



# Sensors and senders in Škoda vehicles

Safety and Convenience

ŠKODA



Self-study programme

# ŠKODA



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You will find the instructions for the installation and removal, repair, diagnosis as well as detailed user information in the workshop manuals, the diagnosis units VAS and in the onboard literature.

**The time for going to press was on the 11/2011.**

This brochure is not subject to an update.

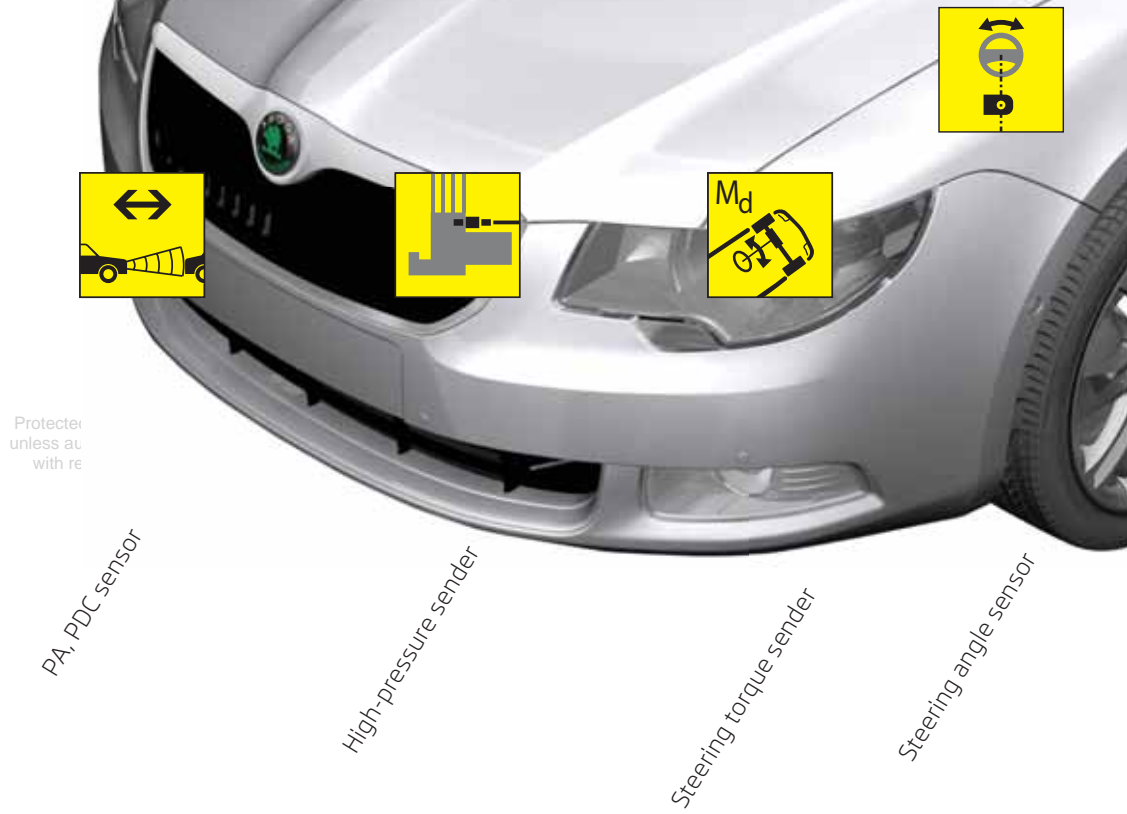
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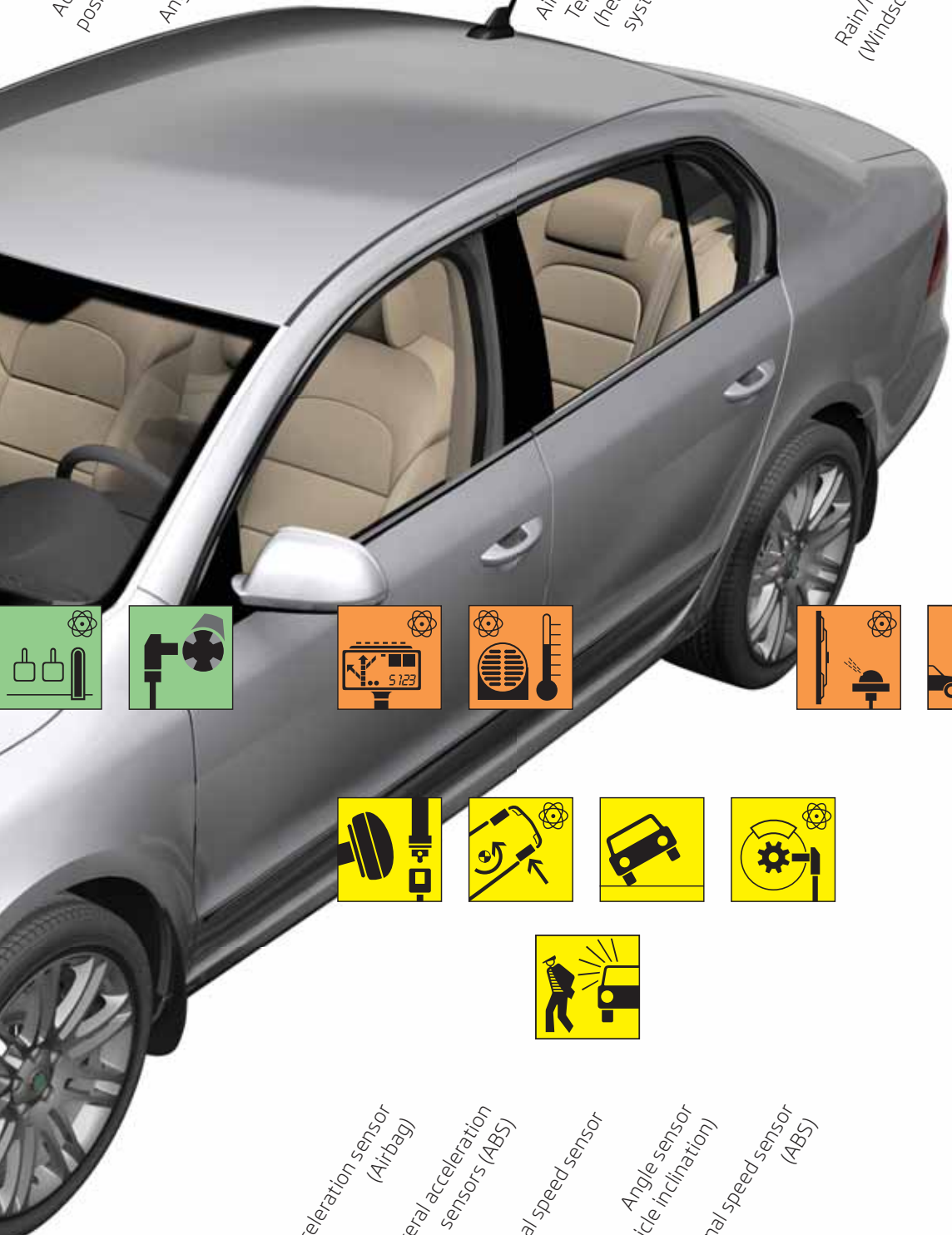
## Drive



## Safety



Accelerator pedal position sender  
 Angular position sensor  
 Angle sensor (Navigation)  
 Air quality sensor  
 Temperature/humidity sensor (heating and air conditioning system)  
 Rain/light sensor (Windscreen wipers, lights)  
 PA, PDC sensor



DA

Convenience



Acceleration sensor (Airbag)  
 Longitudinal and lateral acceleration sensors (ABS)  
 Rotational speed sensor (of the vehicle inclination)  
 Rotational speed sensor (ABS)

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## 1.1. Airbag sensors

### Airbag system

- airbags
- crash sensors
- central airbag control unit
- electrical installation
- front airbag switch on the front passenger side
- belt tensioner

The airbag control unit receives signals from the acceleration sensors, the pressure sensors and the CISS sensor; in the event that the sensors communicate information that a crash has occurred, the control unit transmits an activation signal to the respective group of airbags and belt tensioners. The airbag system is thus firmly connected to the belt tensioners (older vehicles are not equipped with electrically operated belt tensioners).

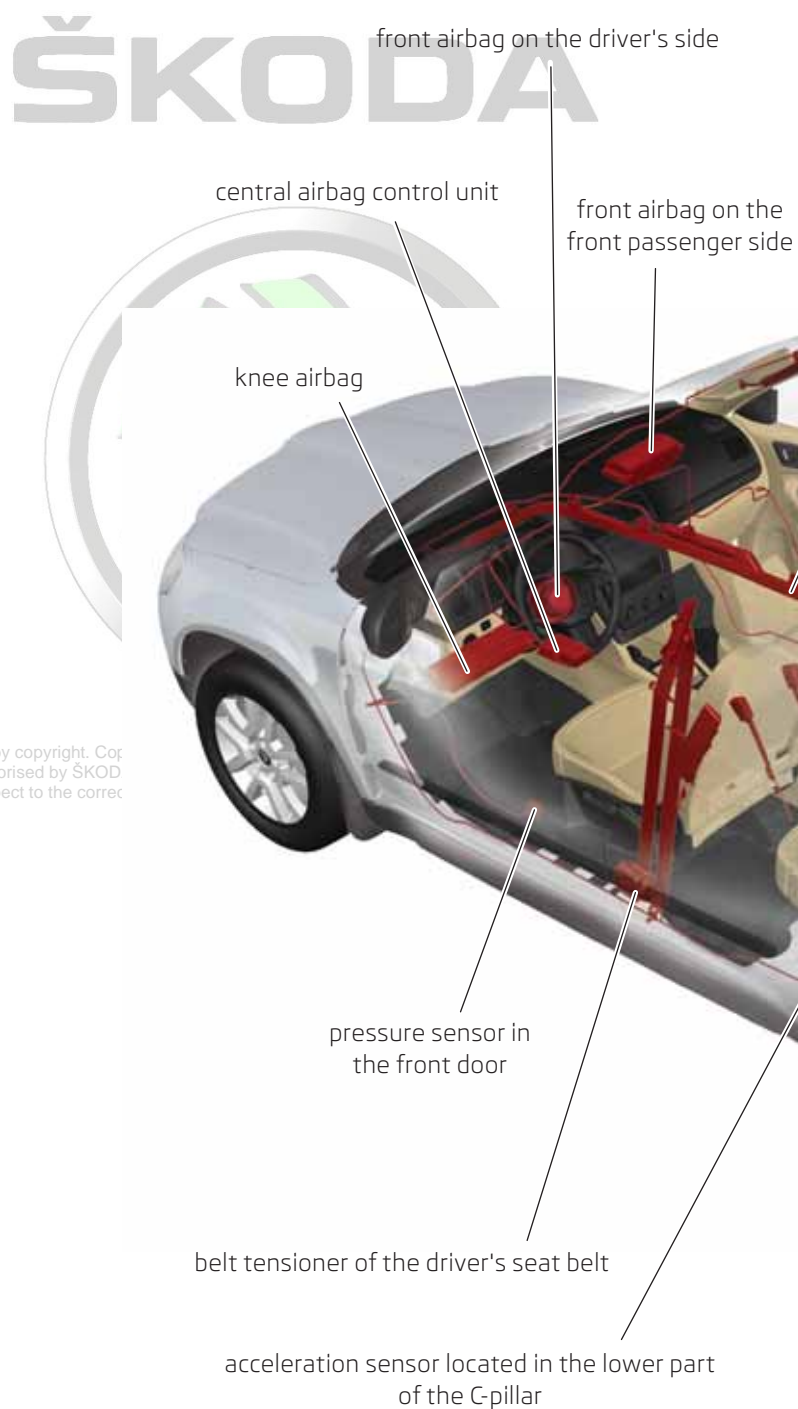
### External crash sensors

Two types of external crash sensors are connected to the airbag control unit. These are pressure and acceleration sensors which transmit data to the airbag control unit. Pressure sensors, which are housed in the "dry" area of the driver and front passenger door, are used for detecting a side crash.

An additional acceleration sensor which is located in the lower part of the C-pillar and detects a side crash which does not deform the front door, must be used in order to detect a crash on vehicles with rear side airbags, respectively head airbags.

### Airbag system

The airbags are deployed depending on the delay, the angle and the side on which the crash occurred.



## Activation system of the airbags

The airbag deployment system consists of the central airbag control unit and four external sensors for the detection of a lateral crash.

### Airbag control unit

The airbag control unit is located in the interior on the middle vehicle tunnel, in which three collision detection sensors are integrated. Two sensors operate according to the principle of negative vehicle acceleration (acceleration sensors), one for detecting a frontal collision, the other one for detecting a side collision. The third and newly employed sensor, the so-called CISS sensor (Crash Impact Sound Sensing), is used as an additional sensor for the detection of a frontal collision and operates according to the principle of acoustic wave level measurement.

### CISS sensor

The CISS sensor is used in the Yeti model. The CISS sensor uses the sound waves which spread out in the solid structure of the chassis and the body when the vehicle is deformed during a crash. Based on the characteristics of the measured signal, the algorithm of the control unit can determine the type of crash and can trigger the impulse which deploys the airbags and the seat belt tensioners. The CISS sensor replaces one acceleration sensor in the airbag control unit (for example on the Superb II model, the signal of three acceleration sensors, two of which are integrated in the airbag control unit, is required in order to deploy an airbag during a frontal collision). An acceleration sensor, which detects the collision strength and the vehicle deceleration as well as the CISS sensor, which detects the acoustic waves, are used for the detection of a frontal collision. In order to deploy the airbags, the acceleration signal as well as the sound signal must be measured. The sensor can detect acoustic vibrations in the range of 400 Hz - 16 Hz. Thanks to the use of the CISS sensor, it is no longer necessary to fit an additional acceleration sensor at the front end, as in the case of the model Superb II.

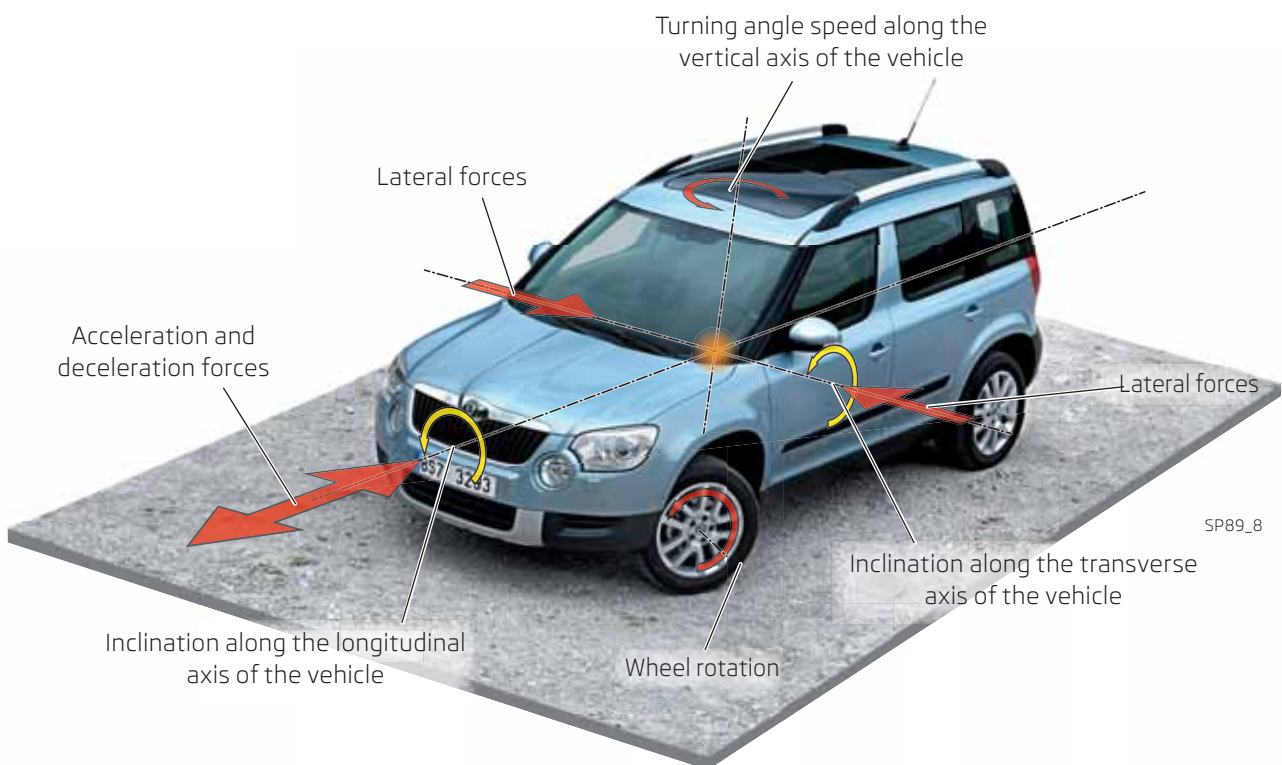


## 1.2. ABS/ESC sensors

Based on the information received from the sensors/senders, it is evaluated in which direction the vehicle accelerates or decelerates and whether it revolves around its own axis using various functions of the wheel slip control and assist systems.

The control systems can use this data in order to determine the actual direction of vehicle motion or the force acting on the vehicle and this may influence the direction of movement to some extent. Highly sensitive sensors/senders are used to detect a critical driving situation already in the beginning phase and thus the corresponding measures can be initiated.

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- values measured by the sensors/senders
- recalculated values
- centre of gravity of the vehicle

- The ABS system uses the wheel speed sensors for determining the wheel rotation speed.
- The ESC system, as opposed to the ABS system, also uses the acceleration sensors and the turning angle sensors in order to evaluate the direction of the vehicle motion on the basis of the centrifugal forces acting on the vehicle.



