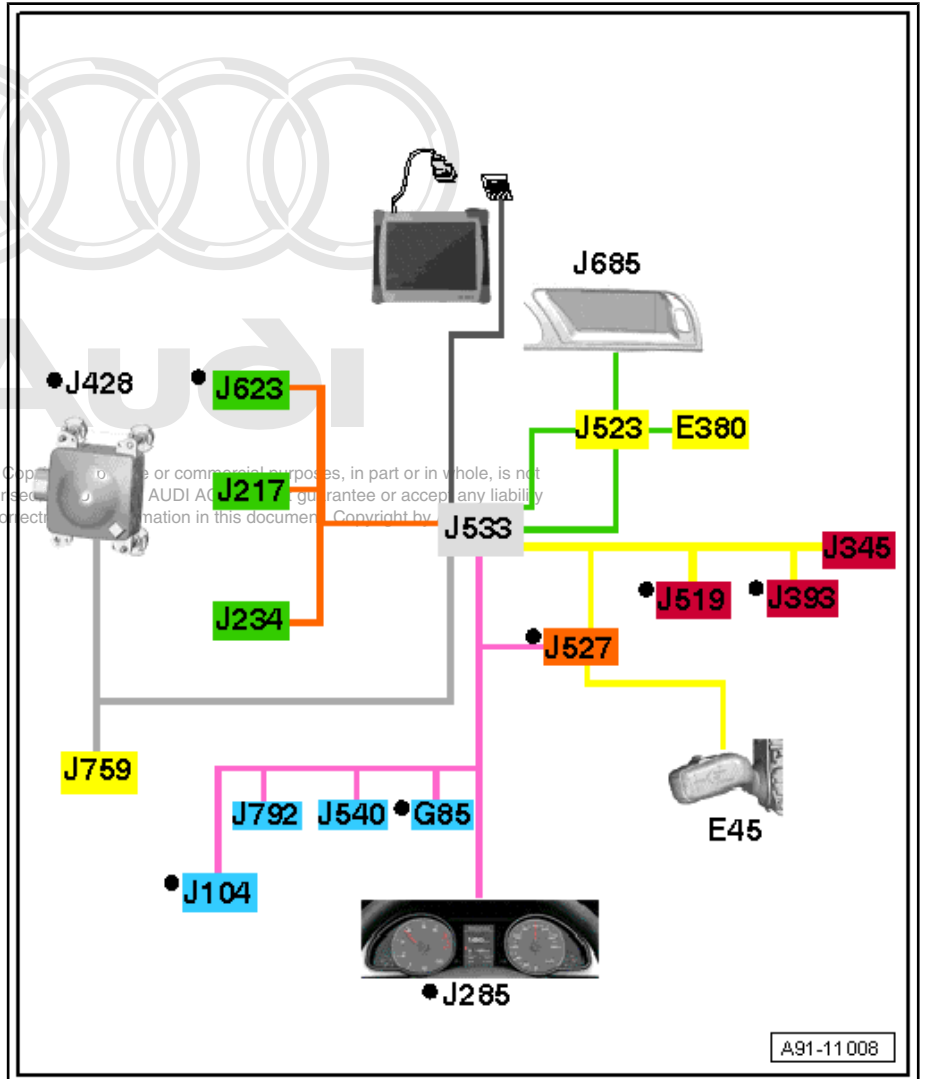
These control units communicate with each other across different types of bus. The data bus diagnostic interface -J533- , which is connected to all the different bus versions, prepares and transmits the data to the corresponding control unit.

The control units shown in the illustration are required for the ACC functionality. The control units shown with a black dot are responsible for the core functionality. The other control units handle the visual and acoustic output of information and error messages and deactivate the ACC immediately in the event of an unresolvable error.



