

Inlet camshaft timing adjustment valve N205

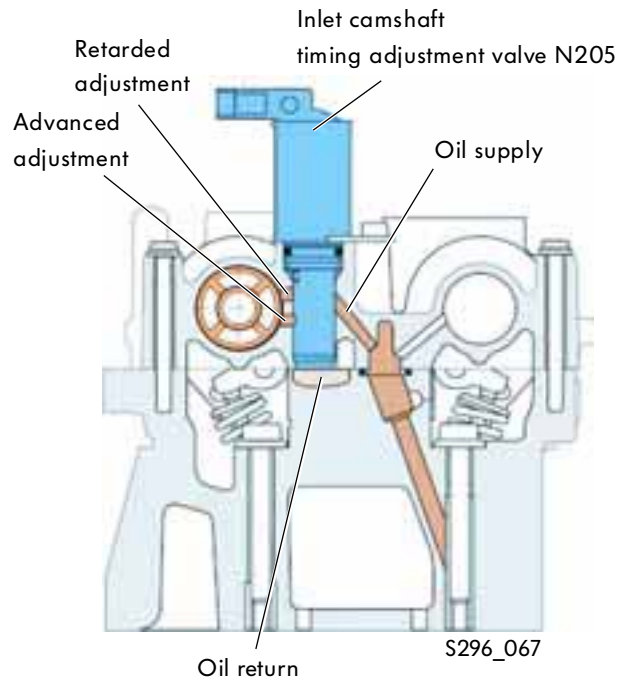
This can be found in the camshaft housing and is included in the oil circuit of the engine.

Actuation of the inlet camshaft timing adjustment valve results in oil being fed to one or both oil channels.

Depending on which oil channel is accessible, the inner rotor is adjusted in the direction of "advanced" or "retarded", or held in its position. As the inner rotor is bolted to the inlet camshaft, the camshaft is adjusted in the same way.

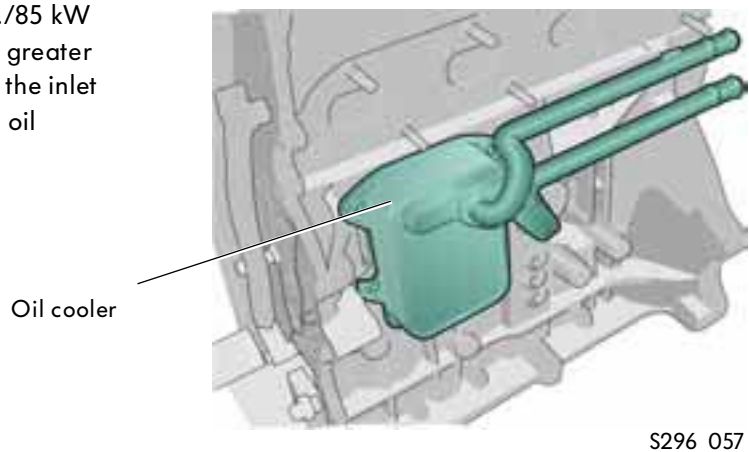
Effects of failure

If the inlet camshaft timing adjustment valve N205 fails in its function, there is no variable timing adjustment.



Oil cooler

Due to the higher rev range of the 1.6 ltr./85 kW FSI engine, the engine oil is subjected to greater heat. To guarantee precise adjustment of the inlet camshaft across the entire rev range, an oil cooler is installed.



Engine management

System overview

- Inlet manifold pressure sender **G71**
- Intake air temperature sender **G42**

- Intake air temperature sender 2 **G299**

- Engine speed sender **G28**

- Hall sender **G40**
- Throttle valve control unit **J338**
- Throttle valve drive angle sender 1+2 **G187** and **G188**

