



Self-study Programme 405

1.4l 90kW TSI Engine with Turbocharger

Design and Function



The 1.4l 90kW TSI engine replaces the 1.6l 85kW FSI engine. Compared with the FSI engine, fuel consumption and CO2 emissions have been reduced considerably and performance has improved significantly.

The difference from the two TSI engines with dual-charging is the omission of the supercharger and a new charge-air cooling system.

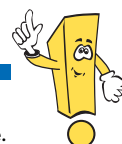


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Over the following pages, we will introduce you to the differences in the design and function between the new 1.4l 90kW TSI engine and the engines with dual-charging.

You will find further information on this engine in self-study programme no. 359 “1.4l TSI Engine with Dual-charging”.

NEW



**Important
Note**



**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.



Introduction	4
Technical features	4
Technical data	5
 Engine Mechanics	 6
Intake system	6
Cylinder head	9
Single-charging with turbocharger	10
Cooling systems	14
Charge-air cooling	15
Demand-regulated fuel system	17
 Engine Management	 20
System overview	20
Bosch Motronic MED 17.5.20	22
Sensors	23
Actuators	26
Functional diagram	28
 Service	 30
 Test Yourself	 31



Introduction



Technical features

Unlike the two previous TSI engines, the 1.4l 90kW TSI engine is only charged with a turbocharger. It is specially configured to deliver high torque in the frequently used low rev ranges. The maximum torque of 200Nm is reached between 1500rpm and 4000rpm.

Another special feature is that the air-to-liquid intercooler is integrated into the intake manifold. Furthermore changes to the design of the intake ports in the cylinder head and the pistons mean there is no need for intake manifold flap change-over.



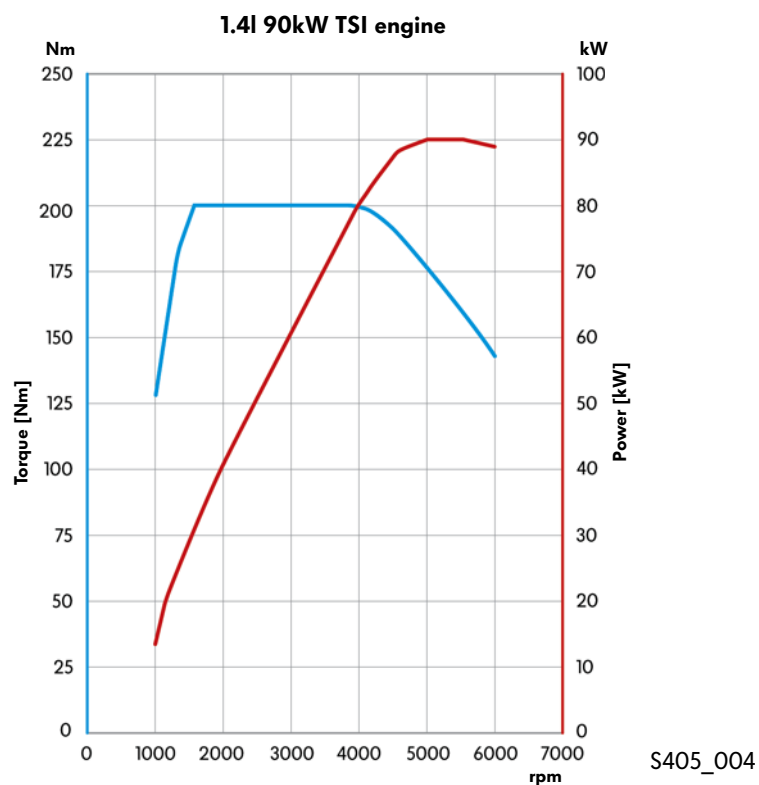
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Technical features

- Bosch Motronic MED 17.5.20
- Homogenous mode (Lambda 1)
- Stratified high-pressure start
- Double injection catalytic converter heating
- Turbocharger with waste gate
- Air-to-liquid charge-air cooling
- Maintenance-free timing chain
- Plastic intake manifold with integrated intercooler
- Continuous inlet camshaft timing adjustment
- Grey cast iron cylinder block
- Steel crankshaft
- Duo-centric oil pump
- Dual-circuit cooling system
- Fuel system regulated according to requirements
- High-pressure fuel pump with integrated pressure limiting valve

Technical data

Torque and power diagram



Technical data

Engine code	CAXA
Type	4-cylinder in-line engine
Displacement in cm ³	1390
Bore in mm	76.5
Stroke in mm	75.6
Valves per cylinder	4
Compression ratio	10:1
Maximum output	90kW at 5000–5500rpm
Maximum torque	200Nm at 1500–4000rpm
Engine management	Bosch Motronic MED 17.5.20
Fuel	Super unleaded RON 95
Exhaust gas treatment	Main catalytic converter, Lambda control
Emissions standard	EU 4



You will find detailed information on the four-letter engine code in self-study programme no. 400 “The Golf Estate”.

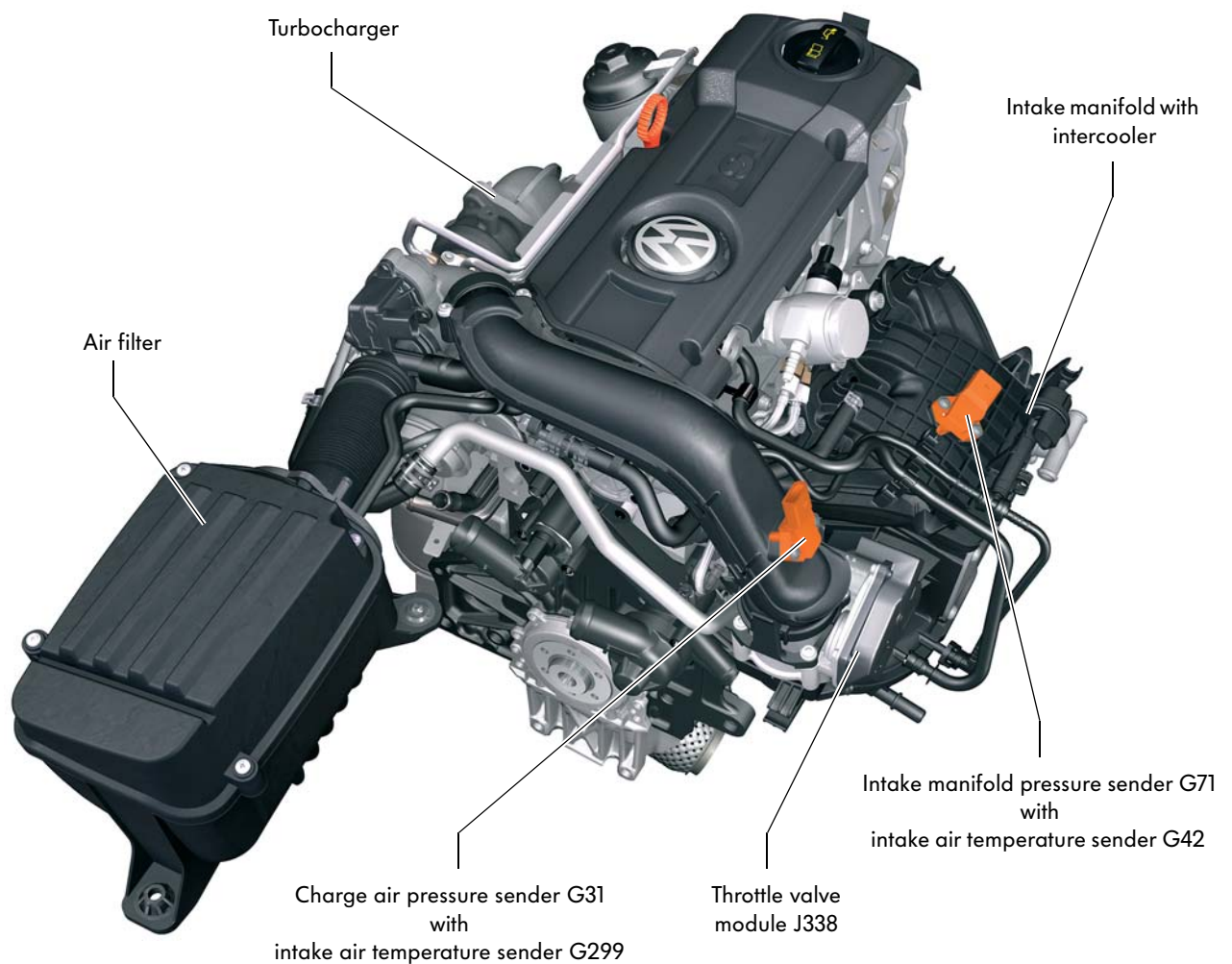
Engine Mechanics

Intake system

The intake system stretches from the air filter via the turbocharger, the throttle valve module and the intake manifold up to the inlet valves.

The design has been made as compact as possible to improve the response of the turbocharger at low revs.

Two pressure sensors with intake air temperature senders are fitted in the intake system. They are in front of the throttle valve module and on the intake manifold behind the intercooler.

