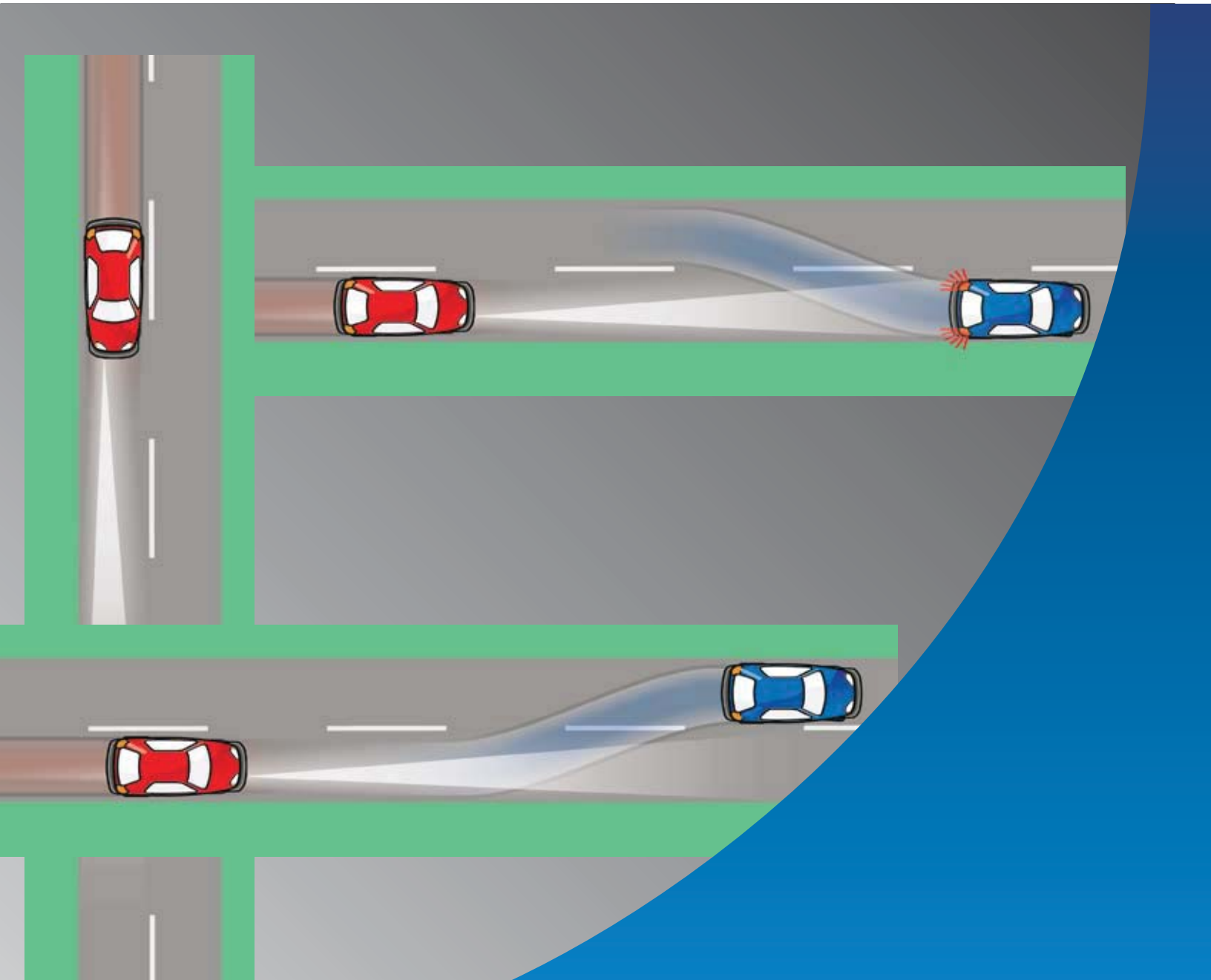
Service Training

Self-Study Program 860193

Adaptive Cruise Control and Lane Change Assist

Design and Function



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

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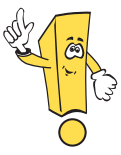

Important!

This Self-Study Program covers information on the features and operation of Volkswagen Acaptive Cruise Control Systems.
This Self-Study Program is not a Repair Manual.

This information will not be updated. For testing, adjustment and repair procedures, always refer to the latest electronic service information.

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Adaptive Cruise Control

Cruise control systems have been around for a long time, and are very good at maintaining the driver-selected vehicle speed while traveling over a variety of flat and moderately hilly terrain.

Adaptive Cruise Control (ACC) systems differ from conventional cruise control systems. In addition to maintaining the selected speed, the ACC systems are able to maintain a driver-selectable **distance** (time gap) from the vehicle in front.

ACC enhances driver convenience considerably because fewer accelerator and brake pedal operations are required.

Advantages of ACC include:

- Reduction in driver fatigue
- Increased fuel efficiency due to gradual changes in speed
- Decreased accident rates, primarily through reduction in rear-end collisions

Further development of ACC systems will provide:

- Platform for next-generation collision avoidance systems
- Foundation for artificial intelligence in vehicles

This Self Study Program reviews the progression of ACC systems in Volkswagen vehicles, beginning with its first use in the Phaeton.

Refer to SSP 898303 – The Phaeton Adaptive Cruise Control, for additional information about the ACC system in the Phaeton.

Notes

ACC Operation

The Phaeton was the first Volkswagen vehicle to offer ACC. It is a radar-based system in which the distance from and speed of the vehicle in front are determined by a radar sensor. If the distance is greater than desired, the vehicle accelerates until the set speed input by the driver is achieved.

If the distance is less than desired, the vehicle decelerates by reducing power, changing gears, and applying the brakes if necessary. The amount and duration of these actions vary by vehicle model and ACC system version.

In certain traffic situations, active braking by the driver may still be necessary.

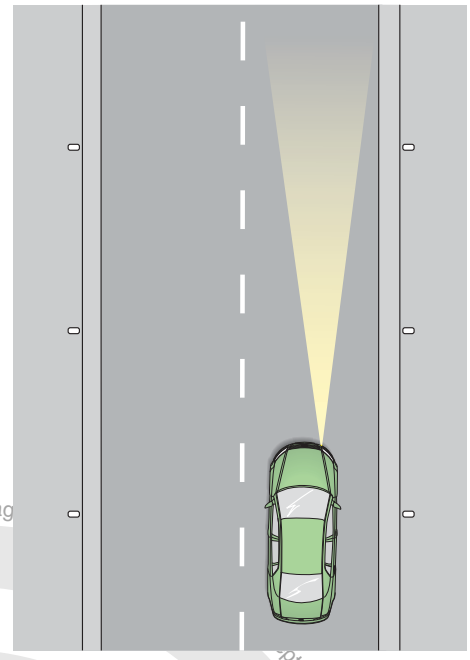
Limits of Adaptive Cruise Control System

- ACC is designed to assist the driver and is not a safety system
  - It is not a fully autonomous driving system
- ACC provides regulation in a speed range of 19 – 125 mph (30 – 200 km/h)
- ACC does not react to stationary objects
- Radar operation is impaired by rain, spray and slush
- Tight bends may restrict operation because of the limited radar detection range

ACC in the Phaeton

Constant Speed

If no vehicle is located within the field of vision when the ACC system is in operation, the set speed is maintained.



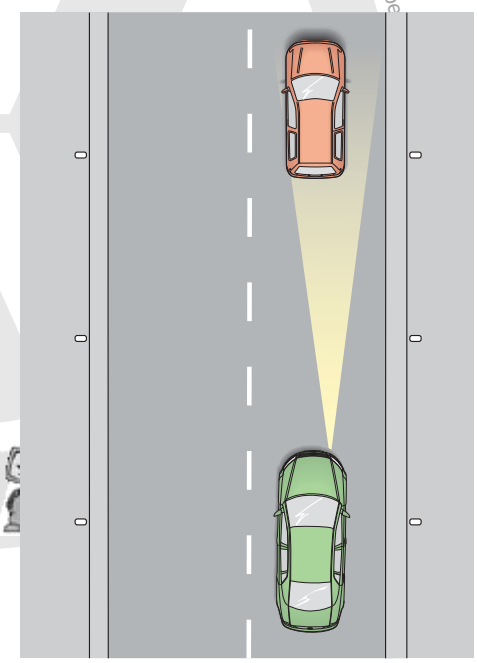
62 mph (100 km/h)

276_006

Deceleration

If an ACC-controlled vehicle detects a slower-moving vehicle ahead of it in the same lane, the ACC system regulates the distance between the two vehicles to a time-dependent value pre-selected by the driver. This is done by reducing the engine speed and, if necessary, a moderate application of the brakes.

The driver is prompted to take over the braking application if the gap between the two vehicles is too small.



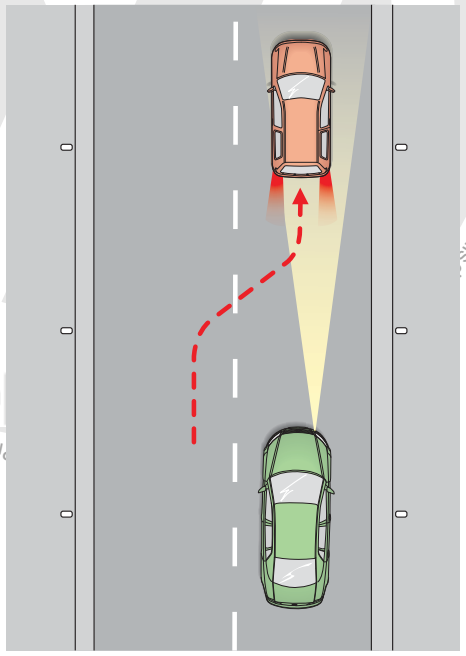
50 mph (80 km/h)

62 mph (100 km/h) ➔ 50 mph (80 km/h)

276_007

The ACC system will also decelerate if a slower moving vehicle cuts in ahead. The vehicle road speed is adapted accordingly.

Warning: Stationary vehicles are not detected in early versions of ACC systems. The driver must perform normal braking operations when approaching stationary objects.

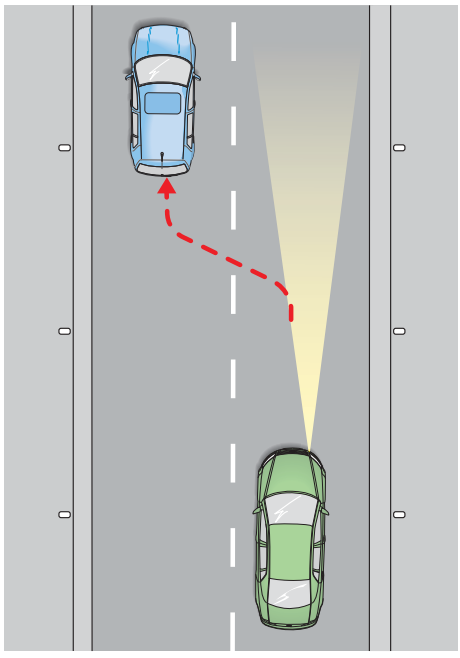


276_037

Acceleration

If the vehicle in front clears the way by accelerating or by changing lanes, the ACC system increases the engine speed to accelerate to the pre-selected road speed.

Warning: Never use ACC or conventional Cruise Control Systems (CCS) while driving on wet or slippery roads. Loss of traction may occur resulting in a vehicle crash.



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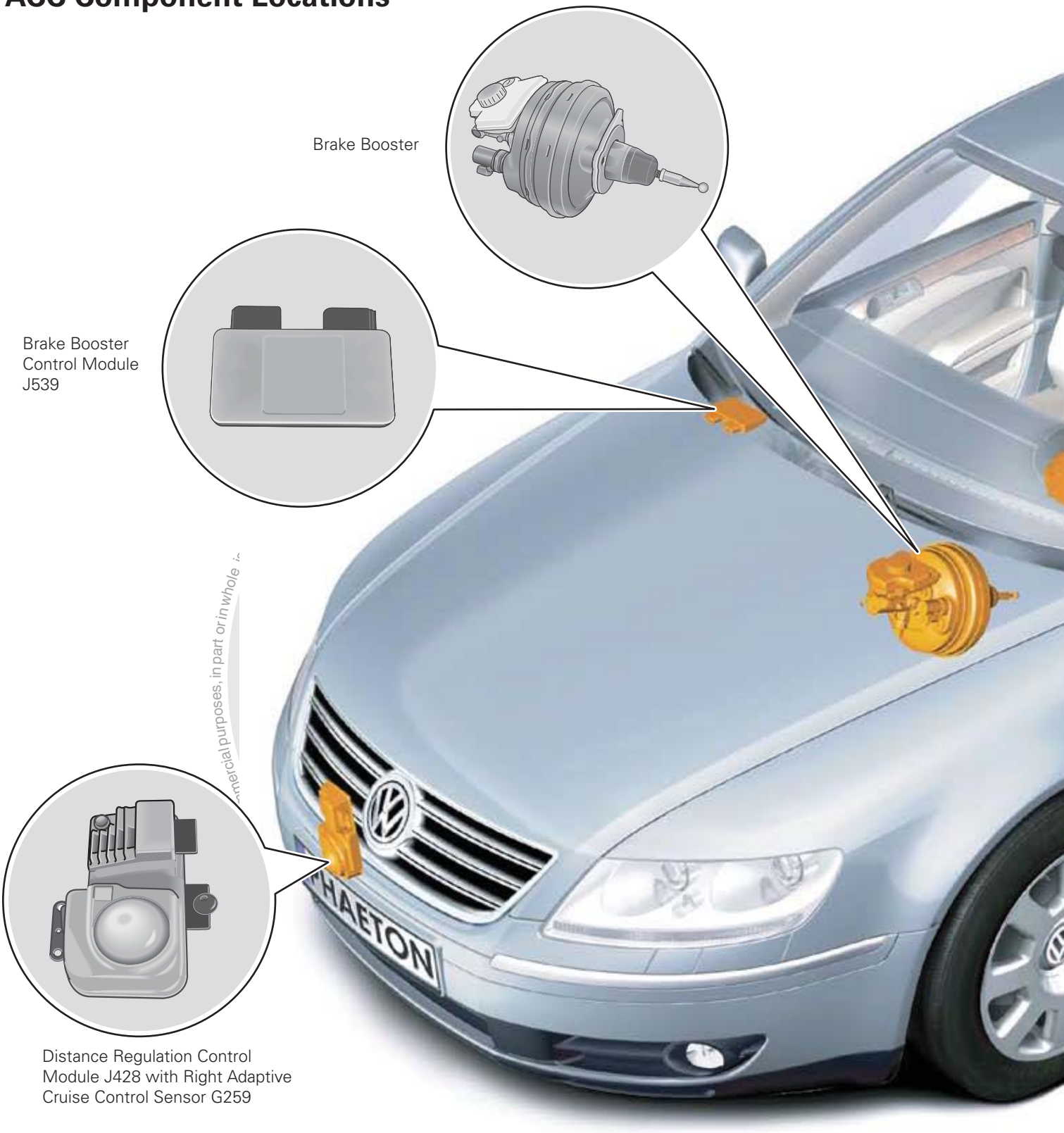
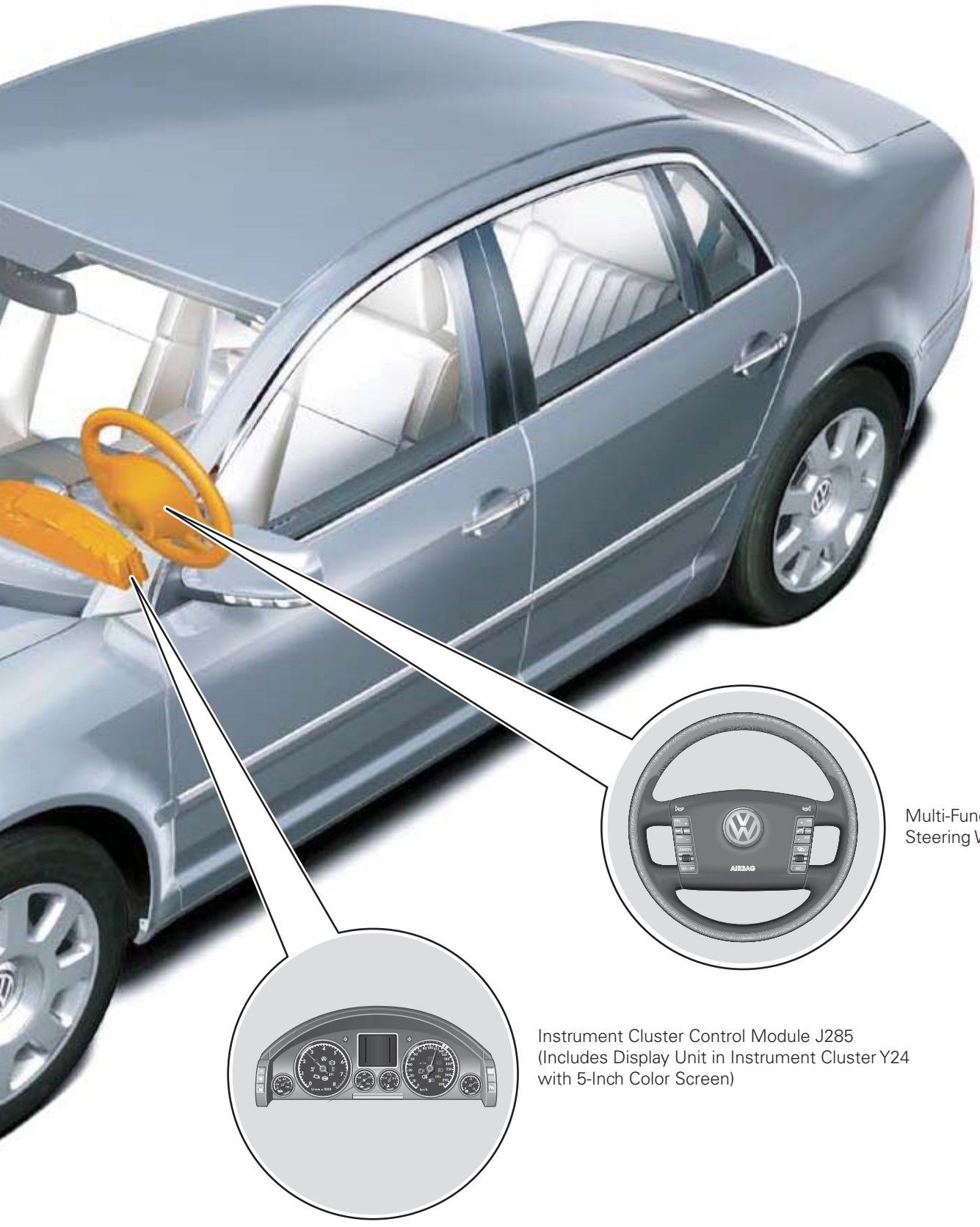
ACC in the Phaeton

ACC Component Locations



ACC in the Phaeton



Multi-Function
Steering Wheel

Instrument Cluster Control Module J285
(Includes Display Unit in Instrument Cluster Y24
with 5-Inch Color Screen)

276_056

ACC in the Phaeton

Operational Limits

Speed Limitations

The ACC system has a maximum speed limitation of 112 mph (180 km/h). This limit is determined by the 492-foot (150-meter) range of the Right Adaptive Cruise Control Sensor G259 that is housed in the Distance Regulation Control Module J428.

Higher speeds require a longer stopping distance than the system can safely accommodate. A braking operation must be initiated at a greater distance to the vehicle in front than can be measured by the Right Adaptive Cruise Control Sensor G259.

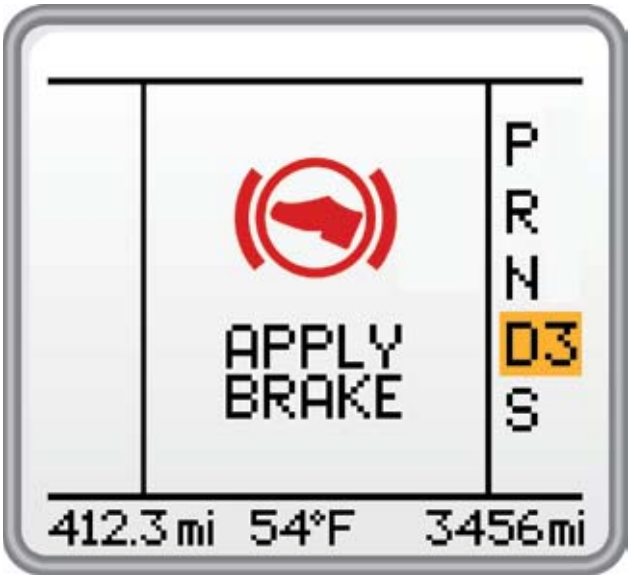
The Right Adaptive Cruise Control Sensor G259 suppresses all stationary objects within its field of vision. As a result, there is also a minimum operational speed of 19 mph (30 km/h) below which the ACC system cannot be activated.

If the ACC system is in the process of decelerating from higher speeds, the driver is prompted to take over the braking when the minimum operational speed is reached.

Warning: Stationary vehicles are not detected by the ACC system as they are approached. The driver must perform normal braking operations when approaching stationary objects.

Lane Forecast Limitations

When approaching a curve, the ACC system may react to a vehicle in an adjacent lane. The ACC system might treat such a vehicle like a slow moving vehicle in the same lane.



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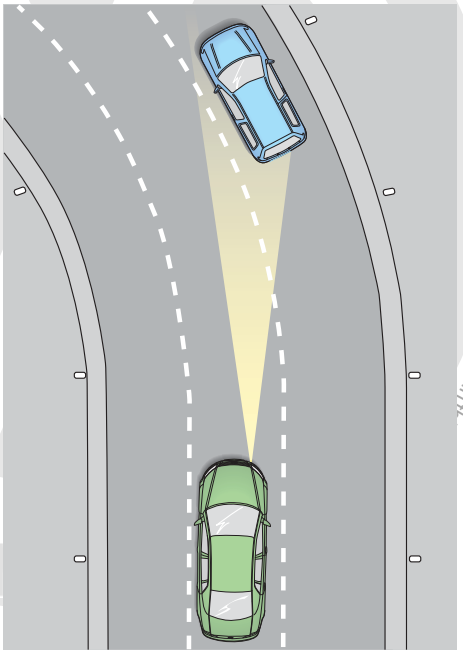

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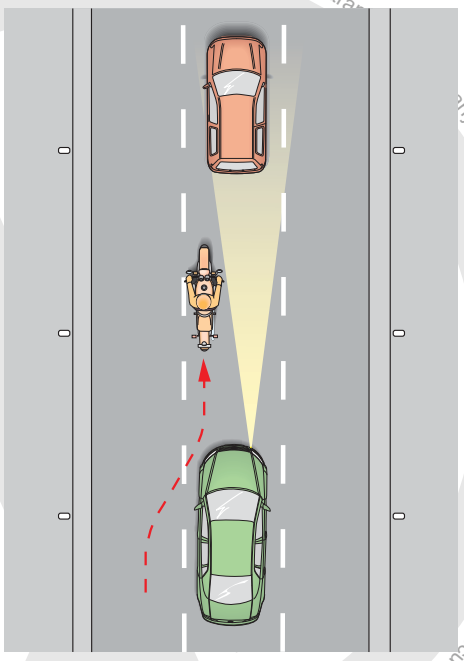
Field of View Limitations

The Right Adaptive Cruise Control Sensor G259 has a horizontal viewing angle of approximately 12 degrees.

