

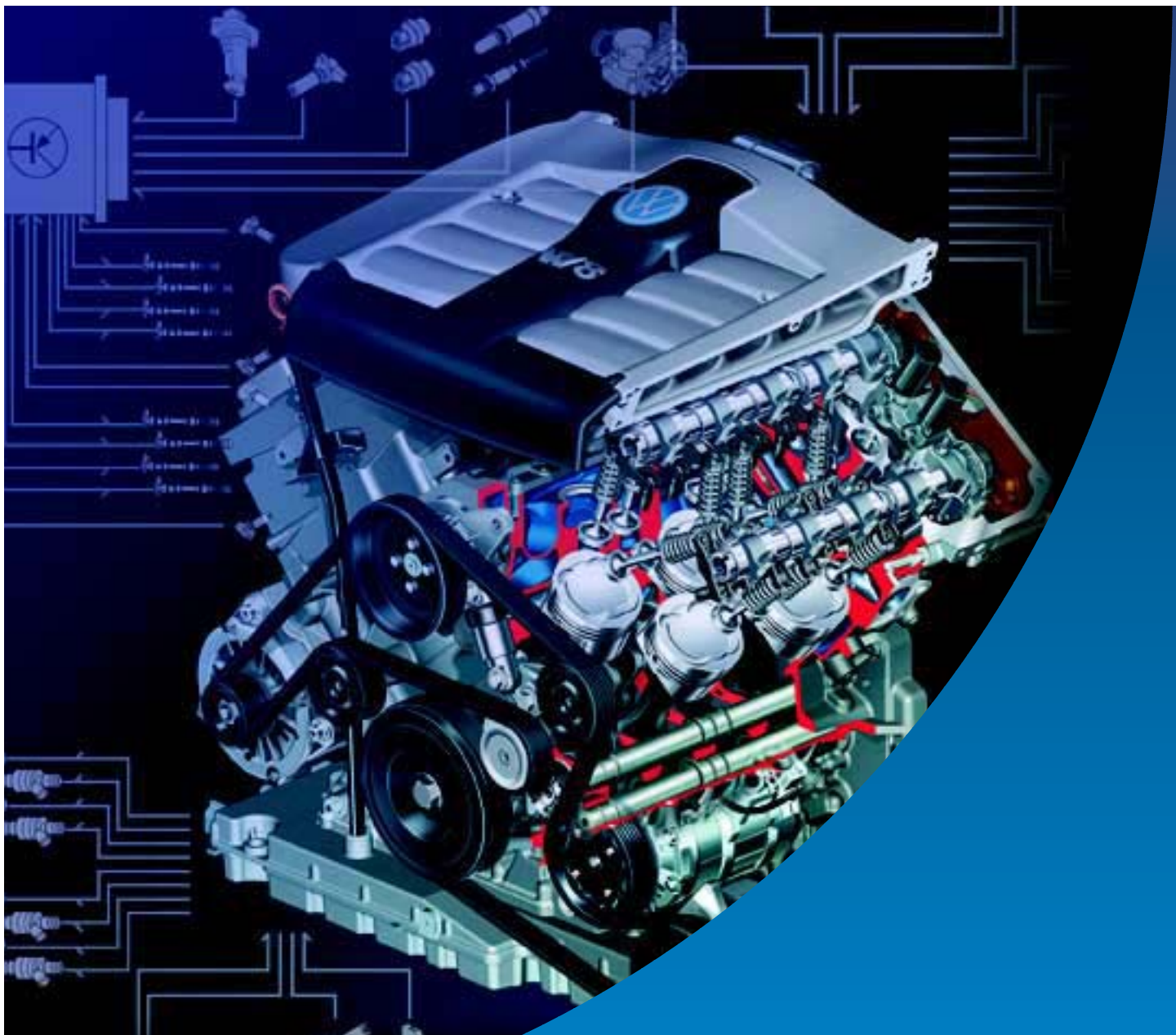
Service.



Self-Study Programme 249

Engine Management of the W8 Engine in the Passat

Motronic ME 7.1.1



The Motronic engine management system of the W8 engine enables high power output with minimal fuel consumption through adaptation to all operating modes. The heart of the Motronic system is the electronic control unit (J220). It processes incoming signals and transmits adjustment commands for controlling the subsystems. At the same time, the control unit serves the diagnosis of subsystems and components.

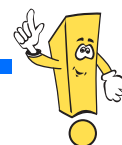


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For further information on the W8 engine, please refer to SSP 248 „The W Engine Concept“.

NEW



**Important
Note**



**This self-study programme explains the design and function of new developments.
The contents are not updated.**

Please always refer to the relevant Service literature for current inspection, adjustment and repair instructions.

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Introduction

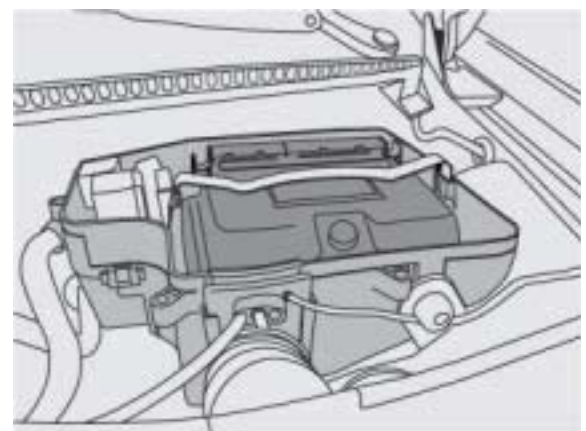
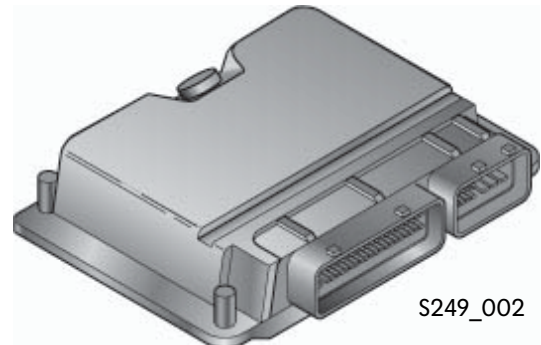


The Motronic ME 7.1.1

The regulation of the W8 engine is performed by the Motronic ME 7.1.1. The management system of the W8 engine is, in many respects, the same as that of the VR6-V4 engine. These are the tasks of the engine management system:

- Optimisation of the fuel-air mixture for all operating modes
- Reduction of fuel consumption
- Regulation of combustion
- Monitoring and regulation of exhaust emissions.

The control unit is located in the electrics box in the plenum chamber.



The control unit performs the following functions:

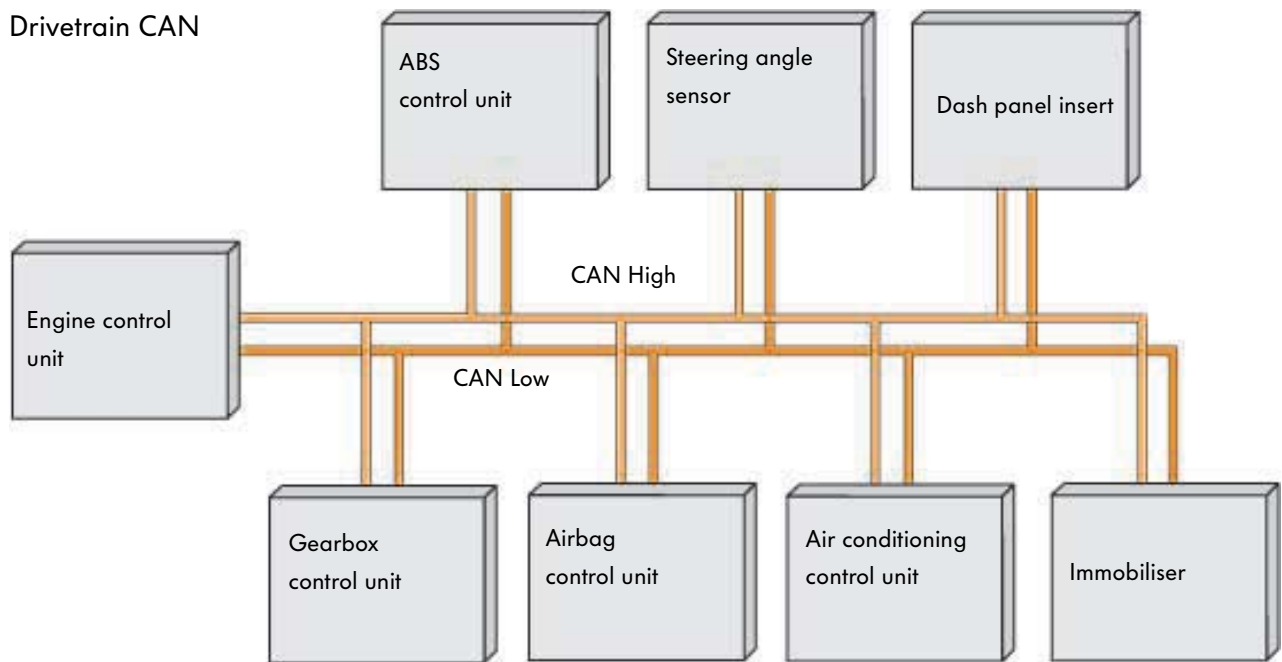
- Regulation of injection
- Regulation of ignition (ignition system with single-spark ignition coils)
- Regulation of idling speed
- Stereo lambda regulation of exhaust emissions
- Fuel tank ventilation system
- Electronic power control
- Cruise control system
- Secondary air system
- Knock control
- Continuously variable inlet valve timing, two-position exhaust valve timing
- Control of engine mountings
- Regulation of coolant temperature
- Regulation of electric vacuum pump
- ESP
- Self-diagnosis

The engine control unit in the CAN data bus



The engine control unit communicates with the control units in other vehicle systems. Data is exchanged through the CAN data bus, which joins the individual control units in a single system.

Drivetrain CAN



S249_004

Through the CAN data bus, data are exchanged between the engine control unit and

- the ABS control unit
- the gearbox control unit
- the airbag control unit
- the steering angle sensor
- the air conditioning control unit
- the dash panel insert (control unit with display unit in dash panel insert)
- the immobiliser.



For further information, please refer to SSP 186 „The CAN Data Bus“.

System overview

Sensors

- G70 Air mass meter
- G42 Intake air temperature sender

- G28 Engine speed sender

- G62 Coolant temperature sender

- G83 Coolant temperature sender radiator outlet

- G39 Lambda probe
- G108 Lambda probe II

- G130 Lambda probe after catalyst
- G131 Lambda probe II after catalyst

- G40 Hall sender 1, G163 Hall sender 2
- G300 Hall sender 3, G301 Hall sender 4

- G61 Knock sensor 1, G66 Knock sensor 2
- G198 Knock sensor 3, G199 Knock sensor 4

- J338 Throttle valve control part
- G187 Throttle valve drive angle sender 1
- G188 Throttle valve drive angle sender 2

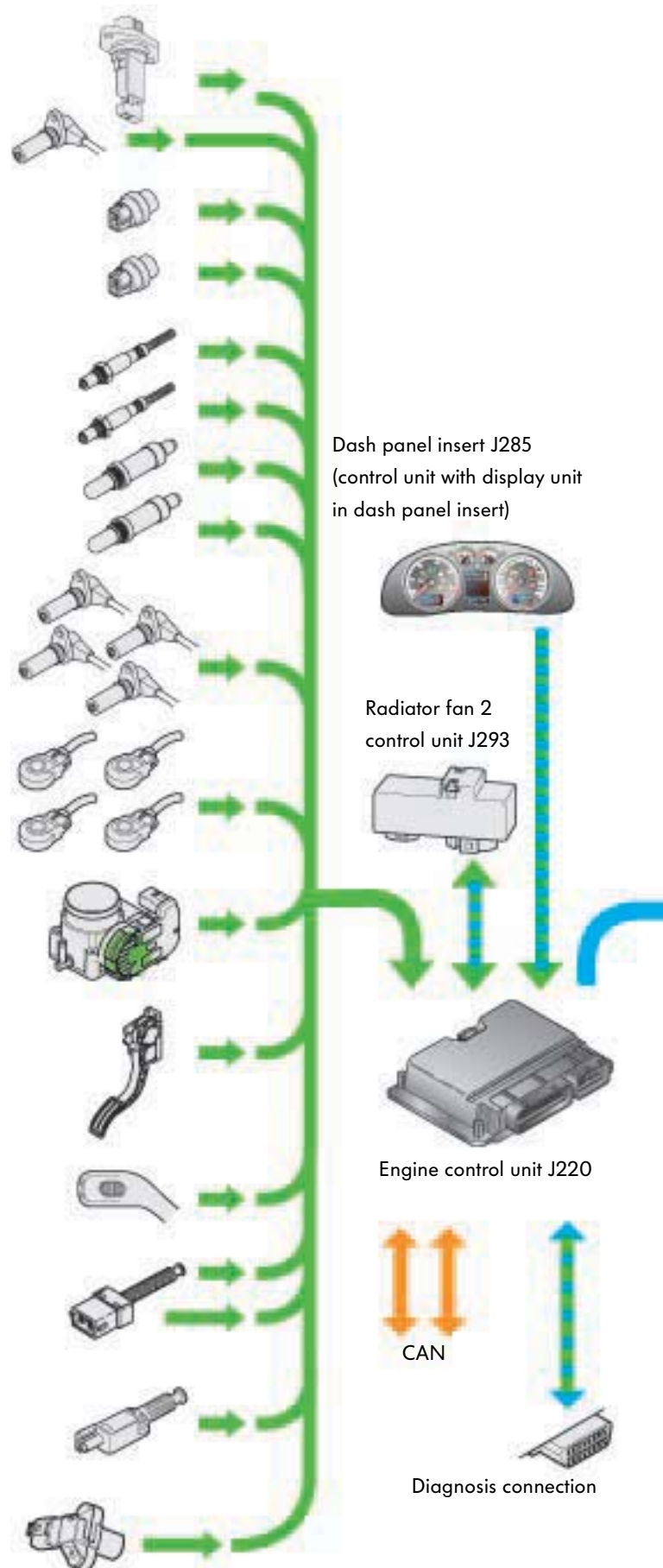
- Accelerator pedal module with
- G79 Accelerator pedal position sender 1
- G185 Accelerator pedal position sender 2

- E45 Cruise control switch
- E227 Cruise control „Set“ button

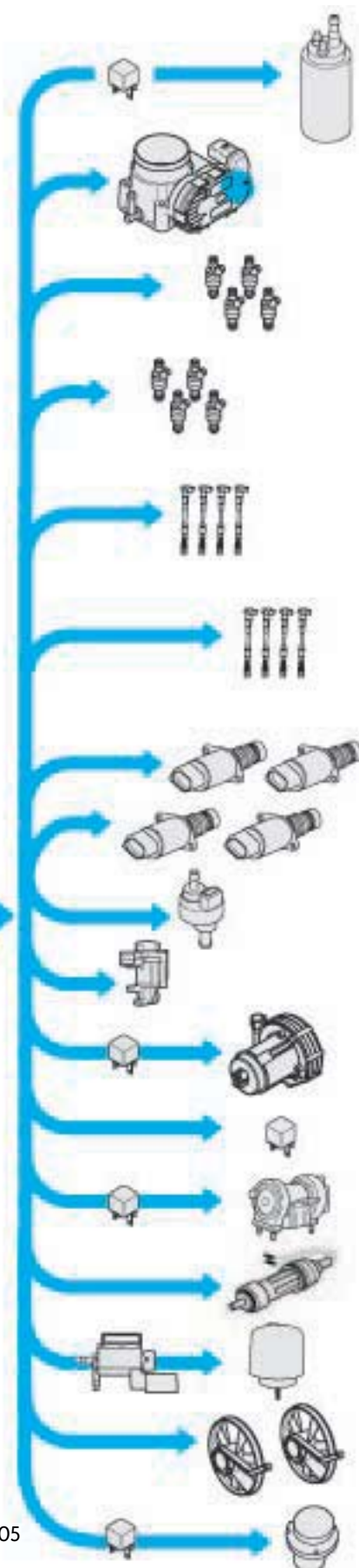
- F Brake light switch
- F47 Cruise control system brake pedal switch

- F36 Clutch pedal switch

- G294 Brake servo pressure sensor (only with automatic gearboxes)



Actuators



J17 Fuel pump relay, G6 Fuel pump

J 338 Throttle valve control part
G186 Throttle valve drive

N30 Injector, cylinder 1, N31 Injector, cylinder 2
N32 Injector, cylinder 3, N33 Injector, cylinder 4

N83 Injector, cylinder 5, N84 Injector, cylinder 6
N85 Injector, cylinder 7, N86 Injector, cylinder 8

N70 Ignition coil 1, N127 Ignition coil 2
N291 Ignition coil 3, N292 Ignition coil 4

N323 Ignition coil 5, N324 Ignition coil 6
N325 Ignition coil 7, N326 Ignition coil 8