ABS/ESC control unit



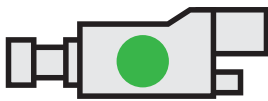
Sensors/senders

Actuators

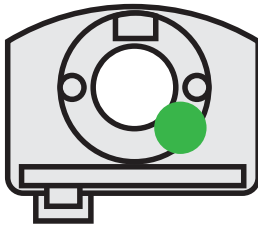
Pushbutton



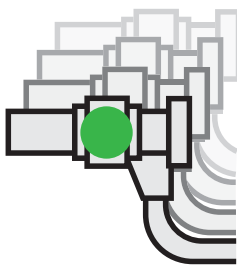
Brake light switch



Steering angle sensor

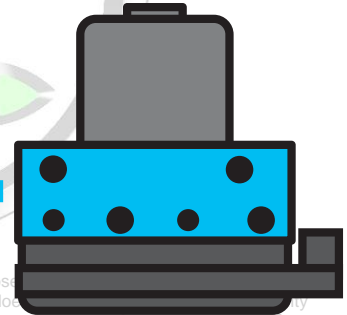


Speed sensor

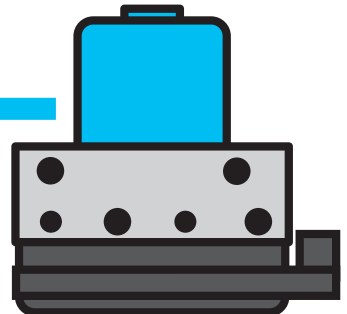


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Hydraulic unit



Return pump



The sensor unit for the acceleration is integrated in the ESC control unit

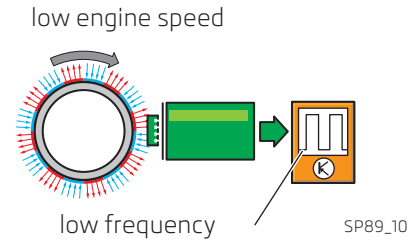
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## ESC system

### ABS system

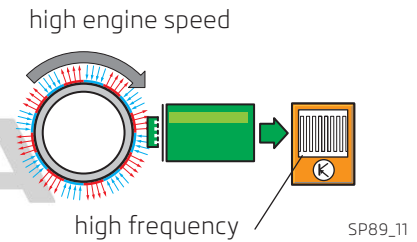
#### Wheel speed sensor

- active sensors, which operate on the Hall effect principle, are used
- the wheel speed is measured depending on the alternating frequency of the Hall voltage, which increases in line with increasing speed



#### Steering angle sensor

- optical sensor or Hall sensor; depending on vehicle class and year of manufacture
- the optical sensor is built into the steering column, the Hall sensor is an integral part of the power steering



**The ESC system, fitted to the models Fabia and Roomster, includes a steering angle sensor.**

#### Turning angle sensor of the vehicle

- the sensor is integrated in the ESC control unit (older models had separated sensors under the rear seats or below the steering wheel)

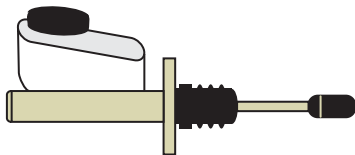
#### Acceleration sensor

- the transverse and longitudinal acceleration sensors are integrated in the ESC control unit

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#### The pressure sensor

- is integrated in the ESC unit



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**You will find a detailed description of the sensors/senders in the Self-Study Programme No. 82.**

## 1.3. Headlight sensors

### AFS control unit

A new technology of the headlight control is used in the vehicle Škoda Superb II: MASTER - SLAVE. The main control unit of the AFS system, the so-called MASTER unit, is located in the interior of the vehicle behind the air conditioning system and is connected to the CAN bus drive. The MASTER control unit communicates via the CAN data bus with two subordinate SLAVE units, the so-called functional units, which take over the control of the stepper motors. Each headlight is equipped with a SLAVE unit. The complete system consists of the MASTER control unit and two SLAVE functional units.

MASTER control unit



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SLAVE functional unit



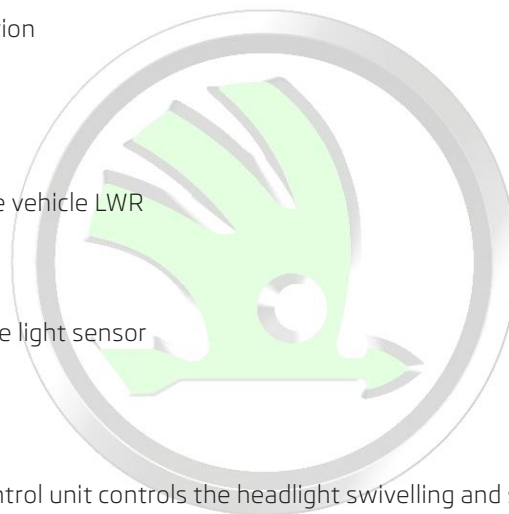
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The AFS control units receives the required information from other control units via the CAN data bus.

Das AFS control unit evaluates the following input information:

- angle and direction of steering wheel rotation
- vehicle speed
- reverse gear selector
- if the low beam / main beam light up
- sender of the longitudinal inclination of the vehicle LWR
- switching on the windscreen wipers
- speed of the individual wheels
- outer luminous intensity, determined by the light sensor
- position of the rotary light switch
- from the ESC system



On the basis of this information, the AFS control unit controls the headlight swivelling and switches into the individual light modes.

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## Overview of the system control unit of the "intelligent" front headlights in the vehicle

- 1) Bi-xenon-rotary and swivel headlights
- 2) SLAVE functional units
- 3) MASTER control unit
- 4) Fog lights with integrated "Corner light" function
- 5) Onboard supply control unit BCM
- 6) Connection to CAN data bus via GATEWAY
- 7) Sender for detecting the longitudinal inclination of the vehicle
- 8) Light sensor



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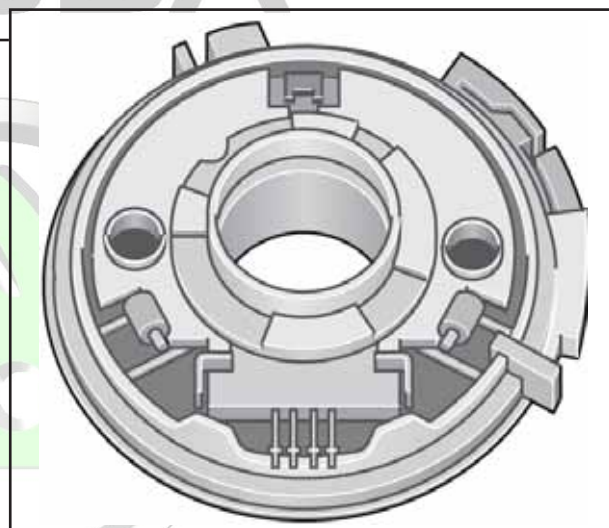
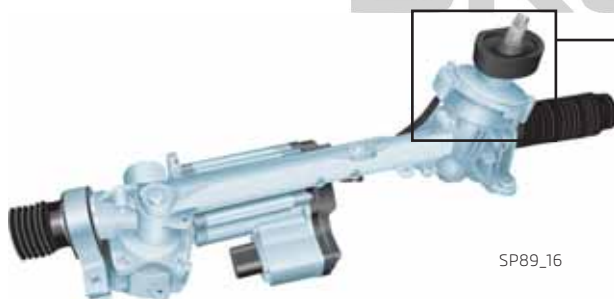
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## 1.4. Power steering sensor

### Steering torque sensor

The steering torque sensor measures the torque resulting from the steering wheel rotation. This sensor uses the magnetoresistive effect\*. To ensure the highest possible reliability, it has two independent circuits (redundant configuration). A torsion bar is located between the input shaft and the shaft of the steering pinion. A magnetic ring with 24 magnetic poles is mounted on the input shaft. To determine the torque, always two poles are used.

When the steering wheel is turned, the two pins are turned against each other depending on the size of the resulting torque. Due to the fact that the mutual position of the magnetic ring and the redundant magnetoresistive pickup element with the mutual rotation of the shafts is changed, it is possible to measure the resulting torque and to send out the information about the size as a signal to the control unit of the electro-mechanical power steering.



### Effect of a sensor/sender failure

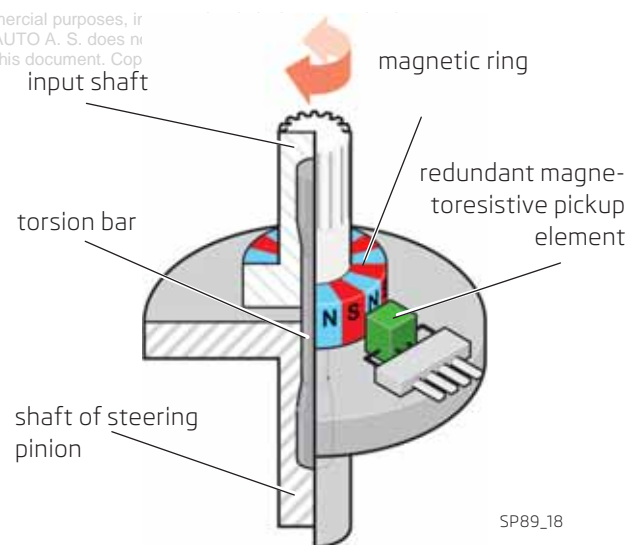
If both circuits of the steering torque sensor malfunction, the steering assistance no longer operates and it is necessary to replace the complete power steering gear. At the moment of fault detection the control unit of the electromechanical power steering calculates, on the basis of the signal of:

- the steering angle sensor G85
- the motor of the electromechanical power steering V187, a replacement signal for the motor of the electromechanical power steering so that the power steering remains operational with assistance for a little while longer. This ensures that the interruption of the steering assistance does not occur suddenly, but slowly. The fault of the steering torque sensor is indicated by the electromechanical power steering indicator lamp K161 lighting up red.

In case of failure of only one sensor circuit, the power steering continues to operate without restriction. In this case the fault is indicated by the indicator lamp K161 lighting up yellow.

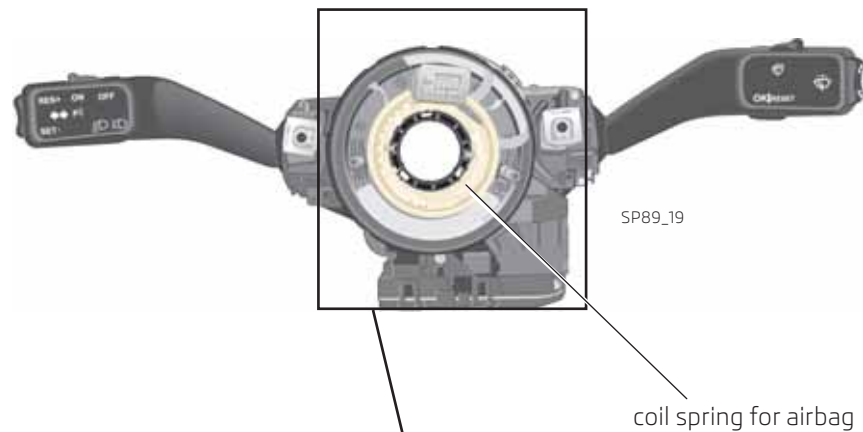
In both cases it is necessary to replace the complete power steering gear.

A redundant magnetoresistive receiving element, which is connected to the shaft of the steering pinions, is attached to the magnetic ring.



\* Magnetoresistive effect = Changing the resistance of the electrical conductors through the effect of the magnetic field.

## Steering angle sensor



The steering angle sensor is located under the deflection ring (for airbag). The sensor is mounted on the steering column below the steering wheel and is coupled to the changeover switch.

The information regarding the turning angle and the speed of the steering wheel rotation is obtained from the signal.

Both signals are first evaluated in the steering column electronics control unit and then transmitted to the control unit of the electromechanical power steering.

steering angle sensor



### Effect of a sensor/sender failure

If the steering angle sensor fails, an emergency programme is activated. The missing signals are replaced with the replacement signals. The steering assistance is maintained. The fault is indicated by the electromechanical power steering indicator lamp K161 lighting up yellow.

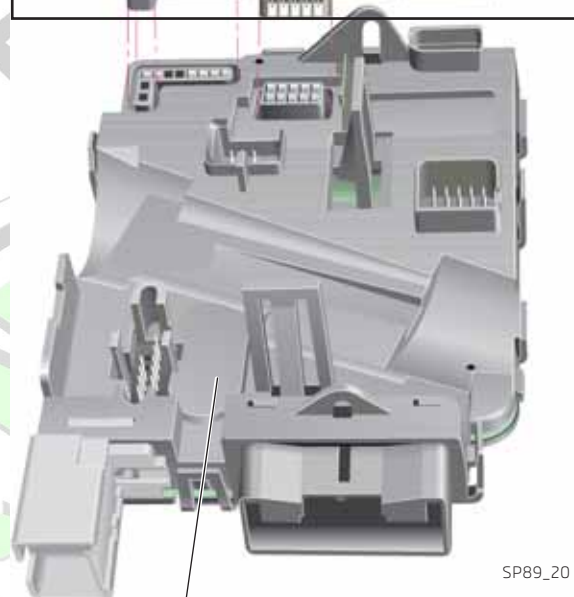
### Description of the operation

The basic components of the steering angle sensor are:

- encoder with two encoder rings
- 7 light barriers, each always consists of a light source and an optical sensor

The encoder consists of two rings

- the outer ring (absolute) and
- the inner ring (incremental = incremental ring).



The steering column electronics control unit (on model Škoda Octavia)

## Rotor speed sensor for the motor of the electromechanical power steering

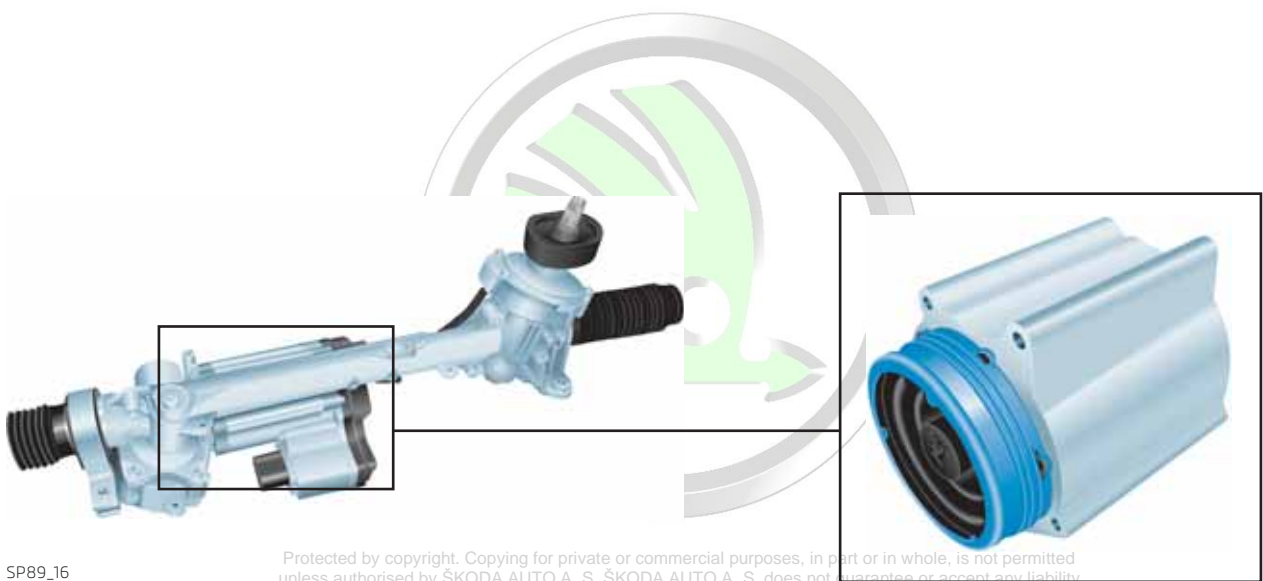
The rotor speed sensor is a component part of the engine of the electromechanical power steering and is not accessible from outside.

### Signal use

The rotor speed sensor for the motor of the electromechanical power steering uses the magnetoresistive effect\*. Its design is equal to that of the steering torque sensor. As its name implies, it detects the rotor speed for the motor of the electromechanical power steering. The information about the speed is sent to the control unit of the electromechanical power steering.

### Effect of a sensor/sender failure

If the rotor speed sensor fails, a replacement signal for the steering wheel rotational speed is used. The steering assistance is not terminated suddenly, but slowly. The driver is made aware of the fault by the indicator lamp lighting up red.



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\* Magnetoresistive effect = Changing the resistance of the electrical conductors through the effect of the magnetic field.

## 2.1. Rain sensor

### Function description

The rain sensor is based on the optical principle of operation. The light emitting diode emits light in such a way that almost the entire amount of light is reflected on an optical sensor if the windscreen is dry. If the glass of the windscreen is covered in snow or is wet, then the reflection characteristics change, the more snow or water is on the glass surface, the less light is reflected. The new rain sensors use infrared light instead of the standard visible light used up to now. Thanks to this fact, the sensor can be accommodated in the dark part of the windscreen and thus it is not visible from the outside.

Based on the measured amount of snow or rain, the sensor controls the speed of the windscreen wipers. Together with the electronically controlled drives of the windscreen wipers, the speed of the wipers can be controlled continuously at intervals. In the event of a snowstorm or if a jet of water is directed onto the windscreen - which happens for example when overtaking trucks, - the device will immediately trigger the highest speed level.

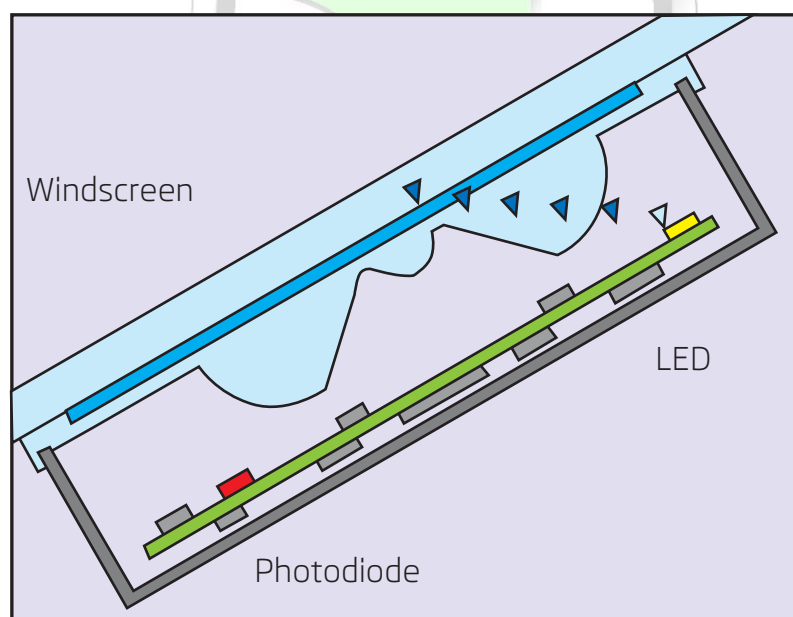
The rain sensor now offers even more potential uses. It can be used, for example, to close the windows and sunroofs automatically. If this sensor is equipped with an additional light sensor, then even the low beams can be controlled: they are switched on in the dark or when entering a tunnel without any driver intervention.

The rain sensors also respond to snow. For this reason they offer in the winter time not only a better view, but also a higher comfort level when operated - and thus a higher level of safety. Moreover, these sensors are much smaller than their predecessors. Due to their dimensions which are not much larger than a matchbox, it is possible to install the sensors on the inside of the windscreen without them being noticeable.



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## 2.2. Parking distance sensors

### PA system

The PA park assist system detects the distance in front as well as behind the vehicle by means of the ultrasonic sensors and allows semi-automatic parking in longitudinal parking spaces.

The PA system carries out the following operations:

- measuring the length and the depth of longitudinal parking spaces while driving
- evaluating the dimensions of the parking space
- determining the appropriate vehicle position for parking
- evaluating the parking distance
- automatic steering of the wheels on the front axle via the electromechanical power steering.



**At least one object must be at the end of the parking space.**



**The PA park assist only takes over the steering of the wheels on the front axle when parking. The vehicle is moved upon actuation of the pedal by the driver.**

### PA park assist control unit

#### Function

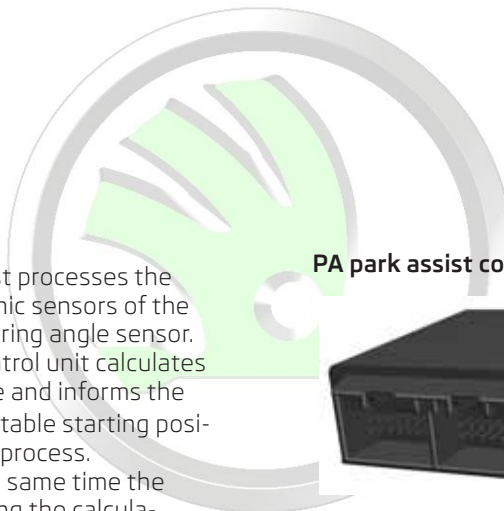
The control unit of the PA park assist processes the information from the lateral ultrasonic sensors of the ESC system as well as from the steering angle sensor. On the basis of this data, the PA control unit calculates the parameters of the parking space and informs the driver via the MaxiDOT display of suitable starting positions in order to initiate the parking process. The PA control unit evaluates at the same time the suitable way to park. After completing the calculation of the parking trajectory, the electromechanical power steering swivels the wheels on the front axle. The wheel swivel angle is determined by the PA control unit.