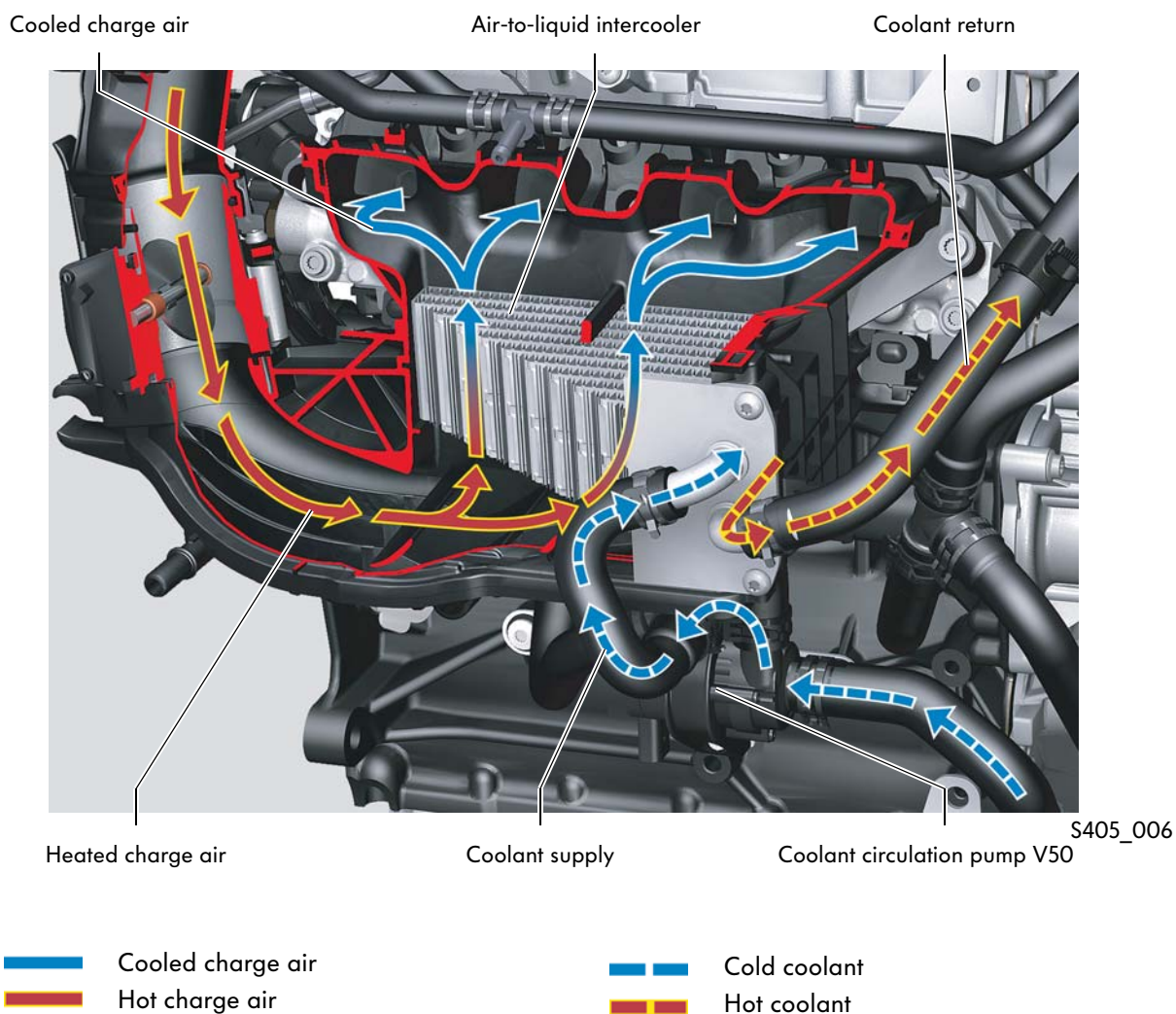


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Intake manifold with intercooler

The pressure and thus the intake air temperature rise due to the compression of the intake air from the turbocharger. The charge air is cooled to ensure optimum cylinder filling. In the previous TSI engines with dual-charging, this was performed via an air-to-air intercooler at the front end. An air-to-liquid intercooler is used on the 1.4l 90kW TSI engine. An intercooler connected to the coolant system is built into the intake manifold.

The heated air flows through the intercooler and transfers a large part of its heat to the intercooler and the coolant. The coolant is pumped to the intercooler by a coolant pump. It then flows back to the radiator for cooling at the front end. The charge-air cooling system is a separate cooling system in which the turbocharger is also incorporated.



Engine Mechanics

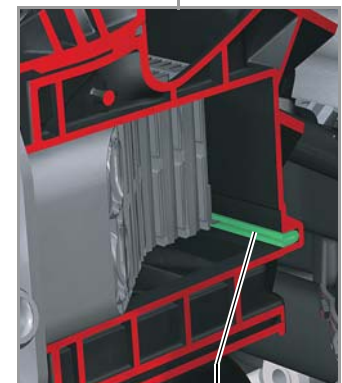
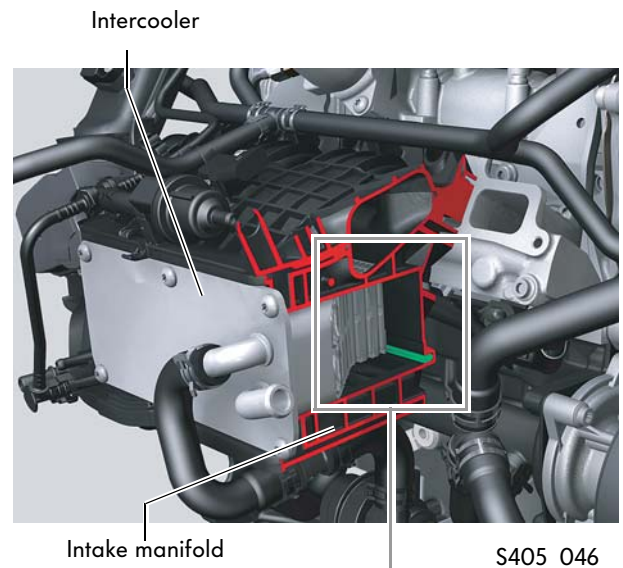
Intercooler

The intercooler slides into the intake manifold and is secured with six screws.

There is a sealing strip on the rear of the intercooler. This sealing strip forms a seal between the intercooler and the intake manifold and also supports the intercooler.

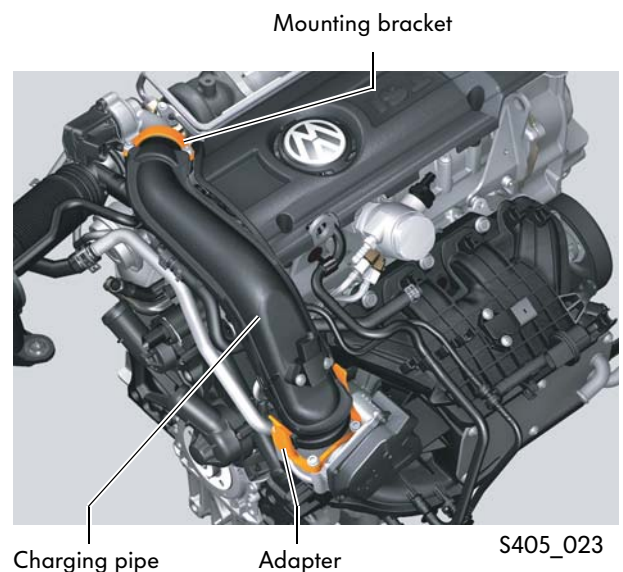


When fitting the intercooler, ensure that the seal strip is correctly fitted. If it is not fitted correctly, vibration occurs and the intercooler will crack and leak.



Securing the charging pipe

The charging pipe is fitted to the turbocharger and the throttle valve module. It is clipped to an adapter on the throttle valve module and bolted to a mounting bracket on the turbocharger.



Cylinder head

Cylinder head

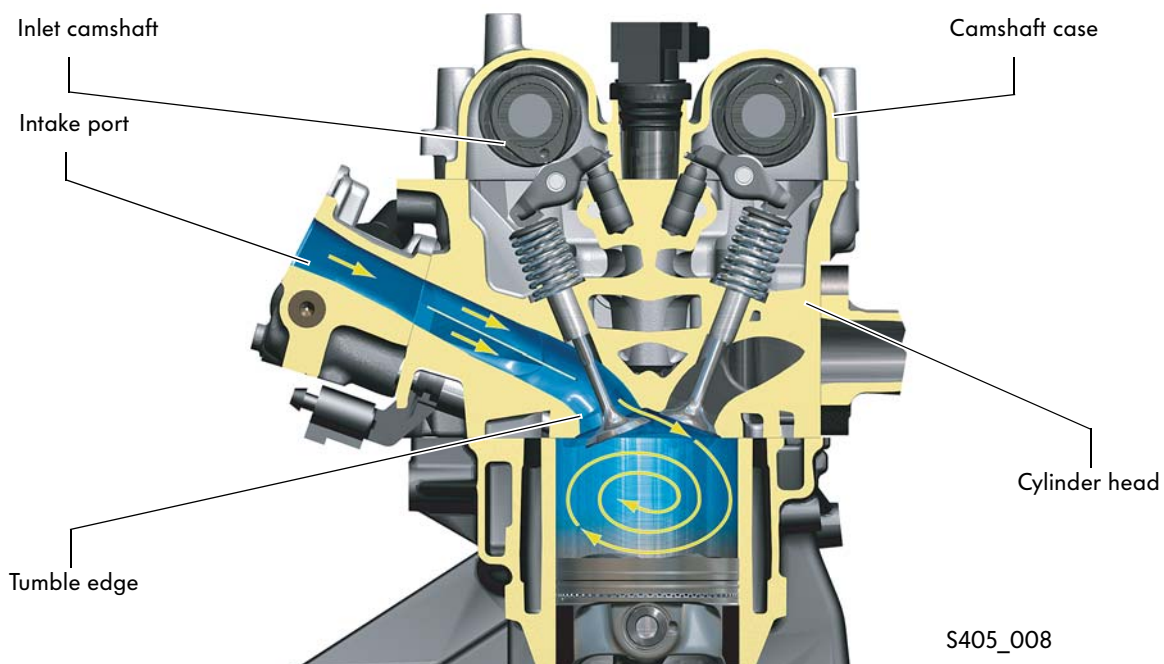
The cylinder head is basically the same as on the 1.4l TSI engine with dual-charging.

However, thanks to an improved combustion design, there is no need for intake manifold flap control. In order to achieve a good tumbling air flow in the cylinder, the intake port angle has been moved closer to horizontal. A tumble edge on the inlet valve seat produces a special tumbling air flow over the upper edge of the valve head in the cylinder.

Camshafts, camshaft housing

The cam profiles have been made smaller by using four cams to drive the high-pressure fuel pump. This has allowed the bearing diameter for the camshafts and camshaft housing to be made smaller.

This has resulted in a weight-saving of approx. 450 grams in total.



Pistons

The combustion chamber recess in the cast lightweight piston has been adapted to the combustion method without intake manifold flap change-over and with a tumble edge on the inlet valve seat. The valve pockets are cast and the wall thicknesses have been minimised reducing weight and inertia masses.

Exhaust valves

Due to the lower exhaust gas temperatures compared with the 1.4l TSI engines with dual-charging, full-stem valves without sodium filled stems are fitted.

Single-charging with turbocharger

Like most supercharged engines, this TSI engine is charged exclusively by a turbocharger. Since only a low charge pressure is required to reach the maximum output of 90kW, it has been possible to configure the turbocharger for high torque at low rev ranges and for low fuel consumption.



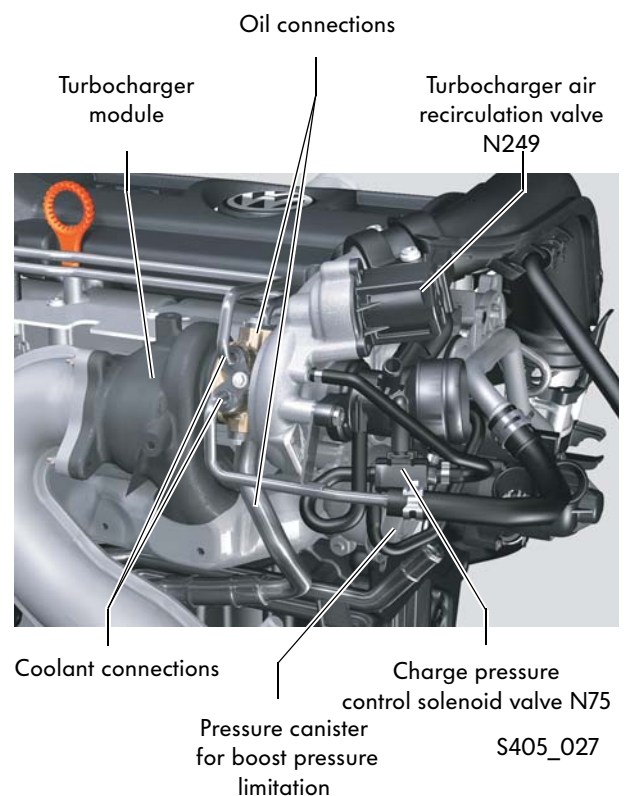
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Turbocharger module

As with the previous TSI engines, the turbocharger and the exhaust manifold form a unit. It is incorporated in the cooling system for the intercooler to keep the temperatures on the shaft bearings low after the engine is switched off.

