Service.

Self-Study Programme 250

Engine Management for the Phaeton W12 Engine

Design and Function

The Motronic engine management system for the W12 engine allows high engine performance with low fuel consumption by adapting to all operating conditions. At the heart of the Motronic ME7.1.1 are two electronic control units. In contrast with the W8 engine, what is known as a two-control unit concept is used in the W12 engine. This concept regards the two cylinder banks as two separate engines. Essentially, each control unit is assigned to just one bank. Control unit 2 obtains information that has been entered only into Control unit 1 via the internal CAN databus. This internal CAN databus serves exclusively to exchange information between the engine control units.

This Self-Study Programme will familiarise you with the ME7.1.1 engine management system, the interaction between the two control units, the sensors, the actuators and individual subsystems.

S250_096

This SSP 250 is based on the information in SSP 248 "The W Engine Concept“.

NEW

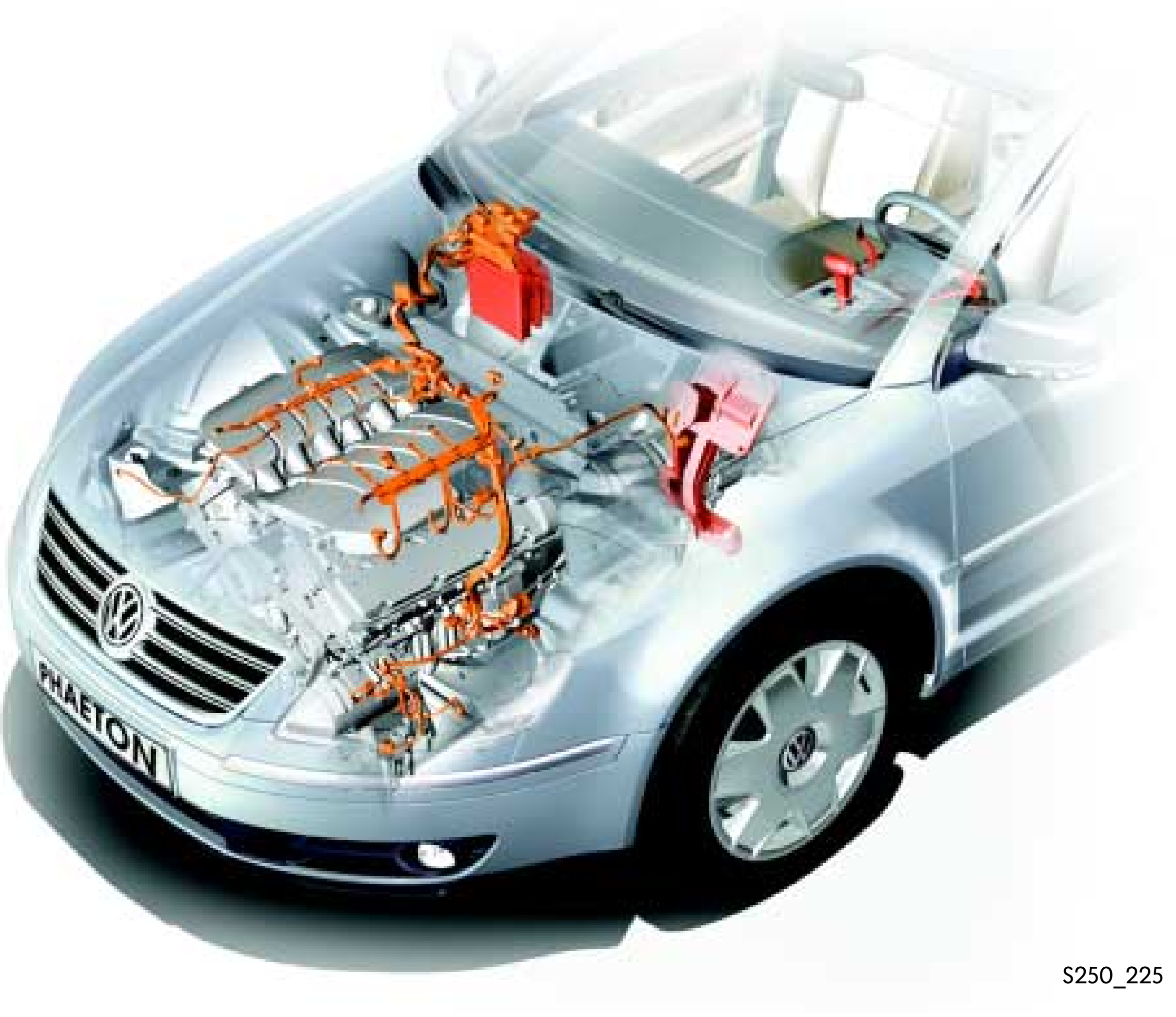
Important Note

The Self-Study Programme presents the design and function of new developments.
The contents are not updated.

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

Table of contents

The Motronic ME7.1.1



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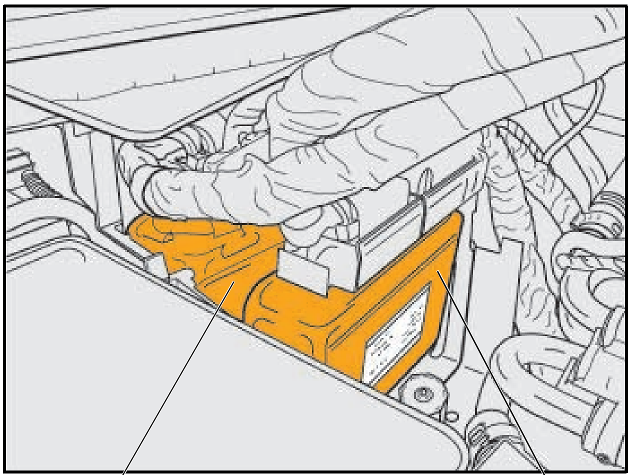
The Motronic ME7.1.1 controls the W12 engine by means of two engine control units.

The engine management system carries out the following tasks:

- creates the optimum mixture for all operating conditions
- reduces fuel consumption
- controls combustion
- checks and controls emission values

Both engine control units are located in the plenum chamber on the right under the coolant expansion tank.



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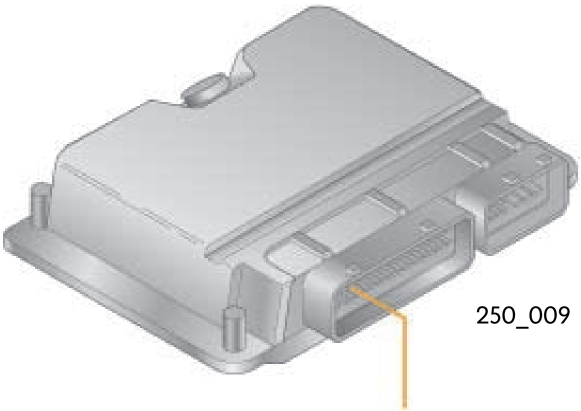
Engine control unit 1 J623

Engine control unit 2 J624



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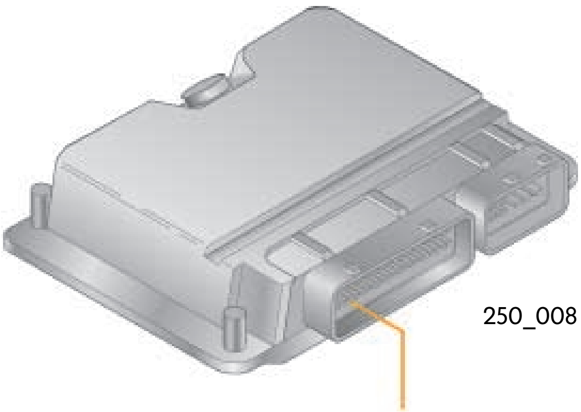
Terminal 15



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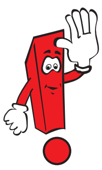
Terminal 31

As both control units are completely identical and the engine control is fundamentally bank-specific, each control unit must be assigned to one of the cylinder banks. A Pin code is used to identify engine control unit 1 J623 for cylinder bank I, and engine control unit 2 J624 for cylinder bank II.

Pin 49 for engine control unit 1 is linked to Terminal 15 and Pin 49 for engine control unit 2 is linked with Terminal 31. The wiring harnesses are colour-marked to distinguish them.



Engine control unit 1 is also referred to as the "Master“ and engine control unit 2 as the "Slave“.

Introduction

Both engine control units manage each bank separately to ensure that the following functions run smoothly:

- injection control
- ignition control (ignition system with single spark ignition coils)
- idling speed control
- stereo lambda control of emission values
- fuel tank breather system
- electronic power control
- cruise control system (CCS)
- secondary air system
- knock control
- continually variable inlet and exhaust camshaft timing
- engine mounting control
- coolant temperature control
- self-diagnosis

The following subfunctions are assumed only by engine control unit 1:

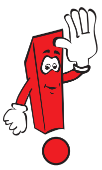
incoming sensor signals:

- from the coolant temperature sender
- from the accelerator position sender
- from the brake light switch
- from the brake pedal switch
- from the CCS switch
- from the kick-down switch

activated actuators:

- the current supply relay
- the fuel pumps
- the continued coolant circulation pump
- the mapped-controlled engine cooling thermostat
- the electro-hydraulic engine mounting solenoid valve
- the radiator fan

The input signals are processed by engine control unit 1 and transmitted to engine control unit 2 via the internal CAN databus.

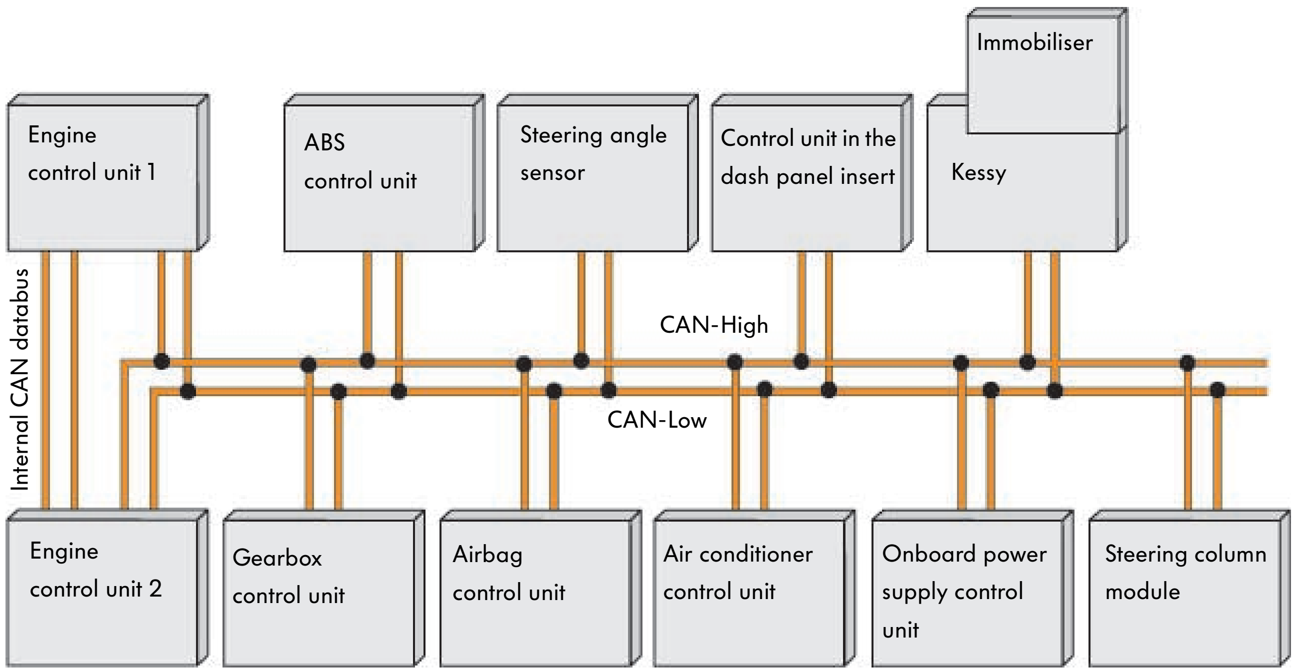


There is only one G28 engine speed sender in the system. It transmits the engine speed signal to both engine control unit 1 and engine control unit 2.

Engine control units in the CAN databus drive

Engine control units 1 and 2 communicate with the control units of other vehicle systems.

Data is exchanged over the Drive Train CAN databus. It connects the individual control units to an overall system.



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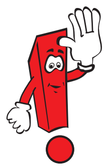
The internal CAN databus has been added for engine management in the W12 engine due to the two-control unit concept.

The internal CAN databus only exchanges information between the two engine control units.



Kessy = entry and start authorisation relay J 518
(Kessy = Keyless Entry)

System control

Engine control unit 1

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
G300 Hall sender 3

G61 Knock sensor I
G66 Knock sensor II

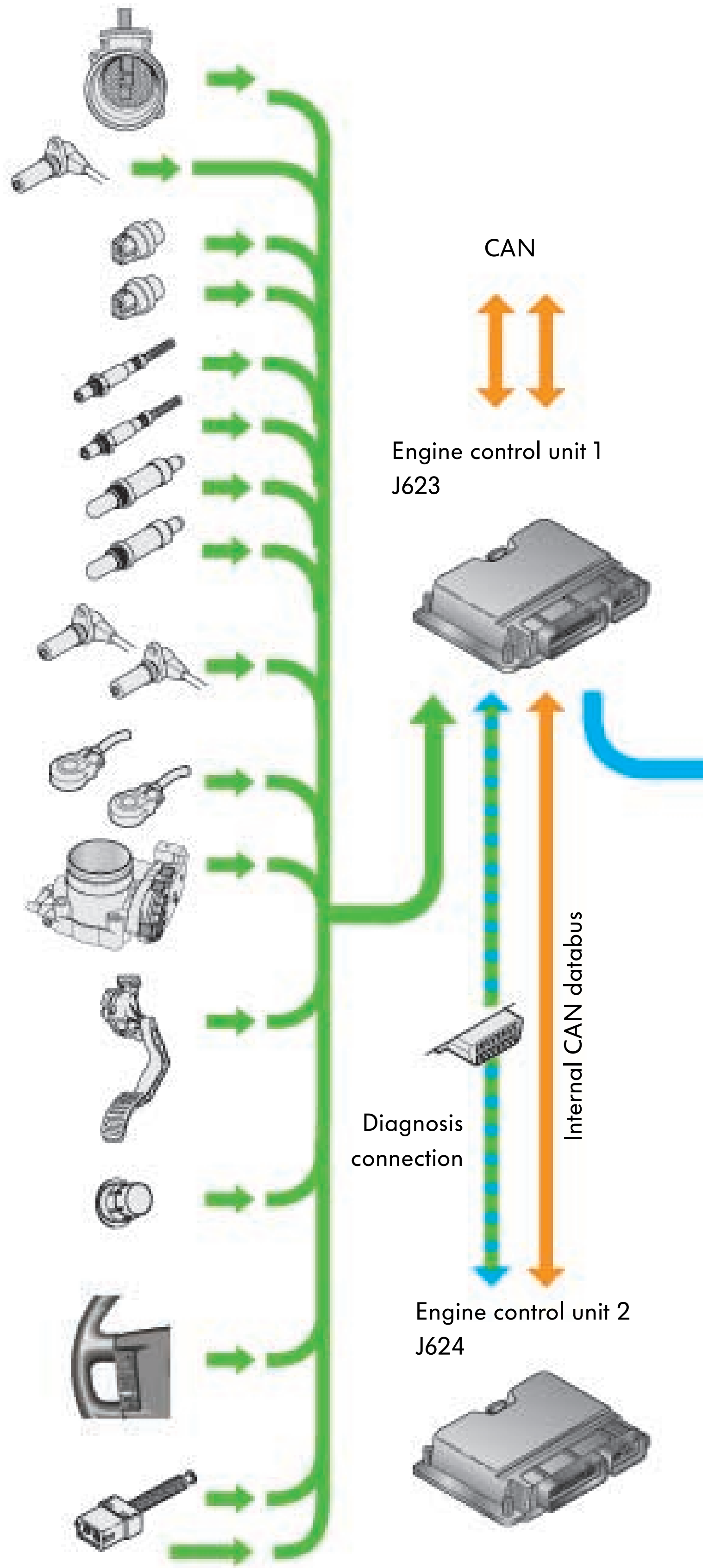
J338 Throttle valve control unit
G187 Throttle valve drive angle sender -1-
G188 Throttle valve drive angle sender -2-

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

F8 Kick-down switch

E45 CCS switch
E227 CCS button

F Brake light switch
F47 CCS brake pedal switch



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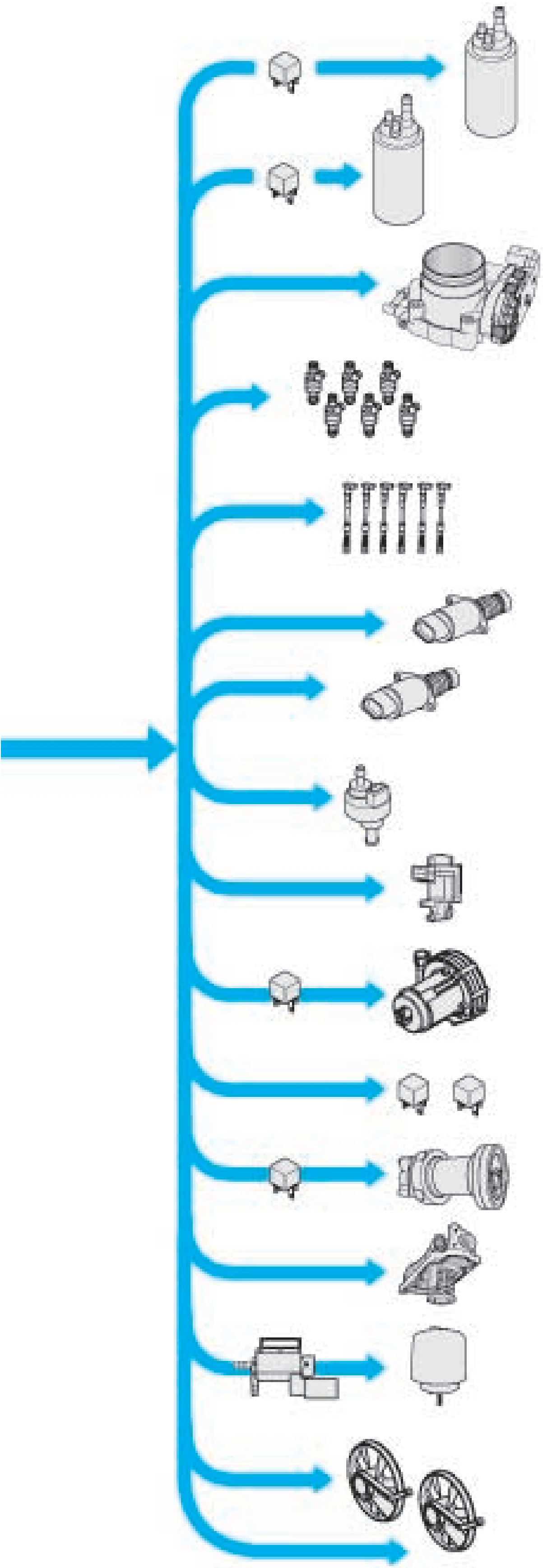


Actuators

J17 Fuel pump relay
G6 Fuel pump (pre-supply pump)

J49 Fuel pump relay
G23 Fuel pump

J338 Throttle valve control unit
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

N70 Ignition coil 1 with output stage, N127 Ignition coil 2
N291 Ignition coil 3 with output stage, N292 Ignition coil 4 output stage
N323 Ignition coil 5 output stage, N324 Ignition coil 6 output stage

N205 Inlet camshaft timing adjustment valve -1-

N318 Exhaust camshaft timing adjustment valve -1-

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
J670 Motronic current supply relay -2-