- Accelerator pedal position sender **G79** and **G185**

- Clutch pedal switch **F36**

- Brake light switch **F** and brake pedal switch **F47**

- Fuel pressure sender, high pressure **G247**

- Fuel pressure sender, vacuum pressure **G410**

- Knock sensor **G61**

- Coolant temperature sender **G62**

- Coolant temperature sender - radiator outlet **G83**

- Potentiometer for intake manifold flap **G336**

- Potentiometer for exhaust gas recirculation **G212**

- Lambda probe **G39**

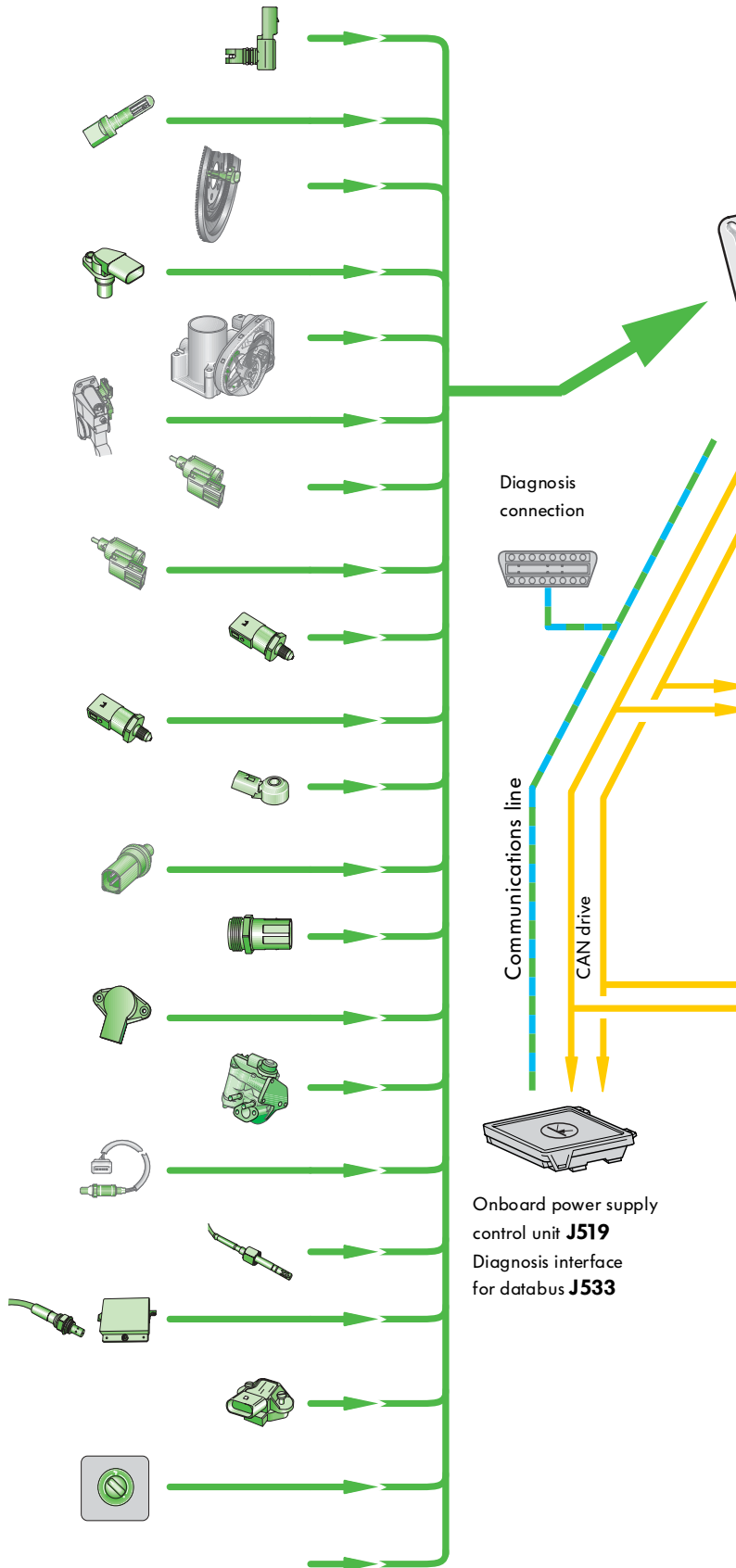
- Exhaust gas temperature sender **G235**