In tight corners, the viewing angle of the sensor may not be wide enough to detect all vehicles in the same lane. The ACC system is designed for curve radii larger than 1640 feet (500 meters).

Vehicles that cut in just ahead or are driving at an offset angle, such as the motorcycle in this illustration, are outside the field of vision of the Right Adaptive Cruise Control Sensor G259. The ACC system is unable to react to these objects.



276_035

Deceleration Limitations

For occupant comfort, ACC deceleration is limited to about 30 percent of maximum possible deceleration.

However, higher rates of deceleration are necessary if the vehicle approaches a vehicle driving ahead and there is a great difference in speed.

If additional deceleration is required, the ACC system prompts the driver to take over the braking operation.

It can generally be said that the ACC system can react as expected only if the following conditions are met:

- The Right Adaptive Cruise Control Sensor G259 has correctly detected the distance, relative speed, and reflection angle of objects ahead of the vehicle
- The electronics have assessed the situation correctly

It can be presumed that these conditions have been met when a vehicle symbol is displayed in the Display Unit in Instrument Cluster Y24.

276_063

Warning: ACC is designed for operation on highways and country roads that are mainly straight.

ACC in the Phaeton

System Overview

The ACC system is integrated into the vehicle drivetrain electronics.

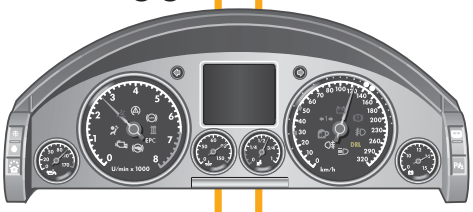
Data is exchanged with the engine electronics, Electronic Stability Program (ESP), and the transmission controls via the drivetrain Controller Area Network (CAN) data bus.

To ensure an accurate lane forecast, the wheel speed signals generated by the Anti-lock Brake System (ABS) wheel speed sensors are sent directly from the ABS Control Module J104 to the Distance Regulation Control Module J428.

Multi-function Steering Wheel Control Module J453

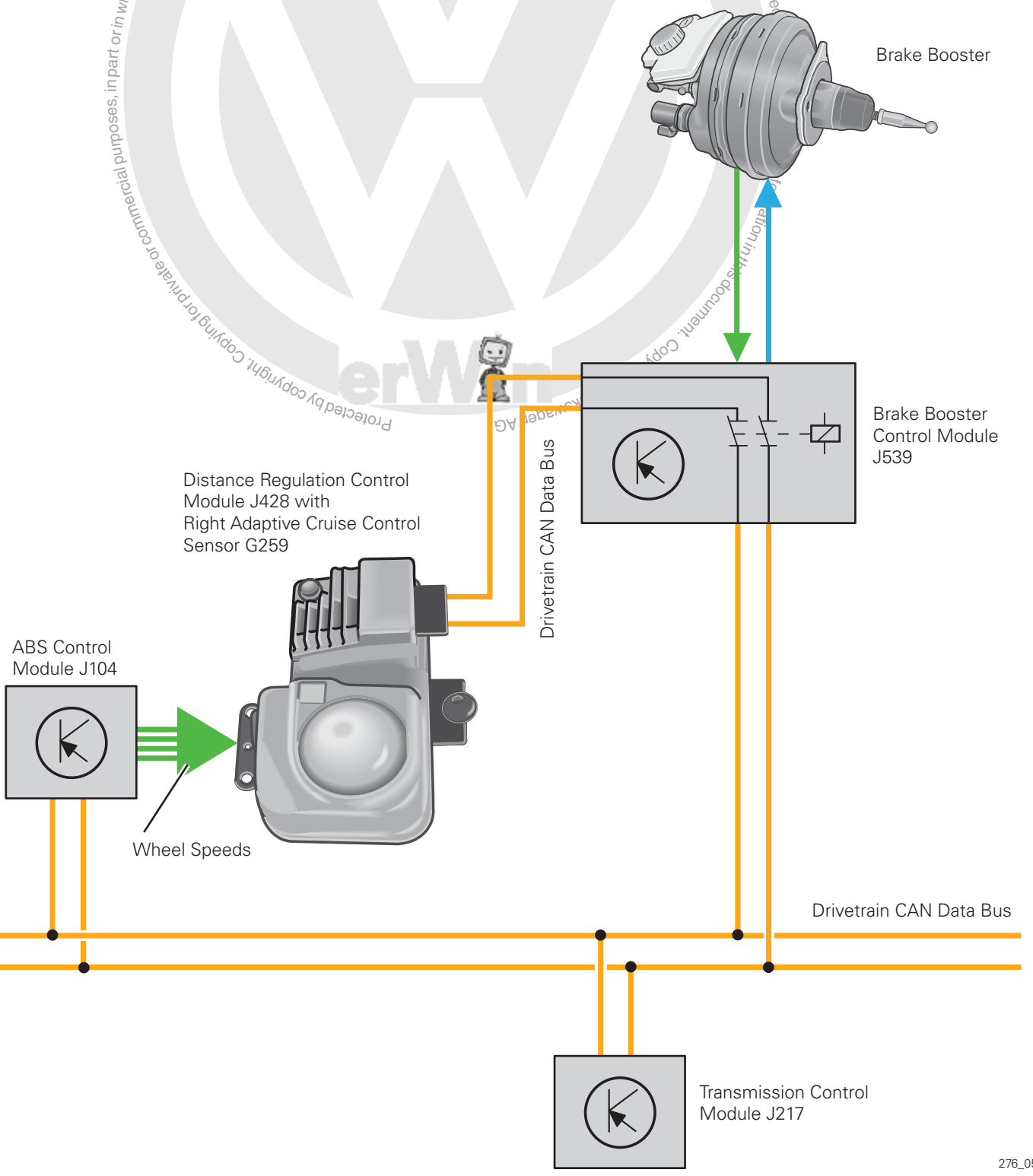
Steering Column Electronic Systems Control Module J527

Convenience CAN Data Bus



Instrument Cluster Control Module J285

Engine Control Module



ACC in the Phaeton

Multi-Function Steering Wheel

The ACC system is operated by the buttons in the multi-function steering wheel.

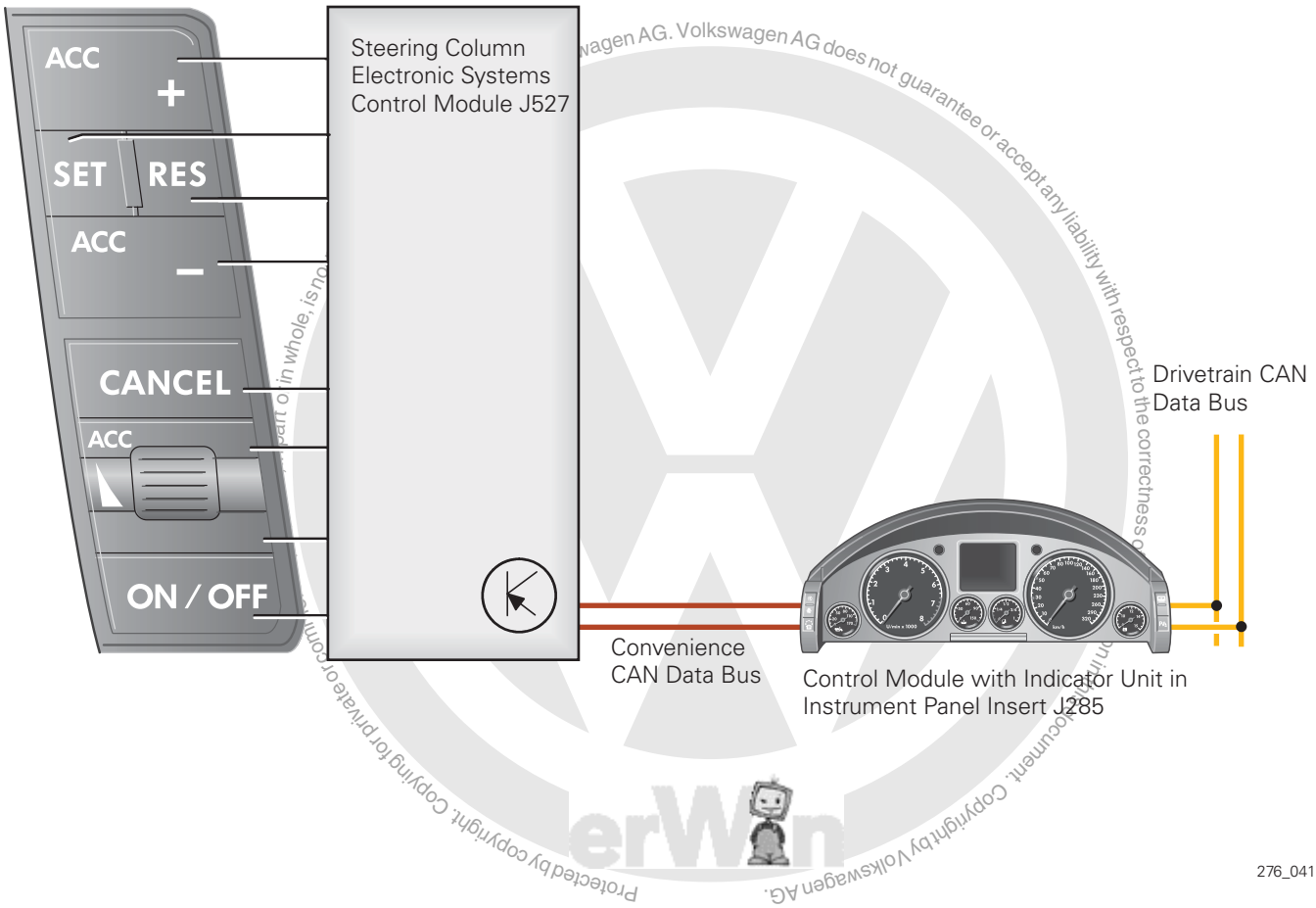
The steering wheel buttons are connected to the Steering Column Electronic Systems Control Module J527 that sends the data to the Control Module with Indicator Unit in Instrument Panel Insert J285 via the convenience CAN data bus.

The Gateway in the Control Module with Indicator Unit in Instrument Panel Insert J285 assumes the data exchange function between the convenience CAN data bus and the drivetrain CAN data bus.

To ensure that the driver is informed about the ACC system operational state at all times, the following information is displayed in the Instrument Cluster Control Module J285:

- ACC Status
- Driver Inputs
- Warnings

Some of the above information displays are supported by acoustic signals.



ACC in the Phaeton

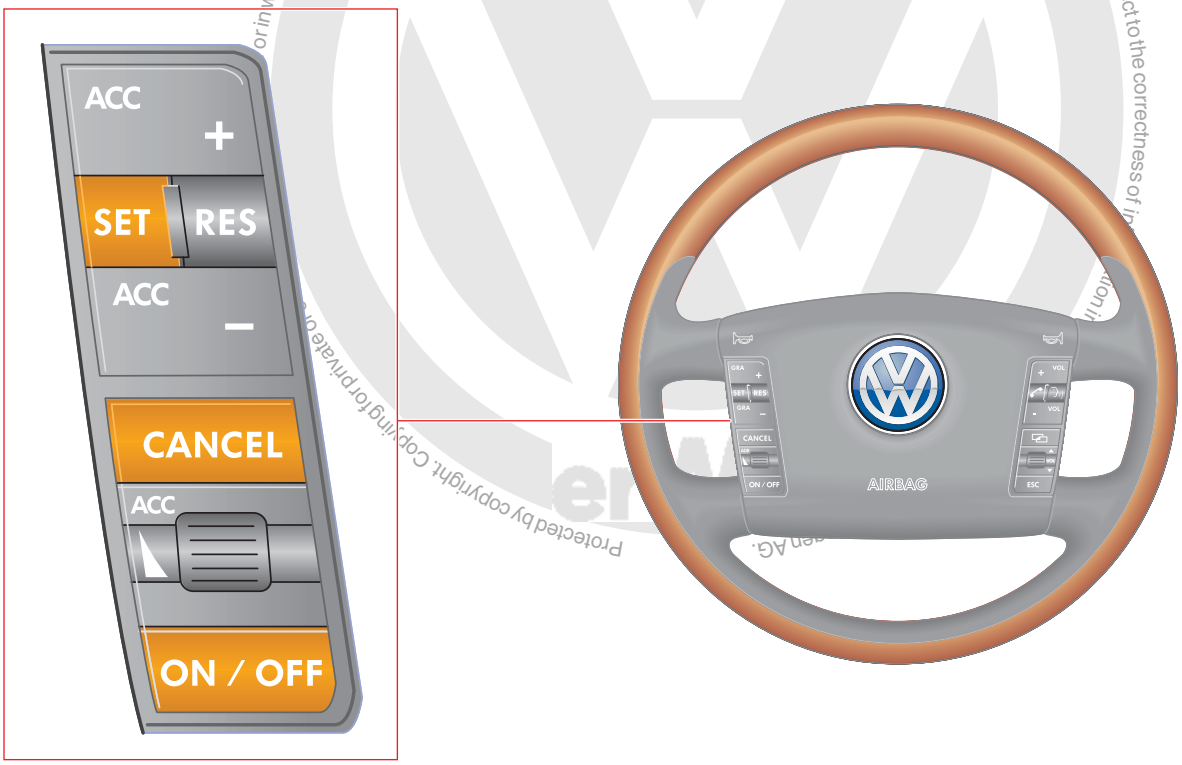
The ACC system is operated by the left button cluster on the multi-function steering wheel. However, the brake and accelerator pedals and the gear selector lever position also influence the ACC system.

When the engine is started, the ACC is always in the OFF state and must be switched to standby mode by pressing the "ON/OFF" button. The set speed memory remains empty and the following distance is set to the default time-dependent value of 1.4 seconds.

The minimum operational speed of the ACC system is 19 mph (30 km/h). While driving above the minimum operational speed with the system in standby mode, the actual speed can be stored as a set speed and the ACC can be activated by pressing the "SET" button.

The set speed can be reduced in 0.6 mph (1 km/h) increments to a minimum value of 19 mph (30 km/h) by repeatedly pressing the "SET" button.

Pressing the "CANCEL" button switches the ACC back to standby mode while retaining the set speed value in memory.



276_046

ACC in the Phaeton

The ACC can be reset to the preselected set speed by pressing the “RES” button.

The set speed can be increased in 0.6 mph (1 km/h) increments to a maximum value of 112 mph (180 km/h) by repeatedly pressing the “RES” button.

The set speed can also be increased or reduced in 6 mph (10 km/h) increments by pressing the “ACC +” or “ACC –” button.

The distance perceived by the driver to be a comfortable following distance to a vehicle ahead depends on the speed of the vehicles. Higher speeds require longer distances between vehicles.

However, the time that the vehicle with ACC system takes to cover the distance to the vehicle ahead remains constant. The speed-dependent following distance is also known as the time gap.

The time gap can be set to a default value of 1.4 seconds by pressing the “ON/OFF” button. The time gap can be adjusted in seven steps using the thumbwheel to values ranging between 1 and 3.6 seconds.

276_047

ACC Displays

The driver receives information about the ACC system on several displays in the Control Module with Indicator Unit in Instrument Panel Insert J285, some of which are redundant.

- Large ACC display at the center of the color screen
- Small ACC display at the bottom left of the color screen
- Light-Emitting Diode (LED) ring around the speedometer
- Red symbol for ACC “APPLY BRAKE” in the tachometer
- Two-stage acoustic signal

The LED ring around the speedometer and the red symbol for the ACC in the tachometer are redundant. They provide the minimum necessary information to the driver in case the color screen is unavailable.

The set speed is indicated by the LED ring in the speedometer.

The optical displays are supplemented by two acoustic signals: a discrete gong and an aggressive gong.

- The discrete gong sounds when the ACC is switched from the active state to the standby mode or the OFF state
- The aggressive gong sounds along with the red warning signal

276_051

ACC in the Phaeton

The large ACC display shares the center of the screen with various Infotainment systems. For this reason it disappears when other displays are active.

To maintain information flow to the driver in this case, a small ACC display remains active at the bottom left of the screen.

Passive display elements are colored gray and active display elements are orange. Very important information is displayed in red.

When the ACC system is inactive, the display “ACC OFF” appears.

276_064

After the ACC is turned ON by pressing the "ON/ OFF" button, the message "ACC IS STARTING" appears for short period of time.

276_065

The activated ACC switches next to standby mode.

In standby mode, the contents of the display are represented in gray. The large display shows a stylized lane, at the end of which the set speed is displayed.

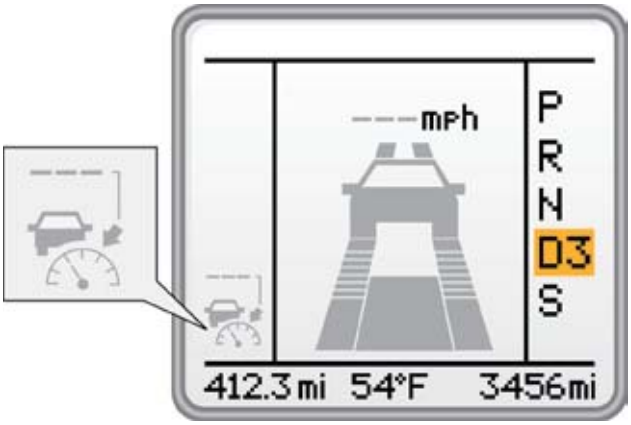
276_066

Warning: When the ACC system is OFF and the vehicle is in CCS mode, no vehicle ahead is detected or displayed.

ACC in the Phaeton

If a relevant vehicle ahead of the car is detected with the ACC active and in standby mode, it is also indicated in gray on the screen.

The small ACC display comes up at the bottom left of the screen and the system awaits driver input for the set speed.



276_067

The ACC is activated by pressing the “SET” button or the “RES” button.

The active display elements are colored orange.

276_068

If a relevant object vehicle is detected, it appears in the display.

The color of the mph display changes to gray since the displayed speed no longer matches the actual speed.

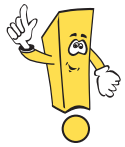
The time gap (following distance) to the vehicle in front is represented in seven steps.

The time gap actively set by the driver is represented in orange.

The center bar indicates the position of the ACC-equipped vehicle in relation to the vehicle ahead.

276_069

If the driver accelerates by pressing the accelerator pedal, the color of the vehicle shown in the display changes from orange to gray.



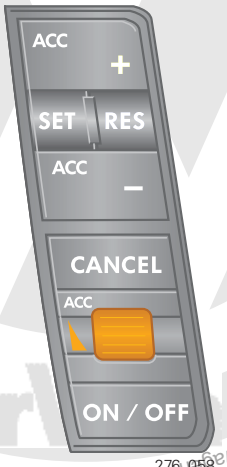
In CCS mode, the color of the set speed changes from orange to gray.

276_070

276_071

If the driver changes the time gap (following distance) by turning the thumbwheel, the display changes for several seconds.

The time gap is indicated in the small display in the form of several bars in the graphic and in digits in the set speed display field.



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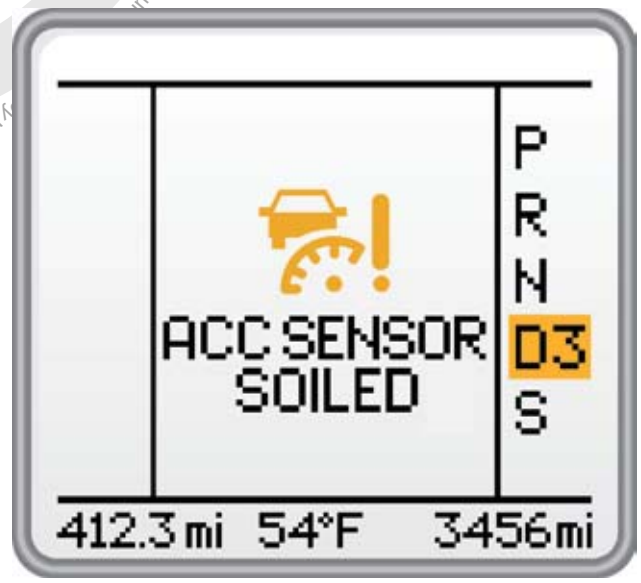
276_072

ACC in the Phaeton

When the braking performance of the ACC system is insufficient, the red warning lights up together with the red symbol for ACC "apply brake" in the tachometer, prompting the driver to take control of the vehicle by applying the brake.

276_063

The "ACC SENSOR SOILED" message is displayed if the sensor is dirty. However, the system remains active as long as it can obtain usable readings.



276_074

If the ACC system internal diagnostics detect a fault, the message “ACC DEFECTIVE” is displayed and the system switches to standby mode. After several seconds, the fault message becomes passive.

276_075

ACC in the Phaeton

Effects of Acceleration, Braking, and Transmission Controls

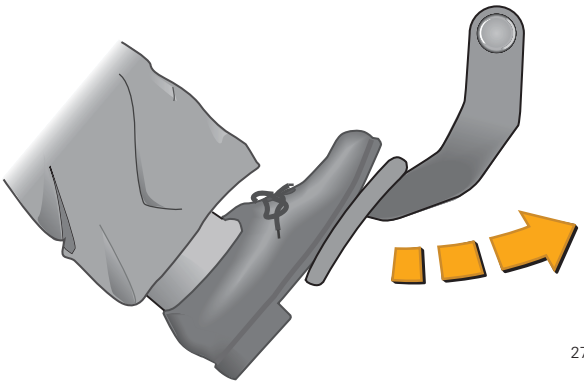
When the ACC system is active, the ACC can be overridden and the vehicle speed increased by pressing the accelerator pedal.

If the driver releases pressure on the accelerator pedal, the ACC resumes operation and decelerates the vehicle to the set speed or to the current time gap (following distance).

Pressing the brake pedal deactivates the ACC immediately. The set speed is retained in the memory and the system reverts to standby mode.

If the transmission selector lever is moved from "D" position to "N," "R," or "P" position, the ACC is deactivated. The ACC remains active in all other selector lever positions.

If the minimum operational speed of 19 mph (30 km/h) is not reached or the upper speed limitation of 112 mph (180 km/h) is exceeded, the ACC is deactivated.