J235 Coolant pump relay
V51 Continued coolant circulation pump

F265 Mapped-controlled engine cooling thermostat

N145 Electro-hydraulic engine mounting solenoid valve, right

V7 Radiator fan
V177 Radiator fan -2-

System overview

Engine control unit 2

Sensors

G28 Engine speed sender

G246 Air mass meter 2
G299 Intake air temperature sender -2-

G285 Lambda probe III

G286 Lambda probe IV

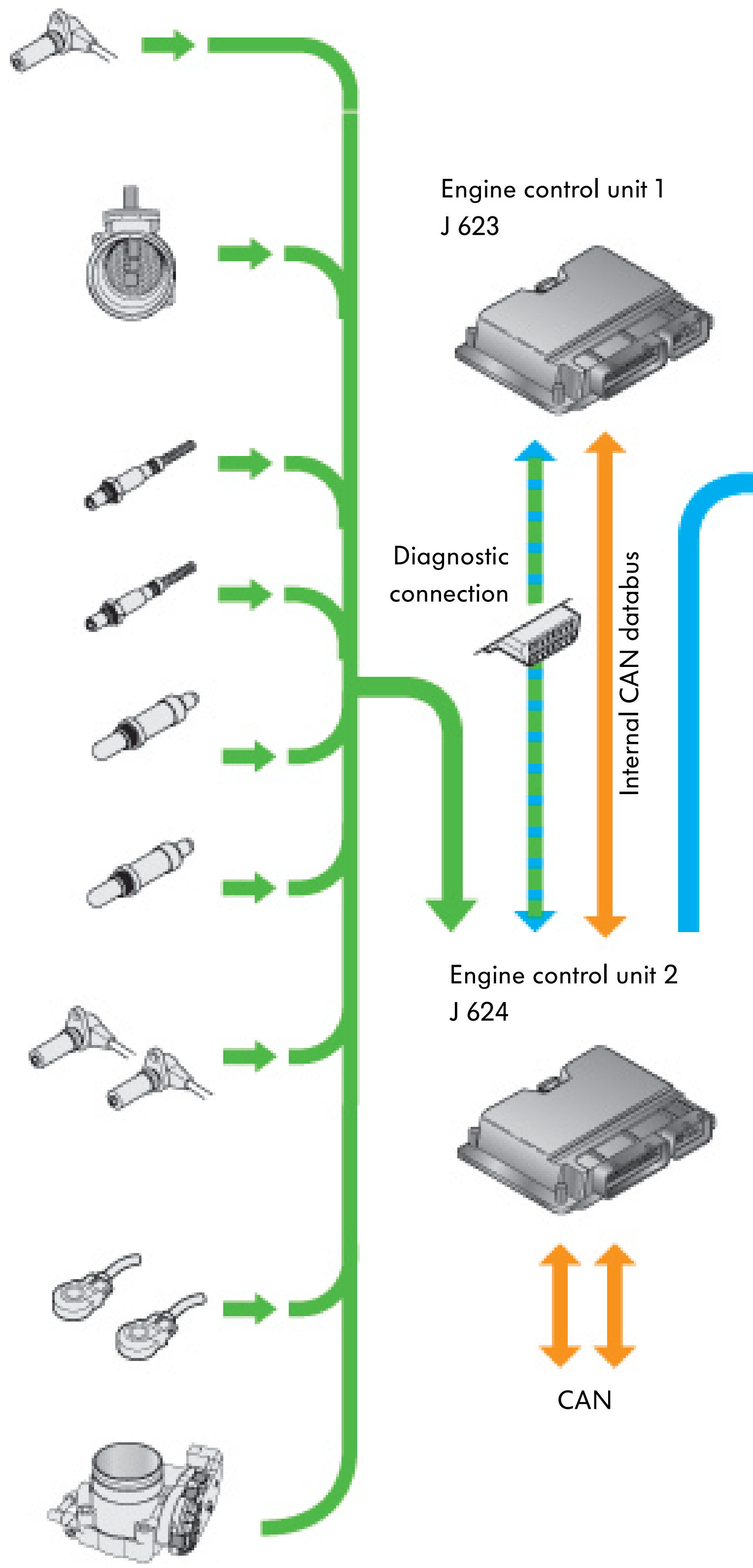
G287 Lambda probe III after catalyst

G288 Lambda probe IV after catalyst

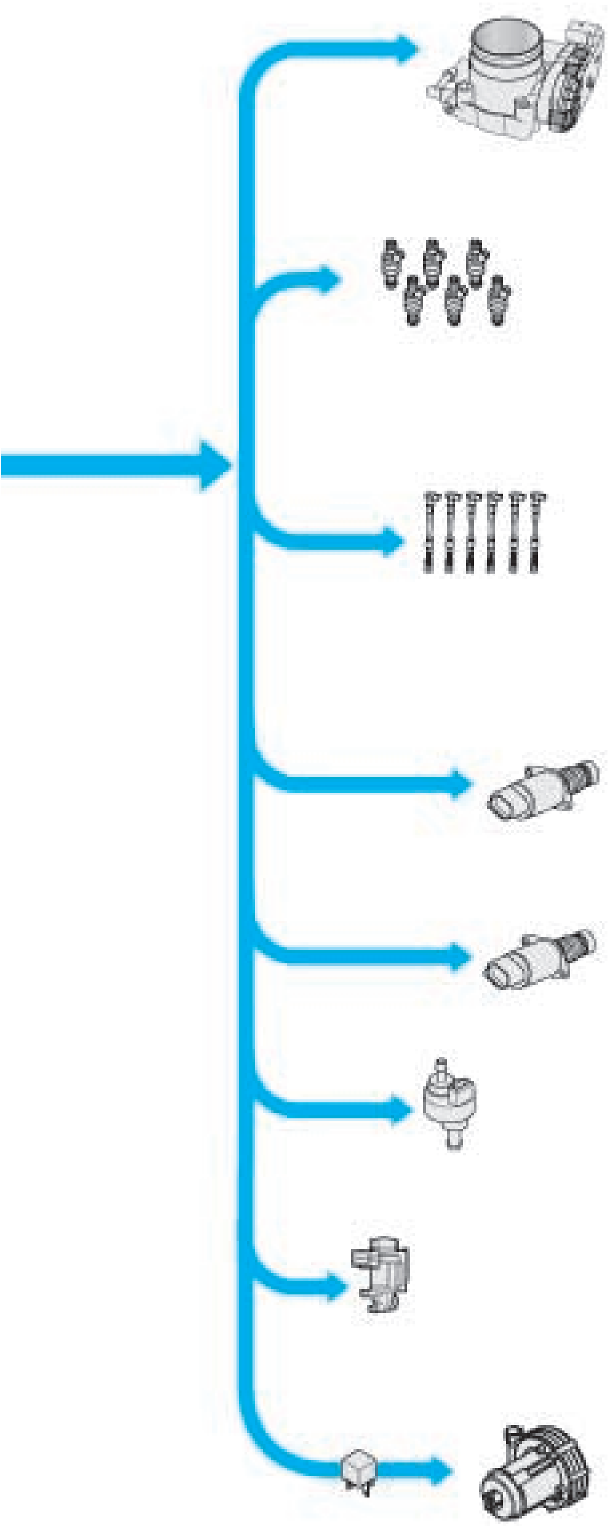
G163 Hall sender 2
G301 Hall sender 4

G198 Knock sensor 3
G199 Knock sensor 4

J544 Throttle valve control unit 2
G297 Angle sender -1- for throttle valve drive 2
G298 Angle sender -2- for throttle valve drive 2



Actuators



J 544 Throttle valve control unit 2
G296 Throttle valve drive 2

N85 Injector, cylinder 7,
N299 Injector, cylinder 9,
N301 Injector, cylinder 11,

N86 Injector, cylinder 8
N300 Injector, cylinder 10
N302 Injector, cylinder 12

N325 Ignition coil 7 with output stage,
N326 Ignition coil 8 with output stage
N327 Ignition coil 9 output stage,
N328 Ignition coil 10 outputstage,
N329 Ignition coil 11 output stage,
N330 Ignition coil 12 outputstage

N208 Inlet camshaft timing adjustment valve 2

N319 Exhaust camshaft timing adjustment valve 2

N333 Activated charcoal filter system solenoid valve 2

N320 Secondary air inlet valve 2

V189 Secondary air pump motor 2
J545 Secondary air pump relay 2

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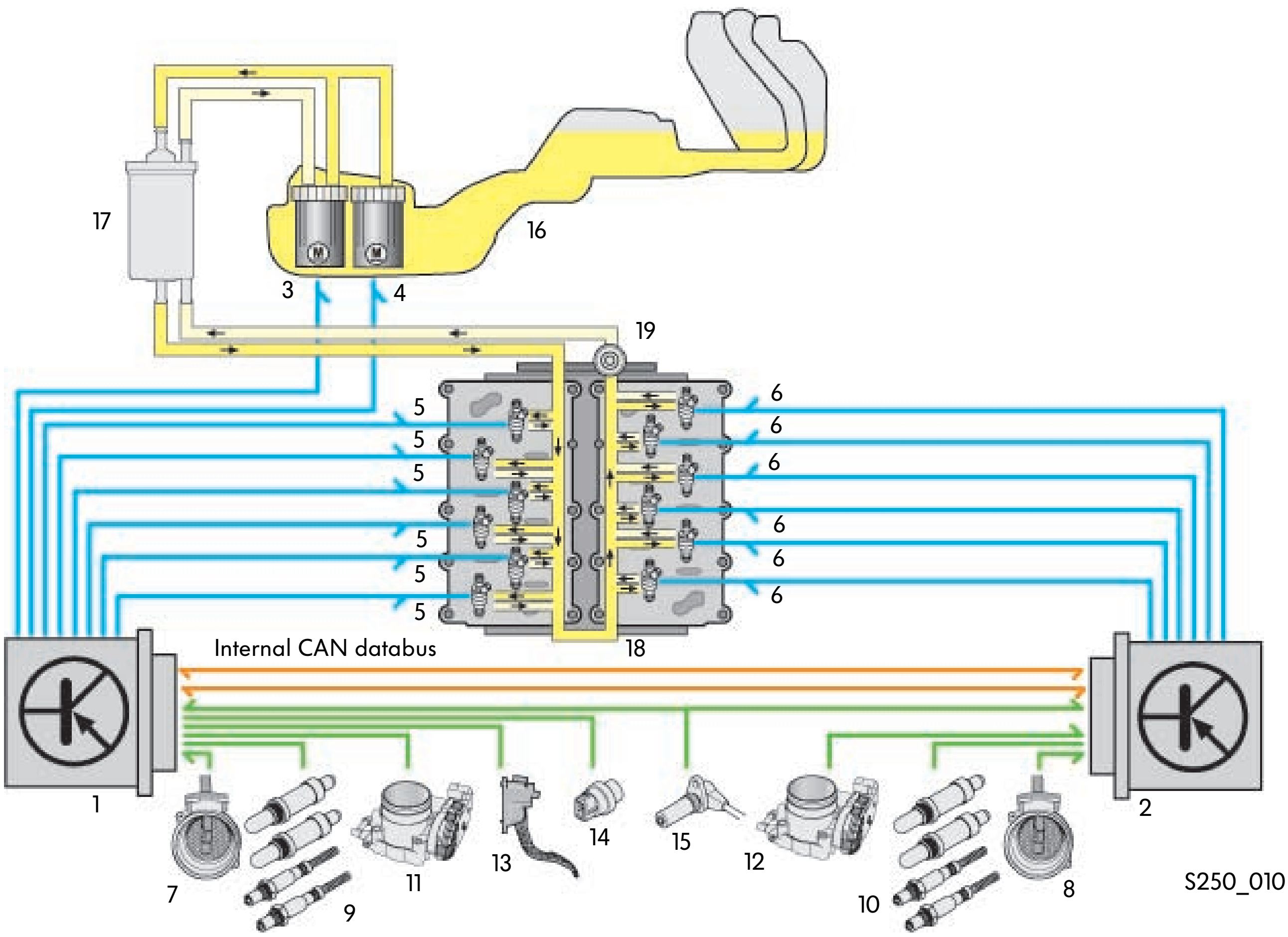
Subsystems

The position of the actuators and sensors in the following diagrams of the subsystems are not identical to the physical layout in the engine compartment.

Fuel injection system



Bank I

1 Engine control unit 1
3 Fuel pump 1
4 Fuel pump 2
5 Injectors, Bank I
7 Air mass meter 1 with intake air temperature sender
9 Lambda probes, Bank I
11 Throttle valve control unit 1
13 Accelerator pedal module
14 Temperature sender G62
15 Engine speed sender

16 Fuel tank
17 Filter
18 Fuel rail
19 Fuel pressure regulator

Bank II

2 Engine control unit 2
6 Injectors Bank II
8 Air mass meter 2 with intake air temperature sender
10 Lambda probes, Bank II
12 Throttle valve control unit 2
15 Engine speed sender

Input signals for calculating injection time

- Air mass meter engine load signals
- Intake air temperatures
- Throttle valve control unit signals
- Engine speed sender signal
- Coolant temperature
- Lambda probe signals
- Accelerator pedal module signal

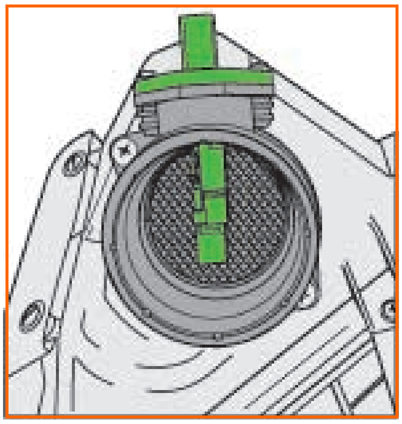
The fuel pumps located in the fuel tank convey the fuel through the fuel filter to the injectors. Fuel pump 2 is switched on additionally depending on the amount of fuel required. The injectors are interconnected by means of a fuel rail. Injection is sequential. Using the input signals, the control units calculate the required fuel quantity and the corresponding injection time for each bank.

The opening time of the injector alone defines the fuel quantity injected. The pressure regulator regulates the injection pressure in the fuel rail and regulates the return of unused fuel to the fuel tank.

Air mass meters G70 and G246 with intake air temperature senders G42 and G299

Air mass meter G70 determines the air mass and sender G42 determines the temperature of the intake air for cylinder bank I.

Air mass meter G246 and sender G299 determine the dimensions and temperature of the intake air for cylinder bank II.



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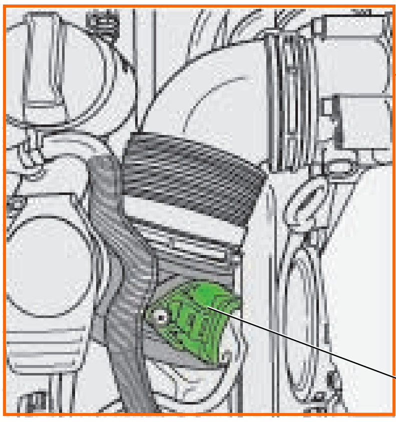

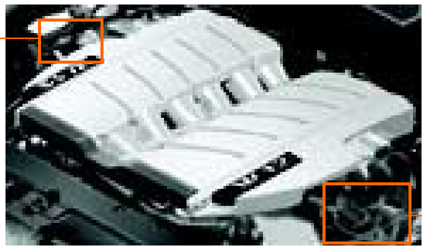

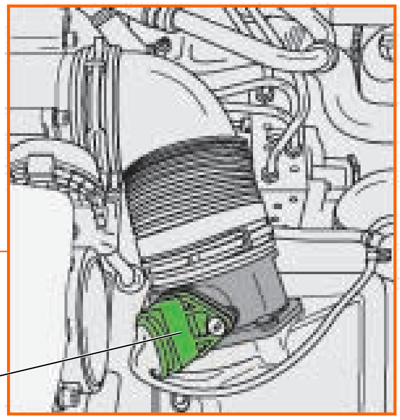

G246, G299

G70, G42

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S250_037

Senders G246, G299 for Bank II

Senders G70, G42 for Bank I

S250_116

Bank I

Bank II

Senders G246 and G299 for cylinder bank II are attached above cylinder bank I. Their signals are transmitted to engine control unit 2.

Senders G70 and G42 for cylinder bank I are attached above cylinder bank II.
Their signals are transmitted to engine control unit 1.

The air filter, the air mass meter with intake air temperature sender, and the throttle valve positioner are attached to the opposite cylinder bank.

Signal failure strategies

If air mass meter G 70 or G246 fails, the air mass is calculated using the throttle valve position which then produces an alternative model. The MIL fault indicator lamp lights up.

If intake air temperature sender G42 or G299 fails, an alternative temperature is calculated using the air conditioning system ambient temperature sensor.

Engine speed sender G28

S250_318

Engine speed sender G28 provides an important input signal. It is located in the gearbox housing.

The sensor used is a Hall sensor.
The engine speed and position of the crankshaft are detected by scanning the teeth of the converter plate with integrated sender wheel.
The gap on the sender wheel acts as a reference mark for the engine control unit.

Engine speed sender G28 is directly linked to both engine control units.
This means it transmits the engine speed signal both to engine control unit 1 and engine control unit 2.

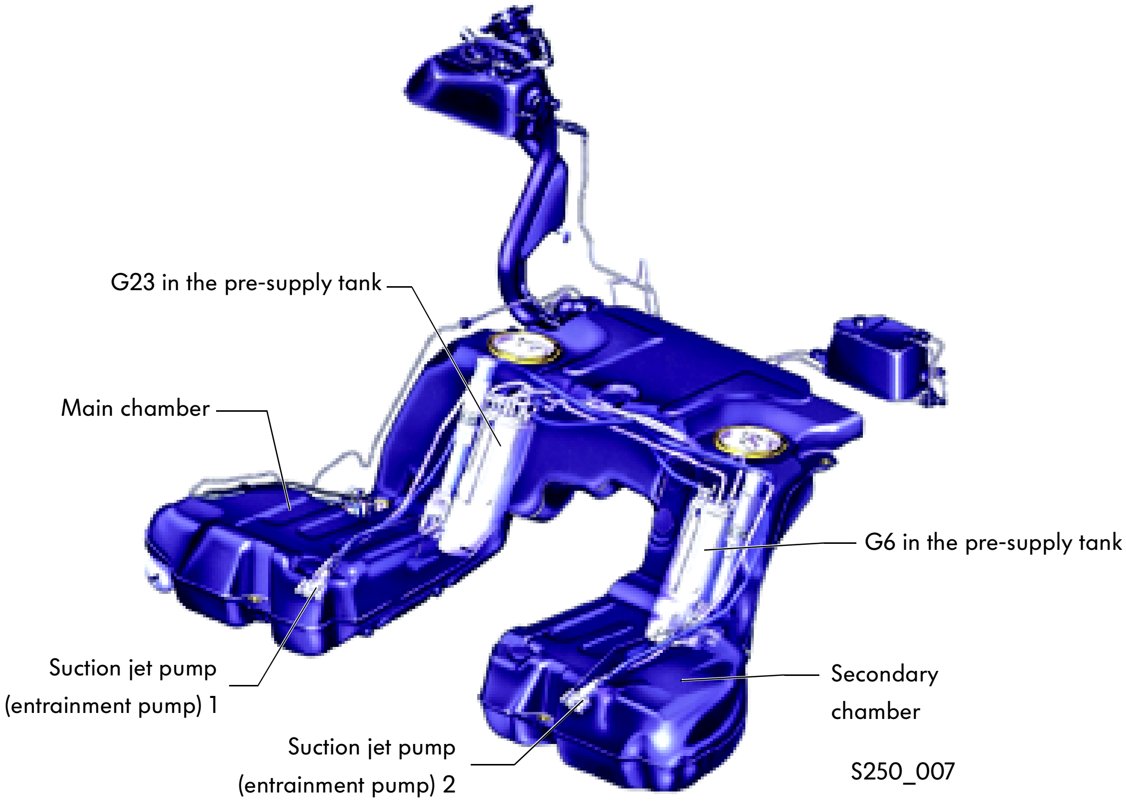
Failure strategies

Continued travel is possible if the sender fails. However, at the next attempt to restart, the engine will not start.

Fuel pumps G6 and G23

The two chambers of the fuel tank each contain both an electric fuel pump and a suction jet pump (entrainment pump).

With the aid of the pressure regulator, electric fuel pumps G6 and G23 generate a fuel system pressure of 4 bar and are activated by engine control unit 1.



Fuel pump G23 is the main pump. It delivers a continuous supply of fuel to the engine while the engine is running. The second fuel pump G6 is additionally switched on either on starting to achieve a quicker pressure build-up, if the fuel tank has less than 20 litres or if there is a high engine load and engine speed.

Suction jet pump (entrainment pump) 1 delivers the fuel from the main chamber into the pre-supply tank of fuel pump G6, and suction jet pump (entrainment pump) 2 pumps fuel out of the secondary chamber into the pre-supply tank of fuel pump G23.

Failure strategies

If one of the pumps fails, engine performance is reduced as the result of a lack of fuel.

It is no longer possible to achieve top speed. At high engine speeds the engine runs unevenly.

Injectors
N30, N31, N32, N33, N83, N84, N85, N86, N299, N300, N301, N302

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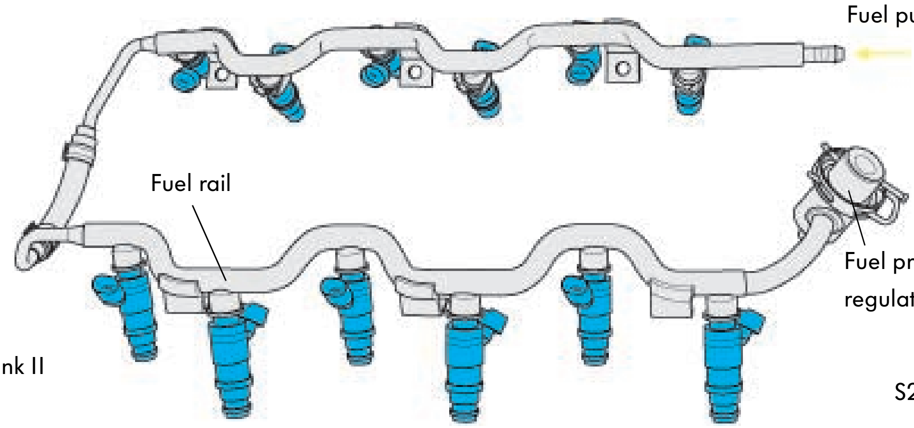

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The injectors are activated by the engine control units according to the firing order.
This means engine control unit 1 activates the injectors for cylinder bank I
N30, N31, N32, N33, N83, N84.

Engine control unit 2 activates the injectors for cylinder bank II
N85, N86, N299, N300, N301, N302 an.

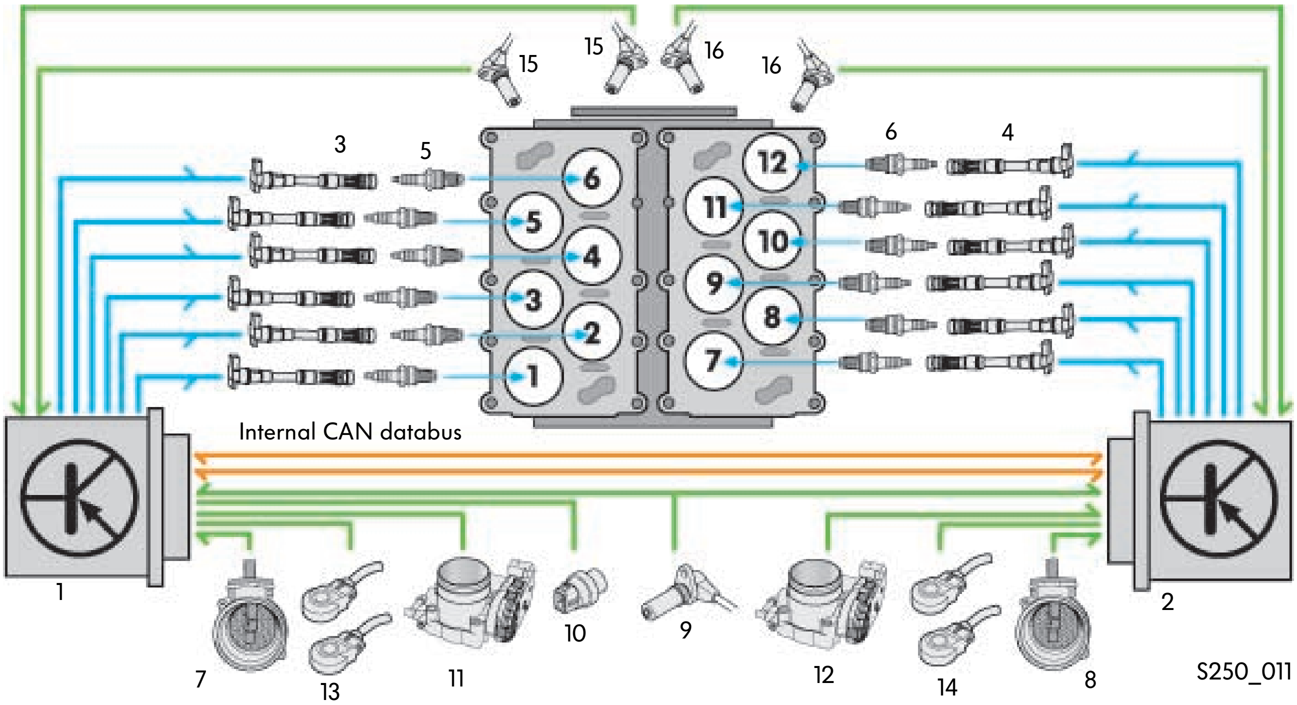
The injectors are directly secured to a common fuel rail with securing clips and inject the finely atomised fuel directly in front of the relevant inlet valves.

Failure strategies

If an injector is blocked, a mixture deviation is detected by the diagnosis system.
The supply of fuel is interrupted, which means the engine runs with reduced power output.
A fault is recorded in the engine control unit.