The shaft bearings are also connected to the oil system for lubrication and cooling.

Furthermore the electrical recirculation valve for the turbocharger and a pressure canister for boost pressure limitation with the waste gate are part of the turbocharger module.

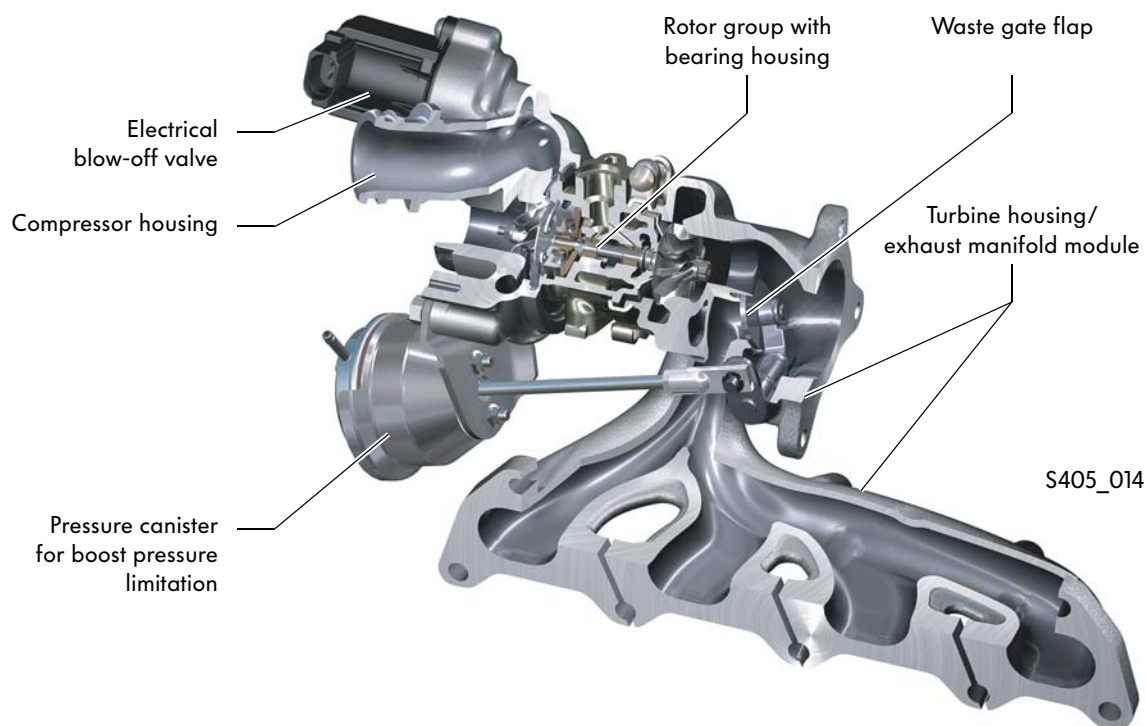


Turbocharger module

The turbocharger is designed for dynamics and fuel consumption. This means that the maximum torque is available in the frequently used lower rev ranges. This is achieved by the inertia of masses of the moving parts inside the turbocharger being kept as low as possible.

This overall configuration leads to the maximum torque of 200Nm being available at 1250rpm 80% and from 1500rpm 100% of the maximum torque of 200Nm. The maximum power is reached at 5000 to 5500rpm.

The exhaust manifold material can withstand temperatures up to 950°C.



Changes to the turbocharger module

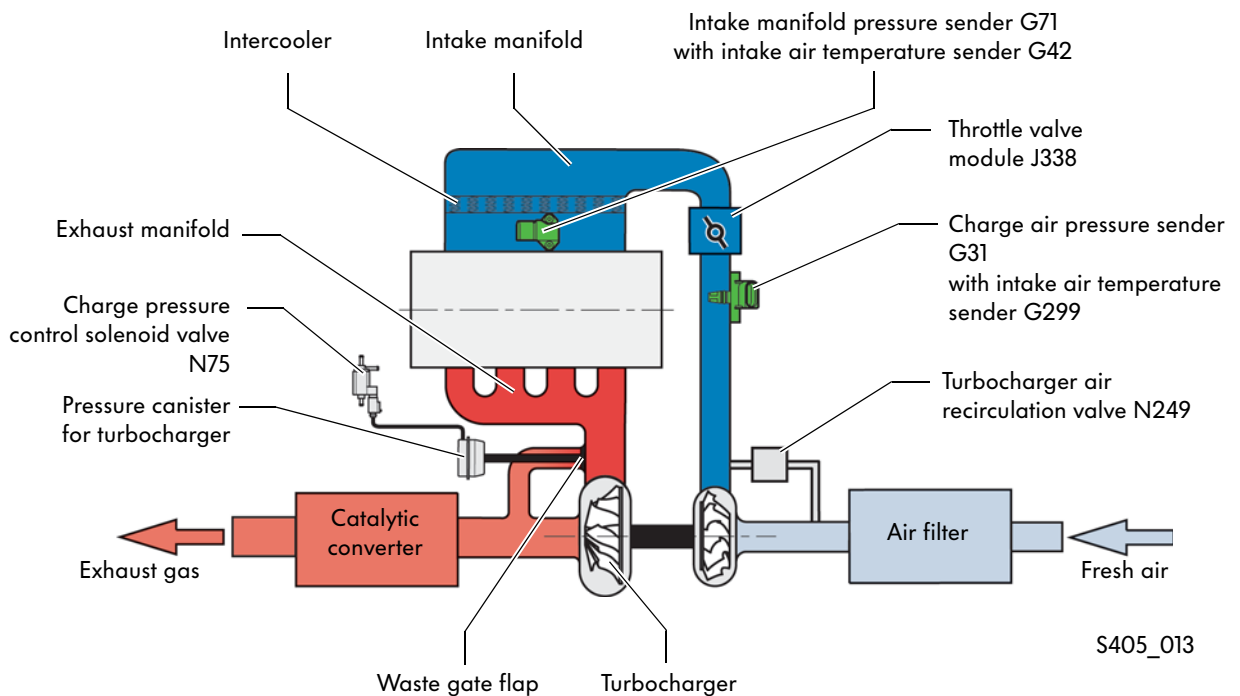
The outside diameters of the turbine wheel and compressor wheel have been reduced from 45mm to 37mm and from 51mm to 41mm compared with the TSI engines. As a result turbo-lag is reduced, lower masses need to be set in motion by the exhaust gas. The turbocharger generates the required charge pressure faster.

Changes to the waste gate flap

At 26mm, the waste gate flap and also the diaphragm diameter in the pressure cell for charge pressure control have larger dimensions. As a result a low pressure is sufficient to open the waste gate flap. This allows a high charge pressure to be obtained for good dynamics at low revs and a lower charge pressure to be obtained in the partial load range for reduced fuel consumption.

Schematic overview of turbocharging

The schematic diagram shows the basic set-up of the turbocharging system and the path of the intake air. The biggest difference from the TSI engines with dual-charging is that there is no supercharger and the charge air is cooled by an air-to-liquid intercooler in the intake manifold.



The fresh air is drawn in via the air filter and is compressed by the turbocharger compressor wheel. The maximum charge pressure is 1.8 bar (absolute).

The charge pressure is mainly controlled by the signals from the charge air pressure sender G31 and the intake air pressure sender G299.

Boost pressure regulation

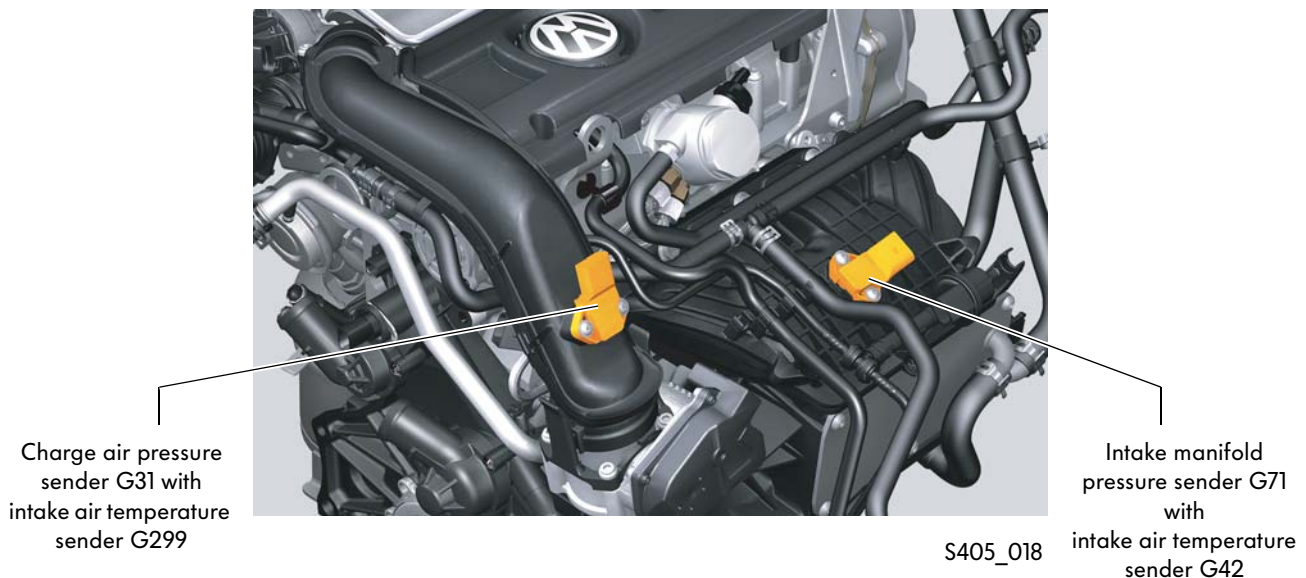
The boost pressure regulation controls the air mass that is compressed by the turbocharger. Two pressure senders, each with an intake air temperature sender, are combined to ensure precise control.

Charge air pressure sender G31 with intake air temperature sender G299

The charge air pressure sender G31 controls the charge pressure. The intake air temperature sender G299 is used as a correction value for charge pressure since the temperature has an influence on the density of the charge air. Furthermore the charge pressure is reduced when the temperatures are too high to protect the components.

Intake manifold pressure sender G71 with intake air temperature sender G42

The air mass in the intake manifold behind the intercooler is calculated by the engine control unit using the intake manifold pressure sender with the intake air temperature sender. Depending on the calculated air mass, the charge pressure is adapted according to a map and increased to up to 1.8 bar absolute pressure.