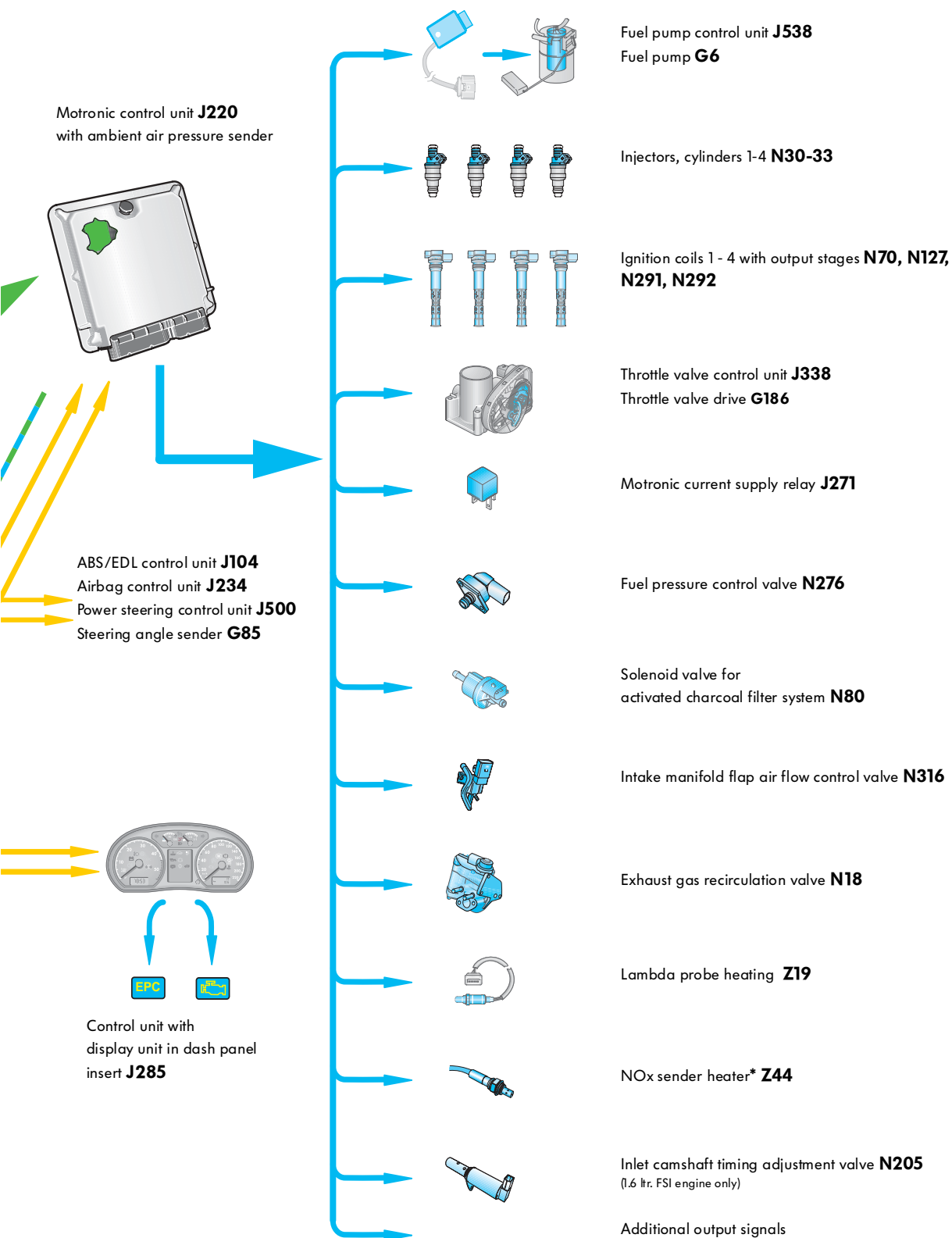
- NOx* sender **G295**,
NOx sensor* control unit **J583**

- Brake servo pressure sensor **G294**

- Temperature selection potentiometer **G267**

- Additional input signals





Engine management

Engine control unit J220 (1.4 ltr./63 kW FSI engine)