Subsystems

Ignition system



Bank I
1 Engine control unit 1
3 Single spark ignition coils with output stage Bank I
5 Spark plugs Bank I
7 Air mass meter 1 with intake air temperature sender
9 Engine speed sender
10 Temperature sender G62
11 Throttle valve control unit 1, Bank I
13 Knock sensors 1 and 2, Bank I
15 Hall senders 1 and 3, Bank I

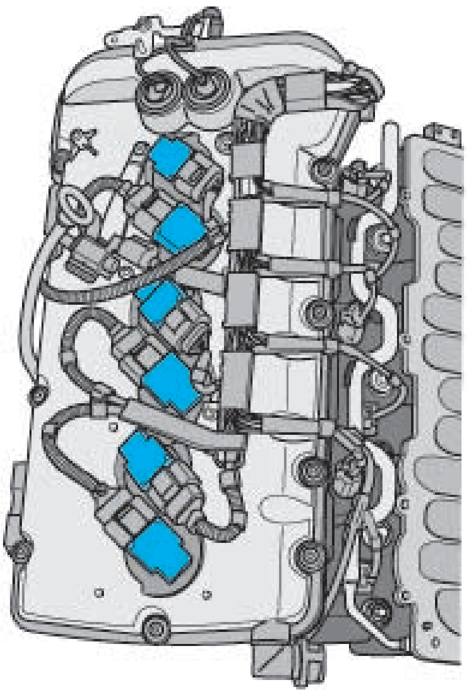
Bank II
2 Engine control unit 2
4 Single spark ignition coils with output stage Bank II
6 Spark plugs Bank II
8 Air mass meter 2 with intake air temperature sender
9 Engine speed sender
12 Throttle valve control unit 2, Bank II
14 Knock sensors 3 and 4, Bank II
16 Hall senders 2 and 4, Bank II

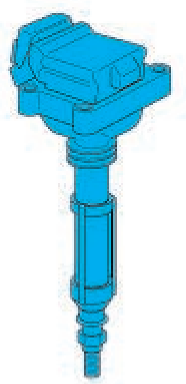
Input signals for calculating the firing point

- Engine speed sender signal
- Air mass meter engine load signals
- Throttle valve control unit signals
- Coolant temperature
- Knock sensor signals
- Hall sender signals

The firing point is calculated from a map stored in the engine control unit memory. The engine control unit also makes allowance for the input signals.

Single spark ignition coils N70, N127, N291, N292, N323, N324, N325, N326, N327, N328, N329, N330





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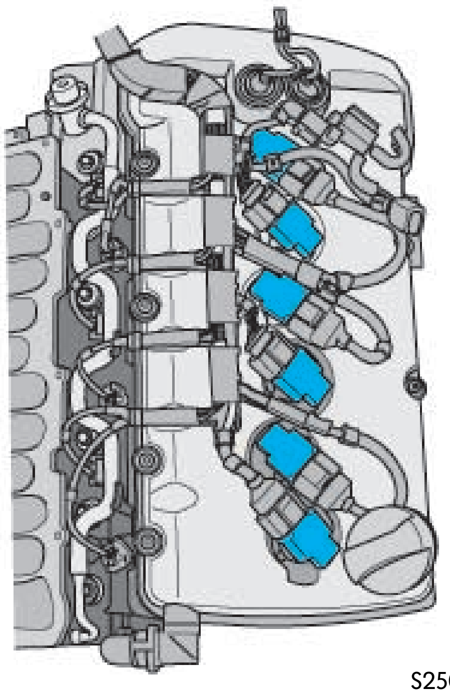

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The output stage and ignition coil are combined in each element of the single spark ignition coils, which means that the ignition can be influenced by the engine management individually for each cylinder.

The single spark ignition coils deliver just one ignition spark via the spark plugs.

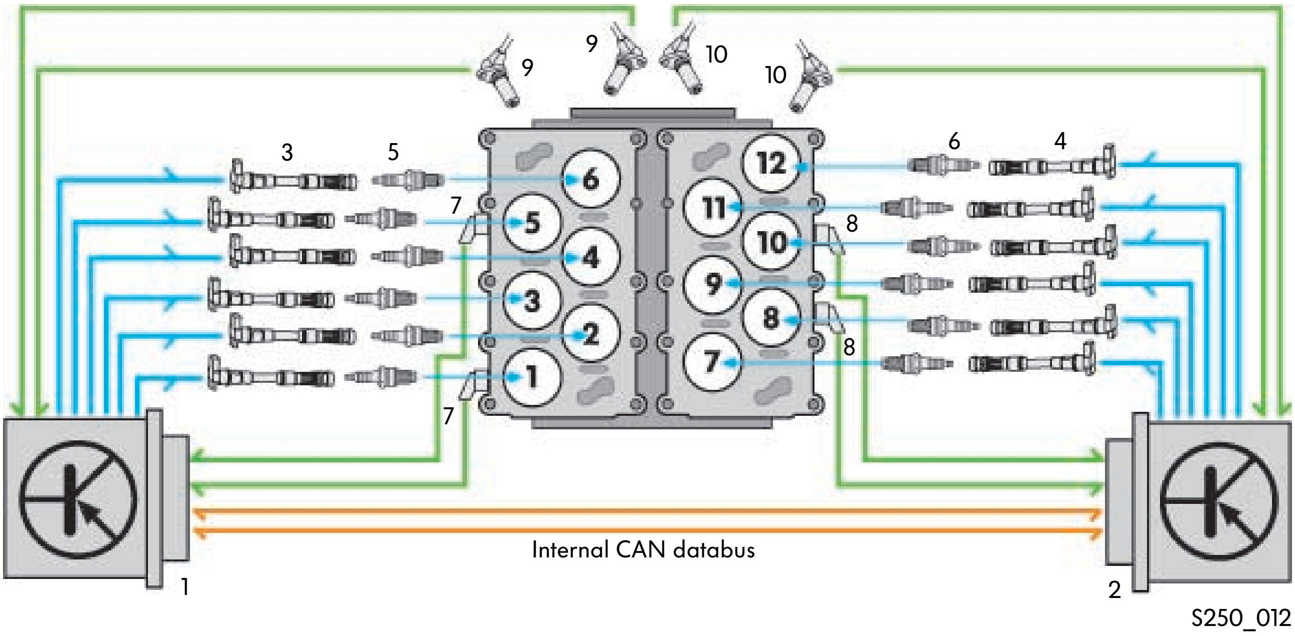
Single spark ignition coils
N70, N127, N291, N292, N323, N324
are activated by engine control unit 1.

Engine control unit 2 activates
single spark ignition coils
N325, N326, N327, N328, N329, N330.

Failure strategies

If an ignition coil fails, a mixture deviation is detected by the diagnosis system. The engine runs at reduced power and a fault is recorded in the engine control unit.

Knock control



Bank I
1 Engine control unit 1
3 Single spark ignition coils with output stage Bank I
5 Spark plugs Bank I
7 Knock sensors 1 and 2, Bank I
9 Hall senders 1 and 3, Bank I

Bank II
2 Engine control unit 2
4 Single spark ignition coils with output stage Bank II
6 Spark plugs Bank II
8 Knock sensors 3 and 4, Bank II
10 Hall senders 2 and 4, Bank II

Input signals

- Knock sensor signal
- Hall sender signal

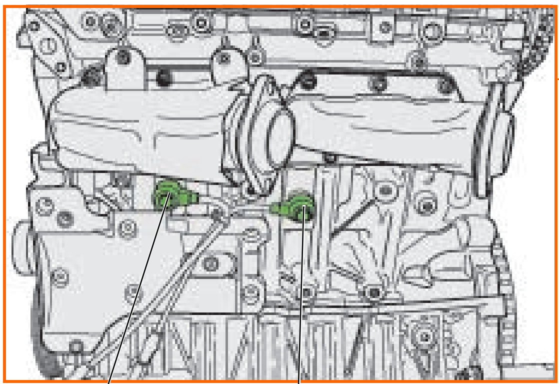
Each bank in the W12 engine has two knock sensors attached to the crankcase. The plug and socket connections are colour coded to avoid confusing the sensors with the connectors in the engine wiring harness. Knock signals are selectively assigned to individual cylinders using the Hall signals.

If the knock sensors detect knocking in a cylinder, then the engine management changes the firing point of the affected cylinder (ignition advance angle adjusted towards "retard“), until knocking no longer occurs.
If there is no further tendency to knocking in the cylinder concerned, then the control unit returns the ignition advance angle to its original position (adjustment towards "advance“).

Knock sensors G61, G66, G198, G199

Cylinder-selective knock control is combined with electronic control of the firing point. Each bank in the W12 engine has two knock sensors attached to the crankcase.
The engine control units detect the knocking cylinder by means of the knock sensors.

Here, knock sensors G61 and G66 transmit the signals to engine control unit 1, and knock sensors G198 and G199 transmit to engine control unit 2. An ignition angle adjustment starts, and this continues until there is no further knocking.



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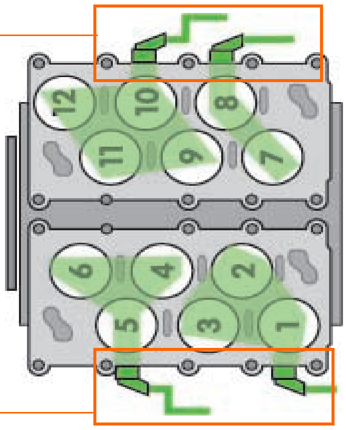

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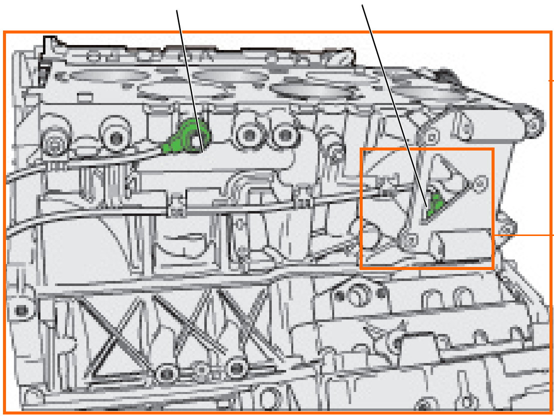

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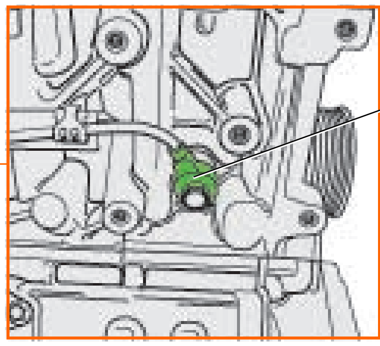

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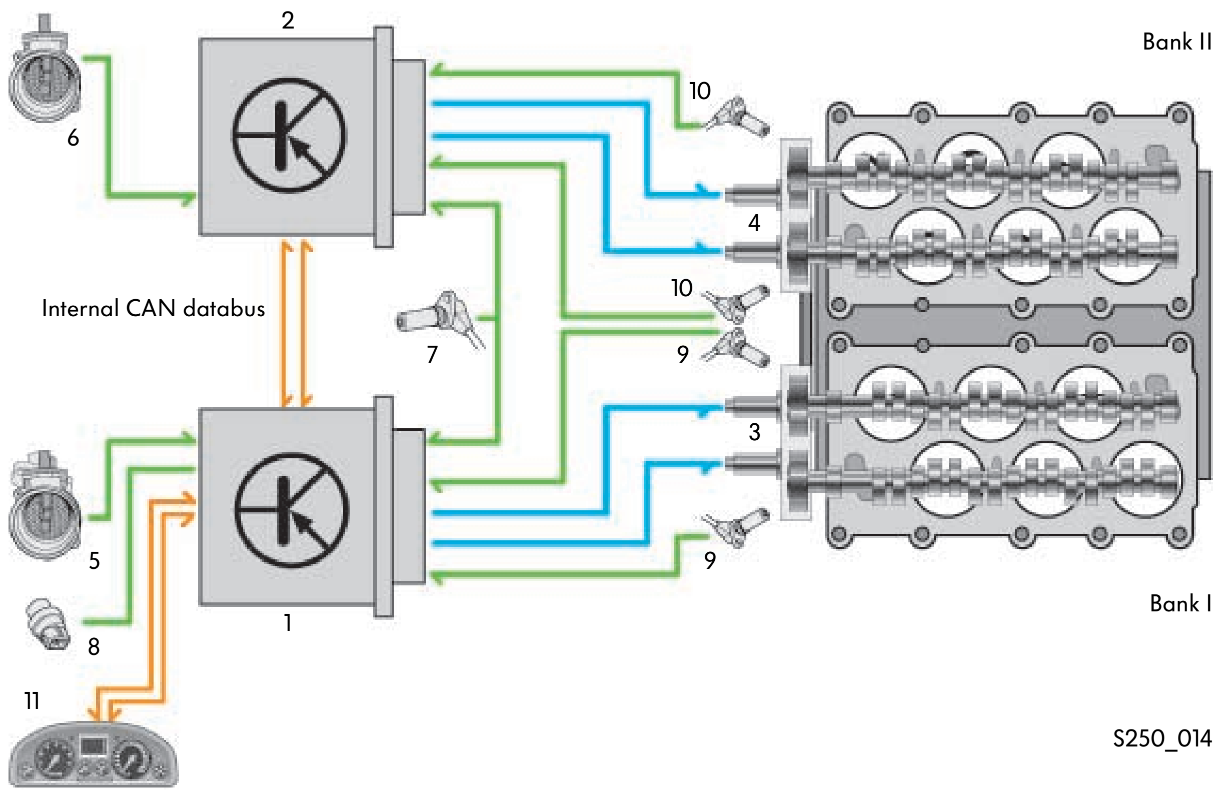
Signal failure strategies

If a knock sensor fails, the ignition advance angles of the cylinder group are retarded by setting them to a safety ignition advance angle in the direction of "retard“. This can also lead to a rise in fuel consumption.

If all the knock sensors fail, the engine management reverts to emergency knock control, where the ignition advance angles are generally retarded and full engine performance is no longer available.

Variable valve timing



Bank I

1 Engine control unit 1
3 Camshaft timing adjustment valves, Bank I
5 Air mass meter 1 with intake air temperature sender
7 Engine speed sender
8 Temperature sender G62
9 Hall senders 1 and 3, Bank I
11 Oil temperature

Bank II

2 Engine control unit 2
4 Camshaft timing adjustment valves, Bank II
6 Air mass meter 2 with intake air temperature sender
7 Engine speed sender
10 Hall senders 2 and 4, Bank II

Input signals

- Hall sender signal
- Engine speed sender signal
- Air mass meter engine load signals
- Coolant temperature
- Oil temperature

To carry out variable valve timing, the engine control units require information about engine speed, engine load, engine temperature, the position of the crankshaft and camshaft, plus the oil temperature from the dash panel insert via the Drive Train CAN databus.

Depending on the operating state, engine control unit 1 activates the electromagnetic valves for Bank I and engine control unit 2 activates the valves for Bank II. Engine oil travels to the vane-cell adjusters via oil galleries in the central housing.

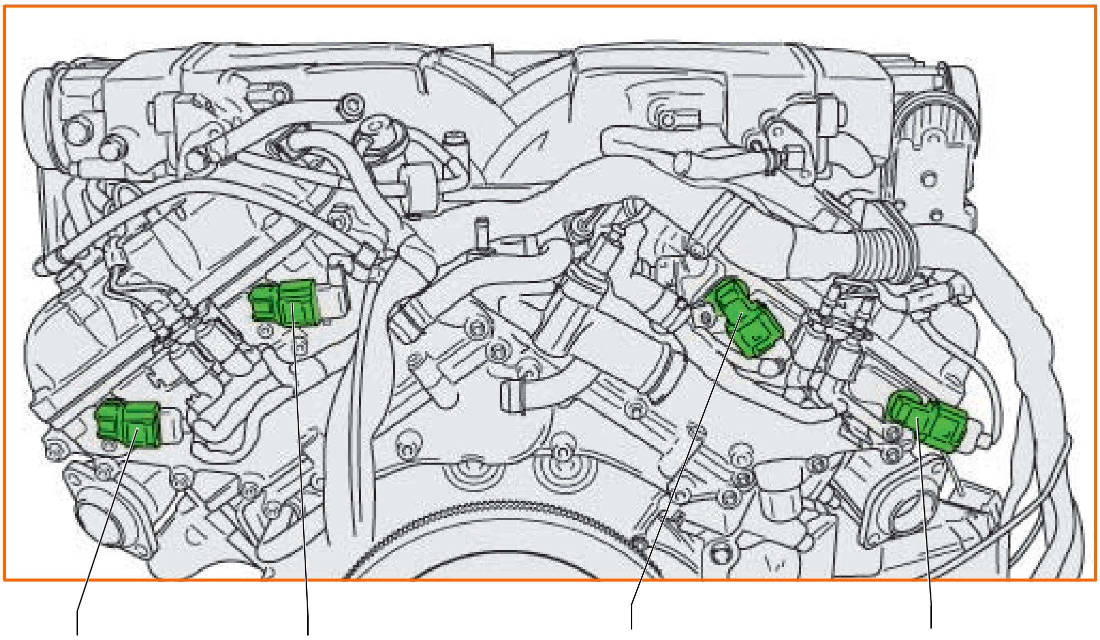
The vane-cell adjusters turn and adjust the camshafts in accordance with defaults in the engine control unit.
The camshafts are adjusted according to maps stored in the control units. Both the inlet and exhaust camshafts are continuously adjustable.

If the fault memory is erased, then the adaption of the camshafts is also erased.
This then requires camshaft timing adaption.
If there is no adaption, camshaft timing is unadjusted, resulting in a noticeably reduced performance.

Hall senders G40, G163, G300, G301

The Hall senders are all located in the engine timing chain cover.
Their task is to inform the engine control unit of the position of the inlet and exhaust camshafts.

They therefore scan a quick-start sender wheel located on the camshaft in question.



Engine control unit 1 detects the position of the inlet camshaft by means of Hall sender G40, and by means of G300 it detects the position of exhaust camshaft in Bank I. Engine control unit 2 detects the position of inlet camshaft by means of Hall sender G163, and by means of G301 it detects the position of exhaust camshaft in Bank II.

The Hall sender signals act as input signals for variable valve timing.
To calculate injection time and firing point, the signal from sender G40 in engine control unit 1 and the signal from sender G163 in engine control unit 2 are processed.

Signal failure strategies

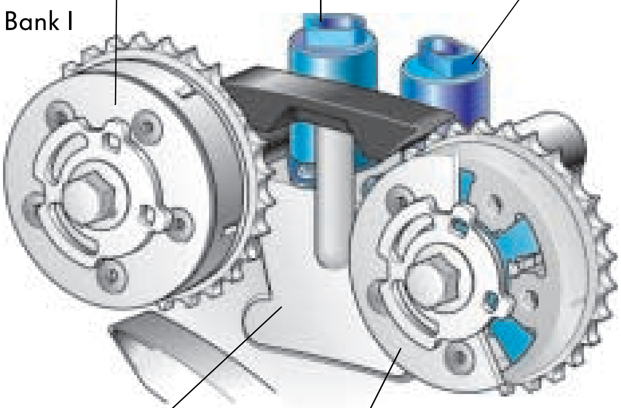
A sender failure will prevent variable valve timing in the associated bank.

The camshafts are positioned at their reference positions (emergency running position). The engine runs with reduced torque.

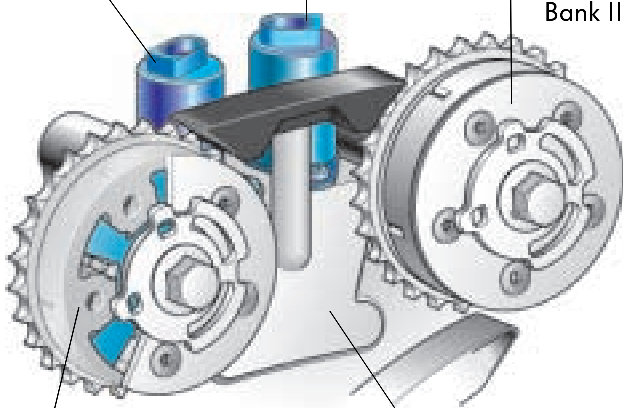
Inlet camshaft timing adjustment valve 1 N205 and valve 2 N208 and exhaust camshaft timing adjustment valve 1 N318 and valve 2 N319.

The electromagnetic valves are integrated in the variable valve timing central housing. Based on defaults from engine control unit 1 for Bank I or from engine control unit 2 for Bank II, they distribute oil pressure depending on the adjustment direction and the adjustment distance to the camshaft adjusters.
The inlet camshafts are continuously adjustable within a range of 52û. Similarly, the exhaust camshaft can be continuously adjusted within a range of 22û.

Valves N205 and N318 for continuous inlet and exhaust camshaft timing adjustment in Bank I are activated by engine control unit 1. Valves N208 and N319 for inlet and exhaust camshaft timing adjustment in Bank II are activated by engine control unit 2.



S250_015



S250_328

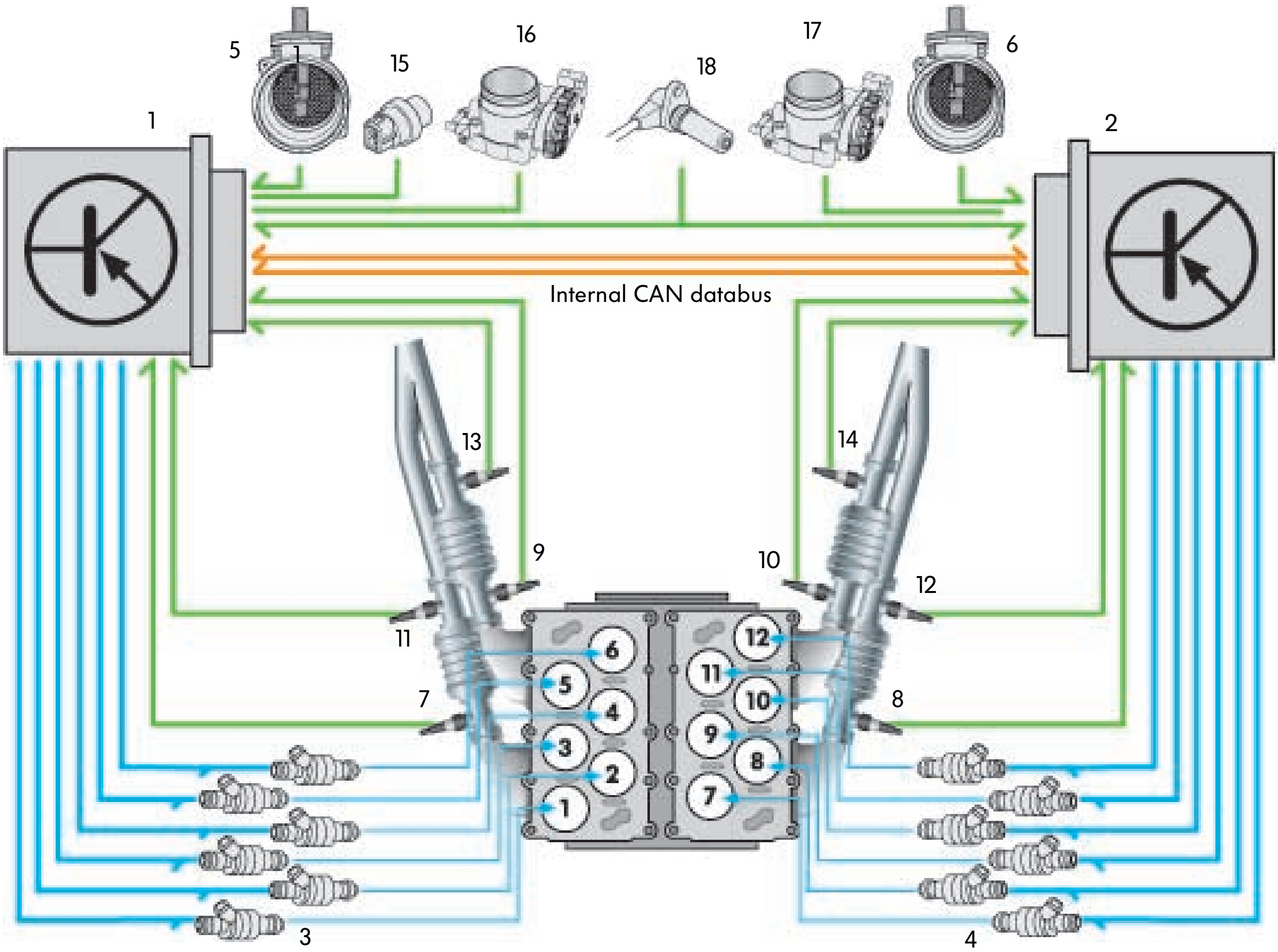
Signal failure strategies

If an electrical lead to the camshaft adjusters is faulty or a camshaft adjuster fails because it has jammed mechanically or oil pressure is too low, no camshaft timing adjustment is made.