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- Adaptive cruise control unit - J428-
- Engine control unit -J623-
- Automatic gearbox control unit -J217- (only fitted optionally in vehicle)
- Airbag control unit -J234-
- Data bus diagnostic interface -J533-
- Display unit for front information display and operating unit control unit -J685-
- Control unit for front display and information control panel - J523-
- Multimedia system operating unit -E380-
- Trailer detector control unit - J345- (only fitted optionally in vehicle)
- Convenience system central control unit -J393-
- Onboard supply control unit - J519-
- Steering column electronics control unit -J527- / steering angle sender -G85-
- Cruise control system switch -E45-
- Control unit in dash panel insert -J285-
- Steering angle sender -G85-
- Control unit for electromechanical parking brake -J540-
- Active steering control unit -J792- (only fitted optionally in vehicle)
- ABS control unit -J104-



Note

Some of the control units are only fitted optionally in the vehicle and are therefore only required for the ACC functionality if they are fitted.

Bus networks (the colour pattern shows which bus connects which components)

Pink -	CAN running gear
Orange -	CAN drive train
Grey -	CAN extended
Green -	MOST bus
Yellow -	CAN convenience
Black -	CAN diagnosis

Information from senders to individual control units

The ACC also draws on these communication paths to access the information transmitted by various senders to the control units specified above.

Component	Designation
-G17-	Ambient temperature sensor
-G44-	Rear right speed sensor (on four-wheel drive vehicles only)
-G45-	Front right speed sensor
-G46-	Rear left speed sensor (on four-wheel drive vehicles only)
-G47-	Front left speed sensor
-G85-	Steering angle sender
-G202-	Yaw rate sender
-G259-	Right adaptive cruise control sender

1.3 General notes on information exchange

Data exchange between the adaptive cruise control unit -J428- and other control units takes place either directly or indirectly. If direct data exchange cannot take place, the data are transmitted via the engine control unit -J623-, which forwards a status bit stream to the adaptive cruise control unit -J428-, on which operational information is stored.

Control units which communicate directly with the adaptive cruise control unit -J428-	Control units which communicate indirectly with the adaptive cruise control unit -J428-
Control unit in dash panel insert -J285-	Control unit for front display and information control panel -J523-
Steering column electronics control unit -J527-	Convenience system central control unit -J393-
Entry and start authorisation control unit -J518-	Automatic gearbox control unit -J217- (only if an automatic gearbox is fitted)
Trailer detector control unit -J345- (only if a towing bracket is fitted)	Airbag control unit -J234-
Steering angle sender -G85-	Control unit for electromechanical parking brake - J540-
ABS control unit -J104-	Active steering control unit -J792- (only if active steering is fitted)
Engine control unit -J623-	

Overview of signals transmitted directly or indirectly from the control units to the adaptive cruise control unit -J428-

Engine control unit -J623-	♦ Engine speed ♦ Switch position of brake light switch ♦ Engine control unit mode ♦ Accelerator pedal signal
Automatic gearbox control unit -J217-	♦ Selector lever position ♦ Gearbox emergency running mode ♦ Gearbox information
Steering column electronics control unit -J527-	♦ Fault messages ♦ Operating lever signals

Onboard supply control unit -J519-	◆ Windscreen wiper function status ◆ Turn signal activation status ◆ Outside temperature
Trailer detector control unit -J345-	◆ Brake light activation status
Steering angle sender -G85-	◆ Steering wheel angle
ABS control unit -J104- Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright by AUDI AG.	◆ ASR/EBC/ESP control ◆ ESP passive cycle ◆ Wheel speed ◆ Yaw rate/direction of rotation ◆ Brake overheated ◆ Brake pressure ◆ Fault messages ◆ Speed generation switchover between front-wheel and four-wheel drive
Convenience system central control unit -J393-	◆ Brake light activation status ◆ Key number for remote control key
Control unit for front display and information control panel -J523-	◆ Status display ◆ Change to default settings (user preference)
Control unit in dash panel insert -J285-	◆ Fault messages ◆ Displayed speed ◆ Country version

Overview of signals transmitted directly or indirectly from the adaptive cruise control unit -J428- to the control units

Adaptive cruise control unit -J428-	◆ adaptive cruise control mode ◆ Specified acceleration (negative for deceleration) ◆ Permissible control deviation ◆ Activation request for instrument cluster displays, lighting and warning tone ◆ Forced activation of ESP ◆ Default settings (warning tone, time delay)
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1.4 Definition of terms and abbreviations

ABS	The anti-lock brake system (ABS) prevents the wheels from locking under braking.
ACC	The adaptive cruise control (ACC) is an advanced cruise control system which maintains the correct distance to the vehicle in front within certain system limits.



