Service Training

Self-study Programme 388

The 4.2l V8 4V FSI Engine

Design and Function

The 4.2l V8 4V FSI engine is a further example of direct petrol injection. It replaces the 4.2l V8 5V engine in the Touareg. Apart from the common cylinder bank angle of 90°, the two engines are no longer comparable.

With output of 257 kW and 440 Nm of torque, the engine offers very good performance, outstanding dynamics and a high level of ride comfort. This engine has already been launched in the Audi Q7.

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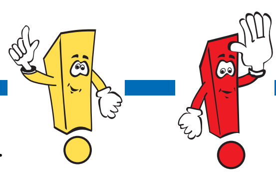
This self-study programme provides information on the design and function of this new engine generation.



The self-study programme shows the design and function of new developments.
The contents will not be updated.

For current testing, adjustment and repair instructions, refer to the relevant service literature.

Contents

Introduction

Special technical features

The 4.2l V8 4V FSI engine is the most recent example of a direct petrol injection engine from Volkswagen. It is the successor of the 4.2l V8 5V engine with intake manifold injection. In addition to direct petrol injection, certain new features have been implemented in both the engine management and in the engine's mechanical systems.

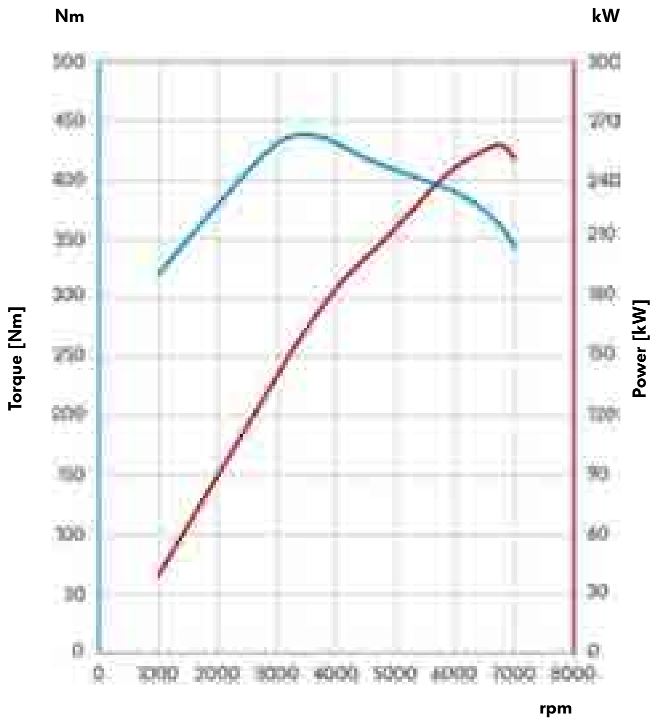
S388_003

Technical features

- Bosch Motronic MED 9.1.1
- Direct petrol injection
- Homogenous mode (Lambda 1)
- Double injection catalytic converter heating
- Electronic throttle
- Two hot film air mass sensors
- Electronically regulated cooling system
- Adjustment of the variable intake manifold and intake manifold flap change-over by means of an electric motor
- Continuous inlet and exhaust camshaft timing adjustment
- Two-stage magnesium variable intake manifold with integrated intake manifold flap change-over
- Two-piece cylinder block
- Flywheel-end chain drives for camshafts and ancillary units
- Spur gear drive for ancillary units
- Secondary air system

Technical data

Torque and output diagram



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Technical data

Engine code	BAR
Type	8 cylinders with 90° V angle
Displacement in cm^3	4163
Bore in mm	84.5
Stroke in mm	92.8
Valves per cylinder	4
Compression ratio	12.5:1
Maximum output	257 kW at 6800 rpm
Maximum torque	440 Nm at 3500 rpm
Engine management	Bosch Motronic MED 9.1.1
Fuel	Premium plus unleaded RON 98 or premium unleaded RON 95
Exhaust gas treatment	4 catalytic converters, 4 lambda probes, secondary air system
Emissions standard	EU 4

Engine mechanics

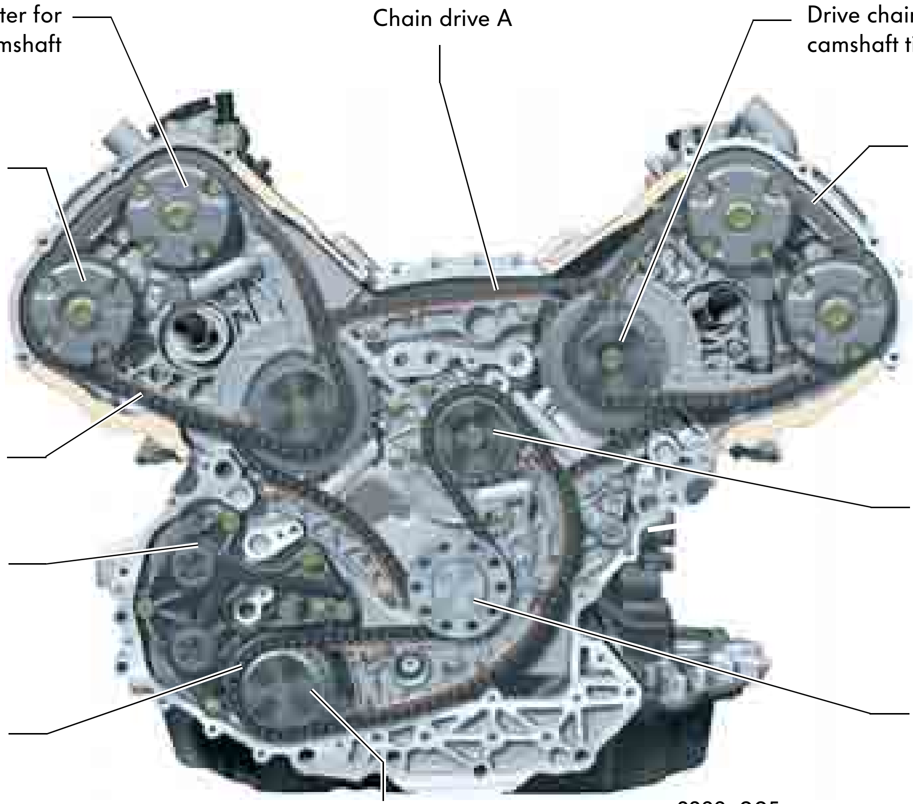
Chain drive

In the 4.2l V8 4V FSI engine, the camshafts and ancillary units are driven via a total of four roller chains on two levels. The chain drive has the advantage that it is maintenance-free and reduces the length of the engine.

The crankshaft drives the two drive gears for the camshaft timing chains via chain drive A. In turn, these two drive gears drive the camshaft adjusters for the exhaust and inlet camshafts via chain drives B and C.

In chain drive D, the crankshaft drives the drive chain sprocket for ancillary drives. This is used to drive the spur gear for the ancillary units.

The chains are tensioned via hydraulic spring tensioners.



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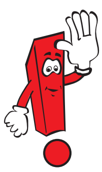
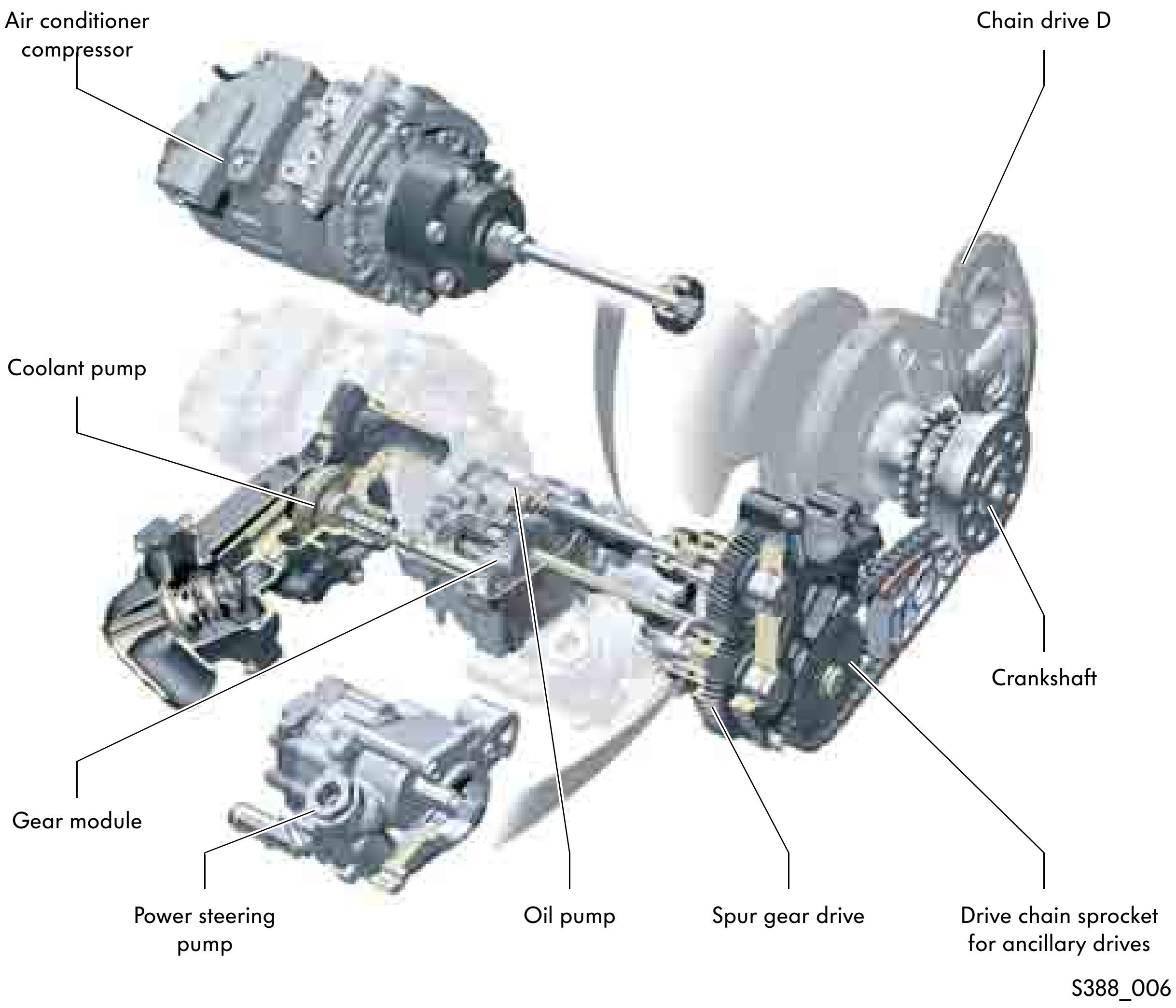


The chain drive is maintenance-free and is designed for use throughout the engine's service life. In the event of repairs, please note the information in ELSA under all circumstances.

Ancillary unit drive

The ancillary units are driven by the crankshaft via chain drive D, a spur gear drive, a gear module and four intermediate shafts. The oil pump, the coolant pump, the power steering pump and the air conditioner compressor are driven.

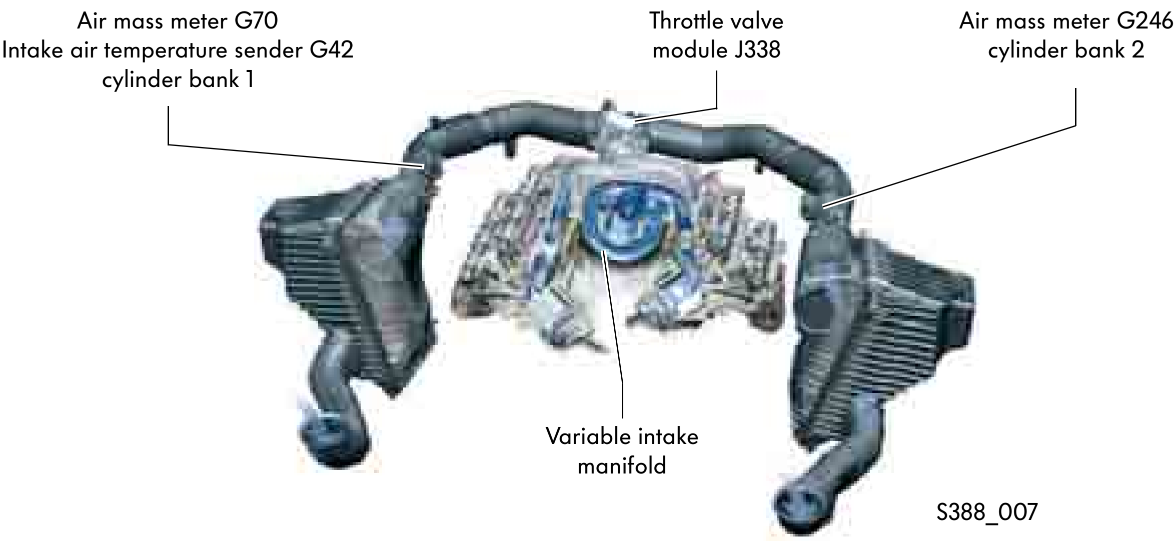
The gear module is used to adapt the rotational speed and therefore the delivery rate of the coolant pump and the oil pump.