The shaft concerned is moved to the reference position in the direction of "retard“. The engine has neither full power nor high torque.

Subsystems

Stereo lambda control



S250_016

Bank I

1 Engine control unit 1
3 Injectors Bank I
5 Air mass meter 1 with intake air temperature sender
7 Lambda probe 1, before catalyst Bank I
9 Lambda probe 2, before catalyst Bank I
11 Lambda probe 1, after catalyst Bank I
13 Lambda probe 2, after catalyst Bank I
15 Temperature sender G62
16 Throttle valve control unit 1, Bank I
18 Engine speed sender

Bank II

2 Engine control unit 2
4 Injectors Bank II
6 Air mass meter 2 with Intake air temperature sender
8 Lambda probe 1, before catalyst, Bank II
10 Lambda probe 2, before catalyst, Bank II
12 Lambda probe 1, after catalyst, Bank II
14 Lambda probe 2, after catalyst, Bank II
17 Throttle valve control unit 2, Bank II
18 Engine speed sender

Input signals

- Engine speed sender signal
- Air mass meter engine load signals
- Lambda probe signals
- Coolant temperature
- Throttle valve control unit signal

In stereo lambda control the correct composition of the fuel/air mixture for the two cylinder banks is achieved via separate closed control loops. For each cylinder head the W12 engine has two exhaust manifolds.
Each of these exhaust manifolds has a lambda probe upstream and downstream of the catalyst. The total of eight lambda probes inform the control unit about how much oxygen remains in the exhaust gas.

Using this signal, the control unit calculates the present mixture composition. If there are deviations from the nominal value, the injection time is adjusted.

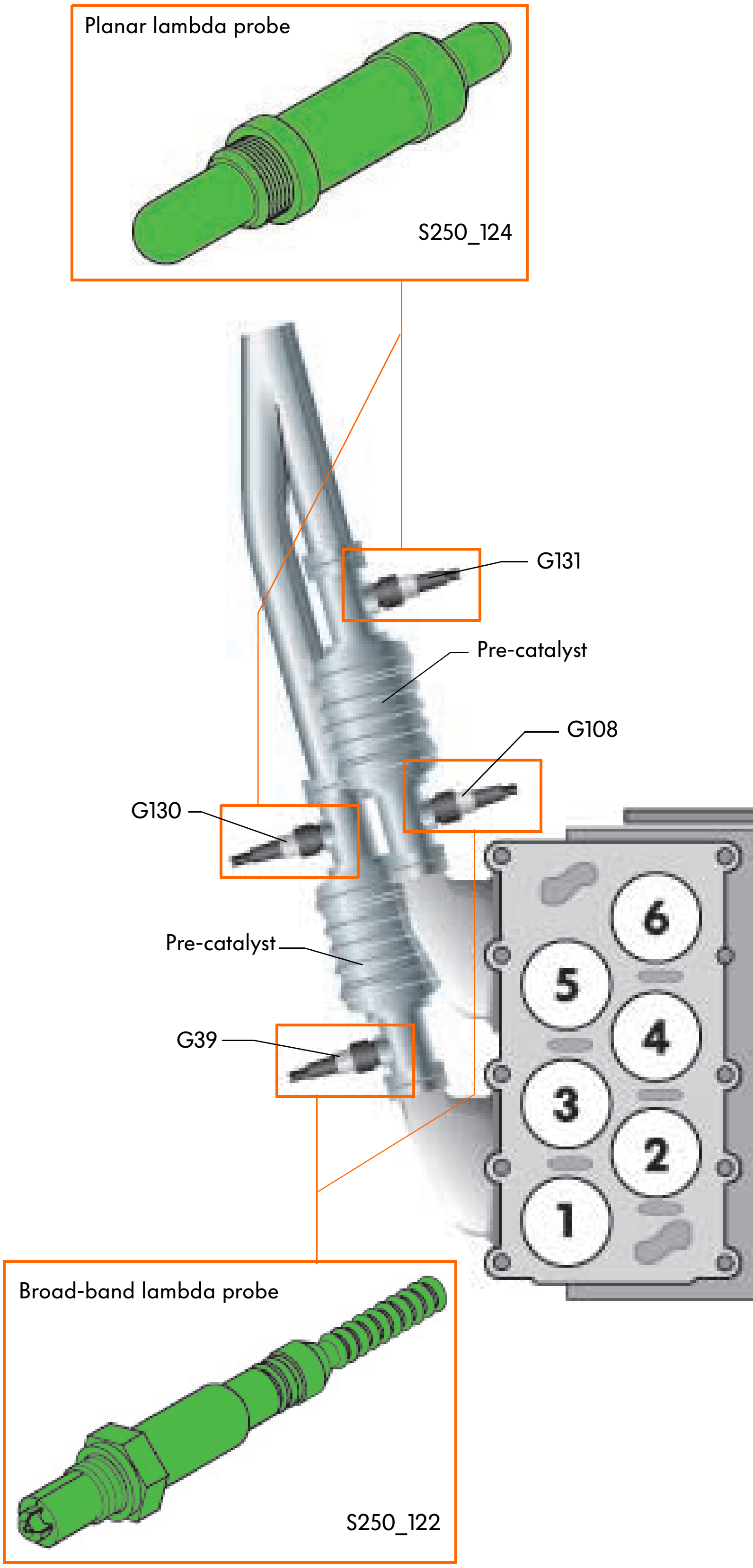
In addition, an adaptive lambda control is carried out in idling mode as well as in two part-throttle ranges. This means that the control unit adjusts to the operating states and stores the learned values.

Subsystems

Lambda probes

Broad-band lambda probes G39, G108, G285, G286

A broad-band lambda probe is assigned to each pre-catalyst as a lambda probe upstream of the catalyst.
The lambda value is determined by means of linear increase in current intensity, making it possible to measure across the entire rev range.

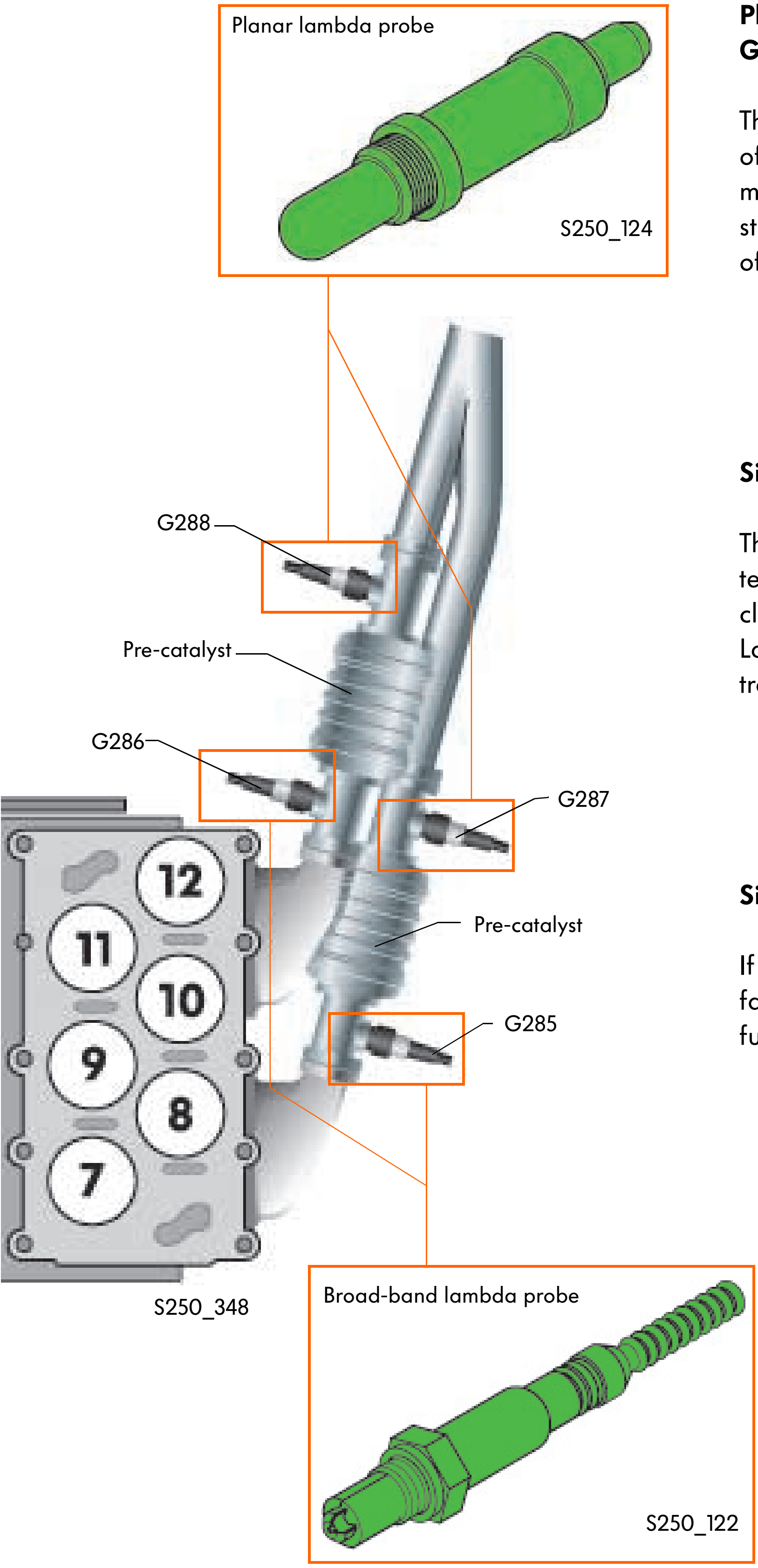


Signal utilisation

The lambda probe upstream of the catalyst supplies the signal for the mixture preparation. Lambda probes G39, G108, G130 and G131 transmit the signals to engine control unit 1.

Signal failure strategies

If the lambda probe upstream of the catalyst fails there is no lambda control. Adaption is inhibited. A map-based open control loop takes over emergency operation.



Planar lambda probes G130, G131, G287 and G288

The planar lambda probe is located downstream of the pre-catalyst. Because of its two-state measurement range it may also be called a two-state lambda probe. It monitors the downstream of the catalyst around the value lambda=1.

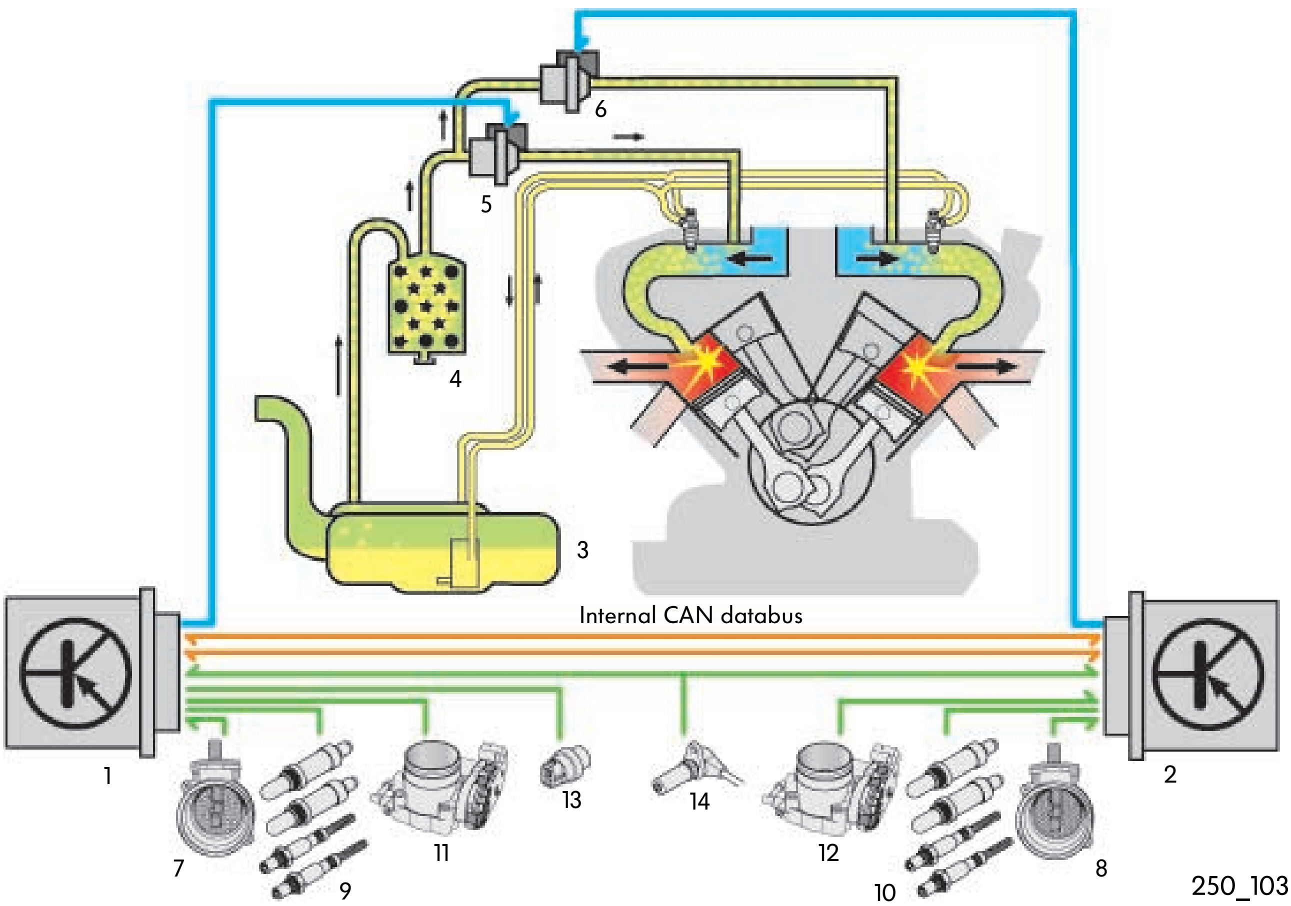
Signal utilisation

The lambda probe downstream of the catalyst tests the function of the catalyst and the lambda closed control loop.
Lambda probes G285, G286, G287 and G288 transmit signals to engine control unit II.

Signal failure strategies

If the lambda probe assigned to the post-catalyst fails, lambda control continues to function. The function of the catalyst cannot be verified.

Fuel tank breather system



Bank I
1 Engine control unit 1
3 Fuel tank
4 Activated charcoal canister
5 Activated charcoal filter system solenoid valve 1, Bank I
7 Air mass meter 1 with intake air temperature sender
9 Lambda probes, Bank I
11 Throttle valve control unit 1, Bank I
13 Temperature sender G62
14 Engine speed sender

Bank II
2 Engine control unit 2
6 Activated charcoal filter system solenoid valve 2, Bank II
8 Air mass meter 2 with intake air temperature sender
10 Lambda probes Bank II
12 Throttle valve control unit 2, Bank II
14 Engine speed sender

Input signals for controlling the fuel tank breather system

- Engine speed
- Air mass meter engine load signals
- Engine temperature
- Lambda probe signal
- Signal from the throttle valve control unit

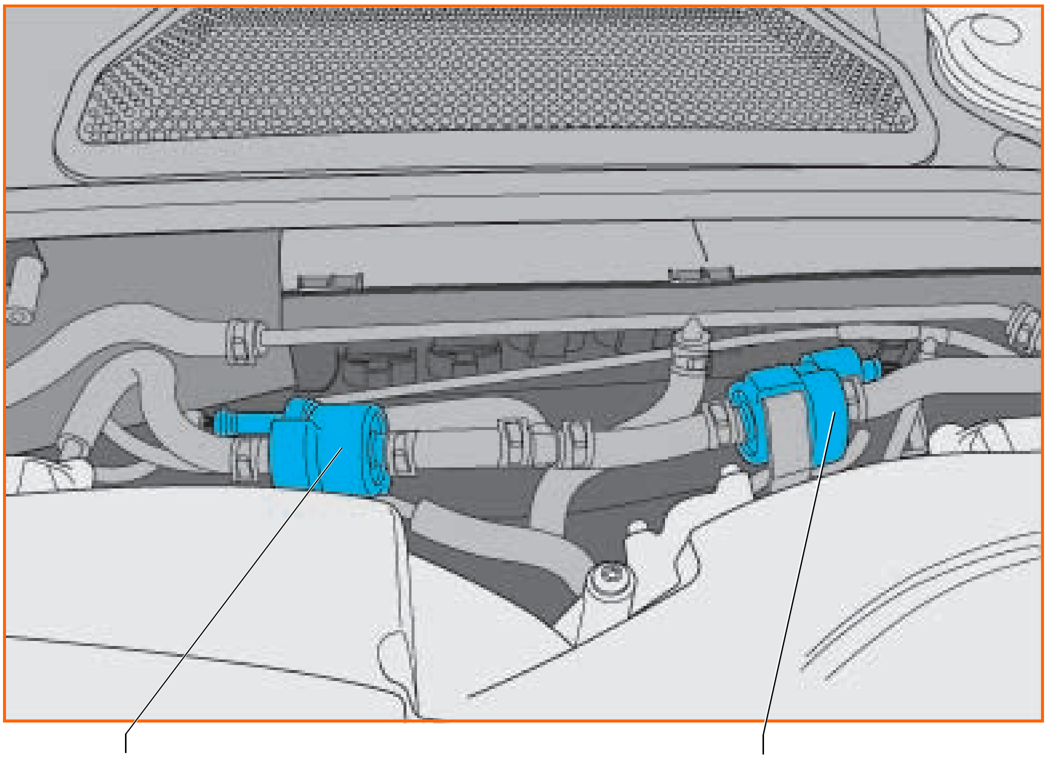
The fuel tank breather system prevents fuel vapour originating in the fuel tank from escaping to the atmosphere.

Fuel vapour is stored in the activated charcoal canister. After evaluating the incoming signals, engine control unit 1 activates solenoid valve 1 for Bank I while engine control unit 2 activates solenoid valve 2 for Bank II.

The fuel vapour stored in the activated charcoal canister is fed to the engine via the intake manifold and is combusted. This causes a temporary change in the fuel/air mixture.

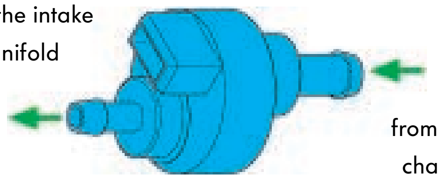
This change in the mixture is detected by the lambda probes, causing the lambda probe control to make a corrective adjustment.

The activated charcoal filter system solenoid valves N80 and N115



S250_332

The activated charcoal filter system solenoid valves are located directly in the direction of travel behind the intake manifold.

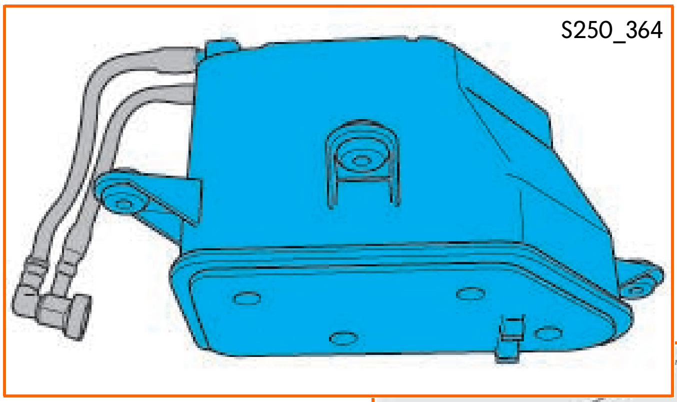


S250_334

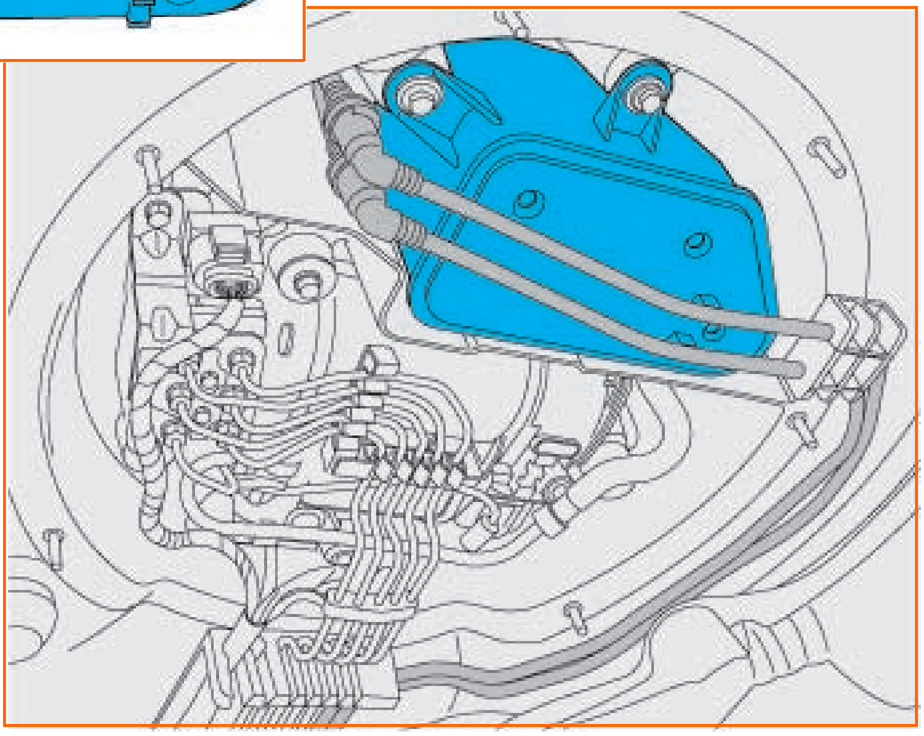
Signal failure strategies

If there is a power interruption, the solenoid valves remain closed. The fuel tank is not vented.