ASR	The traction control system (ASR) prevents the wheels from spinning under acceleration. Under heavy acceleration from a standstill or on treacherous road surfaces such as ice, snow, gravel or wet cobble stones where there is little or no grip, one or more wheels can spin and the vehicle can start to skid.
CAN	A controller area network (CAN) is a serial data bus with a transmission rate of up to 1,000,000 bit/s.
ESP	The electronic stabilisation program (ESP) enhances the control over the vehicle in critical handling situations.
CCS	The cruise control system (CCS) is an electronic aid for controlling the driving speed.
EBC	The engine braking control (EBC) prevents the driven wheels from slipping on a smooth road surface if the driver releases the accelerator pedal or changes down a gear too quickly.
MMI	Protected by copyright. Copying for private or commercial purposes, in part or in whole, is not permitted unless authorised by AUDI AG. AUDI AG does not guarantee or accept any liability with respect to the correctness of information in this document. Copyright © AUDI AG. The Multi Media Interface (MMI) is an integrated operating concept used by Audi for easy, logical and intuitive operation of on-board car systems and infotainment components.
RADAR	Radar is an acronym for radio detection and ranging and is the designation for various detection and direction finder systems which use electromagnetic waves in the radio frequency range.

2 Function: No vehicle in front, cruise control

2.1 General notes, components used

The following components are required for the »no vehicle in front, cruise control« function:

Adaptive cruise control unit -J428- , engine control unit -J623- , cruise control system switch -E45- , control unit in dash panel insert -J285- , ABS control unit -J104- , rear right speed sensor -G44- (only on vehicles with four-wheel drive), front right speed sensor -G45- , rear left speed sensor -G46- (only on vehicles with four-wheel drive) and front left speed sensor -G47- .

2.2 Description

The driver activates the control, accelerates the vehicle up to the desired speed and then presses the SET button on the cruise control system switch -E45-.

The ABS control unit -J104- uses the signals from speed sensors -G44- (only on vehicles with four-wheel drive), -G45- , -G46- (only on vehicles with four-wheel drive) and -G47- to calculate the distance pulse count, and then places this information on the instrument cluster/running gear CAN.

The distance pulse count is required by the control unit in dash panel insert -J285- in order to calculate the current speed.

The adaptive cruise control unit -J428- scans the speed signal placed on the running gear CAN by the control unit in dash panel insert -J285- , calculates the acceleration needed in order to maintain the specified speed, and transmits the specified acceleration to the engine control unit -J623- .

If the actual speed differs from the specified speed, the adaptive cruise control unit -J428- detects the difference, recalculates the required acceleration and transmits the new specified acceleration to the engine control unit -J623- .

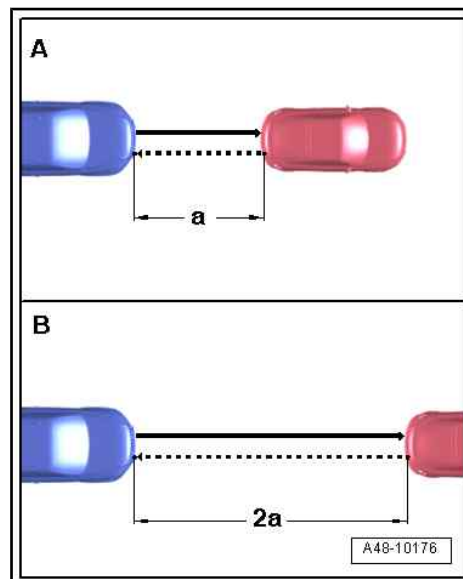
The engine control unit -J623- decides whether, in order to achieve the specified acceleration, it is necessary to increase or reduce the fuel injection quantity, or to apply the brake (the latter is performed via the ABS control unit -J104-).