The control unit of the PA system also fulfills the function of the PDC parking aid, which is activated by pressing the button **PWA**.

If the vehicle is only fitted at the factory with the parking aid control unit for PDC parking, it is not possible to exchange it retroactively for the control unit of the PA park assist and vice versa.

The PA control unit, just as the PDC unit, is fitted on the inside of the rear right wheel house.

The PA control unit is connected to the CAN data bus of the drive and communicates with the other devices via the CAN data bus. Only the communication with the control unit of the radio navigation system or the radio is performed via the BAP protocol.



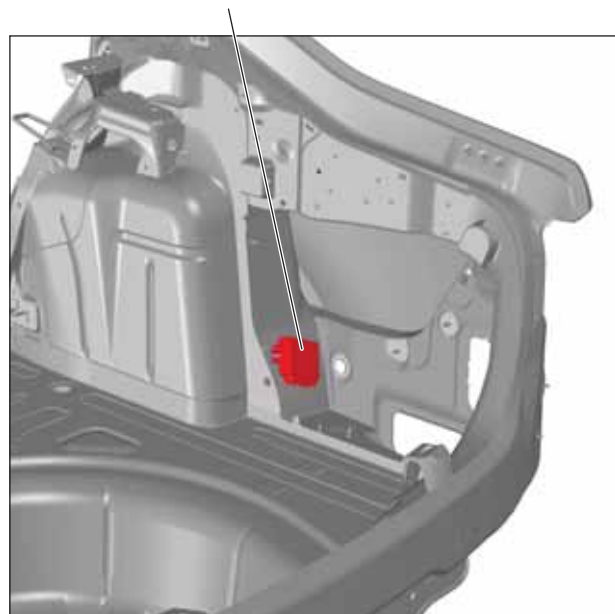
PA park assist control unit



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PA park assist control unit



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## Lateral sensors of the PA park assist

### Function

Upon activation of the PA system 2 ultrasonic sensors, located on the side of the front bumper, transmit signals into the interior on both vehicle sides. When the vehicle is in motion, the ultrasonic sensors transmit the signals and receive their response, from which they then determine the distance to the surrounding objects (based on the same principle as the PDC sensors). The range of these signals corresponds approximately to the distance of 4 m.

To evaluate the free space as a suitable parking space, it is necessary to have a free space of approximately 40 cm available in front as well as behind the vehicle.

The ultrasonic sensors of the PA system are inserted in plastic holders, which are mounted from the rear into the front bumper. The sensors of the PA system are larger than the sensors of the PDC parking aid and therefore they are not interchangeable.



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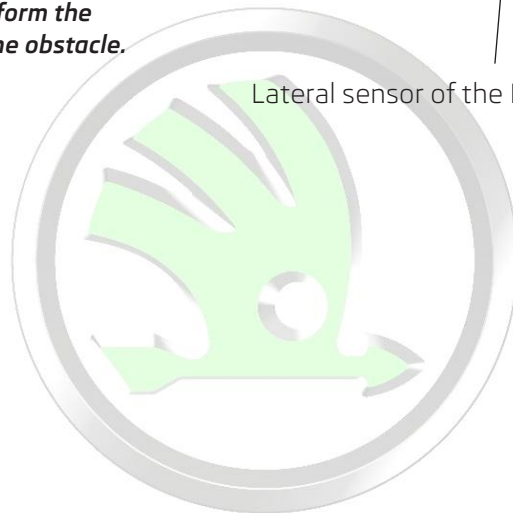


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***If the system of the PDC parking aid is activated by pressing the pushbutton P<sub>PA</sub>, both lateral sensors of the PA park assist fulfill this function, just as the sensors of the PDC system, i.e. they inform the driver about the distance to the obstacle.***

Lateral sensor of the PA park assist

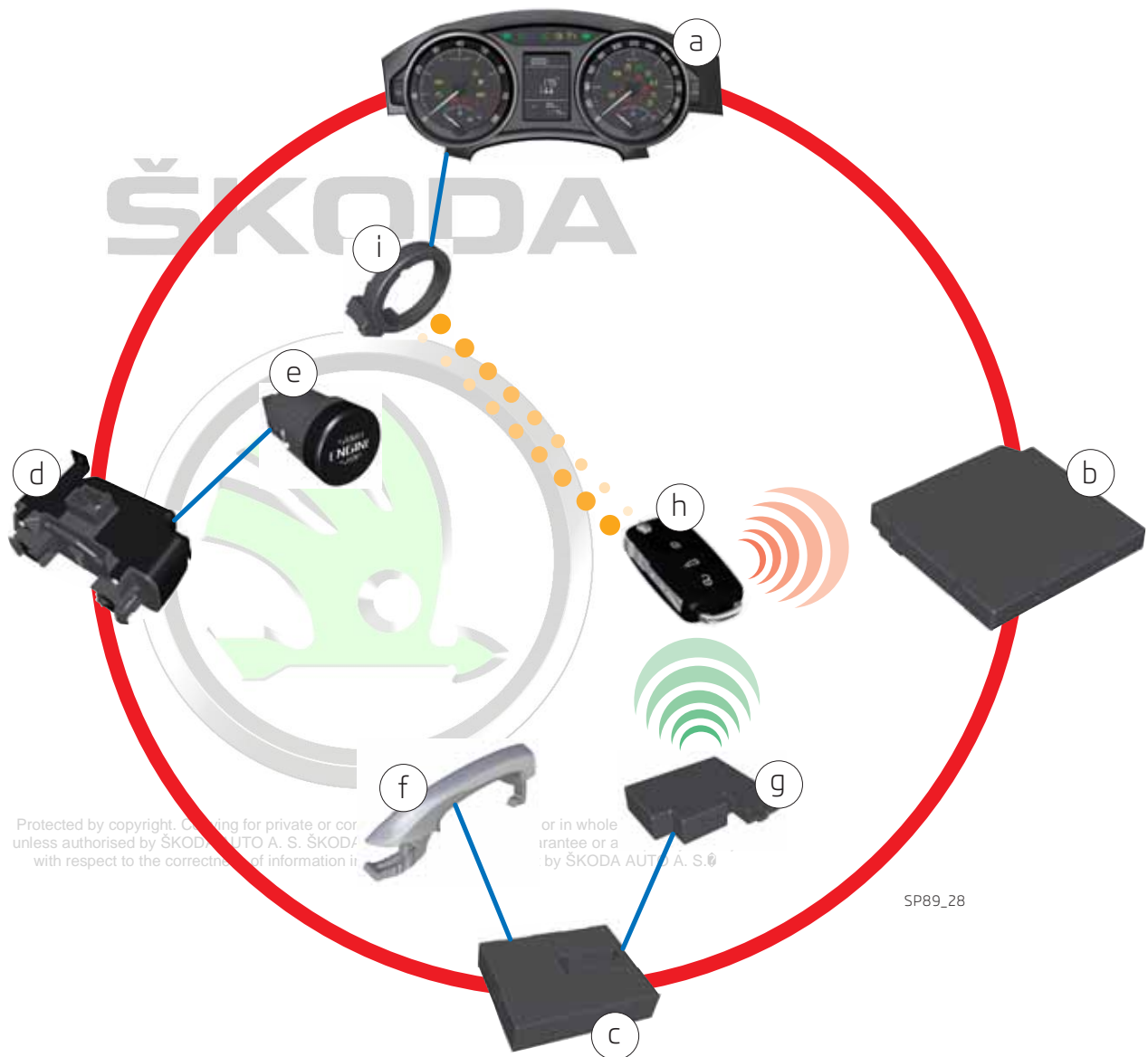


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## 2.3. Sensors of the central locking system (KESY system)

The models Superb and Superb Combi are fitted with the KESY system (Keyless Entry Start Exit System) which allows convenient unlocking/locking as well as start-up of the vehicle without actively using a remote control key (it is sufficient that the key is inside the vehicle, for example in the trouser pocket of the driver, in order to start the vehicle). The central locking function can still be activated by means of the remote control pushbuttons on the key, furthermore a component is integrated in the key to enable the communication with the KESY system.

### Connection wiring diagram of the KESY system



- a - instrument panel.
- b - onboard supply control unit BCM
- c - control unit of the KESY system
- d - electrical steering column lock ESCL
- e - start button
- f - capacitive sensors in the door handles of the front doors
- g - antenna
- h - key
- i - reading coils

- databus CAN bus
- transmitter
- wireless data transmission (125 kHz)
- wireless data transmission (433 MHz)
- wireless data transmission

## Keyless unlocking and locking of the vehicle

Capacitive sensors, integrated in the exterior door handles of the front doors, are used for keyless unlocking or locking of the vehicle.

The KESSY system is notified whether the driver wishes to unlock or lock the vehicle doors by touching the exterior door handles of the vehicle. Then the control unit of the KESSY system searches for the authorised key. This key must be located on the side of the vehicle where the door handle was touched, however not exceeding a distance of 1.5 m.



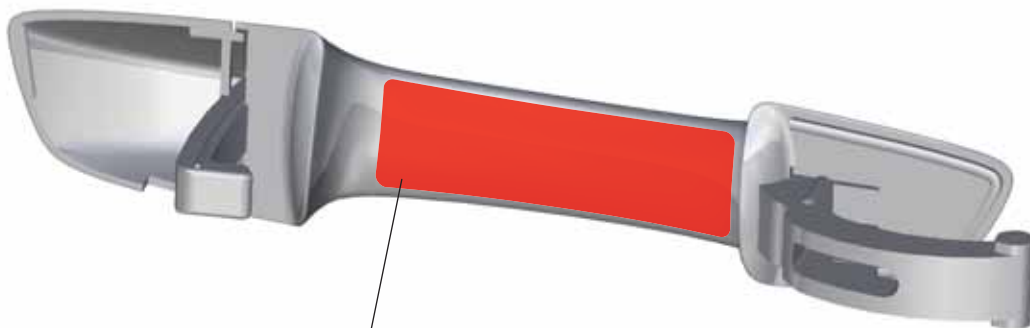
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### Unlocking the vehicle

For keyless unlocking of the vehicle, it is sufficient to pull the door handle or touch the capacitive sensor, integrated in the interior door handle, which enables the communication between the vehicle and the key. This communication is performed in two steps.

During the first step, the KESSY keys located in the proximity of the relevant door handle are assigned to the KESSY control unit. During the second step, the keys belonging to the vehicle receive a command from the control unit of the KESSY system and are authorised. After successful authorisation, the door locks are unlocked by the onboard supply control unit BCM.

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Position of the capacitive sensor for unlocking the vehicle

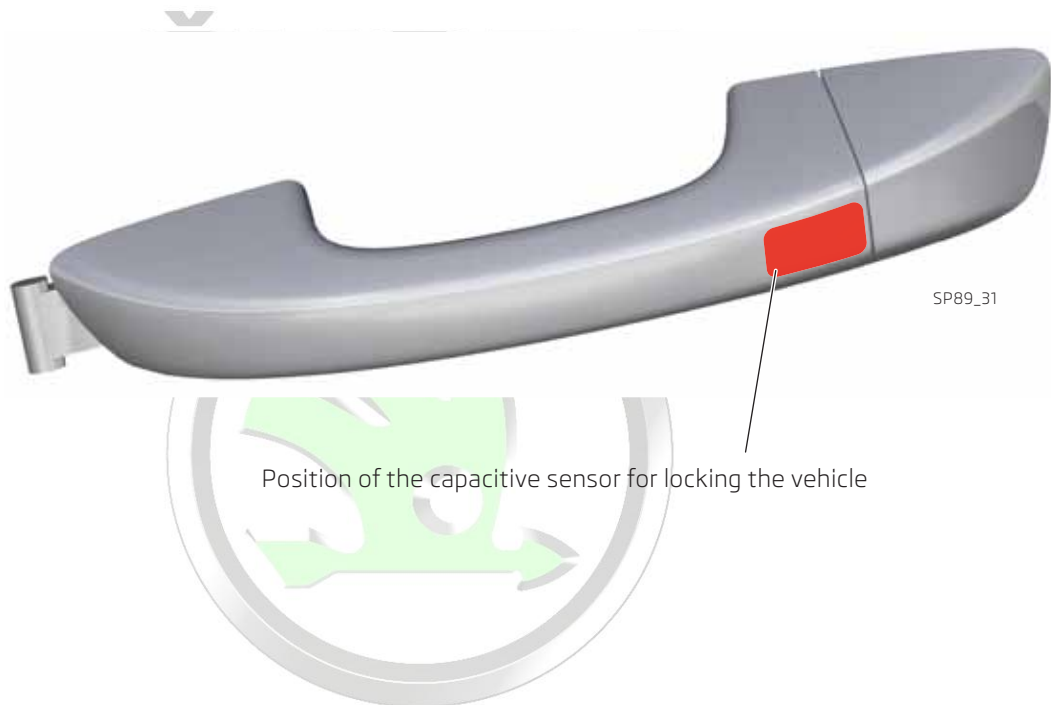
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## Locking the vehicle

For keyless locking of the vehicle after closing the doors, it is necessary to touch the capacitive sensor on the surface of the exterior door handle of the front door. This ensures that communication is established between the vehicle and the key, which is performed in two steps just as for unlocking the vehicle.

During the first step, the KESSY keys located in the proximity of the relevant door handle are assigned to the KESSY control unit. During the second step, the keys belonging to the vehicle receive a command from the control unit of the KESSY system and are authorised. After successful authorisation, the door locks are locked by the onboard supply control unit BCM.

When the SAFE system is active and the first command is given to lock the vehicle via the capacitive sensor, the system changes to the locked state "SAFE" in accordance with the standard. When the second command is given to lock the vehicle, the system changes to the state "externally locked" (the safety lock is deactivated) within 5 s.



## Checking the locking of the vehicle

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After locking the vehicle via the capacitive sensor, it is not possible to carry out a renewed unlocking of the same door handle with this sensor within 2 seconds. Thus, it is possible to check that the vehicle is actually locked without calling up a renewed unlocking of the door lock.

## 2.4. Air conditioning and heating sensors

### Automatic air conditioning system - Climatronic

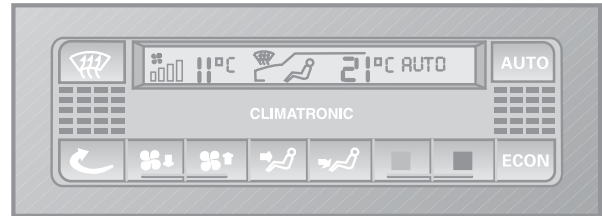
- The Climatronic control unit creates optimal climate conditions and comfort in the vehicle interior (control of temperature and intake air volume).

- For this purpose, the air conditioning system is equipped with the necessary senders, sensors and motors.

- The part of the air conditioning system, which ensures the supply of fresh air as well as its circulation, is supplemented with the throttle valve, which is controlled with the same electric motor as the flap for the fresh and re-circulating air.

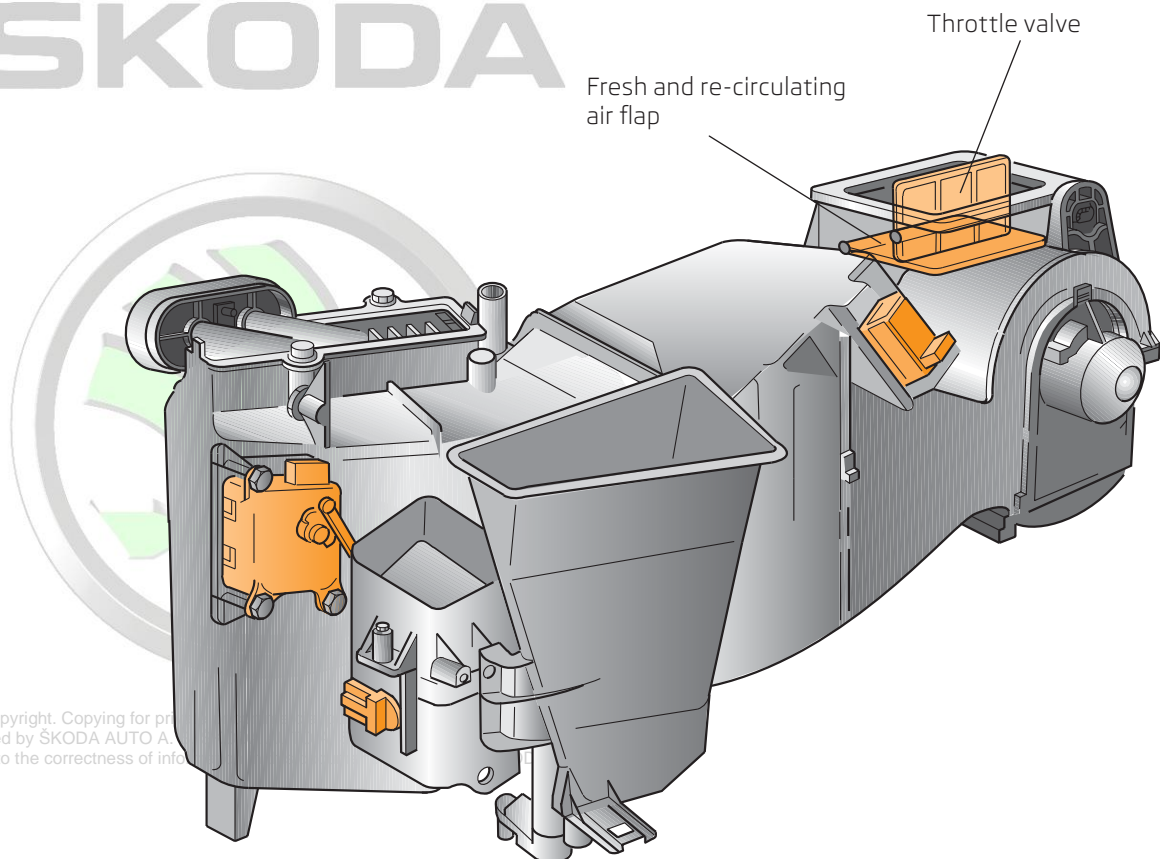
- The distributor flap is controlled electrically.

- The system is able to perform a self-diagnosis.