N205 Inlet camshaft timing adjustment valve 1, N208 valve 2

N318 Exhaust camshaft timing adjustment valve 1, N319 valve 2

N80 Activated charcoal filter system solenoid valve 1

N112 Secondary air inlet valve

V101 Secondary air pump motor,
J299 Secondary air pump relay

J271 Motronic current supply relay

J496 Additional coolant pump relay, V36 Water pump

F265 Map-controlled engine cooling thermostat

N144 Electro-hydraulic engine mounting solenoid valve

V7 Radiator fan, V177 Radiator fan 2

J569 Brake servo relay,
V192 Vacuum pump for brake servo
(only for automatic gearboxes)

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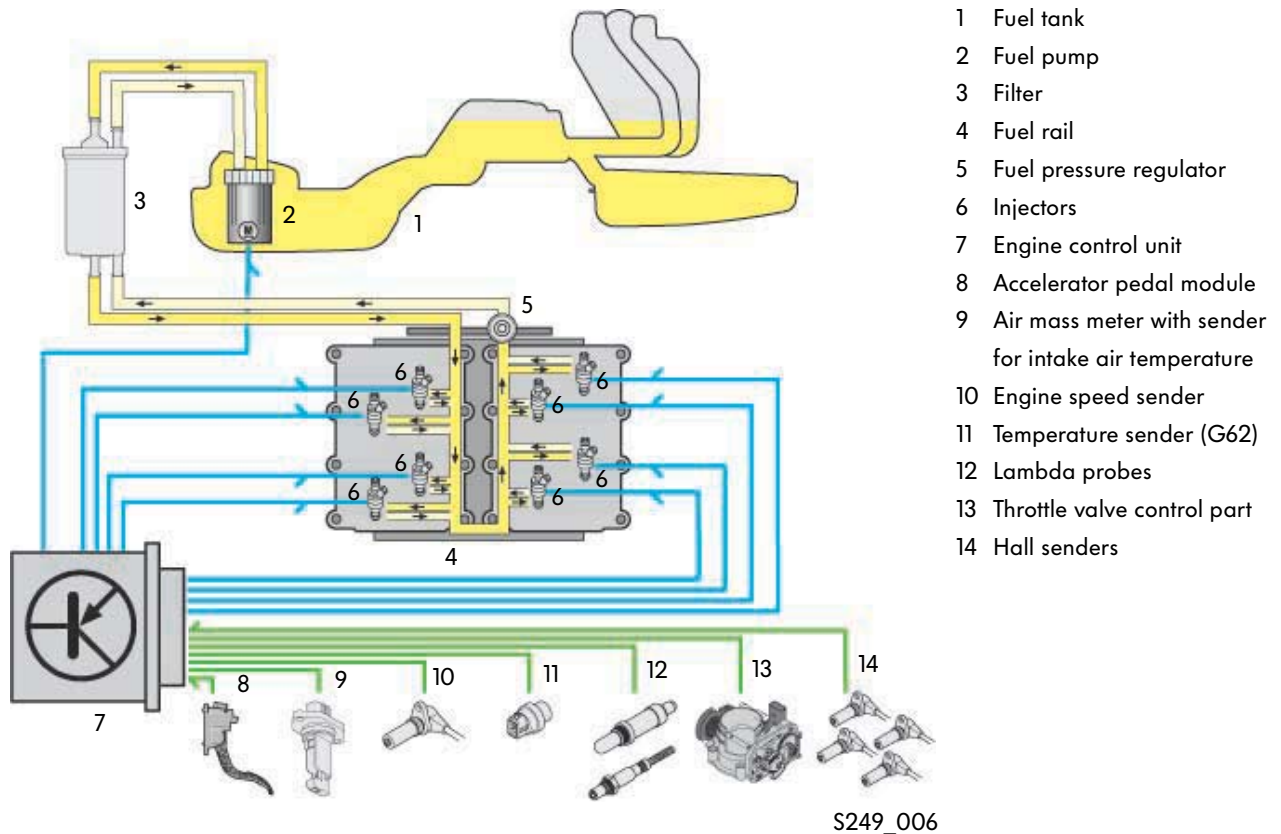


Subsystems

The fuel injection system

Input signals for calculating injection periods

- Engine load signal from air mass meter
- Intake air temperature
- Signal from throttle valve control part
- Signal from engine speed sender
- Coolant temperature
- Signal from Lambda probes
- Signal from accelerator pedal module
- Signal from Hall senders



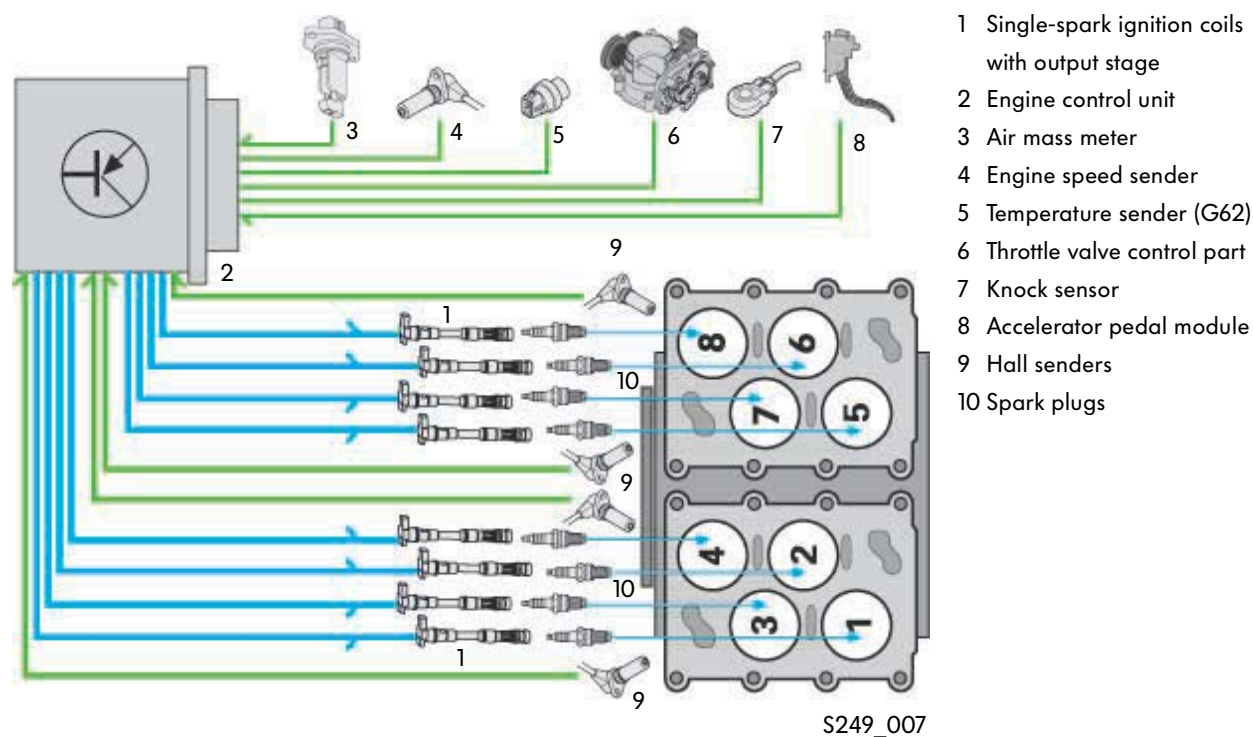
The fuel pump, which is located in the fuel tank, pumps fuel through the fuel filter to the injectors. The injectors are connected to each other by the fuel rail. Injection occurs sequentially. Using the input signals, the control unit calculates the necessary fuel quantity and the required injection period.

The quantity of fuel injected is determined solely by the length of the period during which the injector is open. The pressure regulator regulates the injection pressure in the fuel rail and regulates the return flow of excess fuel to the fuel tank.

The ignition system

Input signals for calculating the ignition timing

- Signal from engine speed sender
- Engine load signal from air mass meter
- Signal from throttle valve control part
- Coolant temperature
- Signal from knock sensors
- Signal from Hall senders
- Signal from accelerator pedal module



The ignition timing is calculated according to a map stored in the engine control unit on the basis of the input signals.



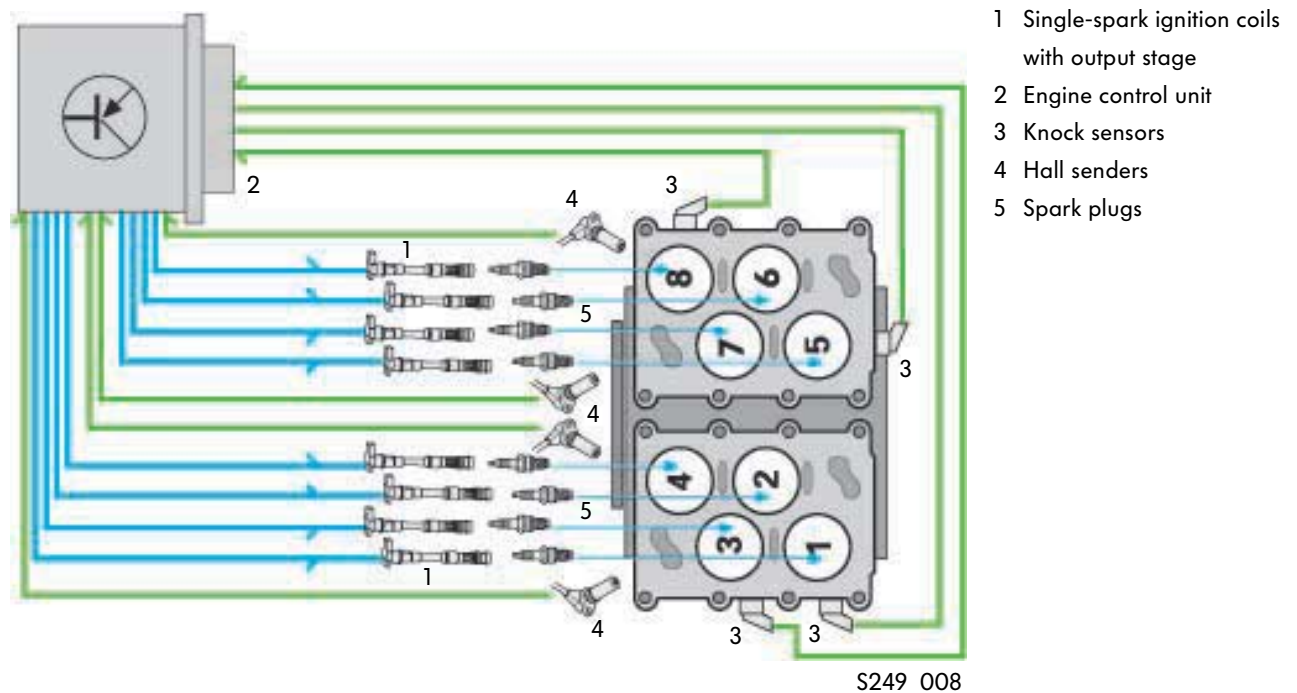
Subsystems

Knock control

Unfavourable operating conditions can lead to self-ignition (pre-ignition knock). Consequently, the ignition timing must be adjusted.

Input signals

- Signal from knock sensors
- Signal from Hall senders
- Engine temperature



Each bank of the W8 engine is equipped with two knock sensors mounted on the crankcase. To prevent the connectors in the wiring harness from being interchanged on the sensors, the connections are colour coded. The knock signals can be related to individual cylinders with the aid of the Hall signals.

When knocking is detected in a cylinder, the engine management system changes the ignition timing of the knocking cylinder (by retarding the firing point) until the knocking ceases.

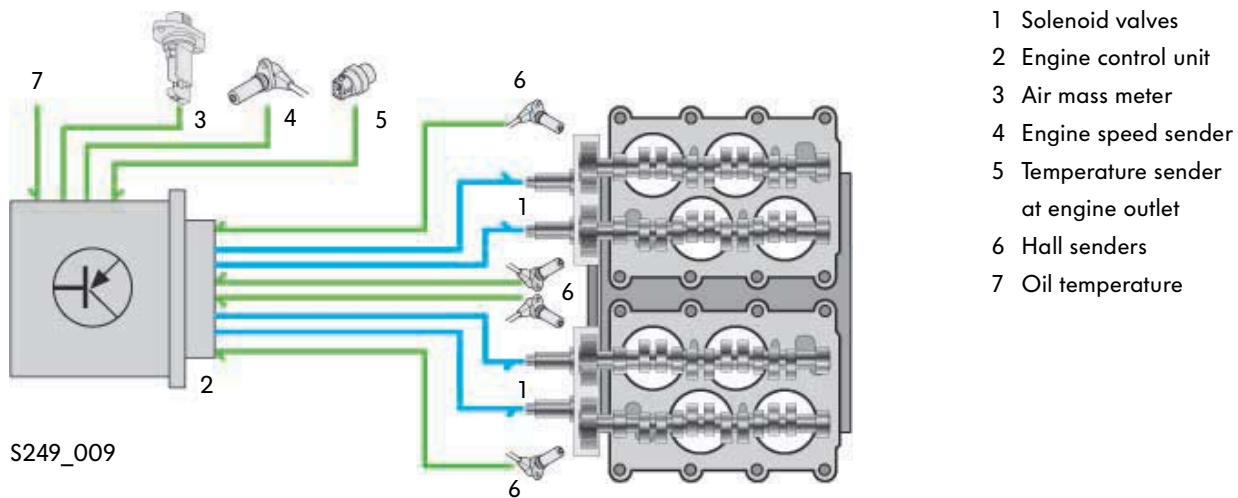
When the affected cylinder no longer has the tendency to knock, the control unit returns the ignition timing to its former setting (advancing the firing point).

Variable valve timing

The task of variable valve timing is to set the best valve timing for the operating modes idle, maximum power and torque. Variable valve timing optimises the ratio between fresh air and exhaust gas. This is referred to as internal exhaust gas recirculation. The overlap angle, during which the inlet valve is already opening while the exhaust valve is not yet closed, determines the quantity of „recirculated“ exhaust gas.

Input signals

- Signal from Hall senders
- Signal from engine speed sender
- Engine load signal from air mass meter
- Coolant temperature
- Oil temperature



To adjust the camshafts, the engine control unit requires information on engine speed, engine load, engine temperature, positions of the crankshaft and camshafts and, from the dash panel insert via CAN, oil temperature. The engine control unit actuates the solenoid valves according to operating mode.

The camshafts are adjusted according to a map stored in the engine control unit, whereby the inlet camshafts can be continuously adjusted. The camshaft adjusters on the exhaust camshafts are always moved by the engine control unit to one end position or the other.



For further information, please refer to SSP 246 „Variable Valve Timing with Fluted Variator“.



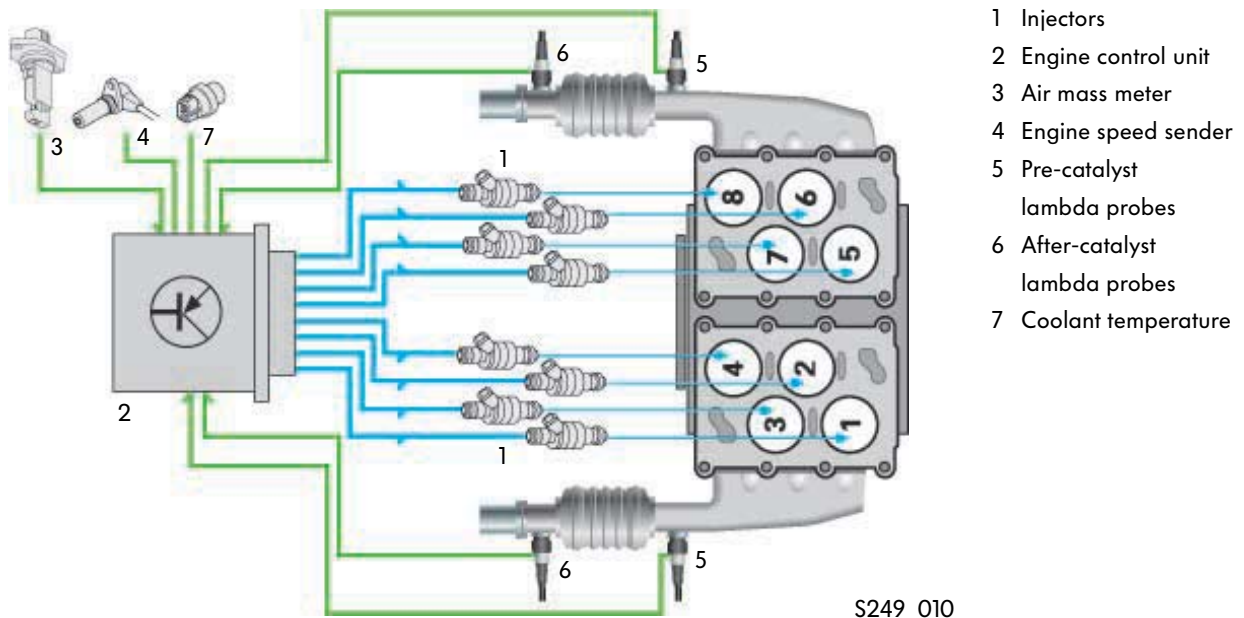
Subsystems

Stereo lambda regulation

The task of the lambda regulation is to maintain a lambda value of 1 during combustion so that exhaust gases can be optimally cleaned in the catalyst.