2.3 Notes for service

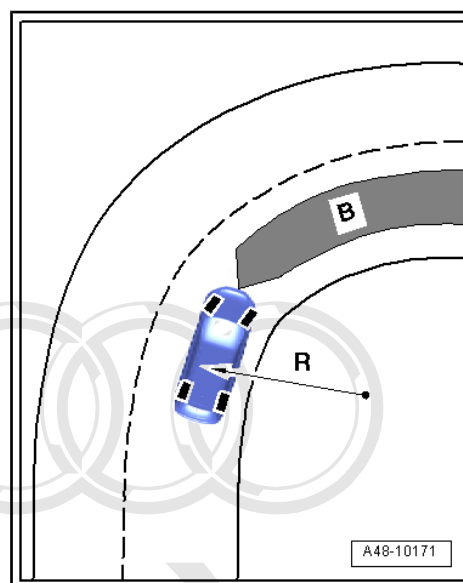
If the engine control unit -J623- has been renewed, the cruise control system (if fitted) must be included in the coding ⇒ Vehicle diagnostic tester in „Guided Functions“ mode.

3 Function: Vehicle in front

3.1 General notes, components used

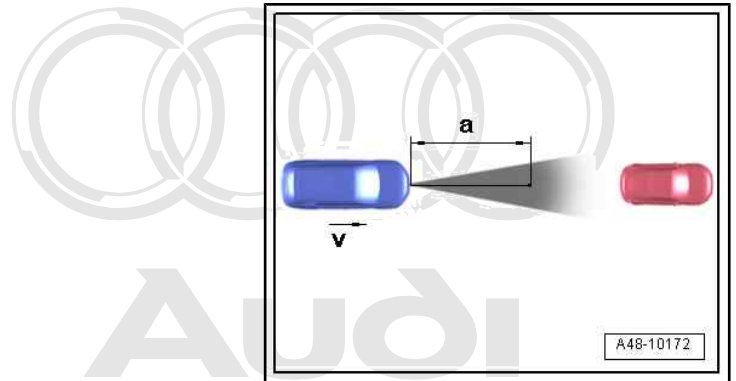


- ◆ The adaptive cruise control unit -J428- operates according to the radar principle.
- ◆ The principle is simple: electromagnetic waves are reflected by the surface of objects. The reflected waves are detected as an „echo“. The time span between the transmission of the signal and the receipt of the reflected signal components depends on the distance to the object.
- ◆ The distance in illustration „B“ is twice the distance in „A“. It follows that the time taken for the reflected signal to reach the receiver in „B“ is twice the time in „A“.
- ◆ In real traffic situations (e.g. on motorways and dual carriageways or when cornering), there are usually several vehicles within the radar's field of vision.
- ◆ In this case, it is necessary to detect which vehicle is in the same lane (and thus to decide which vehicle is to be used as the reference for maintaining the specified distance).
- ◆ The adaptive cruise control unit -J428- requires additional input signals for the lane recognition function: these are provided mainly by the yaw rate sender -G202-, the speed sensors -G44-, -G45-, -G46-, -G47- and the steering angle sender -G85-. By evaluating these signals, inferences can be drawn about the road's curvature.

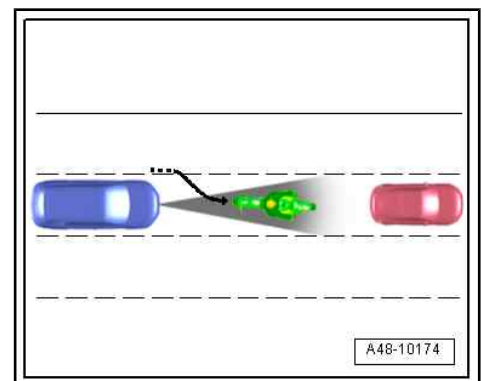
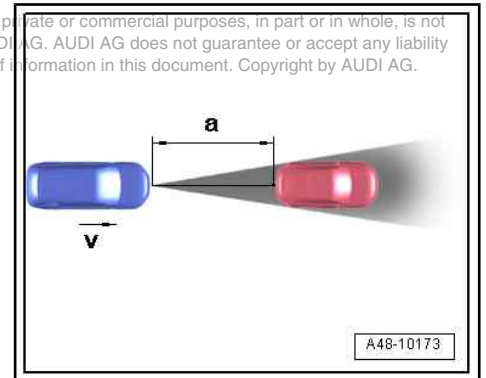