SP89\_32

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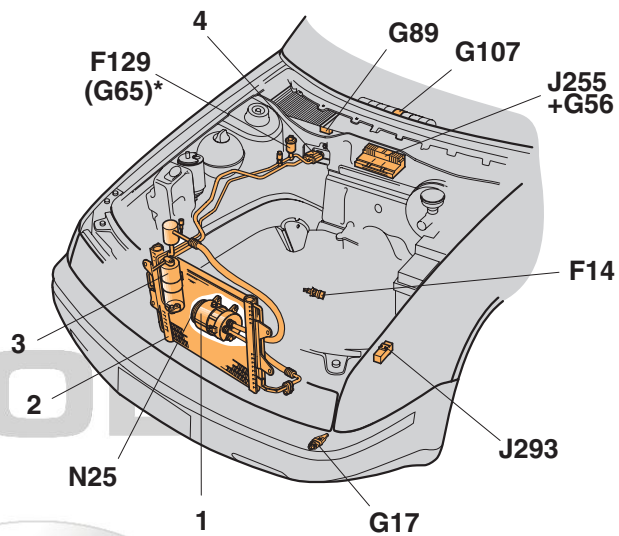
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SP89\_33

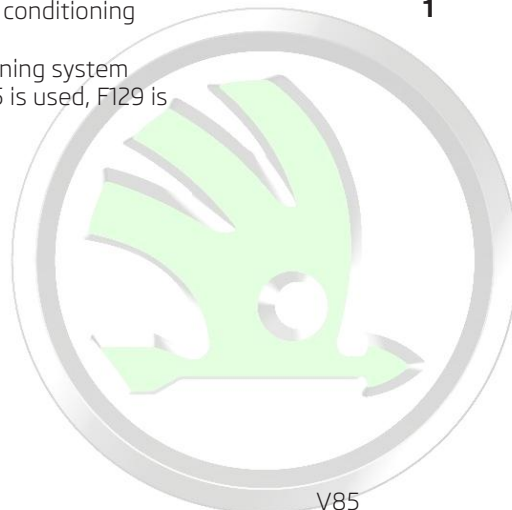
## Spatial distribution of the component parts of the automatic air conditioning system - Climatronic (including the coolant circuit)

In this overview, the spatial distribution of the component parts of the automatic air conditioning system in the engine compartment as well as in the passenger compartment is shown:

- 1 - Compressor
- 2 - Condenser
- 3 - Liquid-filled container
- 4 - Expansion valve
- F14 - Thermal switch of air conditioning system
- F129 - Pressure switch of air conditioning system
- G17 - Outside air temperature sensor
- G56 - Climatronic control panel temperature sensor
- G89 - Suction air temperature sensor
- G107 - Sunlight photo sensor
- J255 - Climatronic control unit
- J293 - Fan control unit
- N25 - Electromagnetic clutch of the air conditioning system
- (G65)\* - Pressure sender of air conditioning system (only for the new system control, if G65 is used, F129 is omitted)



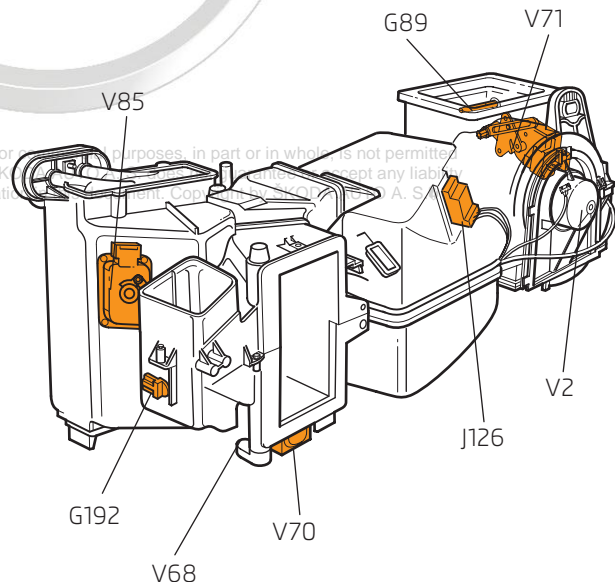
SP89\_34



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This overview shows the component parts which are directly installed on the box of the air conditioning system.

- G89 - Suction air temperature sensor
- G192 - Footwell vent temperature sender
- J126 - Fresh air blower control unit
- V2 - Heater blower
- V68 - Temperature regulator flap motor
- V70 - Distributor flap motor
- V71 - Throttle valve and recirculation flap motor
- V85 - Air distribution flap motor



SP89\_35

## Climatronic control unit with control and display unit

### Description of the operation

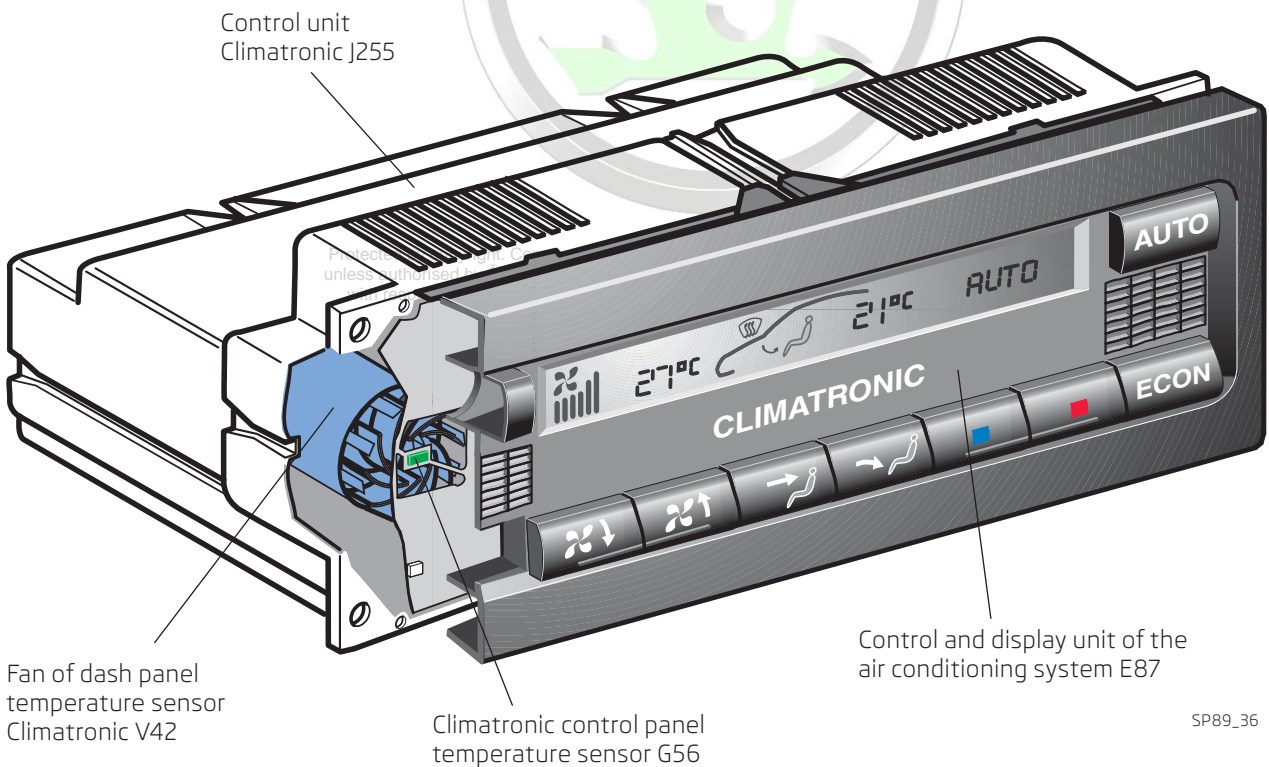
The Climatronic control unit receives the information from the electrical and electronic components (sensors). The incoming information is processed in the Climatronic control unit depending on the set specified values. The output signals are used to control other electrical components - actuators.

The control and display unit E87 is located on the Climatronic control unit J255 and both components form a whole. The sensor for the temperature in the passenger compartment is called the Climatronic control panel temperature sensor G56 and is also integrated in the Climatronic control unit.

A small fan, which supplies the air from the passenger compartment to the sensor, is mounted immediately behind the sensor G56.

The temperature sensor is located in the intake air stream of the small fan and thus measurement errors are avoided.

The Climatronic control unit also has a fault memory. Due to this fact, it is possible to determine the failure of one of the components of the air conditioning system or the line interruption by self-diagnosis. In the event of a fault, the Climatronic control unit ensures the operation of the automatic air conditioning system in the set mode, even in the emergency mode.





# Temperature control

## Automatic temperature control

When the air conditioning system is operating, the Climatronic takes into account the different temperature and driving conditions.

In addition to the other adjustable variables of the air conditioning system, it is primarily the existing (current) temperature that is continuously compared with the specified temperature.

The current temperature sensors (both external and internal temperature) are always installed at two different points.

The automatic temperature control (for the temperature, air distribution and blower intensity) can be set according to personal desire.

## Outside temperature sensor

The outside temperature is one of the fundamental output variables from which the temperature control is derived.

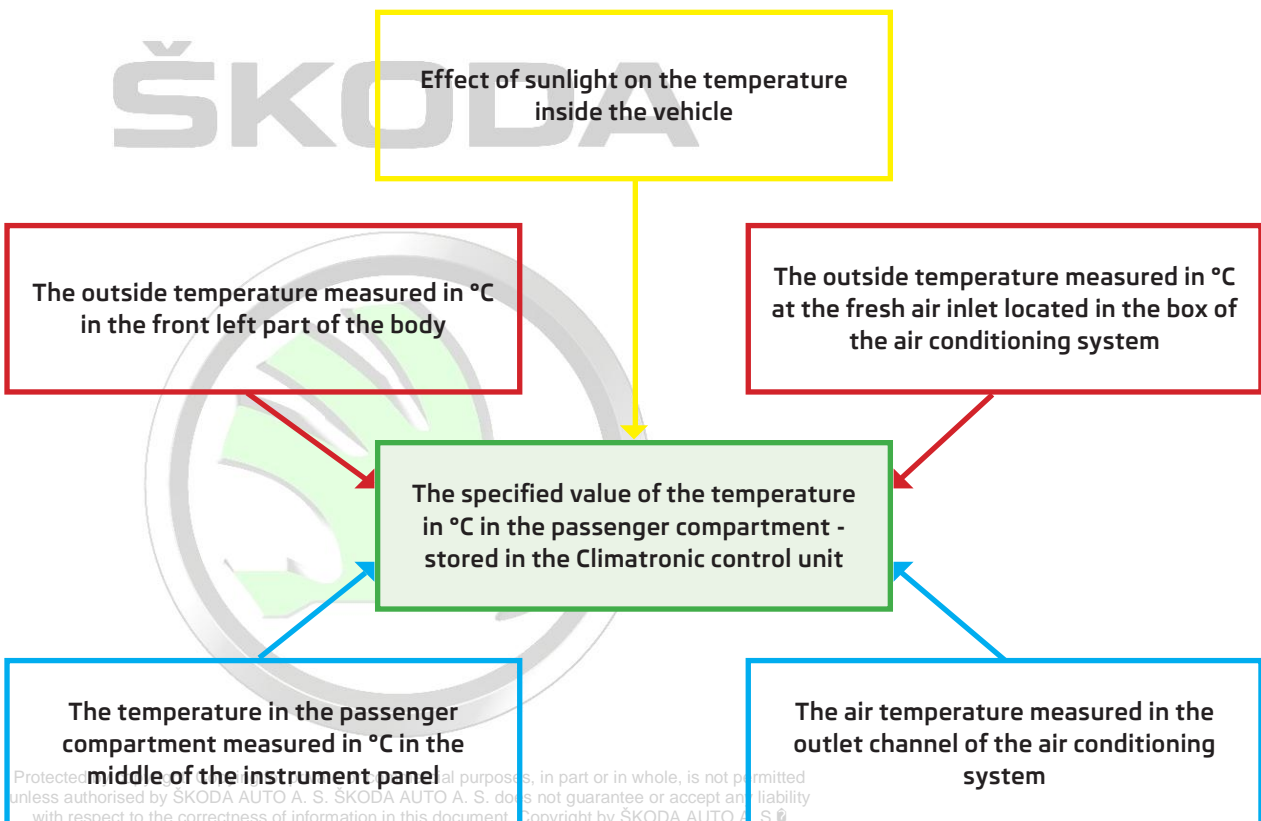
The outside temperature is continuously recorded at two independent points.

The temperature as well as the resistance dependence is the same for both sensors.

The details of both outside temperature measurements are evaluated by the air conditioning control unit.

The information with the lower value is used for operating the automatic control. If one of the sensors fails, the value of another sensor is used as the control variable.

In case of failure of both sensors, the predetermined substitute value is used.



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## Senders, sensors and switches

Sunlight photo sensor G107

Climatronic control panel temperature sensor G56 + temperature sensor fan V42

Outside air temperature sensor G17

Suction air temperature sensor G89

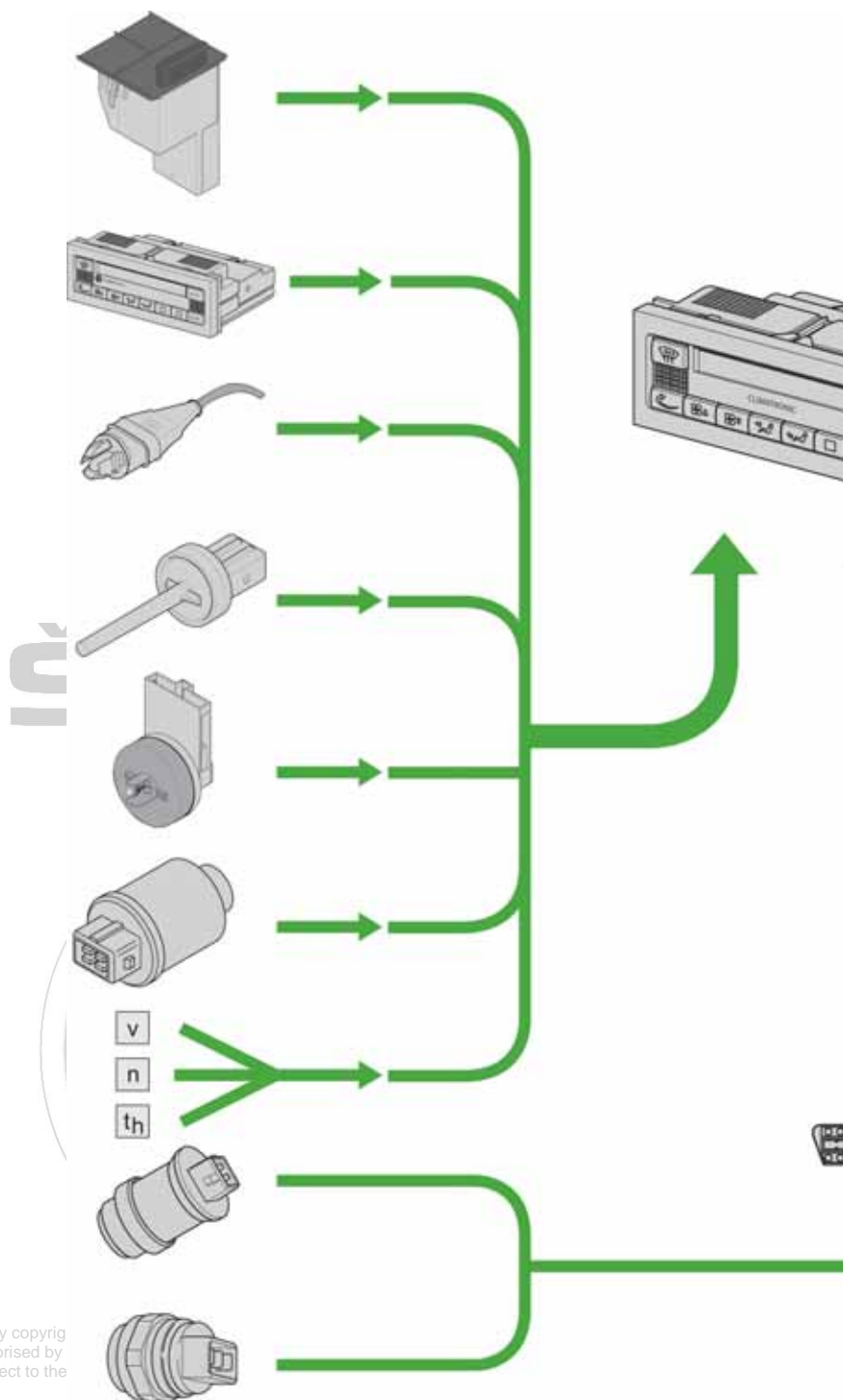
Footwell vent temperature sender G192

Pressure switch of air conditioning system F129 (or the pressure sender of the air conditioning system G65 for the new system control)

Additional signals:  
 - speed signal  
 - speed signal  
 - hold time signal

Thermal switch of air conditioning system F14

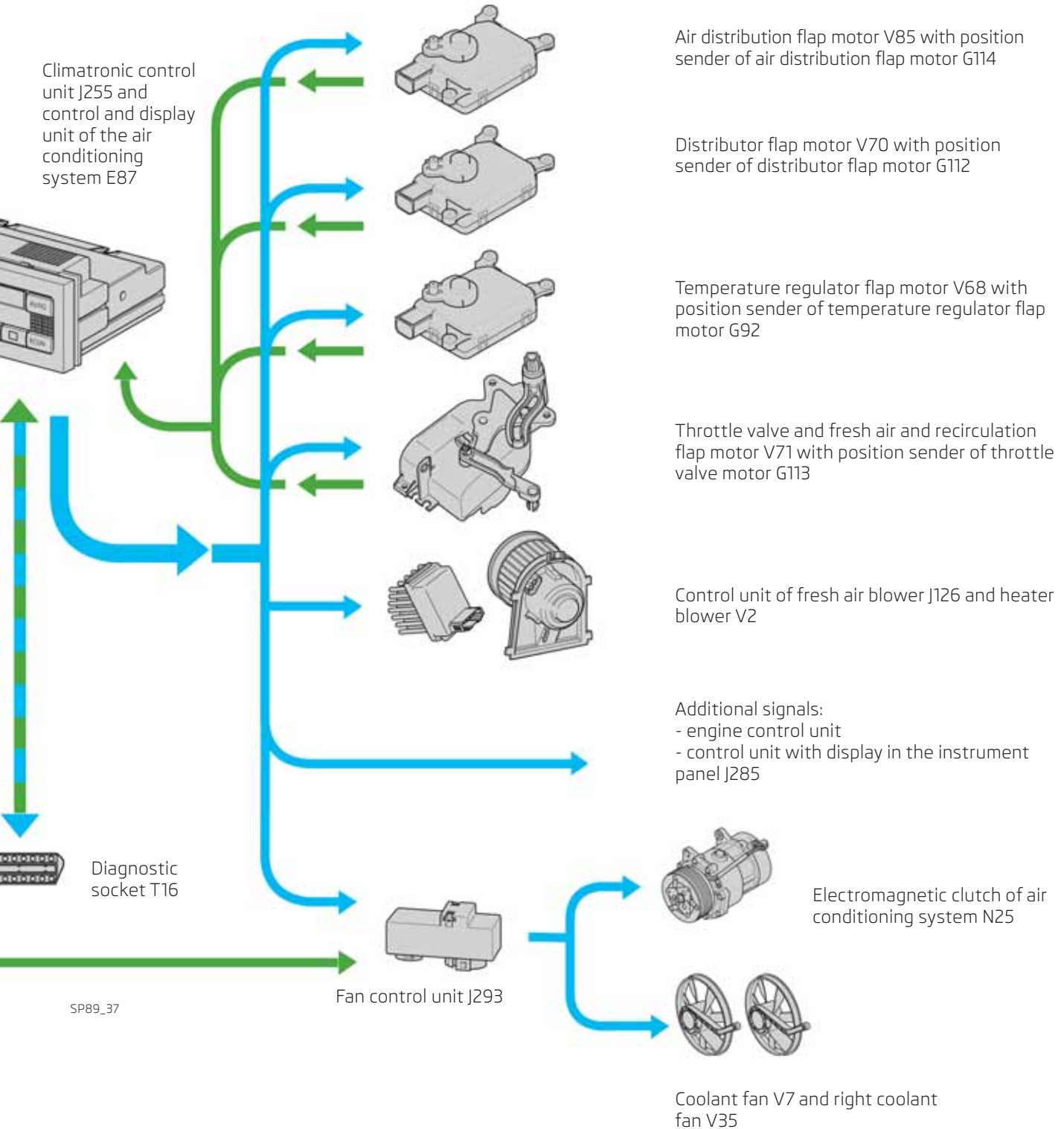
Thermal switch of coolant fan F18



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## Actuators

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## Spatial distribution of sensors and senders

### Interior temperature detection

The selected and measured temperature in the passenger compartment is also one of the basic and necessary variables for the automatic air conditioning system.