Input signals

- Signal from engine speed sender
- Engine load signal from air mass meter
- Signal from lambda probes
- Coolant temperature



During stereo lambda regulation, separate regulation loops, each including a catalyst, a pre-catalyst probe and an after-catalyst probe, determine the correct fuel-air mixture for each cylinder bank.

The lambda probes inform the control unit of the residual oxygen content in the exhaust gas.

Using this signal, the control unit calculates the momentary composition of the fuel-air mixture. When deviation from the specified value occurs, the injection period is corrected.

In addition, adaptive lambda regulation takes place. (The control unit adapts to the operating conditions and stores the learnt values.)

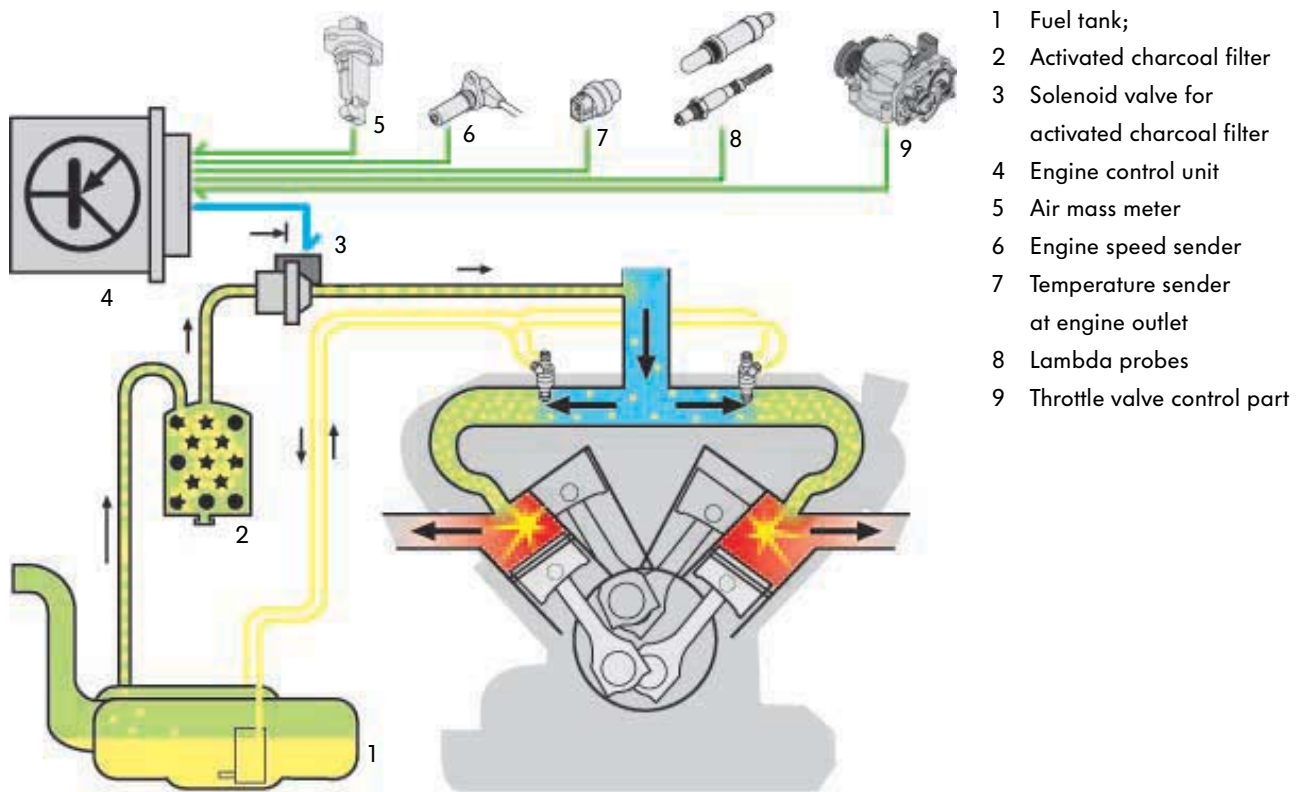


For further information, please refer to SSP 175 „On-Board Diagnosis System II“.

The fuel tank ventilation system

Input signals for fuel tank ventilation regulation

- Engine speed
- Engine load signal from air mass meter
- Engine speed
- Signal from lambda probes
- Signal from throttle valve control part



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The fuel tank ventilation system prevents fuel vapour which develops in the tank from escaping to the atmosphere. The fuel vapour is stored in the activated charcoal filter. After evaluating the input signals, the engine control unit actuates the solenoid valve.

The fuel vapour stored in the activated charcoal filter is directed through the intake manifold to the engine for combustion.

This briefly changes the fuel-to-air ratio. The change in the mixture is registered by the lambda probes, causing lambda regulation to be activated by the engine control unit and the mixture settles back to $\lambda = 1$.



For further information, please refer to SSP 231 „Euro On-Board Diagnostic System“.

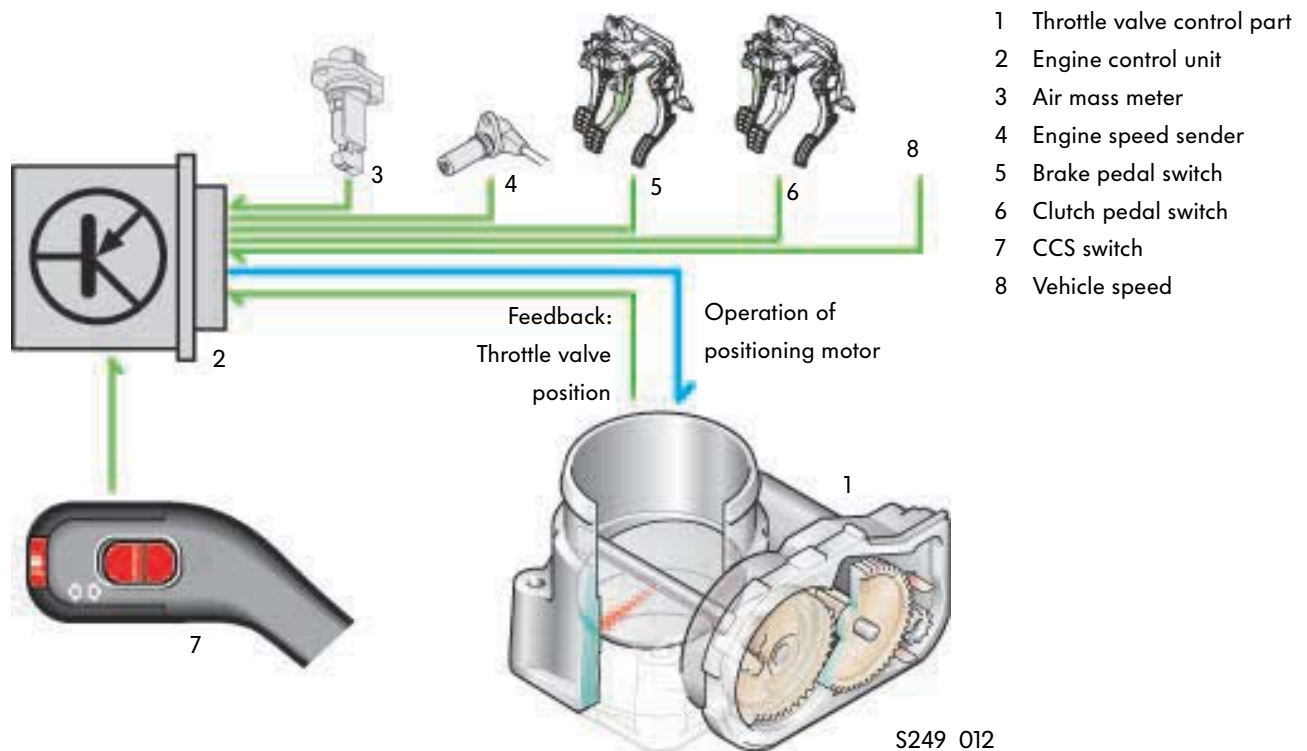
Subsystems

The cruise control system (CCS)

With the aid of the cruise control system, a vehicle speed above 30 km/h can be specified. This speed will then be maintained without driver intervention.

Input signals

- Engine speed
- Engine load signal from air mass meter
- Vehicle speed
- Signal „brake operated“
- Signal „clutch operated“
- „On“ and „off“ signals from CCS switch



The signal from the CCS switch goes to the engine control unit which in turn actuates the throttle valve control part.

The throttle valve control part opens the throttle valve according to the speed set. If the vehicle is equipped with a multi-function steering wheel, an additional CCS switch is located on the steering wheel.

The signal „brake operated“ or „clutch operated“ causes the cruise control system to be switched off.

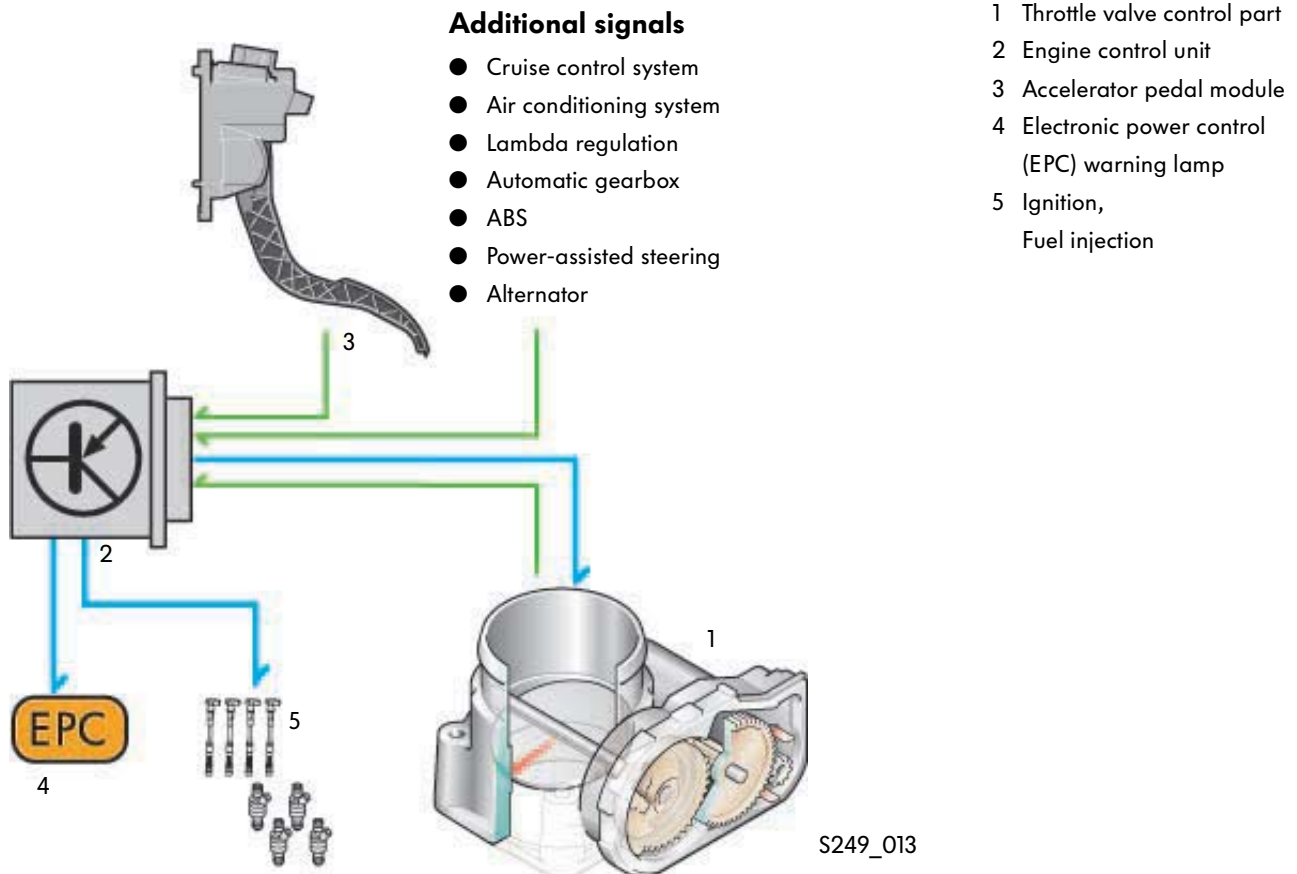


For further information, please refer to SSP 195 „The 2.3 ltr. V5 Engine“.

Electronic power control

Input signals

- Signal from accelerator pedal module
- Additional signals



The driver's input, i.e. the signals from the accelerator pedal, are transmitted to the engine control unit, which uses these signals to calculate, in consideration of the additional signals, the optimal realisation of the torque demand.

This realisation is achieved via the throttle valve (which is adjusted by an electric motor), the ignition and the fuel injection. The ESP warning lamp indicates to the driver that there is a fault in the electronic power control system.



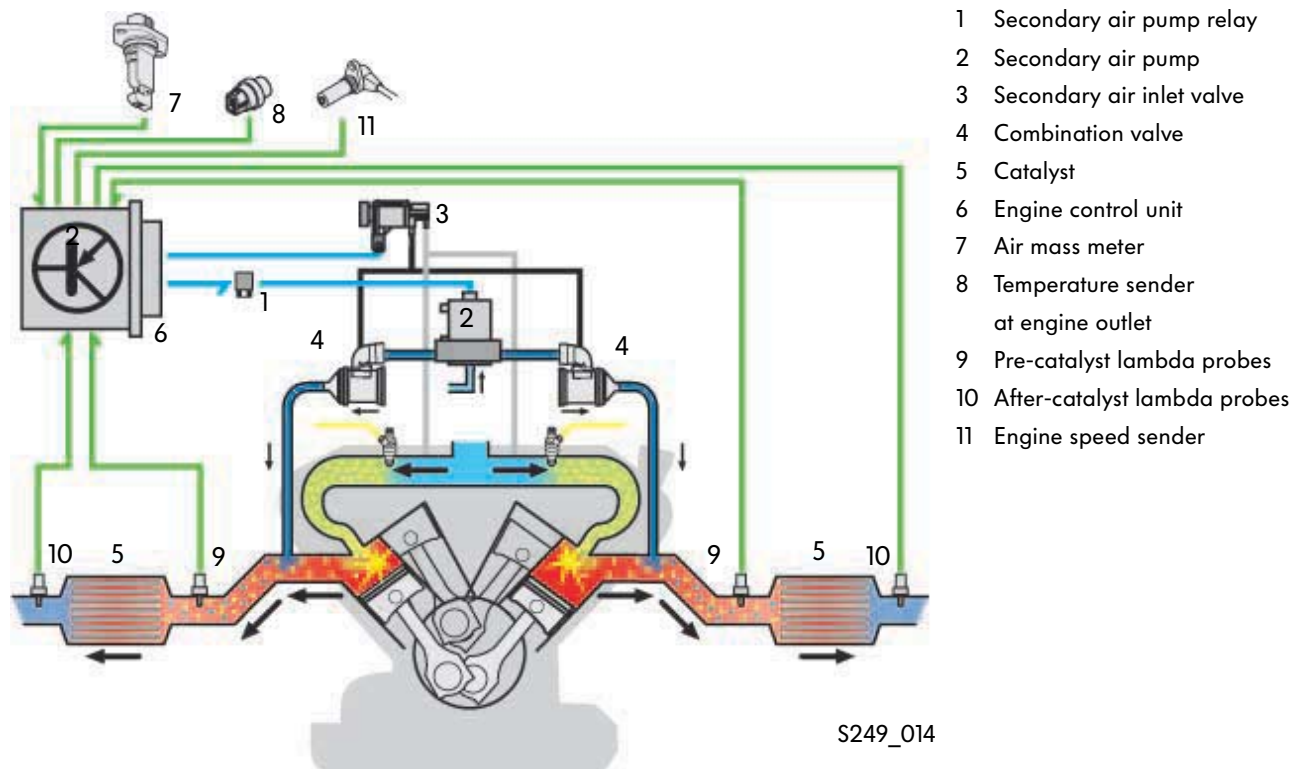
For further information, please refer to SSP 210 „Electronic Power Control“.