Ambient pressure sender

The ambient pressure sender in the engine control unit measures the ambient air pressure. This is used as a correction value for charge pressure regulation as the density of the intake air decreases with increasing altitude.

Charge pressure control solenoid valve N75

The charge pressure control solenoid valve is controlled by the engine control unit and regulates the control pressure in the pressure cell for the turbocharger. This operates the waste gate flap and diverts part of the exhaust gases past the turbine to the exhaust system. This regulates the turbine power and the boost pressure.

Engine Mechanics

Cooling systems

The 1.4l 90kW TSI engine has two separate cooling systems — one to cool the engine and a second one to cool the charge air.

Both systems are separate apart from two connection points. These connection points allow an expansion tank to be shared.

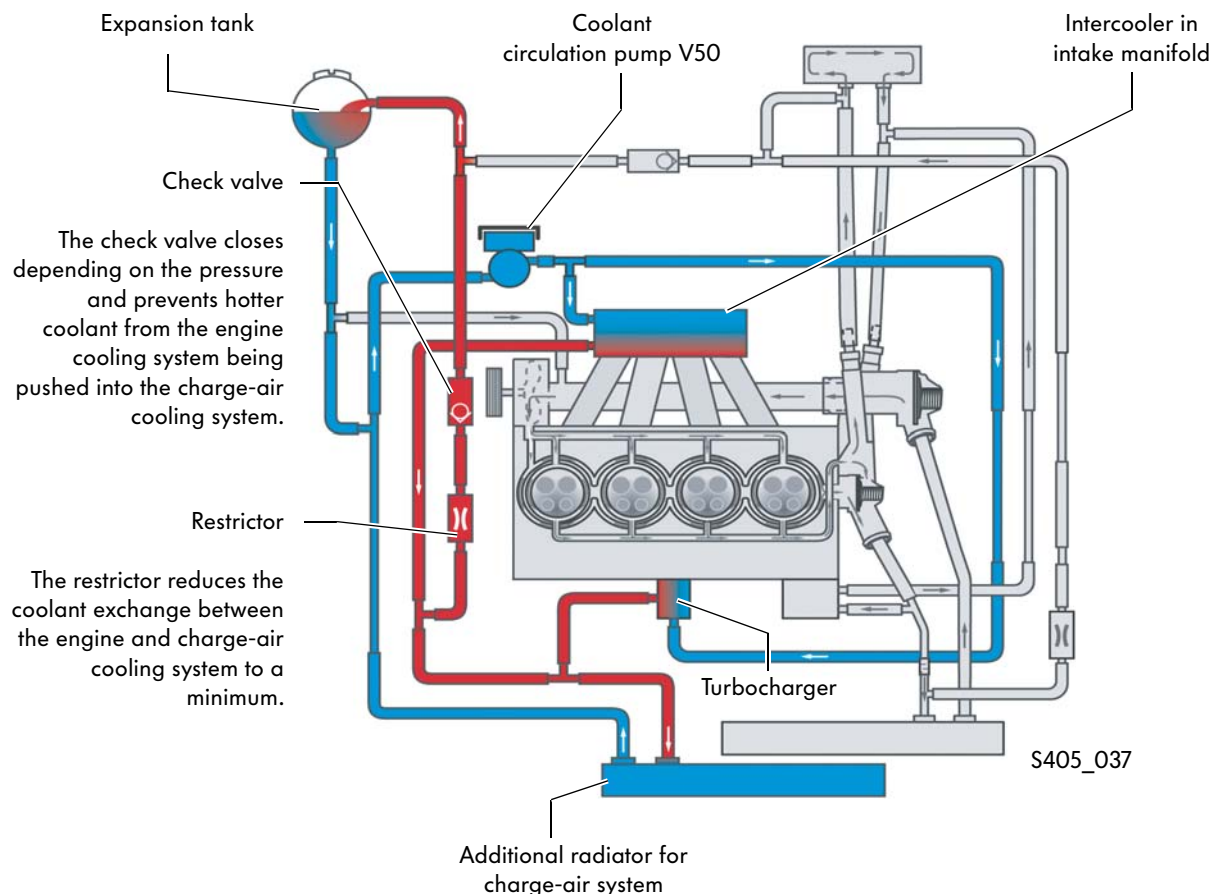
The temperature difference between the engine cooling system and the charge-air cooling system can be up to 100°C.

Special features of engine cooling system

- Two-circuit cooling system for different coolant temperatures in the cylinder head and cylinder block
- Coolant distributor housing with single-stage thermostat

Special features of charge-air cooling system

- Coolant circulation pump V50
- Air-to-liquid intercooler in intake manifold
- Cooling of turbocharger

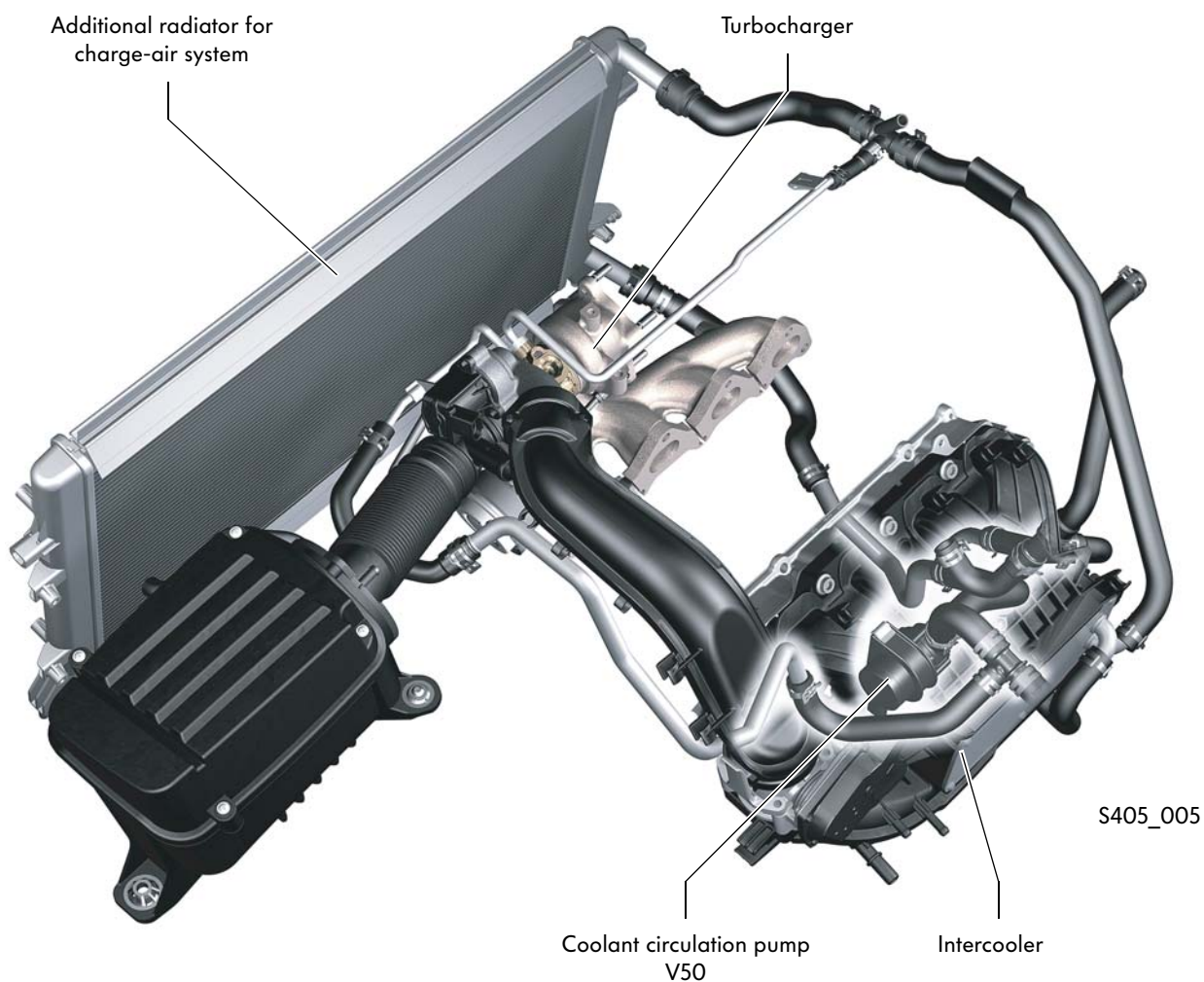
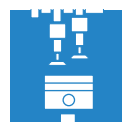


The charge-air cooling system needs to be bled after it is opened to ensure proper cooling. The system is bled either with the cooling system charge unit -VAS 6096- or the guided function "Filling and bleeding cooling system". Please note the instructions on ELSA.

Charge-air cooling

Volkswagen is using an air-to-liquid intercooler for the first time. An air-to-liquid intercooler in the intake manifold is used to cool the charge air. This allows the size of the charge-air system from the turbocharger to the inlet valves to be reduced by more than half from 11l in the 1.4l TSI engines with dual-charging to 4.8l in the 1.4l TSI engine with turbocharger. The turbocharger has to compress a smaller volume and the necessary charge pressure is obtained faster.

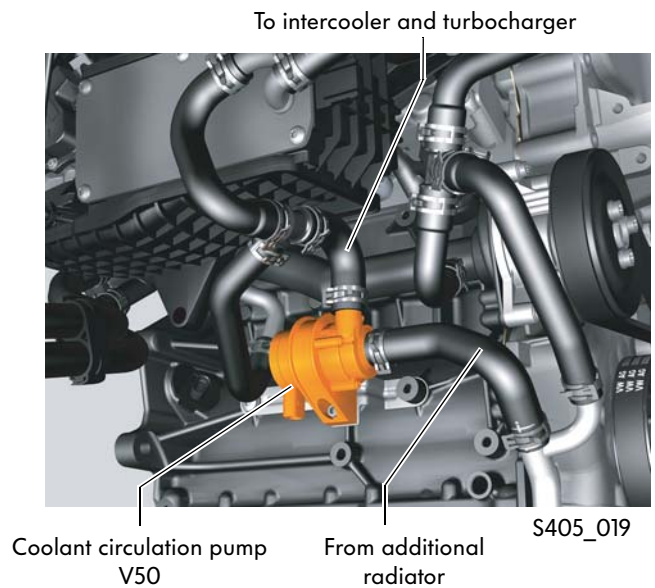
To cool the charge air, the coolant circulation pump is operated according to the requirements. It draws the coolant from the additional radiator at the front end and pumps it to the intercooler and to the turbocharger. The temperature difference between the air after the intercooler and the outside temperature is around 20°C to 25°C with high load requirements.