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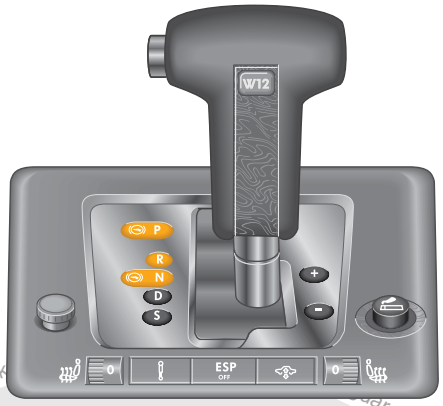

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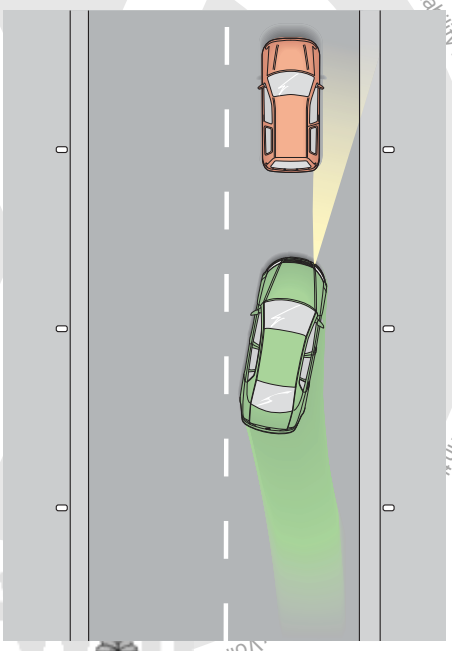
The ACC system is also deactivated by intervention in the brake system by a vehicle stability program or ABS, but ACC system braking operations in progress are completed. Dynamic intervention is independent of any ACC braking operations.



276_050

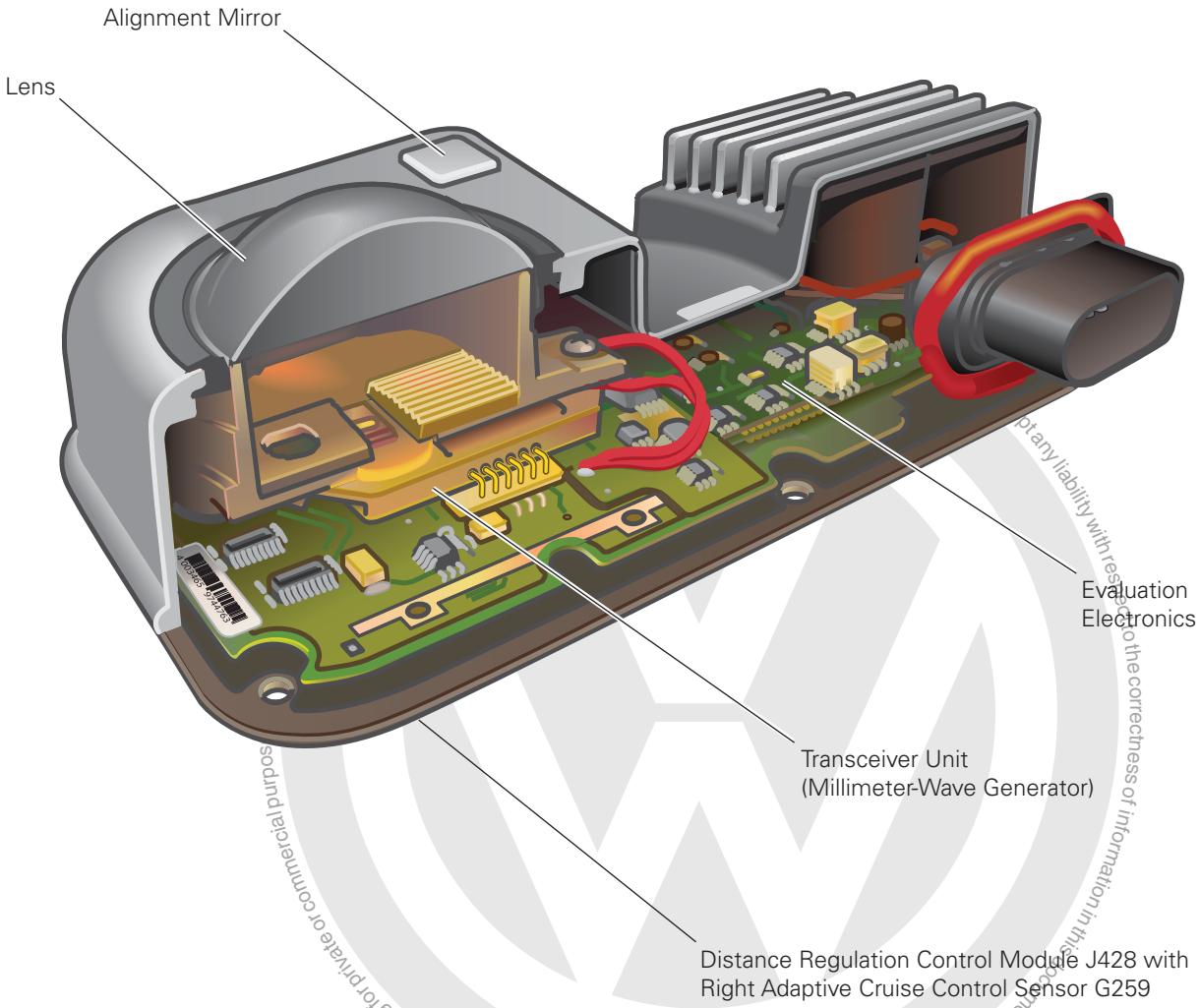
Right Adaptive Cruise Control Sensor G259

The Distance Regulation Control Module J428 contains the Right Adaptive Cruise Control Sensor G259.

In the ACC system the distance is measured by the Right Adaptive Cruise Control Sensor G259 based on millimeter-wave radar technology.

The ACC system measures the distance to several objects in the field of vision and their relative speeds along the longitudinal axis of the vehicle.

From the measured values, the angular deviation (azimuth angle, or reflection angle) from the centerline of the field of vision is calculated for each object.



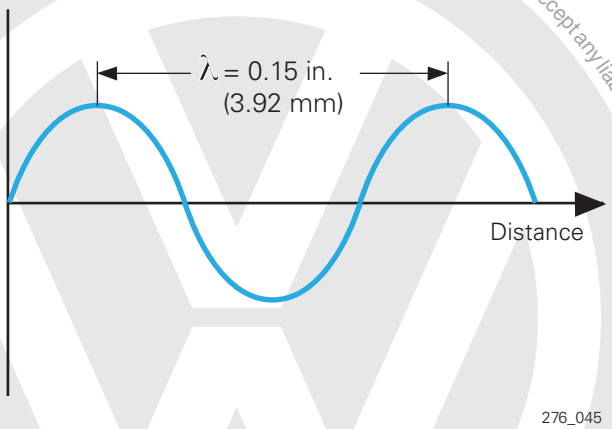
ACC in the Phaeton

The radar system uses electromagnetic waves that travel at the speed of light.

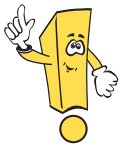
Waves within a frequency range from approximately 30 GHz to approximately 150 GHz are referred to as "millimeter" waves.

A wave of frequency ***f*** requires a wavelength of **λ** for a wave train.

The transmit frequency of the Right Adaptive Cruise Control Sensor G259 is 76.5 GHz. The wavelength is 3.92 mm.

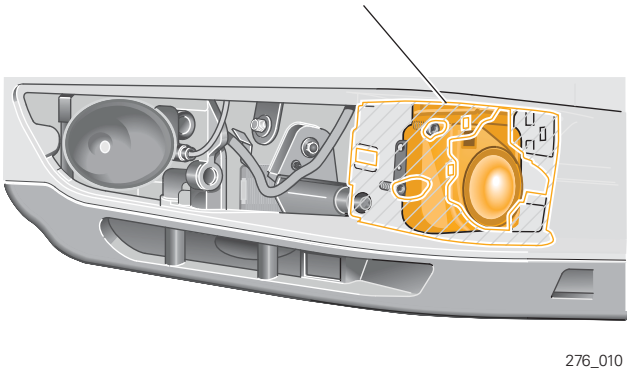


The Distance Regulation Control Module J428 with Right Adaptive Cruise Control Sensor G259 is installed behind a plastic cover in the bumper. The lens through which the beam is emitted is easily recognizable.



The sensor cover must only be painted in a millimeter-wave permeable color. It must not be recoated on the inside or outside, and must not be covered.

The sensor cover must be kept free of dirt, ice, and snow.



Distance Regulation Control Module J428 with Right Adaptive Cruise Control Sensor G259

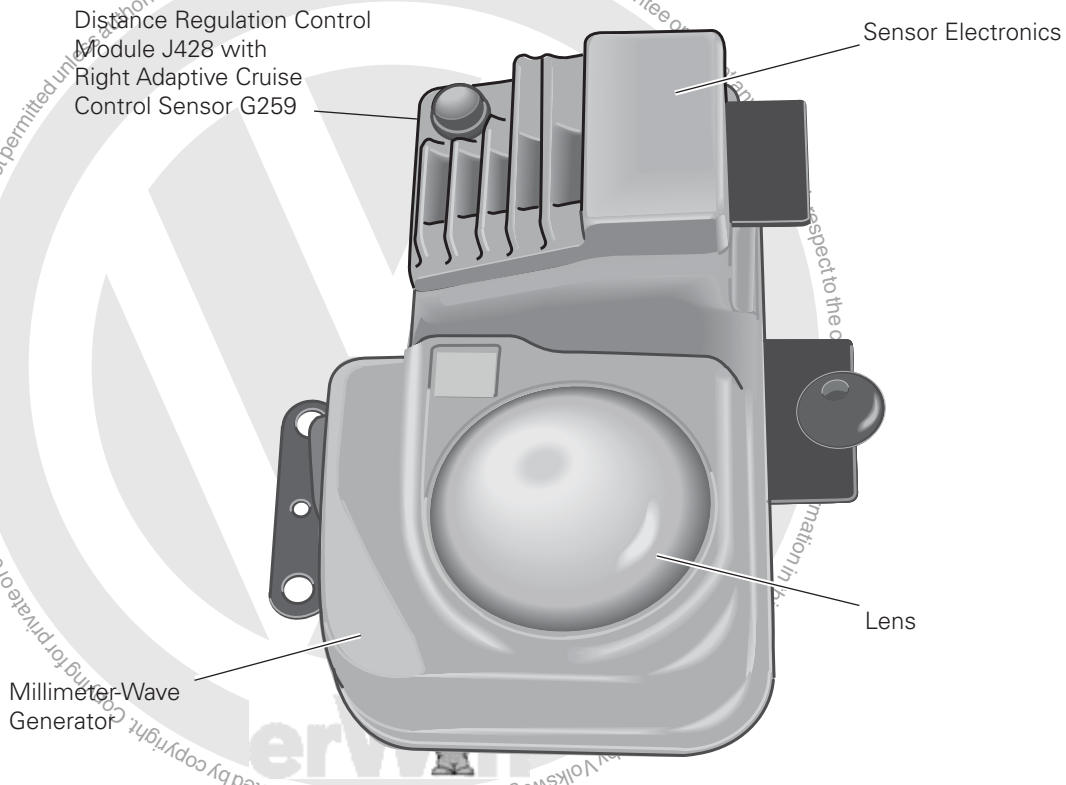
The field of vision of Right Adaptive Cruise Control Sensor G259 can be compared to the illumination zone of a highly focused headlight. As with the headlight, the centerline of the field of vision of Right Adaptive Cruise Control Sensor G259 must be exactly aligned in the direction of vehicle travel.

A microprocessor with high computing power is integrated in the sender housing. The following calculations are performed:

- Lane forecast
- Selection of the relevant object
- Distance and speed control
- Activation of the engine control module, brake booster, and Control Module with Indicator Unit in Instrument Panel Insert J285
- Self-diagnosis

Specifications:

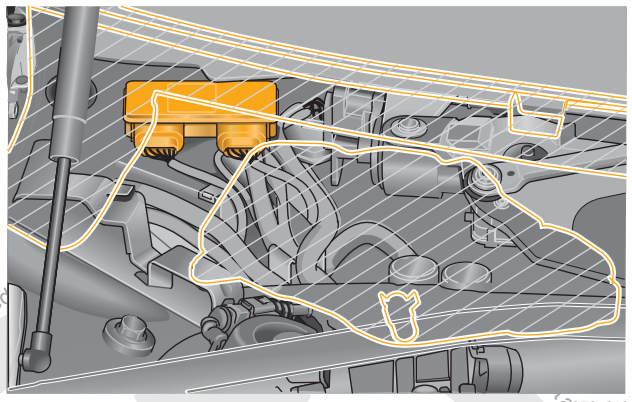
- Transmit frequency: 76.5 GHz
- Optical (visual) range: 492 feet (150 meters)
- Horizontal angle of vision (viewing angle): 12 degrees
- Vertical angle of vision (viewing angle): 4 degrees
- Speed measuring range: ± 112 mph (180 km/h)



Brake Booster Control Module J539

The Brake Booster Control Module J539 is located in the plenum chamber on the right side and is only accessible by removing the coolant expansion tank.

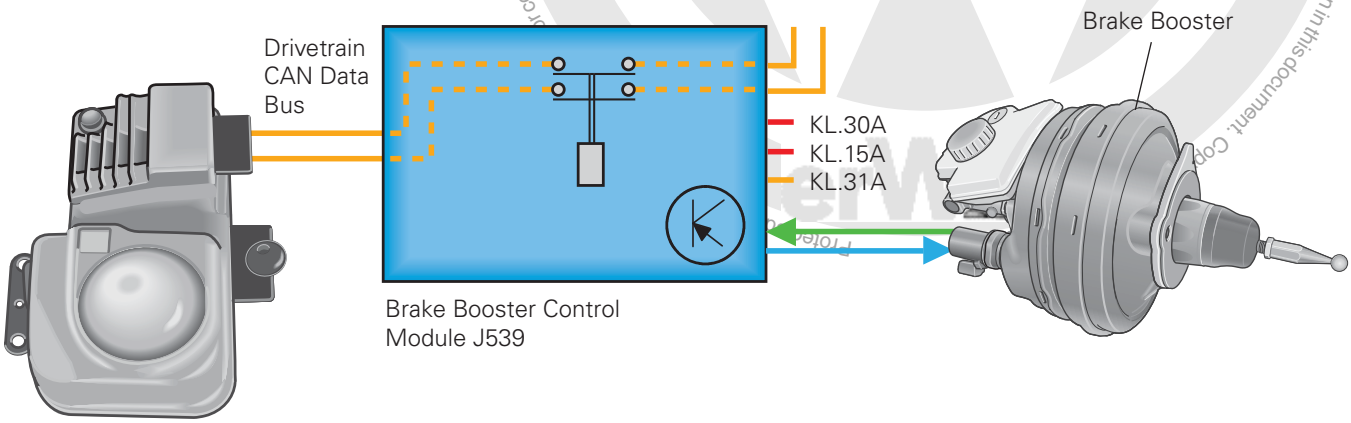
Brake Booster Control Module J539



276_012

The Brake Booster Control Module J539 controls brake pressure build-up and relief.

For reasons of anti-theft security, the bus interface of the Distance Regulation Control Module J428 cannot be deactivated directly. It can only be switched OFF via the Brake Booster Control Module J539.



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Anti-Theft Alarm System Security

Because the Distance Regulation Control Module J428 with its drivetrain CAN data bus connection is mounted on the exterior of the vehicle, it would be possible to interrogate the immobilizer code if precautions were not in place.

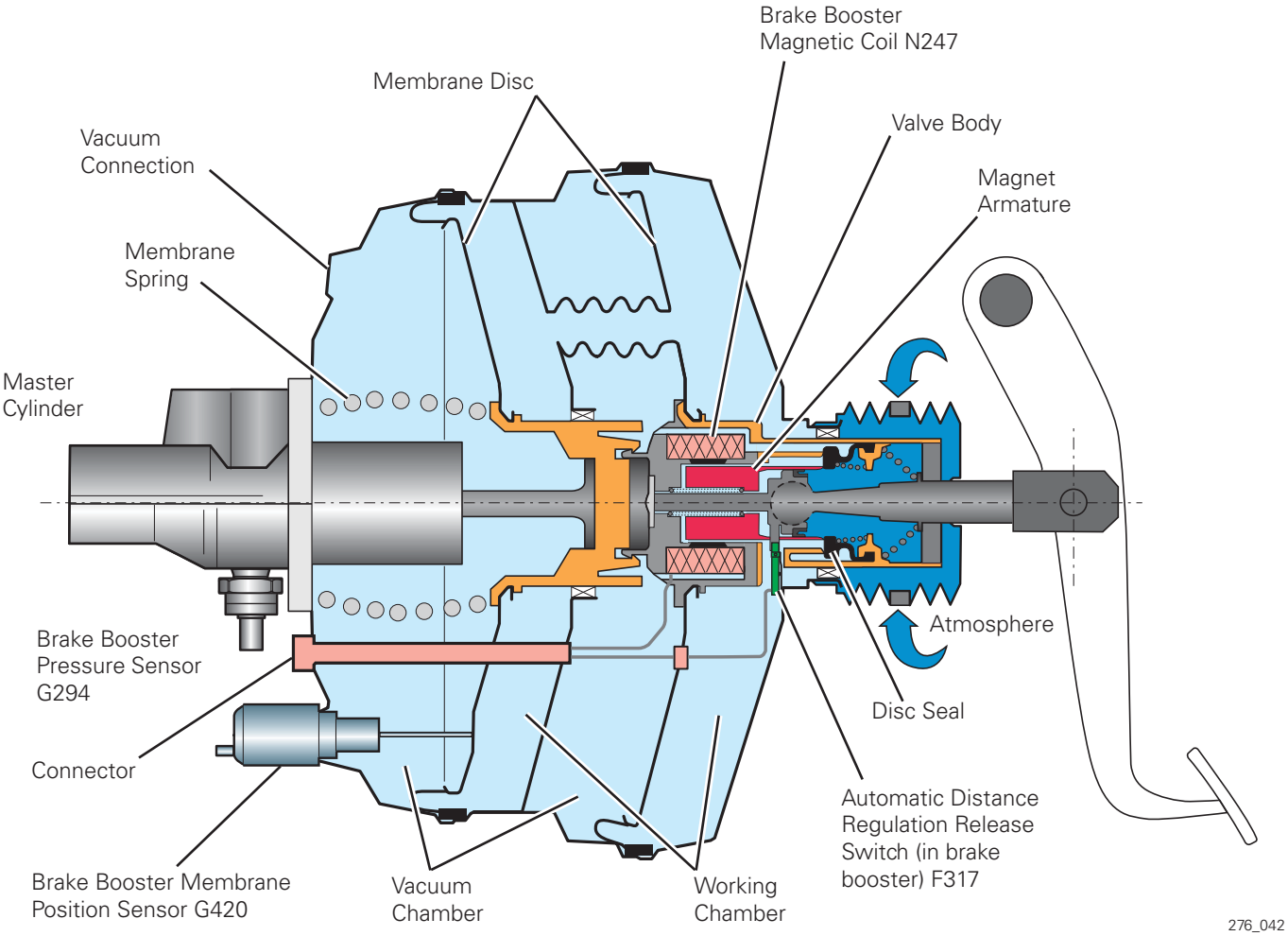
To avoid impairing the immobilizer function, a special switch-on procedure is performed via the CAN data bus relay in the Brake Booster Control Module J539.

ACC in the Phaeton

Brake Booster

In the ACC system, the electronic brake booster activates the brakes to control the distance to a vehicle in front. In designing the system, special emphasis was placed on gradual, comfortable braking.

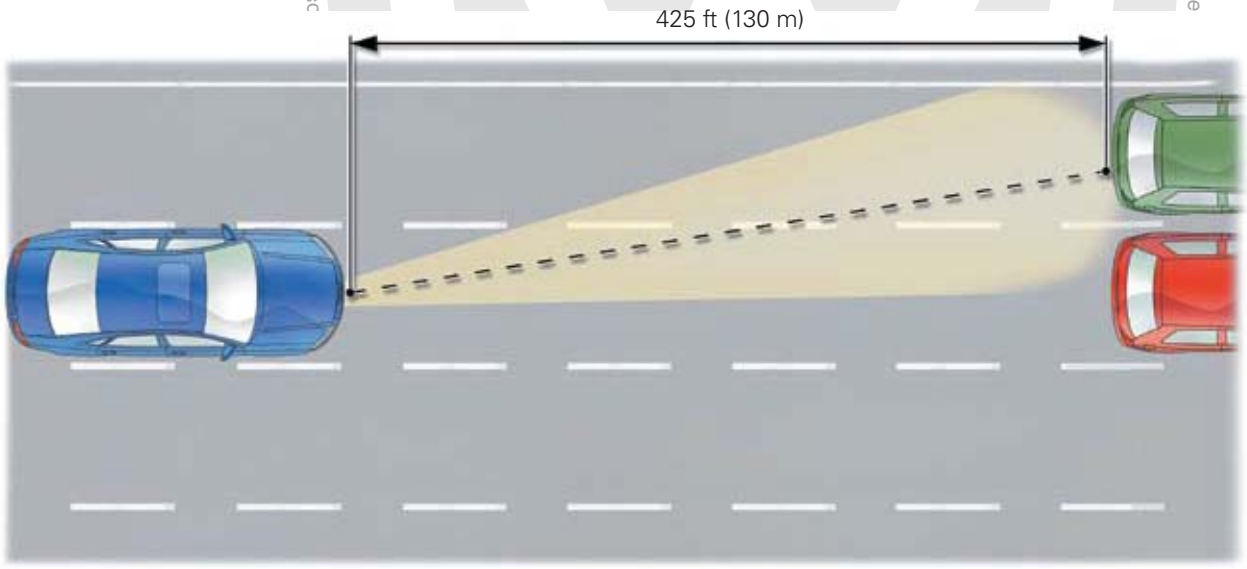
Refer to SSP 898303 The Phaeton Adaptive Cruise Control for additional information about the brake booster operation.



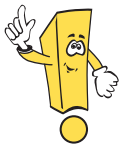
Service

The radar signal range for vehicle detection is approximately 425 ft (130 m). A misalignment of J428 by only 1 degree results in a deviation of approximately 7 ft (2.1 m) at the limit of the sender range.

In extreme cases this would lead to regulation of the distance from the vehicle in the adjacent lane.



289_039



Mechanical adjustment of the Distance Regulation Control Module J428 with Right Adaptive Cruise Control Sensor G259 is absolutely necessary after:

- Replacement of Control Module for Distance Regulation J428
- Adjustments to the front **or** rear suspension
- Replacement or repair of sender holder, bumper, cross member, or any front end damage (e.g. after collision)

For detailed information on setting procedure, refer to the Workshop Manual.