The temperature inside the vehicle is detected with two separate sensors.

By means of these sensors, the Climatronic control unit receives information about the existing temperature in the vehicle interior as well as the temperature of the air flowing from the body of the automatic air conditioning system into the vehicle interior.

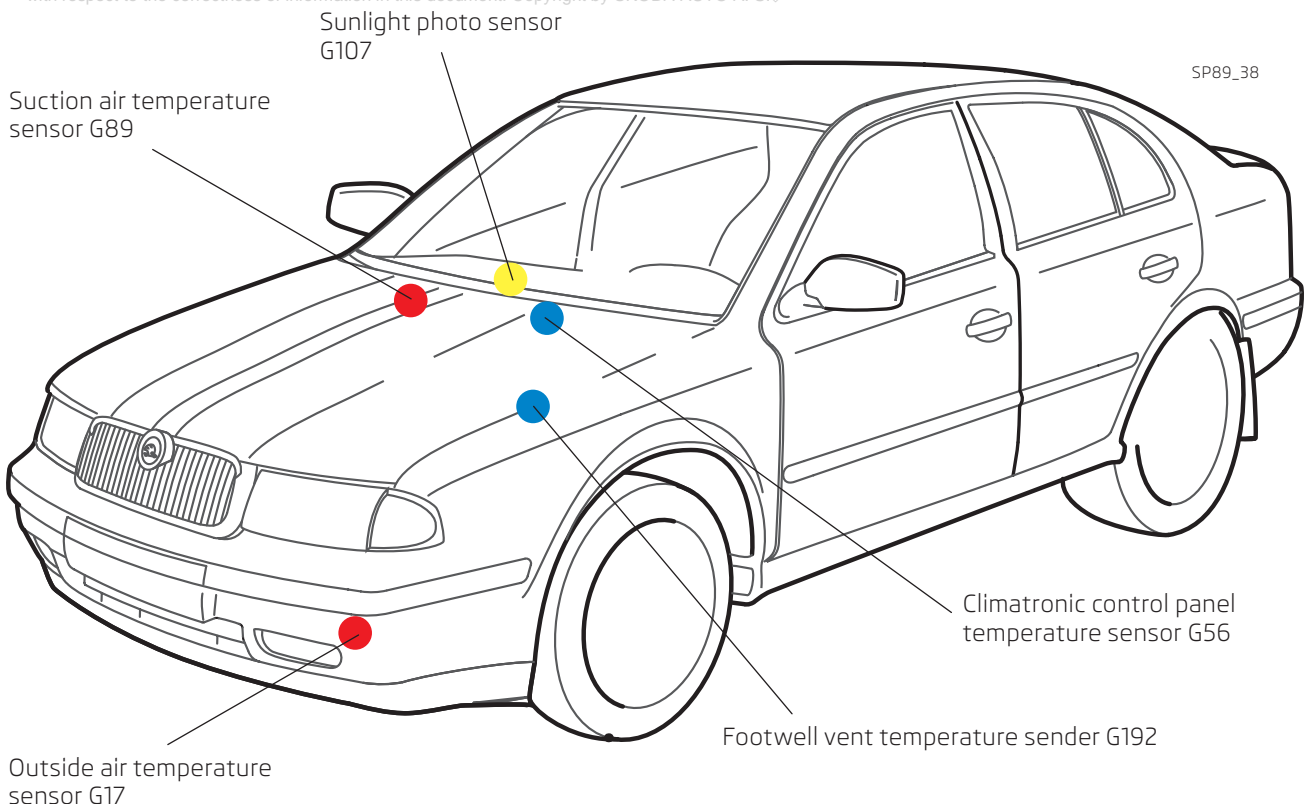
In case of failure of one of the sensors, the fixed value is used as a replacement variable. Thus, the automatic air conditioning system can continue to operate.

### Sunlight - regulating variable

The thermal effect of the sunlight influences the temperature comfort in the vehicle besides the outside temperature. The rays of the sunlight falling onto the photo sensor are evaluated by the Climatronic control unit. This ensures that the influence of the thermal effect of the sunlight is also taken into account for the automatic temperature control.

THE IMAGE IS REPLACED WITH THE IMAGE OF THE MODEL SUPERB

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## Climatronic control panel temperature sensor with fan

The air temperature inside the vehicle is detected by the sensor, which is accommodated directly in the Climatronic control unit.

From the passenger compartment, the air is blown by the fan onto the sensor. Due to the fact that it is located in the intake air stream, the measurement of the actual temperature inside the vehicle is ensured. The small fan is actuated by the control and display unit. The air flow around the sensor prevents that measurement errors occur on the temperature sensor.

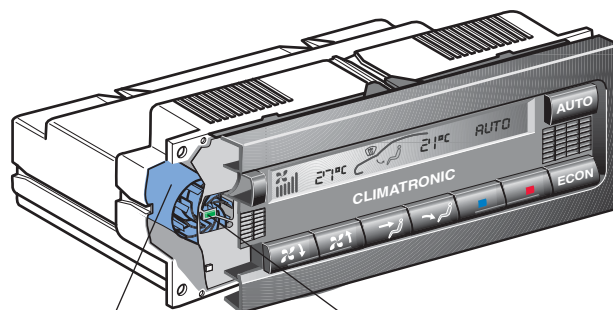
### Signal use

The measured temperature is used for comparison with the specified temperature. Based on the evaluation, the regulator flap as well as the speed of the heater blower is adjusted.

### Signal failure

If the signal fails, the temperature of +24°C is used as a substitute value and the system continues to operate. The temperature sensor in the Climatronic control panel can perform a self-diagnosis.

SP89\_36



Fan of Climatronic control panel temperature sensor V42

Climatronic control panel temperature sensor G56

## Footwell vent temperature sender

The temperature of the air flowing from the air conditioning system into the vehicle interior is measured. A thermally sensitive resistor is used to detect the temperature. With decreasing temperature, the electrical resistance increases.

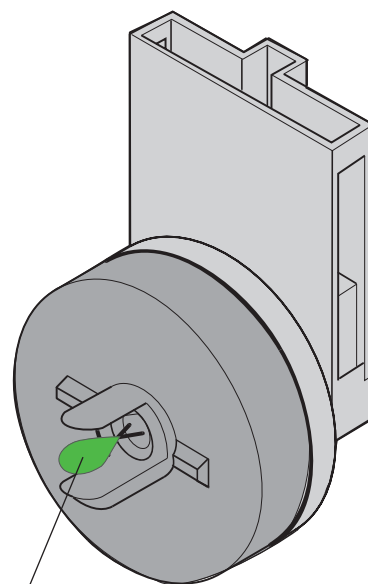
### Signal use

The signal is used by the Climatronic control unit. It is used to control the air distribution when blowing off the air from the windscreen or in the footwell and in addition to adjust the speed of the heater blower.

### Signal failure

In the case of signal failure, the substitute value of +80°C is calculated by the Climatronic control unit. The air conditioning system continues to operate. The temperature sensor of the air supplied to the footwell is able to perform a self-diagnosis.

SP89\_39



NTC resistance

## Outside air temperature sensor

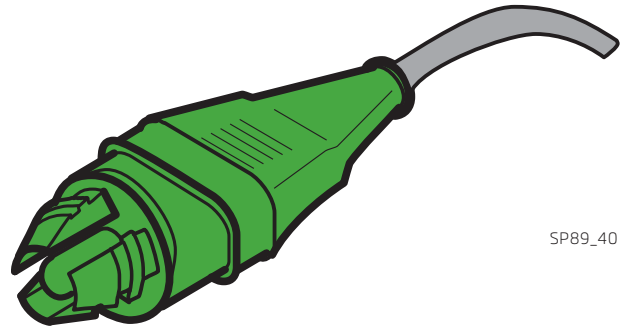
The outside air temperature sensor is incorporated in the front part of the body. It records the actual outside temperature.

### Signal use

Depending on the outside temperature, the Climatronic control unit adjusts the regulator flap and controls the speed of the heater blower.

### Signal failure

If the signal fails, the information from the suction air temperature sensor G89 is used as a substitute value. In the event that G89 also fails, the air conditioning system continues to operate and the temperature of +10°C is used as a substitute value. However, the air circulation does not operate. The outside air temperature sensor G71 is able to perform a self-diagnosis.



SP89\_40



## Suction air temperature sensor

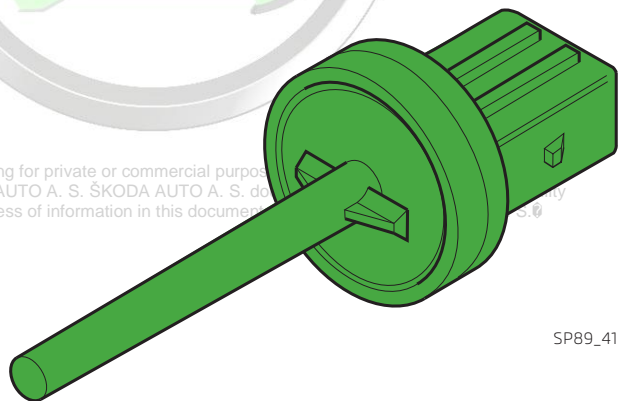
The suction air temperature sensor can be found directly in the suction channel of the fresh air. This is the second location where the actual outside temperature is detected.

### Signal use

Depending on the outside temperature, the Climatronic control unit adjusts the regulator flap and controls the speed of the heater blower.

### Signal failure

In the case of signal failure, the value of the outside air temperature sensor G17 is used. The suction air temperature sensor G89 is able to perform a self-diagnosis.



SP89\_41

## Sunlight photo sensor (single zone air conditioning system)

SP89\_42

The sunlight influences the control of the automatic air conditioning system via the sunlight photo sensor. The unit measures the sunlight which shines on the passengers.

### Description of the operation

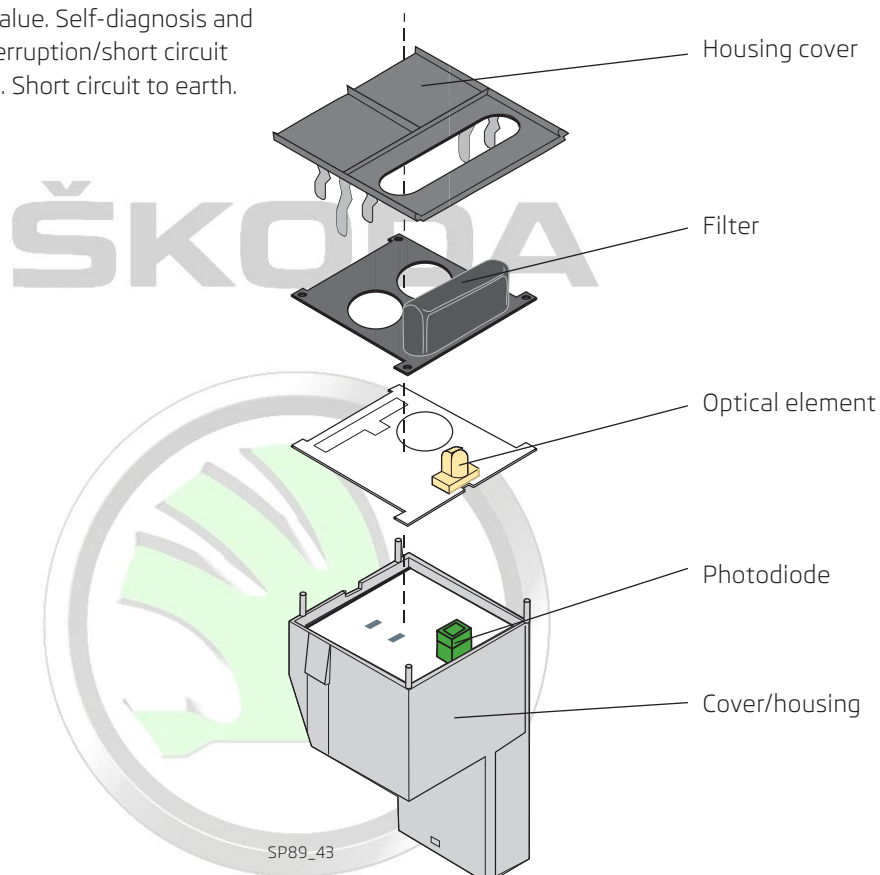
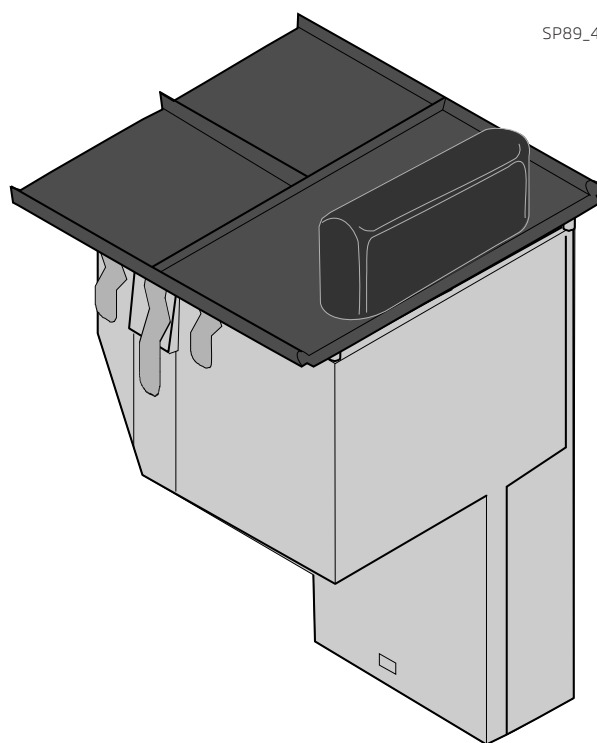
The sunlight passes through the filter, the optical element and falls on the photodiode. The filter has a similar function as a pair of sunglasses. It protects the photodiode from damage due to solar radiation.

The photodiode consists of a photosensitive semiconductor. If no light falls on the photodiode, only a small current can flow through it. The current flow increases through the exposure to light. The stronger the light that falls on the diode, the greater the current.

Depending on the increase of current, the Climatronic control unit detects the increased solar radiation. It adjusts the regulator flap and adapts the speed of the heater blower in order to influence the temperature in the vehicle interior.

### Signal failure

The Climatronic control unit operates with a fixed substitute value. Self-diagnosis and error messages interruption/short circuit to positive terminal. Short circuit to earth.



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## Pressure switch of air conditioning system

The pressure switch of the air conditioning system continuously monitors the pressure in the coolant circuit of the automatic air conditioning system Climatronic. It is a triple switch.

It is necessary to incorporate it in the air conditioning system for safety reasons. It was also integrated in the manual air conditioning system.

### Tasks and operation

- The pressure switch of the air conditioning system comes on when the pressure exceeds the value of 1.6 MPa. The coolant fan is switched to the next higher stage via the fan control unit. Thus, the optimal performance of the condenser is achieved.

- If the pressure is too high - above 3.2 MPa (e.g. if a fault in the engine cooling occurs), the switch is opened. The air conditioning system is switched off.

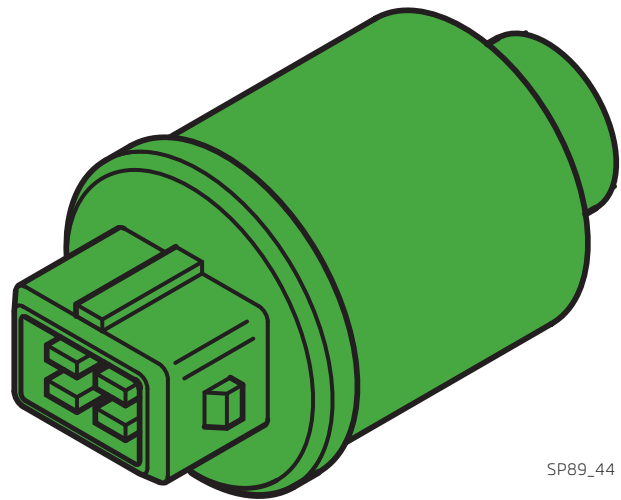
- If the pressure value is below 0.2 MPa

- e.g. when the coolant flows out - the switch is opened. The air conditioning system is switched off. The pressure switch of the air conditioning system can be removed without suctioning off the coolant.

### Self-diagnosis

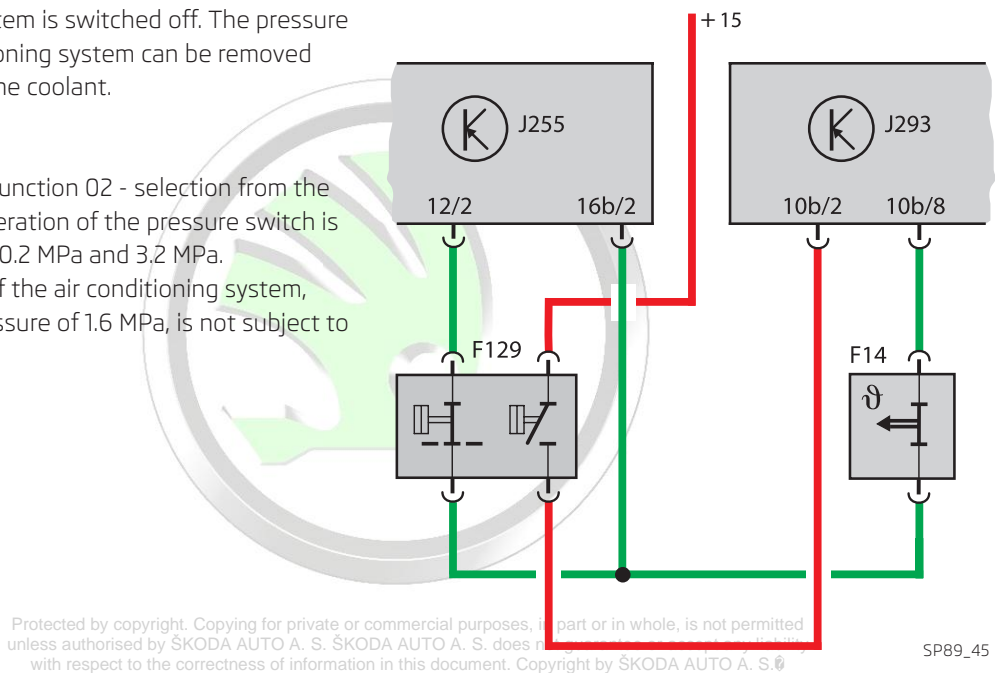
In the self-diagnosis in function 02 - selection from the fault memory - if the operation of the pressure switch is checked when pressing 0.2 MPa and 3.2 MPa. The part of the switch of the air conditioning system, which operates at a pressure of 1.6 MPa, is not subject to any test.