Engine Mechanics

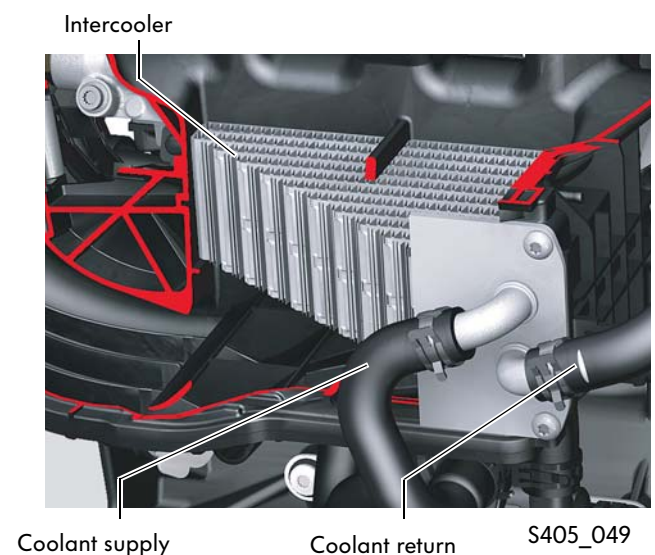
Coolant circulation pump V50

The coolant circulation pump is operated as required. It draws the coolant from the additional radiator for charge air and pumps it to the intercooler in the intake manifold and to the turbocharger.



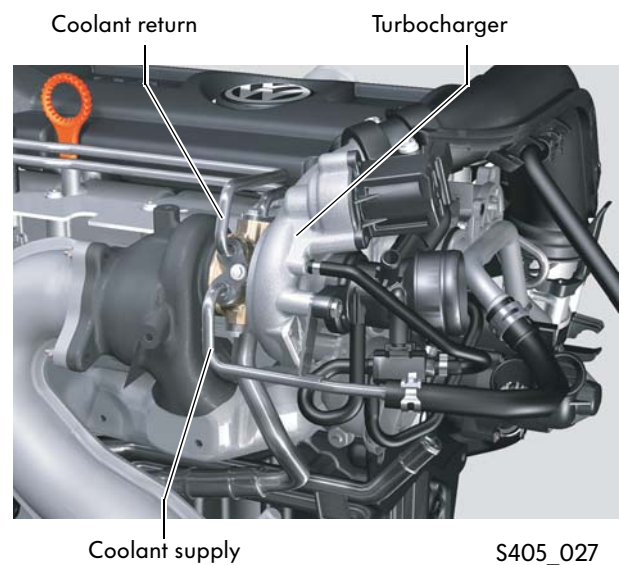
Intercooler

The intercooler consists of a large number of aluminium vanes through which a pipe with coolant passes. The hot air flows past the vanes and transfers the heat to them. The vanes then transfer the heat to the coolant. The coolant is then pumped back to the additional radiator at the front end where it is cooled.



Turbocharger

While the engine is running, the turbocharger is mainly cooled by the engine oil. The coolant is only transported to the turbocharger as required. When the warm engine is switched off, the coolant circulation pump is switched on for up to 480 seconds. This prevents vapour locks forming in the turbocharger coolant circuit.



Demand-regulated fuel system

The demand-regulated fuel system has to a great extent been taken from the existing TSI engines with dual-charging. Both the electrical fuel pump and also the high-pressure fuel pump only convey the amount of fuel that the engine requires at any given moment. The electrical and also the mechanical power used is thus as low as possible and fuel is saved.

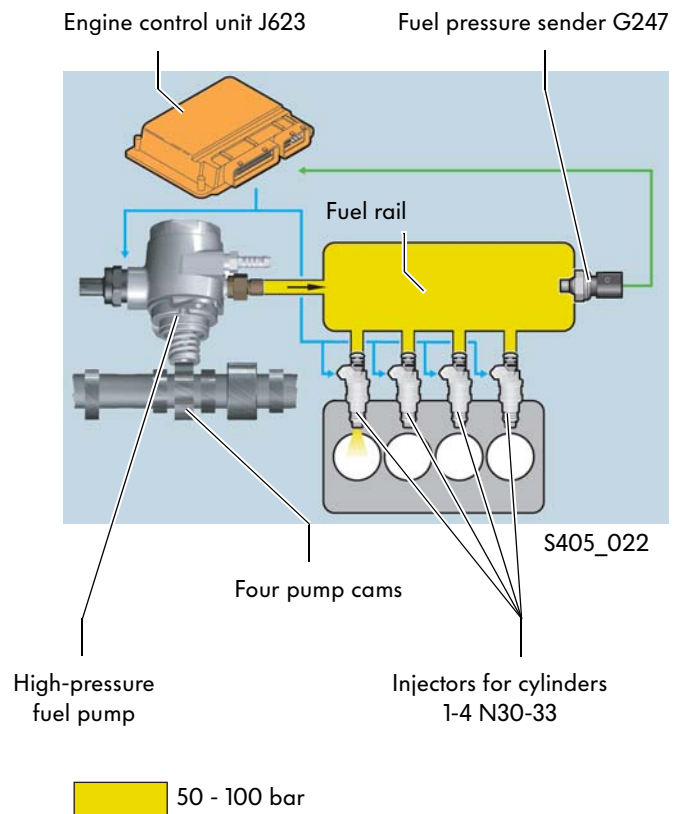
Whilst the low-pressure fuel system is identical, some changes have been made to the high-pressure fuel system.



Changes to the high-pressure fuel system

The high-pressure fuel pump is driven by four cam profiles with 3mm stroke on the inlet camshaft. The pressure limiting valve is built into the high-pressure fuel pump. This has allowed the leakage line from the fuel rail to the low-pressure fuel system to be omitted.

The control concept of the high-pressure fuel pump has been changed. When operated, the fuel pressure regulating valve is closed and fuel is transported to the fuel rail. This allows pressure to be built up faster for cold starts.

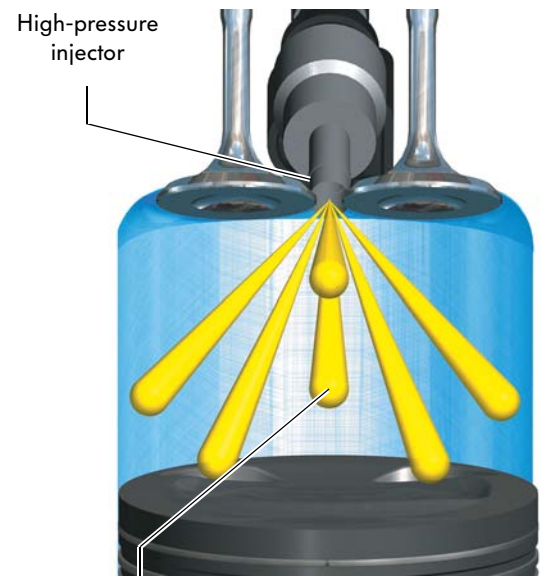


During deceleration fuel cut-off, the fuel pressure can rise to over 100 bar due to heating and the resulting expansion.

High-pressure injector

The jet shape of the 6-hole high-pressure injector has been optimised.

Until now the jet shape of the high-pressure injectors were circular or oval. Now the jets are arranged so that wetting of the piston crown is avoided at full load or during the double injection to heat up the catalytic converter.



Higher injection jet

S405_043

High-pressure fuel pump

The metered single-cylinder high-pressure fuel pump is bolted at an angle to the camshaft case. It is driven by four cam profiles on the inlet camshaft. The stroke is 3mm for each cam profile.

Another new feature is that the fuel pump does not pump the fuel to the high-pressure fuel system when it is not operated.



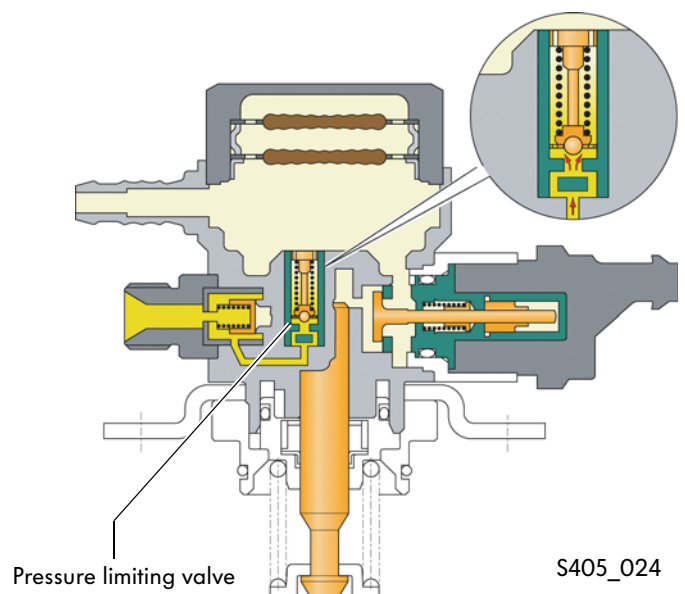
High-pressure fuel pump

S405_021

Pressure limiting valve

The pressure limiting valve is integrated into the high-pressure fuel pump and protects the components against excessive fuel pressure when there is heat expansion or a malfunction.

It is a mechanical valve and opens when the fuel pressure rises above 140 bar. It opens the route from the high-pressure side to the low-pressure side in the high-pressure fuel pump. The fuel is returned to the high-pressure fuel system from there.

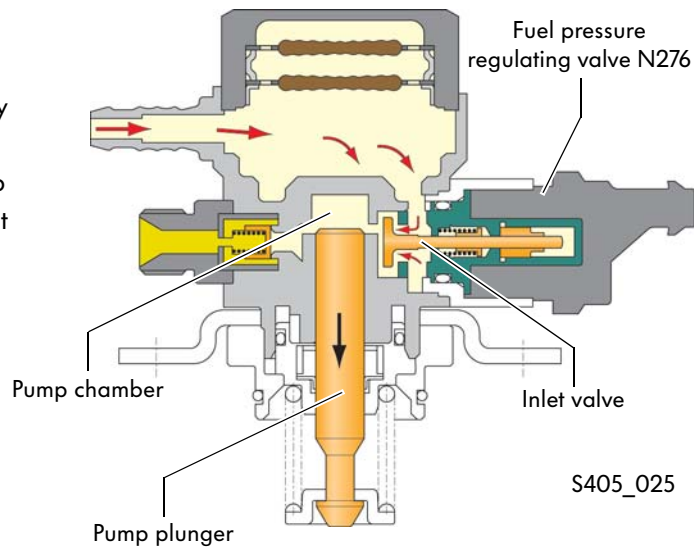


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High-pressure fuel pump function

Fuel suction stroke

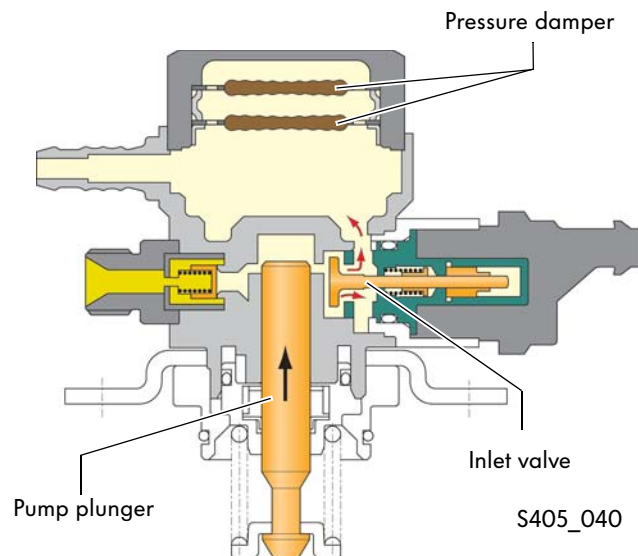
During the suction stroke, a suction effect is created by the downwards movement of the pump piston. This opens the inlet valve and fuel is drawn into the pump chamber. In the last third of the downwards movement of the pump plunger, the fuel pressure regulating valve is energised. As a result, the inlet valve also remains open at the start of the upwards movement for the fuel return.