ACC in the Phaeton

Adjusting the Right Adaptive Cruise Control Sensor G259

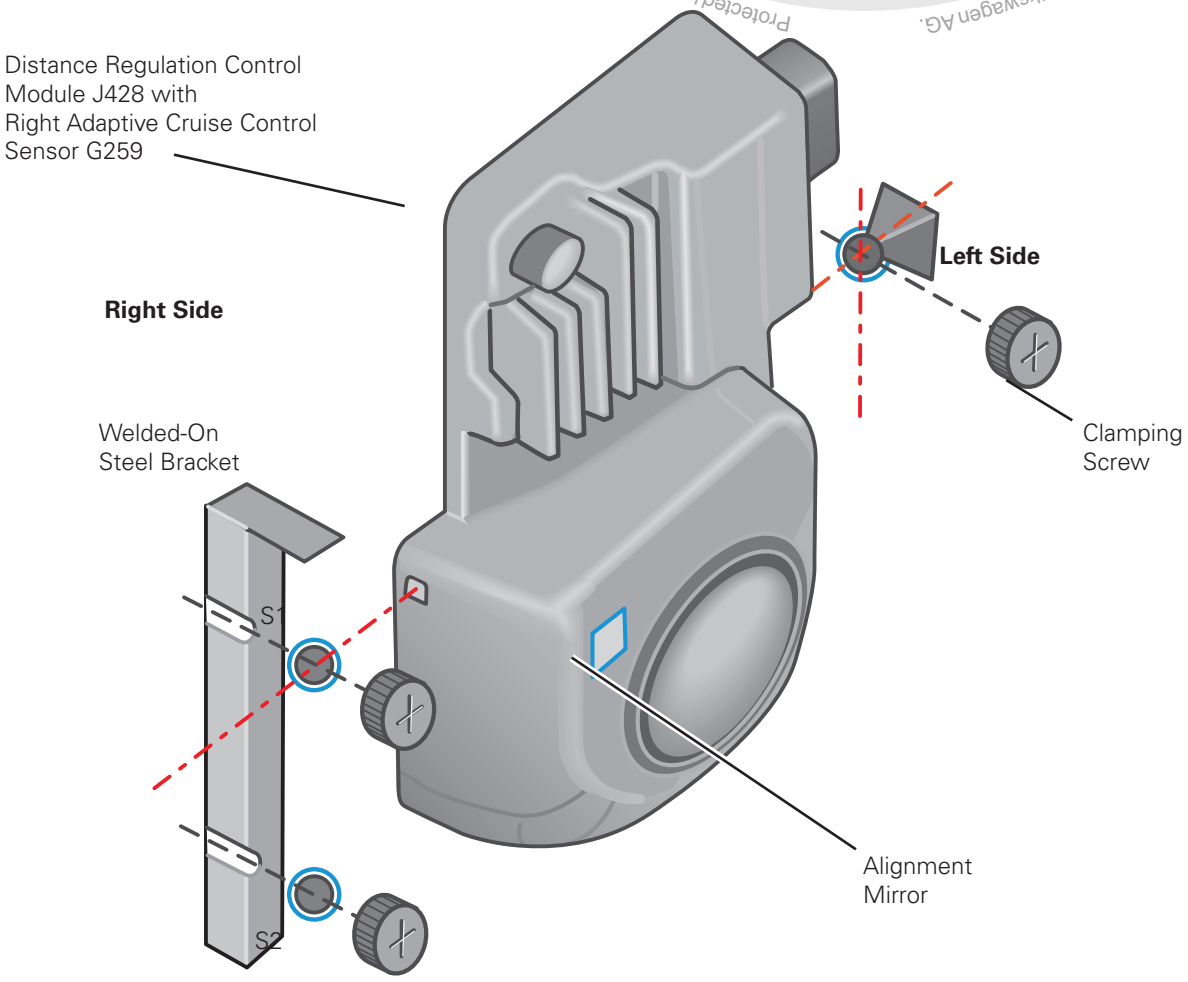
The Right Adaptive Cruise Control Sensor G259 is adjusted by means of two adjusting screws (S1 and S2) located on the right side of the Distance Regulation Control Module J428 .

A single screw clamps the left side of the Distance Regulation Control Module J428 to a ball joint, which serves as a third bearing point.

The adjusting screws have six detent positions per rotation.

Turning adjusting screws S1 and S2 evenly swivels the J428 / G259 on the horizontal plane.

Turning adjusting screw S2 by itself swivels the J428 / G259 on the vertical plane.

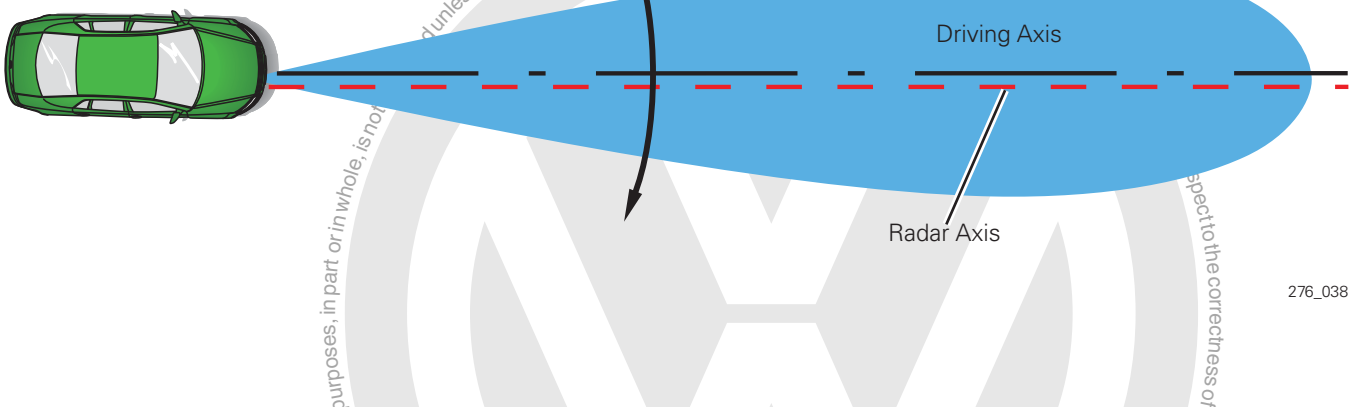


276_053

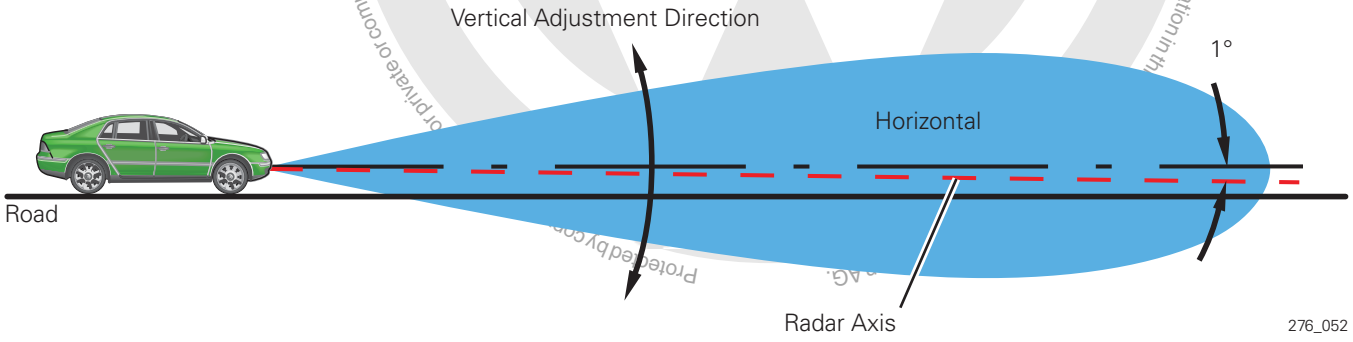
The centerline of the detection field must be aligned on both the horizontal and vertical planes.

- On the horizontal plane, align the centerline (radar axis) parallel with the driving axis
- On the vertical plane, set one degree of downward angle from the horizontal plane

Horizontal Plane



Vertical Plane



ACC in the Phaeton

Adjustment Method

The driving axis is determined using a wheel alignment test stand and the ACC adjustment device VAS 6041.

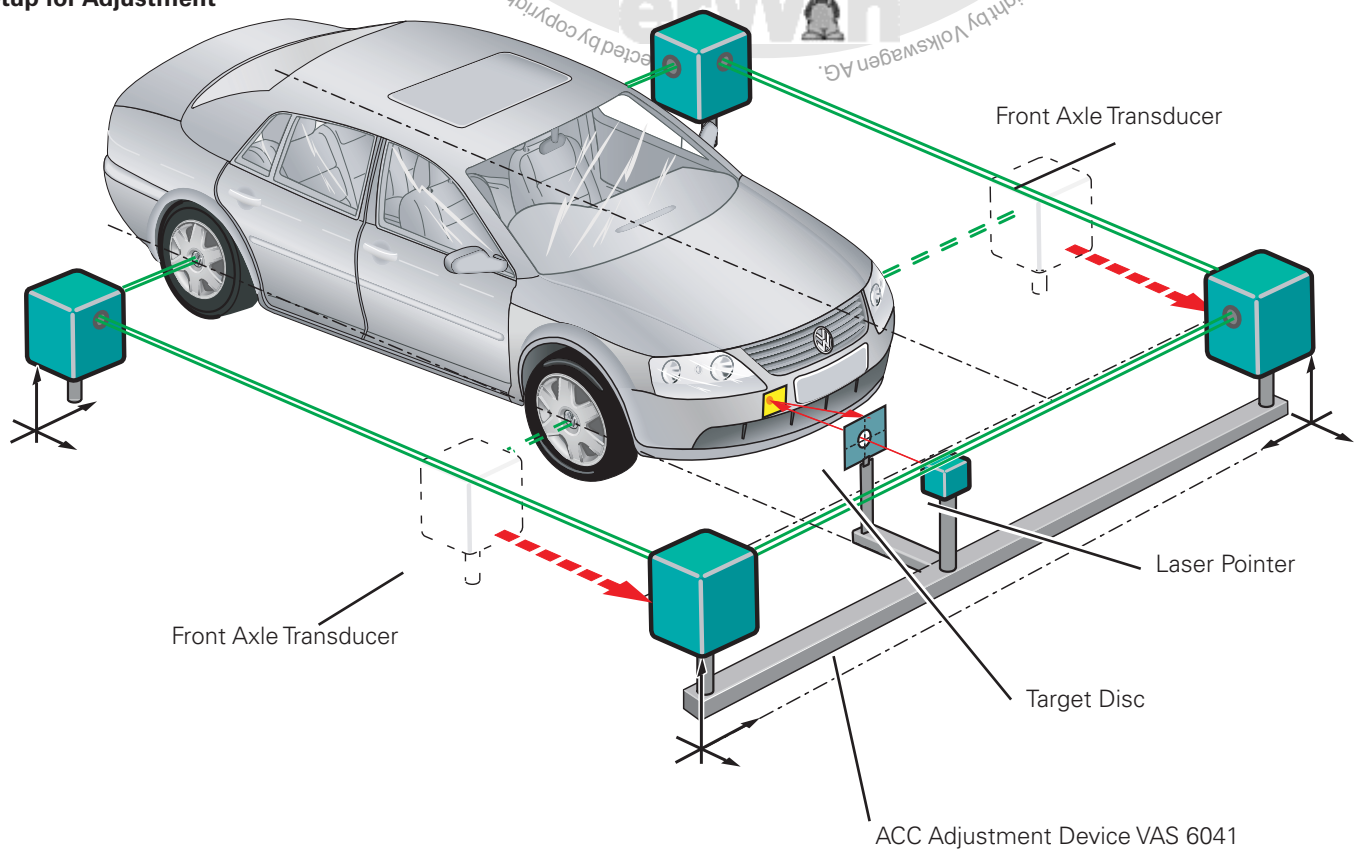
The laser pointer is emitted from the target plate of the VAS 6041 to the setting mirror of the ACC sensor and is reflected against the target plate.

A target disc is positioned between the laser pointer and the Right Adaptive Cruise Control Sensor G259. The target disc has a center hole through which the laser is beamed on the alignment mirror of the Right Adaptive Cruise Control Sensor G259.

When the suspension is adjusted, the measuring equipment of the test bench is aligned in parallel with the driving axis.

The ACC adjustment device VAS 6041 is aligned with the driving axis using the front axle transducers together with the rear axle transducers.

Setup for Adjustment

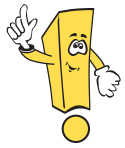


276_013

When the Right Adaptive Cruise Control Sensor G259 is perfectly aligned, the laser beam is reflected through the center hole in the target disc.

If the Right Adaptive Cruise Control Sensor G259 is not properly adjusted, the laser beam will hit the target disc in one of the four quadrants. The Right Adaptive Cruise Control Sensor G259 must be aligned using the adjusting screws on the Distance Regulation Control Module J428 so that the reflected laser beam passes through the center hole in the target disc.

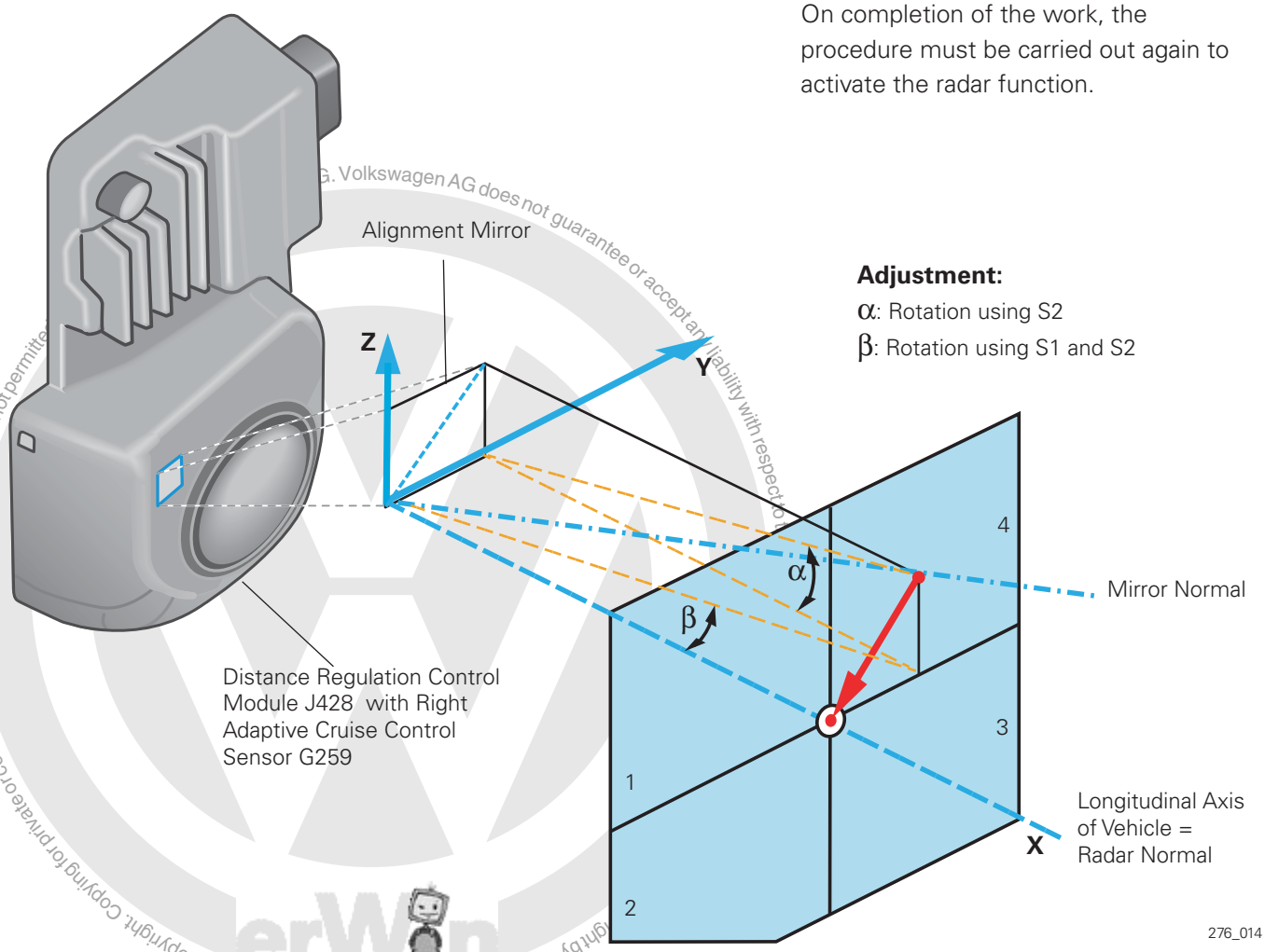
In the horizontal plane, a high degree of adjustment accuracy is required. Only a rough adjustment can be made using the adjusting screws. Fine adjustment is carried out electronically inside the Distance Regulation Control Module J428 with Right Adaptive Cruise Control Sensor G259 while driving.



If working on the front end of the vehicle when the ignition is switched on, it is advisable to suppress the radar function.

To do this, select menu item Adaptation for work in front of control unit J428 in Guided Functions.

On completion of the work, the procedure must be carried out again to activate the radar function.



Correcting an Indication Error

The mirror normal and the centerline of the detection field (radar normal) do not match up for production reasons.

The indication error in the horizontal and vertical planes is measured at the factory and stored in the memory of Distance Regulation Control Module J428 with Right Adaptive Cruise Control Sensor G259 as a correction value.

The indication error is specified as a number of detents of the adjusting screw.

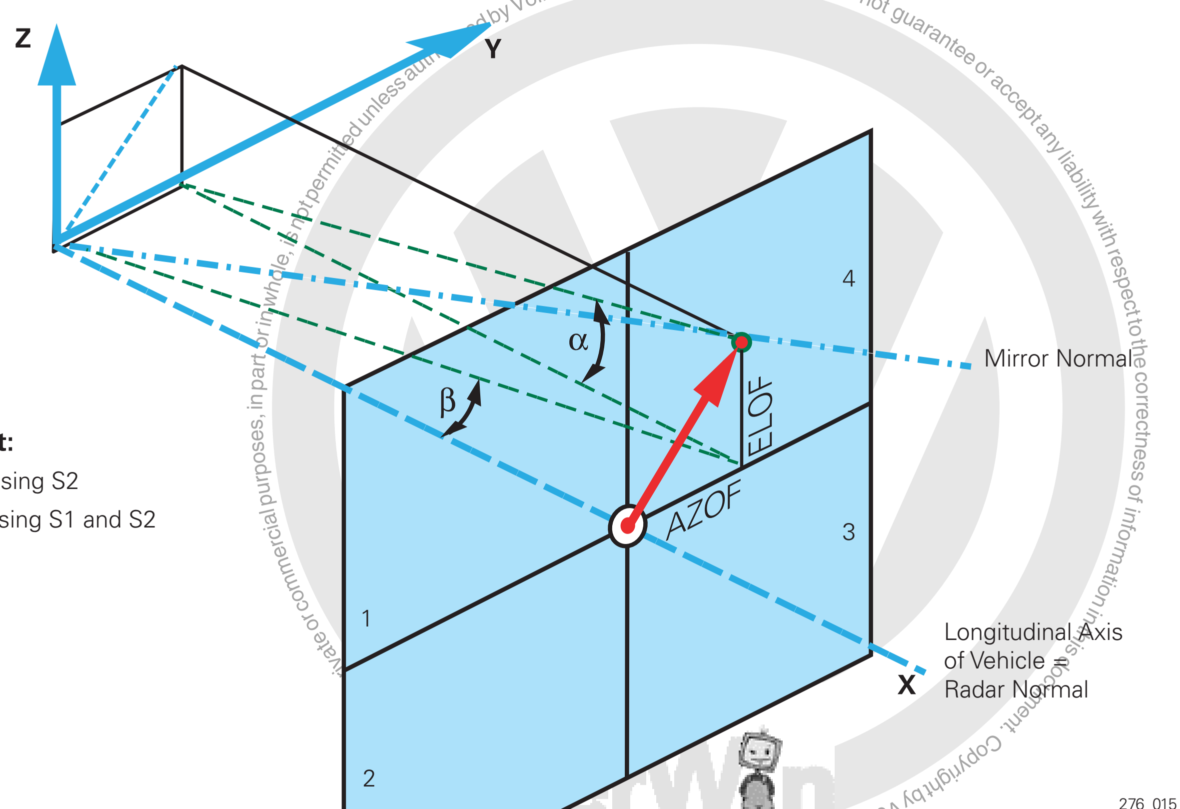
The correction values can be exported with the Scan Tool.

Once adjusted to the correction values, the laser beam moves from the center into one of the quadrants. To check that the adjusting screws have been turned in the correct direction, the target quadrant is also stored in the sender memory.

Data Block 06

- Measured value 2: AZOF mirror indication error in the horizontal plane (AZOF = AZimuth OFfset).
- Measured value 3: ELOF mirror indication error in the vertical plane (ELOF = ELevation OFfset).

Details for adjusting the alignment of the Right Adaptive Cruise Control Sensor G259 are in the Workshop Manual.



Adjustment:
α: Rotation using S2
β: Rotation using S1 and S2

276_015

Overview

ACC was offered, with limited availability, beginning with the MY 2004 Passat. Changes to the system from the Phaeton include:

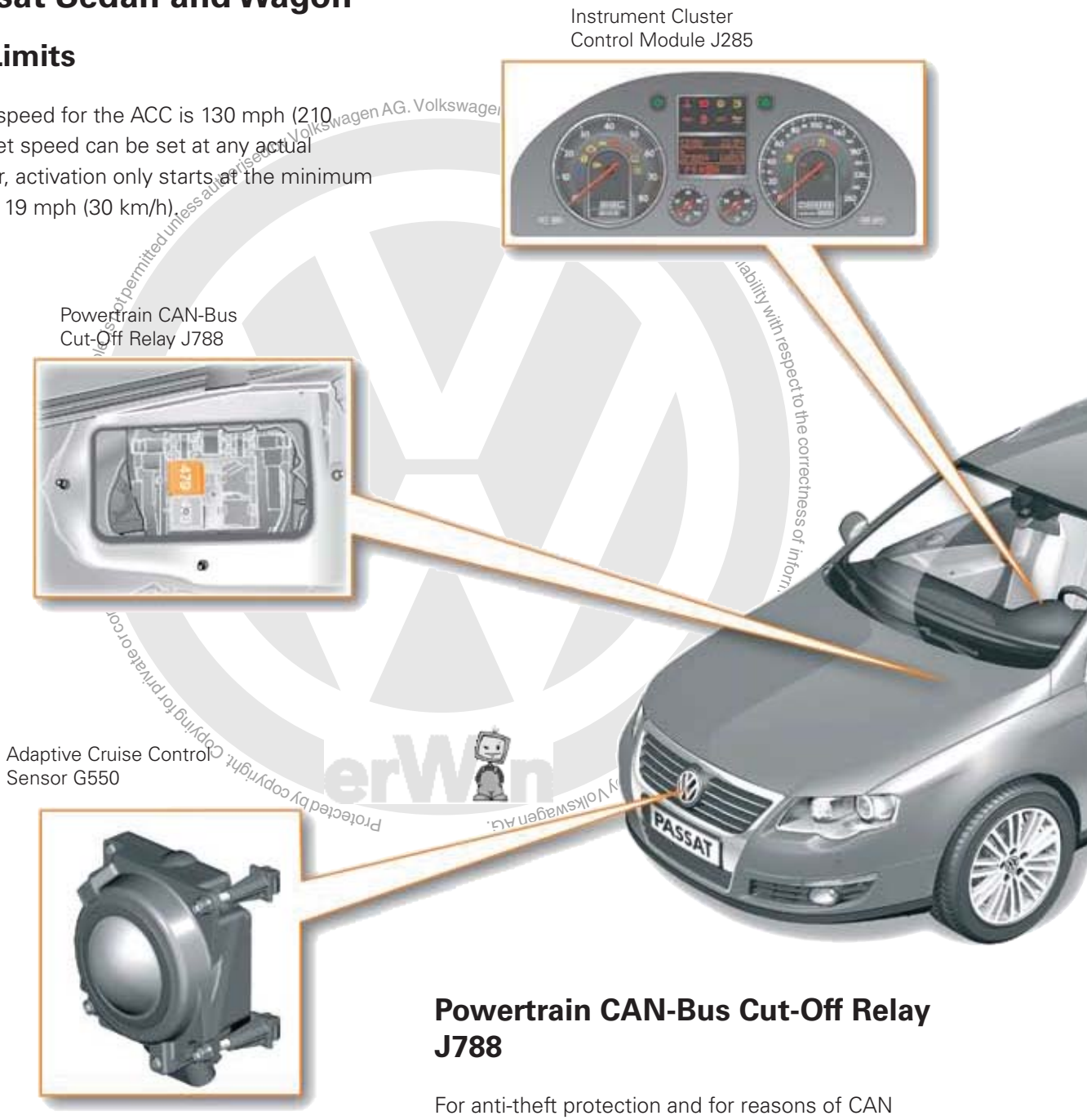
- Adaptive Cruise Control Sensor G550 replaces Right Adaptive Cruise Control Sensor G259
- J788 replaces the CAN data bus relay in the Brake Booster Control Module J539
- Controls are moved to a dedicated steering column stalk
- Maximum speed control is raised to 130 mph (210 km/h)

ACC in the Passat

2006 Passat Sedan and Wagon

Function Limits

The maximum speed for the ACC is 130 mph (210 km/h). The target speed can be set at any actual speed, however, activation only starts at the minimum actual speed of 19 mph (30 km/h).