Activated charcoal canister



S250_364



S250_346

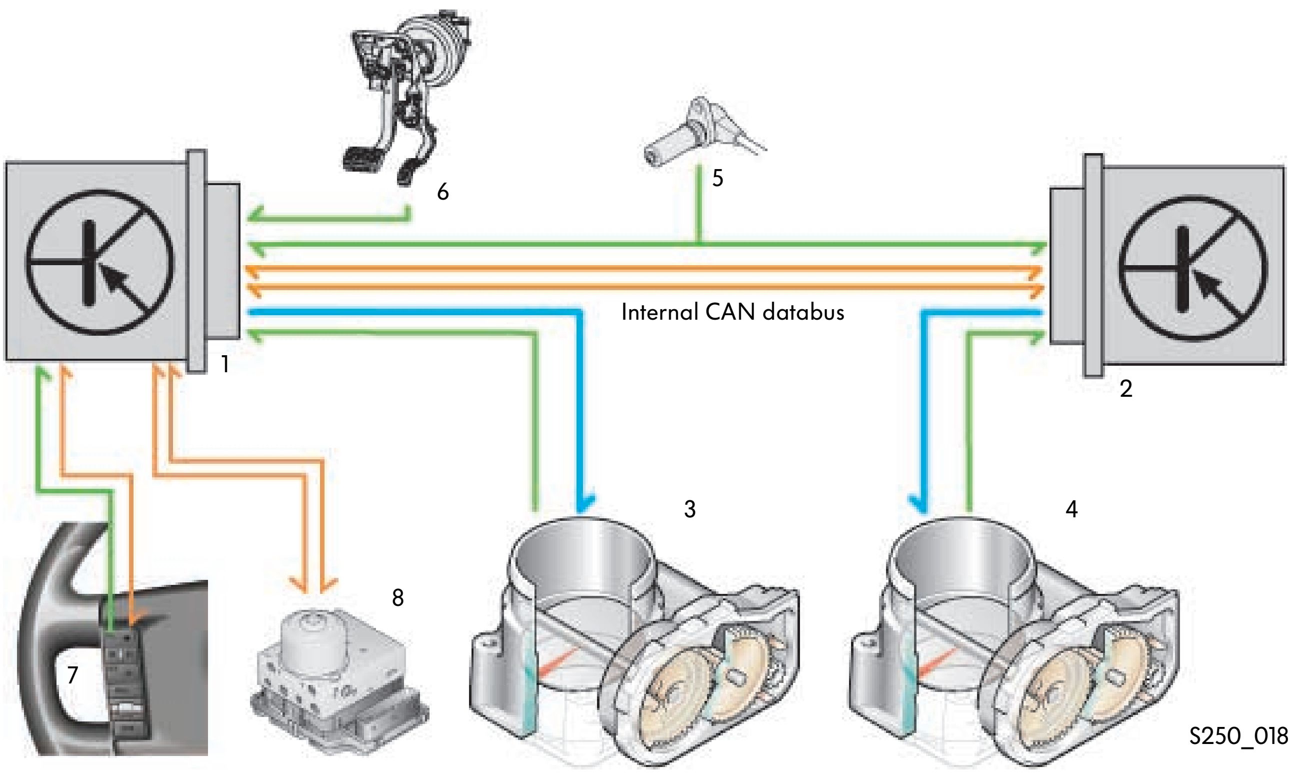
The activated charcoal canister is located below the vehicle in the spare-wheel well.
The spare-wheel well is closed off by a plastic cover to protect it against soiling.

The activated charcoal canister absorbs fuel vapours. The stored fuel vapour is fed in pulses to the engine via the intake manifold.

Subsystems

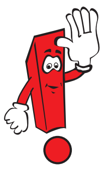
Cruise control system (CCS) without automatic distance control (ADC)

The cruise control system can be activated from a road speed of 30 kph.



Bank I
1 Engine control unit 1
3 Throttle valve control unit 1, Bank I
5 Engine speed sender
6 Brake pedal switch
7 CCS switch
8 Road speed signal from ABS control unit J104

Bank II
2 Engine control unit 2
4 Throttle valve control unit 2, Bank II
5 Engine speed sender



CCS with ADC

For more detailed information about the CCS with APC please refer to SSP 276 "Automatic Distance Control ADC“.

Input signals

- Engine speed sender signal
- Throttle valve control unit signals
- Road speed
- "Brake actuated“ signal
- On and off signal from the CCS switch

The signal from the CCS switch is sent to engine control unit 1. Engine control unit 1 directs the relevant information via the internal CAN databus to engine control unit 2. The throttle valve positioners open the throttle valves depending on the road speed.

Throttle valve positioner 1 is activated by engine control unit 1 and throttle valve positioner 2 is activated by engine control unit 2.
When the "Brake actuated“ signal is received, the cruise control system is switched off.

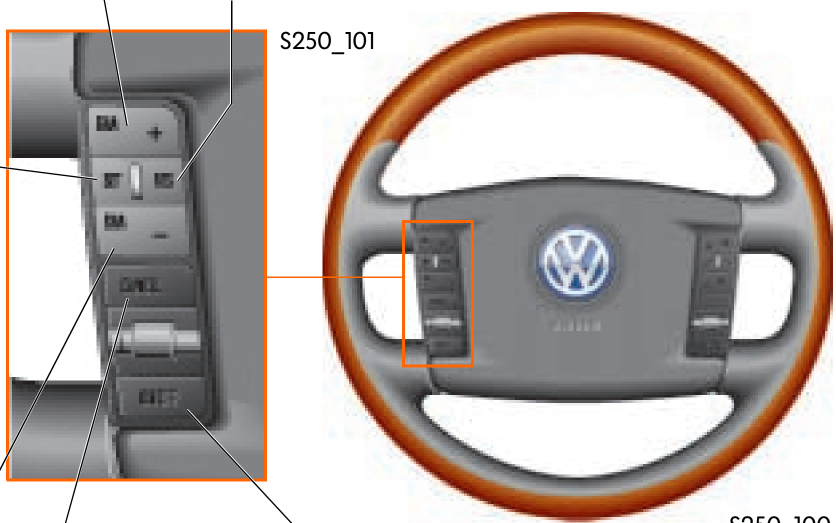
CCS switch

The cruise control system can be actuated on the left-hand side of the multifunctional steering wheel.

"CCS +“ button
Increases the set speed (without touching the accelerator pedal)

"RES“ button
Resumes the previously stored speed

"SET“ button
Stores the required speed
- Actuation when the desired speed has been reached.
- Remove foot from the accelerator pedal
- the speed is kept constant.

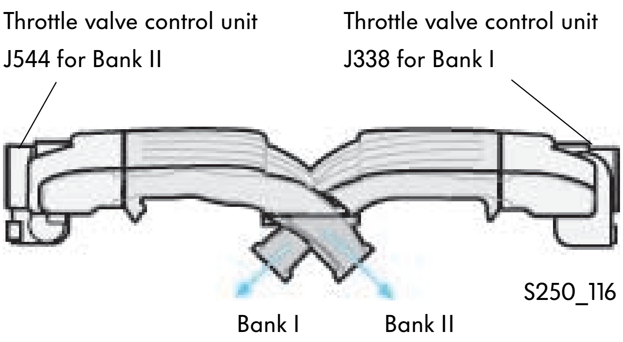

S250_101
S250_100

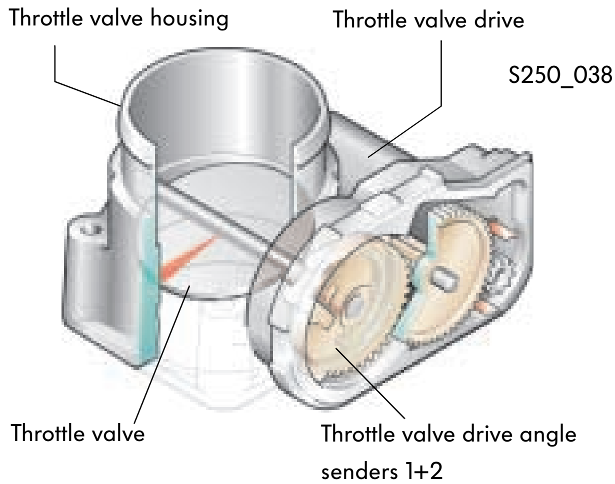
"CCS -“ button
Reduces the set speed (without touching the accelerator pedal)

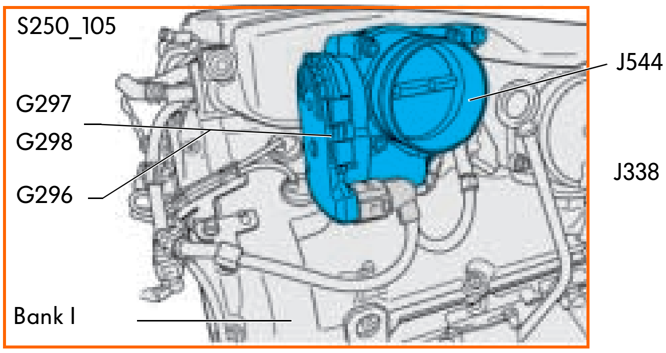
"CANCEL“ button
Cancels selected speed

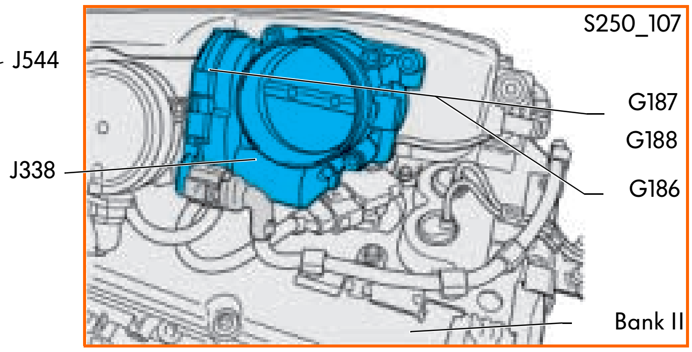
"On/Off“ button

Throttle valve control units J338 and J544









Angle senders G297 and G298 of throttle valve control unit J544 transmit the current position of the throttle valve engine control unit 2. Engine control unit 2 activates the electric motor for throttle valve drive G296 to open or close the throttle valve as well as to adjust a determined throttle valve position.

Angle senders G187 and G188 of throttle valve control unit J338 transmit their signals to engine control unit 1. Throttle valve drive G186 is activated by engine control unit 1.

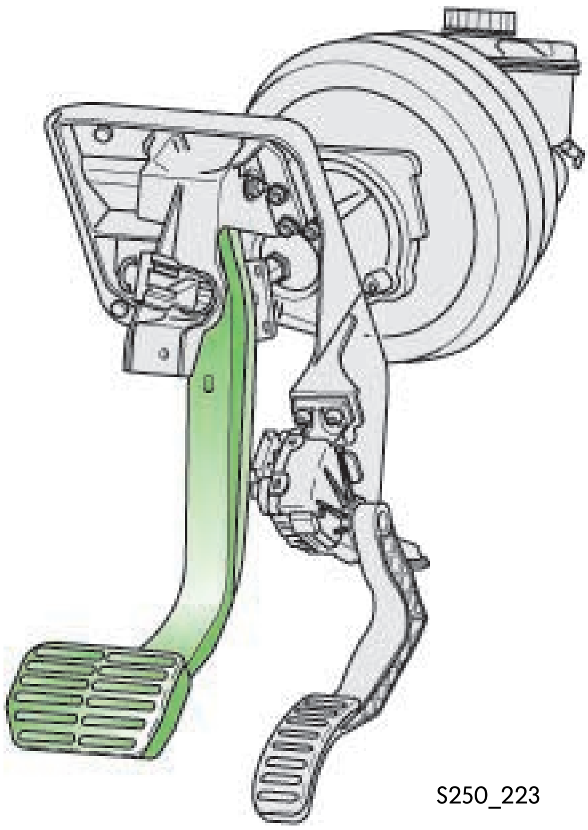
Signal failure strategies

If a potentiometer fails, the throttle valve goes to emergency operation. The speed is limited to 120 kph.

If both potentiometers fail, the bank containing the faulty throttle valve is switched off at an engine speed of 1200 rpm. The EPC lamp lights up. It is still possible to achieve a speed of up to 120 kph.

Brake light switch F and brake pedal switch F47

The brake light switch and the brake pedal switch are part of one component located in the foot controls.



S250_223

Signal utilisation:

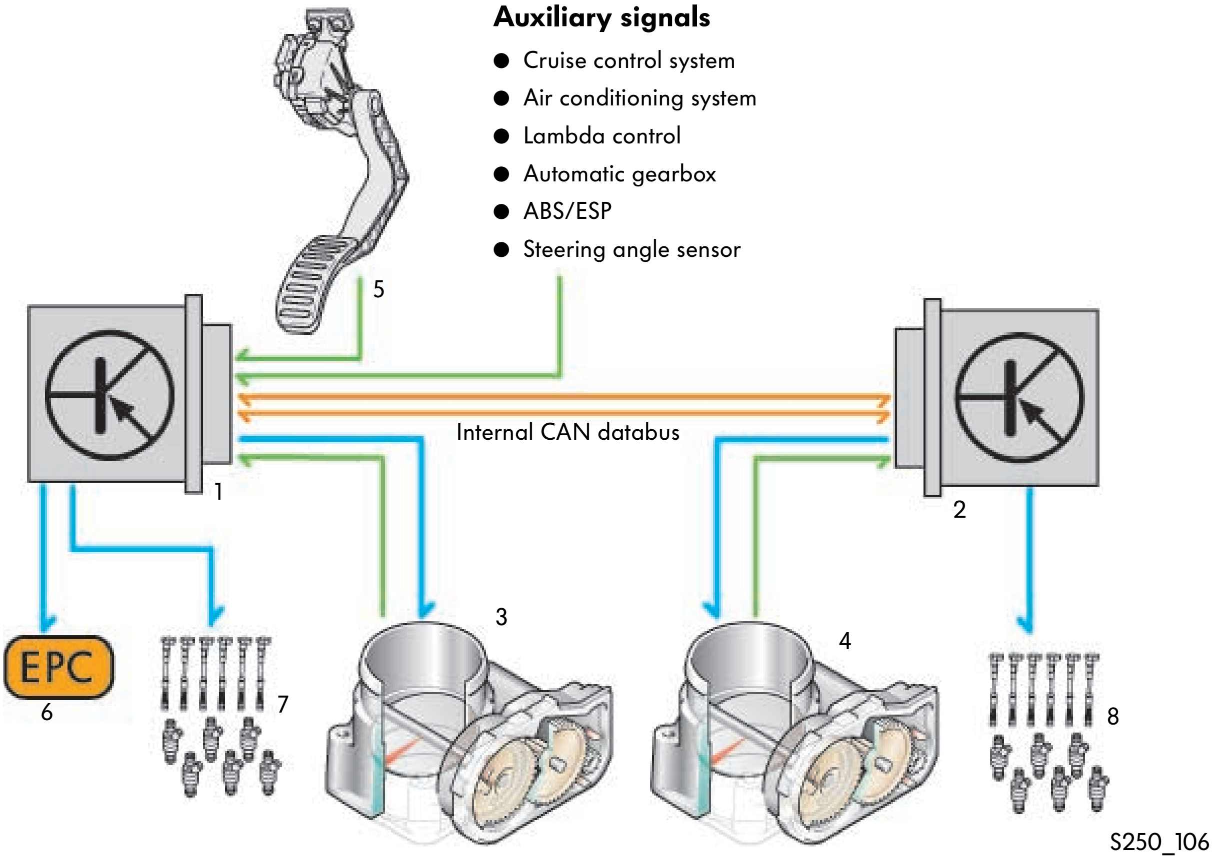
Both switches deliver the "Brake actuated" signal to engine control unit 1. This leads to the cruise control system being switched off.

Failure strategies

If a sensor fails, CCS operation is no longer possible.

Subsystems

Electronic accelerator



Bank I
1 Engine control unit 1
3 Throttle valve control unit 1, Bank I
5 Accelerator pedal module
6 Electronic power control fault lamp
7 Ignition, fuel injection, Bank I

Bank II
2 Engine control unit 2
4 Throttle valve control unit 2, Bank II
8 Ignition, fuel injection, Bank II

Input signals

- Signal from the accelerator pedal module
- Auxiliary signals

The driver input and the signals from the accelerator pedal module are sent to engine control unit 1. Engine control unit 1 calculates the optimum implementation of the torque requirements, making allowance for all auxiliary signals, and transfers the data to engine control unit 2.

Implementation for each bank is by means of the servo-adjustable throttle valve, the ignition and the fuel injection.
The electronic power control warning lamp shows the driver that there is a fault in the electric throttle operation system.

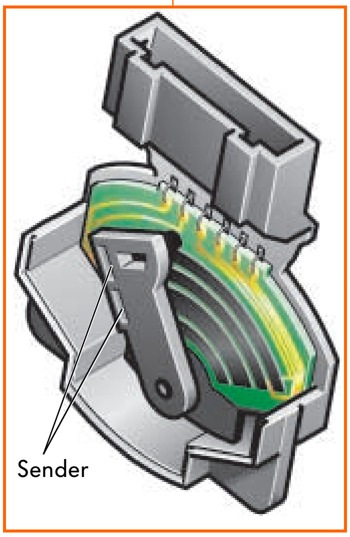
Accelerator pedal module

The accelerator pedal module is located in the foot controls. The accelerator pedal module comprises:

- the accelerator pedal
- accelerator pedal position sender 1, G79 and
- accelerator pedal position sender 2, G185

Both senders are sliding potentiometers, secured to a common shaft.
Each time the accelerator pedal position is changed, the resistances of the sliding potentiometers also change, as well as the voltages transmitted to the engine control unit. The engine control unit recognises the current position of the accelerator pedal by means of the signals from both accelerator position senders.

S250_233

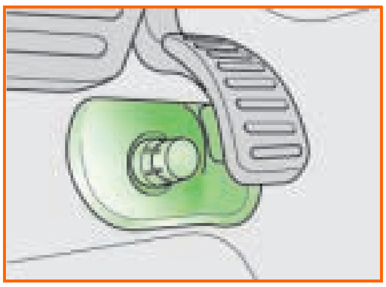


S250_034

Signal failure strategies

If a sender fails, the system initially goes to idling mode. If the second sender is detected within a defined period, driving mode is re-enabled. If both senders fail, the engine only runs at increased idling speed and no longer reacts to the accelerator pedal.

Kick-down switch F8



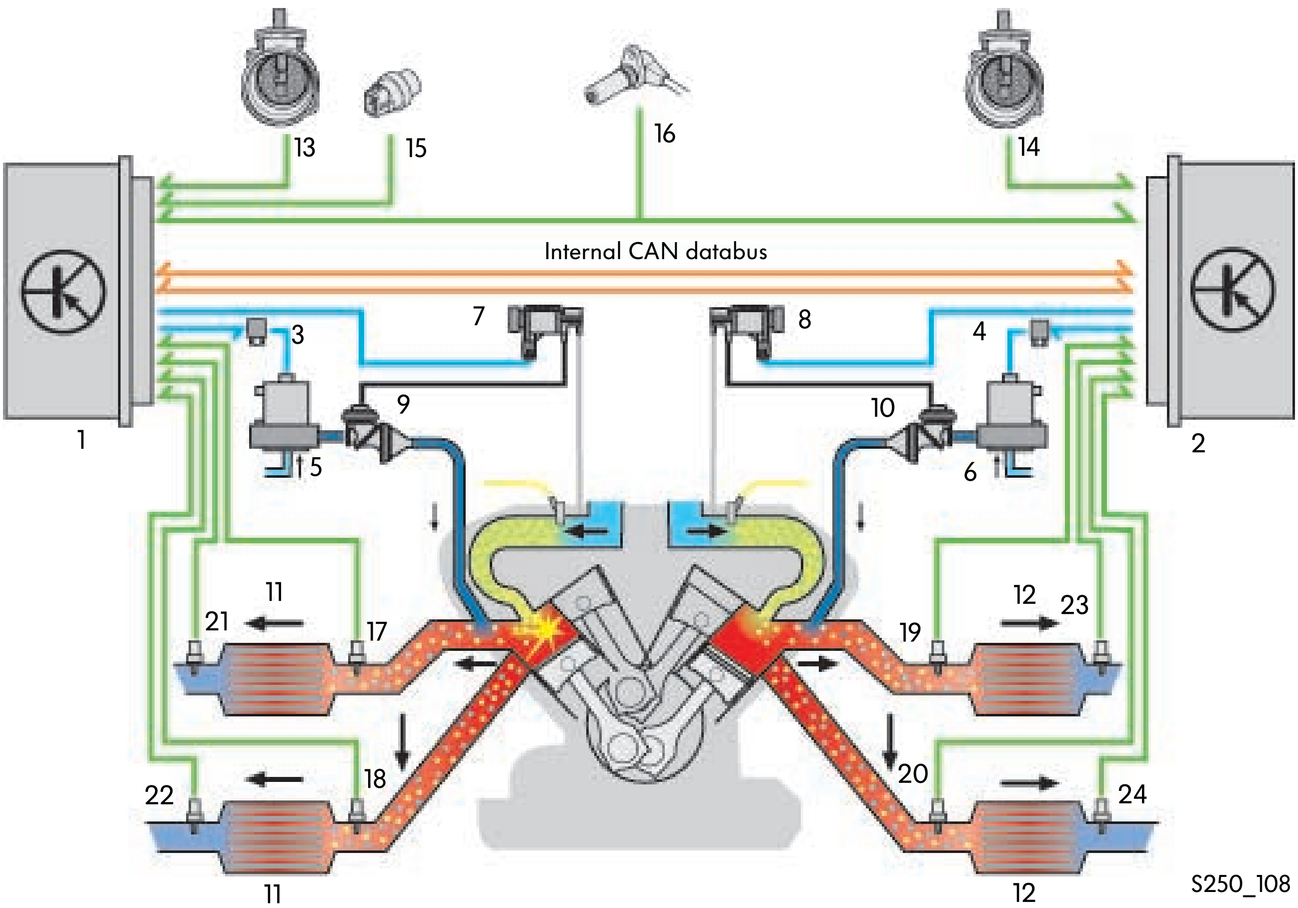
S250_330

Once the accelerator pedal has been depressed as far as the kick-down switch, the full throttle position has been reached. If the accelerator pedal is further depressed, a spring in the kick-down switch is overcome and a switching contact closed.
This switch signal, along with the accelerator position sender, helps the engine control unit to detect the kick-down position.

Signal failure strategies

In the event of failure, the values of the accelerator position sender are used.

Secondary air system



Bank I

1 Engine control unit 1
3 Secondary air pump relay 1, Bank I
5 Secondary air pump 1, Bank I
7 Secondary air inlet valve 1, Bank I
9 Combi valve 1, Bank I
11 Pre-catalyst Bank I
13 Air mass meter 1 with intake air temperature sender
15 Temperature sender G62
16 Engine speed sender
17 Lambda probe 1, before catalyst, Bank I
18 Lambda probe 2, before catalyst, Bank I
21 Lambda probe 1, after catalyst, Bank I
22 Lambda probe 2, after catalyst, Bank I

Bank II

2 Engine control unit 2
4 Secondary air pump relay 2, Bank II
6 Secondary air pump 2, Bank II
8 Secondary air inlet valve 2, Bank II
10 Combi valve 2, Bank II
12 Pre-catalyst Bank II
14 Air mass meter 2 with intake air temperature sender
16 Engine speed sender
19 Lambda probe 1, before catalyst, Bank II
20 Lambda probe 2, before catalyst, Bank II
23 Lambda probe 1, after catalyst, Bank II
24 Lambda probe 2, after catalyst, Bank II

Input signals

- Signal from the lambda probes (lambda probes before catalyst for system diagnosis only)
- Coolant temperature
- Air mass meter engine load signals

The secondary air system reduces exhaust emissions in the cold starting phase. During a cold start there is an increased percentage of unburned hydrocarbons.
The catalyst cannot process this quantity as it has not yet reached its operating temperature and a mixture must be present from lambda 1.

The level of oxygen in the exhaust gases is enriched by injecting air behind the exhaust valves. This causes afterburning. The heat this releases brings the catalyst to its operating temperature more quickly.

The input signals are sent to both engine control unit 1 and engine control unit 2.
For each bank the secondary air pumps are then activated via secondary air relays, and parallel to this the secondary air inlet valves are also activated.