Engine mechanics

Intake system

As in the 4.2l V8 5V engine fitted in the Touareg, the fresh air intake system is designed with two branches, and therefore reduces pressure losses.
Both intake tracts are brought together upstream of a common throttle valve module. To determine the intake mass of fresh air as accurately as possible, each intake tract is equipped with a hot film air mass meter.



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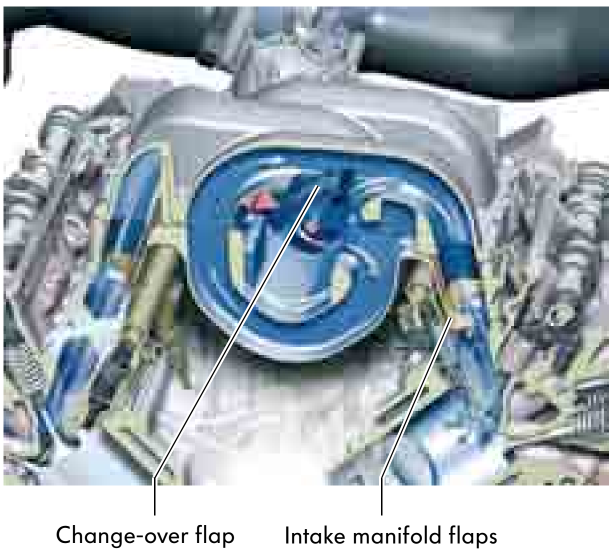
Intake manifold

The two-stage variable intake manifold is manufactured from die-cast magnesium.

It contains the change-over flaps for the variable intake manifold and the intake manifold flaps for intake manifold flap change-over.



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Variable intake manifold

In the variable intake manifold, switching between the short and the long intake manifold is carried out depending on a performance map.

- In the lower engine speed range, switching takes place to the torque position (long intake manifold)
- In the upper engine speed range, switching takes place to the output position (short intake manifold)

The change-over flaps are actuated by the variable intake manifold motor. If this is actuated by the engine control unit, it adjusts the selector shafts, which are connected together via a linkage system, and the change-over flaps located on these.
The change-over flaps are equipped with a sealing lip, in order to ensure that the long intake manifold remains leak-tight in the torque position.

S388_009

Intake manifold flap change-over

The intake manifold flaps are installed in the two intake manifold lower sections. They are actuated, depending on load and engine speed, by an intake manifold flap motor and two linkage systems.

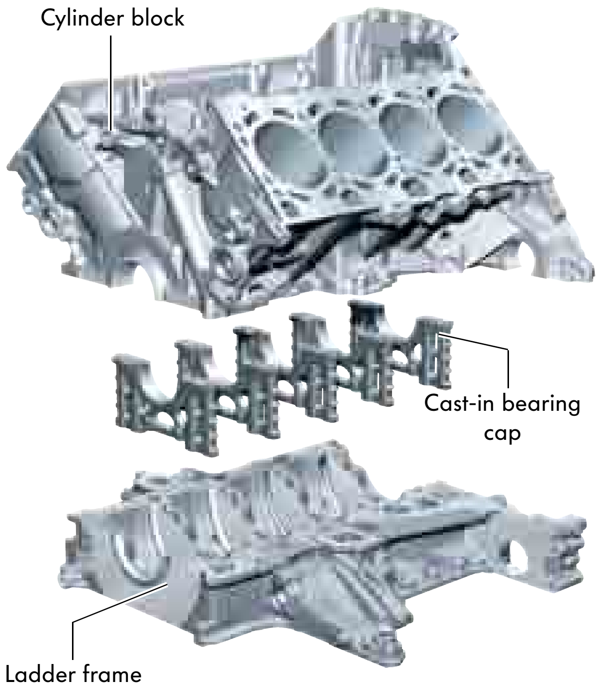
- At low load and engine speed, they are actuated and close off the lower section of the intake ports. This results in cylinder-shaped air flow into the cylinder.
- At high load and engine speed, they are not actuated, and lie flush against the surface of the intake port in order to avoid flow losses.

Due to emission-relevant reasons, the positions of the intake manifold flaps are monitored by two intake manifold flap potentiometers.

S388_010

Cylinder block

The cylinder block is manufactured from an aluminium-silicon alloy by means of low-pressure gravity die casting. It is characterised by high strength, very low cylinder warming and good thermal dissipation.
To obtain the narrowest cylinder webs possible, cylinder liners have been omitted.
Final cylinder bore surface machining is carried out in a three-stage honing and exposure process. During this process, the aluminium is separated out from the surface and the silicon is exposed in the form of minute and particularly hard particles. These finally form the wear-resistant contact surface for the pistons and the piston rings.
The ladder frame is manufactured from an aluminium-silicon alloy by means of die casting.
Cast-in bearing caps manufactured from cast iron with nodular graphite reinforce the ladder frame and absorb the majority of the flow of force. Due to their thermal expansion, which is lower than that of aluminium at high temperatures, they simultaneously limit main bearing clearance.
The ladder frame design with bearing caps offers high longitudinal and transverse stiffness.



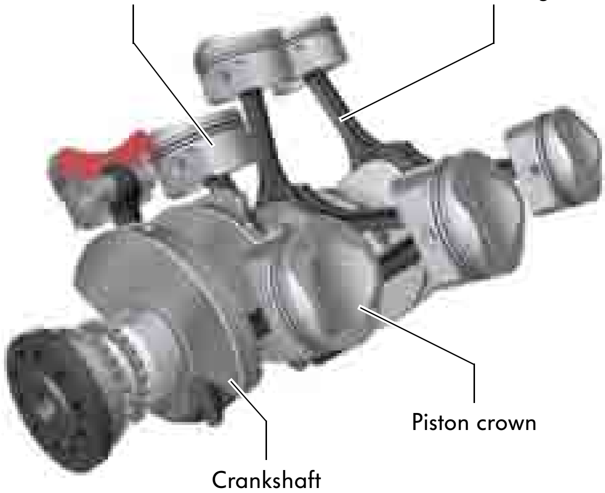
S388_011

Crankshaft drive

The crankshaft is manufactured from high-quality tempered steel, and is supported at five points.

The connecting rods are manufactured using the cracking method.

The pistons are forged due to reasons of strength. The piston crown has been adapted to the combustion process involved in FSI technology, and supports the cylindrical flow of air in the cylinder. The piston skirts are coated with Ferrostan, a contact layer which contains iron. This prevents direct contact between the aluminium surfaces of the pistons and the cylinder contact surfaces, as this increases wear.



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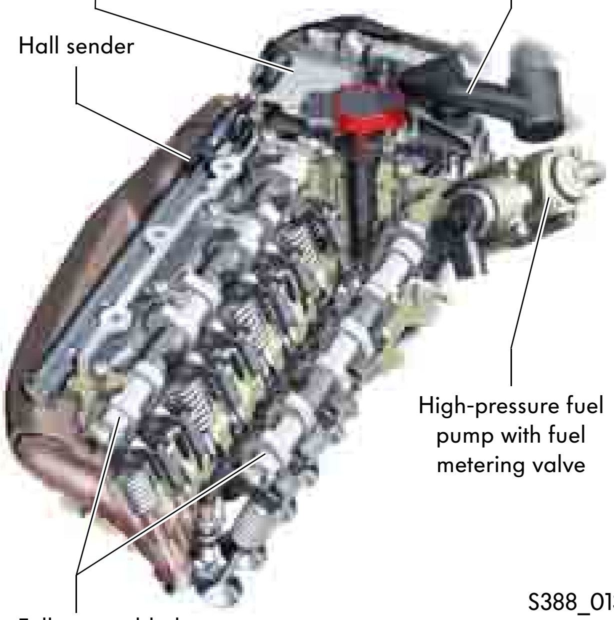
Cylinder heads

The 4-valve cylinder head is manufactured from an aluminium alloy. This material guarantees very good thermal conductivity with good strength values.

- The separating plates for intake manifold flap change-over are installed in the intake ports.
- The injectors are fitted on the intake side in the cylinder head.
- The high-pressure fuel pumps are driven via dual cams on the inlet camshafts.
- The cylinder head cover is made of plastic and contains a labyrinth oil separator.
- The camshafts are fully-assembled and are driven via a chain drive.
- The exhaust valves are filled with sodium. This reduces the temperature at the valve by approx. 100°C.



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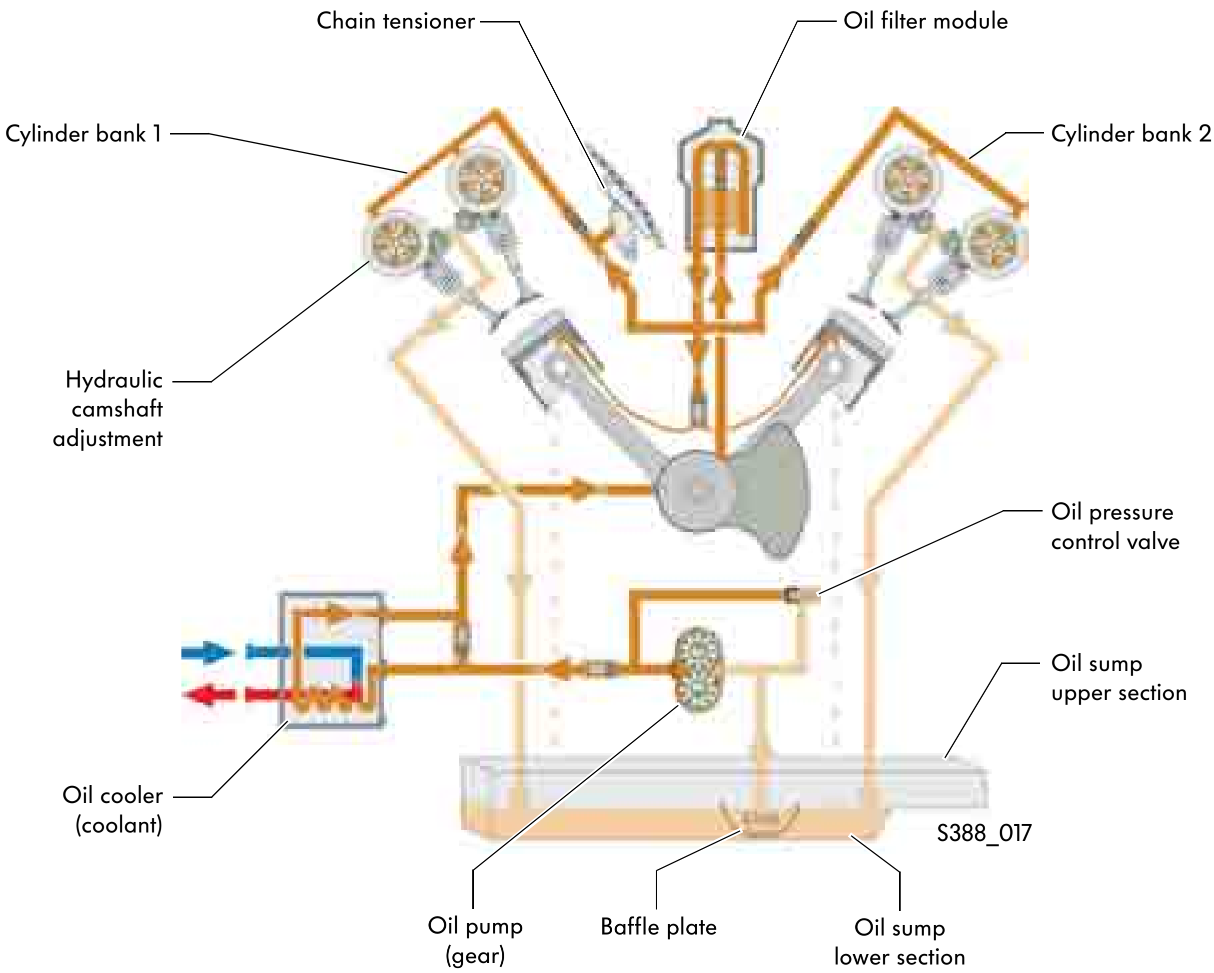
Camshaft adjustment system

The gas exchange processes in the engine's combustion chamber exert a significant influence on output, torque and pollutant emission. The camshaft adjustment system allows these gas exchange processes to be adapted to the engine's relevant requirements. Camshaft adjustment is carried out continuously via vane adjusters, and equates to a maximum of 42°. The position of the camshafts are detected by means of four Hall senders.
When the engine is stationary, the vane adjusters are locked using a spring-loaded locking pin.
The inlet camshafts are set to the "retarded" position and the exhaust camshafts to the "advanced" position. To achieve this, a return spring is installed in the exhaust camshafts' vane adjusters.