Fuel return

In order to adapt the fuel quantity to the actual consumption, the inlet valve is also opened at the start of the upwards movement of the pump plunger. The excessive fuel is pushed back by the pump plunger in the low-pressure range.

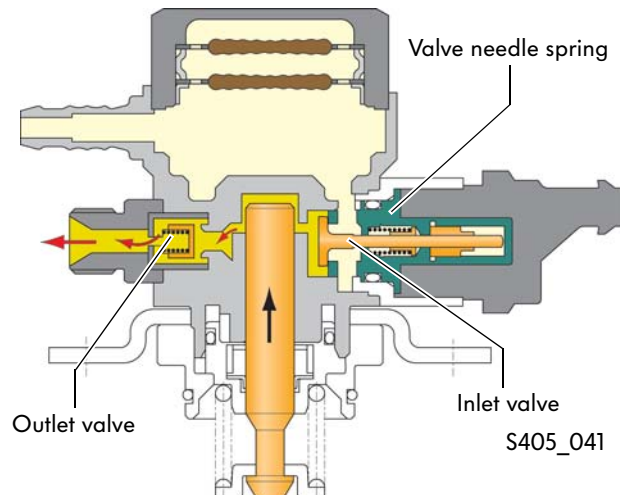
The resulting pulses are compensated by the pressure damper.



Fuel delivery stroke

The fuel pressure regulating valve is no longer powered at the calculated start of the delivery stroke. As a result, the inlet valve is closed by the rising pressure in the pump chamber and the force of the valve needle spring.

The upwards movement of the pump plunger builds up the pressure in the pump chamber. If the pressure in the pump chamber is greater than in the fuel rail, the outlet valve will open. The fuel is pumped to the fuel rail.



Engine Management

System overview

Sensors

Intake manifold pressure sender **G71**
with intake air temperature sender **G42**

Charge air pressure sender **G31** with
intake air temperature sender **G299**

Engine speed sender **G28**

Hall sender **G40**

Throttle valve module **J338**

Angle sender for throttle valve drive **G187, G188**

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

Clutch position sender **G476**

Brake pedal position sender **G100**

Fuel pressure sender **G247**

Knock sensor **G61**

Coolant temperature sender **G62**

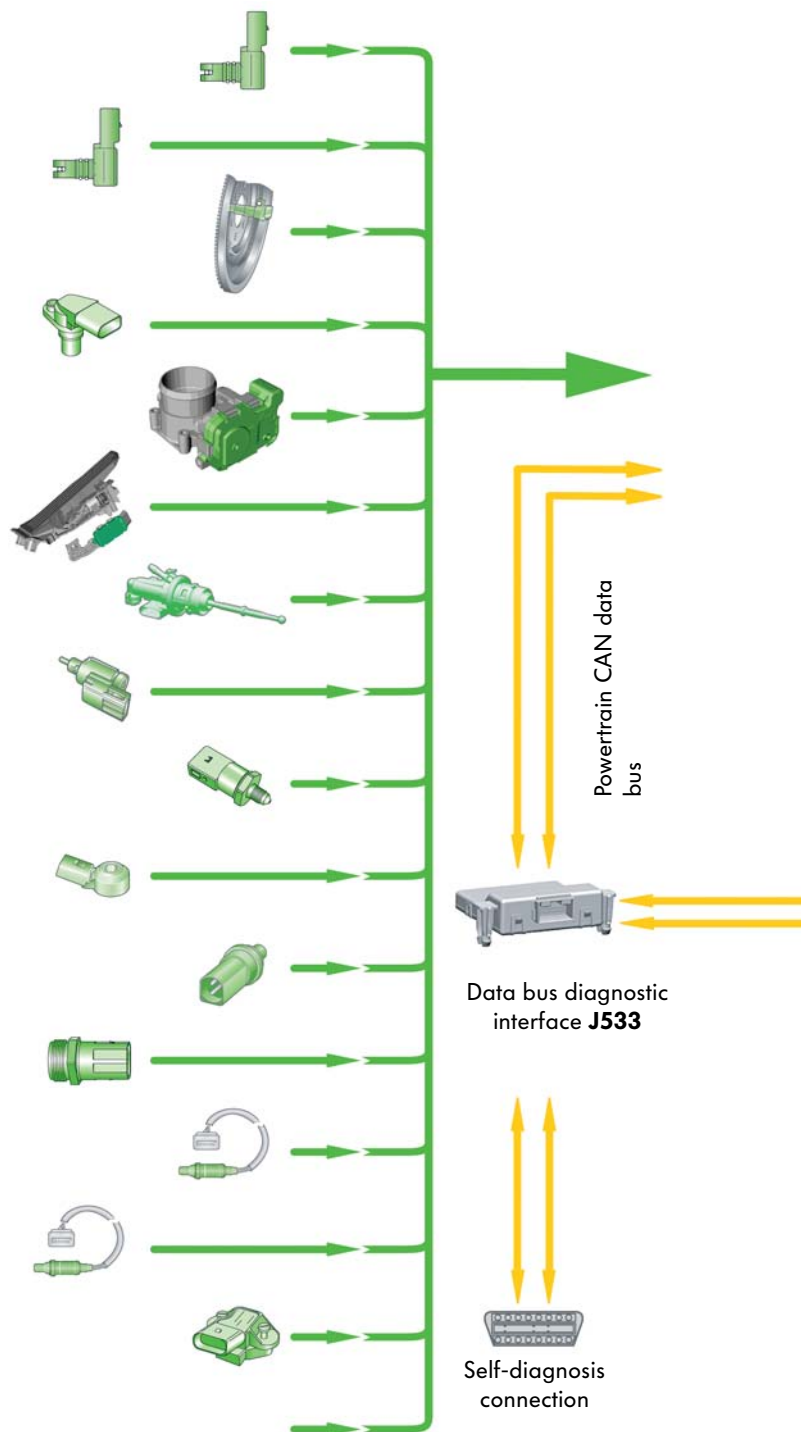
Radiator outlet coolant temperature sender **G83**

Lambda probe **G39**

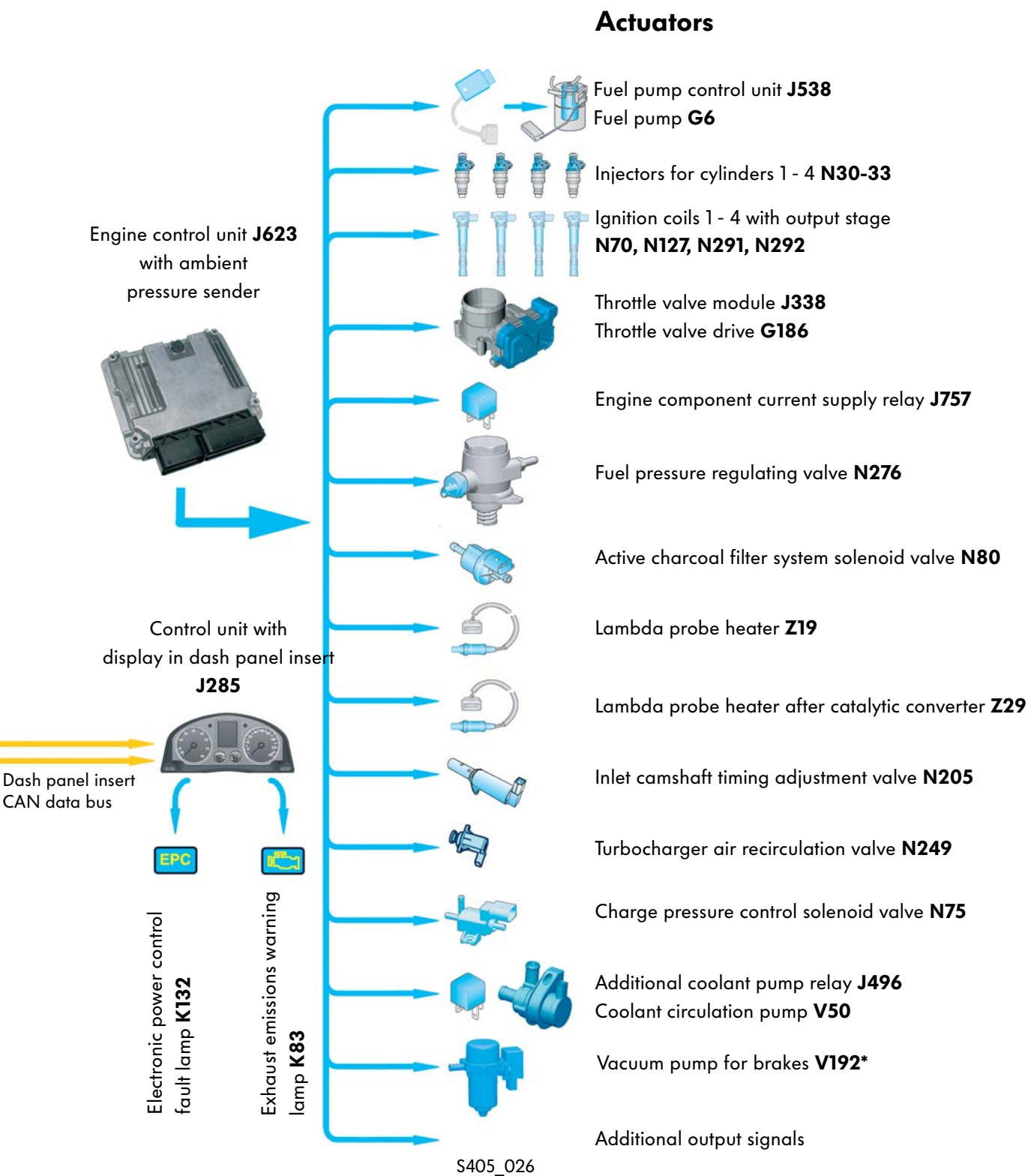
Lambda probe after catalytic converter **G130**

Brake servo pressure sensor **G294***

Additional input signals



* only relevant for vehicles with a dual-clutch gearbox (DSG) and ABS without ESP

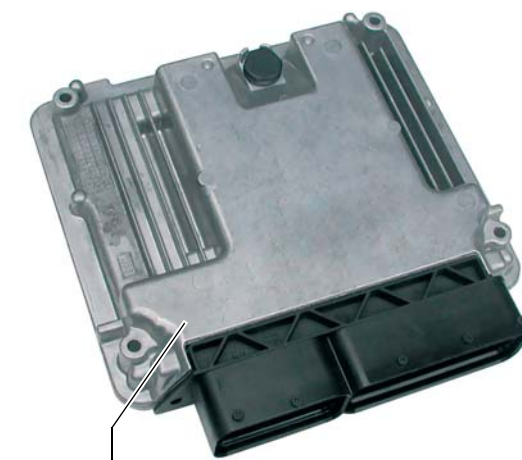


Engine Management

Bosch Motronic MED 17.5.20

The Bosch Motronic MED 17 is the follow-up engine management system to the Bosch Motronic MED 9. It differs in the following areas.