Wiring diagram



SP89\_44

### Wiring diagram



SP89\_45

F14 Thermal switch of air conditioning system - coolant temperature (+119°C)  
 F 129 Pressure switch of air conditioning system  
 J255 Climatronic control unit  
 J293 Fan control unit



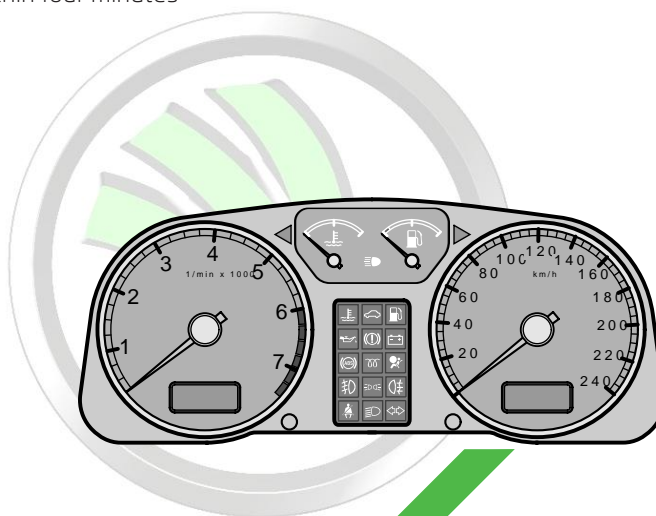
## Auxiliary signal - vehicle speed "v"

The information regarding the vehicle speed is necessary for the throttle valve control.

The gearbox speedometer signal is fed into the control unit using the indicator of the instrument panel. Here the signal is used for the control. The signal is directly fed to the throttle valve motor via the signal cable.

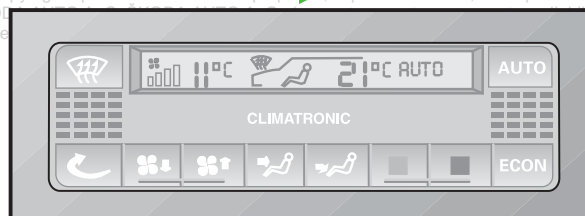
The speed signal is checked using the self-diagnosis. The fault can only be detected if the signal is not measured during five drive cycles (start, drive, speed above 15 km/h, engine switch-off) within four minutes after starting the vehicle.

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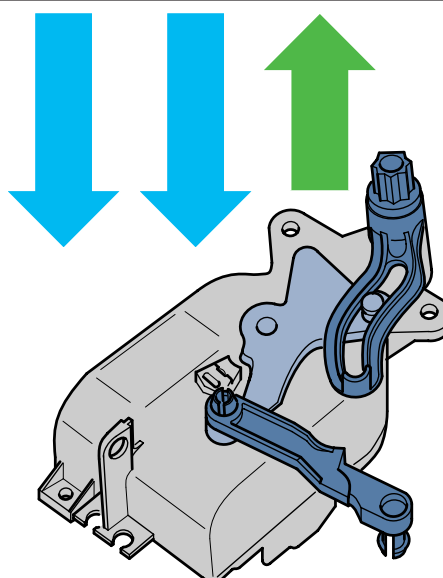


J285

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J255



V71/G113

SP89\_46

## Pressure sender of the air conditioning system

Pressure sender of the new generation for monitoring the pressure in the coolant circuit.

The pressure sender of the air conditioning system is an electronic pressure sender, located in the high-pressure line.

It detects the coolant pressure while the physical variable converts the pressure into an electrical signal.

Compared to the previous pressure sender of the air conditioning system, it not only detects the predetermined pressure values, but also the coolant pressure during the course of the entire operating cycle.

### Signal use

- in the engine control unit
- in the fan control unit

The engine load resulting from the air conditioning system and the pressure conditions in the coolant circuit are determined by the signal.

The fan control unit ensures that the fan as well as the electromagnetic coupling of the compressor of the air conditioning system can be switched on and off on the next higher stage.

### Alternative function

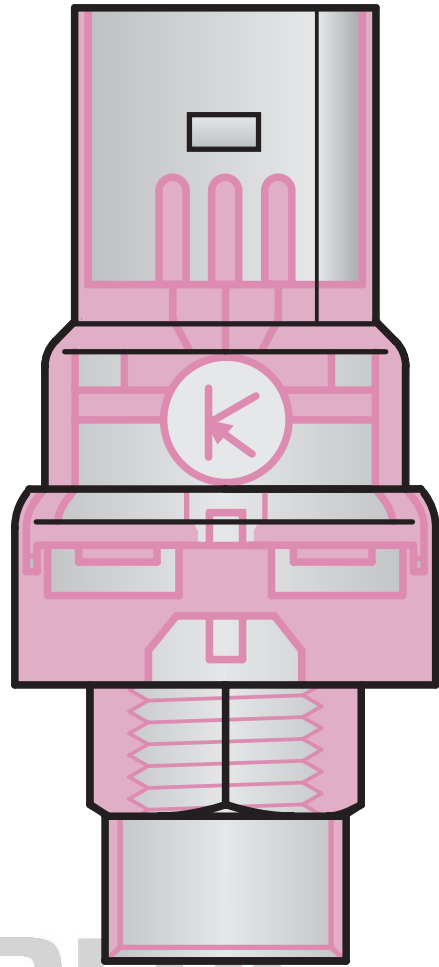
If the fan control unit does not detect any signals, the compressor of the air conditioning system must be switched off for safety reasons.

### Advantages

- At idle speed, it is possible to accurately regulate the engine speed with the compressor of the air conditioning system according to the load.
  - Switching the fan stages on and off is carried out with short time delay.
- The change in the fan speed can hardly be detected.

### Self-diagnosis "fault message"

The pressure sender of the air conditioning system is also stored in the fault memory of the engine electronics.  
e.g.: 00819 high-pressure switch G65 „signal too low“



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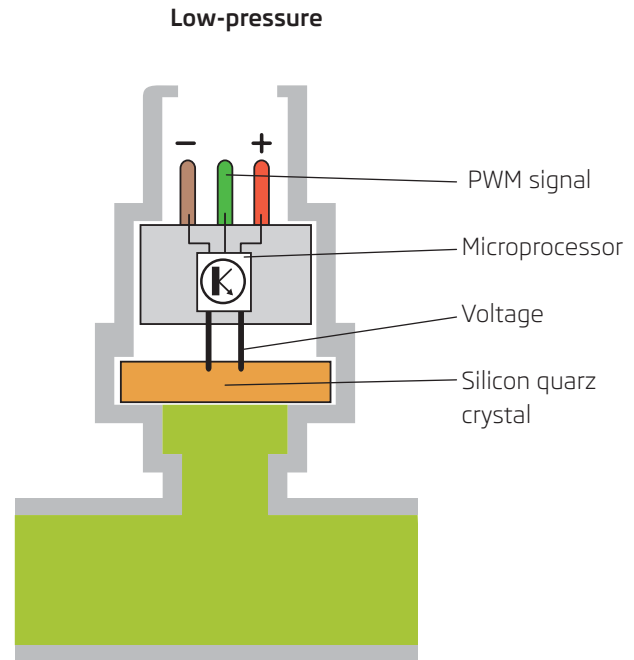
## Function of the air conditioning pressure sender

The coolant pressure is supplied to the silicon quartz crystal box. Depending on the pressure, the quartz crystal is more or less deformed.

As a result of the deformation of the quartz crystal, the electrical resistance changes. If the coolant pressure curve changes, the voltage curve resulting on the silicon quartz crystal also changes.

The changes in the voltage are fed to the microprocessor (a component part of the pressure sender of the air conditioning system) and are converted into the PWM signal (pulse-width modulation signal).

If the pressure is lower, the quartz crystal is deformed or altered. This means that the resulting voltage is exposed to a smaller resistance at low pressure.



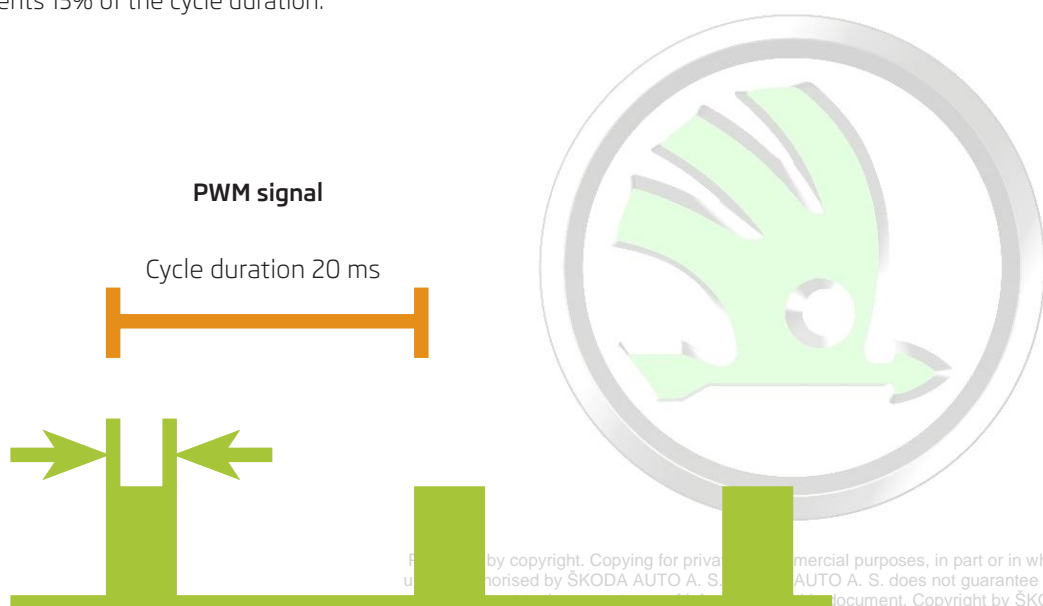
SP89\_48

The lower the pressure, the shorter the pulse duration = smaller pulse width generated by the microprocessor.

The PWM signal frequency is 50 Hz. This corresponds to the cycle duration of 20 ms = 100%.

If the pressure is 0.24 MPa, the pulse lasts 2.6 ms, which represents 13% of the cycle duration.

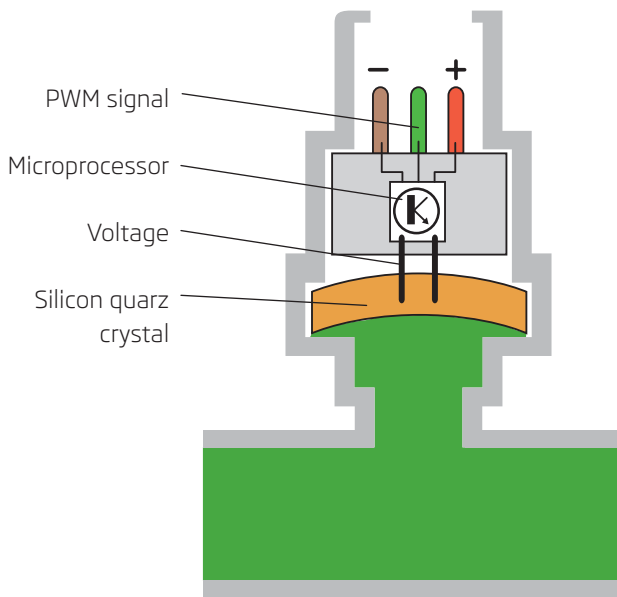
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### High-pressure (rising)

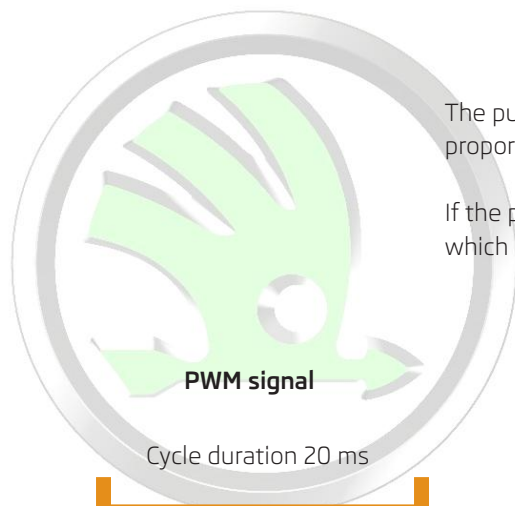


SP89\_50

If the coolant pressure is high (rising), the quartz crystal will deform more. The electrical resistance increases.

The voltage is reduced in direct proportion.

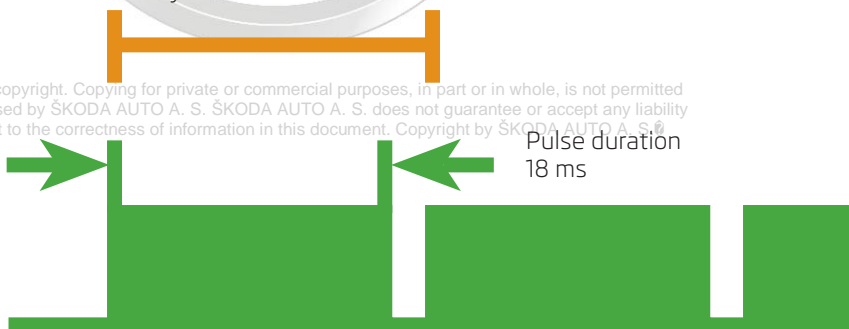
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The pulse duration (pulse width) increases in direct proportion to the pressure increase.

If the pressure is 3,7 MPa, the pulse lasts 18 ms, which represents 90% of the cycle duration.

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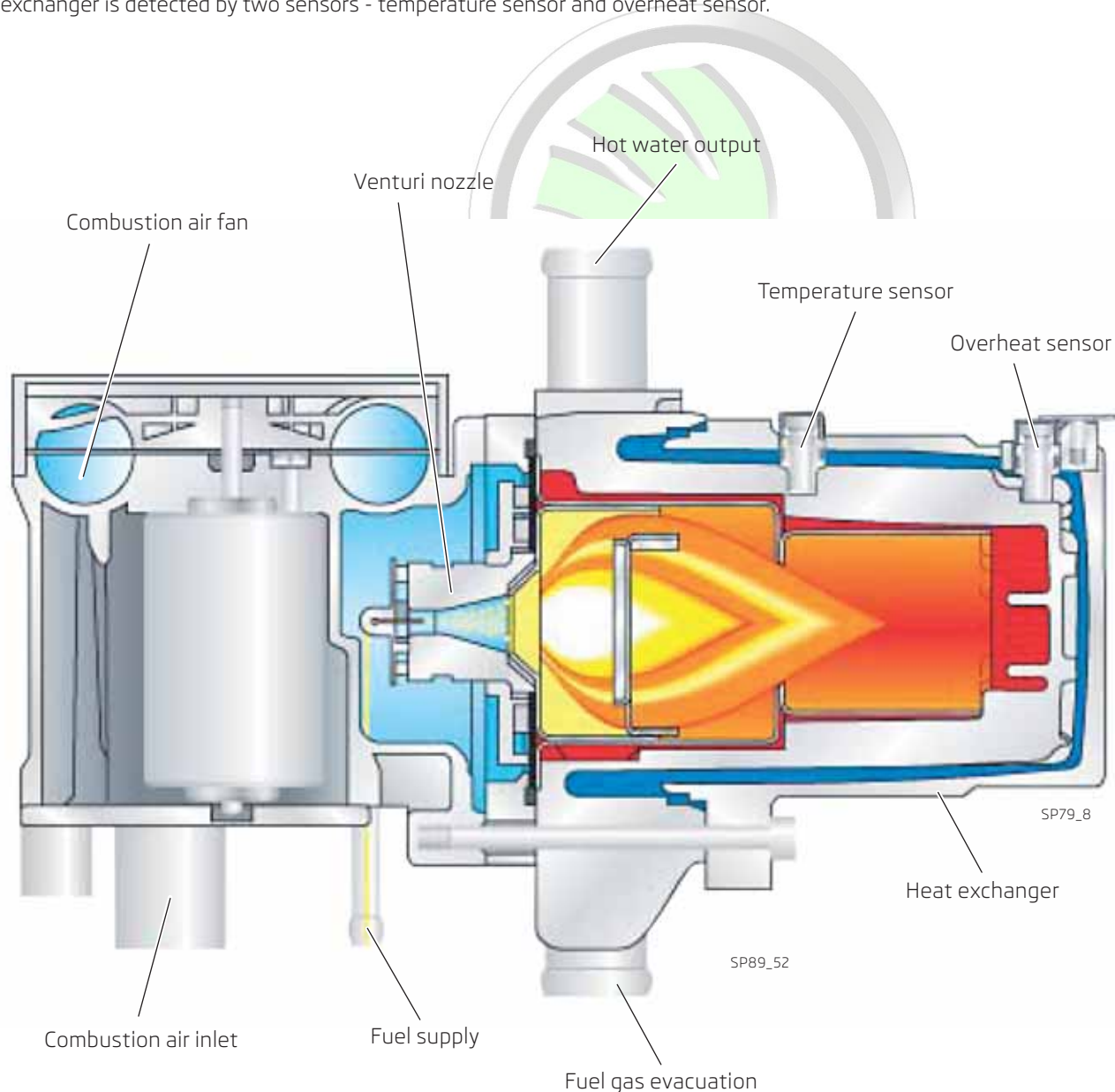
SP89\_51

## Heating

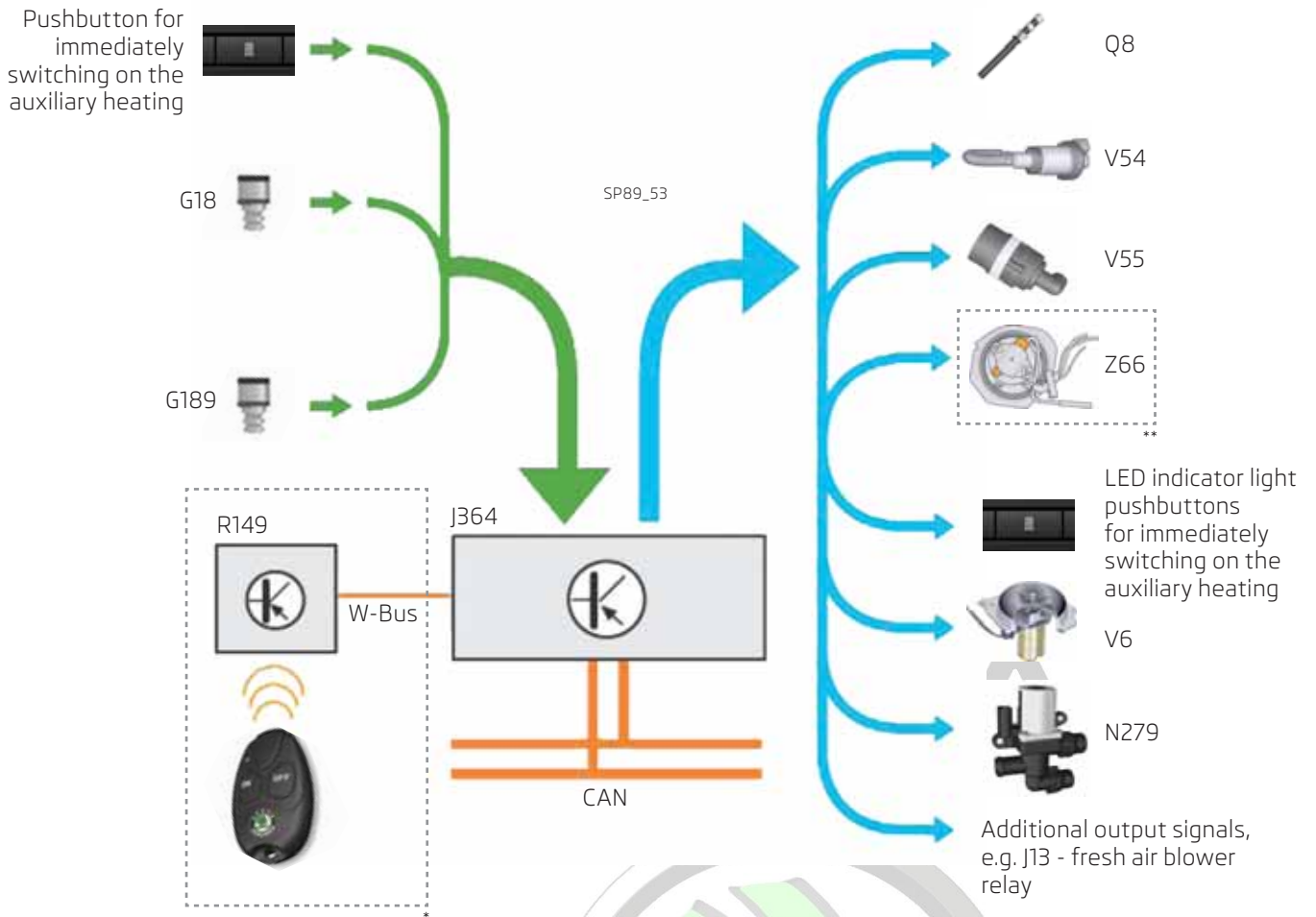
### Function principle of the auxiliary heating

The fuel from the fuel tank of the vehicle (petrol or diesel) is transferred to the heating unit by means of a special pump. This is where the fuel and air mixes as it enters the combustion chamber via the venturi nozzle. The air is fed into the system by a fan, which is located in front of the nozzle, whereas the mouth of the fan is equipped with a silencer. The glow plug which extends into the combustion chamber ignites the fuel-air mixture. The heat released during the combustion heats the heat exchanger, which in turn heats the water which flows through it. The heat exchanger is connected to the coolant circuit of the vehicle. The auxiliary heating pump ensures the water circulation in the water circuit. The exhaust gases emitted as a result of the combustion process are diverted through the exhaust pipe which is fitted with a silencer.