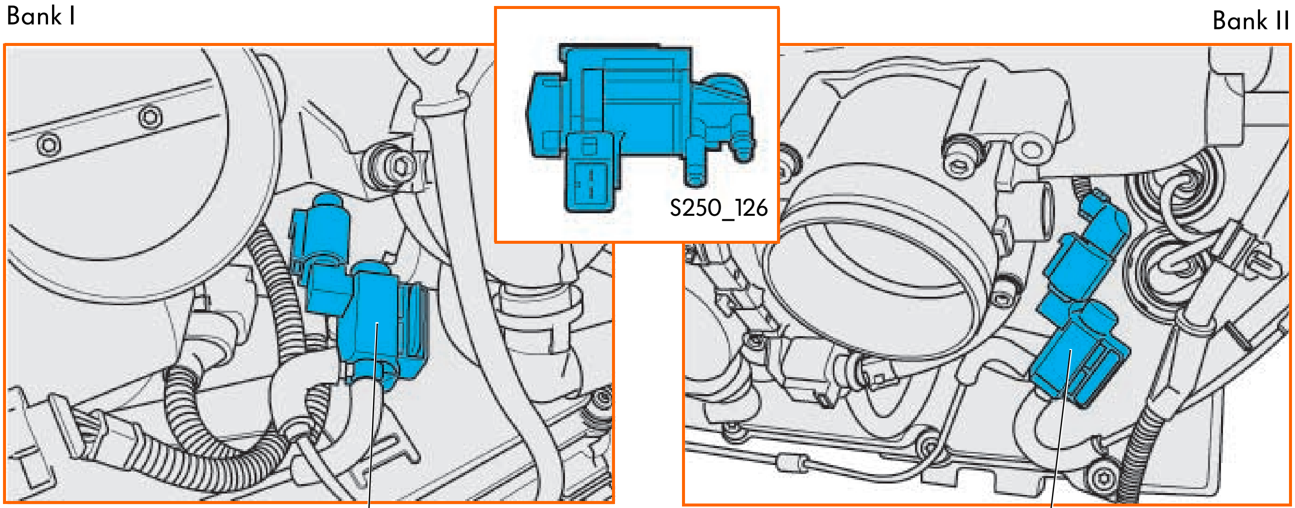
The combi valves are actuated via the secondary air inlet valves by means of a vacuum. The secondary air pumps temporarily push air behind the exhaust valves into the exhaust gas flow.

Subsystems

Secondary air inlet valves N112 and N320

Bank I

Bank II



N112 S250_370

N320 S250_336

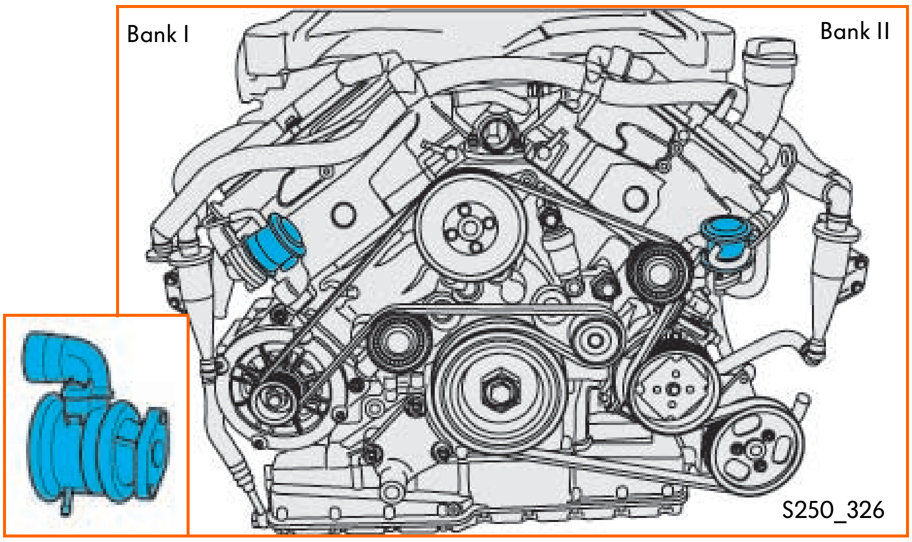
Secondary air inlet valves N112 and N320 are two 3/2-way solenoid valves and are switched by the engine control units. They activate the combi valves via a vacuum line.

Failure strategies

If the control unit signal fails, the combi valve can no longer be opened. The secondary air pump is unable to inject air.

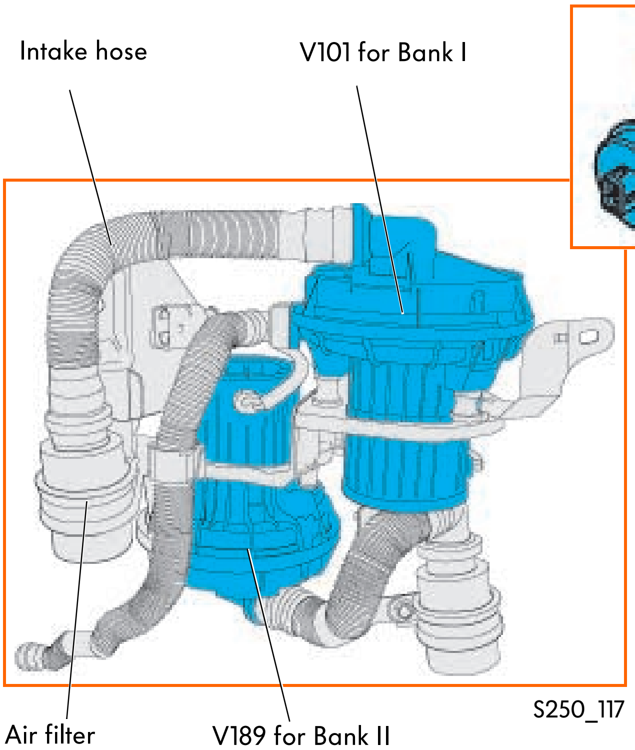
Combi valves

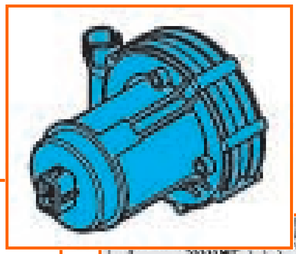
As a result of the vacuum from the secondary air inlet valve, the air route opens from the secondary air pump to the cylinder head secondary air duct. At the same time, the valve prevents hot exhaust gases from reaching the secondary air pump.

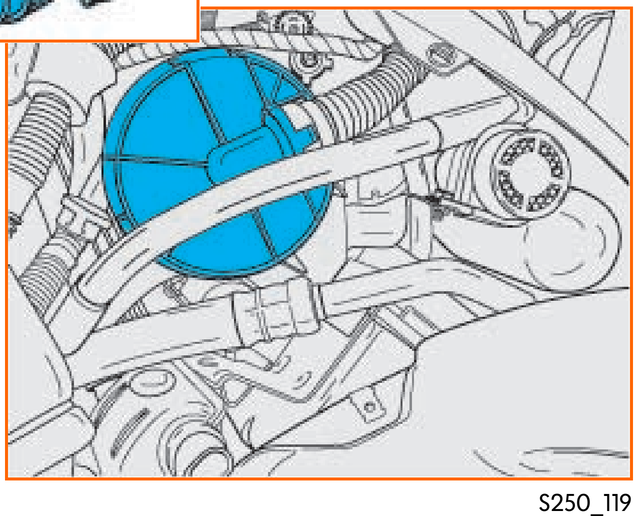


S250_055

Secondary air pumps V101 and V189





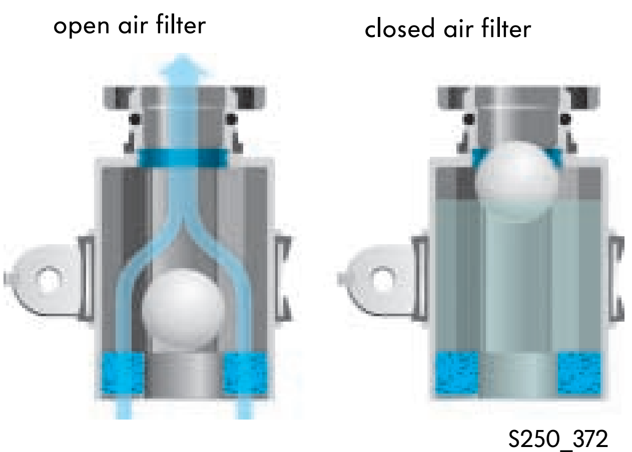


The secondary air pumps pump air and therefore oxygen via the secondary air system behind the exhaust valves. This contributes to pollution control in the engine warm-up period.

Failure strategies

If the power supply is interrupted, no air is pumped.

Air filter

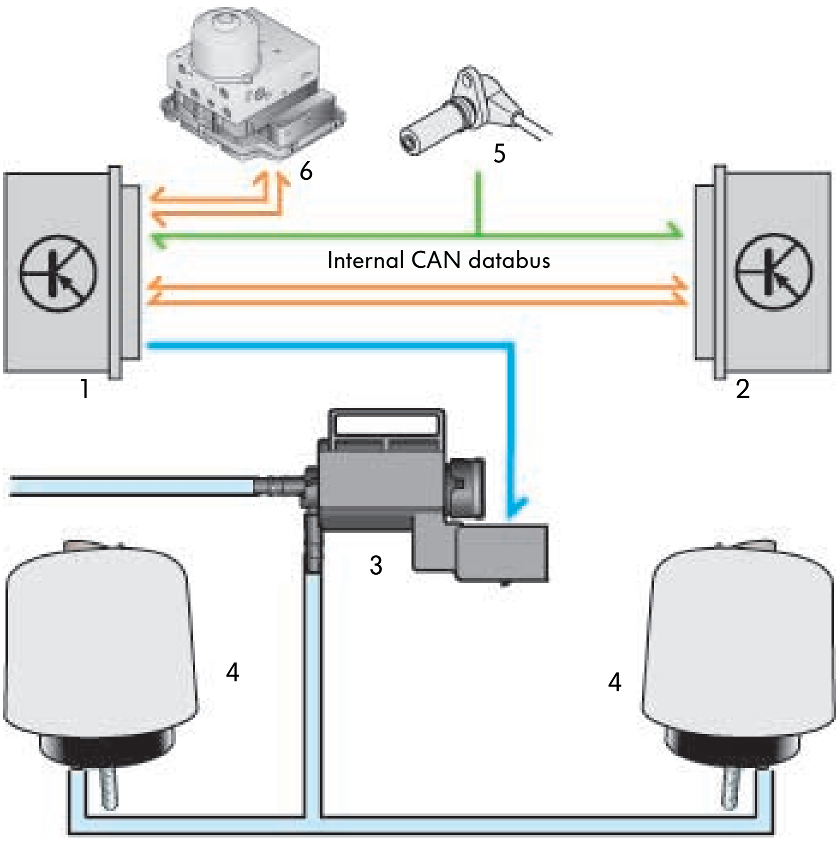


An air filter is attached to the entrance of the intake hose. There is a ball in the air filter, which closes the opening to the suction jet pump (entrainment pump) when the vehicle travels through puddles (snorkel effect).

Engine mounting control

Input signals

- Engine speed sender signal
- Road speed



S250_110

Bank I
1 Engine control unit 1
3 Electro-hydraulic engine mounting solenoid valve
4 Engine mounting
5 Engine speed sender
6 Road speed

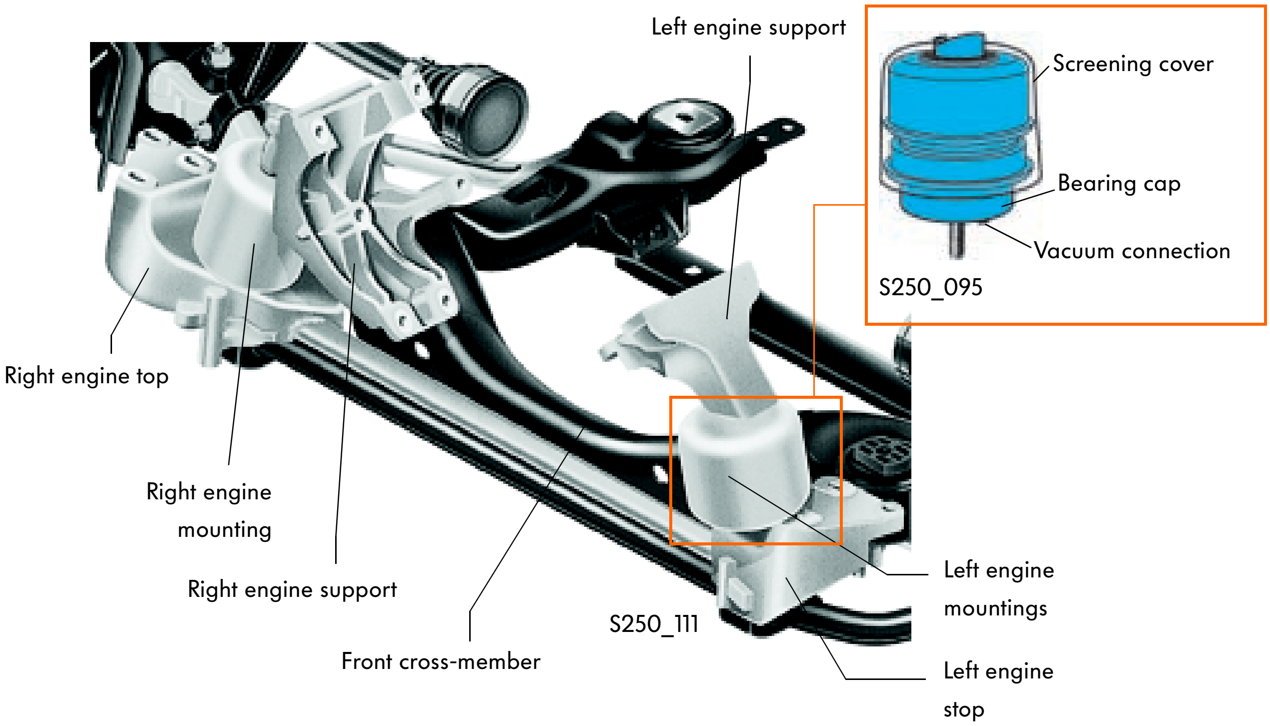
Bank II
2 Engine control unit 2
5 Engine speed sender

The hydraulically damped engine mountings with electrical activation prevent engine vibrations from being transmitted to the body across the entire rev range.

The engine control unit controls the solenoid valves depending on the engine speed and the road speed.

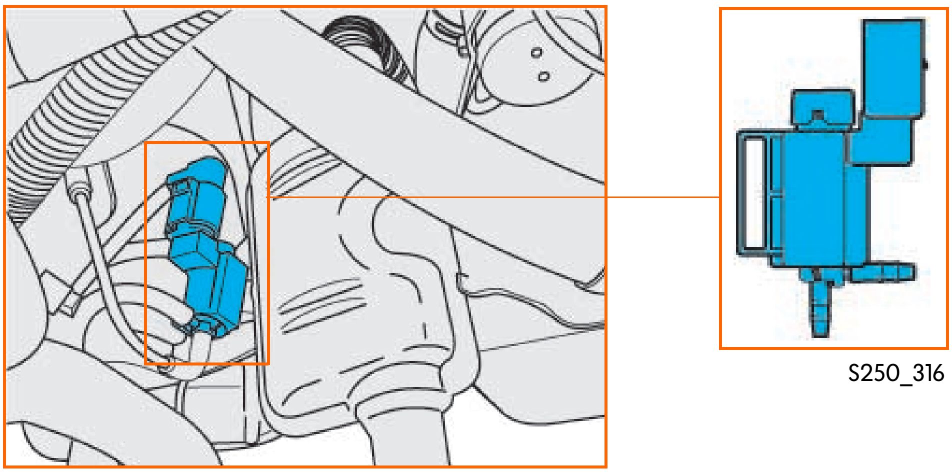
Engine mounting

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



S250_111

Electro-hydraulic engine mounting solenoid valve N145

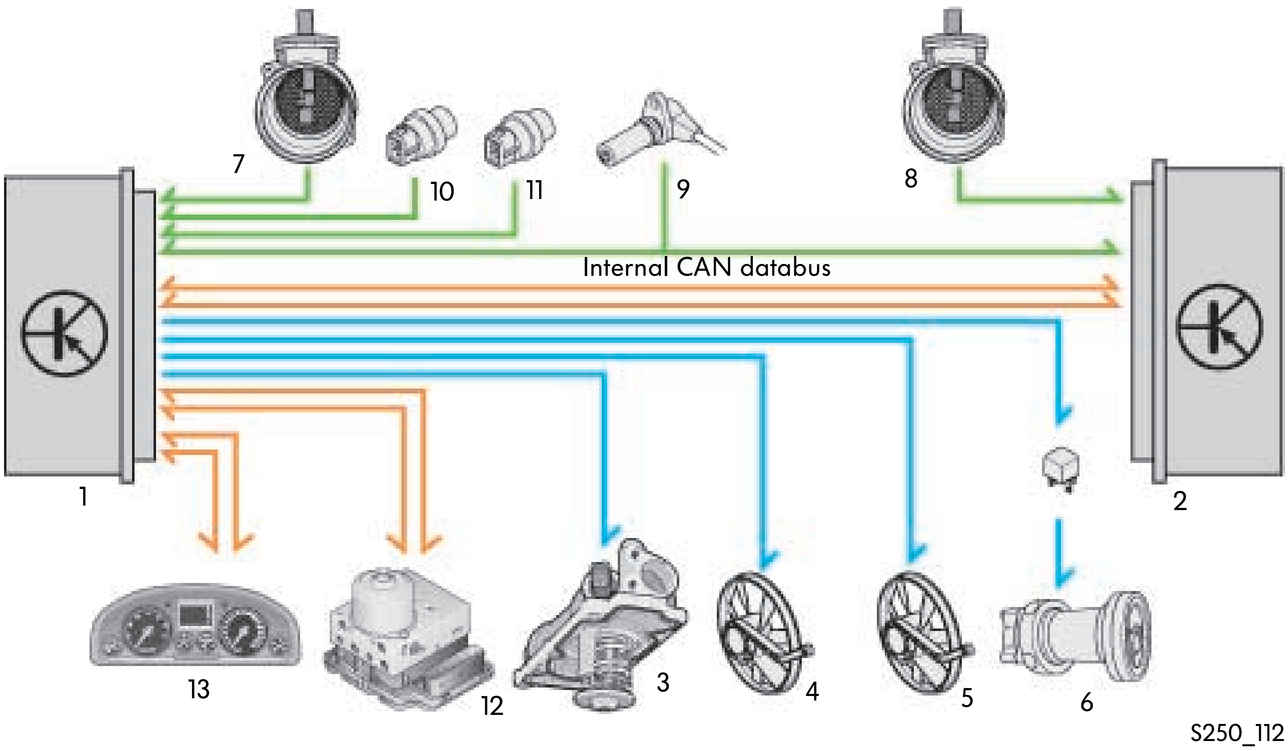


S250_316

S250_338

For explanations on how the engine mounting functions, please refer to SSP 249 "Engine management for the Passat W8 engine“.

Coolant temperature control



Bank I

1 Engine control unit 1
3 Mapped-controlled engine cooling thermostat
4 Radiator fan
5 Radiator fan -2-
6 Water pump
7 Air mass meter 1 with intake air temperature sender
9 Engine speed sender
10 Temperature sender G62
11 Temperature sender G83
12 Road speed signal from ABS control unit J104
13 Oil temperature

Bank II

2 Engine control unit 2
8 Air mass meter 2 with intake air temperature sender
9 Engine speed sender

The coolant temperature control allows the coolant temperature to be adjusted to suit the engine operating state.

Input signals

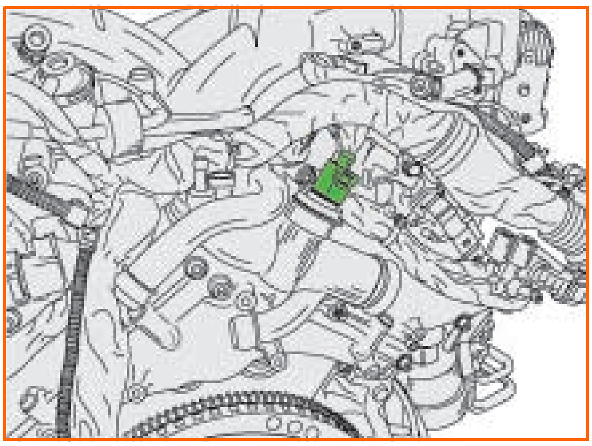
- Engine speed
- Air mass meter engine load signals
- Coolant temperature - engine outlet
- Coolant temperature - radiator outlet
- Road speed
- Oil temperature

The coolant temperature is regulated steplessly. If a large cooling capacity proves necessary after the input signals are processed, the thermostat is activated by engine control unit 1 by means of maps.

At this point the large cooling circuit opens. To increase cooling capacity, engine control unit 1 activates the two mapped-controlled radiator fans.

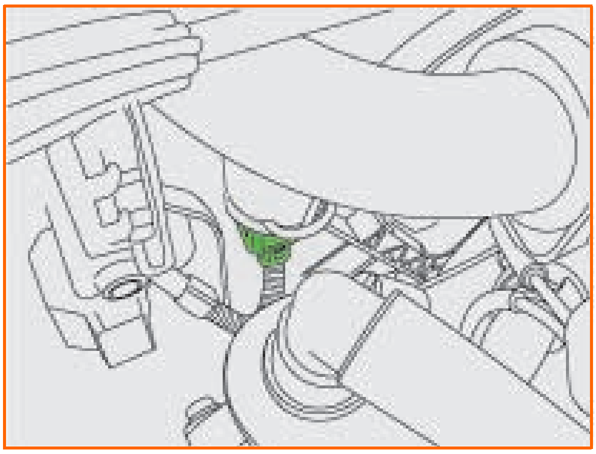
Coolant temperature senders G62 and G83

Sender G62
on the coolant outlet pipe on the engine (rear)



S250_121

Sender G83
on the radiator outlet



S250_356

The actual values for the coolant temperature are measured at two different points in the cooling circuit. Sender G62 is located on the coolant outlet pipe on the engine and Sender G83 is on the radiator outlet.

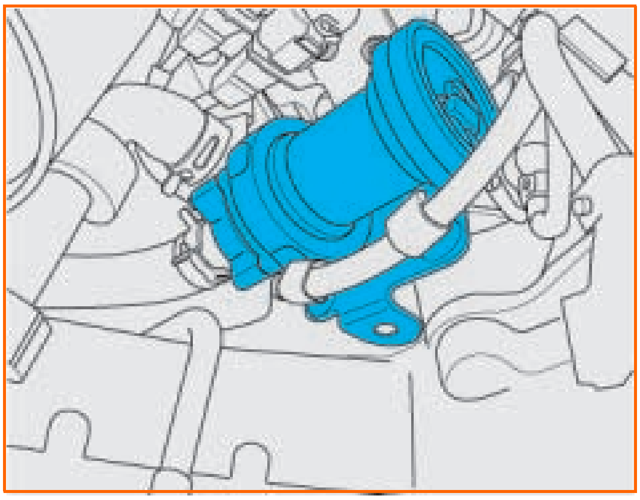
Both senders transmit their signals to engine control unit 1 only.
Engine control unit 2 receives the necessary information via the internal CAN databus from engine control unit 1.