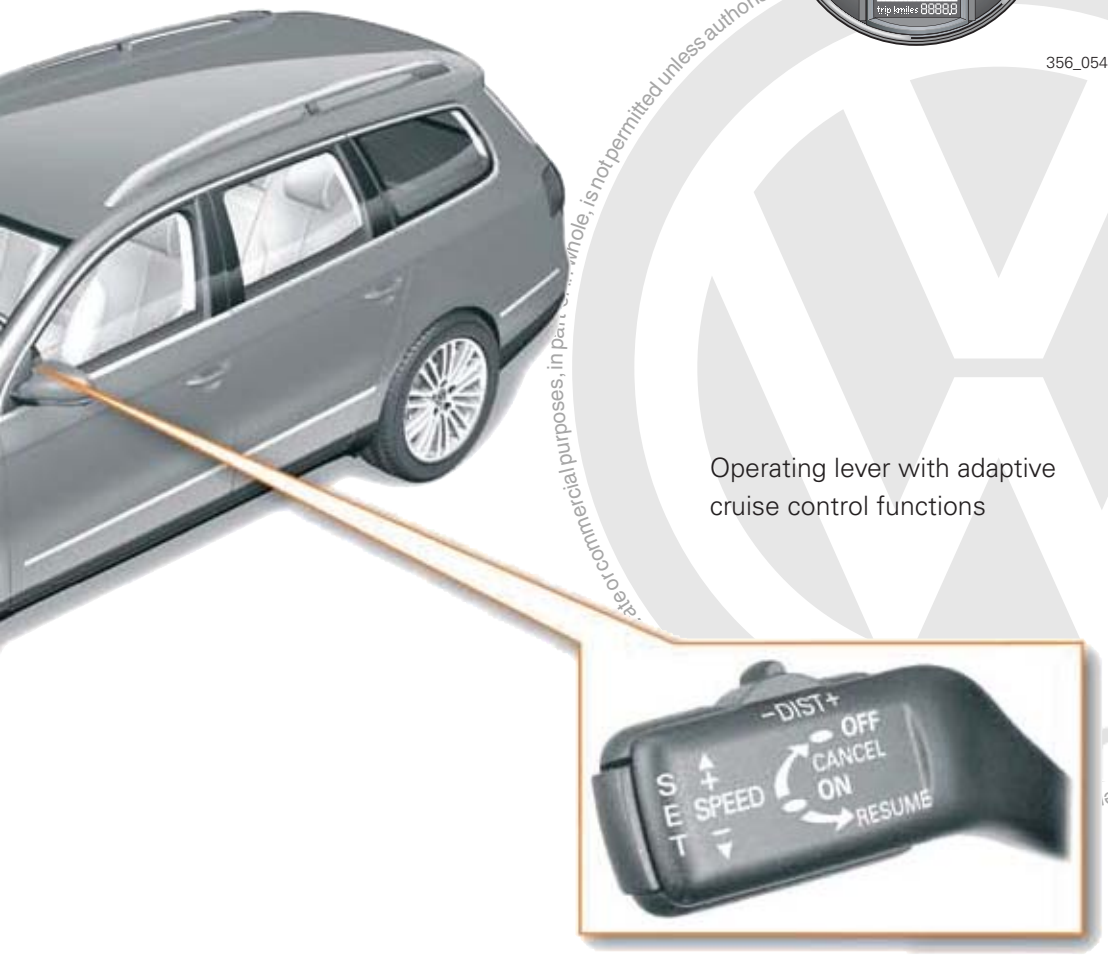
Powertrain CAN-Bus Cut-Off Relay J788

For anti-theft protection and for reasons of CAN stability in crashes, the bus connection is not direct, but can be deactivated via a cut-off relay for CAN powertrain bus J788.

This cut-off relay is located on a separate carrier for eight relays above the onboard supply control module.

Speed limits from
30 km/h to 210 km/h

356_054



Operating lever with adaptive
cruise control functions

356_073

ACC in the Passat

Driver Information in Dash Panel Insert

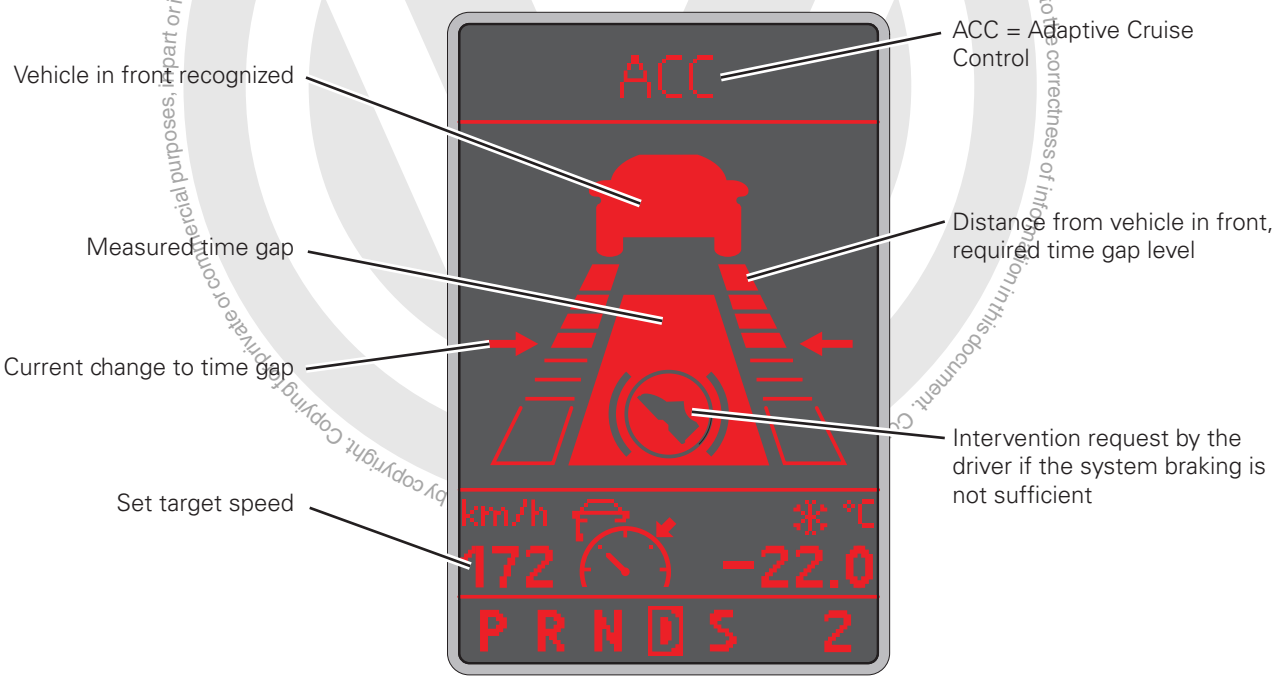
Information on the system states (active, passive and ACC in background) is displayed in the dash panel insert for the driver.

Also the following are displayed and indicated acoustically:

- The set target speed
- A possible vehicle in front
- The distance from the vehicle in front
- A possible intervention request for the driver

The two arrows on the road depicted indicate that the required distance from the vehicle in front (time gap) is being changed on the new steering column switch.

Warning: Oncoming and parked vehicles or objects are recognized, but not taken into consideration in the calculation.



356_048

Display of System States

"Active" – Indicated by filled in road lines

"Passive" – Outline of road displayed

"ACC in background" – The outline of the vehicle in front is displayed and the target speed is in a smaller font

Using the ACC System

The ACC system is operated exclusively with the third dedicated control stalk mounted on the left side of the steering column.

356_047

Control	Function
On/Off	Switches adaptive cruise control system ON and OFF
Set	Activates the adaptive cruise control with the current speed as the target speed
Cancel	Temporarily switches OFF cruise control
Resume	Resumes cruise control
+ – Speed	Increases/reduces the set target speed
+ – Dist	Increases/reduces the set distance

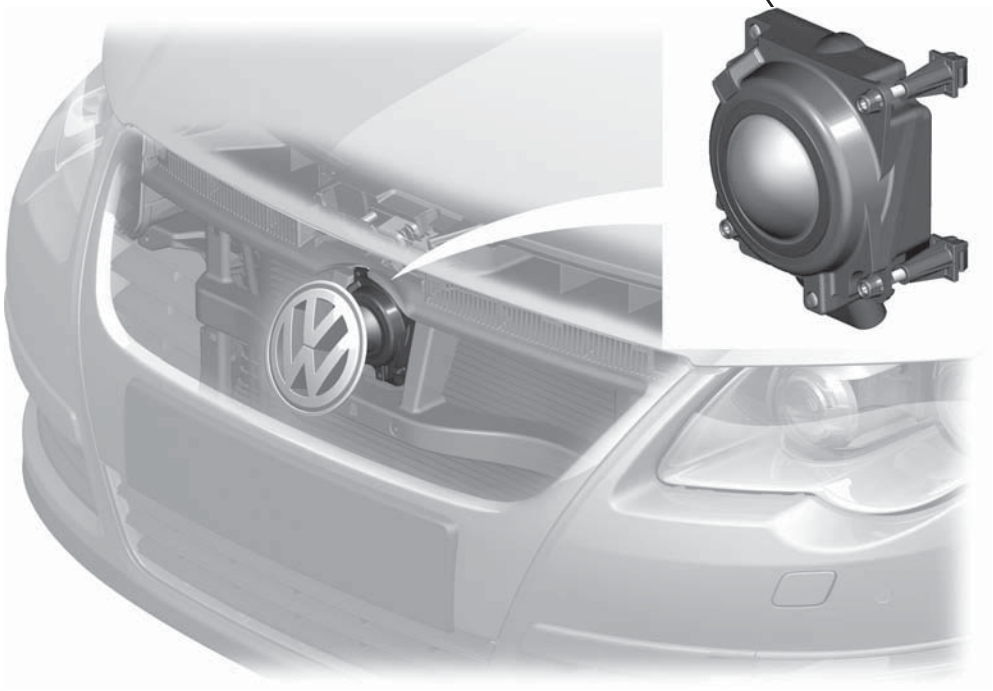
Distance Regulation Control Module J428 and Adaptive Cruise Control Sensor G550

The Distance Regulation Control Module J428 and the Adaptive Cruise Control Sensor G550 are integrated in one component and mounted behind the VW badge. To allow the unimpeded transmission of the radar signals, the badge is made of a special plastic with an indium coating. The maximum attenuation of the badge is 2.5 dB.

Specifications:

- Transmission Frequency = 76.5 GHz
- Range = 500 ft (150 m)
- Horizontal Opening Angle = 12°
- Vertical Opening Angle = ± 4°
- Speed Range = 19 – 130 mph (30 – 210 km/h)
- Minimum Curve Radius = 1650 ft (500 m)

Distance Regulation Control Module J428 with Adaptive Cruise Control Sensor G550



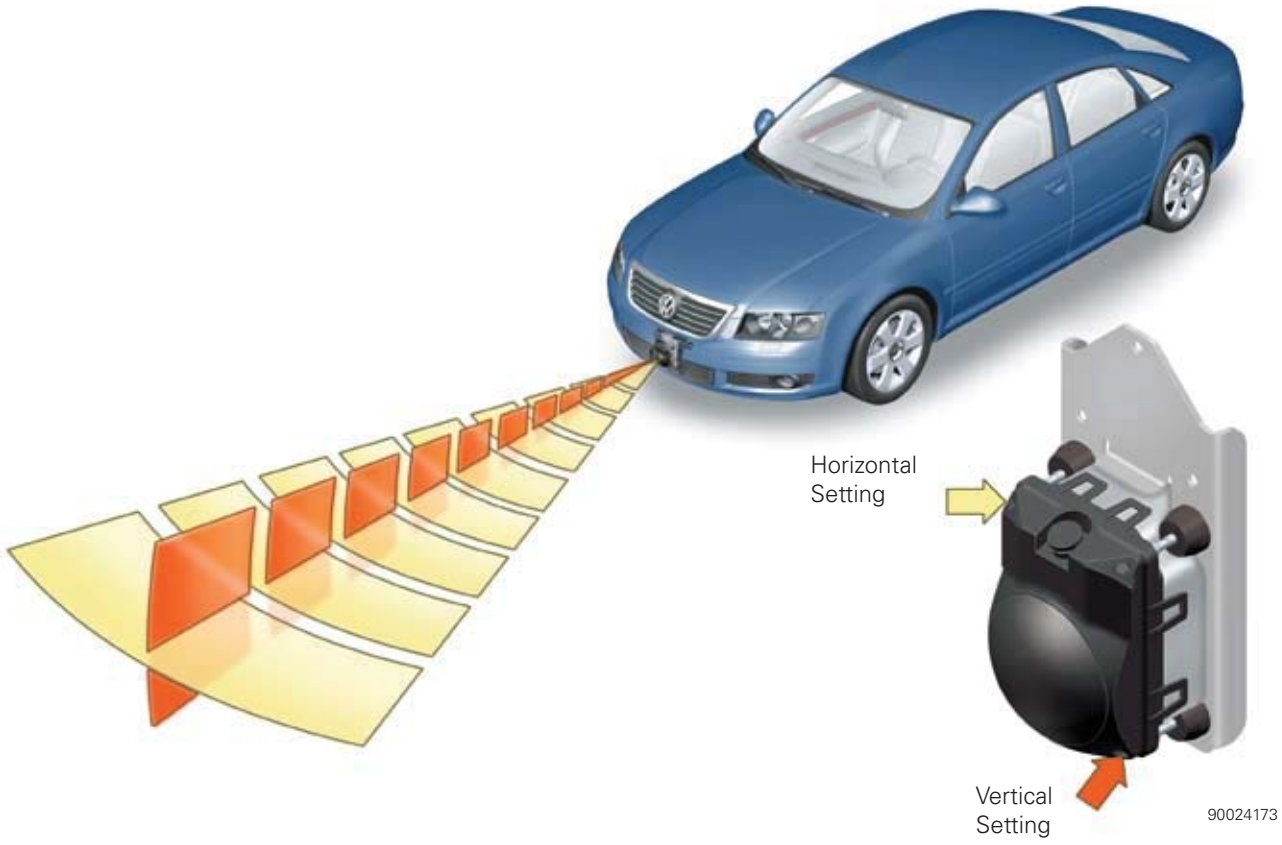
356_052

Adjustment Procedure:

As mentioned in the Phaeton section, mechanical adjustment of the J428 / G550 is absolutely necessary after:

- Replacement of Control Module for Distance Regulation J428
- Adjustments to the front **or** rear suspension
- Replacement or repair of sender holder, bumper, cross member, or any front end damage (e.g. after collision)

Setting is performed on wheel alignment equipment in the same manner as for the Phaeton. Refer to the Workshop Manual for details.



Diagnosis

Operation of all adaptive cruise control system components is constantly monitored.

Any faults occurring are stored in the fault memory.

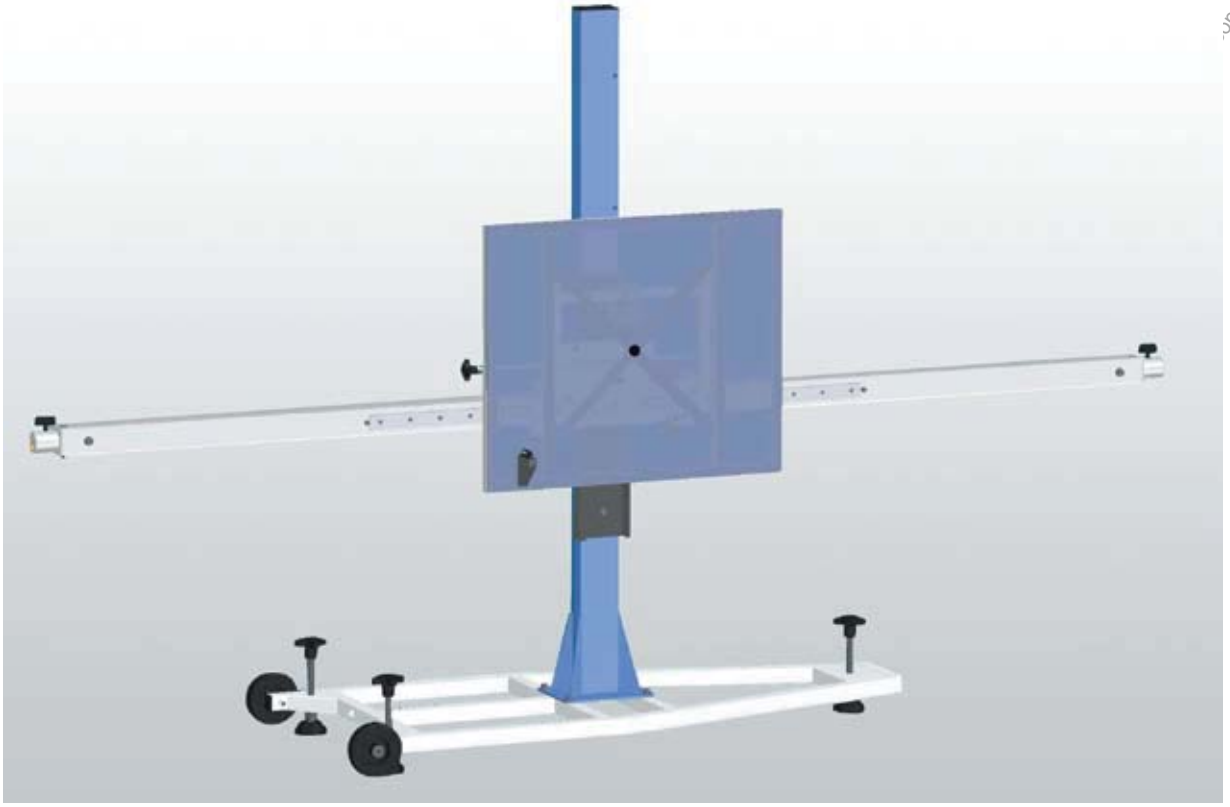
The fault memory can be interrogated in Guided Fault-Finding (GFF) using the Scan Tool. Detailed information is in the relevant Workshop Manual

Special Tools

Two special tools are available for setting the distance control sender.

Gauge VAS 6190/1 is used for rough setting. Precision setting is made with setting tool VAS 6190.

Refer to the Workshop Manual for details.



289_062

Overview

ACC was offered in the MY 2004 – 2009 Touareg.

The major difference over previous systems is that ACC in the Touareg can bring the vehicle to a complete stop. If you are following a vehicle that stops due to a traffic situation, you will come to a complete stop as well. Other differences include:

- The display is multi-color in the Multi-Function Display (MFD)
- The controls are mounted on the steering wheel, similar to the Phaeton

Warning: As with previous ACC systems, the Touareg's ACC will NOT detect stationary objects.

ACC in the Touareg

ACC Controls

Controls in the Touareg are integrated with the multi-function steering wheel.

If the situation requires, the ACC can bring the vehicle to a standstill by active braking intervention. The system can only work within specific limits, and in certain circumstances it may warn the driver to take over control by means of visual and audible warnings.

Warning: "Resting" your foot on the accelerator prevents the ACC from braking because the control system is subordinate to the manual acceleration of the driver.

Using the ACC

Switching the ACC System On and Off

- Press the ON/Off button to activate the ACC
  - The distance indicators appears in the MFD
- Press the ON/OFF button again to turn Off the ACC
  - The MFD reverts to normal display
  - The stored speed is deleted when the ACC is switched OFF

Switching Off the ACC System Temporarily

- Press the brake pedal or press the CANCEL button to temporarily turn OFF the ACC system
  - The set speed and distance measurements remain stored

Restarting the ACC System

- Release the brake pedal
  - As soon as the vehicle has reached a speed of approximately 3 mph (4 km/h)
- Press the RES button
  - The stored speed and distance settings are resumed
  - The stored speed may not be reached immediately if there is a slow vehicle travelling in front of you

Conditions for Starting the ACC

- ESP must be switched ON
- The selector lever must be in position D or in the Tiptronic gate
- The vehicle speed must be between 19 and 124 mph (30 and 200 km/h)
- The control can be restarted as soon as the vehicle speed reaches approximately 3 mph (4 km/h)

In the automatic transmission program "S" the vehicle accelerates more aggressively when the lane ahead becomes clear and the distance control ceases. Active braking interventions also are made later and braking is heavier.

Warning: It is dangerous to use a set speed which is too high for the prevailing road, traffic or weather conditions.

Setting the Speed

To use the ACC, both a speed and a distance must be set. The speed is set with the Set button, or the + or – buttons. The distance is set with the thumb wheel.

While driving the vehicle between 19 and 124 mph (30 and 200 km/h),

- Briefly press the SET button to store the current speed as the set speed
  - The ACC is switched ON and the selected speed is displayed on the MFD
  - In distance control mode the set speed may vary from the actual speed

To increase the stored speed, perform any of the following:

- Depress the accelerator until the desired speed is reached and then briefly press the SET button
- Press the + button one or more times to increase the set speed in 5 mph (10 km/h) increments
- Press and hold the + button to continuously increase the set speed in 5 mph (10 km/h) increments
- Press the RES button one or more times to increase the set speed in increments of 0.5 mph (1 km/h)
- Press and hold the RES button to increase the set speed continuously

Perform any of the following to reduce the set speed:

- Depress the brake pedal until the desired speed is reached and then briefly press the SET button
- Press the – button one or more times to reduce the set speed in 5 mph (10 km/h) increments
- Press and hold the – button to continuously reduce the set speed in 5 mph (10 km/h) increments
- Press the SET button one or more times to decrease the set speed in increments of 0.5 mph (1 km/h)
- Press and hold the SET button to decrease the set speed continuously
  - The ACC reduces the speed by releasing the accelerator and actively braking
- If a speed has not been stored, the display shows --- mph (km/h)

The set speed can also be selected using the + and – buttons, even if the ACC has been switched OFF temporarily. To resume the set speed, press the RES button.