- Faster processor
- Configuration for transient lambda probes
- Omission of communications line
- Stratified high-pressure start from -30°C



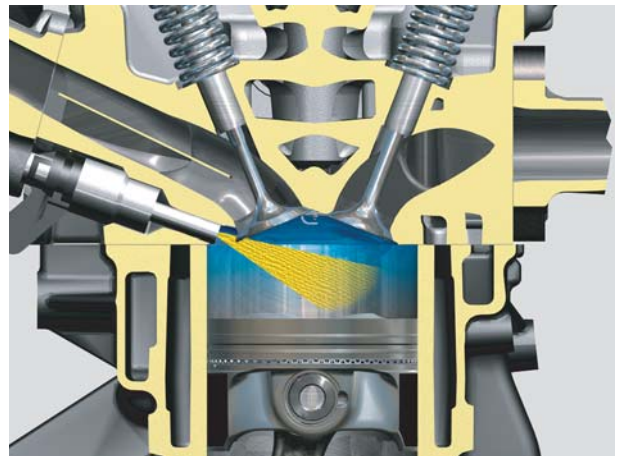
Engine control unit J623

S405_048

Stratified high-pressure start

Due to the new operation of the high-pressure fuel pump, a pressure of approx. 60 bar is built up very quickly and the stratified high-pressure start is possible from -30°C . The fuel is injected just before ignition.

The temperatures present in the cylinder at this time and the high pressure ensure a very good mixture preparation. The fuel quantity required for start can thus be reduced and above all the hydrocarbon emissions can be decreased.



S405_047

Sensors

Charge air pressure sender G31 with intake air temperature sender 2 G299

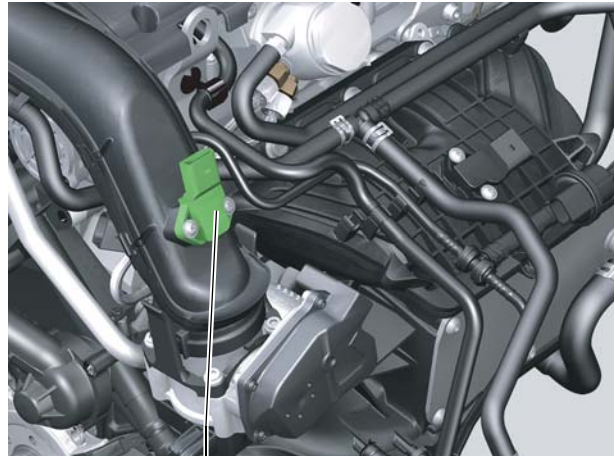
The charge air pressure sender with intake air temperature sender is screwed into the pressure pipe just in front of the throttle valve module. It measures the pressure and temperature in this area.

Signal use

The engine control unit regulates the turbocharger charge pressure using the signal from the charge air pressure sender. It is controlled via the charge pressure control solenoid valve.

The signal from the intake air temperature sender is required ...

- to calculate a correction value for the boost pressure. The temperature influence on the density of the charge air is taken into consideration.
- to protect components. If the temperature rises above a certain value, the charge pressure is reduced.
- to control the coolant circulation pump. If the temperature difference of the charge air before and after the intercooler is less than 8°C, the coolant circulation pump is activated.
- for a plausibility check of the coolant circulation pump. If the temperature difference of the charge air before and after the intercooler is less than 2°C, it is presumed that the coolant circulation pump is faulty. The exhaust emissions warning lamp K83 is illuminated.



Charge air pressure sender G31 with intake air temperature sender G299 S405_042



Effects of signal failure

If both senders fail, the turbocharger uses a default setting. The charge pressure is lower and the power is reduced.

Engine Management

Intake manifold pressure sender G71 with intake air temperature sender G42

The intake manifold pressure sender with intake air temperature sender is screwed into the intake manifold behind the intercooler. It measures the pressure and temperature in this area.

Signal use

The engine control unit calculates the air mass drawn in from the signals and the engine speed. The signal from the intake air temperature sender is also required ...

- to control the coolant circulation pump. If the temperature difference of the charge air before and after the intercooler is less than 8°C, the coolant circulation pump is activated.
- for a plausibility check of the coolant circulation pump. If the temperature difference of the charge air before and after the intercooler is less than 2°C, it is presumed that the coolant circulation pump is faulty. The exhaust emissions warning lamp K83 is illuminated.



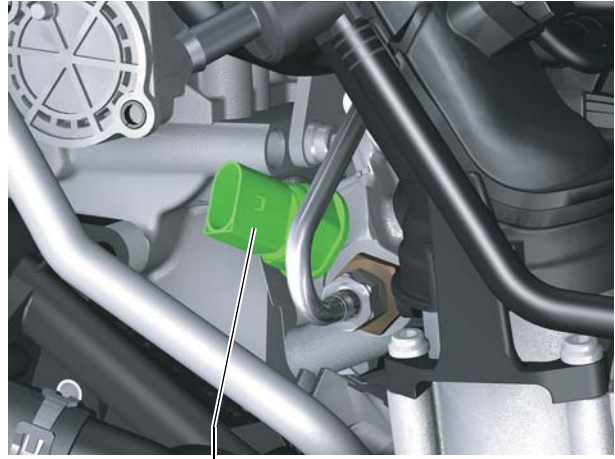
Intake manifold pressure sender G71 S405_044
with intake air temperature sender G42

Effects of signal failure

If the signal fails, the throttle valve position and the temperature of the intake air temperature sender G299 is used as a replacement signal. The turbocharger uses a default setting.

Fuel pressure sender, high pressure G247

The sender is on the lower part of the intake manifold on the flywheel side and is screwed into the plastic fuel distribution pipe. It measures the fuel pressure in the high-pressure fuel system and transmits the signal to the engine control unit.



Fuel pressure sender G247

S405_034



Signal use

The engine control unit evaluates the signals and regulates the pressure in the fuel distribution pipe using the fuel pressure regulating valve.

If the fuel pressure sender detects that the target pressure can no longer be regulated, the fuel pressure regulating valve is constantly energised during compression and is open. The fuel pressure is thus reduced to 5 bar of the low-pressure fuel system.

Effects of signal failure

If the fuel pressure sender fails, the fuel pressure regulating valve is constantly energised during compression and is open. The fuel pressure is thus reduced to 5 bar of the low-pressure fuel system. The engine torque and the power are reduced drastically.

Engine Management

Actuators

Fuel pressure regulating valve N276

The fuel pressure regulating valve is located on the side of the high-pressure fuel pump.

Task

It has the task of supplying the required quantity of fuel in the fuel rail.



Effects upon failure

Unlike the 1.4l TSI engines with dual charging, the regulating valve is closed when not energised. This means that the fuel pressure rises when the regulating valve fails until the pressure limiting valve in the high-pressure fuel pump opens at approx. 140 bar. The engine management adjusts the injection times in relation to the high pressure and the engine speed is limited to 3000rpm.



The fuel pressure needs to be released before the high-pressure fuel system is opened.

Until now, the connector could be pulled off the fuel pressure regulating valve, the regulating valve was open when not energised and the fuel pressure was released.



High-pressure
fuel pump

Fuel pressure
regulating valve N276

S405_050

As the regulating valve for this engine is closed when not energised, the fuel pressure is no longer released when the connector is disconnected. For this reason, the function "Releasing high fuel pressure" is included in the guided functions. It is used to open the regulating valve and release the pressure while the engine is running.

Please note that the fuel pressure rises again when the system heats up.

Please note the instructions on ELSA.

Additional coolant pump relay J496

The additional coolant pump relay is located in the left of the engine compartment in the E-box.

Task

The high working currents for the coolant circulation pump V50 are switched by the relay.

Effects upon failure

If the relay fails, the coolant circulation pump can no longer be controlled.



Additional coolant pump relay J496

S405_029



Coolant circulation pump V50

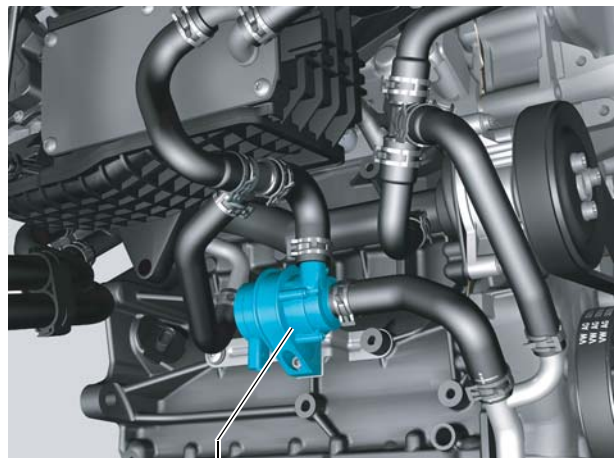
The coolant circulation pump is bolted to the cylinder block underneath the intake manifold. It is part of a separate cooling system.

Task

The coolant circulation pump transports coolant from an additional radiator in the front end to the intercooler and to the turbocharger.

It is activated under the following conditions:

- briefly after each time the engine is started
- constantly above a torque requirement of approx. 100Nm
- constantly from a charge air temperature of 50°C in the intake manifold
- at temperature differences of less than 8°C in the charge air before and after the intercooler
- when the engine is running every 120 seconds for 10 seconds to avoid heat accumulation in the turbocharger and
- based on a map for 0-480 seconds after the engine is turned off to avoid overheating with formation of vapour locks in the turbocharger.