Subsystems

The secondary air system

Input signals

- Signal from lambda probes
- Coolant temperature
- Engine load signal from air mass meter
- Engine speed



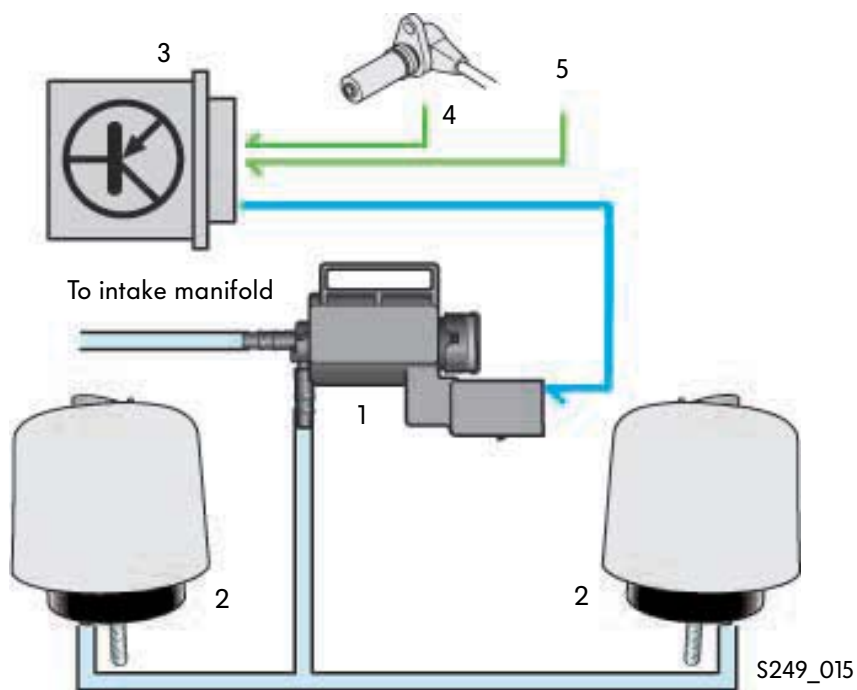
The secondary air system reduces the exhaust emissions following a cold start. During the warm-up phase, the level of unburned hydrocarbons is elevated. The catalyst cannot process this amount because it has not yet attained its operating temperature, but a mixture of $\lambda = 1$ must be attained. Blowing in air behind the exhaust valve enriches the exhaust gas with oxygen, and post-combustion occurs. The heat released warms the catalyst more quickly to its operating temperature.

The input signals enter the engine control unit, which then actuates the secondary air pump and the secondary air inlet valve simultaneously via the secondary air pump relay. Vacuum from the secondary air inlet valve operates the combination valve. The secondary air pump briefly forces air into the exhaust gas stream behind the exhaust valve. Beginning at partial load, the secondary air system is switched off.

Engine mounting regulation

Input signals

- Signal from engine speed sender
- Vehicle speed



- 1 Electro-hydraulic engine mounting solenoid valve
- 2 Engine mounting
- 3 Engine control unit
- 4 Engine speed sender
- 5 Vehicle speed



The hydraulically damped engine mountings with electro-pneumatic actuation reduce the transmission of engine oscillation to the body over the entire engine speed range.

Depending on the engine speed and the vehicle speed, the engine control unit actuates the solenoid valve. The solenoid valve switches between the damped engine mounting state in idling mode and the undamped engine mounting state in driving mode.

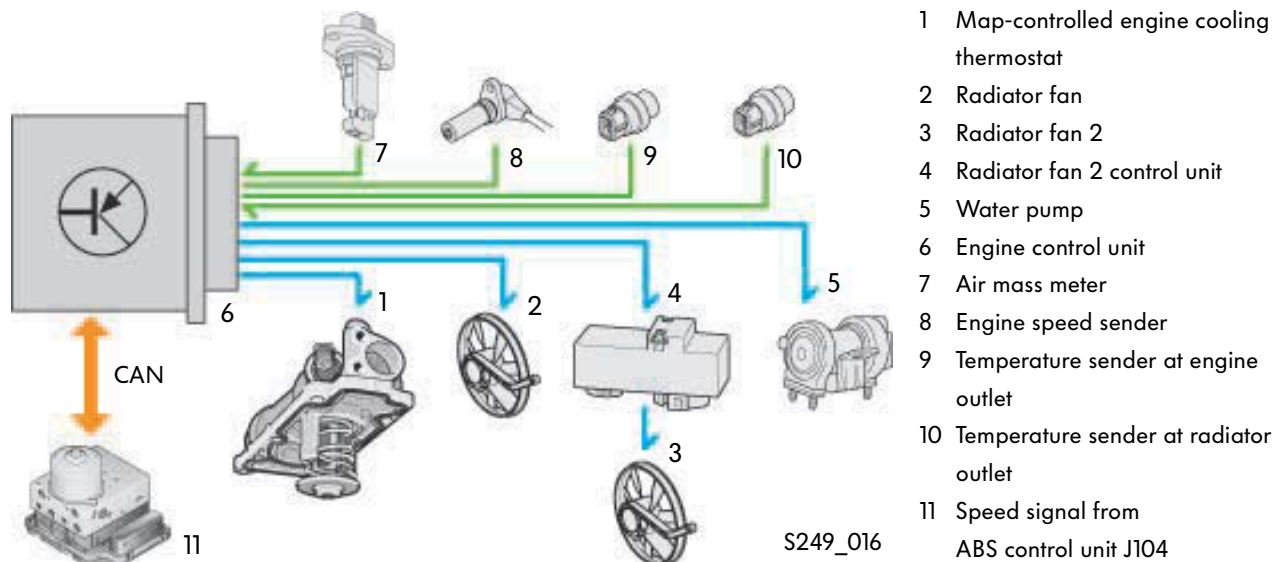
Subsystems

Coolant temperature regulation

Coolant temperature regulation enables the coolant temperature to be adapted to the current operating mode of the engine.

Input signals

- Engine speed
- Engine load signal from air mass meter
- Coolant temperature at engine outlet
- Coolant temperature at radiator outlet
- Vehicle speed



If, after the input signals have been evaluated, a larger cooling capacity is required, the map-controlled engine cooling thermostat is actuated, opening the larger coolant circuit. To increase the cooling capacity, both radiator fans are actuated by the engine control unit, whereby radiator fan 2 is switched on by the radiator fan 2 control unit.

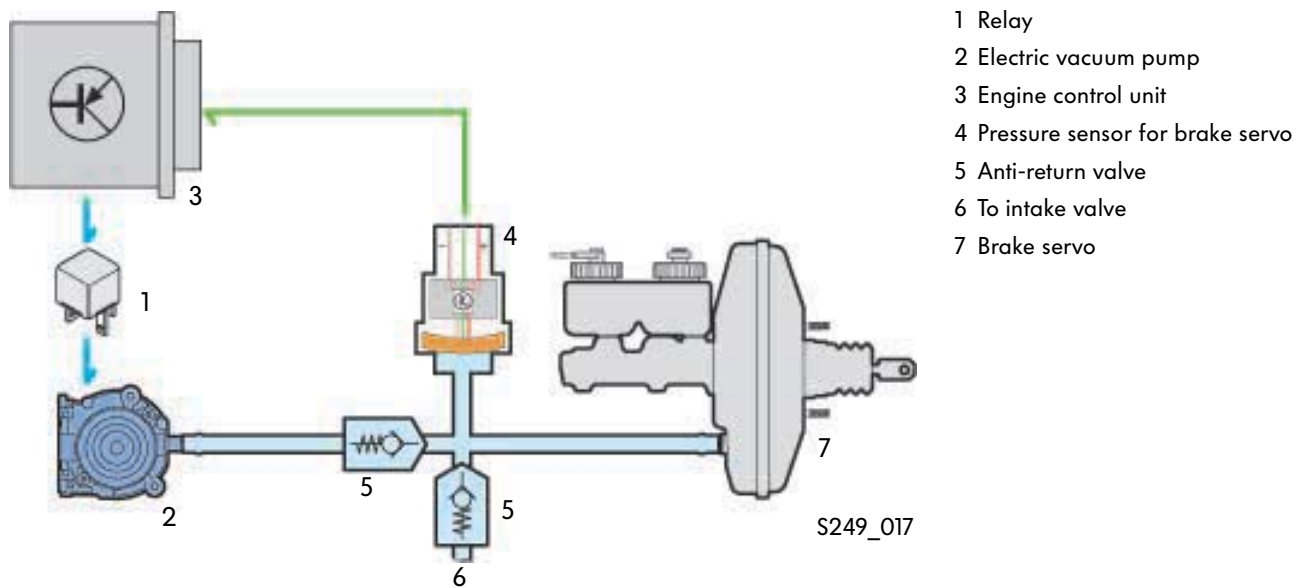


For further information, please refer to SSP 222 „Electronically Mapped Cooling System“.

The regulated vacuum pump system (only for vehicles with automatic gearboxes)

Input signals

- Signal from pressure sensor for brake servo



Vehicles with an automatic gearbox are equipped with an electric vacuum pump. This pump supports the brake servo by ensuring that there is sufficient vacuum at the connection point for the brake servo.

The pressure sensor measures the current pressure and sends this value to the engine control unit. The engine control unit compares the actual value with the stored specification and actuates vacuum pump for brakes V192 via brake servo relay J569.



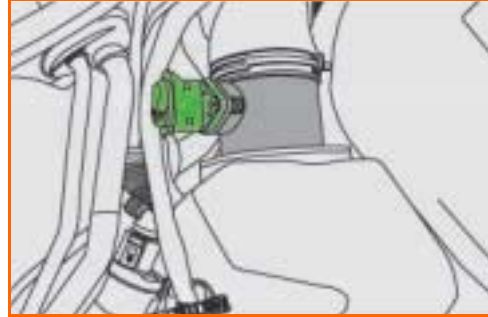
For further information, please refer to SSP 257 „Electronic Vacuum Pump for Brake Servo Unit“.



Sensors

Air mass meter G70 with intake air temperature sender G42

Air mass meter G70 with backflow recognition and intake air temperature sender G42 are integrated in one component which is located in the intake tract at the air filter housing. The air mass meter determines the mass of the inducted air and sender G42, the temperature.



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Use of the signal

The air mass meter signal is used for calculating all functions dependent on engine speed and load like, for example, injection period, ignition timing, variable valve timing and fuel tank ventilation.

Effects of failure

If the signal fails, the engine control unit calculates a substitute value.



For further information, please refer to SSP 195 and SSP 252.

Engine speed sender G28

The engine speed sender G28 is located in the gearbox housing. It senses the teeth of the dual-mass flywheel. On the basis of these signals, the engine control unit determines the engine speed and the crankshaft position.

The gap in the sender wheel serves as a reference point for the engine control unit.



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Use of the signal

This signal is used to calculate the injection time, the injection quantity and the ignition timing. Further, it is used for variable valve timing and tank ventilation.

Effects of failure

If the signal fails, the engine cannot run.



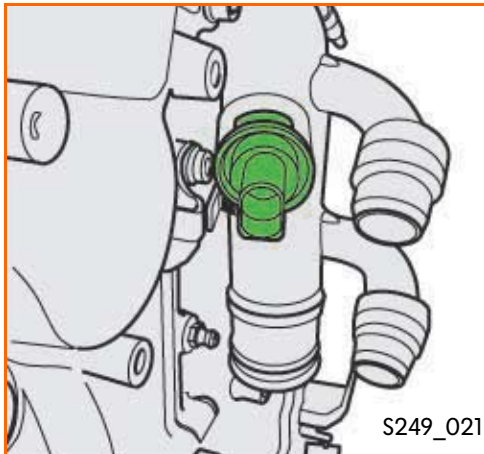
For further information, please refer to SSP 127 „VR 6 Engine“.

Coolant temperature senders G62 and G83



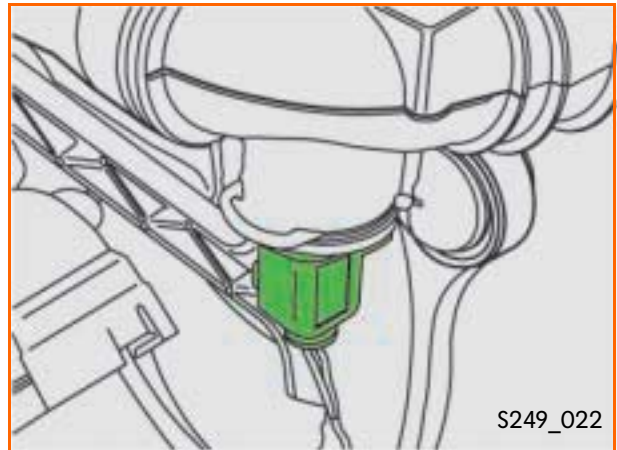
Sender G62

Coolant outlet at rear of engine



The actual values of the coolant temperature are measured at two different points. Coolant temperature sender G62 is located on the engine block (at the coolant outlet) and coolant temperature sender G83 on the radiator outlet.

Sender G83 at radiator outlet



Use of signal

The signals of both temperature senders G62 and G83 serve the coolant temperature regulation in the coolant circuit.

The signal from temperature sender G62 is used as an input signal for calculating injection periods and ignition timing, for idling speed regulation, for fuel tank ventilation and for the secondary air system.

Effects of signal failure

If the signal fails, the control unit uses a substitute temperature stored in it. The fans go into emergency operation (both fans run).



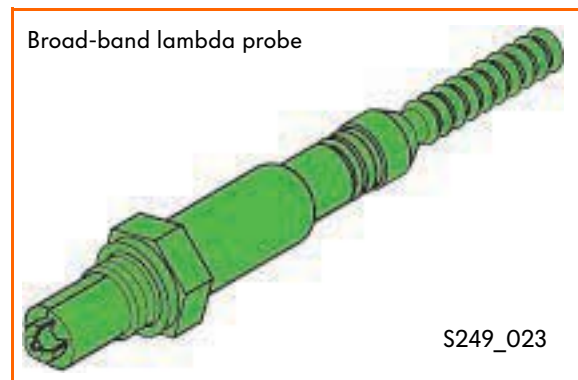
For further information, please refer to SSP 222 „Electronically Mapped Cooling System“.

Sensors

Lambda probes

The broad-band lambda probes G39, G108

Each is located in the exhaust manifold of its specific bank upstream to the catalyst (pre-catalyst probe). With the wide-band lambda probe, the oxygen content in the exhaust gas can be determined over a wide measuring range.



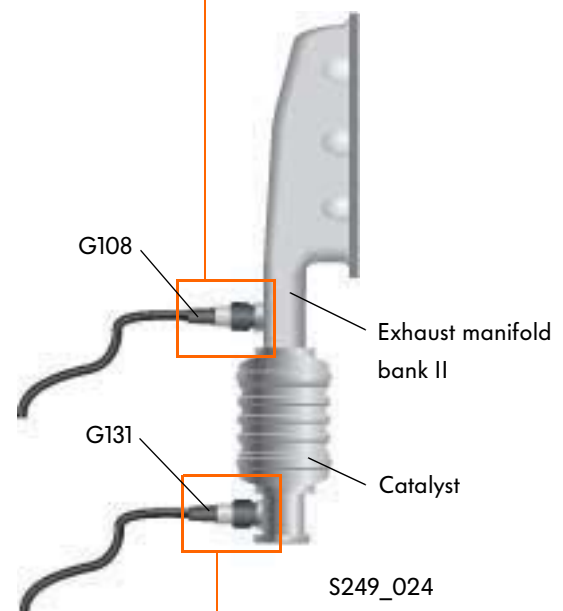
The two-state lambda probes G130, G131

Each is located in the exhaust manifold of its specific bank downstream to the catalyst (after-catalyst probe).

Use of signal

The pre-catalyst probe supplies the signal for fuel-air mixture preparation.

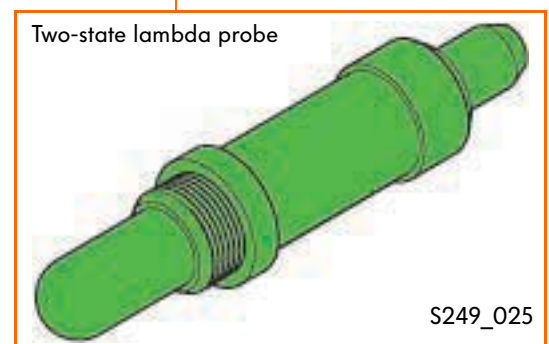
The after-catalyst probe serves for checking the function of the catalyst and the lambda regulation loop.



Effects of signal failure

If the pre-catalyst probe fails, no lambda regulation can occur. Adaptation is blocked. Emergency running dependent on map control takes place.

If the post-catalyst probe fails, lambda regulation continues. The function of the catalyst cannot be monitored.

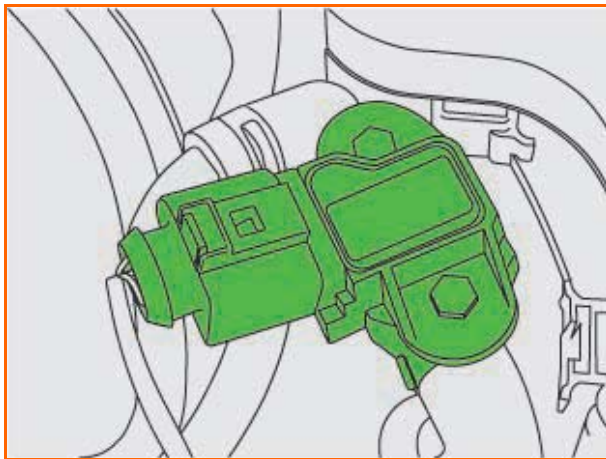


For further information, please refer to SSP 175 „On-Board Diagnose II“ and SSP 231 „Euro-On-Board-Diagnose“.

Brake servo pressure sensor G294 (only for vehicles with automatic gearbox)



The brake servo pressure sensor is located in the plenum chamber below the vacuum line to the brake servo. It transmits a voltage signal to the engine control unit.