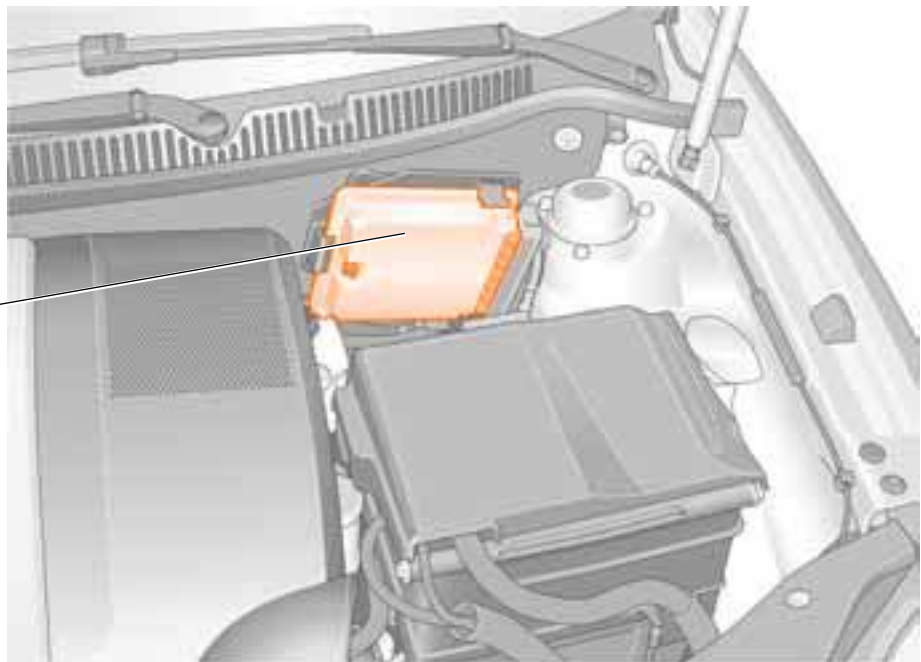
The engine control unit on the Polo can be found on the bulkhead in the engine compartment and has 121 pins.

The installation location was carefully selected to allow easy access but also to protect against dampness.

The torque-based engine management system is Bosch Motronic MED 7.5.11. In the housing of the control unit there is also an ambient air pressure sender.

The engine control unit calculates and controls the optimum fuel and air mixture for the following modes of operation.

- Stratified injection
- Homogeneous-lean
- Homogeneous
- Double injection, catalyst warm-up



Engine control unit with ambient air pressure sender J220

S296_025

The designation MED 7.5.11 stands for:

M =Motronic

E =Electric throttle operation

D =Direct injection

7. =Version

5.11 =Development stage

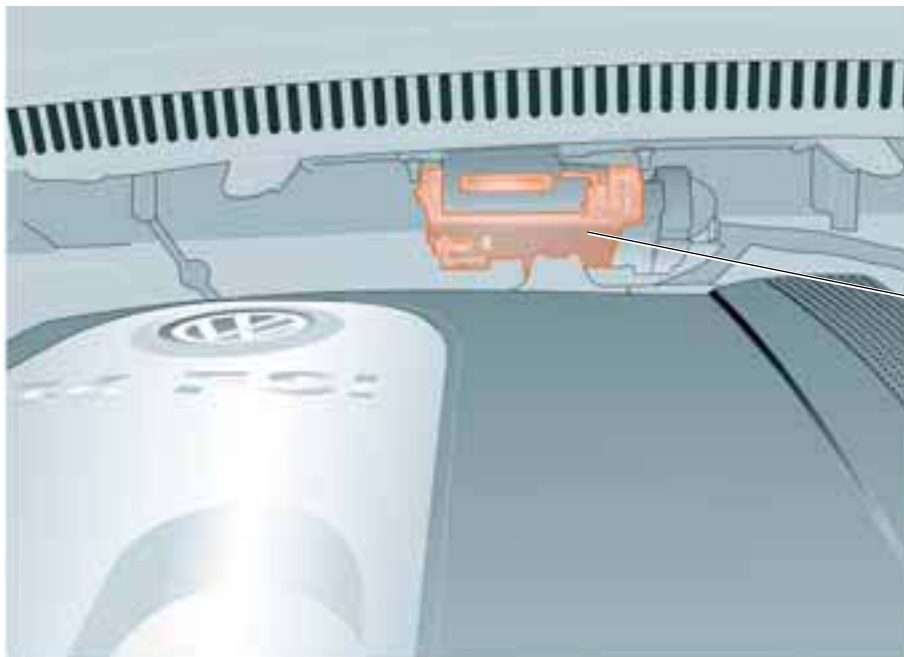
Engine control unit J220 (1.6 ltr./85 kW FSI engine)

The engine control unit on the Touran can be found in the plenum chamber and has 154 pins.

The torque-based engine management system is Bosch Motronic MED 9.5.10.

The engine control unit calculates and controls the optimum fuel and air mixture for the following modes of operation.