The control unit of the Thermo Top V system is a direct component of the heating unit. The temperature in the heat exchanger is detected by two sensors - temperature sensor and overheat sensor.



# Auxiliary heating control unit



- G18 Temperature sensor
- G189 Overheat sensor
- R149 Receiver of the remote control
- W-Bus Special databus for the connection of R149
- J364 Auxiliary heating control unit

- \* Only for the model range Škoda Superb I and II
- \*\* Only for vehicles with diesel engines

- █ Output signal
- █ Input signal
- █ Databus

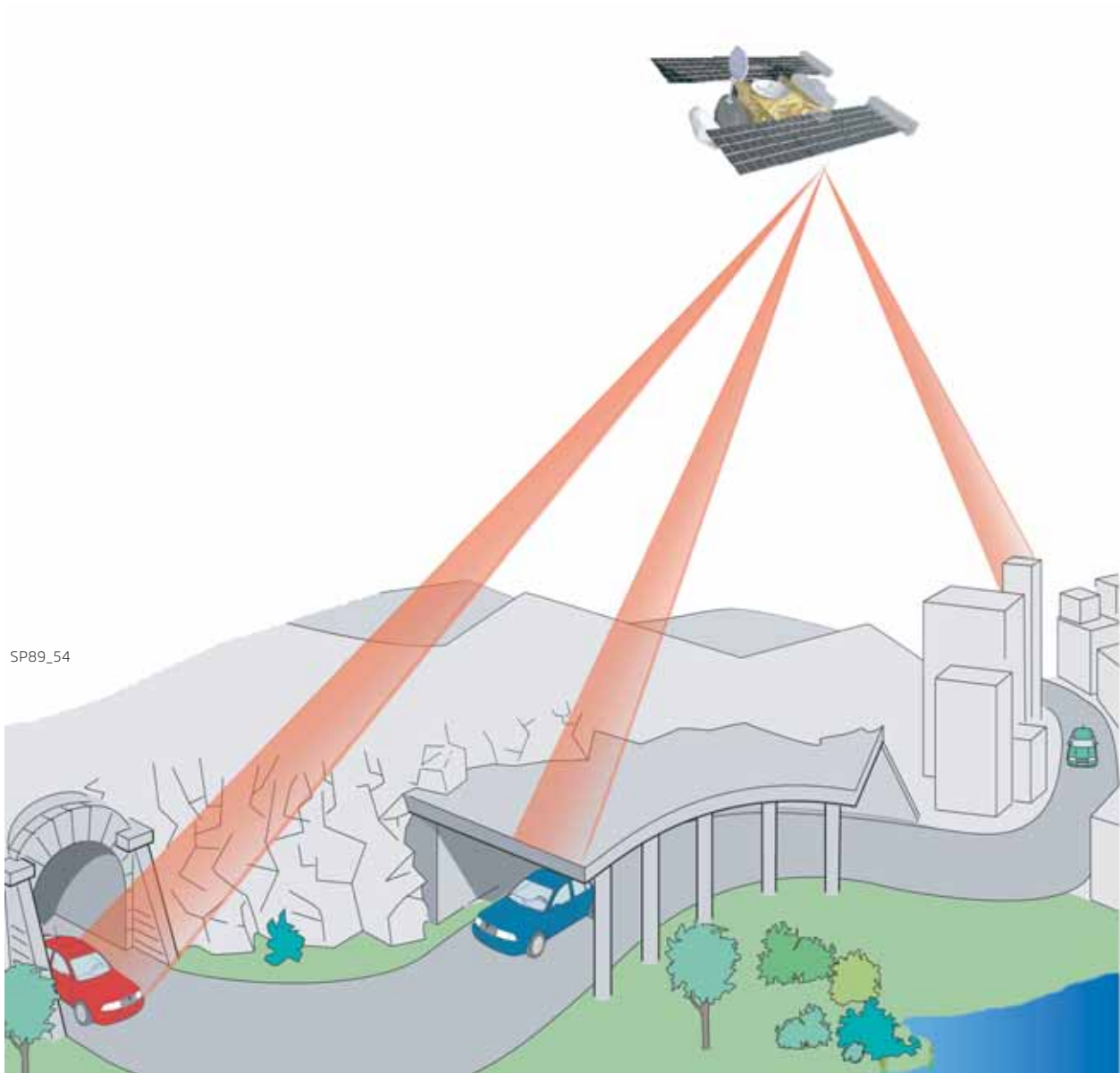
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## 2.5. Navigation sensors

Although the positioning per satellite is the most important source of information for the GPS system, the navigation system of the vehicle can eliminate these short signal failures. This is achieved by determining the driving direction of the vehicle wheels by means of the tilt angle sensor and the distance traveled by means of the ABS speed sensor.

In this case, the comparison of the signals received by the turning angle sensor and the ABS speed sensor with the signals from the GPS system is not possible and the inaccuracy of the calculated vehicle position increases if the radio signals from the GPS system are not received for a longer period of time.

Vehicle tilt angle sensor. The vehicle tilt angle sensor measures the change in driving direction. It replaces the magnetic sensor, which has been used in previous models of the navigation units.



## Vehicle tilt angle sensor

As already mentioned, the vehicle tilt angle sensor is a system component that aims to specify the satellite navigation. The sensor is directly integrated in the navigation unit.

### Advantages:

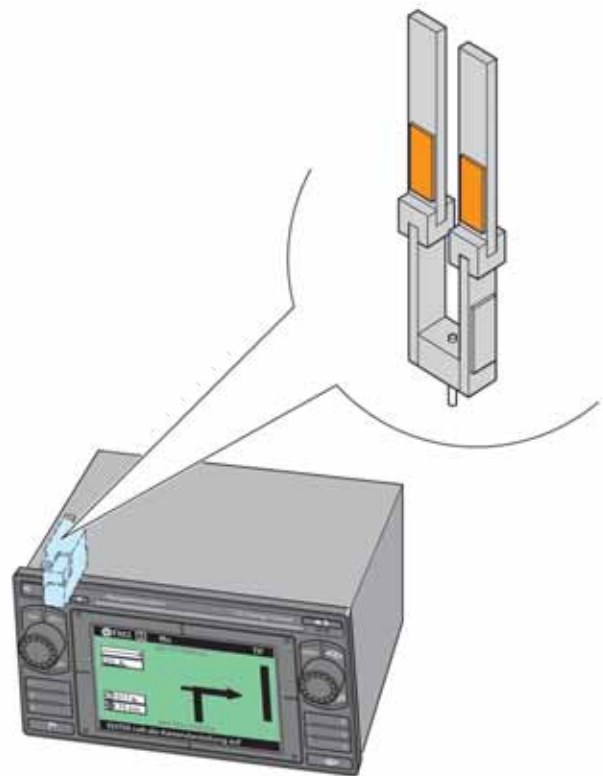
- the sensor is not affected by magnetic interference
- small dimensions
- high sensitivity
- no need for adjustment or setting

If the vehicle changes the driving direction, it rotates around its vertical axis.

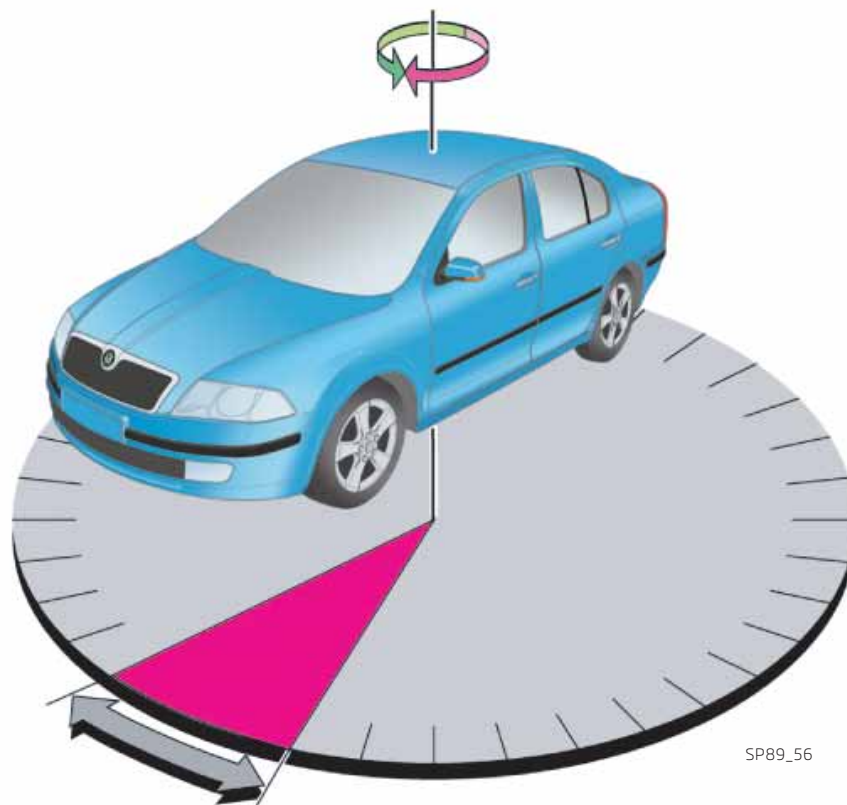
The tilt angle sensor detects the tilting of the vehicle and transmits this information to the navigation control unit. The control unit evaluates the sensor signal and calculates the angle that the wheels deviate from the driving direction. To distinguish the driving direction (forwards or backwards), the navigation control unit receives a signal from the switch of the rear lights.

To calculate the tilt radius, it is also necessary to know the length of the distance traveled. The length of the distance traveled is transmitted to the control unit by means of the signals from the ABS speed sensor.

The tilt angle sensor must be installed at different points depending on the type of the radio navigation system.



SP89\_55

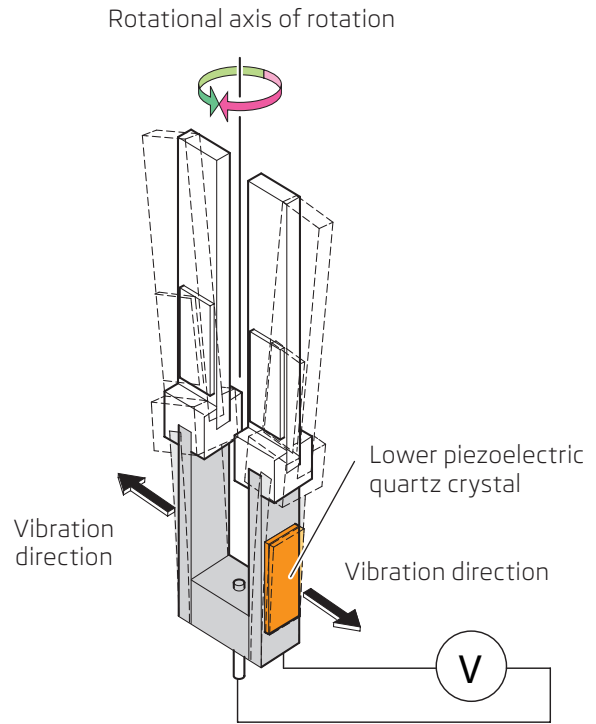


SP89\_56



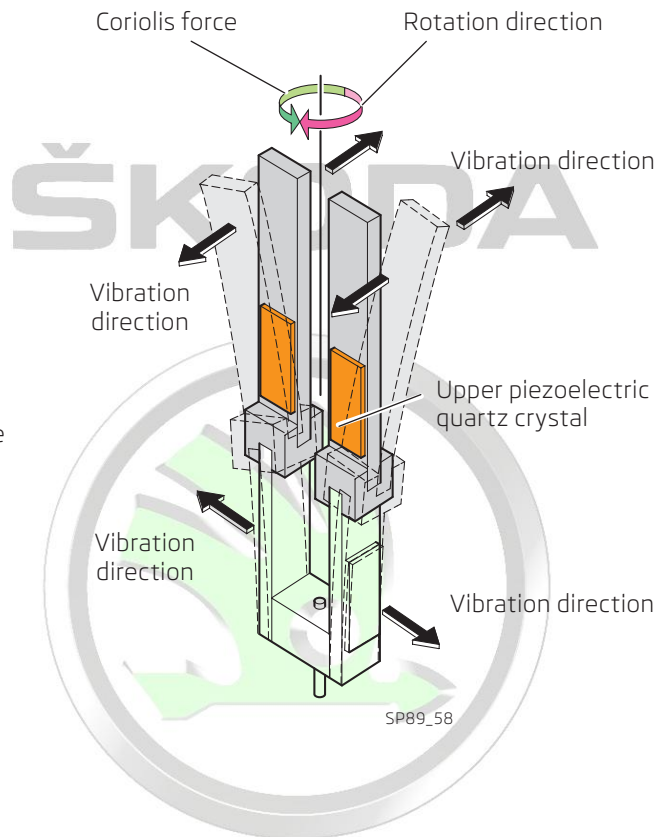
**Function of the vehicle tilt angle sensor**

Both legs of the sensor body are designed as an oscillating body. When switching on the ignition, the lower piezoelectric quartz crystals are energised simultaneously and begin to vibrate. The oscillation generated by the piezoelectric quartz crystals is transmitted to both legs of the body.



SP89\_57

The so-called Coriolis force acts on the swinging sensor legs when changing the driving direction (cornering and the like) of the vehicle. This force acts against the rotation direction of the vehicle about its vertical axis. The upper part of the hitherto only laterally swinging legs begins to deform through the effect of the Coriolis force. When the legs deform, so do the upper piezoelectric quartz crystals, where the electrical voltage is generated by the effect of the Coriolis force. The generated voltage is supplied to the navigation control unit which evaluates it and in turn changes the driving direction of the vehicle.



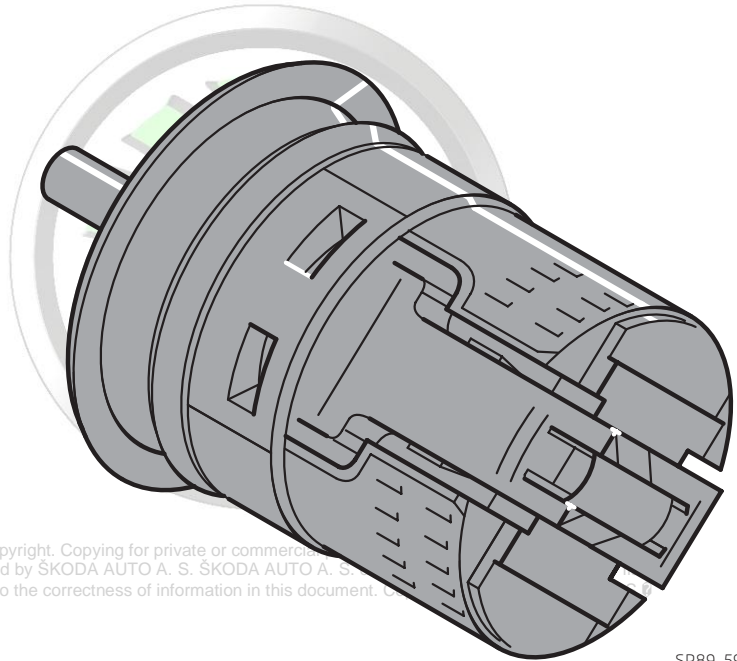
SP89\_58

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## ABS speed sensor

The ABS speed sensor aims to specify the satellite navigation and obtains information about the distance traveled by the vehicle. The sensor is mounted on the vehicle wheel and detects the rotational speed of the respective wheel. This wheel-speed information is converted into signals which are transmitted to the ABS control unit.

The control unit of the ABS system transmits this information signal to the navigation control unit which is able to evaluate the signal and to determine in this way the distance traveled by the vehicle.



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SP89\_59

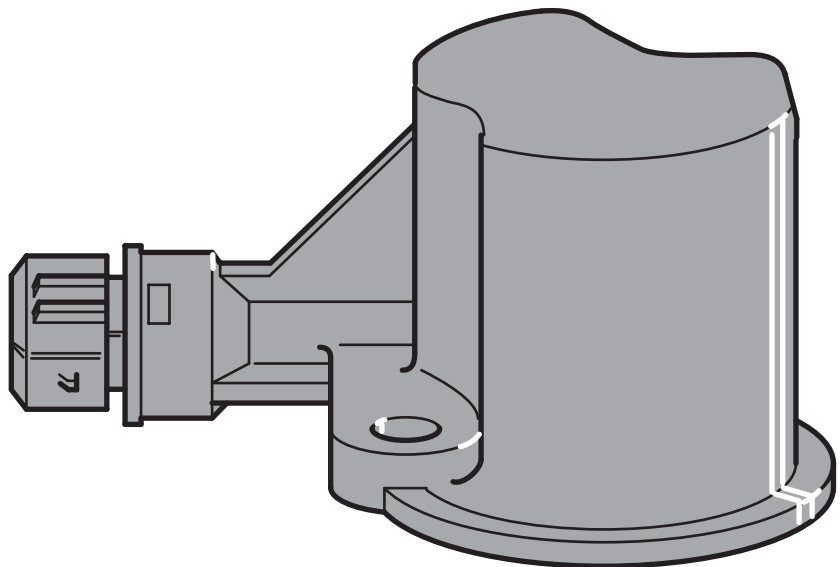
## Rear light switch

When the reverse gear is engaged, the navigation control unit receives a signal from the switch of the rear lights.

The navigation control unit can detect whether the vehicle is moving forwards or backwards.

### Effects of signal failure:

- If a signal fails, the navigation control unit does not detect when the vehicle is moving backwards and the guidance is therefore less accurate.