Effects of signal failure

If the signal fails, the engine control unit calculates the pressure in the brake servo on the basis of the input values for engine load, engine speed, throttle valve position and brake light switch, and actuates the vacuum pump.

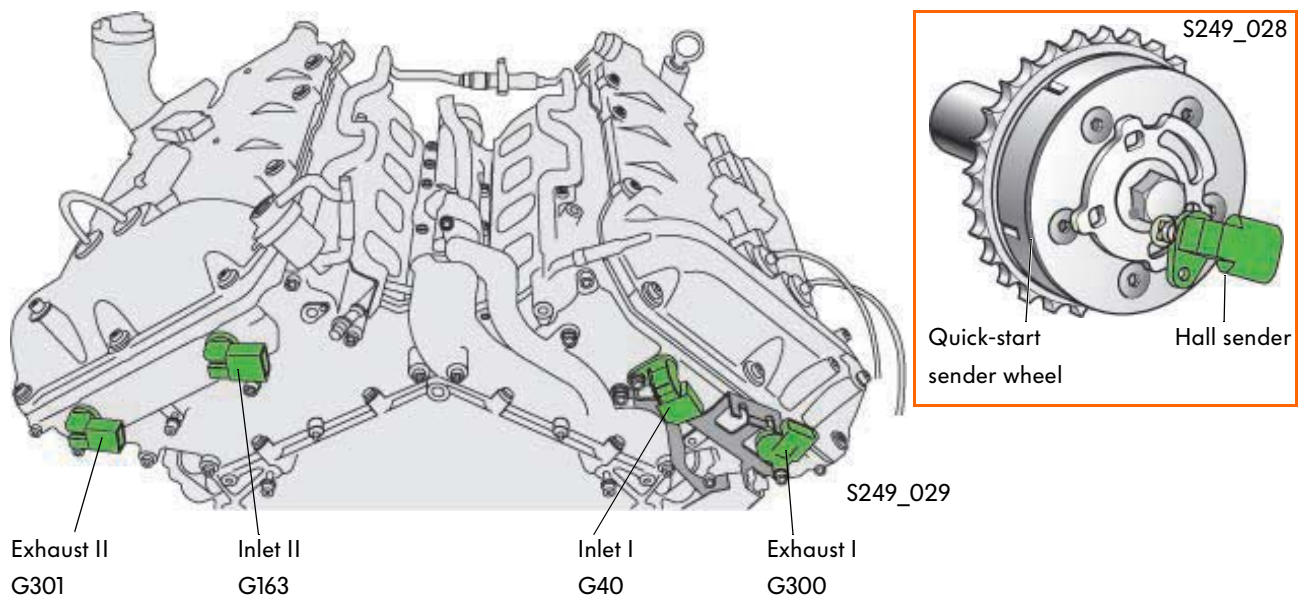


For further information, please refer to SSP 257 „Electronic Vacuum Pump for Brake Servo Unit“.

Sensors

Hall senders G40, G163, G300, G301

All Hall senders are located in the timing chain cover of the engine. They have the task of informing the engine control unit of the positions of the inlet and exhaust camshafts by sensing a quick-start sender wheel located on the respective camshaft.



Use of signal

Hall senders G40 and G163 indicate to the engine control unit the positions of the inlet camshafts and Hall senders G300 and G301, the positions of the exhaust camshafts.

The signals of all four Hall senders serve as input signals for variable valve timing as well as for the calculation of sequential injection and ignition timing.

The signal from sender G40 is also used for determining the TDC point of the No. 1 cylinder.

Effects of signal failure

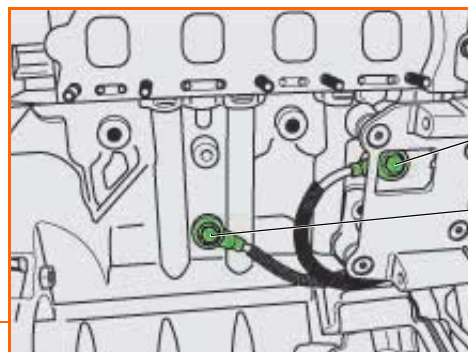
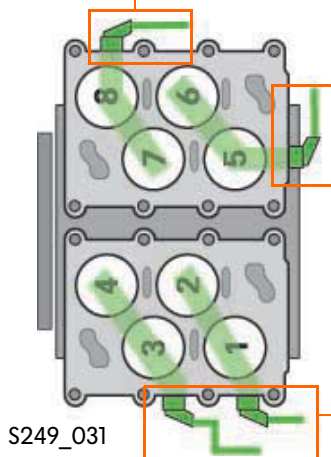
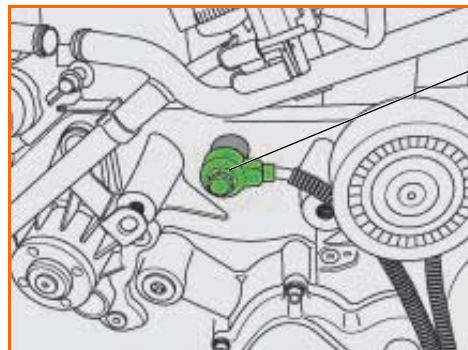
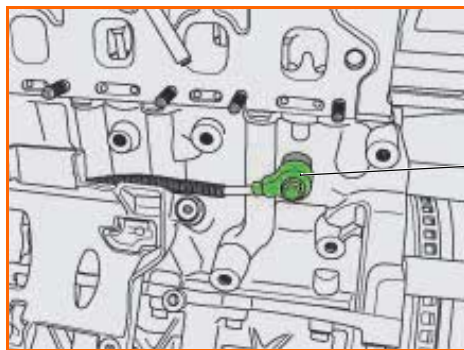
If a Hall sender fails, the camshafts cannot be adjusted. However, the engine continues to run, and will also start again after it is shut off.



For further information, please refer to SSP 127 „VR 6 Engine“.

Knock sensors G61, G66, G198, G199

The electronic regulation of ignition timing is based on cylinder-specific knock control. The W8 engine has two knock sensors on each bank, located on the crankcase.



Use of signal

The knock sensors indicate to the engine control unit when knocking combustion occurs. It initiates an ignition timing adjustment until the knocking ceases.

Effects of signal failure

If a knock sensor fails, the ignition timing of the affected cylinders is retarded. If all knock sensors fail, the engine management system switches to emergency knock control, during which the ignition timing is generally retarded so that the maximum engine output is not available.



For further information, please refer to SSP 127 „VR 6 Engine“.

Sensors

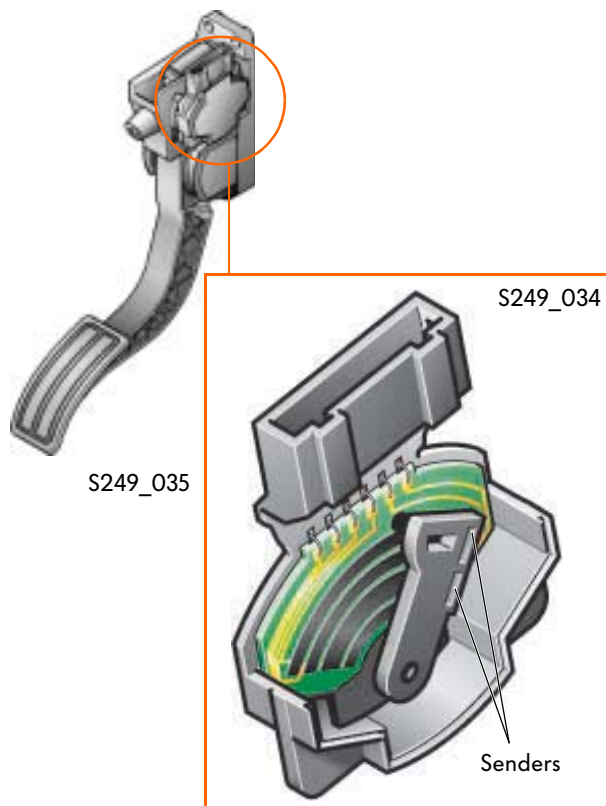
The accelerator pedal module

The accelerator pedal module is located on the pedal cluster and consists of

- the accelerator pedal
- the accelerator pedal position sender G79 and
- the accelerator pedal position sender 2 G185.

Both senders are sliding contact potentiometers located on a common shaft.

Every change in the accelerator pedal position changes the resistance of the sliding contact potentiometers and consequently the voltage transmitted to the engine control unit.



Use of signal

The signals from the accelerator pedal position senders serve to communicate the driver's input to the engine control unit and also as kickdown information for the automatic gearbox.



No separate switch is used for kickdown information. A mechanical pressure point is integrated in the gas pedal module which communicates the „kickdown feeling“ to the driver.



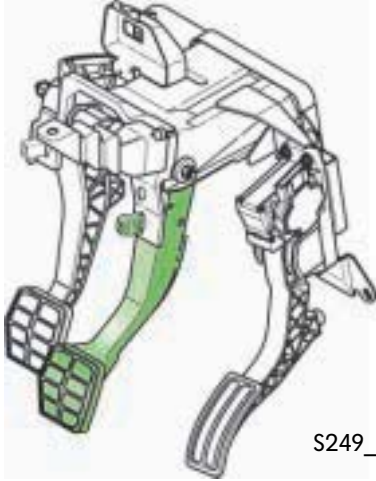
For further information, please refer to SSP 210 „Electronic Power Control“.

Effects of signal failure

If a sender fails, the pedal value is limited to a defined value. At full load, the output is increased slowly. If the signals between G79 and G185 implausible, the lower value is used. The EPC (electronic power control) warning lamp indicates a fault.

If both senders fail, the engine will run only at idle and does not respond to the accelerator pedal. The EPC (electronic power control) warning lamp indicates a fault.

Brake light switch F and brake pedal switch F47



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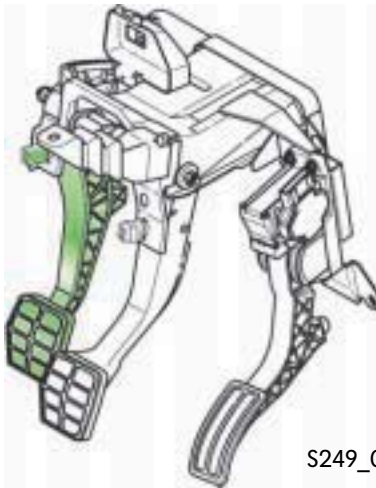
The brake light switch and the brake pedal switch are located together in one component on the pedal cluster.

Use of signal:

Both switches supply the engine control unit with the signal „brake operated“. This leads to the cruise control system being switched off.



Clutch pedal switch F36



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The clutch pedal switch is located on the pedal cluster.

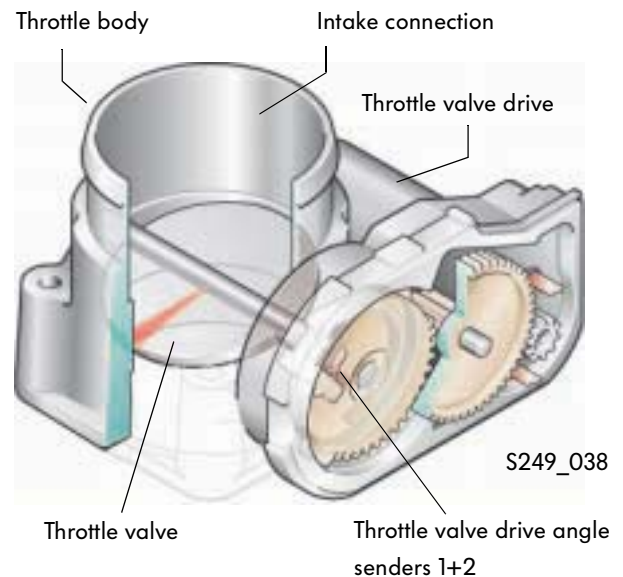
Use of signal

The signal indicates to the engine control unit when the clutch pedal is operated, at which point the cruise control system is switched off. When the clutch pedal is operated, the quantity of fuel injected is briefly reduced to prevent the engine speed from increasing while the gear is changed, reducing the jolt when load returns.

Throttle valve control part J338

The throttle valve control part is located on the intake manifold and has the task of providing the engine with the required quantity of air under all conditions.

It differs from the control part installed in the VR6 engine in that the intake connection has a greater diameter. This is necessary because the W8 engine has a greater need for air due to its greater displacement. Further, the connection for throttle valve heating has been eliminated.



To open or close the throttle valve as well as to adjust a particular throttle valve setting, the engine control unit actuates the electric motor for throttle valve drive.

Both angle senders transmit the current position of the throttle valve to the engine control unit.

Effects of signal failure

If the throttle valve drive fails, the throttle valve is automatically drawn to the emergency running position, permitting limited operation with an increased idling speed.

If an angle sender fails, the maximum output will not be available.

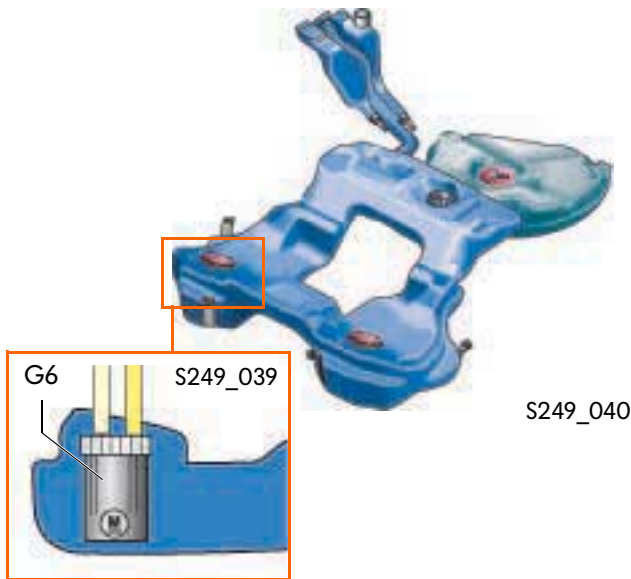
However, the engine can be started and the vehicle driven.

If both angle senders fail, the throttle valve drive is switched off. The engine will only run at an increased idling speed.



For further information, please refer to SSP 210 „Electronic Power Control“.

Fuel pump G6



The fuel pump is installed directly in the fuel tank. With the aid of the pressure regulator, it creates a pressure of 4 bar in the fuel system. To supply the engine, fuel is delivered from the fuel pump G6 through the fuel filter to the fuel rail.

Effects of failure

If the fuel pump fails, no fuel is delivered. The engine stops.

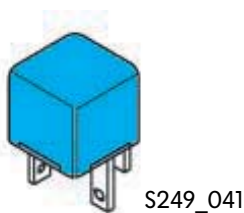


In addition, fuel pump G23 is located in the additional fuel tank and a suction-jet pump in the fuel tank. The fuel pump G23 is actuated by fuel pump control unit J538 and delivers fuel from the additional fuel tank to the main fuel tank. The suction-jet pump ensures that fuel from the left chamber of the fuel tank reaches the fuel pump G6. Neither fuel pump G23 nor the suction-jet pump are actuated by the engine control unit.



For further information, please refer to SSP 261 „The Passat W8“.

Fuel pump relay J 17



The fuel pump relay actuates the fuel pump when it receives an impulse from the engine control unit.

Effects of failure

If the relay fails, the engine cannot be started.

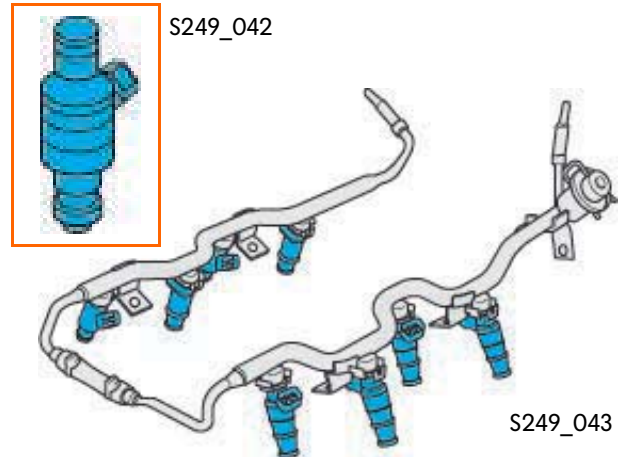


For further information, please refer to SSP 127 „VR 6 Engine“.

Actuators

Injectors N30, N31, N32, N33, N83, N84, N85, N86

The injectors are actuated by the engine control unit according to the firing order. They are secured with retaining clips directly to a common fuel rail and inject atomised fuel immediately before the inlet valve.



Effects of failure

If individual injectors fail, fuel is not injected at that position. This means that the engine runs at reduced output.