Signal failure strategies

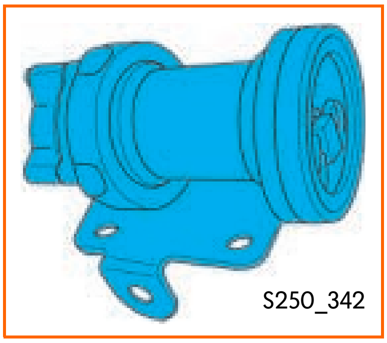
An engine temperature model is calculated from the figures for the engine load, engine speed, intake temperature on starting the engine plus the time after starting the engine. While the engine is running, this model is constantly compared with the temperature signal from sender G62.

If the measured temperature from sender G62 falls below the calculated model temperature, it is assumed that sender G62 is transmitting a fault signal and calculations continue using the model temperature as a back-up temperature.

Continued coolant circulation pump V51



S250_340



S250_342

Continued coolant circulation pump V51 is an electrically driven pump, located in the large cooling circuit. It carries out two tasks in the cooling circuit:

1. Continued coolant circulation pump V51 supports the mechanically driven coolant pump at low engine speeds.
   This guarantees adequate coolant circulation even during "stop and go“ trips.
   Coolant pump V51 is switched on if required after the engine speed and coolant temperature input signals have been mapped-controlled and evaluated. It is activated by engine control unit 1.

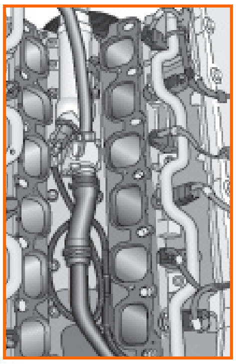
2. Continued coolant circulation pump V51 ensures the circulation of coolant during coolant pump run-on. Depending on the coolant temperatures at the radiator and engine outlets, the engine oil temperature as well as the intake air temperature, after the engine is turned off it is map-controlled by engine control unit 1.

If constant short trips are made, the switch-on temperature for the continued coolant circulation pump V51 is not reached, and the continued coolant circulation pump must not be allowed to seize. For this reason, it is activated for approximately 5 seconds each time the engine is started.

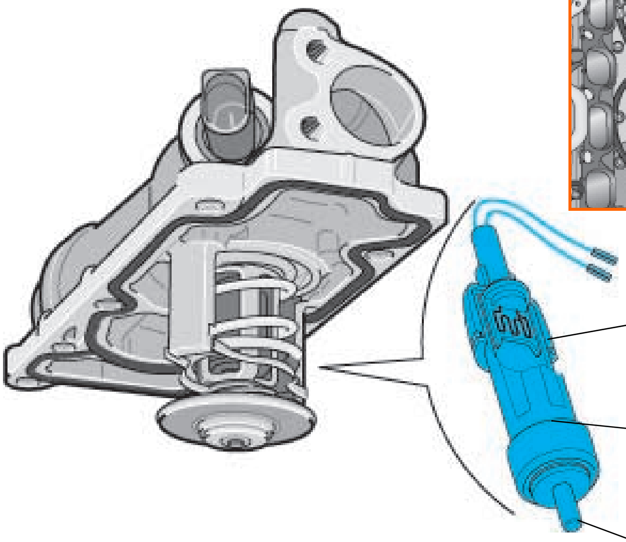
Signal failure strategies

The self-diagnosis system does not detect whether continued coolant circulation pump V51 is blocked.

Mapped-controlled engine cooling thermostat F265



S250_123



S250_059

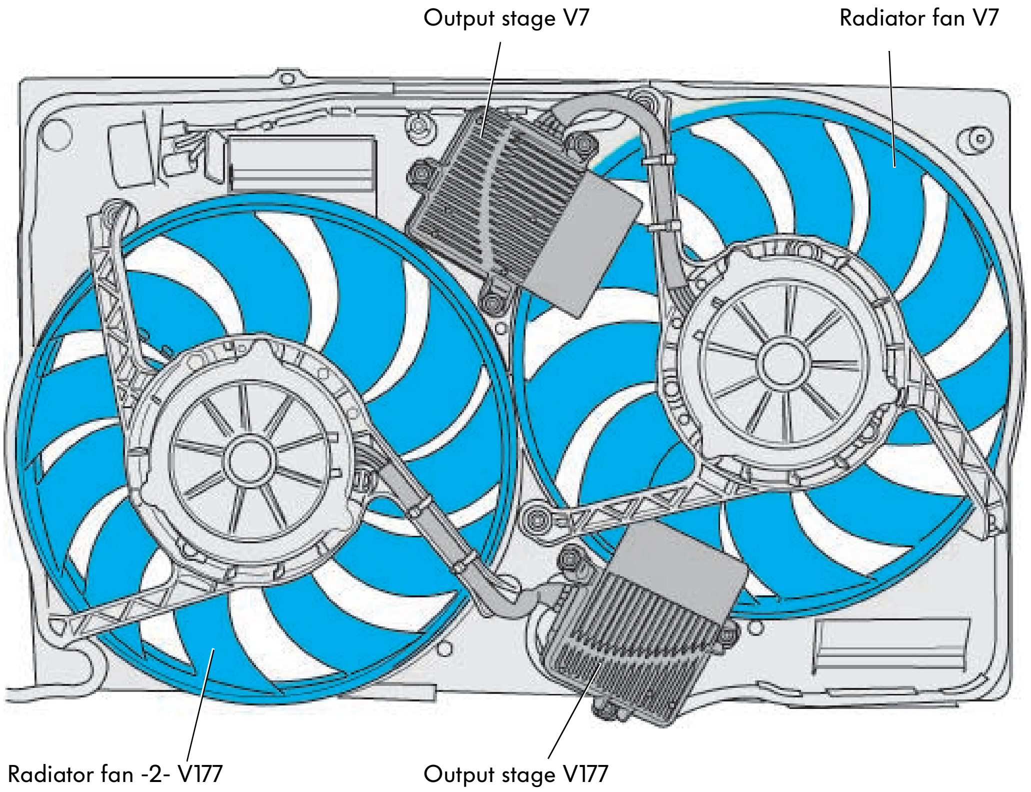
The thermostat is inserted from above into the upper part of the crankcase. The thermostat switches over from the small to the large cooling circuit.

Maps are stored in the engine control unit and they are used to activate the thermostat. The required temperature can be reached depending on the engine operation requirements.

Failure strategies

It is not possible to open the large cooling circuit. The radiator fan must provide the cooling capacity.

Radiator fans V7 and V177



S250_344

Radiator fans V7 and V177 are attached to the front end behind the capacitor for the air conditioning system and the cooler.

The fans are activated as required by a map integrated in the engine control unit.

The fan controllers are accommodated in the output stages.

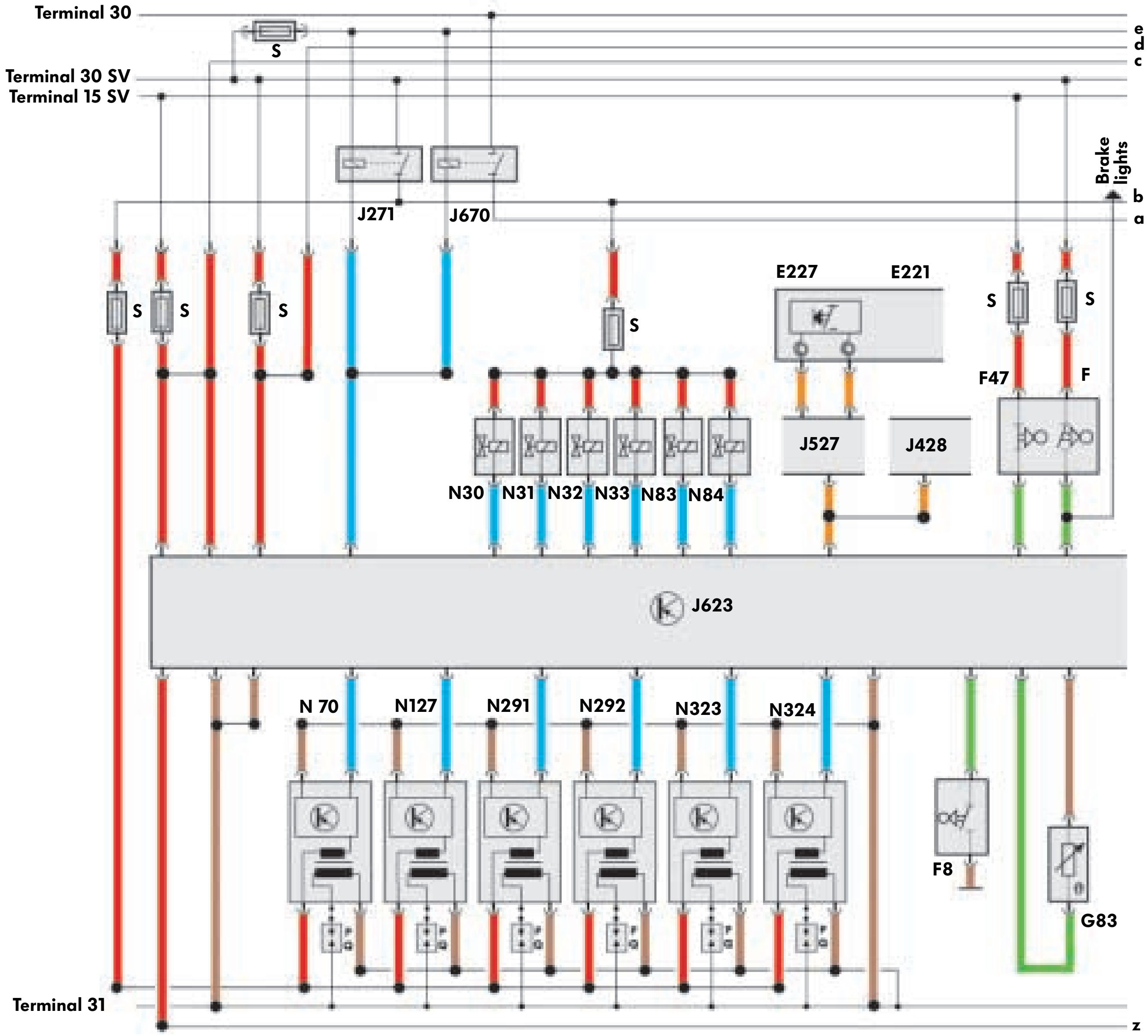
This means that, based on the signals from the engine control unit, the fans can also be operated individually and at different engine speeds.

Failure strategies

If a fan fails, the indicator lamp is activated and it is not possible to travel any further.

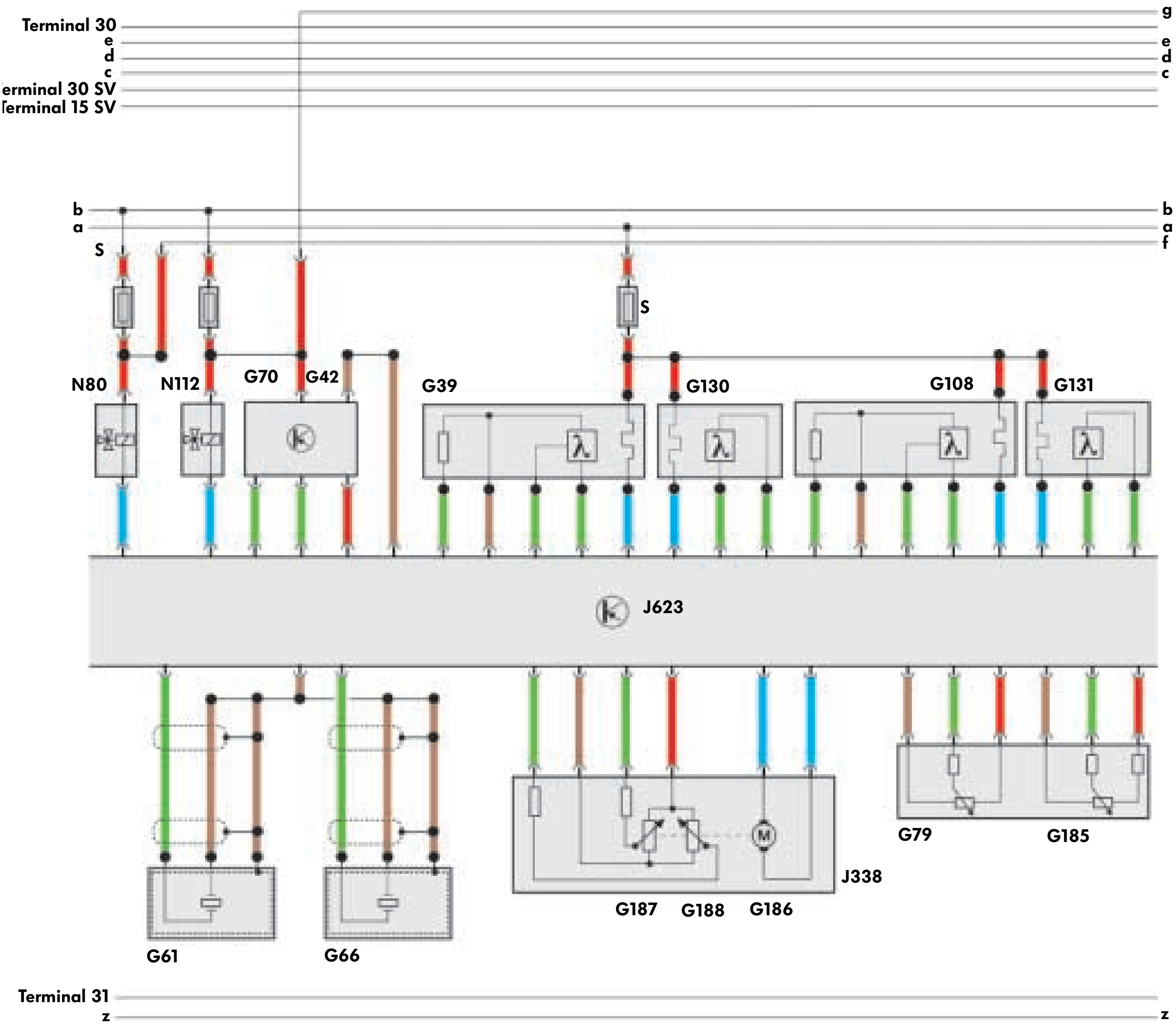
This also applies if both fans fail.

Function diagram



S250_302

E221- Operating unit in the steering wheel
E227- CCS button
F - Brake light switch
F47- CCS brake pedal switch
F8 - Kick-down switch
G83- Coolant temperature sender - radiator outlet
J623- Engine control unit 1
J271 - Motronic current supply relay
J428- Distance control unit
J527- Steering column electronics control unit
J670 - Motronic current supply relay -2-
N30- Injector, cylinder 1
N31- Injector, cylinder 2
N32- Injector, cylinder 3
N33- Injector, cylinder 4
N83- Injector, cylinder 5
N84- Injector, cylinder 6
N70- Ignition coil 1
N127- Ignition coil 2
N291- Ignition coil 3
N292- Ignition coil 4
N323- Ignition coil 5
N324- Ignition coil 6
P - Spark plug socket
Q - Spark plugs
S - Fuse



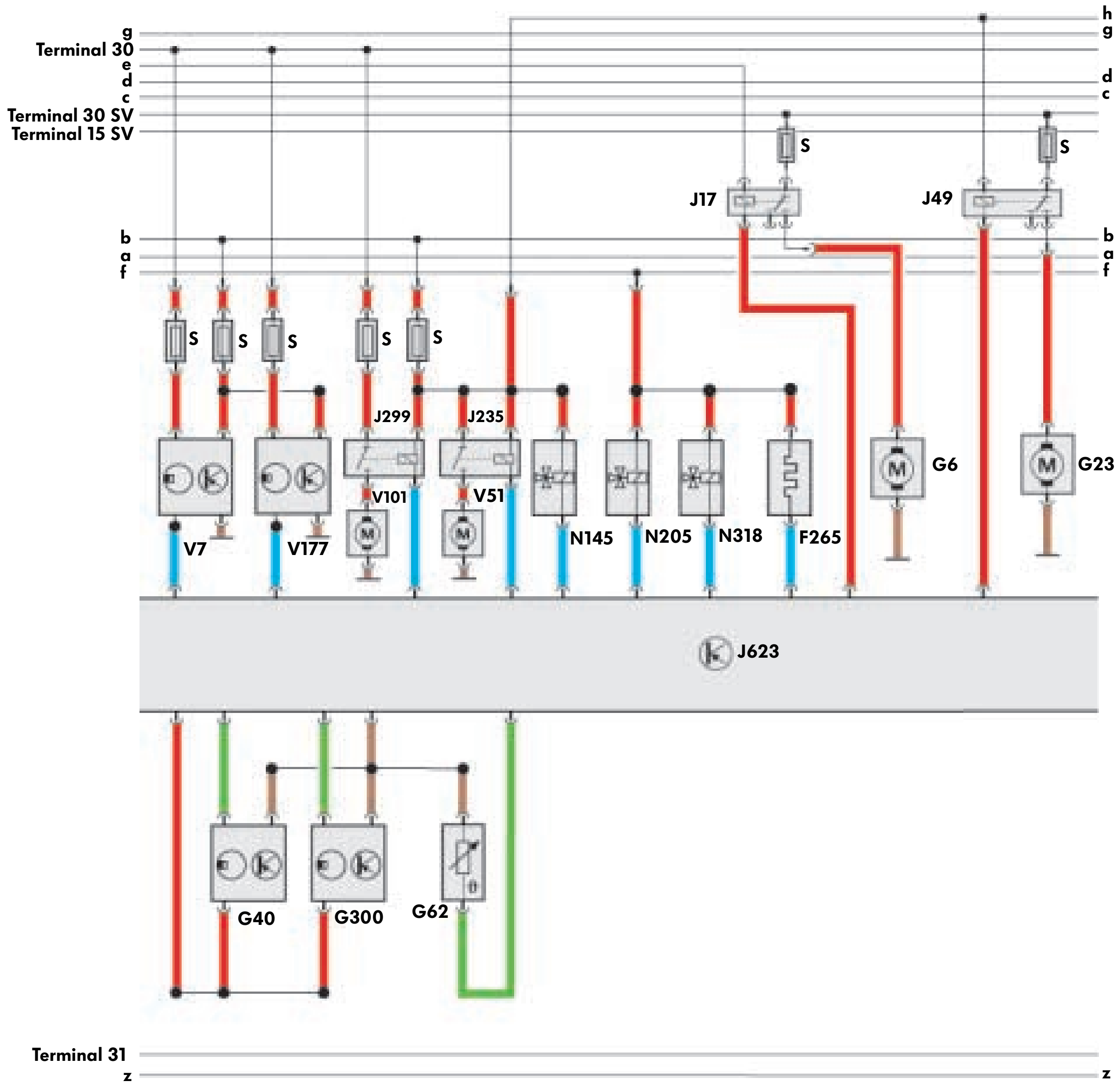
S250_304

G42	- Intake air temperature sender	J623	- Engine control unit 1
G61	- Knock sensor I	N80	- Activated charcoal filter system solenoid valve 1
G66	- Knock sensor II	N112	- Secondary air inlet valve
G70	- Air mass meter	S	- Fuse
G39	- Lambda probe		
G108	- Lambda probe II		
G130	- Lambda probe after catalyst		
G131	- Lambda probe II after catalyst		
G79	- Accelerator position sender		
G185	- Accelerator pedal position sender -2-		
J338	- Throttle valve control unit		
G186	- Throttle valve drive		
G187	- Throttle valve drive angle sender -1-		
G188	- Throttle valve drive angle sender -2-		

Colour code/legend

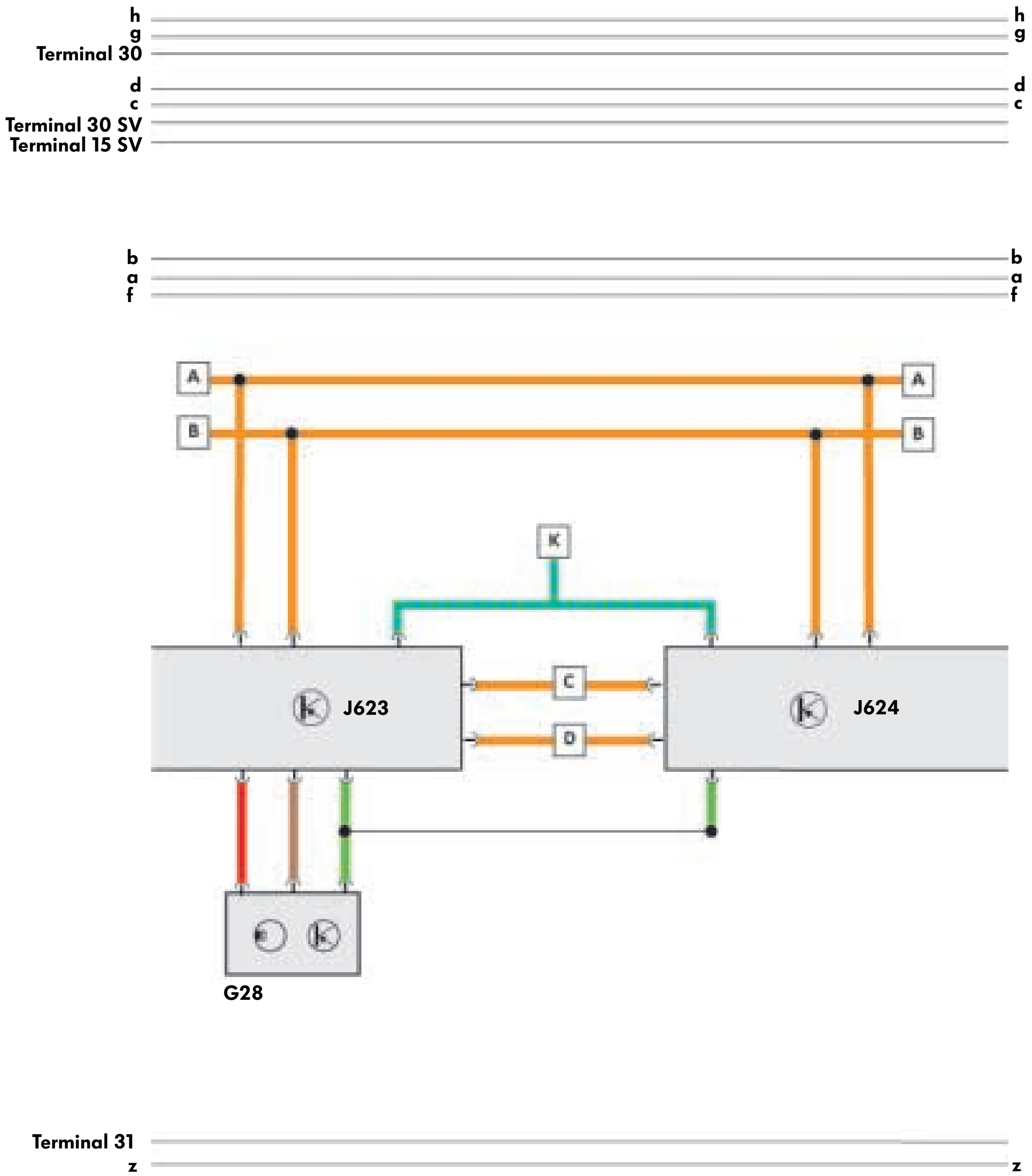
- green = input signal
- blue = output signal
- red = positive
- brown = dimensions
- orange = CAN databus