S388_014

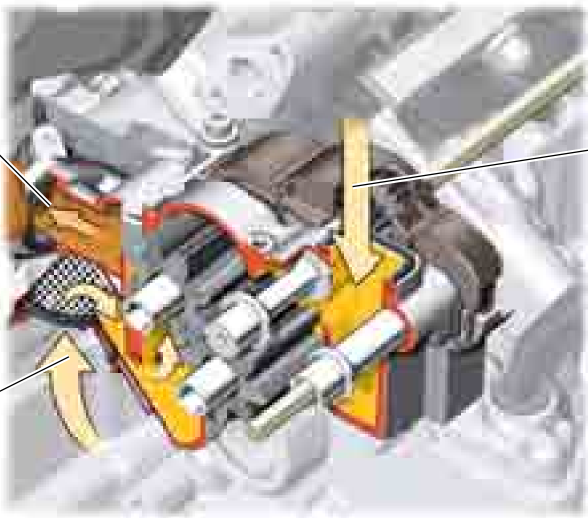
Oil supply

During development of the oil supply system, great emphasis was attached to the lowest possible oil throughput. The camshaft adjusters and various friction bearings were therefore optimised. This engine's oil throughput, 50 l/min at
7000 rpm and an oil temperature of 120°C, is very low.
The advantage is that the oil remains in the oil sump for a longer period of time, and that better water and hydrocarbon (uncombusted fuel) degasification is possible. A smaller oil pump can additionally be used, as a result of which the necessary drive power and therefore the fuel consumption are reduced.
A baffle plate in the area of the inlet connection ensures that no oil, which has been worked into a foam by the oil pump, is drawn into to oil system.
The oil is cooled by an oil-water heat exchanger.



Oil pump

The oil pump is located inside the oil sump upper section, and is bolted to the ladder frame. Intake is carried out via a filter on the base of the oil sump and, during vehicle operation, simultaneously via the engine's return duct. All engine lubrication points are supplied from the pressure oil side.



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Oil filter module

The oil filter module is designed as a main flow filter. It is located in the innner V of the engine to facilitate maintenance. The filter element can be easily exchanged without special tools. It consists of a polymer mat.

S388_020

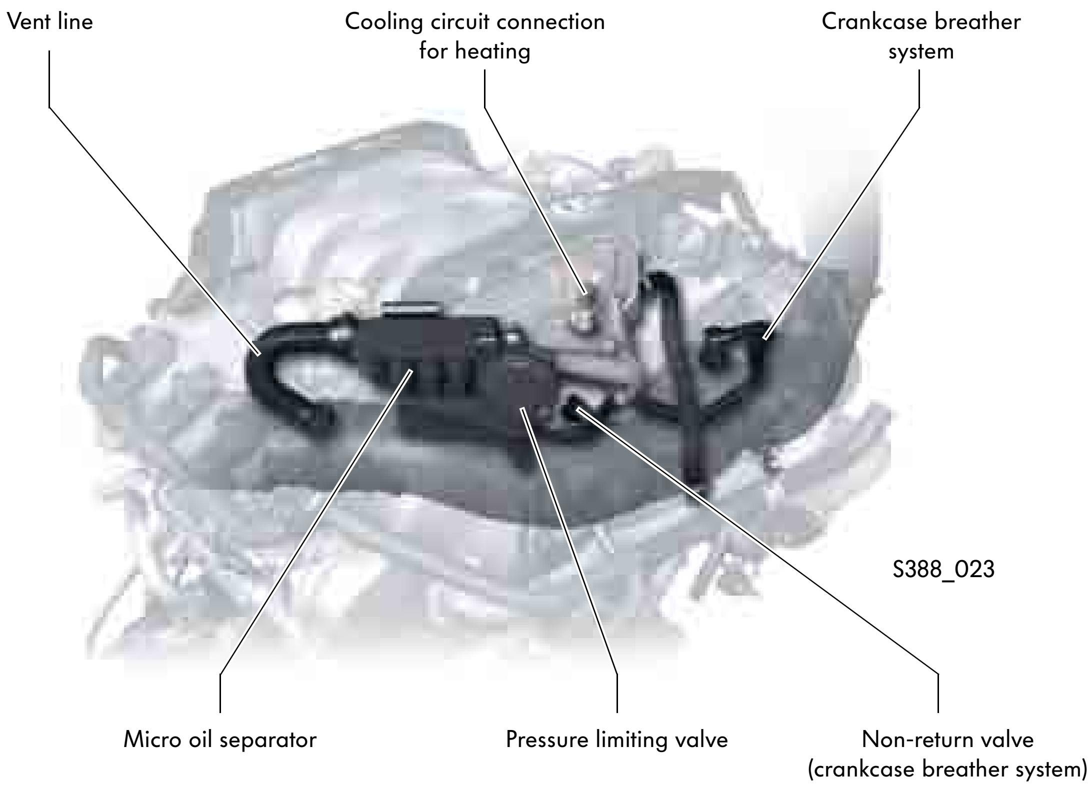
Crankcase breather and ventilation system

Crankcase breather system

The crankcase breather system is used to flush fresh air through the crankcase. As a result of this, water vapour and low-boiling hydrocarbons are flushed from the crankcase and the accumulation of water and uncombusted hydrocarbons in the oil is avoided.
The air is removed downstream of the air filter, and is guided into the inner V of the cylinder block via a non-return valve. A restrictor downstream of the non-return valve ensures that only the defined quantity of fresh air is supplied to the crankcase.

Crankcase ventilation system

Via the crankcase ventilation system, the uncombusted hydrocarbons (blow-by gases) are returned to the combustion process and do not escape into the outside air.
To minimise the oil contained in the blow-by gases, they are separated via a labyrinth oil separator in the cylinder head cover and a three-stage cyclonic micro oil separator.
In the cylinder head cover, the gas encounters impact plates, on which the larger oil droplets are separated. The gases are then channelled via hoses to the micro oil separator. Here, the smaller oil droplets are separated off, thereby preventing inlet valve coking. The induction point downstream of the throttle valve module is integrated into the cooling circuit to prevent it from freezing.

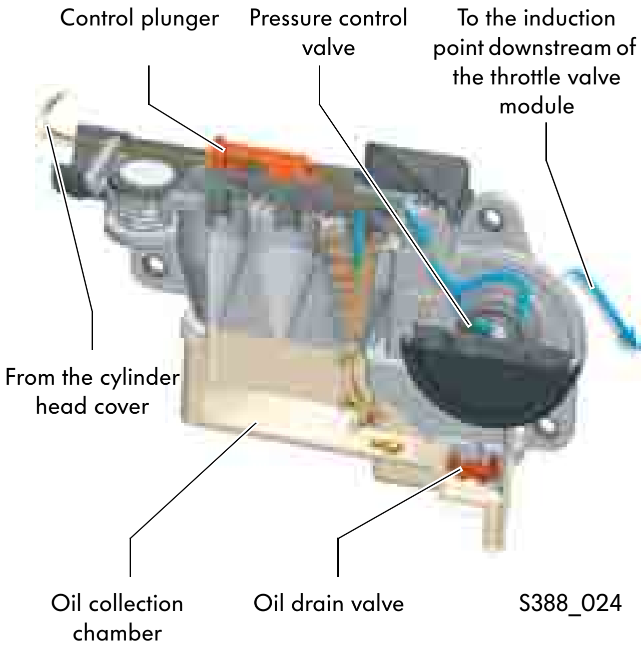


Three-stage cyclonic micro oil separator

The quantity of uncombusted hydrocarbons and oil vapour is dependent on the engine load and speed. The micro oil is separated off via a three-stage cyclonic micro oil separator.
As cyclonic oil separators only perform well in a low volumetric flow range, one, two or three cyclones are released in parallel depending on the throughput quantity of gas.

Low engine load/speed – low gas throughput

At low engine load and speed, the gas throughput is low. The gas flows past the control plunger into the first cyclonic oil separator. Here, the oil which is still present in the gas is pressed outwards via centrifugal force, adheres to the wall and drips into the oil collection chamber.
The oil collection chamber contains an oil drain valve, which is closed via the pressure in the crankcase when the engine is running. If the engine is switched off, the valve opens and the oil which is present flows into the oil sump via a hose located below the level of the oil.
The pressure control valve ensures a constant pressure level and good crankcase ventilation.



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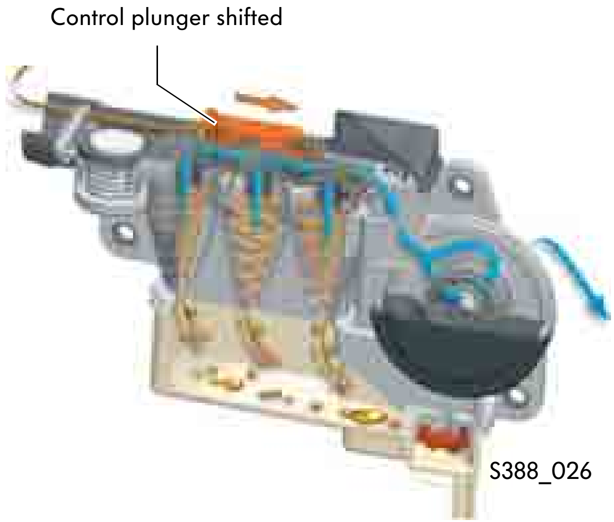
Increasing engine load/speed – increasing gas throughput

As the engine load and speed increases, so to does the mass flow of the blow-by gases. The higher the mass flow, the greater the force which acts on the control plunger. The control plunger force overcomes the spring force and releases the access ducts to further cyclones.



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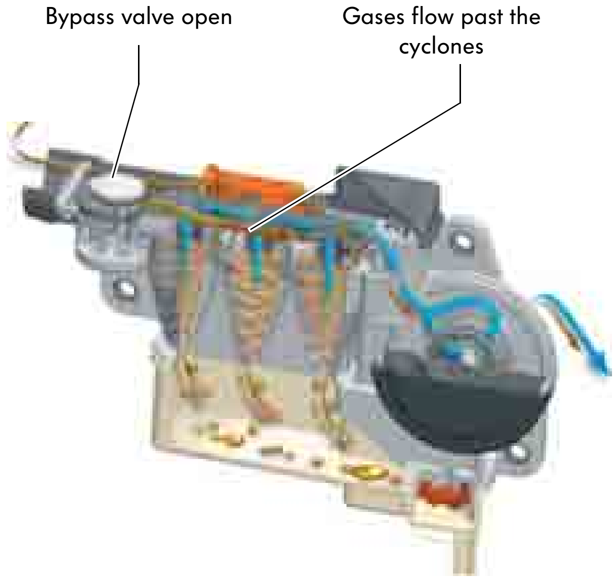
Bypass valve opens – very high gas throughput

The bypass valve ensures that the pressure in the crankcase does not become excessive.
If the pressure in the crankcase increases rapidly, e.g. due to a jammed control plunger or piston ring flutter (may occur at high engine speeds and low load), the cyclones are no longer able to cope with this pressure increase. The pressure continues to rise and now opens the bypass valve. Part of the blow-by gases now flows past the cyclone and is guided to the intake manifold directly via the pressure control valve.