If you drive faster than the stored speed for a long period, the ACC switches OFF temporarily. The stored speed is not deleted.

Setting the Distance

The distance to the vehicle travelling ahead can be set to one of five levels:

- To increase the distance to the vehicle ahead, rotate the thumb wheel downward
- To reduce the distance to the vehicle ahead, rotate the thumb wheel upward
  - The set distance is displayed for approximately three seconds in the MFD

Maximum Distance

The distance to the vehicle ahead is defined by time intervals, creating a speed-dependent distance. A higher speed means that the distance in feet (meters) is increased while the time interval remains constant.

The acceleration response is also altered along with the time interval. The vehicle accelerates dynamically in Level 1 and more smoothly in Level 5.

Minimum Distance

ACC in the Touareg

Driver Information

With the ACC switched ON, the distance indicators and a stored speed are displayed in the Multi-Function Display (MFD). If no speed has been stored, for example because the ACC has not yet been used during the current ignition cycle, then - - - mph (or km/h) is displayed in the MFD.

The stored speed is deleted when the ACC is switched OFF with either the steering wheel control or by switching OFF the ignition.

The status of the ACC system is indicated in the MFD by the color of the symbol:

- Gray – Passive
- Green – Active
- Yellow – Fault

Important information is shown on the MFD when driving.

The ACC switches OFF temporarily if the function of the radar sensor is impaired because of heavy rain, spray, snow, etc. The MFD shows the message "Clean ACC!" If this happens, the ACC functions as a "normal" cruise control system, i.e. the set speed is held constant, but the distance to the vehicle in front is not controlled.

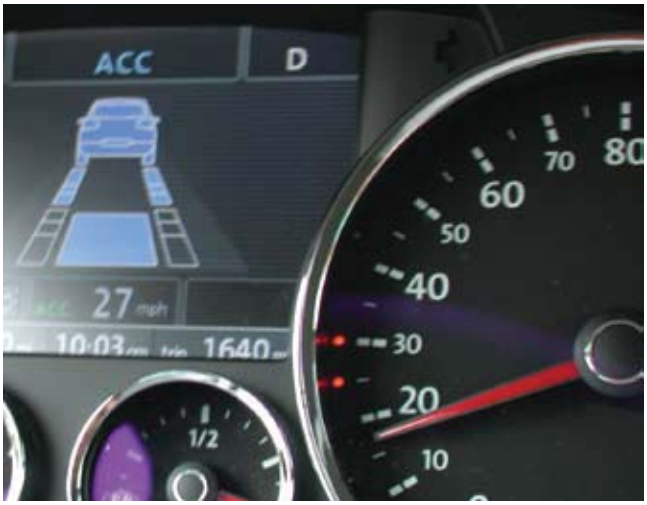
The distance control function of the ACC starts as soon as the radar sensor is working properly again. The "Clean ACC!" display disappears.

ACC Active

No ACC Set Speed

The speedometer has an outer ring of red LEDs. When the ACC is active, the stored speed is indicated by the illumination of one or more of the LEDs.

In the photo, the set speed is 27 mph, so the LEDs for 25 and 30 mph are illuminated. If the set speed were 25, 30, 35 mph, etc, only one corresponding LED would be illuminated.



ACC in the Touareg

Vehicles Ahead

If your vehicle pulls up behind a slower moving vehicle, the ACC automatically matches the speed of your vehicle to the speed of the slower vehicle. This is accomplished through engine deceleration, transmission shifting, or brake intervention.

If the vehicle ahead accelerates, the ACC accelerates to your predefined speed while maintaining the set distance to the vehicle ahead.

If the vehicle driving ahead decreases in speed and comes to a complete stop, e.g. due to reaching the end of a traffic jam, the ACC also brings your vehicle to a standstill.

The brake is released approximately two seconds after the vehicle has been braked to a standstill by an active brake intervention. This is preceded by an optical and acoustic warning asking you to assume control of the vehicle.

Warning: If the vehicle is brought to a stop by ACC, it will not remain stationary longer than two seconds. You MUST take control of the vehicle to keep it from rolling after the brakes are disengaged!

Warnings

- It is the driver's responsibility consider current traffic and road conditions when adapting the speed and distance to the vehicles ahead. The ACC is merely an aid for the driver.
- To lower the risk of an accident, ACC should never be used on roads with bends or where road conditions are poor (e.g. rain, gravel, slippery surfaces, fog, snow).
- To prevent using the ACC by mistake, always switch OFF the system when finished.
- It is dangerous to use a set speed which is too high for the prevailing road, traffic or weather conditions.
- It is the drivers responsibility to use the foot brake when necessary to prevent colliding with a vehicle in front. This is especially true when the difference in speed between the two vehicles is so great that the braking action of the ACC is insufficient!
- The ACC has system-specific limits. It will not respond, for example, to stationary obstacles such as a traffic jam, a disabled vehicle, or if a vehicle is approaching in the same lane.
- Always switch the ACC OFF temporarily (press the CANCEL button or tap the brake pedal) when turning off roads, exiting from freeways, or driving through construction zones, to prevent the vehicle from accelerating to the set speed in these situations.
- The ACC may switch OFF temporarily if the brakes or the radar sensor overheat.
- Any pressure on the accelerator pedal will disable the ACC braking function. This is because the braking control system is subordinate to the manual acceleration of the driver.
- When the system actively brakes, the brake pedal moves downwards slightly. Ensure the area under the brake pedal is clear of obstructions.
- The cover of the radar sensor (Volkswagen badge in the radiator grille) must not be painted over or covered by any auxiliary equipment (e.g. fog lights or other covers).
- The distance control function of the ACC will not work if the cover of the radar sensor (Volkswagen badge in the radiator grille) is soiled by heavy rain, spray, snow etc.
- During a heavy snowfall, snow might collect between the radar sensor and the Volkswagen badge and impair the function.

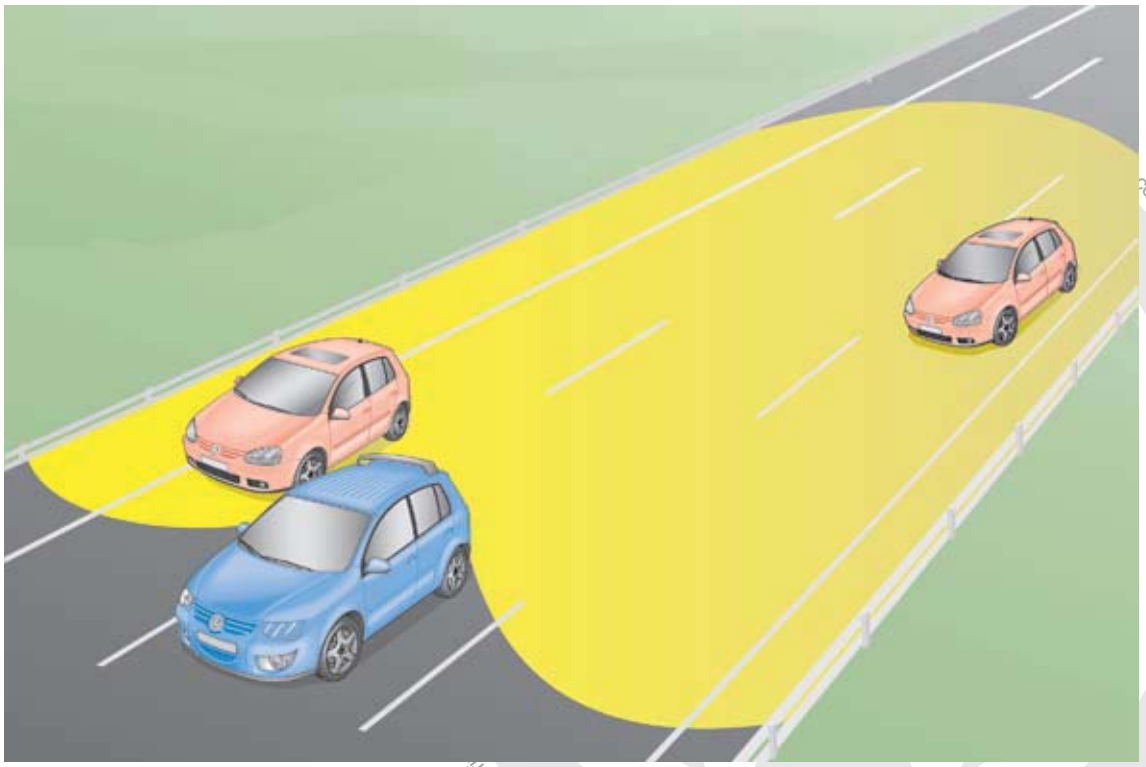
Notes

General Description

The Lane Change Assistant system (LCA) uses radar sensors to monitor "blind spots"– areas to the rear and sides of the vehicle to help the driver during a lane change.

The driver's and the passenger's sides are both monitored, each with its own separate radar module.

If the system detects a critical situation that could result in an accident during a lane change, it both informs and warns the driver. The driver is informed by the activation of the warning lights in the appropriate exterior rear-view mirror, and is warned by the warning lights flashing brightly. Though there is a warning, no active intervention is taken by the vehicle.



S396_001

Lane Change Assist

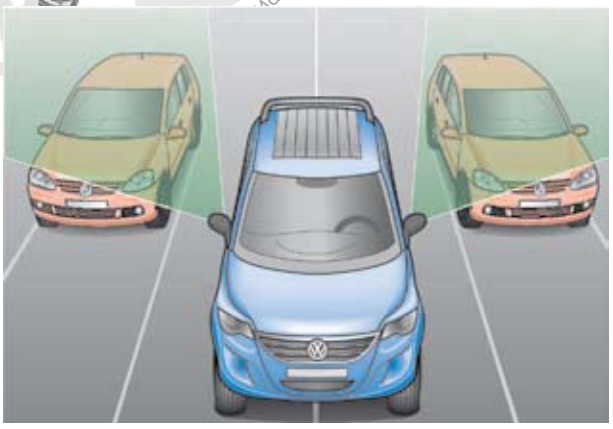
Situation

A frequent cause of accidents is failing to see vehicles when changing lanes on multi-lane roads. In 2005, there were approximately 5000 accidents involving personal injury and property damage that were caused partly by mistakes when changing lane.

Driver assistance systems can contribute to reducing accidents in these traffic situations and warn the driver about possible dangers.

Blind Spot

If a vehicle is travelling in the next lane, there is a danger that it is in the blind spot of the rear-view mirrors and will not be seen prior to a lane change maneuver.



S396_002

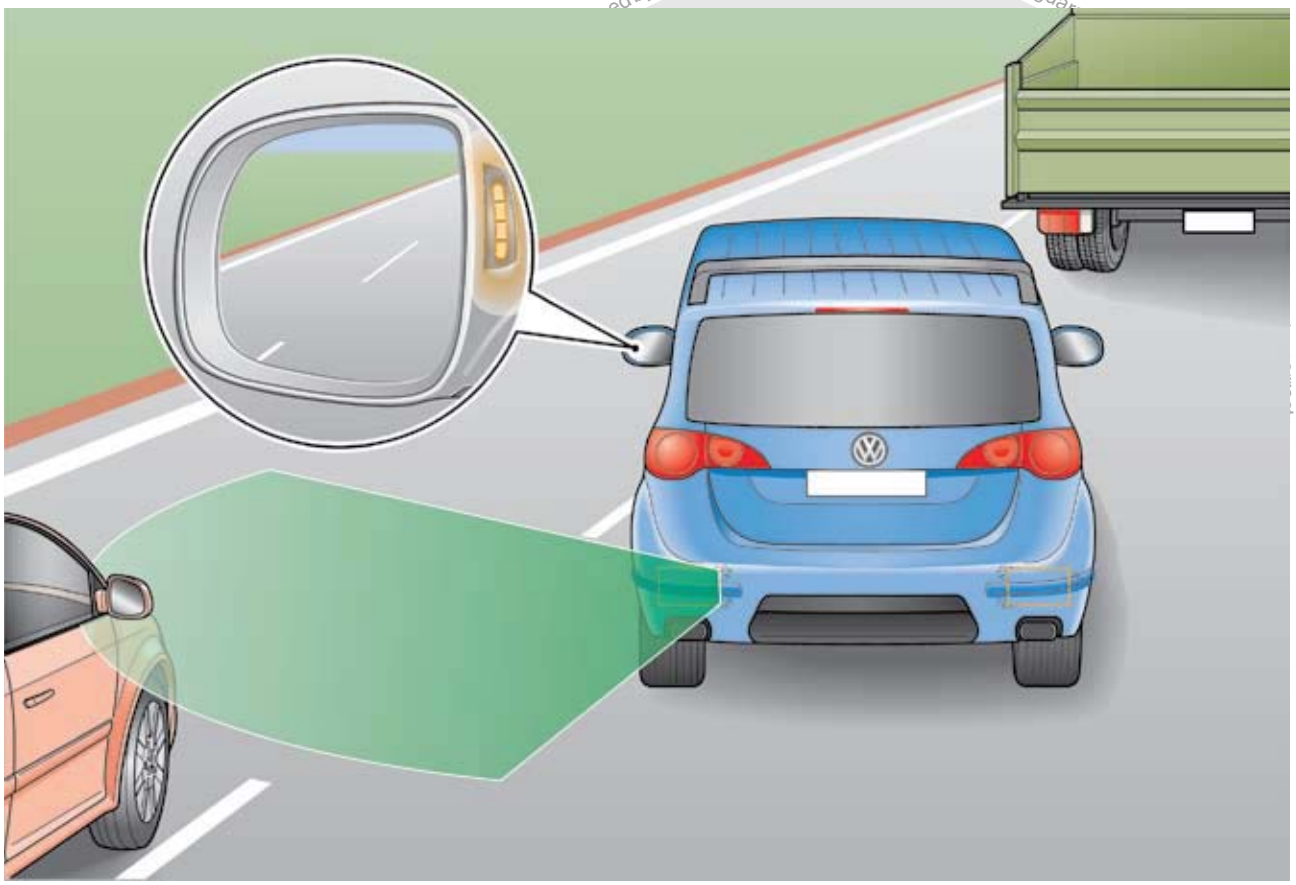
Reducing Risks When Changing Lanes

The LCA monitors the space next to and behind the vehicle with the aid of radar beams.

The driver is informed if there is a vehicle in the monitored area or if a vehicle is approaching at a higher speed.

If the driver is planning to change lanes in this situation and indicates this by activating the turn signal, the system issues a warning.

The risk of accident is reduced by the LCA and therefore contributes to safety.



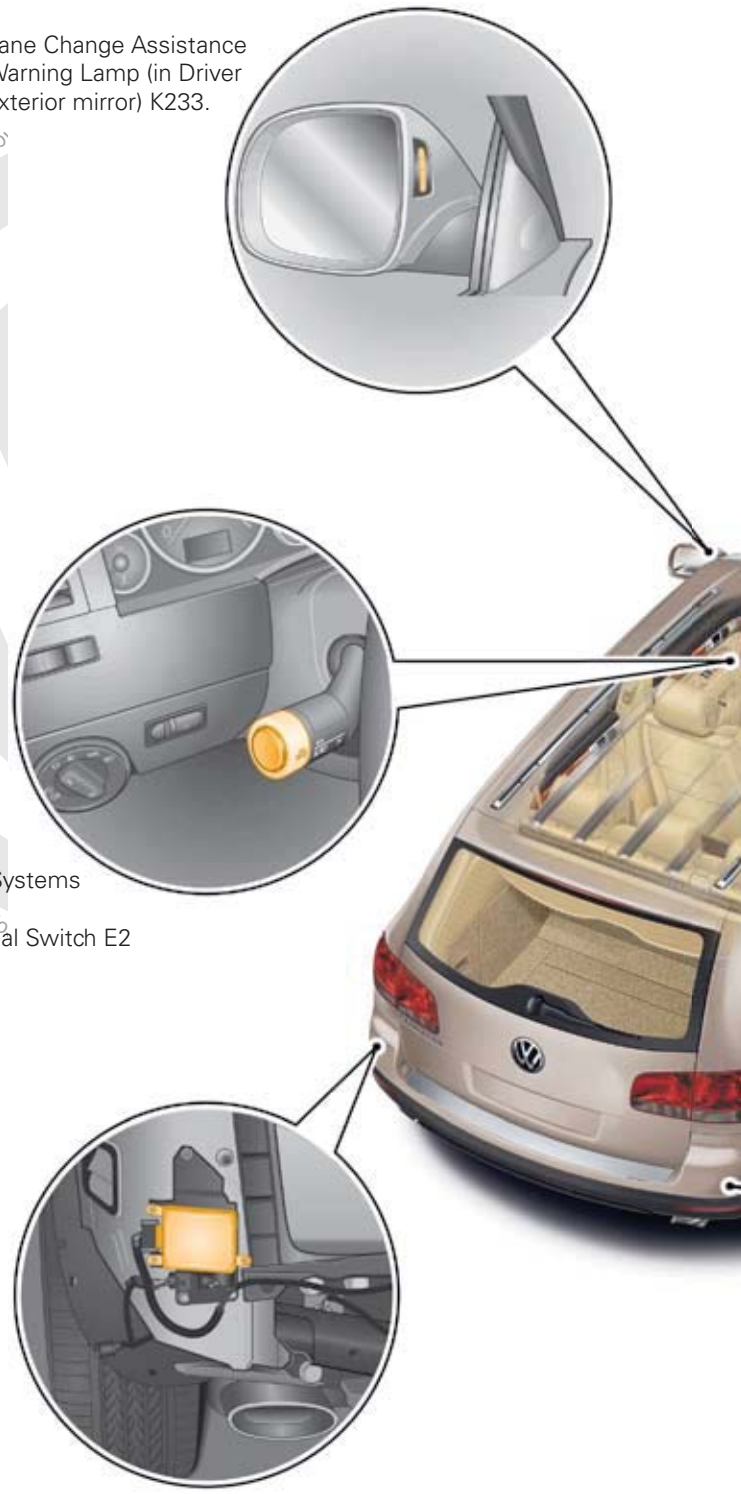
S396_004

Lane Change Assist

Component Locations

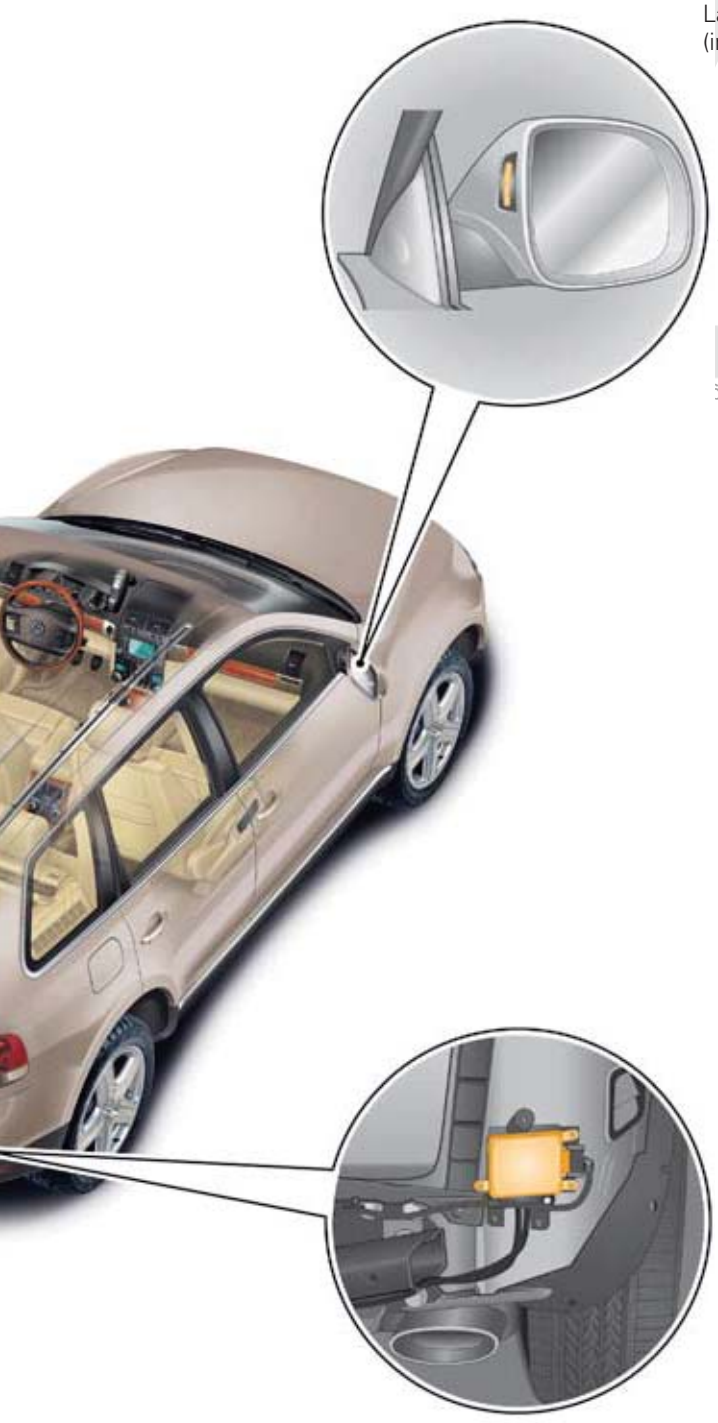
LCA is currently only available on the Touareg. Its components are as follows:

- Lane Change Assistance Warning Lamp (in Driver exterior mirror) K233
- Lane Change Assistance Warning Lamp (in front Passenger exterior mirror) K234
- Lane Change Assistance Control Module J769 is on the left side behind the rear bumper
- Lane Change Assistance Control Module 2 J770 is on the right side behind the rear bumper
- Driver Assistance Systems Button E617 is on the end of Turn Signal Switch E2



Lane Change Assist

Lane Change Assistance Warning Lamp
(in front Passenger exterior mirror) K234



Lane Change Assistance
Control Module 2 J770

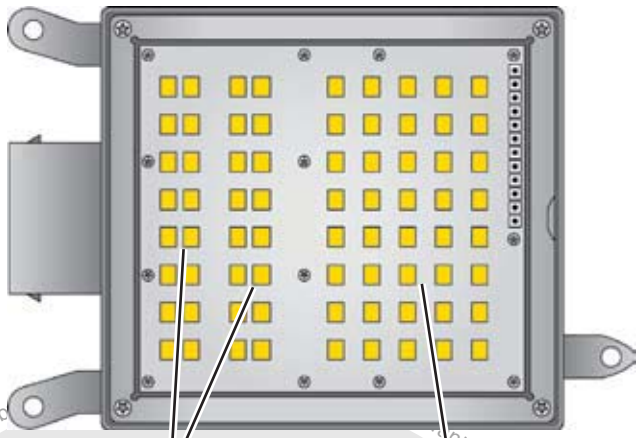
S396_009

Lane Change Assist

Components

Radar Sensors

The radar sensors are configured as transmitter and receiver antennas that are in the control module under a radome plastic cover. These radar sensors are located under the rear bumper cover on each side of the vehicle.