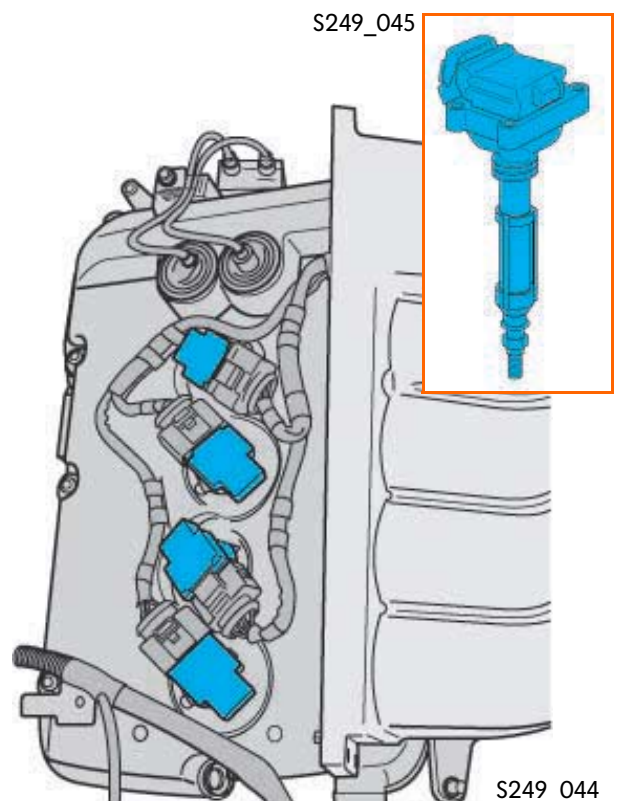


For further information, please refer to SSP 127 „VR 6 Engine“.

Single-spark ignition coils N70, N127, N291, N292, N323, N324, N325, N326

The single-spark ignition coils deliver only one spark via the spark plugs, and one is fitted at each cylinder.

An output stage and an ignition coil are combined in each element so that the engine management system can influence the ignition individually for each cylinder.



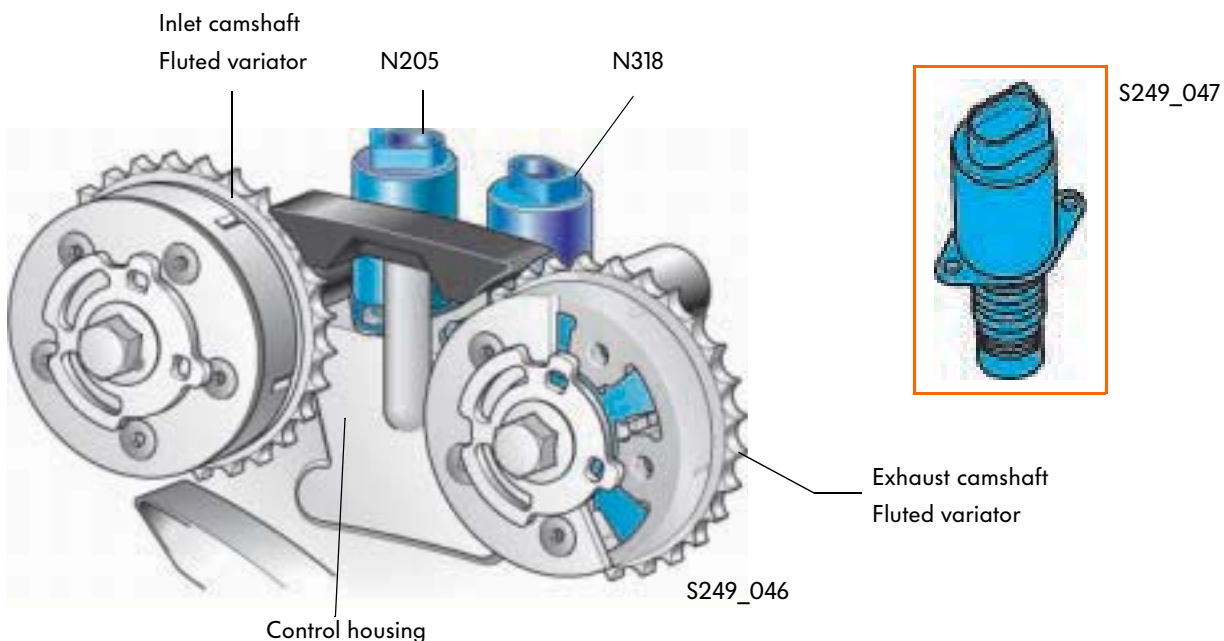
Effects of failure

If an ignition coil fails, injection is switched off for that cylinder. This prevents damage to the catalyst.

Inlet camshaft timing adjustment valves 1 N205 and 2 N208 and Exhaust camshaft timing adjustment valves 1 N318 and 2 N319

The solenoid valves are integrated in the control housing of the camshaft adjuster. They direct the oil pressure to the camshaft adjusters according to the specifications of the engine control unit in regard to the direction and distance of adjustment. Fluted variators are used as camshaft adjusters.

In the process, valves N205 and N208 are responsible for the continuous adjustment of the inlet camshafts and valves N318 and N319, for the adjustment of the exhaust camshafts. The exhaust camshaft adjusters can only be set to the end positions „advanced“ or „retarded“.



Effects of signal failure

If an electrical wire to the camshaft adjusters is defective or if a camshaft adjuster fails, no camshaft adjustment can take place. In the event of an electrical fault, the camshafts remain in their reference positions (emergency running positions).



The reference point for all four camshafts is „retarded“.



For further information, please refer to SSP 246 „Variable Valve Timing with Fluted Variator“.



Actuators

Activated charcoal filter system solenoid valve 1 N80

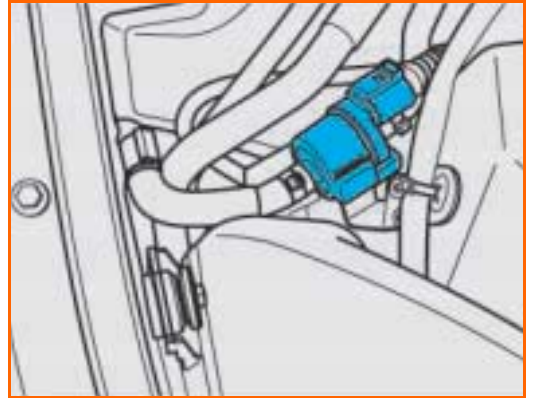
Opening the solenoid valve empties the activated charcoal filter and directs the collected fuel vapour to combustion.

Effects of signal failure

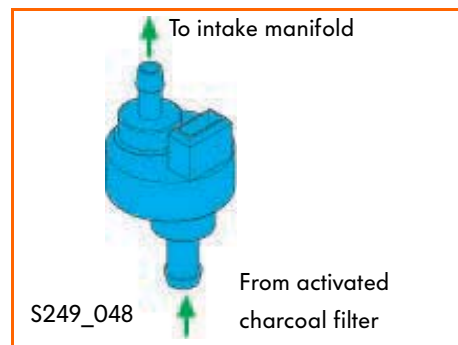
If current is interrupted, the valve remains shut and tank ventilation cannot occur.



For further information, please refer to SSP 174 „Changes in the VR6 Engine“.



S249_049



S249_048

From activated charcoal filter

Secondary air inlet valve N112

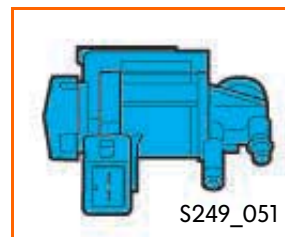
This solenoid valve is switched by the engine control unit and controls the combination valve via a vacuum line.

Effects of failure

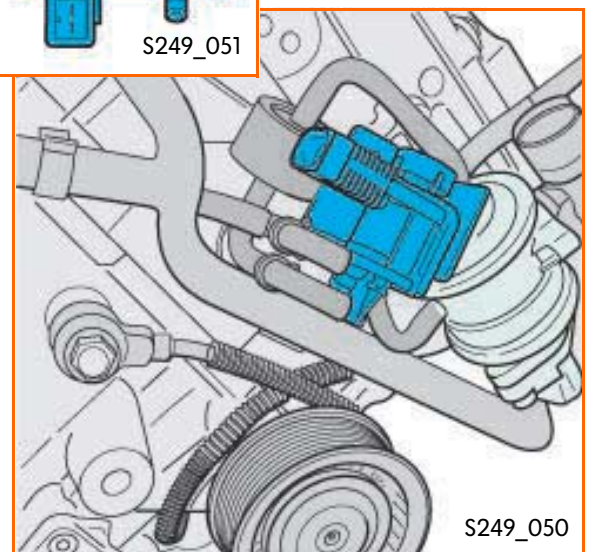
If the control unit signal fails, the combination valve cannot be opened.
The secondary air pump cannot inject air.



For further information, please refer to SSP 174 „Changes in the VR6 Engine“.

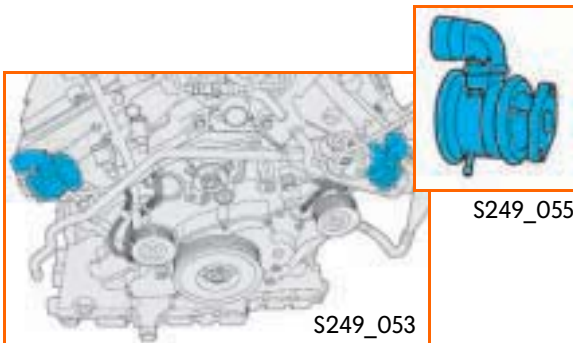


S249_051



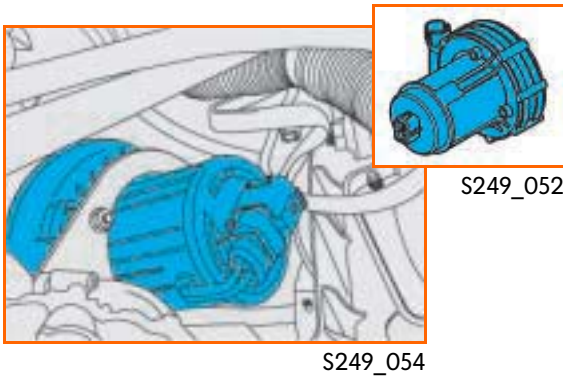
S249_050

Combination valve



Vacuum from the secondary air inlet valve operates the combination valve, opening the path for air from the secondary air pump to the secondary air duct in the cylinder head. At the same time, the valve prevents hot exhaust gases from reaching the secondary air pump.

Secondary air pump V101



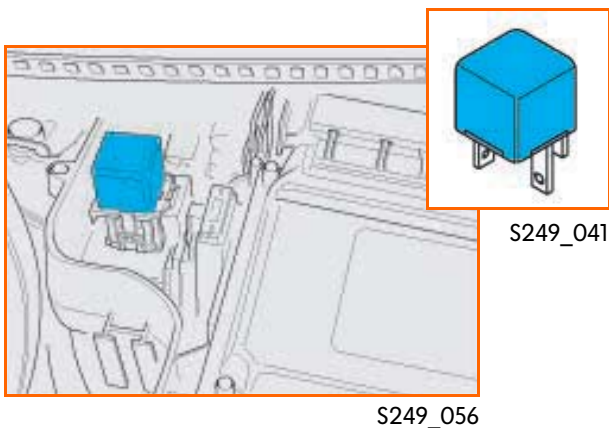
The secondary air pump transports fresh air for the secondary air system.

Effects of failure

If the current supply is interrupted, no air is transported.



Secondary air pump relay J299



The secondary air pump relay is actuated by the engine control unit to switch on the secondary air pump.

Effects of failure

The secondary air pump will not run.



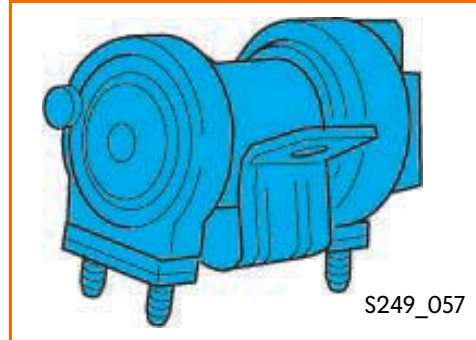
For further information, please refer to SSP 174 „Changes in the VR6 Engine“ and SSP 217 „The V8 V5 Engine“.

Actuators

Water pump V36

The water pump V36 is located on the left side (in direction of travel) of the engine compartment on the suspension strut mounting.

Depending on the coolant temperature at the radiator and engine outlets, the pump will be operated after the engine is shut off on the basis of a map. The water pump is responsible for circulating coolant so that the engine block cools uniformly.



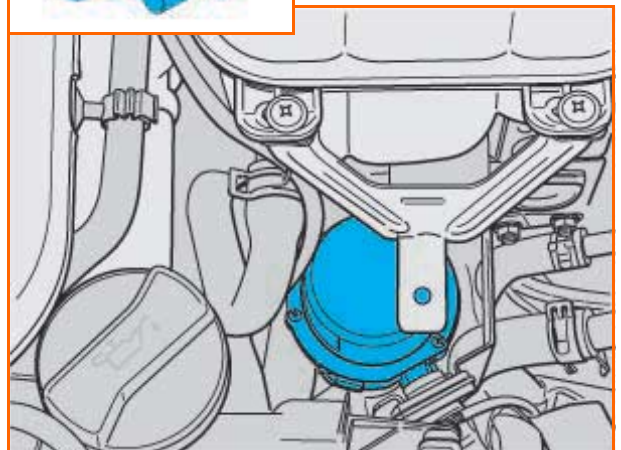
Vacuum pump for brake servo V192 (only for vehicles with automatic gearboxes)

The regulated electric vacuum pump is located on the left side of the engine compartment under a cover and supports the brake servo.



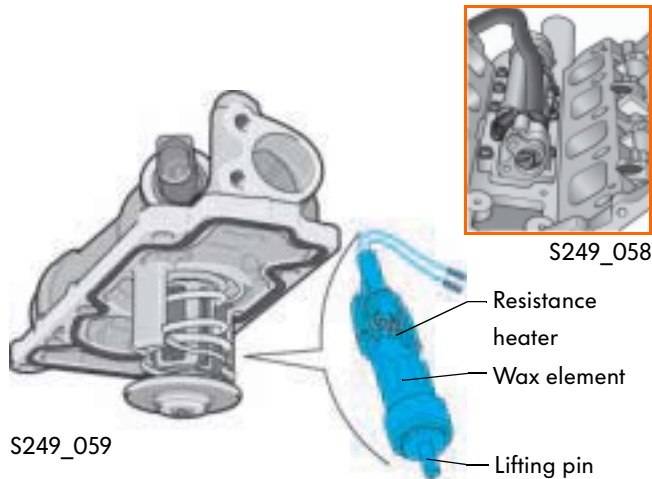
Effects of failure

Under certain circumstances (frequent braking) sufficient vacuum cannot be built up.



For further information, please refer to SSP 257 „Electronic Vacuum Pump for Brake Servo Unit“.

Map-controlled engine cooling thermostat F265



The thermostat is inserted in the upper part of the crankcase from above. The thermostat switches between the small and the large cooling circuits. The individual engine operating phases require different engine temperatures. The thermostat is actuated by the engine control unit according to the needs. A map is stored in the engine control unit to attain the desired temperature.

Effects of failure

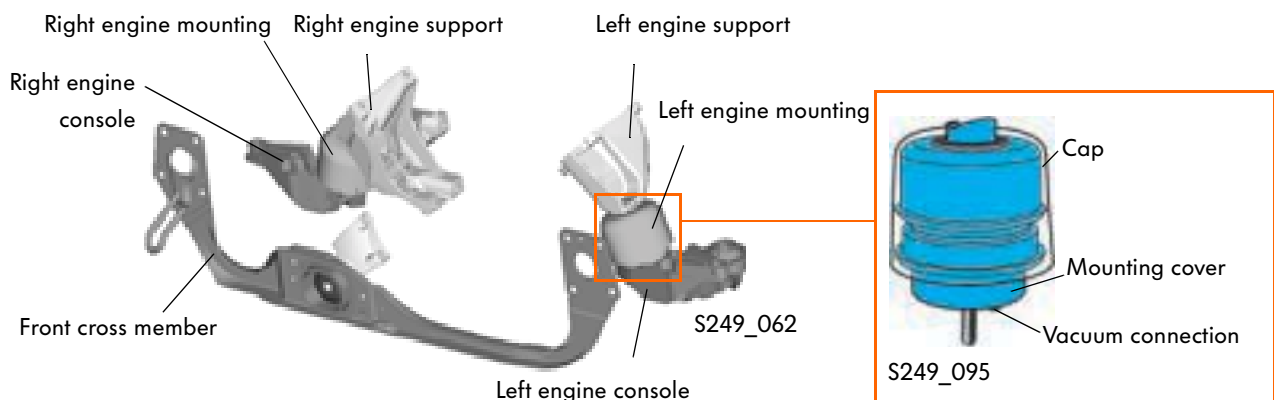
At a temperature of 110° C or above, the large cooling circuit is opened and the radiator fans are actuated.



For further information, please refer to SSP 222 „Electronically Mapped Cooling System“.

Engine mountings

Two hydraulically damped engine mountings ensure improved driving comfort. They reduce the transmission of engine vibration to the body.