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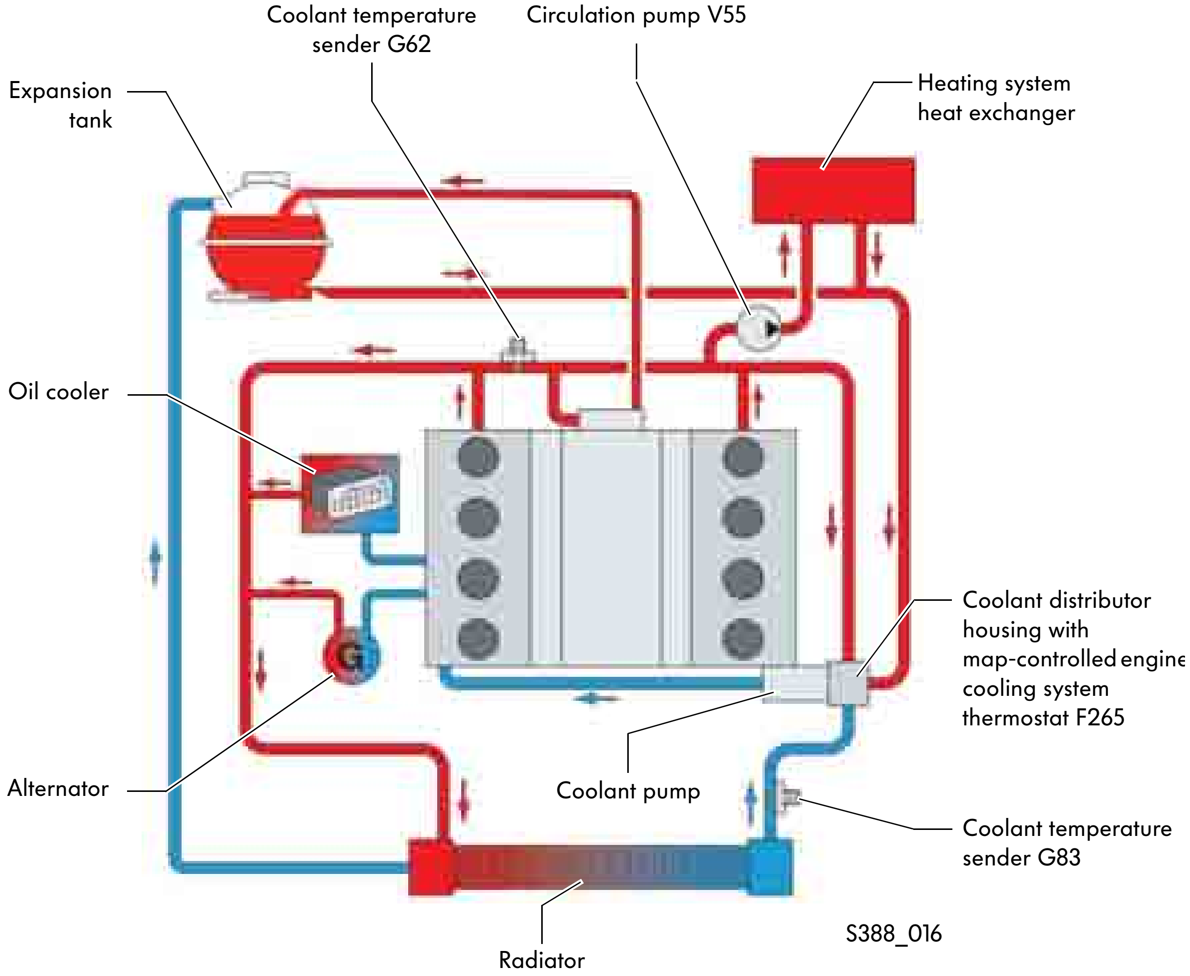
Cooling circuit

The cooling system is designed as a longitudinal cooling system. The coolant flows in on the intake side and, via the cylinder head gasket, into the head, where it flows out longitudinally via the timing chain cover. Cylinder web cooling has been improved by drilling coolant ducts with optimised cross-sections into the webs. Forced flow through these bores is ensured with the aid of specifically sealed water ducts.

In addition, the engine is equipped with an electronically controlled cooling system.

- In the partial load range which is not critical with regards to knocking, the coolant temperature is regulated to 105°C. In the lower partial load range, the thermodynamic advantages and reduced friction power result in a fuel saving of approx. 1.5%.
- In the full load range, the coolant temperature is regulated to 90°C via the map-controlled engine cooling system thermostat. Cooler combustion chambers and better cylinder charging with reduced knocking tendency are achieved as a result.



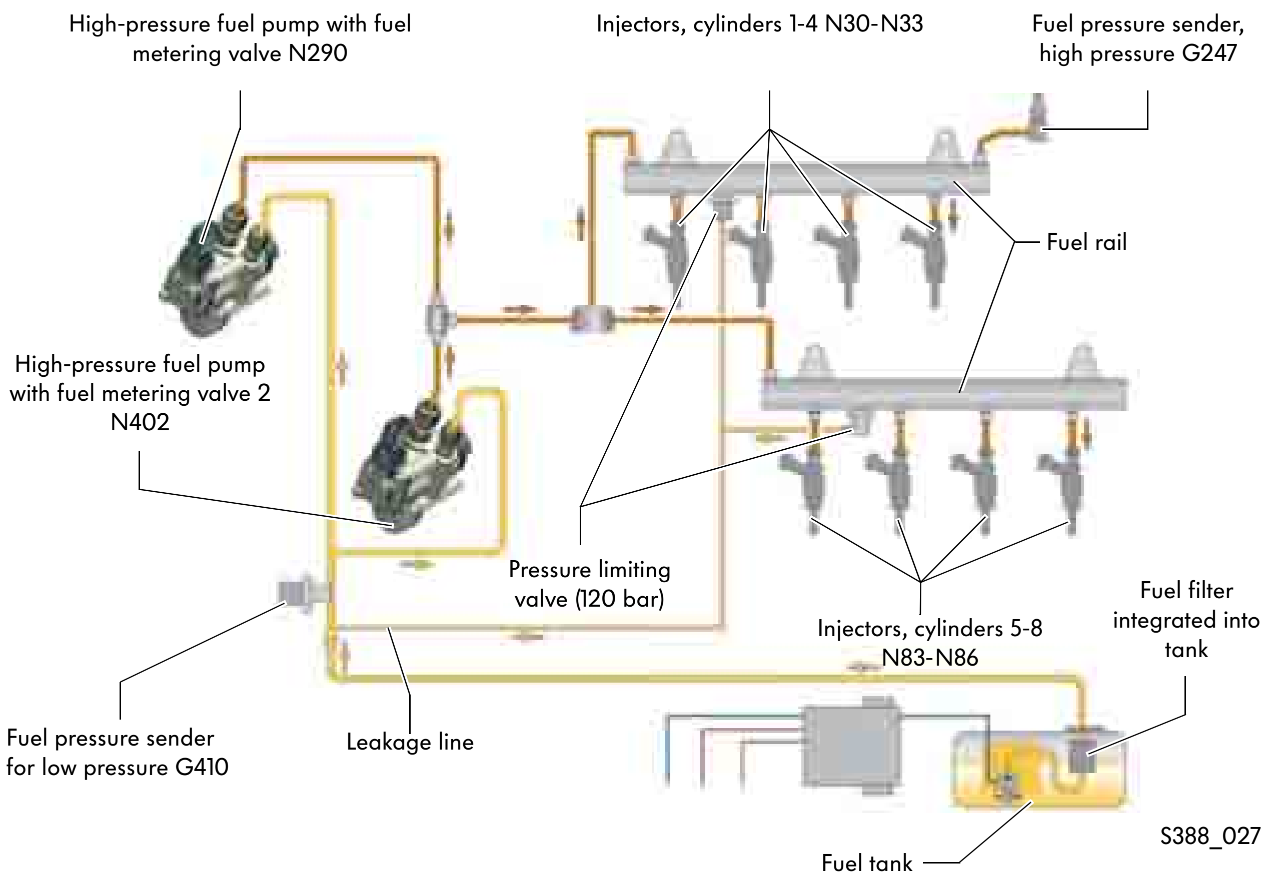
Engine mechanics

Fuel system

The fuel system is a requirement-controlled fuel system. This means that both the electronic fuel pump and the two high-pressure fuel pumps only deliver the amount of fuel required by the engine at that particular moment. As a result of this, electrical and mechanical power requirements are reduced and fuel consumption is lowered.

The fuel system is sub-divided into a low-pressure and a high-pressure fuel system.

- The fuel pressure of up to 7 bar in the low-pressure fuel system is generated by an electronic fuel pump, which is actuated by the engine control unit via a fuel pump control unit.
- The fuel pressure of 25 to 105 bar in the high-pressure fuel system is generated by two mechanical high-pressure fuel pumps, each of which is driven via a dual cam by the inlet camshafts.
  To minimise fuel pressure pulsations, both high-pressure fuel pumps deliver fuel into a common fuel line to the fuel rails. In addition, this high-pressure delivery has been chosen in such a way that both pumps' delivery into the high-pressure area is offset.



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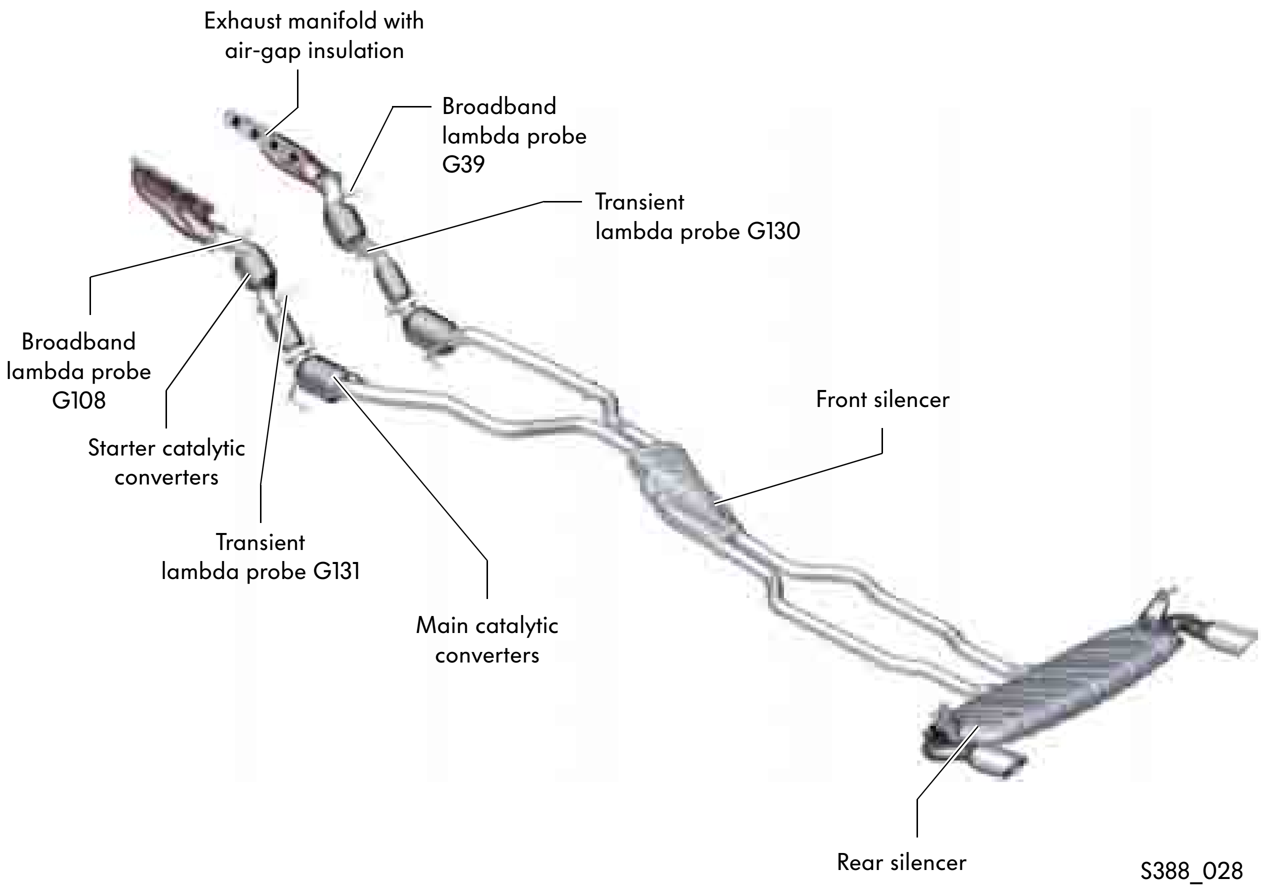
Exhaust system

The exhaust system is a twin-branch design. This means that each cylinder block has a separate exhaust tract.