Button for Driver Assistance Systems

The Driver Assistance Systems Button E617 can be used to switch OFF the LCA.

The icon on the button indicates the driver assistance systems.

Press and hold the button for more than one second to change system status.

Displays

Highline Dash Panel Insert

The Lane Change Assistance Indicator Lamp K232 in the dash panel insert indicates that the LCA is active. The warning lamp is in the Speedometer G21.

The systems status is indicated by the color of the warning light:

- Green
  - LCA switched ON and active (at speeds above 60 km/h)
- Yellow
  - LCA switched ON and passive (at speeds below 50 km/h)

Lane Change Assistance Indicator Lamp K232

S396_013

Premium Dash Panel Insert

The Lane Change Assistance Indicator Lamp K232 in the dash panel insert indicates that the LCA is active. The warning lamp is located in the MFD.

The activation state is indicated by the color of the warning light:

- Green
  - LCA switched ON and active (at speeds above 60 km/h)
- Gray
  - LCA switched ON and passive (at speeds below 50 km/h)

Lane Change Assistance Indicator Lamp K232

S396_014

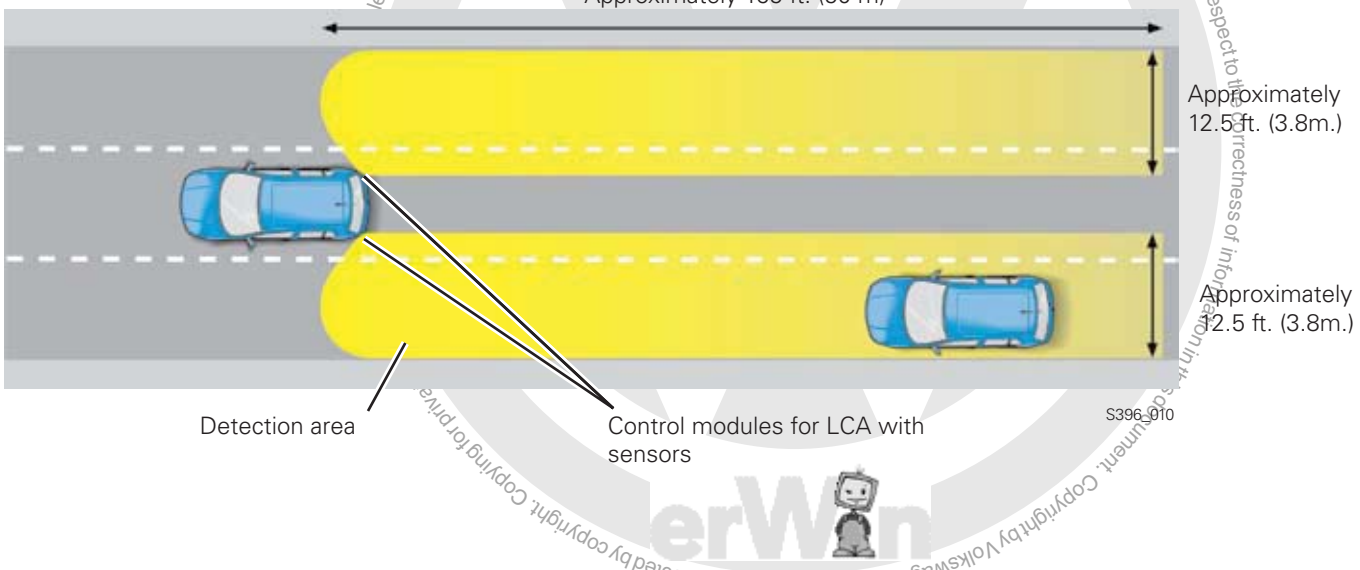
Lane Change Assist

Monitoring Procedure

Scanning Area

The LCA system detects dangers next to and behind the vehicle. The scanning area reaches from the B-pillar to approximately 165 ft. (50 m) to the rear of the vehicle.

The width of the scanning area is approximately 12.5 ft. (3.8m.)



How It Works:

The sensors in the control modules monitor the scanning area and recognize objects that are in this area using radar waves. These objects are recognized by the respective Lane Change Assist Control Module (J769 or J770) and the time to a possible collision is calculated. The control module calculates whether the object in the blind spot is at the same speed, is slowly dropping back or getting closer. If the calculated time falls below a set value, the driver is informed or warned when the turn signal is active.

Information and Warning

The information or warning that there is an object in the scanning area is provided by the LCA warning lamps in the exterior mirrors.

Information

Information is provided when there is a danger, the LCA warning lamp on the corresponding side illuminates. It remains illuminated until the object leaves the scanning area.

S396_011

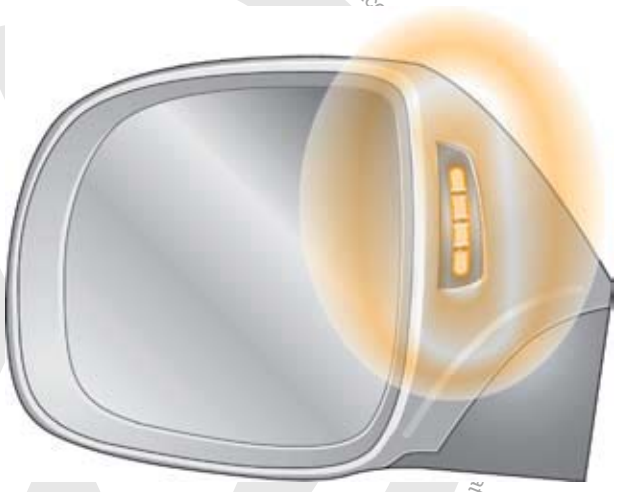
Warning

A warning is issued when the driver indicates his intention to change lanes by activating the turn signal in the direction of a detected object. This causes the LCA warning light on the corresponding side to start flashing.

The warning is limited to a set time and then the system returns to information level.

If the turn signal is left active after the original object poses no further danger and another object is detected another warning is issued.

The warning is activated again if the turn signal is switched OFF and ON again.



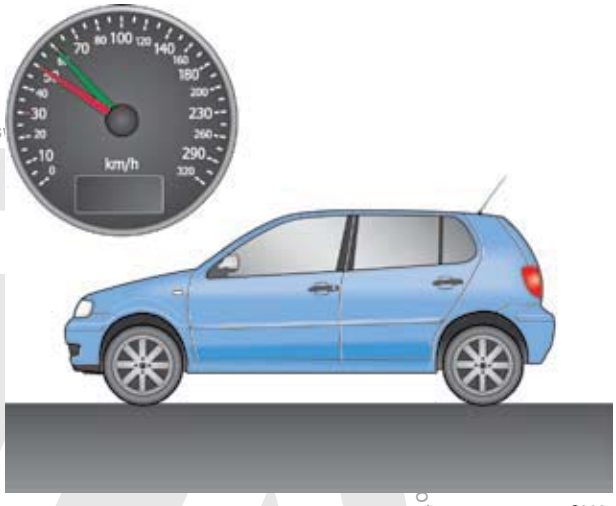
S396_012

Lane Change Assist

Function

Activation Speed

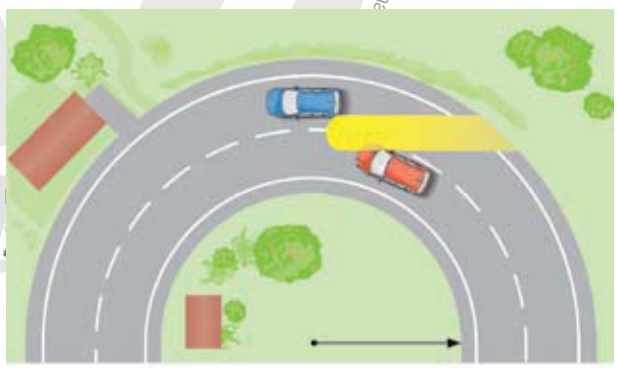
The LCA is active at speeds above 37 mph (60 km/h). In order for the LCA to be active, the LCA button must be enabled. If the speed falls below 31 mph (50 km/h), the LCA switches to passive mode.



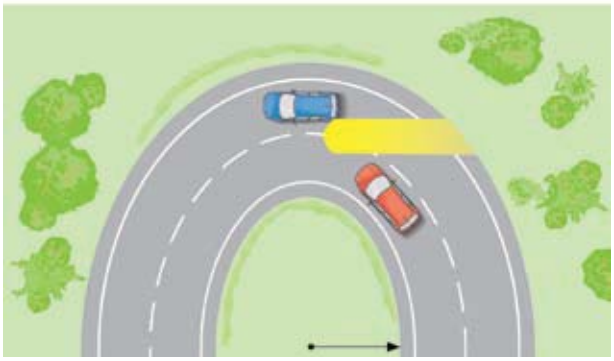
S396_029

Cornering

Vehicles are recognized on curves with over 650 ft (200 m) radius. On curves with smaller radii, the LCA switches to passive mode.



Radius > 650 ft. (200m)

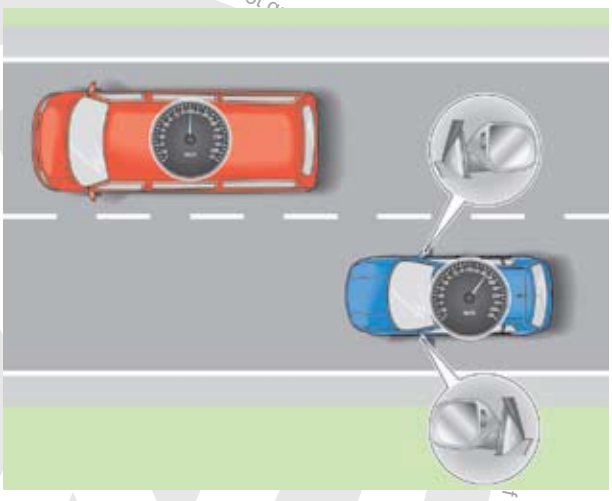


Radius < 650 ft. (200m)

S396_030

Passing

When vehicles are overtaken or when they are falling behind, information or a warning is provided up to a speed difference of approximately 10 mph (15 km/h). Above that no information on the object is displayed.

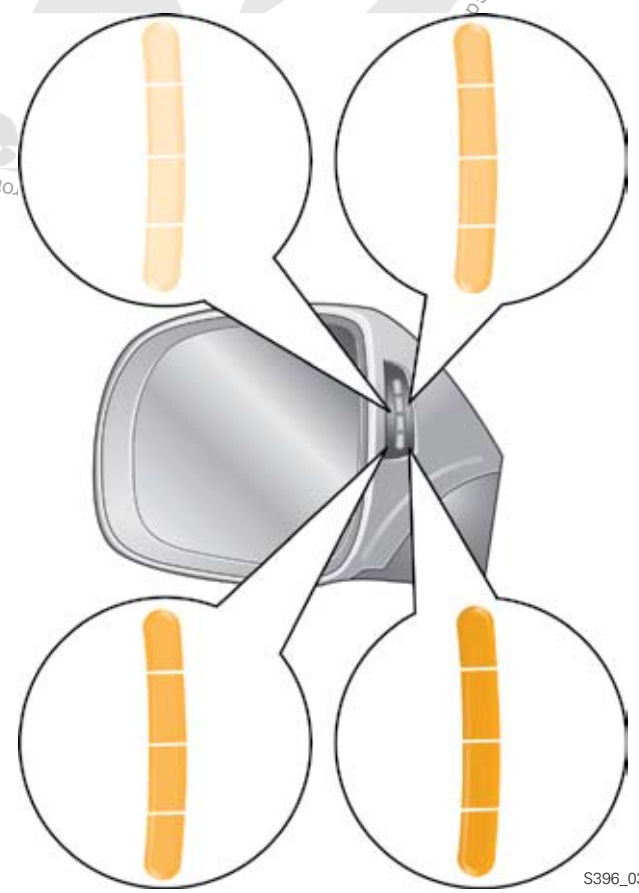


S396_031

Brightness of Warning Lamps

The driver can adjust the brightness of the LCA warning lamps using the customization options. The brightness is also automatically adapted to the ambient light.

The information for this is supplied by the Rain/Light Recognition Sensor G397.



S396_032

Lane Change Assist

Networking

Control Modules

The LCA system consists of two control modules:

- Lane Change Assistance Control Module J769
- Lane Change Assistance Control Module 2 J770.

The Lane Change Assistance Control Module J769 is configured as the master control module. The Lane Change Assistance Control Module 2 J770 is the slave control module. Both control modules are linked to each other for data exchange via their own LCA private CAN data bus. The data transfer speed is 500 kbit/s.

The Lane Change Assistance Control Module J769 is still a subscriber on the powertrain CAN data bus and can therefore receive all necessary CAN data bus messages for its functions.

When the ignition is switched OFF, the connection between the powertrain CAN data bus and the LCA control module is disconnected by the cutoff relay for safety reasons.

CAN Data Bus Messages

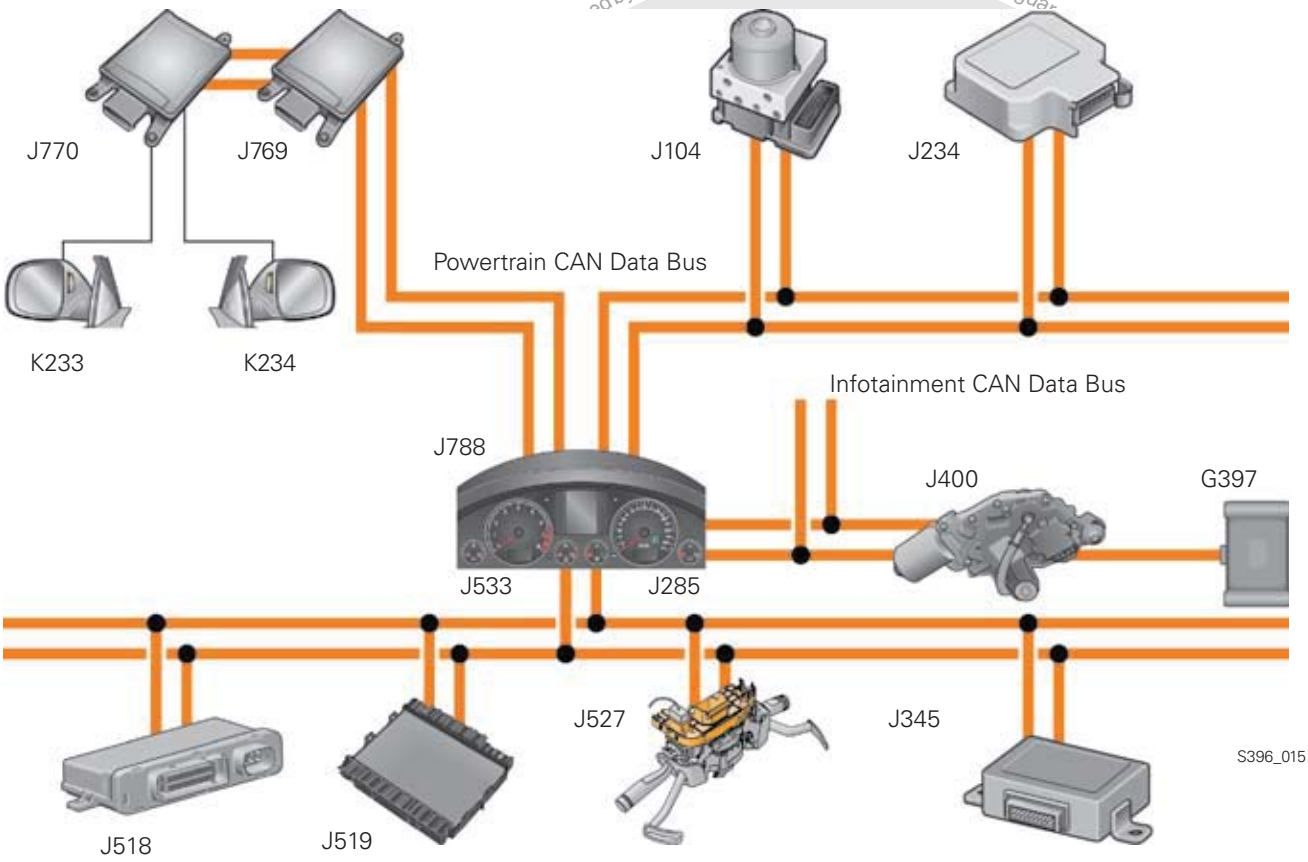
The following CAN data bus messages are required for trouble-free operation of the LCA system:

Message

- Airbag Control Module J234
  - Storage of warning lamp status
- ABS Control Module J104
  - Provision of speed and yaw rate signal
- Instrument Cluster Control Module J285 and Data Bus On Board Diagnostic Interface J533
  - Display of activation status
  - Forwarding all CAN data bus messages
- Vehicle Electrical System Control Module J519
  - Provision of turn signals
- Towing Recognition Control Module J345
  - Indication of whether a trailer is attached and, if necessary, deactivation of the LCA
- Wiper Motor Control Module J400
  - Provision of the signal from the rain and light sensor G397 and adjustment of the brightness of the LCA warning lamps
- Access/Start Authorization Control Module J518
  - Provision of the remote key signal for customization

Network Overview

LCA CAN Data Bus

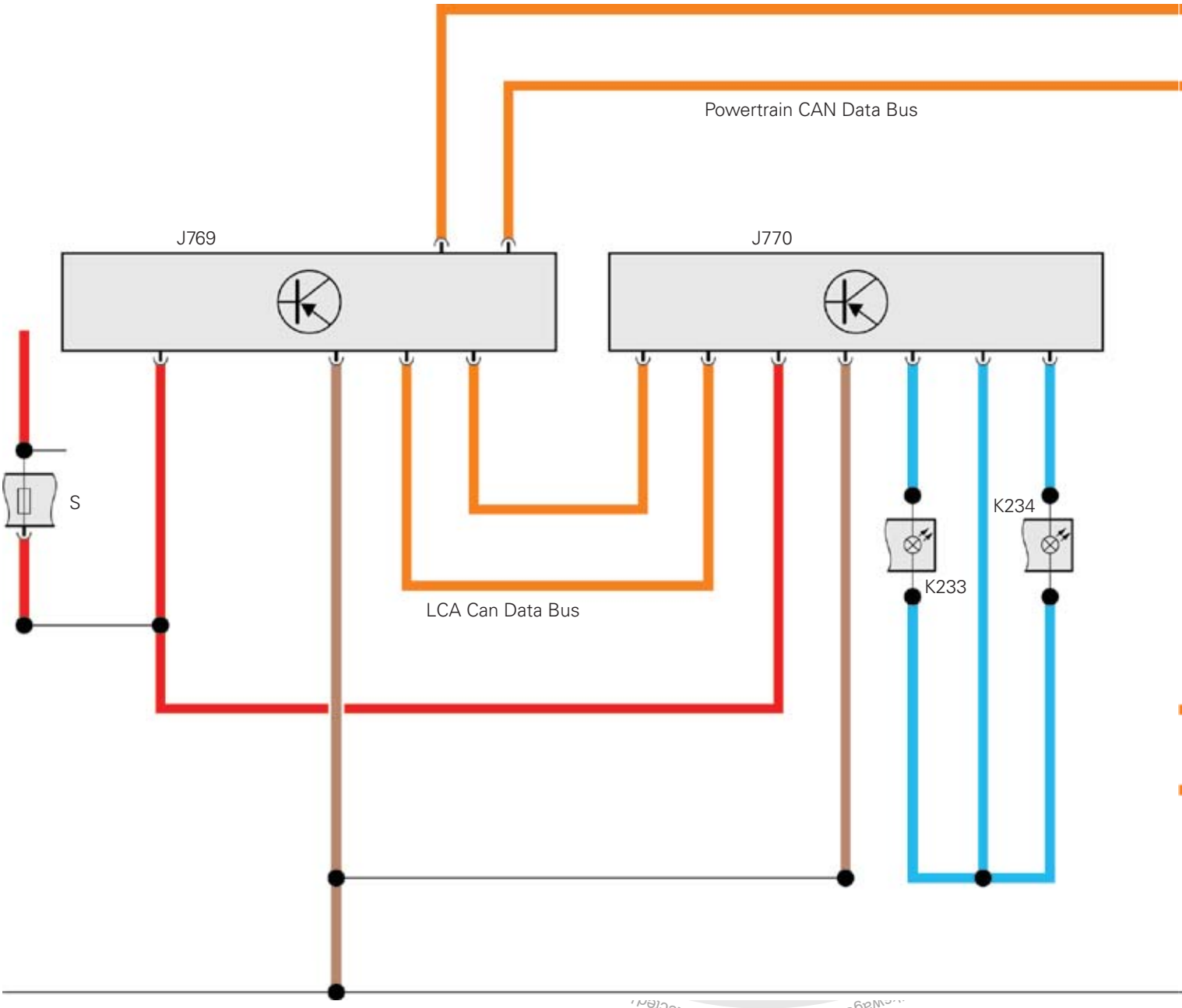


Legend

G397 Rain/Light Recognition Sensor
J104 ABS Control Module
J234 Airbag Control Module
J285 Instrument Cluster Control Module
J345 Towing Recognition Control Module
J400 Wiper Motor Control Module
J518 Access/Start Authorization Control Module
J519 Vehicle Electrical System Control Module
J527 Steering Column Electronic Systems Control Module
J533 Data Bus On Board Diagnostic Interface J533
J769 Lane Change Assistance Control Module
J770 Lane Change Assistance Control Module2
J788 Powertrain CAN-Bus Cut-Off Relay
K233 Lane Change Assistance Warning Lamp (in Driver exterior mirror)
K234 Lane Change Assistance Warning Lamp (in front Passenger exterior mirror)