- Stratified injection
- Homogeneous-lean
- Homogeneous
- Double injection, catalyst warm-up
- Double injection, full throttle



Engine control unit with ambient air pressure sender J220

S296_056

The designation MED 9.5.10 stands for:

M =Motronic

E =Electric throttle operation

D =Direct injection

9. =Version

5.10 =Development stage



Engine management

Operating types

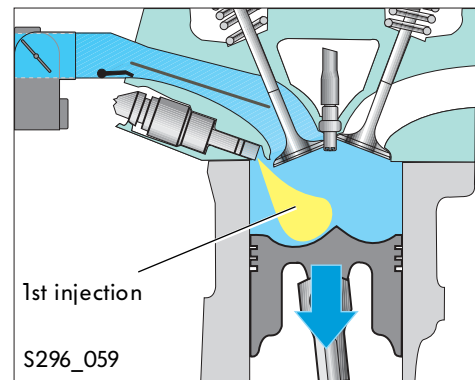
In addition to the operating types stratified injection, homogeneous-lean and homogeneous, there are two further operating modes. These are 'double injection, catalyst warm-up' and 'double injection, full throttle'. Thanks to these two modes, firstly, the catalyst is warmed up faster and, secondly, torque is increased in the lower rev range.

Double injection, catalyst warm-up

In homogeneous catalyst warm-up mode, the catalyst is warmed up faster and it therefore reaches its optimal operating temperature earlier. Furthermore, quieter running is the result and there are fewer HC emissions. All in all, there is a reduction in exhaust emissions and fuel consumption.

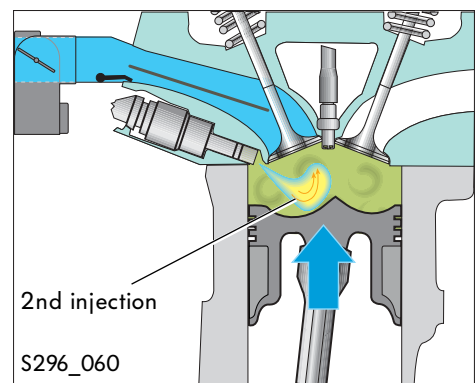
First injection

The first injection is when the crankshaft angle is at approx. 300° before TDC during the intake stroke. This helps to achieve a balanced distribution of the air and fuel mixture.

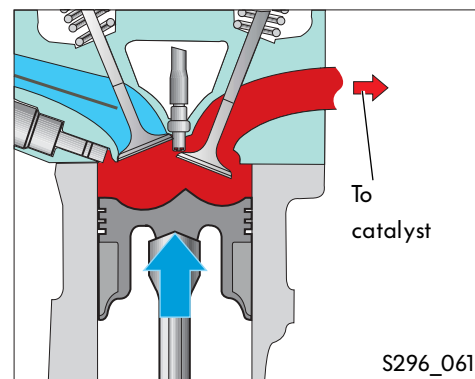


Second injection

During the second injection, a small amount of fuel is injected when the crankshaft angle is at approx. 60° before TDC. This mixture burns very late and exhaust gas temperature increases.



The warmer exhaust gas heats up the catalyst, which allows it to reach its optimal operating temperature.

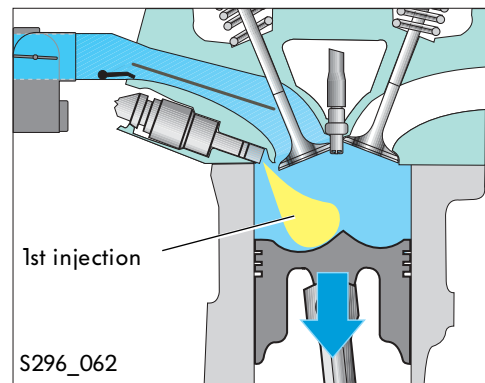


Double injection, fullthrottle (1.6 ltr./85 kW FSI engine)

On petrol direct injection systems, there are times when the fuel and air mixture is unfavourable at engine speeds up to 3000 rpm and at full throttle. Thanks to double injection, this is avoided and torque is increased by 1-3 Nm.

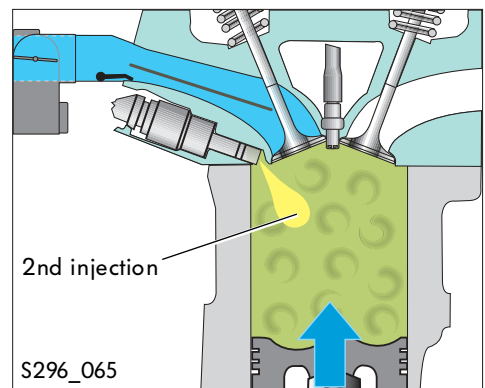
The first injection

The first injection happens when the crankshaft angle is at approx. 300° before TDC during the intake stroke. Here, approx. two thirds of the total amount is injected.