Coolant circulation pump V50

S405_020

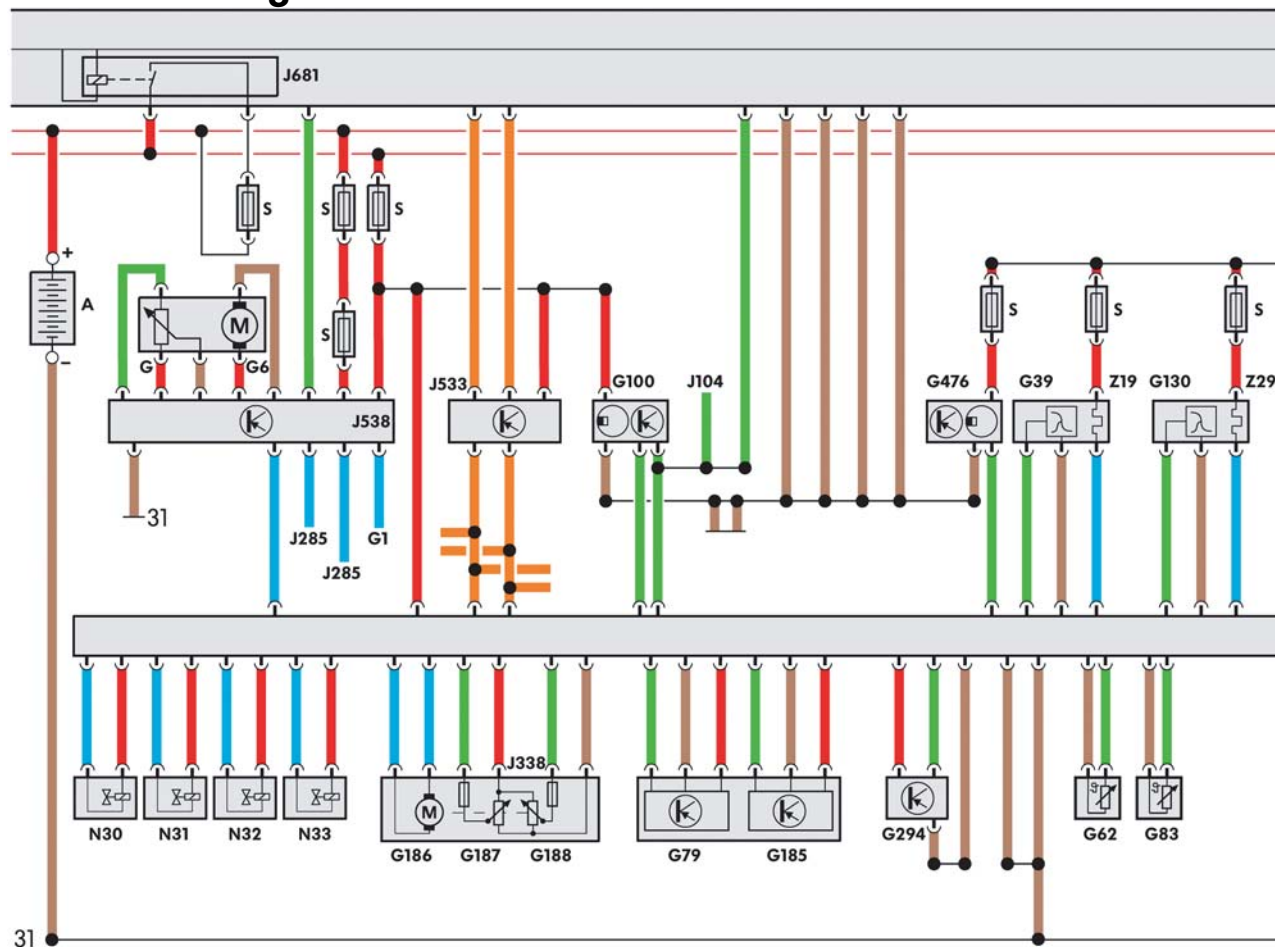
Effects upon failure

If the coolant circulation pump fails, overheating may occur.

The pump is not checked directly by self-diagnosis. By comparing the temperature before and after the intercooler, a fault can be recognised in the cooling system and the exhaust emissions warning lamp K83 is illuminated.

Engine Management

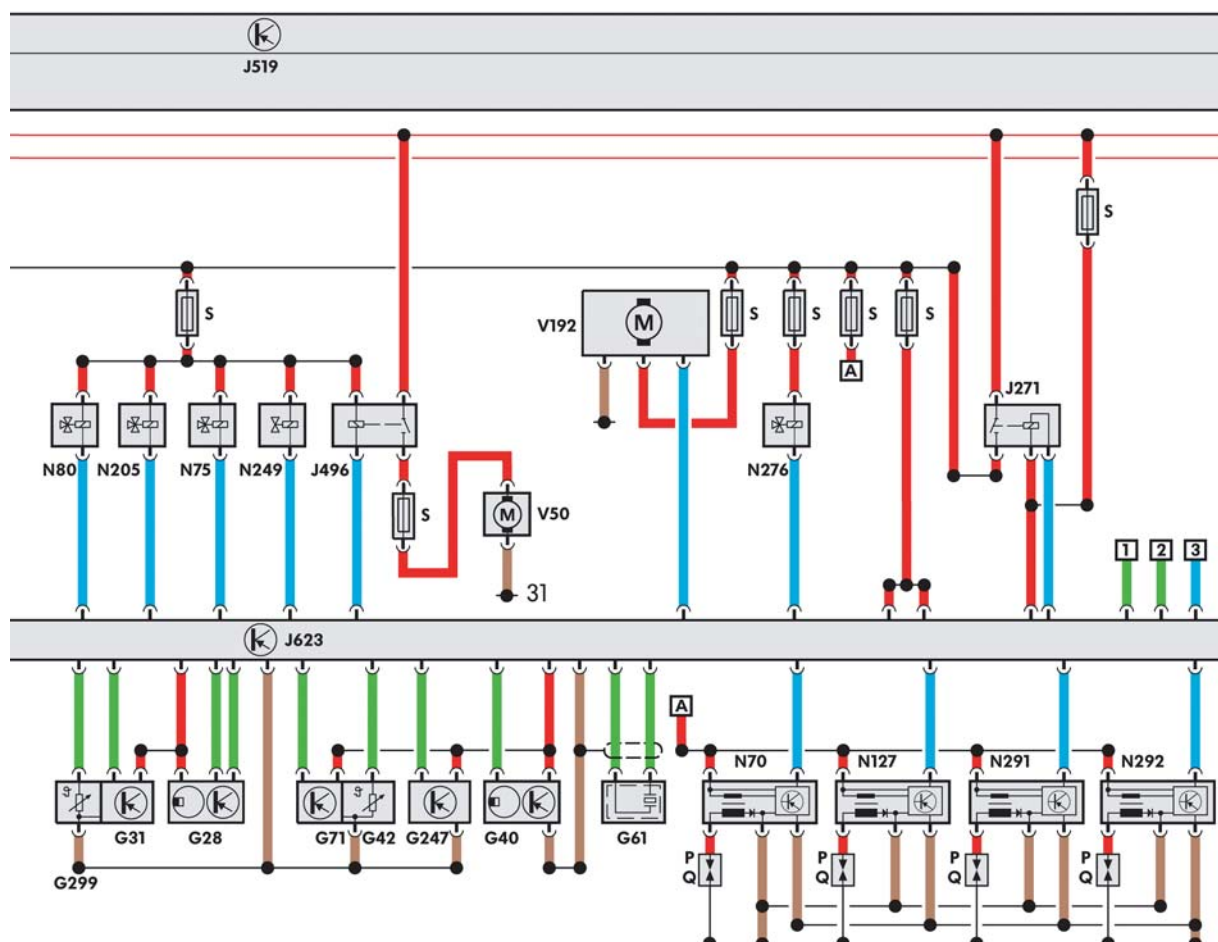
Functional diagram



S405_030

- | | | | |
|-------------|--|-------------|--|
| A | Battery | G188 | Throttle valve drive angle sender |
| G | Fuel gauge sender | G294 | Brake servo pressure sensor* |
| G1 | Fuel gauge | G476 | Clutch position sender |
| G6 | Fuel pump | J104 | ABS control unit |
| G39 | Lambda probe | J285 | Control unit with display in dash panel insert |
| G62 | Coolant temperature sender | J533 | Data bus diagnostic interface |
| G79 | Accelerator position sender | J681 | Terminal 15 voltage supply relay |
| G83 | Radiator outlet coolant temperature sender | N30- | Injectors for cylinders 1 - 4 |
| G100 | Brake pedal position sender | N33 | |
| G130 | Lambda probe after catalytic converter | S | Fuse |
| G185 | Accelerator position sender 2 | Z19 | Lambda probe heater |
| G186 | Throttle valve drive | Z29 | Lambda probe heater after catalytic converter |
| G187 | Throttle valve drive angle sender | | |

* only relevant for vehicles with a dual-clutch gearbox (DSG) and ABS without ESP



S405_030



- A** Battery
- G28** Engine speed sender
- G31** Charge air pressure sender (turbocharger)
- G40** Hall sender
- G42** Intake air temperature sender
- G61** Knock sensor
- G71** Intake manifold pressure sender
- G247** Fuel pressure sender
- G299** Intake air temperature sender
- J271** Motronic current supply relay
- J496** Additional coolant pump relay
- J519** Onboard supply control unit
- J623** Engine control unit
- N70** Ignition coil 1 with output stage
- N75** Charge pressure control solenoid valve
- N80** Active charcoal filter system solenoid valve
- N127** Ignition coil 2 with output stage
- N205** Inlet camshaft timing adjustment valve
- N249** Turbocharger air recirculation valve
- N276** Fuel pressure regulating valve

- N291** Ignition coil 3 with output stage
- N292** Ignition coil 4 with output stage
- P** Spark plug connectors
- Q** Spark plugs
- S** Fuse
- V50** Coolant circulation pump
- V192** Vacuum pump for brakes
- 1** Cruise control switch
- 2** Alternator terminal DFM
- 3** Radiator fan level 1

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



Special tools

Designation	Tool	Application
Camshaft clamp -T10171A-	 <p>S405_035</p>	<p>The camshaft clamp allows the two camshafts to be locked and the timing to be adjusted.</p> <p> This special tool corresponds with the old special tool camshaft clamp -T10171-. As the fixing point for the special tool has changed, you will need to adapt the old tool accordingly. Please note the instructions on ELSA.</p>



Which answers are correct?

One or several of the answers could be correct.

1. How is the 1.4l 90kW TSI engine charged?

- ☐ a) It is charged by a supercharger and a turbocharger.
- ☐ b) It is charged only by a turbocharger.
- ☐ c) It is charged by means of oscillation pipe charging.

2. What statement about the area of cooling systems is correct?

- ☐ a) The coolant in the charge-air cooling system is circulated by the mechanical coolant pump for the engine cooling system.
- ☐ b) The charge-air cooling system uses an air-to-air intercooler.
- ☐ c) The charge-air cooling system is to a great extent independent of the engine cooling system and only connected to it for filling and bleeding.

3. What possibilities are there for filling and bleeding the cooling systems?

- ☐ a) The cooling systems can be filled and bled with the -VAS 6096- cooling system charge unit.
- ☐ b) The cooling systems are filled up to the max. mark on the expansion tank. Bleeding is not necessary.
- ☐ c) The cooling systems can be filled and bled with the guided function "Filling and bleeding cooling system".

4. What should you observe before opening the high-pressure fuel system?

- ☐ a) The high pressure needs to be reduced by disconnecting the connector on the fuel pressure regulating valve.
- ☐ b) The high pressure needs to be reduced with the vehicle diagnosis, testing and information system -VAS 5051- in the guided function "Releasing high fuel pressure".
- ☐ c) There is no need for special measures as the high pressure is released on its own after the engine is turned off.

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



405



TSI

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