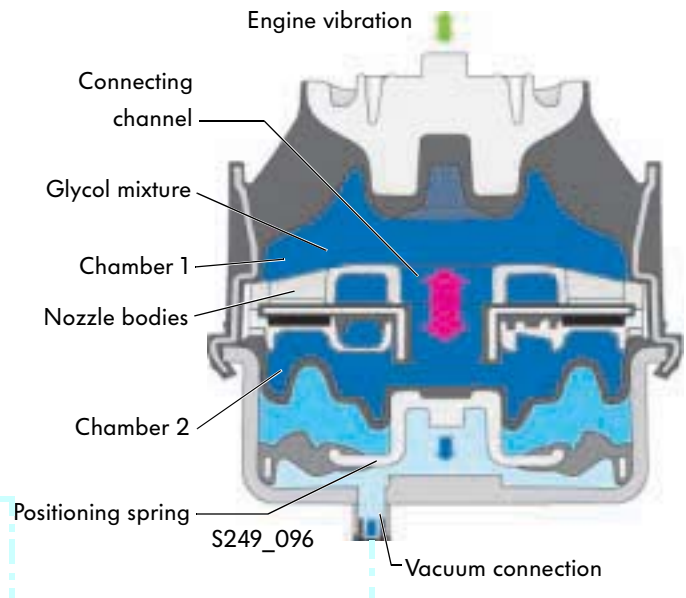
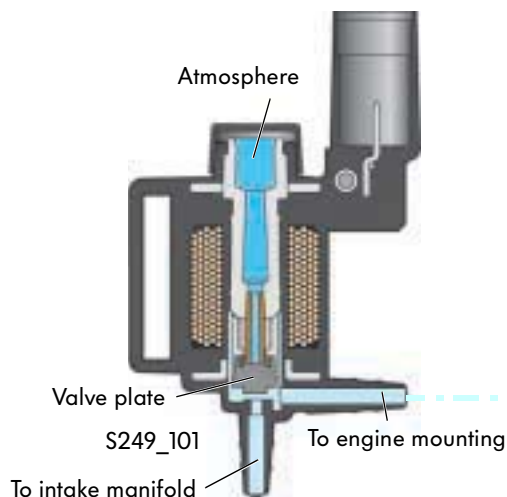
Actuators

Function of engine mountings

The engine oscillation on a bad road surface is damped by the flow of a liquid (glycol mixture) between chambers 1 and 2. The task of the damping is to reduce resonant engine oscillation due to uneven road surface. The damping is dependent on the form (length and diameter) of the spiral-shaped channel and is adapted to the particular engine in the vehicle.

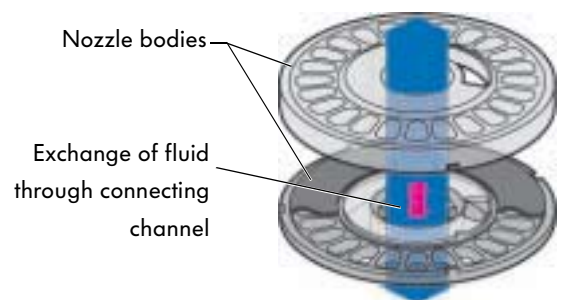
Engine mounting - idling position

Solenoid N144 under current



The engine mounting is pneumatically actuated by the 3/2-way solenoid. The electro-hydraulic engine mounting valve directs vacuum or atmospheric pressure to the positioning spring of the engine mounting. When current is applied, the valve plate lifts, opening the connection between the intake manifold and the engine mounting. The vacuum present at the vacuum connection of the engine mounting pulls the positioning spring downwards, which opens the connecting channel between chambers 1 and 2.

Opening the connecting channel changes the damping. The mounting is dynamically soft, which reduces the transmission of engine vibration at idling speed.



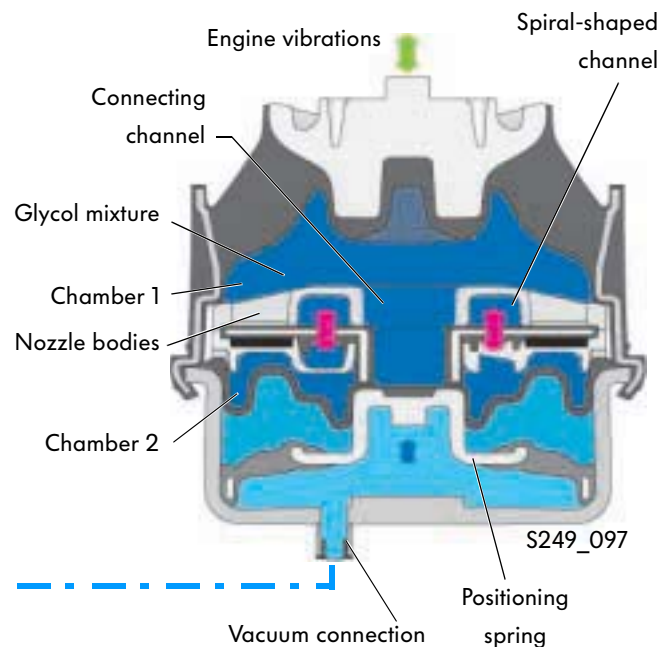
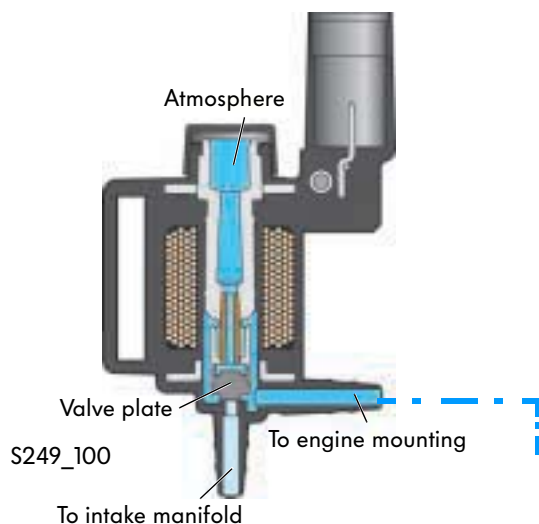
Engine mounting - driving mode

At a speed of about 5 km/h, the engine control unit cuts off current to the solenoid valve. The valve plate of the solenoid valve closes the connection to the intake manifold. Via the solenoid valve, atmospheric pressure reaches the positioning spring of the engine mounting.

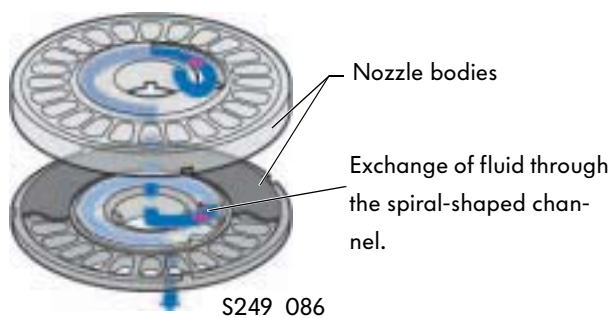
Due to the atmospheric pressure at the positioning spring, the connecting channel between chambers 1 and 2 closes. The exchange of fluid (glycol mixture) between the two chambers occurs through the spiral-shaped channel in the nozzle bodies.

Resting state

(no current to solenoid valve N144)



The damping characteristics (level of damping and resonance) are adapted to the requirements of the engine in the vehicle through the length and diameter of the spiral-shaped channel. The damping lies in the range of agitation by unevenness in the road.

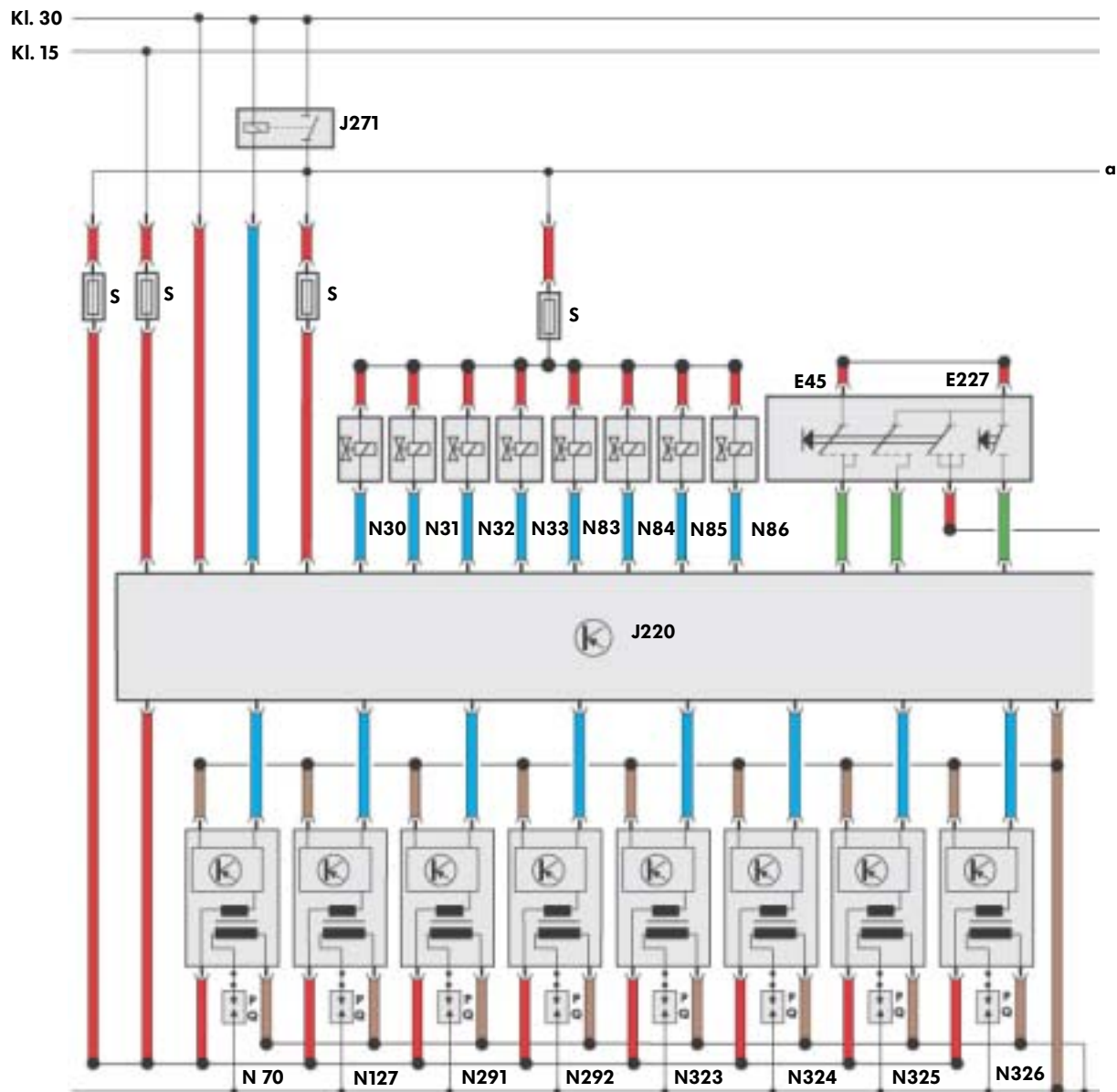


Effects of failure

The engine mountings characteristics below 5 km/h change.

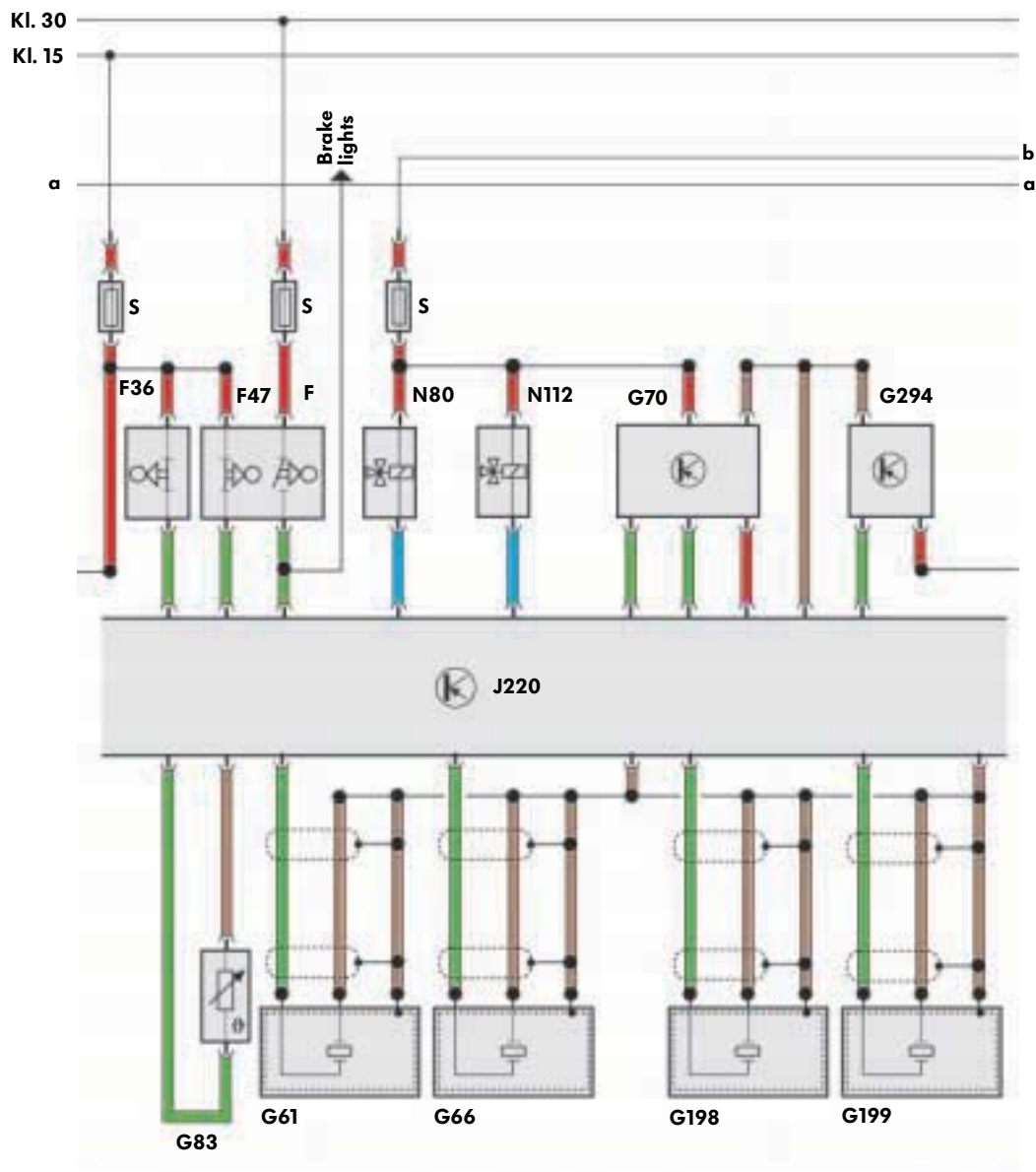
Functional diagram

Functional diagram



S249_070

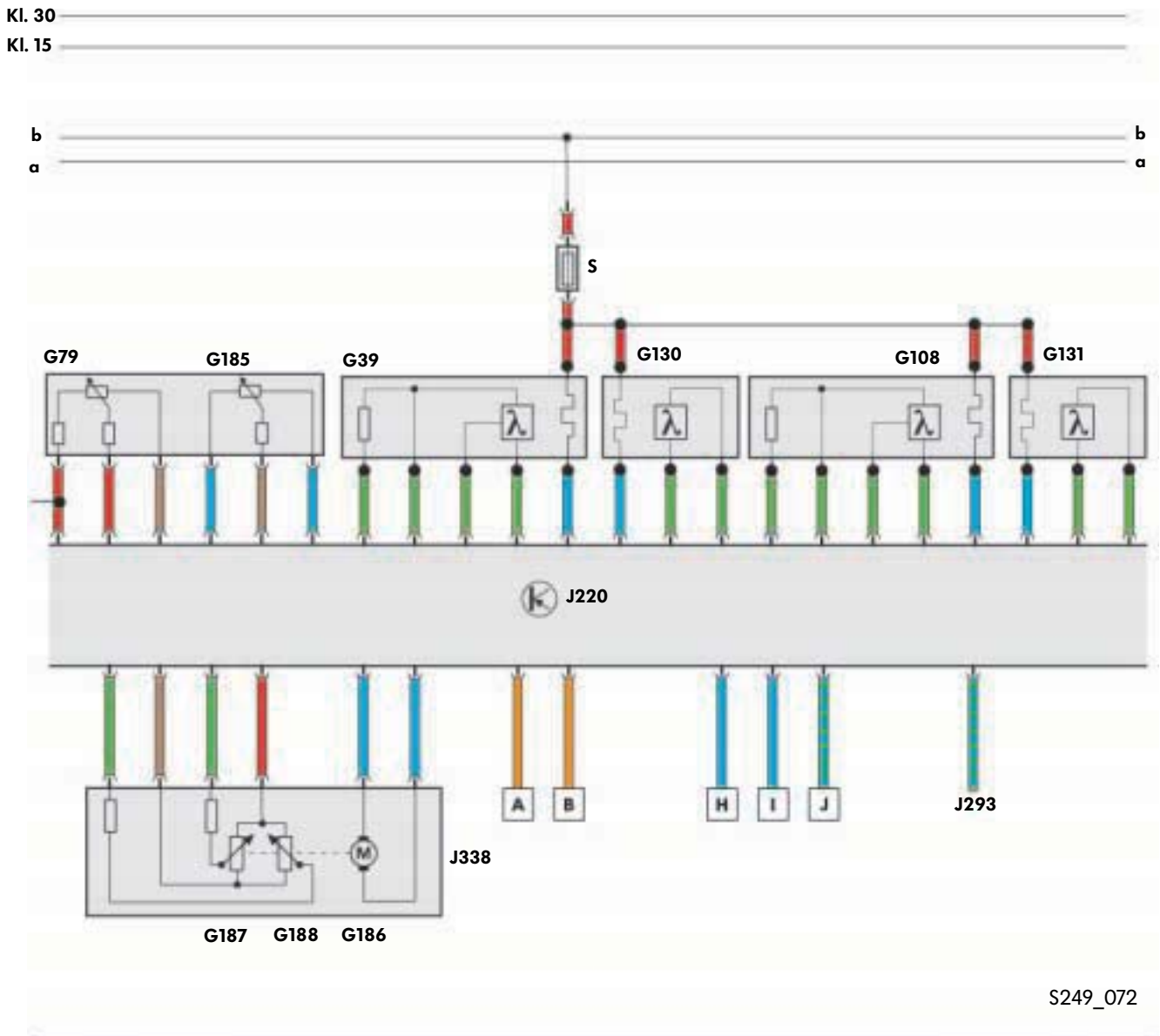
- | | |
|--------------------------------------|--------------------------|
| E45 - CCS switch | N70 - Ignition coil 1 |
| E227 - CCS button | N127 - Ignition coil 2 |
| J220 - Motronic control unit | N291 - Ignition coil 3 |
| J271 - Motronic current supply relay | N292 - Ignition coil 4 |
| N30 - Injector, cylinder 1 | N323 - Ignition coil 5 |
| N31 - Injector, cylinder 2 | N324 - Ignition coil 6 |
| N32 - Injector, cylinder 3 | N325 - Ignition coil 7 |
| N33 - Injector, cylinder 4 | N326 - Ignition coil 8 |
| N83 - Injector, cylinder 5 | P - Spark plug connector |
| N84 - Injector, cylinder 6 | Q - Spark plug |
| N85 - Injector, cylinder 7 | S - Fuse |
| N86 - Injector, cylinder 8 | |