The exhaust manifolds are insulated sheet metal manifolds with a gas-tight inner shell. This air-gap insulation enables a compact design and fast heating. Additional heat shield measures are no longer necessary. The exhaust manifolds are secured to the cylinder heads using clamping flange technology.

Two broadband lambda probes are installed downstream of the exhaust manifolds and two transient lambda probes downstream of the starter catalytic converters.
The starter and main catalytic converters' substrate material is comprised of ceramic.

Both exhaust tracts end in the front silencer. There, the sound waves overlap and noise emissions decrease. Two exhaust pipes lead from the front silencer to the rear silencer. Both exhaust pipes are routed separately in the interior of the rear silencer.
The front and rear silencers function as absorption silencers.
The exhaust gas flows into the outside air via two tailpipes.



Secondary air system

To heat the catalytic converters as quickly as possible, the mixture is enriched with fuel on cold-starting and during warming up. This results in a higher percentage of uncombusted hydrocarbons in the exhaust gas during this period.

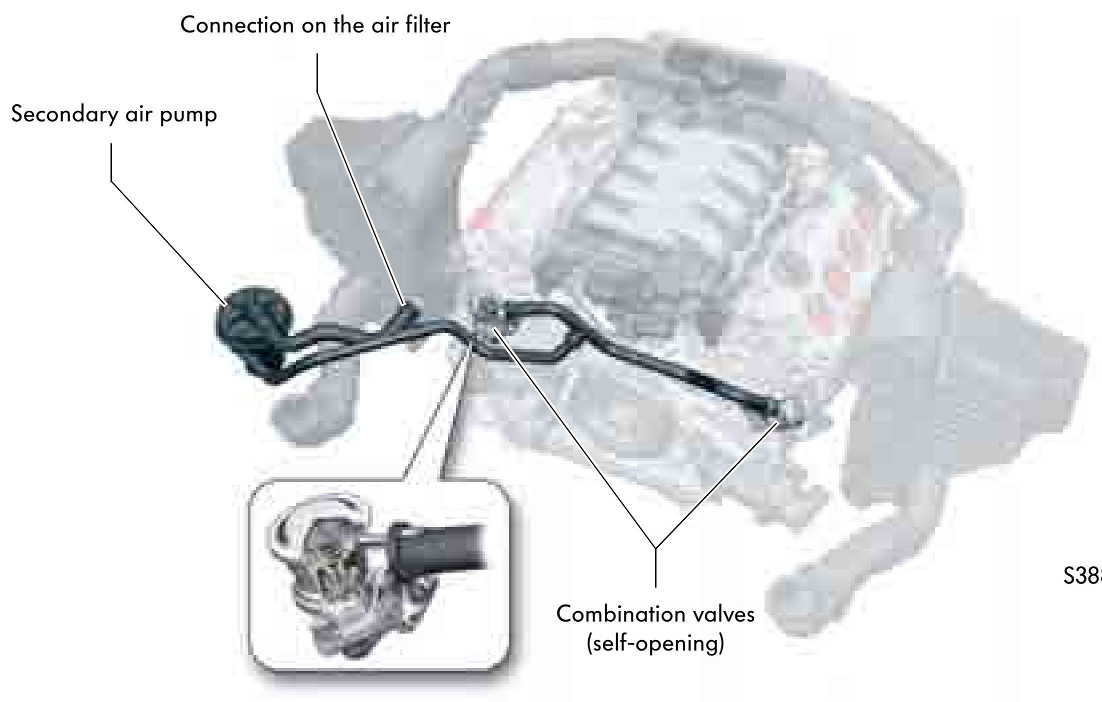
Thanks to air injection downstream of the exhaust valves, the exhaust gases are enriched with oxygen, leading to oxidation (afterburning) of the hydrocarbons and the carbon monoxide. The heat released during this process also heats the catalytic converter, helping it to reach its operating temperature faster.

The secondary air system is comprised of:

- the secondary air pump relay J299,
- the secondary air pump motor V101 and
- two self-opening combination valves

Input signals

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



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Secondary air injection

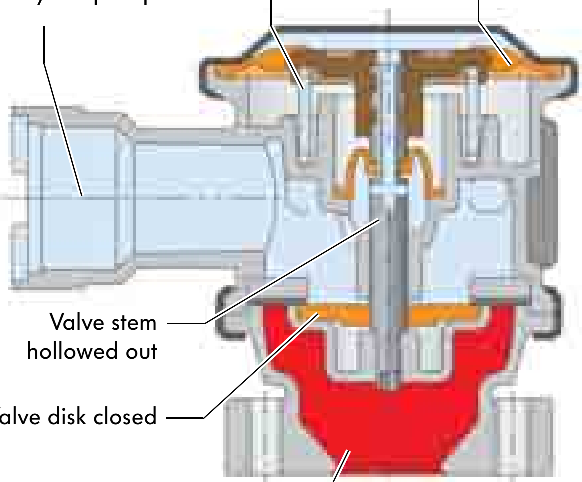
The secondary air system is switched on during cold-starting, at the start of the warm-up phase and for test purposes as part of EOBD. In this case, the engine control unit actuates the secondary air pump via the secondary air pump relay. When the pressure which has been generated is present at the combination valves, they open and the air flows downstream of the exhaust valves. Afterburning takes place.

Function of the combination valves

The combination valves are self-opening valves. This means that they are opened via the pressure generated by the secondary air pump, and not via vacuum as in the previous secondary air systems.

Combination valve closed

The pressure in the combination valves corresponds to ambient pressure. The valves are closed.



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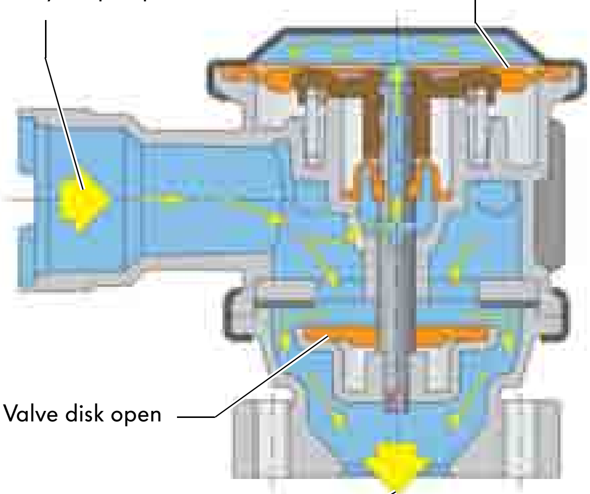
Combination valve open

If the current for the secondary air pump is activated via the relay, it begins to deliver air. Pressure builds up due to the fact that the combination valve is closed. This is present at the valve disk and, via the hollowed-out valve stem, at the diaphragm. If a pressure of approx. 450 mbar above ambient pressure acts on the diaphragm and the valve disk, the valve opens.
The air delivered by the secondary air pump now flows downstream of the exhaust valves and afterburning takes place.



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Engine management

System overview

Sensors

Air mass meter **G70, G246**
Intake air temperature sender **G42**

Engine speed sender **G28**

Accelerator position sender **G79** and **G185**

Hall sender **G40, G163, G300, G301**

Throttle valve module **J338**
Angle sender for throttle valve drive **G187, G188**