Function diagram



S250_306

F265	-	Mapped-controlled engine cooling thermostat	N145	-	Electro-hydraulic engine mounting solenoid valve, right
G6	-	Fuel pump (pre-supply pump)	N205	-	Inlet camshaft timing adjustment valve -1-
G23	-	Fuel pump	N318	-	Exhaust camshaft timing adjustment valve -1-
G40	-	Hall sender	V7	-	Radiator fan
G62	-	Coolant temperature sender	V51	-	Continued coolant circulation pump
G300	-	Hall sender 3	V101	-	Secondary air pump motor
J17	-	Fuel pump relay	V177	-	Radiator fan 2
J49	-	Fuel pump relay	S	-	Fuse
J623	-	Engine control unit 1			
J235	-	Coolant pump relay			
J299	-	Secondary air pump relay			



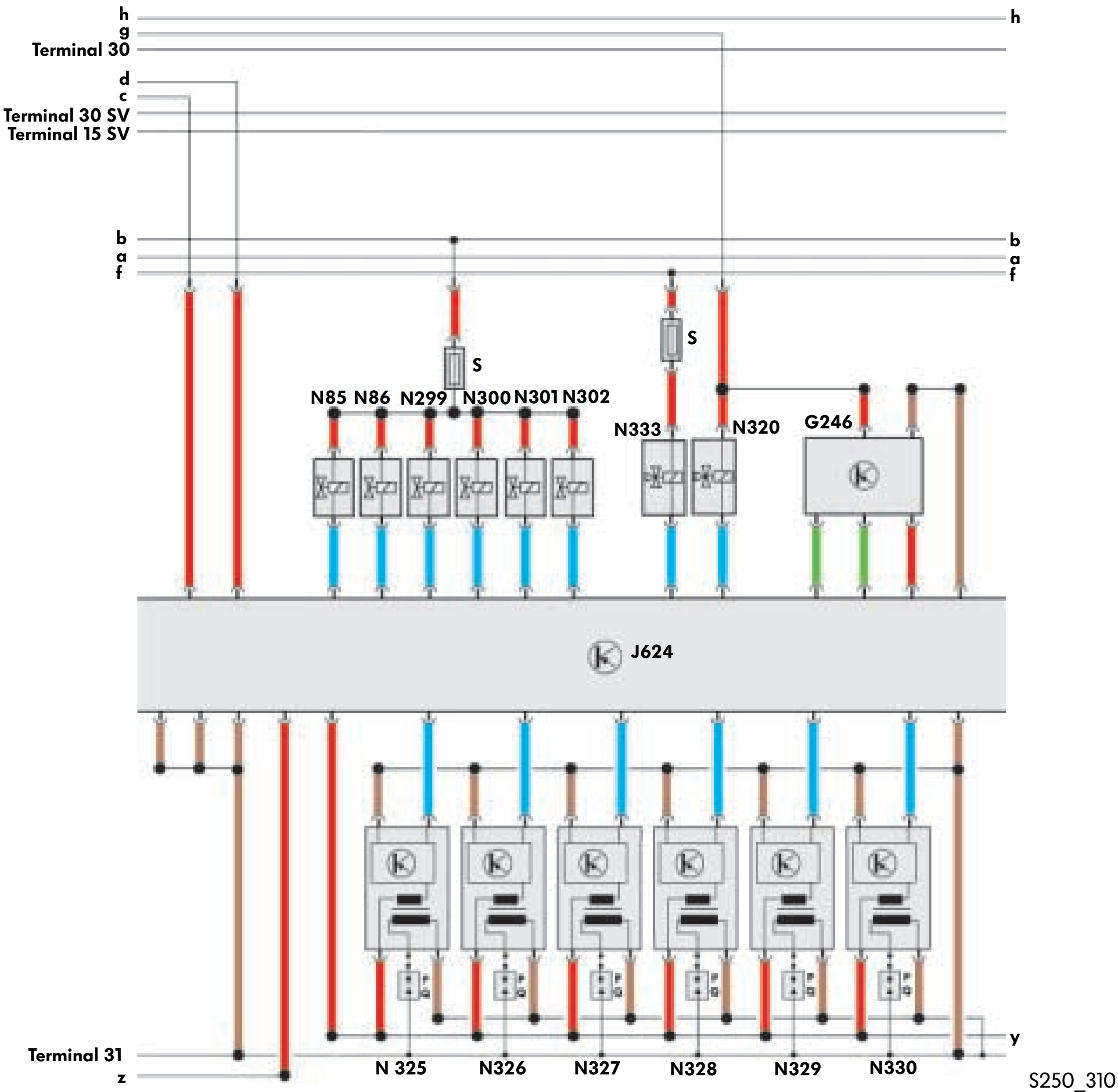
S250_308

J623 - Engine control unit 1
J624 - Engine control unit 2
G28 - Engine speed sender
A - Drive Train CAN databus - low
B - Drive Train CAN databus - high
C - Internal CAN databus - low
D - Internal CAN databus - high
K - Diagnosis wire

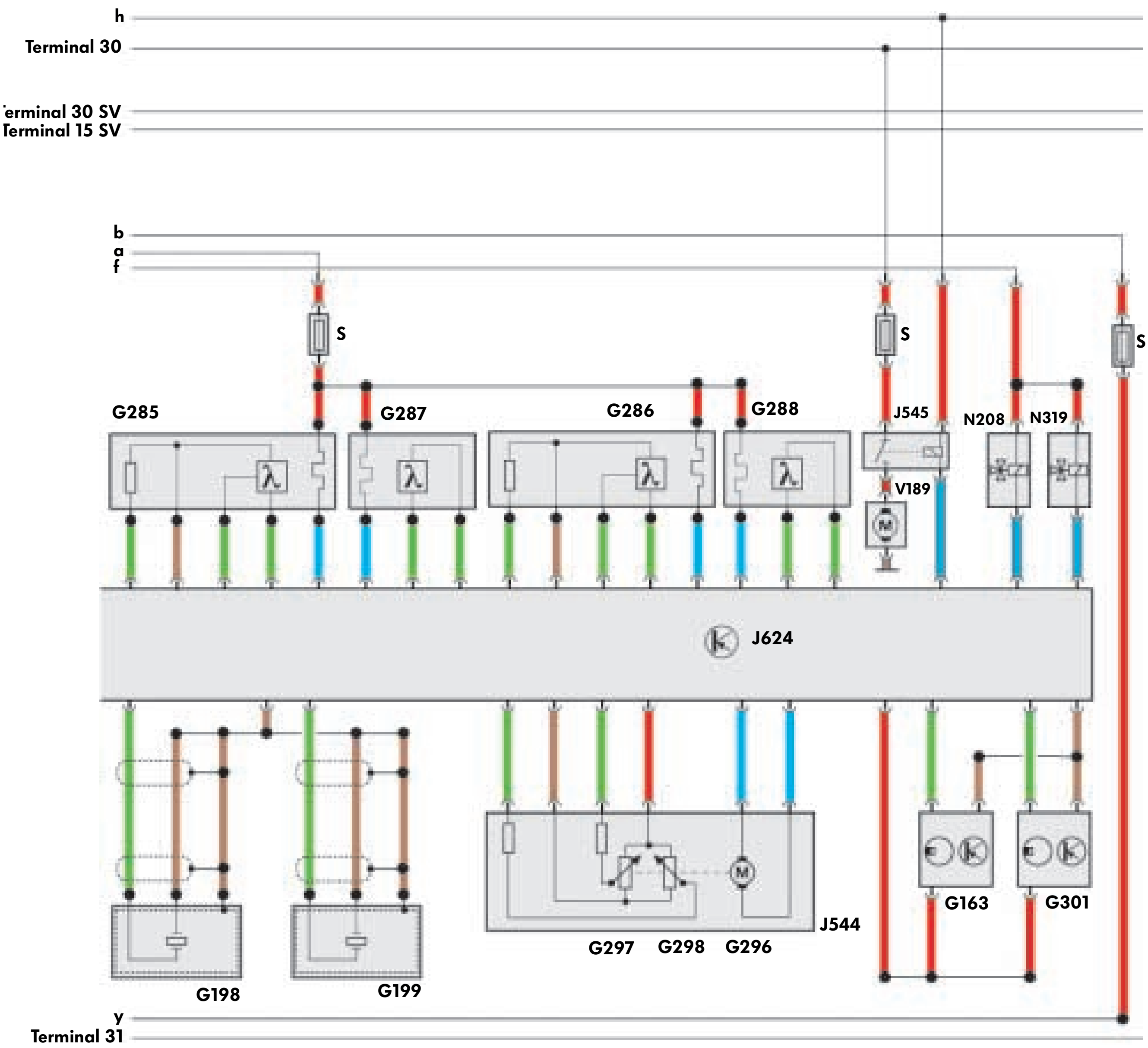
Colour code/legend

= input signal
= output signal
= positive
= dimensions
= CAN databus

Function diagram



G246 - Air mass meter 2
J624 - Engine control unit 2
N85 - Injector, cylinder 7
N86 - Injector, cylinder 8
N299 - Injector, cylinder 9
N300 - Injector, cylinder 10
N301 - Injector, cylinder 11
N302 - Injector, cylinder 12
N320 - Secondary air inlet valve 2
N325 - Ignition coil 7
N326 - Ignition coil 8
N327 - Ignition coil 9
N328 - Ignition coil 10
N329 - Ignition coil 11
N330 - Ignition coil 12
N333 - Activated charcoal filter system solenoid valve 2
P - Spark plug socket
Q - Spark plugs
S - Fuse



S250_312

G163 - Hall sender 2
G198 - Knock sensor 3
G199 - Knock sensor 4
G285 - Lambda probe III
G286 - Lambda probe IV
G287 - Lambda probe III after catalyst
G288 - Lambda probe IV after catalyst
G296 - Throttle valve drive 2
G297 - Angle sender -1- for throttle valve drive 2
G298 - Angle sender -2- for throttle valve drive 2
G301 - Hall sender 4
J544 - Throttle valve control unit 2

J545 - Secondary air pump relay 2
J624 - Engine control unit 2
N208 - Inlet camshaft timing adjustment valve -2-
N319 - Exhaust camshaft timing adjustment valve -2-
S - Fuse
V189 - Secondary air pump motor 2

Colour code/legend

= input signal
= output signal
= positive
= dimensions
= CAN databus

Self-diagnosis system

The engine control unit permits extensive self-diagnosis of all subsystems and electrical components.

It communicates with various vehicle diagnosis systems.

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

Using the VAS 5051 Vehicle Diagnostic, Testing and Information System it is possible to carry out the following:

- **vehicle self-diagnosis**
- **measurements**
- **guided fault-finding**
- **administration.**

Using the mobile VAS 5052 Vehicle Diagnostic, Testing and Information System it is possible to carry out or operate the following:

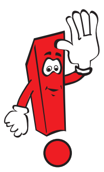
- **vehicle self-diagnosis**
- **service information system**
- **administration.**

VAS 5051

S250_378

VAS 5052

S250_235



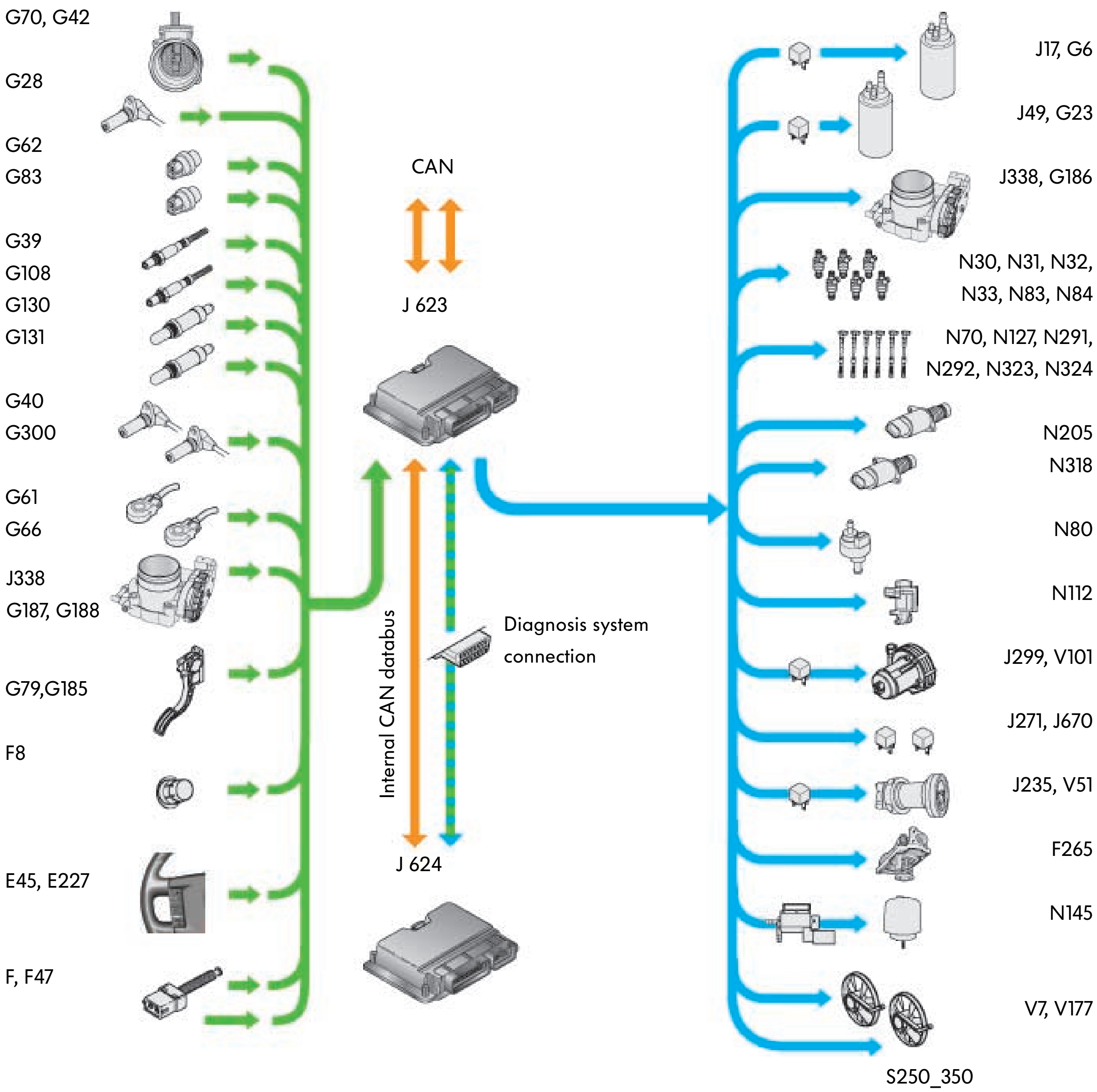
For information on how to handle the VAS 5051 Vehicle Diagnostic, Testing and Information System, please refer to SSP 202 "VAS 5051 Vehicle Diagnostic, Testing and Information System“. For the VAS 5052 Vehicle Diagnostic, Testing and Information System please refer to SSP 256 "VAS 5052“.

Reading the fault memory

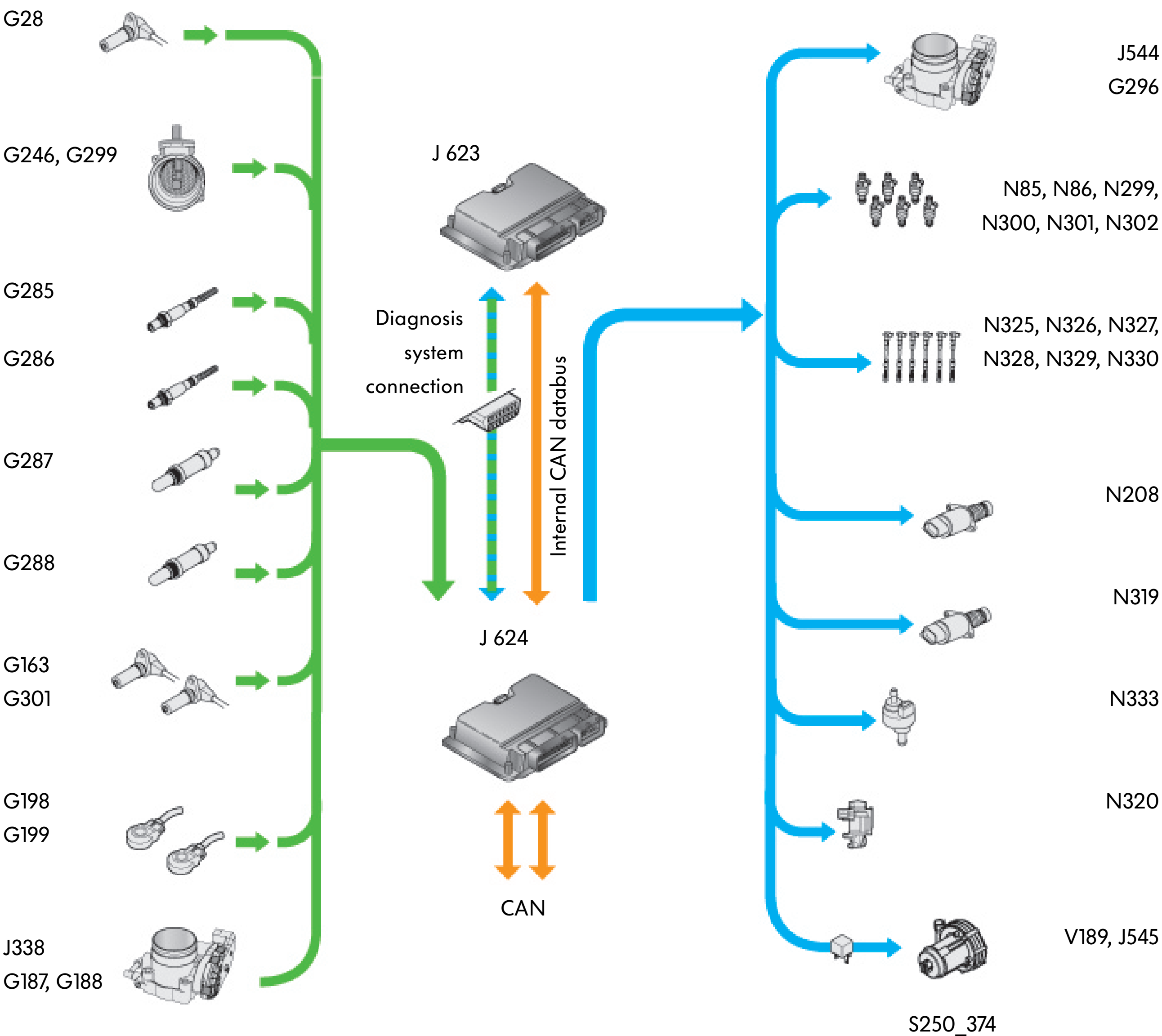
If faults occur in the system, they are detected by the self-diagnosis system and stored in the fault memory. The fault memory can be read in function 02 with the vehicle diagnosis system.

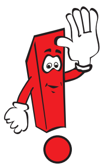
The following components are monitored by the self-diagnosis system:

Engine control unit 1



Engine control unit 2





Please note that repairs group 01 is integrated in "Guided Fault-Finding“.
The "Read data block" and "Actuator diagnosis" functions are also located there.

Erasing the fault memory

After "Interrogate fault memory“ this function deletes the contents of the fault memory. In addition, however, the readiness code and various adaption values such as the camshaft adaption values and the lambda adaption values are also erased. To check that the fault memory has been erased correctly, the ignition must be switched off once.

After "Erase fault memory“, check whether the camshafts have been re-adapted. If there is no adaption, the camshaft timing is unadjusted, resulting in a noticeably reduction in performance. There are two procedures for adapting the camshafts:

- with a short idling phase after the fault memory has been erased and the engine has been restarted;
- by starting basic adjustment following the instructions in the Workshop Manual.

Careful consideration should be given before erasing the fault memory as the readiness code is also deleted at the same time, making it necessary to start "Generate readiness code". The readiness code must always be generated at the conclusion of any repair work, so that it is not deleted again when further work is carried out. The readiness code is generated with VAS 5051 in the "Guided Fault-Finding“ function.

Readiness code

Once the complete number of diagnoses has been conducted, the 8-digit readiness code is set. It is possible to assign a 0 (diagnosis carried out) or 1 (diagnosis not carried out) to each position in the number code. The readiness code does not provide information as to whether there are faults in the system. An illuminated exhaust emissions warning lamp is the optical indication that one or more faults have been detected and stored.

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

For further information about the readiness code please refer to SSP 175 and SSP 231.

Test your knowledge

1. The Motronic ME7.1.1 controls the W12 engine. Which of the following statements are correct?

☐ a. The Motronic ME7.1.1 is designed with two J623 and J624 control units.

☐ b. The Motronic ME7.1.1 is designed with one J623 control unit.

☐ c. Both control units are identical.

☐ d. Engine control unit 2 is responsible for Cylinder bank II and is also called the "Slave“.

2. Engine control units 1 and 2 are:

☐ a. fitted on the left and right in the plenum chamber.

☐ b. fitted on the right in the plenum chamber under the coolant expansion tank.

3. How many lambda probes are fitted?

☐ a. Two lambda probes upstream of the catalyst

☐ b. Two lambda probes downstream of the catalyst

☐ c. Four lambda probes upstream of the catalyst.

☐ d. Four lambda probes downstream of the catalyst.

4. The injectors are supplied with the necessary fuel pressure via a fuel pressure line. The pressure regulator is attached at the end of the pressure line.

☐ a. It regulates the pressure to approximately 3 bar.

☐ b. It regulates the pressure to approximately 8 bar.

☐ c. It regulates the pressure to approximately 4 bar.

5. Two electrical fuel pumps pump the fuel via a closed circular pipeline to the injectors. A second fuel pump is necessary because of the two-part fuel tank.
When is the second fuel pump activated by the engine control unit?

☐ a. On a bad stretch of road

☐ b. When the engine is started

☐ c. During acceleration

☐ d. When there is a high load

☐ e. When the fuel quantity is less than 20 litres

6. Which injectors are activated by engine control unit 1 and are fitted in Cylinder bank I?

☐ a. N70, N127, N291, N292, N323, N324

☐ b. N30, N31, N32, N33, N83, N84.

☐ c. N85, N86, N299, N300, N301, N302

7. Four knock sensors are fitted to monitor knock control.
Which of the knock sensors monitors four cylinders?

☐ a. Knock sensor G198

☐ b. Knock sensor G61

☐ c. Knock sensor G199

☐ d. Knock sensor G66

Test your knowledge

8. A camshaft adaption is necessary after the fault memory has been erased. Without camshaft adaption

- [ ] a. there is no camshaft timing adjustment.
- [ ] b. there is a noticeable reduction in performance.
- [ ] c. the engine will not start.

9. In the fuel tank breather system

- [ ] a. there are two activated charcoal canisters.
- [ ] b. there is one activated charcoal canister.
- [ ] c. there are two activated charcoal filter system solenoid valves.
- [ ] d. there is one activated charcoal filter system solenoid valve.

10. Throttle valve control unit J338 is located structurally on Cylinder bank II.

- [ ] a. It is responsible for Cylinder bank II.
- [ ] b. It is responsible for Cylinder bank I.

Solutions

1.) a, c, d

2.) b

3.) c, d

4.) c

5.) b, d, e

6.) b

7.) c

8.) a, b

9.) b, c

10.)b

Notes

250

140.2810.69.20 Technical status: 03/02