Lane Change Assist

Functional Diagram



Legend

J769 Lane Change Assistance Control Module

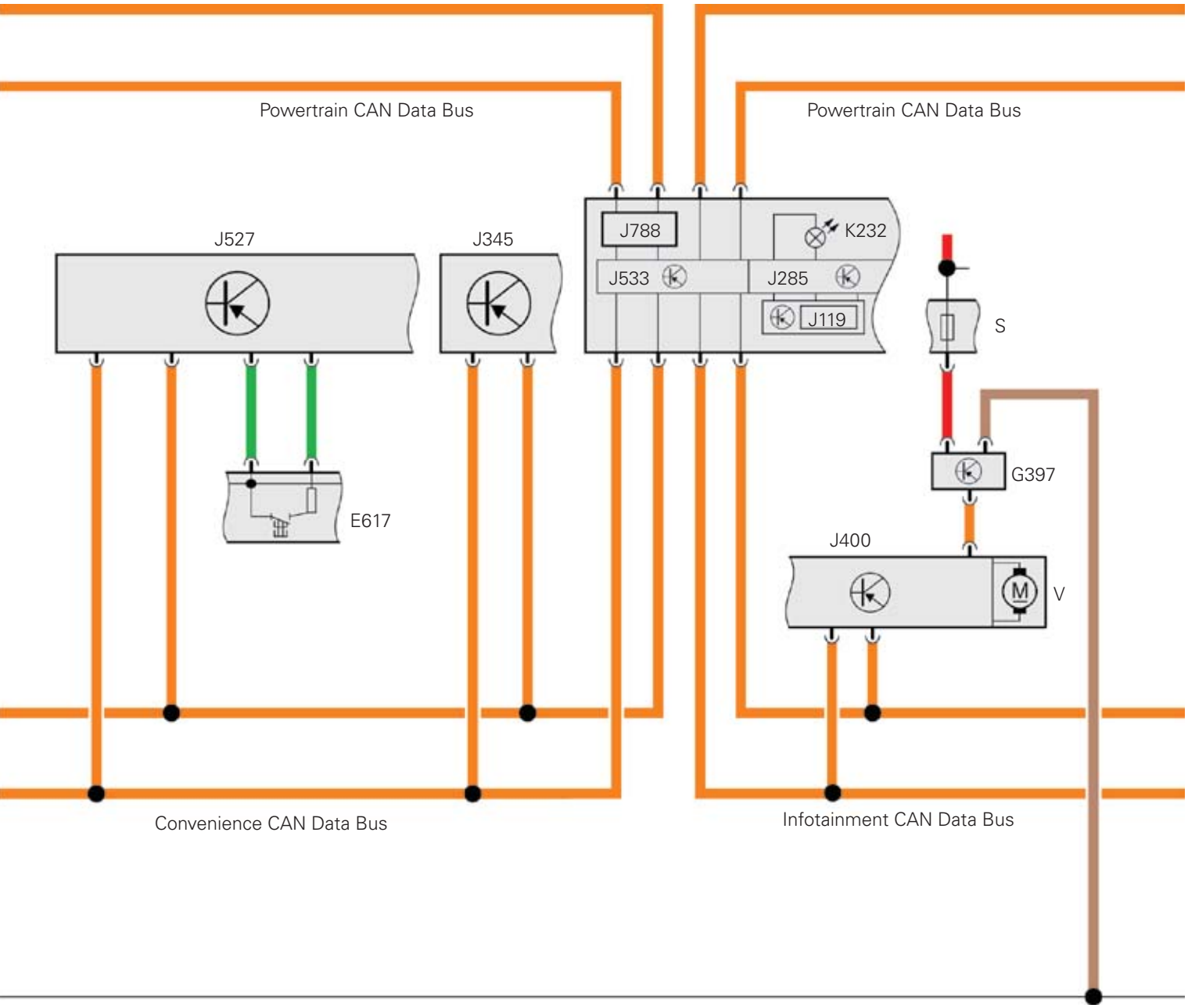
J770 Lane Change Assistance Control Module2

K233 Lane Change Assistance Warning Lamp (in Driver exterior mirror)

K234 Lane Change Assistance Warning Lamp (in front Passenger exterior mirror)

S Fuse

Lane Change Assist



S396_017

Legend

E617 Driver Assistance Systems Button
G397 Rain/Light Recognition Sensor
J119 Multi-Function Indicator
J285 Instrument Cluster Control Module
J345 Towing Recognition Control Module
J400 Wiper Motor Control Module
J527 Steering Column Electronic Systems Control Module
J533 Data Bus On Board Diagnostic Interface
J788 Powertrain CAN-Bus Cut-Off Relay
K232 Lane Change Assistance Indicator Lamp
S Fuse
V Windshield Wiper Motor

Diagnosis

Diagnosis Functions

The following diagnosis functions can be performed with the VAS diagnosis testers:

- Identification of Control Modules
- Query Fault Memory
- Delete Fault Memory
- Read Data Blocks
- Control Element Test
- Basic Setting
- Customization
- Code

The individual diagnosis functions are available in Guided Fault Finding or Guided Functions.

VAS 5051B

S396_018

VAS 5052B

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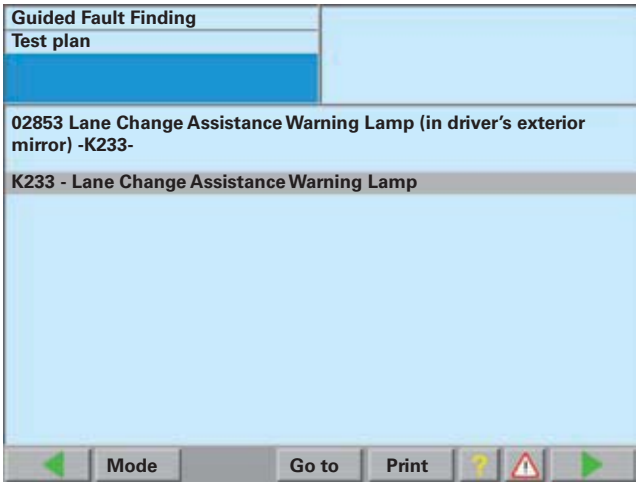
Fault Finding

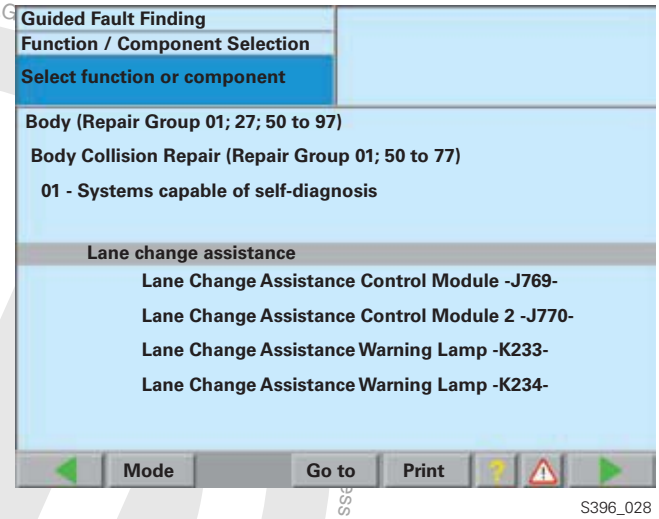
Fault-finding programs are available in GFF for use with the LCA.



S396_027

Testing Individual Components

Individual component tests can be called up via the function and component selection in GFF.



S396_028

Lane Change Assist

Calibration

To work correctly, the LCA must be calibrated after the following work on the vehicle:

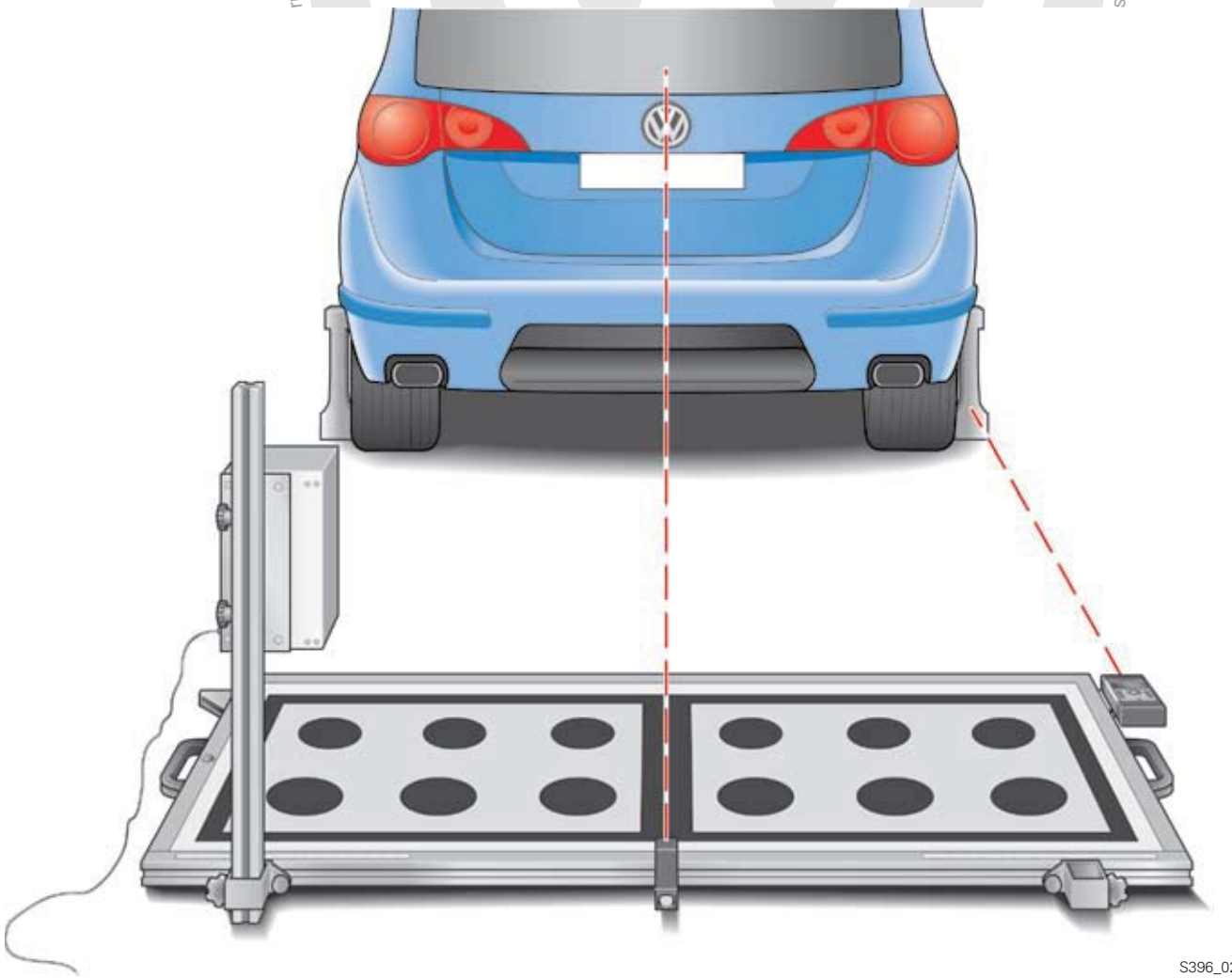
- One of the two LCA control units is replaced
- The location of one of the two LCA control units is changed
- Body repairs are performed at the rear
- Removal or repositioning of the rear bumper

The calibration procedure is described in the Workshop Manual in ElsaWeb.

During calibration, radar beams are emitted that are reflected by the Doppler simulator. This simulates a vehicle. Since the Doppler simulator has a defined position, a certain number of radar beams are expected in a set time.

Deviations indicate that the control units are not in the correct position.

These deviations are displayed on the VAS diagnosis tester.



S396_026

Required Special Tools

Calibration Unit

The calibration unit is part of the VAS 6350 tool set and is required to calibrate the reversing camera.

S396_019

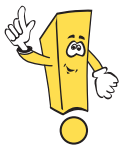
Doppler Simulator

The VAS 6350/4 Doppler simulator is equipped with reflector plates. This simulates a driving vehicle.

The system is powered with A/C voltage.

The package includes:

- Doppler Simulator VAS 6350/4
- Holding Post VAS 6350/4-1
- Post Mounting, Left VAS 6350/4-2
- Post Mounting, Right VAS 6350/4-3



The VAS 6350 tool set includes the wheel center mountings, the spacing laser, and the linear laser.

S396_023

Glossary

Azimuth Angle

See "Reflection Angle."

Detection Field

See "Field of Vision of Sensor."

Driver Assistance System

Systems that support the driver without relieving him of his responsibility to guide the vehicle safely.

Driving Axis

Direction of movement of the vehicle with the steering wheel in the straight ahead position.

Electronic Brake Booster

A pneumatic brake booster that operates the brake via an electromagnetic valve. The dedicated Brake Booster Control Module J539 ensures precise brake pressure application.

Elevation Angle

Vertical reflection angle.

Field of Vision of Sensor

The region in front of the ACC-equipped vehicle in which vehicles and obstacles are detected. Comparable with the illumination zone of a headlight (also referred to as detection field).

Following Time

The road speed-dependent distance to a vehicle in front (also referred to as time gap).

Gateway

Electronic circuit or circuit component that facilitates data exchange between various CAN data buses.

Indium

A soft silvery-colored rare metallic chemical element, often found in zinc and tin ores, used in alloys, transistors, and electroplating.

Indication Error

Angular error in relation to the ideal direction.

Lane Forecast

A system that calculates the lane ahead from the measured variables of wheel speeds, yaw rate, and steering wheel angle.
The ACC system should only respond to vehicles driving ahead of the vehicle in the same lane. This requires a lane forecast.

Millimeter-Waves

Electromagnetic waves in the frequency range from approximately 30 GHz to 150 GHz. The limits are fuzzy and are referred to as millimeter-waves since their wavelength is in the millimeter range.

Mirror Normal

Line perpendicular to the surface of the mirror.

Proportional Solenoid

Solenoid whose armature length is proportional to the coil current in the design range.

Proximity Controller

Calculates the necessary engine torque or braking torque from the measured variables of distance and relative speed to maintain the adjusted following time to a vehicle driving in front.
The Right Adaptive Cruise Control Sensor G259 is the proximity controller in the Phaeton ACC system.

Radar Axis

Axis of symmetry of the radar detection field.

Redundant

Components or signals that duplicate the functions of others for increasing fail safety.

Reflection Angle

Horizontal angular deviation of an object in relation to the radar center line (also referred to as azimuth angle).

Release Switch

A two-way switch integrated in the electronic brake booster to detect brake application by the driver and brake application initiated by the ACC.
The Automatic Distance Regulation Release Switch in Brake Booster F317 is a two-way switch.

Relevant Object

An object that the Right Adaptive Cruise Control Sensor G259 in the ACC system uses for proximity control based on distance and relative speed.

Set Speed

The speed selected by the driver in CCS mode. In ACC mode, the actual speed is less than the set speed.

Stator

Along with armatures, they form the magnetic circuit of a solenoid. The stator is the stationary part and the armature is the moving part.

Steering Column Electronic Systems Control Module J527

Sends steering wheel button information to the convenience CAN data bus. The information provided by the steering angle sensor is sent to the drivetrain CAN data bus.

Time Gap

See "Following Time."

Notes

Knowledge Assessment

An on-line Knowledge Assessment (exam) is available for this Self-Study Program.

You can find this Knowledge Assessment at:

www.vwwebsource.com

For Assistance, please call:

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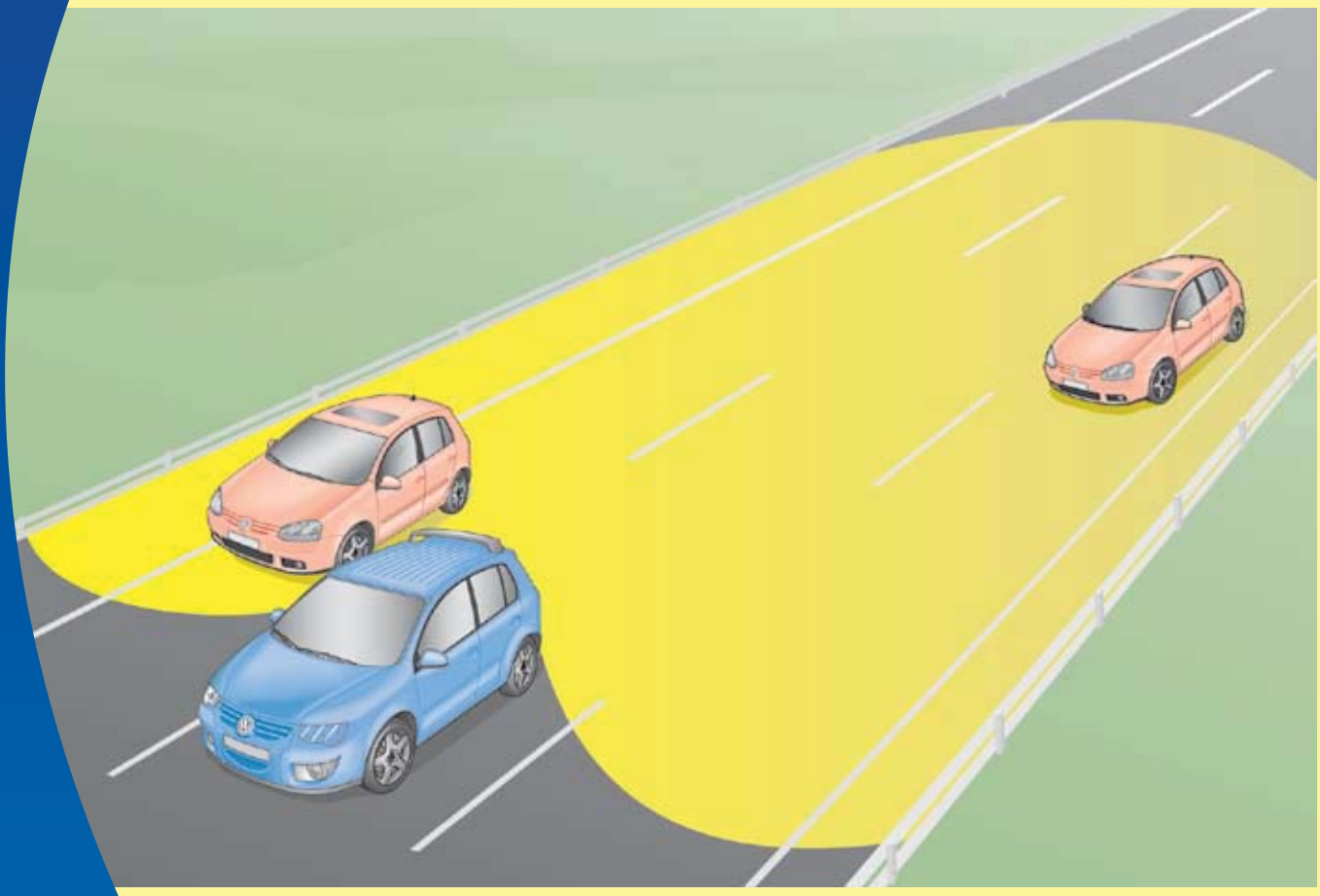

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February, 2010

Cautions & Warnings

Please read these WARNINGS and CAUTIONS before proceeding with maintenance and repair work. You must answer that you have read and you understand these WARNINGS and CAUTIONS before you will be allowed to view this information.

- If you lack the skills, tools and equipment, or a suitable workshop for any procedure described in this manual, we suggest you leave such repairs to an authorized Volkswagen retailer or other qualified shop. We especially urge you to consult an authorized Volkswagen retailer before beginning repairs on any vehicle that may still be covered wholly or in part by any of the extensive warranties issued by Volkswagen.

- Disconnect the battery negative terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.

- Volkswagen is constantly improving its vehicles and sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, part numbers listed in this manual are for reference only. Always check with your authorized Volkswagen retailer parts department for the latest information.

- Any time the battery has been disconnected on an automatic transmission vehicle, it will be necessary to reestablish Transmission Control Module (TCM) basic settings using the VAG 1551 Scan Tool (ST).

- Never work under a lifted vehicle unless it is solidly supported on stands designed for the purpose. Do not support a vehicle on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a vehicle that is supported solely by a jack. Never work under the vehicle while the engine is running.

- For vehicles equipped with an anti-theft radio, be sure of the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered when the power is restored, the radio may lock up and become inoperable, even if the correct code is used in a later attempt.

- If you are going to work under a vehicle on the ground, make sure that the ground is level. Block the wheels to keep the vehicle from rolling. Disconnect the battery negative terminal (ground strap) to prevent others from starting the vehicle while you are under it.

- Do not attempt to work on your vehicle if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medicine or any other substances that may impair you or keep you from being fully alert.

- Never run the engine unless the work area is well ventilated. Carbon monoxide (CO) kills.

- Always observe good workshop practices. Wear goggles when you operate machine tools or work with acid. Wear goggles, gloves and other protective clothing whenever the job requires working with harmful substances.

- Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

- Do not re-use any fasteners that are worn or deformed in normal use. Some fasteners are designed to be used only once and are unreliable and may fail if used a second time. This includes, but is not limited to, nuts, bolts, washers, circlips and cotter pins. Always follow the recommendations in this manual - replace these fasteners with new parts where indicated, and any other time it is deemed necessary by inspection.

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Cautions & Warnings

- Illuminate the work area adequately but safely. Use a portable safety light for working inside or under the vehicle. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

- Friction materials such as brake pads and clutch discs may contain asbestos fibers. Do not create dust by grinding, sanding, or by cleaning with compressed air. Avoid breathing asbestos fibers and asbestos dust. Breathing asbestos can cause serious diseases such as asbestosis or cancer, and may result in death.

- Finger rings should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.

- Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly; do not attempt shortcuts. Use tools that are appropriate to the work and use only replacement parts meeting Volkswagen specifications. Makeshift tools, parts and procedures will not make good repairs.

- Catch draining fuel, oil or brake fluid in suitable containers. Do not use empty food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.

- Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque listed.

- Keep sparks, lighted matches, and open flame away from the top of the battery. If escaping hydrogen gas is ignited, it will ignite gas trapped in the cells and cause the battery to explode.

- Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond, or lake. Consult local ordinances that govern the disposal of wastes.

- The air-conditioning (A/C) system is filled with a chemical refrigerant that is hazardous. The A/C system should be serviced only by trained automotive service technicians using approved refrigerant recovery/recycling equipment, trained in related safety precautions, and familiar with regulations governing the discharging and disposal of automotive chemical refrigerants.

- Before doing any electrical welding on vehicles equipped with anti-lock brakes (ABS), disconnect the battery negative terminal (ground strap) and the ABS control module connector.

- Do not expose any part of the A/C system to high temperatures such as open flame. Excessive heat will increase system pressure and may cause the system to burst.

- When boost-charging the battery, first remove the fuses for the Engine Control Module (ECM), the Transmission Control Module (TCM), the ABS control module, and the trip computer. In cases where one or more of these components is not separately fused, disconnect the control module connector(s).

- Some of the vehicles covered by this manual are equipped with a supplemental restraint system (SRS), that automatically deploys an airbag in the event of a frontal impact. The airbag is operated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious personal injury. To guard against personal injury or airbag system failure, only trained Volkswagen Service technicians should test, disassemble or service the airbag system.

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Cautions & Warnings

- Do not quick-charge the battery (for boost starting) for longer than one minute, and do not exceed 16.5 volts at the battery with the boosting cables attached. Wait at least one minute before boosting the battery a second time.
- Never use a test light to conduct electrical tests of the airbag system. The system must only be tested by trained Volkswagen Service technicians using the VAG 1551 Scan Tool (ST) or an approved equivalent. The airbag unit must never be electrically tested while it is not installed in the vehicle.
- Some aerosol tire inflators are highly flammable. Be extremely cautious when repairing a tire that may have been inflated using an aerosol tire inflator. Keep sparks, open flame or other sources of ignition away from the tire repair area. Inflate and deflate the tire at least four times before breaking the bead from the rim. Completely remove the tire from the rim before attempting any repair.
- When driving or riding in an airbag-equipped vehicle, never hold test equipment in your hands or lap while the vehicle is in motion. Objects between you and the airbag can increase the risk of injury in an accident.

I have read and I understand these Cautions and Warnings.

back OK

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