Intake manifold flap potentiometer **G336, G512**

Fuel pressure sender for low pressure **G410**

Fuel pressure sender for high pressure **G247**

Coolant temperature sender **G62**

Radiator outlet coolant temperature sender **G83**

Knock sensors **G61, G66, G198, G199**

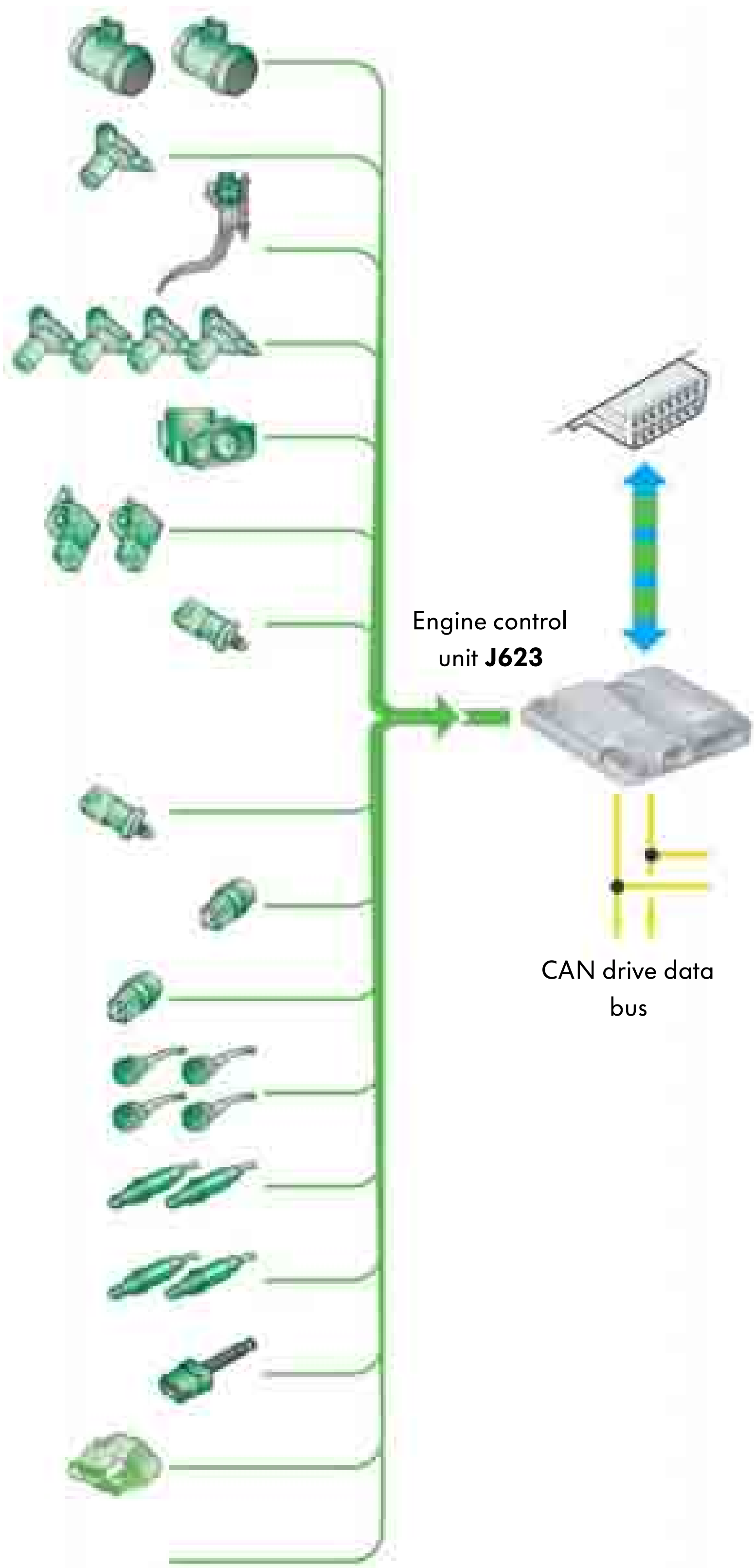
Lambda probe **G39, G108**

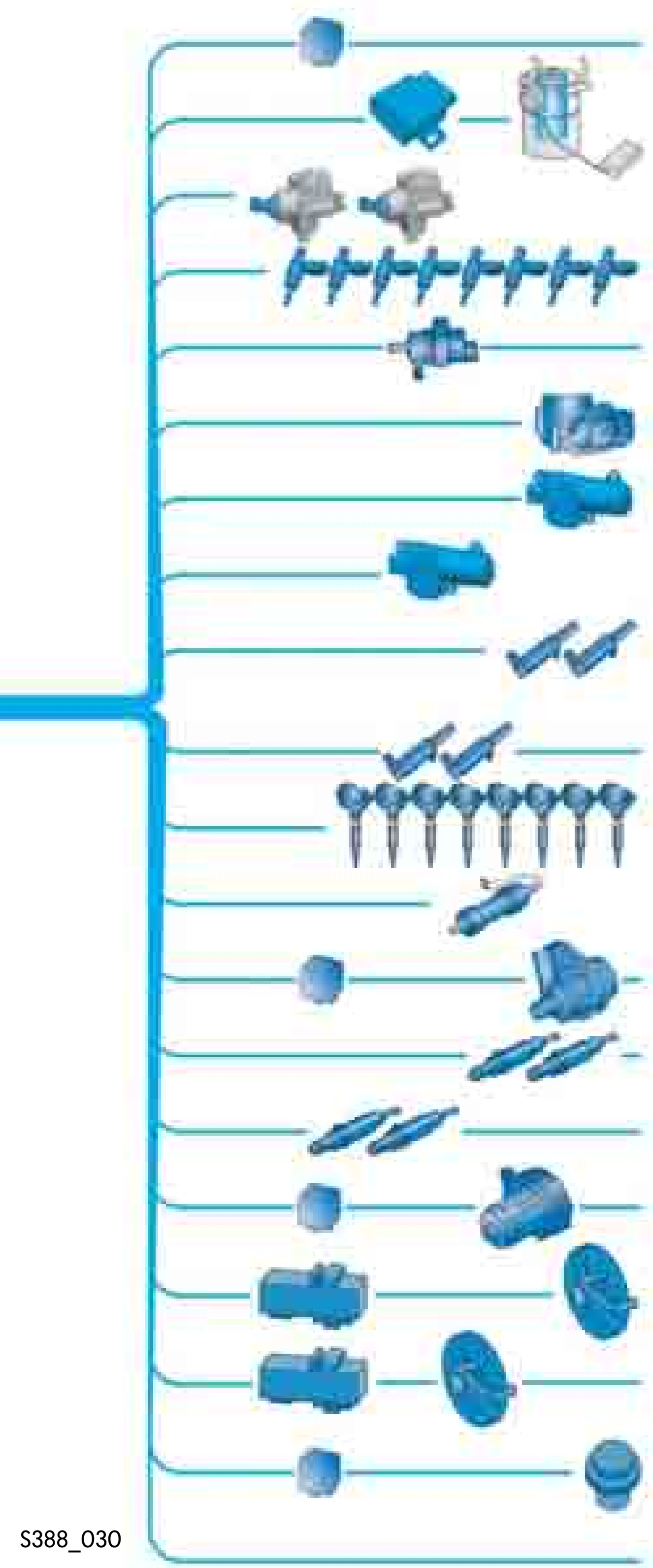
Lambda probe after catalytic converter **G130, G131**

Brake light switch **F**
Brake pedal switch **F47**

Brake servo pressure sensor **G294**

Additional input signals





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Actuators

Motronic current supply relay **J271**

Fuel pump control unit **J538**
Fuel pump **G6**

Fuel metering valve **N290, N402**

Injectors for cylinders 1 - 8 **N30-33, N83-N86**

Active charcoal filter system solenoid valve **N80**

Throttle valve module **J338**
Throttle valve drive for electric throttle **G186**

Intake manifold flap motor **V157**

Variable intake manifold motor **V183**

Inlet camshaft control valves **N205, N208**

Exhaust camshaft control valves **N318, N319**

Ignition coil 1 - 8 with output stage
N70, N127, N291, N292, N323-N326

Map-controlled engine cooling system
thermostat **F265**

Continued coolant circulation relay **J151**
Circulation pump **V55**

Lambda probe heater **Z19, Z28**

Lambda probe heater after
catalytic converter **Z29, Z30**

Secondary air pump relay **J299**
Secondary air pump motor **V101**

Radiator fan control unit **J293**
Radiator fan **V7**

Radiator fan control unit 2 **J671**
Radiator fan **V177**

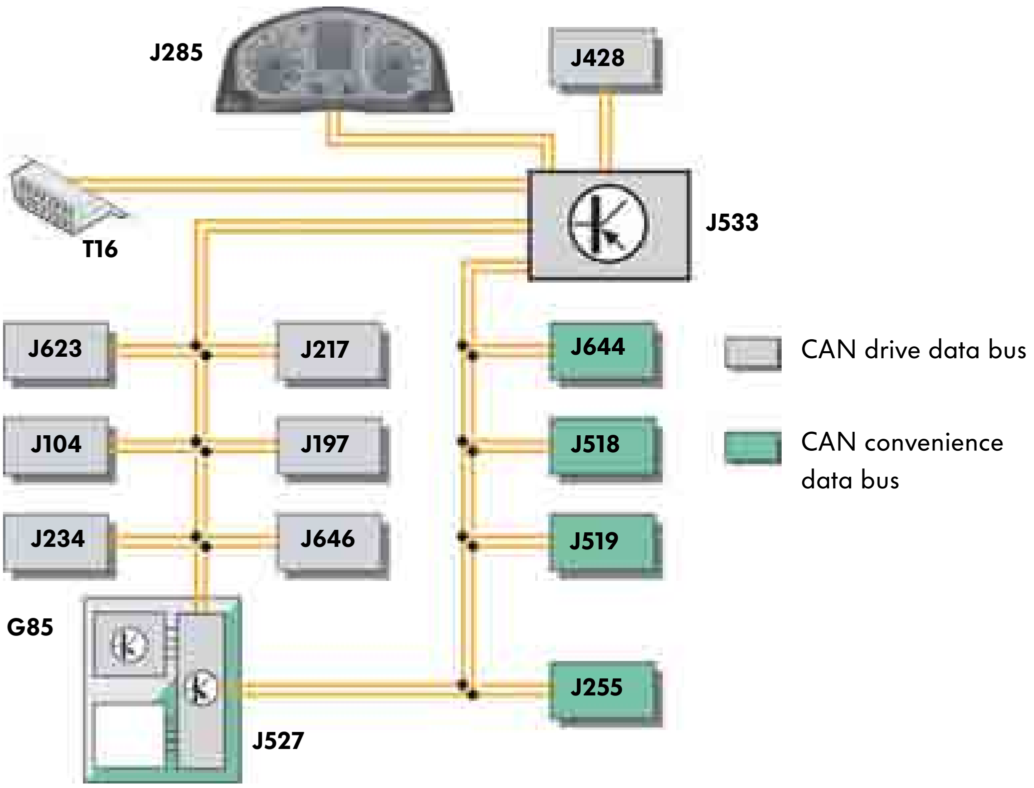
Brake servo relay **J569**
Vacuum pump for brakes **V192**

Additional output signals

Engine management

CAN networking

The diagram below shows the control units with which the engine control unit J623 communicates via the CAN data bus and exchanges data.



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G85 Steering angle sender
J104 ABS control unit
J197 Adaptive suspension control unit
J217 Automatic gearbox control unit
J234 Airbag control unit
J255 Climatronic control unit
J285 Control unit with display in dash panel insert
J428 Adaptive cruise control unit
J518 Entry and start authorisation control unit
J519 Onboard supply control unit
J527 Steering column electronics control unit
J533 Data bus diagnostic interface
J623 Engine control unit
J644 Energy management control unit
J646 Transfer box control unit
T16 Diagnosis connector

Sensors

Hot film air mass meter G70 with intake air temperature sender G42 and hot film air mass meter 2 G246

To minimise pressure losses, the intake tract has a twin-branch design. The most accurate possible air mass signal is achieved by two hot film air mass meters. Hot film air mass meter G70 is installed along with intake air temperature sender G42 in the intake tract on the cylinder bank 1 side. Hot film air mass meter G246 is installed in the intake tract on the cylinder bank 2 side.

From the signals transmitted by the two air mass meters and the intake air temperature sender, the engine control unit calculates the mass and the temperature of the intaken air respectively.

Hot film air mass meter G70 with intake air temperature sender G42 cylinder bank 1

Hot film air mass meter G246 cylinder bank 2

S388_032

Signal use

The signals are used to calculate all load- and engine speed-dependent functions. These include the injection period, ignition timing or camshaft adjustment, for example.

Effects in the event of failure

If one or both air mass meters fail, the throttle valve position and the engine speed are used as correction values.
If the intake air temperature sender fails, a fixed, substitute value is assumed.

Hall sender G40, G163, G300, G301

Hall senders G40 and G300 are located on cylinder bank 1 and Hall senders G163 and G301 are located on cylinder bank 2.

By scanning a quick-start sender wheel, the engine control unit recognises the position of each cylinder bank's inlet and exhaust camshafts.

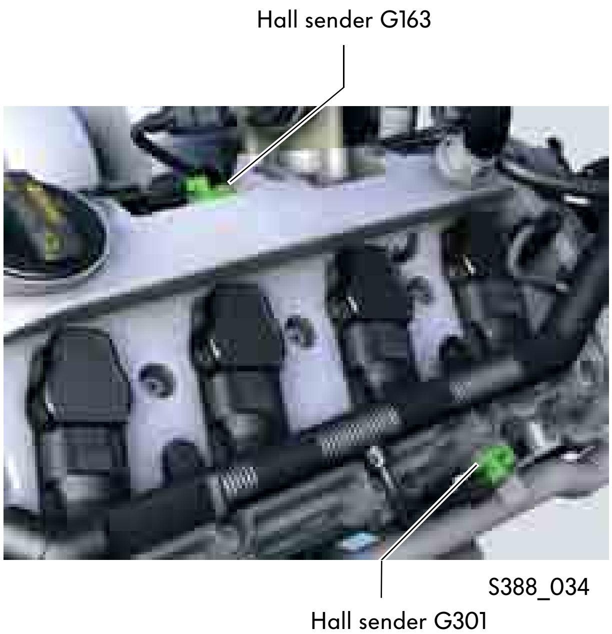
Cylinder bank 1
Hall sender G40 - inlet camshaft
Hall sender G300 - exhaust camshaft

Cylinder bank 2
Hall sender G163 - inlet camshaft
Hall sender G301 - exhaust camshaft

S388_033

Signal use

The signals are used to detect the first cylinder, for camshaft adjustment, and to calculate the injection point and the ignition timing.



S388_034

Effects in the event of signal failure

No further camshaft adjustment takes place if a Hall sender fails. The engine continues to run and also re-starts again after switching off thanks to run-on recognition. Torque and power are reduced at the same time.

Fuel pressure sender for low pressure G410

The sender is installed in the supply line to the two high-pressure fuel pumps. It measures the fuel pressure in the low-pressure fuel system and transmits a signal to the engine control unit.

Fuel pressure sender for low pressure G410

S388_035

Signal use

The signal is used by the engine control unit to regulate the low-pressure fuel system.
Following the sender signal, the engine control unit transmits a signal to the fuel pump control unit J538, which then regulates the electronic fuel pump G6 as required.

Effects in the event of signal failure

If the fuel pressure sender fails, the fuel pressure is regulated by a fuel pressure pilot control system. The fuel pressure is then approx. 6.5 bar.

Fuel pressure sender, high pressure G247

The sender is located in the inner V of the cylinder block, and is connected to the fuel rail via a line.
It measures the fuel pressure in the high-pressure fuel system and transmits the signal to the engine control unit.

S388_036

Fuel rail

Fuel pressure sender, high pressure G247

Signal use

The engine control unit evaluates the signals and regulates the pressure in the fuel rail pipes via the two fuel metering valves.

Effects in the event of signal failure

If the fuel pressure sender fails, no further high fuel pressure is built up. The engine runs in emergency mode with low fuel pressure. Power and torque are reduced.

Intake manifold flap potentiometer G336 and G512

The two intake manifold flap potentiometers are secured to the intake manifold and are connected to the shaft for the intake manifold flaps. They recognise the position of the intake manifold flaps.

S388_037

Potentiometer for intake manifold flap G336

Potentiometer for intake manifold flap G512

Signal use

The position is important, as intake manifold change-over affects air flow in the combustion chamber and the inlet air mass. The position of the intake manifold flaps is therefore relevant to the exhaust gas, and must be checked via self-diagnosis.

Effects in the event of signal failure

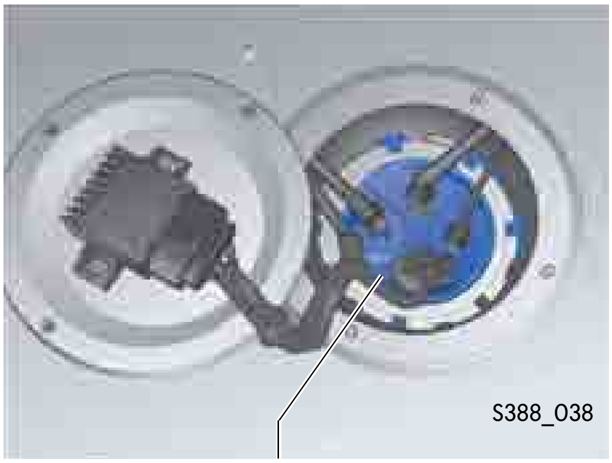
If the signal from the potentiometer fails, the position of the intake manifold flaps at the time of failure and the relevant ignition timing are used as substitute values. Power and torque are reduced and fuel consumption increases.