S249_071



Functional diagram



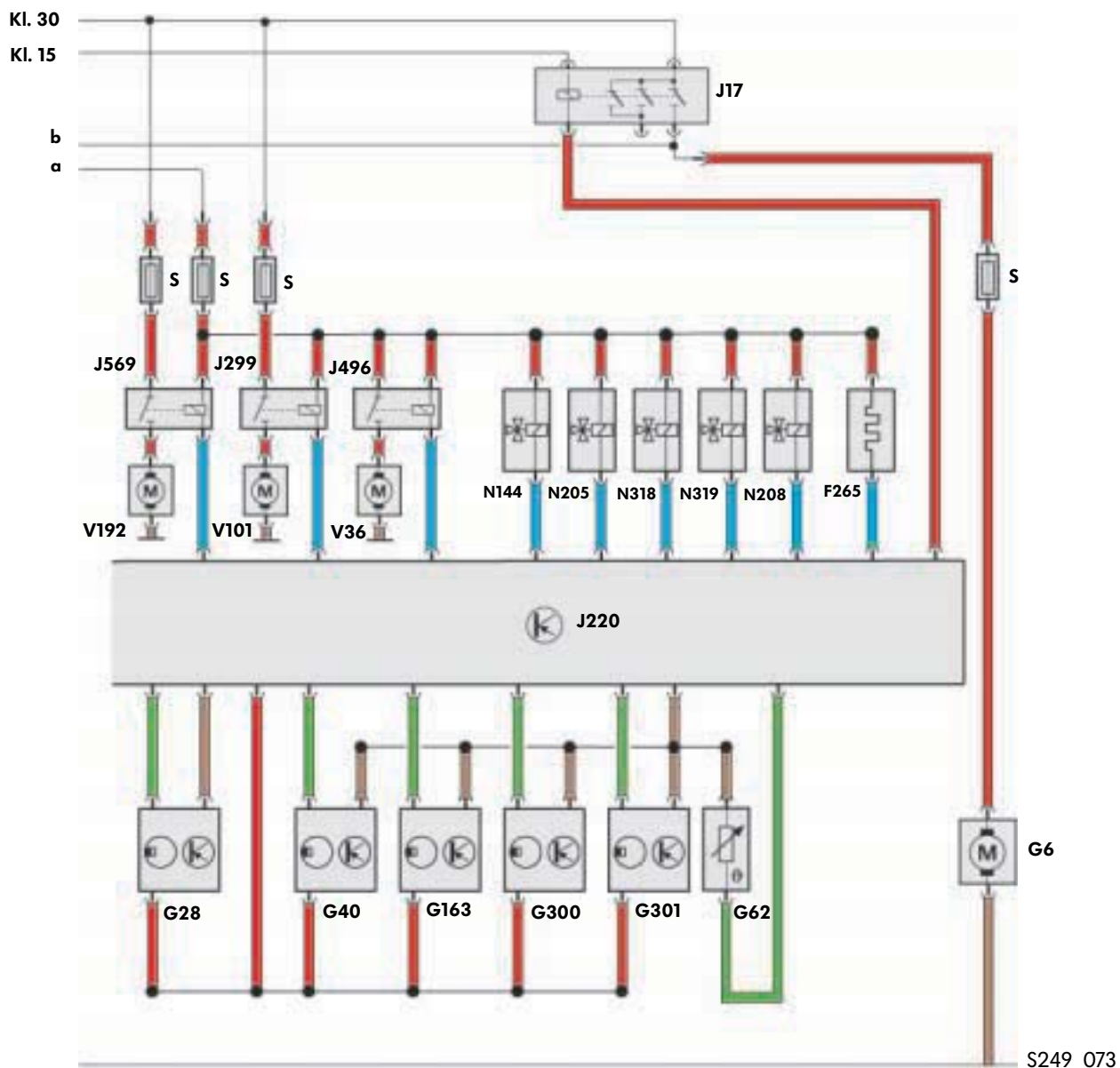
S249_072

- A - CAN Low
- B - CAN High
- G39 - Lambda probe
- G108 - Lambda probe II
- G130 - Lambda probe after catalyst
- G131 - Lambda probe II after catalyst
- G79 - Accelerator pedal position sender
- G185 - Accelerator pedal position sender 2
- G186 - Throttle valve drive
- G187 - Throttle valve drive angle sender 1
- G188 - Throttle valve drive angle sender 2
- H, I - Radiator fan control

- J - Diagnosis wire
- J220 - Motronic control unit
- J293 - Radiator fan control unit
- J338 - Throttle valve control part
- S - Fuse

Colour coding/Key

- = Input signal
- = Output signal
- = Positive
- = Earth
- = CAN data bus



F265 - Map-controlled engine cooling thermostat

G6 - Fuel pump

G28 - Engine speed sender

G40 - Hall sender 1

G163 - Hall sender 2

G300 - Hall sender 3

G301 - Hall sender 4

G62 - Coolant temperature sender

J17 - Fuel pump relay

J220 - Motronic control unit

J299 - Secondary air pump relay

J496 - Additional coolant pump relay

J569 - Brake servo relay

N144 - Electro-hydraulic engine mounting solenoid valve

N205 - Inlet camshaft timing adjustment valve 1

N208 - Inlet camshaft timing adjustment valve 2

N318 - Exhaust camshaft timing adjustment valve 1

N319 - Exhaust camshaft timing adjustment valve 2

S - Fuse

V36 - Water pump

V101 - Secondary air pump

V192 - Vacuum pump for brakes



Self-diagnosis

The engine control unit enables a broad self-diagnosis of all subsystems and electrical components.

These vehicle diagnosis systems are used for communication:

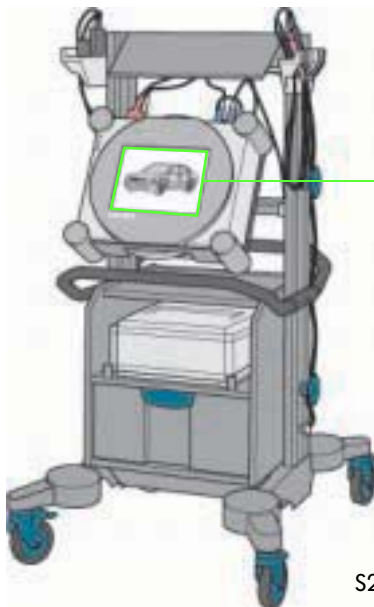
- **VAS 5051**
- **VAS 5052**

With the vehicle diagnosis, testing and information system VAS 5051,

- **Vehicle self-diagnosis**
- **Testing**
- **Guided fault finding** and
- **Administration**

can be performed.

VAS 5051



S249_080



S249_089



The use of the vehicle diagnosis system VAS 5051 is explained in SSP 202 „Vehicle Diagnosis, Testing and Information System VAS 5051“.

With the vehicle diagnosis and service information system VAS 5052,

- **Vehicle self-diagnosis**
- **Service Information System** and
- **Administration**

can be performed.

VAS 5052



S249_081



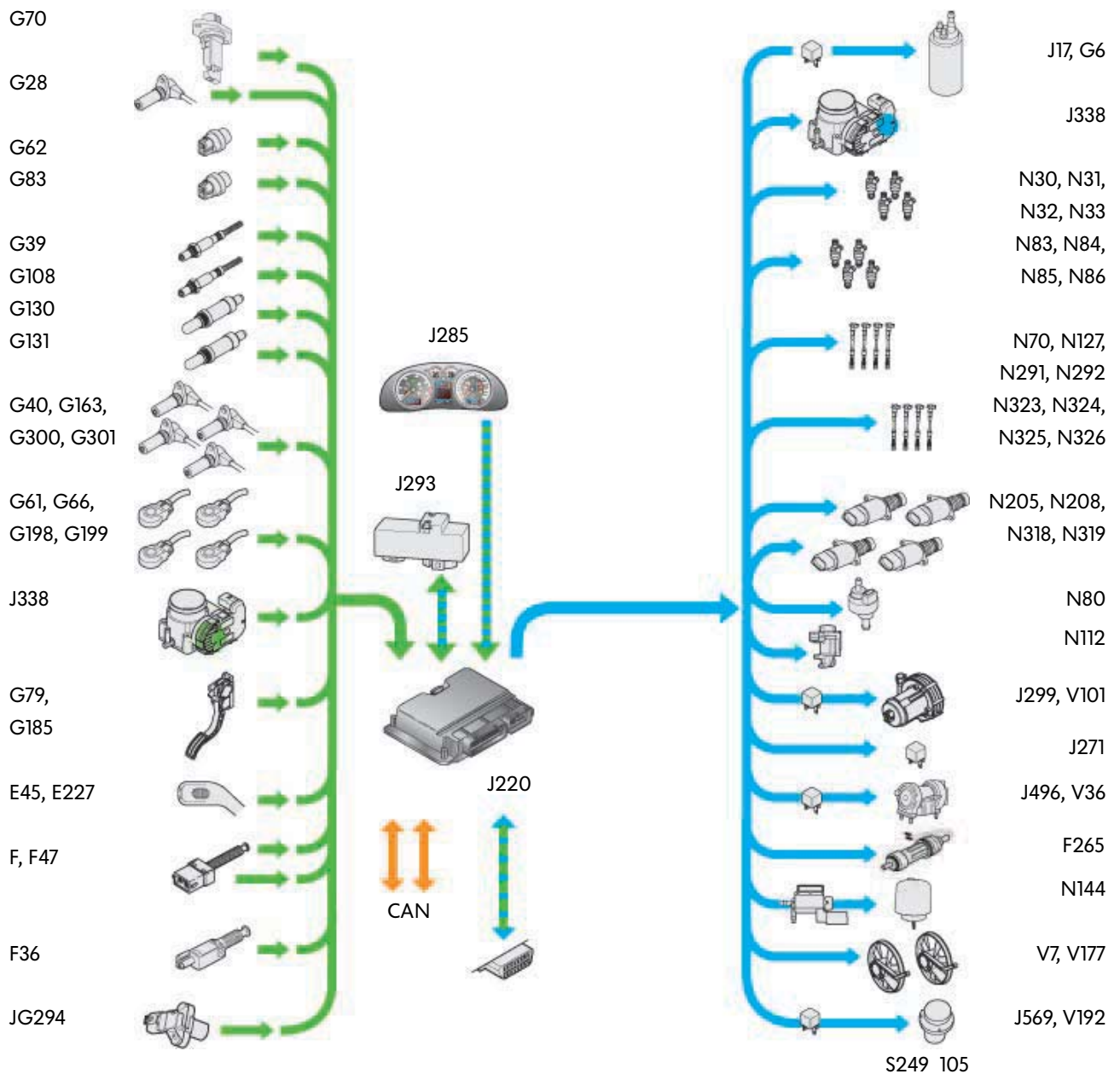
The use of the vehicle diagnosis system VAS 5052 is explained in SSP 256 „VAS 5052“.



Read fault memory

When faults occur in the system, they will be detected by self-diagnosis and stored in the fault memory. With function 02, the fault memory can be read using the vehicle diagnosis systems.

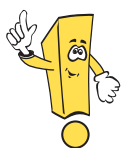
The following components are monitored by self-diagnosis.



Please note that Repair group 01 is integrated in „Guided fault finding“. In it, you will also find the functions „Read measured value block“ and „Final control diagnosis“.

Erase fault memory

This function erases the contents of the fault memory following „Read fault memory“. However, the readiness code and various adaptation values such as the camshaft and lambda adaptation values will also be erased. To ensure that the fault memory is properly erased, the ignition must be switched off once.



Following „Erase fault memory“, one must check whether the camshafts have readapted themselves. Without adaptation, camshaft adjustment will not occur, resulting in a noticeable loss in power. There are two ways to adapt the camshafts:

- Idle the engine briefly after erasing the fault memory and restarting the engine.
- Initiate basic settings following the instructions in the workshop manual.

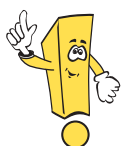


Erasing the fault memory should be carefully considered because the readiness code will be erased simultaneously, and „Create readiness code“ will be required.

The readiness code must always be created following a repair so that it will not be erased in the course of further work. The readiness code can be created with the VAS 5051 using the function „Guided fault finding“.

Readiness code

After the entire number of diagnoses has been performed, an 8-digit readiness code is set. Each position of the number code may have the value 0 (diagnosis performed) or 1 (diagnosis not performed). The readiness code does not provide any information about whether a fault exists in the system. A lit-up exhaust warning lamp is the visual indication of one or more detected and stored faults.



A vehicle must only leave the workshop and be delivered to the customer after the readiness code has been generated.



For more information about the readiness code, please refer to SSP 175 as well as SSP 231.

Test Your Knowledge

1. The engine control unit receives the signal for engine load from

- ☐ a. the lambda probes.
- ☐ b. the air mass meter.
- ☐ c. the accelerator pedal module.

2. Which tasks does the secondary air system perform?

- ☐ a. It elevates exhaust emissions during the cold start phase.
- ☐ b. It ensures that the engine operates with excess air.
- ☐ c. The secondary air system increases performance in the partial-load range.
- ☐ d. Secondary air injection brings the catalyst up to operating temperature more quickly.

3. What is the task of the brake servo pressure sensor G294?

- ☐ a. The signal identifies faults in the brake system.
- ☐ b. In brake systems with ESP, the pressure sensor is screwed directly into the hydraulic unit and measures the current pressure in the brake system.
- ☐ c. The pressure sensor measures the momentary pressure at the connection for the brake servo.

4. The coolant temperature is regulated using a map stored in the engine control unit. The coolant temperature in any engine operating mode

- ☐ a. is measured by a temperature sender and transmitted to the engine control unit.
- ☐ b. is measured by two temperature senders and transmitted to the engine control unit.



5. If a temperature sender fails

- ☐ a. the radiator fans go to emergency running mode.
- ☐ b. the engine stops.
- ☐ c. the control unit uses a substitute temperature stored in the engine control unit.

6. The electro-hydraulic engine mountings can change in their mounting characteristic. A pneumatic 3/2-way solenoid valve is actuated by the engine control unit. Which statements are true?

- ☐ a. Current is supplied to the solenoid valve at 5 km/h.
- ☐ b. Current is cut off to the solenoid valve at 5 km/h.
- ☐ c. Current is supplied to the solenoid valve at idling speed.
- ☐ d. The characteristic of the engine mounting when the solenoid does not receive current is dynamically „soft“.

7. The readiness code

- ☐ a. can be created with the VAS 5051 using the function „Guided fault finding“.
- ☐ b. is an 8-digit code. From this code, one can determine whether the diagnoses were performed or not.
- ☐ c. provides information about faults which exist in the system.



Notes



Notes


- 1.) b
- 2.) d
- 3.) c
- 4.) b
- 5.) a, c
- 6.) b, c
- 7.) a, b



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