SP89\_60

## 2.6. Sensors of the Start-Stop system

The Start-Stop systems operate by cutting the engine when the driver comes to a complete standstill, e.g. for a traffic light or in traffic jams; then the engine automatically restarts by depressing the clutch pedal and the respective gear is engaged again. A special starter is provided for this system, which ensures a safe, fast and quiet engine start due to its powerful electric motor, together with the advanced noise-free gear system. This system also has a control software, which is usually implemented in the electronic engine control unit ECU, and the battery sensor, whose task it is, among others, to detect the present state of the battery charge and to transmit this information to the energy management system. Thus, it is ensured that the engine is brought only to a standstill when the battery has sufficient energy for rapid and repeated engine restarts. The system is rounded off by a crankshaft sensor, sensors on the pedals, and a deep-cycle resistant battery.

### Pushbutton switch for the operation of the START-STOP system

The pushbutton switch F416 is located in the center console next to the handbrake.

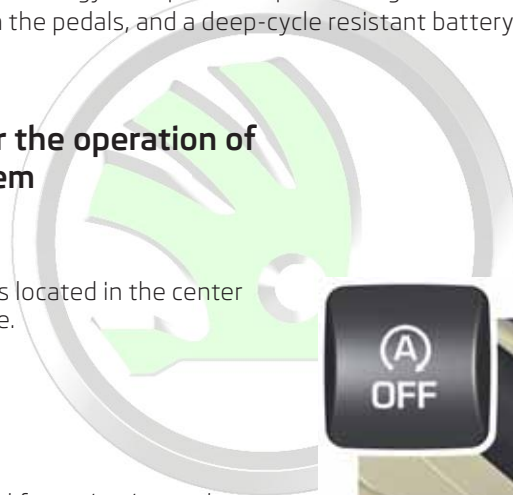
#### Function

The pushbutton switch is used for activating and deactivating the operation of the START-STOP system while driving.

The START-STOP system is activated automatically each time the ignition is switched on. The operation of the system itself is carried out as soon as the above-mentioned operating conditions are fulfilled and checked.

#### Effects of signal failure

If the pushbutton switch function for the operation of the START-STOP system fails, the engine control unit automatically switches off the START-STOP system. The fault is entered in the fault memory of the engine control unit.



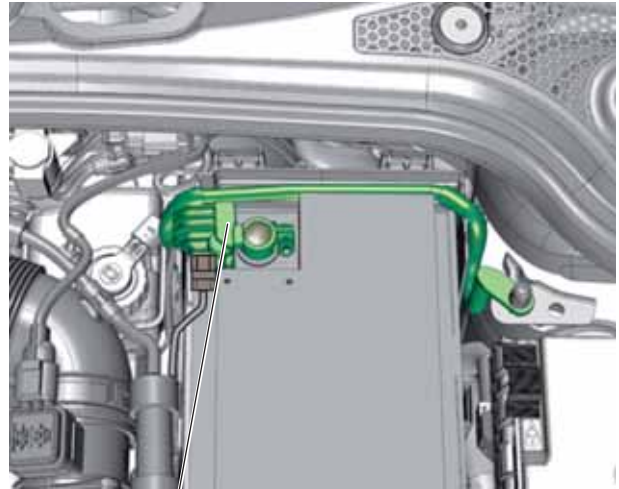
SP89\_61

Pushbutton switch for the operation of the START-STOP system F416

## Battery monitor control unit

The information whether the battery has sufficient energy to repeatedly restart the engine is an important prerequisite for the operation of the START-STOP system. Therefore, vehicles with the START-STOP system are equipped with a battery monitor control unit with integrated battery sensor.

The battery monitor control unit J367 is directly located on the negative pole terminal of the earth cable and is connected to the data bus diagnostic interface (Gateway) J533 via the LIN data line.



SP89\_62

Battery monitor control unit J367

### Signal use

The battery sensor integrated in the battery control unit J367 detects:

- the battery temperature
- the battery voltage
- the current flowing through

The battery temperature is recorded on the negative terminal of the battery and the internal temperature of the battery is evaluated on the basis of the characteristics.

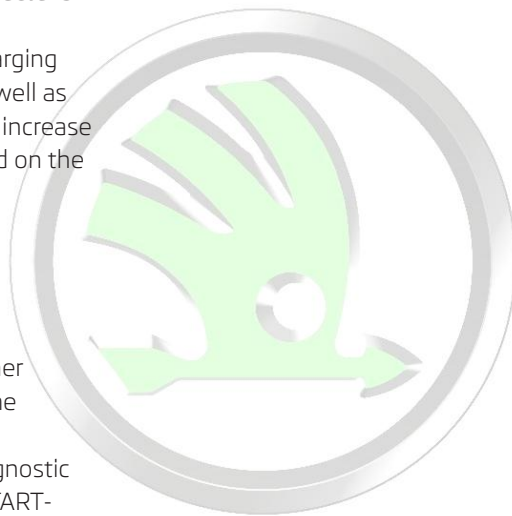
Using the data obtained, the charge control (charging voltage) can be adapted to the charge state as well as the operating state of the battery. The aim is to increase the availability of the START-STOP system based on the detailed data evaluation of the battery.

### Effects of signal failure

If the signal of the battery sensor fails, it is further impossible to detect and monitor the state of the battery correctly.

An entry is made in the fault memory of the diagnostic interface of the data bus (Gateway) J533. The START-STOP system is deactivated.

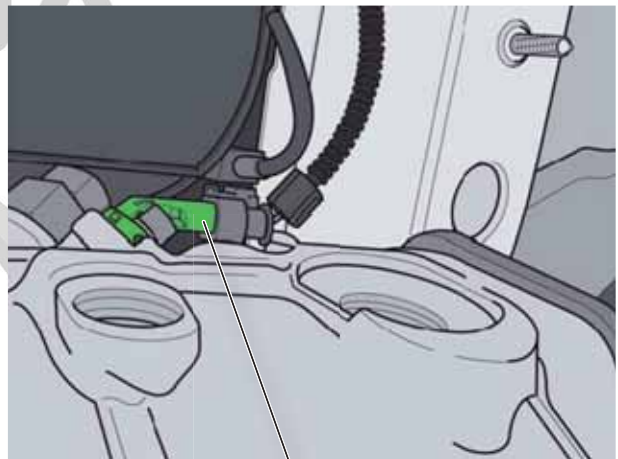
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## Sender for gearbox neutral position

To ensure the function of the START-STOP system, it was necessary to equip the gearbox with an additional sensor, which allows the system to detect the neutral gear position - sender for gearbox neutral position G701. The sender is screwed into the gearbox housing from above and detects the position of the gearshift lever shaft without contact.



SP89\_63

Sender for gearbox neutral position G701

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## Alternator

On vehicles with the START-STOP system, the information is transmitted via the LIN data line, which is connected to the data bus diagnostic interface (Gateway) J533. Gateway transmits this information to other control units via the CAN data bus (such as the engine control unit).

## Starter

In order to meet the higher demands imposed on the starter by the active START-STOP system (e.g. in city traffic), the mechanical cycle durability of the starter was increased and the ring gear was strengthened.

## 2.7. Accelerator pedal position sensor

### Implementation

Engine control

### Function\_

Detection of driver instructions (immediate request)

### Installation\_

Passenger compartment

### Detection principle

Hall effect or potentiometer

### Technical data

Supply voltage: 5 V

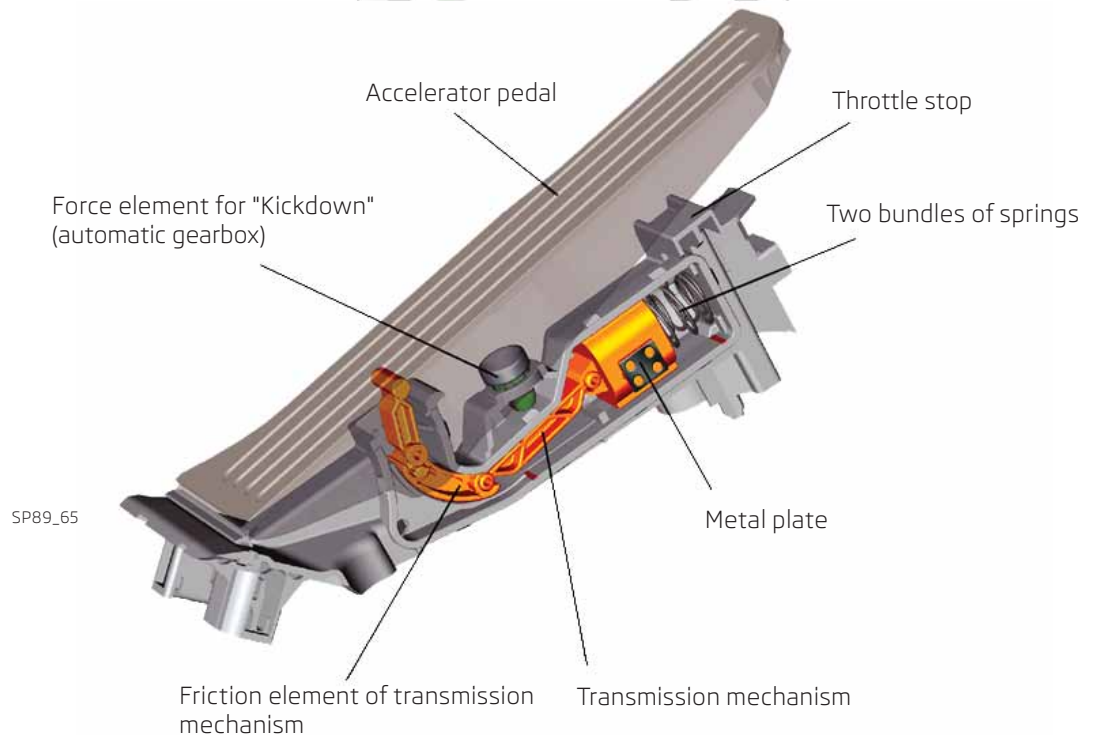
Measuring range: 40 - 80 mm

Temperature range: -40°C ... +80°C

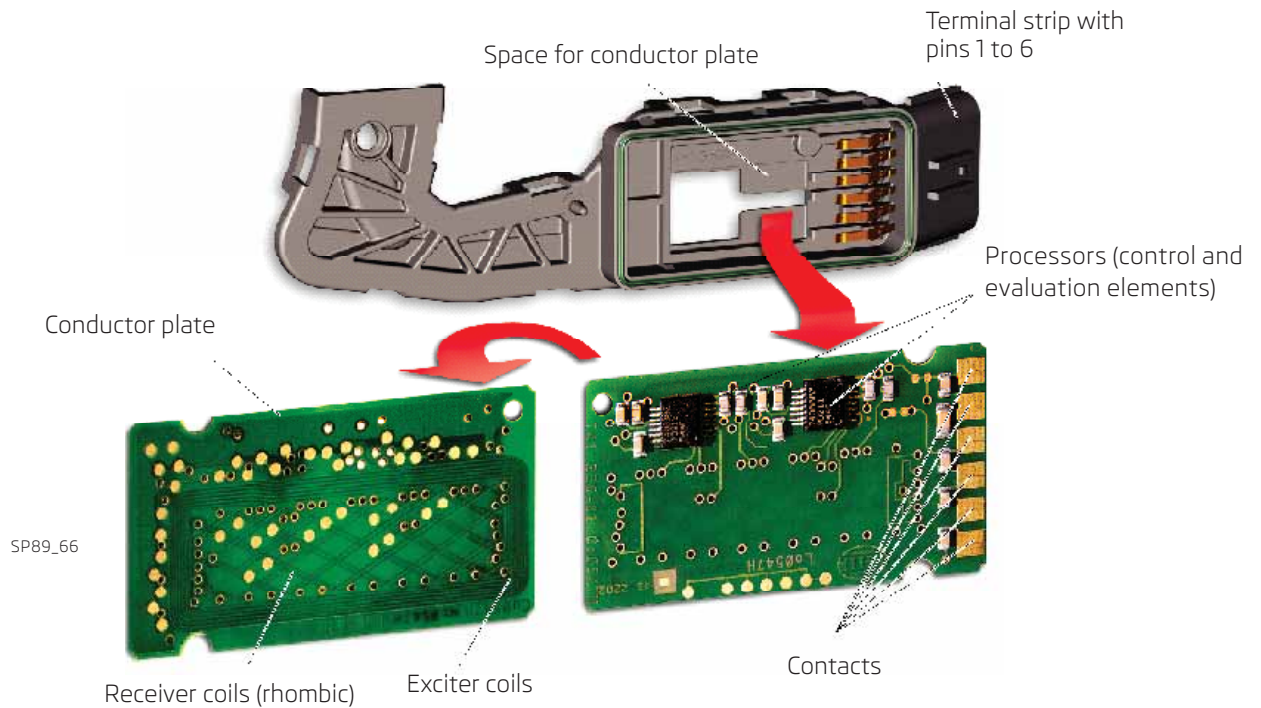
Output signal: analog



SP89\_64



## Accelerator pedal sender



### ŠKODA

#### Assignment of terminal strip

Pin 1 supply voltage 5 V for G185

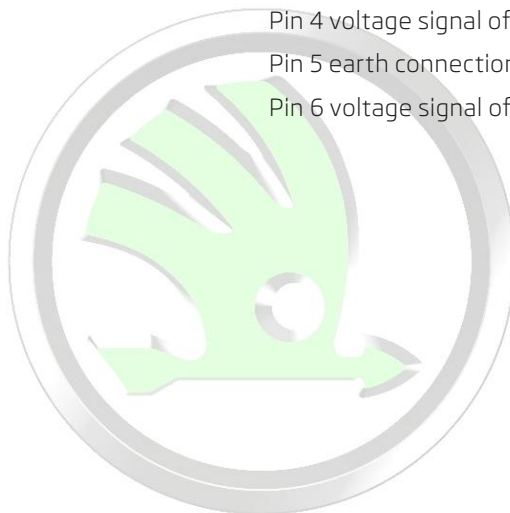
Pin 2 supply voltage 5 V for G79

Pin 3 earth connection G79

Pin 4 voltage signal of G79

Pin 5 earth connection G185

Pin 6 voltage signal of G185



# Overview of the previously edited workshop teaching aids

## No. Designation

- 1 Mono-Motronic
- 2 Central locking
- 3 Vehicle alarm
- 4 Working with wiring diagrams
- 5 ŠKODA FELICIA
- 6 Safety of the ŠKODA vehicles
- 7 Principles of ABS - were not published
- 8 ABS - FELICIA
- 9 System for safe start-up with transponder
- 10 Air conditioning in the vehicle
- 11 Air conditioning FELICIA
- 12 1.6 engine - MPI 1AV
- 13 Four-cylinder diesel engine
- 14 Power-assisted steering
- 15 ŠKODA OCTAVIA
- 16 1.9 ltr. TDI diesel engine
- 17 ŠKODA OCTAVIA Convenience electronic system
- 18 ŠKODA OCTAVIA Manual gearbox 02K, 02J
- 19 1.6 ltr. and 1.8 ltr. petrol engines
- 20 Automatic gearbox - fundamentals
- 21 Automatic gearbox 01M
- 22 1.9 ltr./50 kW SDI, 1.9 ltr./81 kW TDI diesel engines
- 23 1.8 ltr./110 kW and 1.8 ltr./92 kW petrol engines
- 24 OCTAVIA, CAN BUS
- 25 OCTAVIA - CLIMATRONIC
- 26 OCTAVIA - safety of the vehicle
- 27 OCTAVIA - 1.4 ltr./44 kW engine and gearbox 002
- 28 OCTAVIA - ESP - fundamentals, design, function
- 29 OCTAVIA 4 x 4 - all-wheel drive
- 30 2.0 ltr. 85 kW and 88 kW petrol engines
- 31 Radio navigation system - design and functions
- 32 ŠKODA FABIA - technical information
- 33 ŠKODA FABIA - electrical systems
- 34 ŠKODA FABIA - electro-hydraulic power-assisted steering
- 35 1.4 ltr. - 16 V 55/74 kW petrol engines
- 36 ŠKODA FABIA - 1.9 ltr. TDI Unit injection
- 37 Manual gearbox 02T and 002
- 38 ŠkodaOctavia; model 2001
- 39 Euro-On-Board-Diagnosis
- 40 Automatic gearbox 001
- 41 6-Speed gearbox 02M
- 42 ŠkodaFabia - ESP
- 43 Exhaust emissions
- 44 Extended service intervals
- 45 Three-cylinder petrol engines 1.2 ltr.
- 46 ŠkodaSuperb; Vehicle presentation; part I
- 47 ŠkodaSuperb; Vehicle presentation; part II
- 48 ŠkodaSuperb; 2.8-ltr./142 kW V6 petrol engine
- 49 ŠkodaSuperb; 2.5 ltr./114 kW TDI V6 petrol engine

## No. Designation

- 50 ŠkodaSuperb; automatic gearbox 01V
- 51 2.0 ltr./85 kW petrol engine with balancing shafts and two-stage intake manifold
- 52 ŠkodaFabia; 1.4 ltr. TDI engine with unit injection system
- 53 ŠkodaOctavia; Vehicle presentation
- 54 ŠkodaOctavia; Electrical components
- 55 FSI petrol engines; 2.0 ltr./110 kW and 1.6 ltr./85 kW
- 56 Automatic gearbox DSG-02E
- 57 Diesel engine; 2.0 ltr./103 kW TDI with pump-nozzle units, 2.0 ltr./100 kW TDI with pump-nozzle units
- 58 ŠkodaOctavia, Chassis and electromechanical power-assisted steering
- 59 ŠkodaOctavia RS, 2.0 ltr./147 kW FSI turbo engine
- 60 2.0 ltr./103 kW 2V TDI diesel engine; particle filter with additive
- 61 Radio navigation systems in Škoda vehicles
- 62 ŠkodaRoomster; Vehicle presentation part I
- 63 ŠkodaRoomster; Vehicle presentation part II
- 64 ŠkodaFabia II; Vehicle presentation
- 65 ŠkodaSuperb II; Vehicle presentation part I
- 66 ŠkodaSuperb II; Vehicle presentation part II
- 67 Diesel engine; 2.0 ltr./125 kW TDI with Common Rail injection system
- 68 1.4 ltr./92 kW TSI petrol engine with turbocharger
- 69 3.6 ltr./191 kW FSI petrol engine
- 70 All-wheel drive with Haldex coupling of the IV. generation
- 71 ŠkodaYeti; Vehicle presentation part I
- 72 ŠkodaYeti; Vehicle presentation part II
- 73 LPG system in Škoda vehicles
- 74 1.2 ltr./77 kW TSI petrol engine with turbocharger
- 75 7-speed dual-clutch automatic gearbox 0AM
- 76 Green Line vehicles
- 77 Geometry
- 78 Passive safety
- 79 Additional heating
- 80 2.0 ltr., 1.6 ltr., 1.2 ltr. diesel engines with Common Rail injection system
- 81 Bluetooth - in Škoda vehicles
- 82 Vehicle sensors - drive
- 83 1.4 ltr./132 kW TSI petrol engine with dual-charging (compressor, turbocharger)
- 84 ŠkodaFabia II RS; Vehicle presentation
- 85 KESSY system in Škoda vehicles
- 86 START-STOP system in Škoda vehicles
- 87 Immobilisers in Škoda vehicles
- 88 Brake and stabilisation systems
- 89 Sensors and senders in Škoda vehicles

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