Engine management

Actuators

Fuel pump G6

The electronic fuel pump and the fuel filter are combined to form a fuel delivery unit.
The fuel delivery unit is located in the fuel tank.



Fuel pump G6

Task

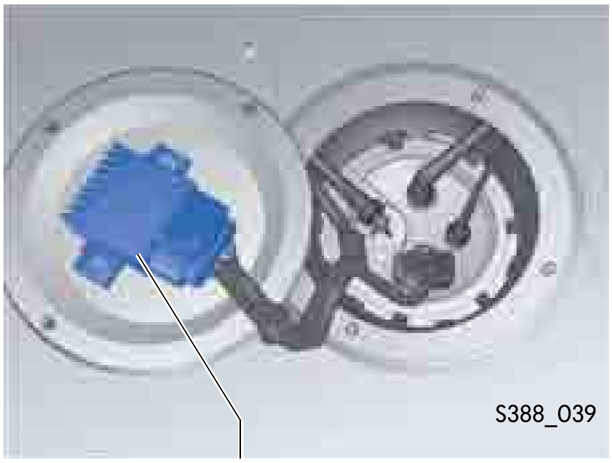
The electronic fuel pump delivers the fuel in the low-pressure fuel system to the high-pressure fuel pump. It is actuated with a PWM signal by the fuel pump control unit.
The electronic fuel pump always supplies the quantity of fuel required by the engine at the present moment in time.

Effects in the event of failure

If the electronic fuel pump fails, engine operation is no longer possible.

Fuel pump control unit J538

The fuel pump control unit is mounted under the rear seat bench in the cover for the electronic fuel pump.



Fuel pump control unit J538

Task

The fuel pump control unit receives a signal from the engine control unit and controls the electronic fuel pump with a PWM signal (pulse-width modulation). It regulates the pressure in the low-pressure fuel system between 5 and 7 bar.

Effects in the event of signal failure

If the fuel pump control unit fails, engine operation is not possible.

Fuel metering valve N290 and N402

The fuel metering valves are located at the sides of the high-pressure fuel pumps.

Task

They have the task of making the required quantity of fuel available at the required fuel pressure in the fuel rail pipe.

Effects in the event of signal failure

The regulating valve is open when currentless. This means that high pressure is not built-up and the engine is run with the existing fuel pressure from the electronic fuel pump. As a result of this, output and torque are significantly reduced.

S388_040

Inlet camshaft control valve 1 and 2 N205 and N208
Exhaust camshaft control valve 1 and 2 N318 and N319

These solenoid valves are secured to the cylinder head covers.

S388_041

Task

Depending on actuation by the engine control unit, they distribute the oil pressure to the camshaft adjusters according to the adjustment direction and adjustment travel.

Both camshafts are infinitely adjustable:

- Inlet camshaft 42° crank angle
- Exhaust camshaft 42° crank angle
- Maximum valve overlap angle 47° crank angle

When no oil pressure is available (engine switched off), the exhaust camshaft is mechanically locked.

S388_042

Effects in the event of signal failure

If an electrical cable to the camshaft adjusters is defective or a camshaft adjuster fails due to mechanical jamming or insufficient oil pressure, no further camshaft adjustment is carried out. Power and torque are reduced.

Variable intake manifold motor V183

The variable intake manifold motor is bolted to the intake manifold.

S388_043

Task

The motor is actuated by the engine control unit depending on engine load and speed.
The motor actuates the change-over flaps via a shaft and switches to the torque or the output position.

Effects in the event of failure

If the variable intake manifold motor fails, intake manifold change-over is no longer possible. The intake manifold remains in the position in which the change-over flaps were located at the time of failure. Power and torque are reduced.

Intake manifold flap motor V157

The intake manifold flap motor is bolted to the variable intake manifold.

S388_044

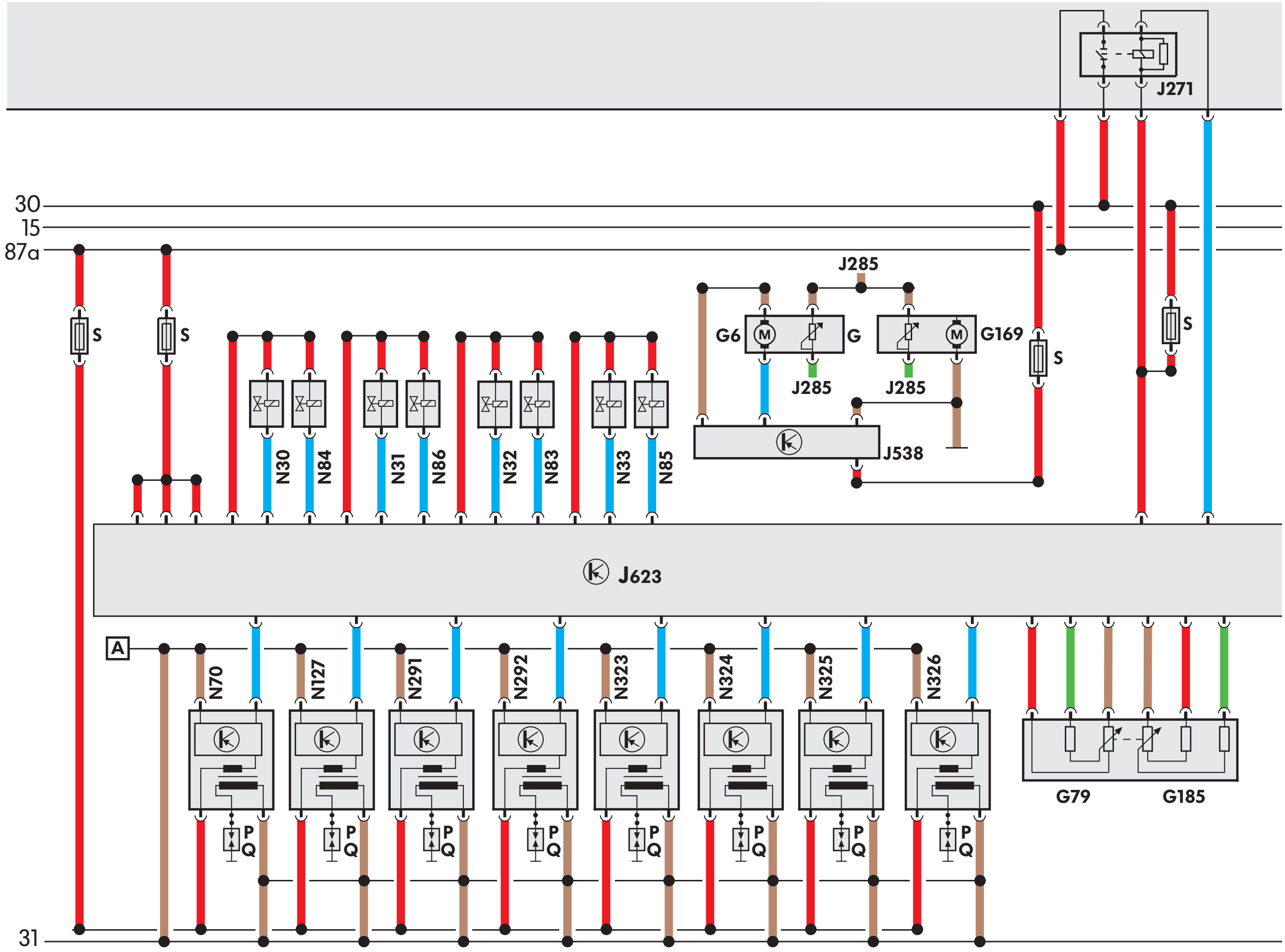
Task

The motor is actuated by the engine control unit depending on engine load and speed. Via two operating rods, it thereby adjusts four intake manifold flaps per cylinder bank.
If these are actuated, they close part of the intake port in the cylinder head. This leads to cylindrical air movement in the cylinder head and improves mixture formation.

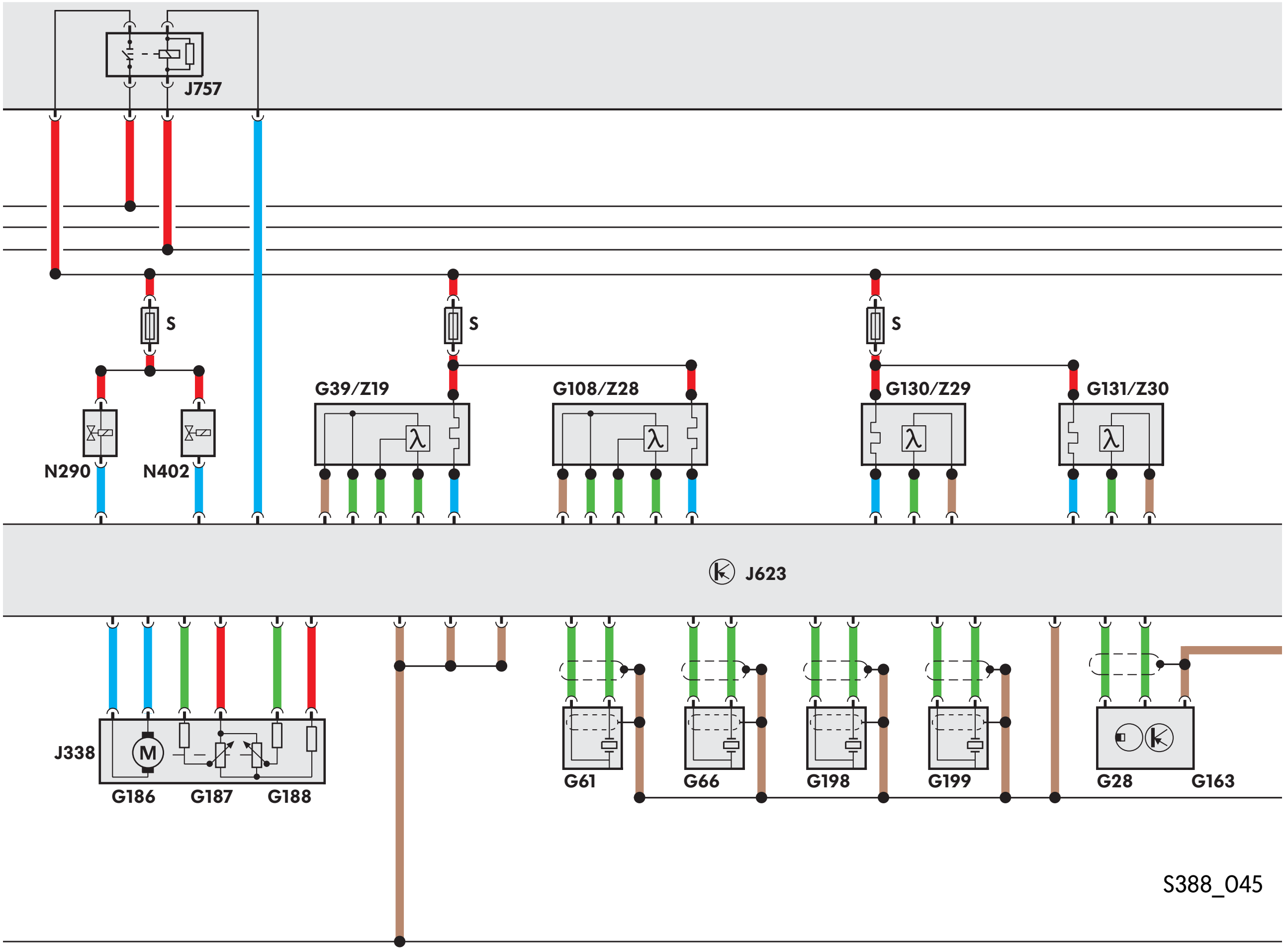
Effects in the event of failure

If the intake manifold motor fails, the intake manifold flaps can no longer be actuated. This leads to a deterioration in combustion and a reduction in output and torque. The fuel consumption also increases.