- ◆ The „imaginary“ lane „B“ is inferred from the current cornering radius „R“ and a specified average lane width.
- ◆ The nearest object measured by the radar sensor in this lane is used as the relevant object for distance control.
- ◆ In addition, the following components are used: control unit in dash panel insert -J285-, steering column electronics control unit -J527-, cruise control system switch -E45-, engine control unit -J623-, ABS control unit -J104-, rear right speed sensor -G44- (only on vehicles with four-wheel drive), front right speed sensor -G45-, rear right speed sensor -G46- (only on vehicles with four-wheel drive) and front left speed sensor -G47-.

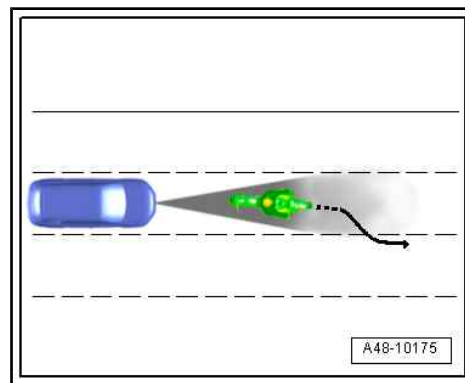
3.2 Description



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- ◆ The driver of the blue vehicle activates the control and sets the desired speed „V“ and desired distance „a“ via the cruise control system switch -E45-. This switch position is scanned by the steering column electronics control unit -J527- and transmitted across the CAN bus to the adaptive cruise control unit -J428-. The adaptive cruise control unit -J428- scans the current speed, which is placed on the running gear CAN by the control unit in dash panel insert -J285-, and transmits a specified acceleration to the engine control unit -J623- so that the specified speed can be reached. The vehicle accelerates up to the specified speed.
- ◆ A vehicle (shown in red) ahead in the same lane is detected by the adaptive cruise control unit -J428-, which responds by modifying the specified acceleration and transmitting the new value to the engine control unit -J623- so that the specified distance can be maintained. The engine control unit -J623- decides whether, in order to achieve the specified acceleration, it is necessary to reduce the fuel injection quantity or apply the brake (the latter is performed via the ABS control unit -J104-). As a result, the speed „V“ of the blue vehicle is reduced such that the desired distance „a“ is attained.
- ◆ A second vehicle (motorbike) cuts in between the vehicles. The specified acceleration calculated by the adaptive cruise control unit -J428- cannot be realised by the engine control unit -J623-. In other words, the system cannot maintain the desired distance on its own by applying the brakes, and there is a risk of a collision with the motorbike. An optical warning (in the control unit in dash panel insert -J285-) and an acoustic warning (over the loudspeakers) prompt the driver to apply the brakes in order to avoid a collision.
- ◆ The ACC is deactivated when the driver applies the brakes. The driver can now either reactivate the settings which were active prior to the brake application using the »resume« function (by pulling the cruise control system switch -E45-), or set a new speed and distance (by pressing the SET button). The motorbike in front moves out of the lane. This is detected by the radar sensor. The blue vehicle accelerates up to the specified speed again.



3.3 Notes for service

If the adaptive cruise control unit -J428- is removed during repair work on the front of the vehicle, it must be recalibrated after it is reinstalled ⇒ Rep. gr. 44 and ⇒ Vehicle diagnostic tester in „Guided Functions“ mode.

- ◆ The adaptive cruise control is deactivated immediately if the driver applies the brakes.
- ◆ Pressing the clutch for longer than 20 seconds also deactivates the adaptive cruise control.

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