Functional diagram



A	Battery
G	Fuel gauge sender
G6	Fuel pump
G79	Accelerator position sender
G169	Fuel gauge sender 2
G185	Accelerator position sender 2
J271	Motronic current supply relay
J285	Control unit with display in dash panel insert
J538	Fuel pump control unit
J623	Engine control unit
N30-	Injector, cylinder 1 to
N33	Injector, cylinder 4
N70	Ignition coil 1 with output stage
N83-	Injector, cylinder 5 to
N86	Injector, cylinder 8
N127	Ignition coil 2 with output stage
N291-	Ignition coil 3 with output stage
N292	Ignition coil 4 with output stage
N323-	Ignition coil 5 with output stage to
N326	Ignition coil 8 with output stage
P	Spark plug connector
Q	Spark plugs
S	Fuse

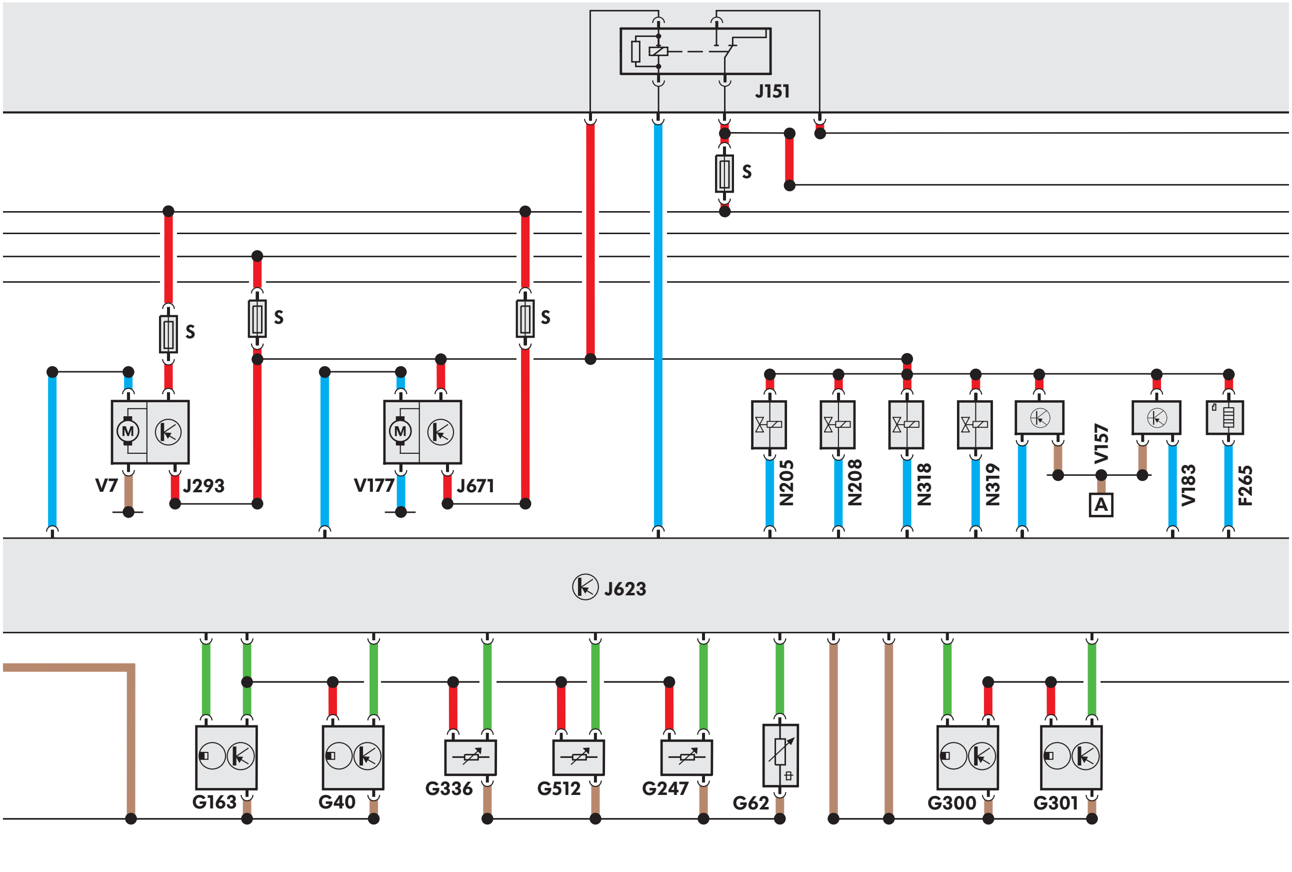


G28 Engine speed sender
G39 Lambda probe
G61 Knock sensor 1
G66 Knock sensor 2
G108 Lambda probe 2
G130 Lambda probe after catalytic converter
G131 Lambda probe 2 after catalytic converter
G163 Hall sender 2
G186 Throttle valve drive
G187 Throttle valve drive angle sender
G188 Throttle valve drive angle sender
G198 Knock sensor 3
G199 Knock sensor 4
J338 Throttle valve module
J623 Engine control unit
J757 Engine component current supply relay
N290 Fuel metering valve
N402 Fuel metering valve 2

S Fuse
Z19 Lambda probe heater
Z28 Lambda probe 2 heater
Z29 Lambda probe 1 heater after catalytic converter
Z30 Lambda probe 2 heater after catalytic converter

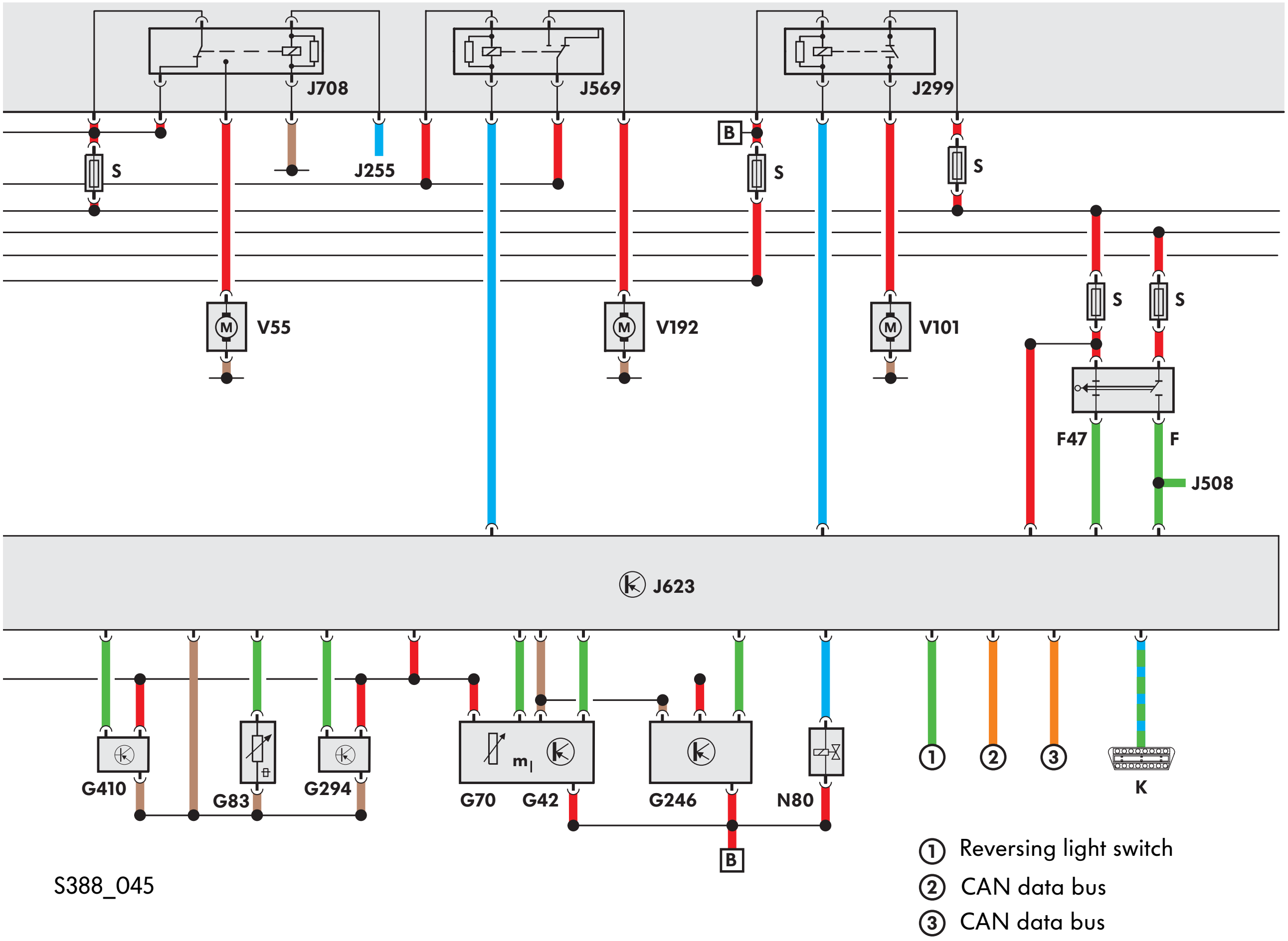
- Positive
- Earth
- Input signal
- Output signal
- Bi-directional cable
- CAN data bus

Functional diagram



S388_045

A Battery
F265 Map-controlled engine cooling system thermostat
G40 Hall sender
G62 Coolant temperature sender
G163 Hall sender 2
G247 Fuel pressure sender, high pressure
G300 Hall sender 3
G301 Hall sender 4
G336 Intake manifold flap potentiometer
G512 Intake manifold flap potentiometer 2
J151 Continued coolant circulation relay
J293 Radiator fan control unit
J623 Engine control unit
J671 Radiator fan control unit 2
N205 Inlet camshaft control valve 1
N208 Inlet camshaft control valve 2
N318 Exhaust camshaft control valve 1
N319 Exhaust camshaft control valve 2
S Fuse
V7 Radiator fan
V157 Intake manifold flap motor
V177 Radiator fan 2
V183 Variable intake manifold motor



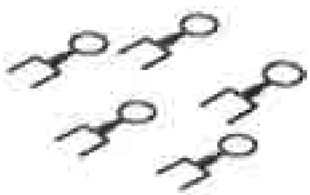
S388_045

B Starter
F Brake light switch
F47 Brake pedal switch
G42 Intake air temperature sender
G70 Air mass meter
G83 Radiator outlet coolant temperature sender
G246 Air mass meter 2
G294 Brake servo pressure sensor
G410 Fuel pressure sender for low pressure
K Dash panel insert
J255 Climatronic control unit
J299 Secondary air pump relay
J508 Brake light suppression relay
J569 Brake servo relay
J623 Engine control unit
J708 Residual heat relay
N80 Active charcoal filter system solenoid valve 1
S Fuse
V55 Circulation pump
V101 Secondary air pump motor
V192 Vacuum pump for brakes

Positive
Earth
Input signal
Output signal
Bi-directional cable
CAN data bus

Service

Special tools

Designation	Tool	Application
Thrust piece T 40051		For installing A/C compressor drive sealing ring.
Thrust piece T40052		For installing power steering pump drive sealing ring.
Camshaft clamps T40070		For locking camshafts on cylinder bank 1 and cylinder bank 2.
Locking pins T40071		For locking chain tensioners for chain drives A, B, C, D.
Key T40079		For pre-tensioning inlet and exhaust camshafts after installing the camshaft timing chain.
Locating pins T40116		For locating the ladder frame on attachment to the cylinder head.

Test yourself

Which answer is correct?
One or several of the answers which are provided may be correct.

1. How are the camshafts driven?

☐ a) Via a toothed belt drive.

☐ b) Via an individual roller chain from the crankshaft.

☐ c) From the crankshaft, a roller chain drives two drive chain sprockets for the camshaft timing chains. In turn, these drive the camshafts via one chain each.

2. How is intake manifold change-over carried out?

☐ a) Intake manifold change-over is carried out via a vacuum unit.

☐ b) Intake manifold change-over is carried out via a variable intake manifold electric motor.

☐ c) Intake manifold change-over is carried out via a Bowden cable.

3. Which statement on the high-pressure fuel pumps is correct?

☐ a) Each of the two high-pressure fuel pumps delivers to one cylinder bank.

☐ b) Both high-pressure fuel pumps deliver the fuel jointly to both fuel rails.

☐ c) One or both high-pressure fuel pumps deliver fuel depending on engine load and speed.

4. Which statement on the cooling system is correct?

☐ a) It is an electronically controlled cooling system with a thermostat for map-controlled engine cooling.

☐ b) It is a dual-circuit system with different cooling temperatures in the cylinder block and cylinder head.

☐ c) It is an unregulated system with constant coolant temperatures.

Answers
1. c
2. b
3. b
4. a

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000.2811.83.20 Technical status 05.2007

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