The second injection

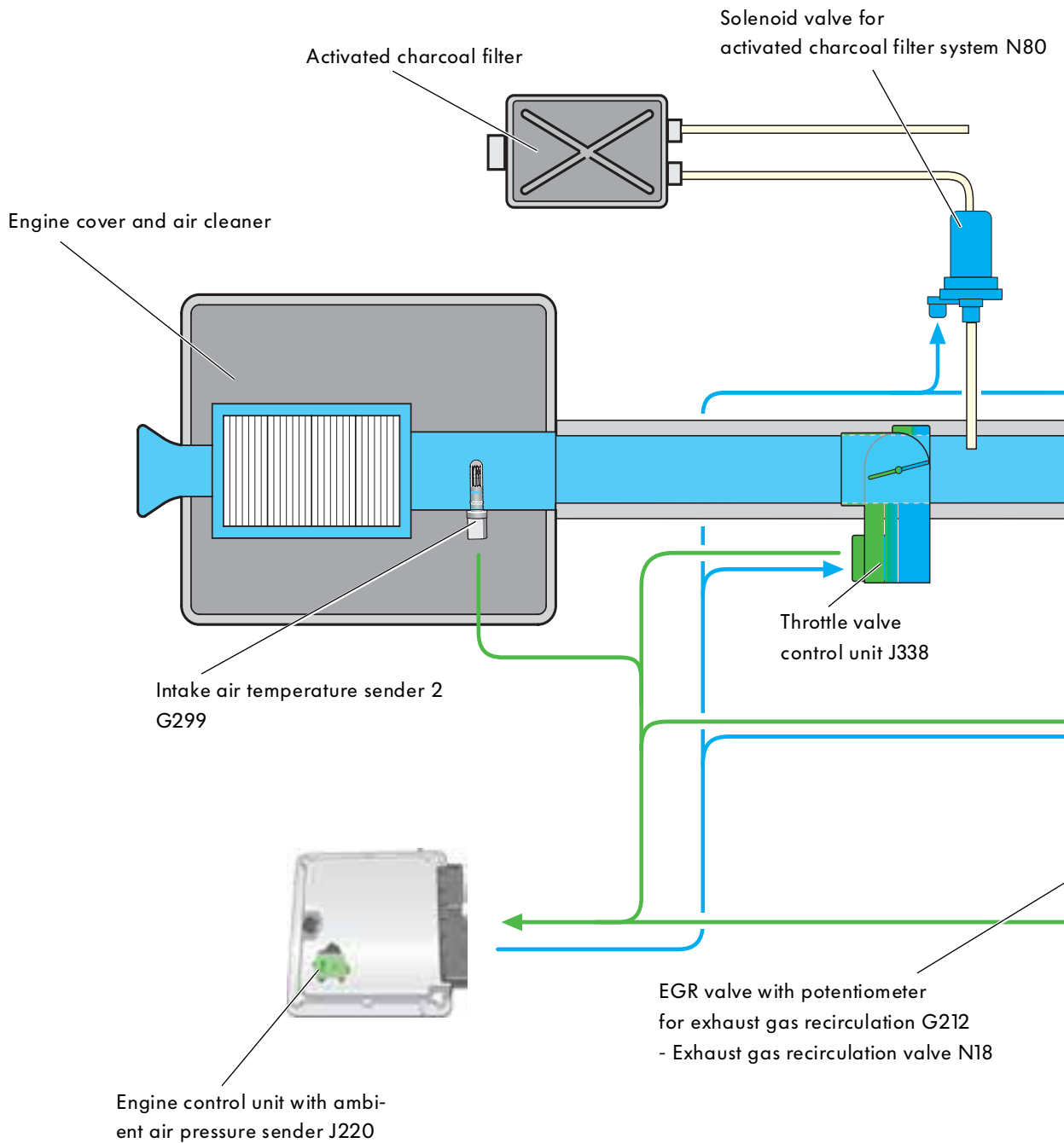
The remaining amount of fuel, approx. one third, is injected at about the start of the compression stroke. In this way, less fuel is built up on the cylinder wall. The fuel evaporates almost completely and mixture distribution is improved. Furthermore, there is also a richer mixture in the area of the spark plug compared to the rest of the combustion chamber. This improves combustion and reduces the risk of knocking.

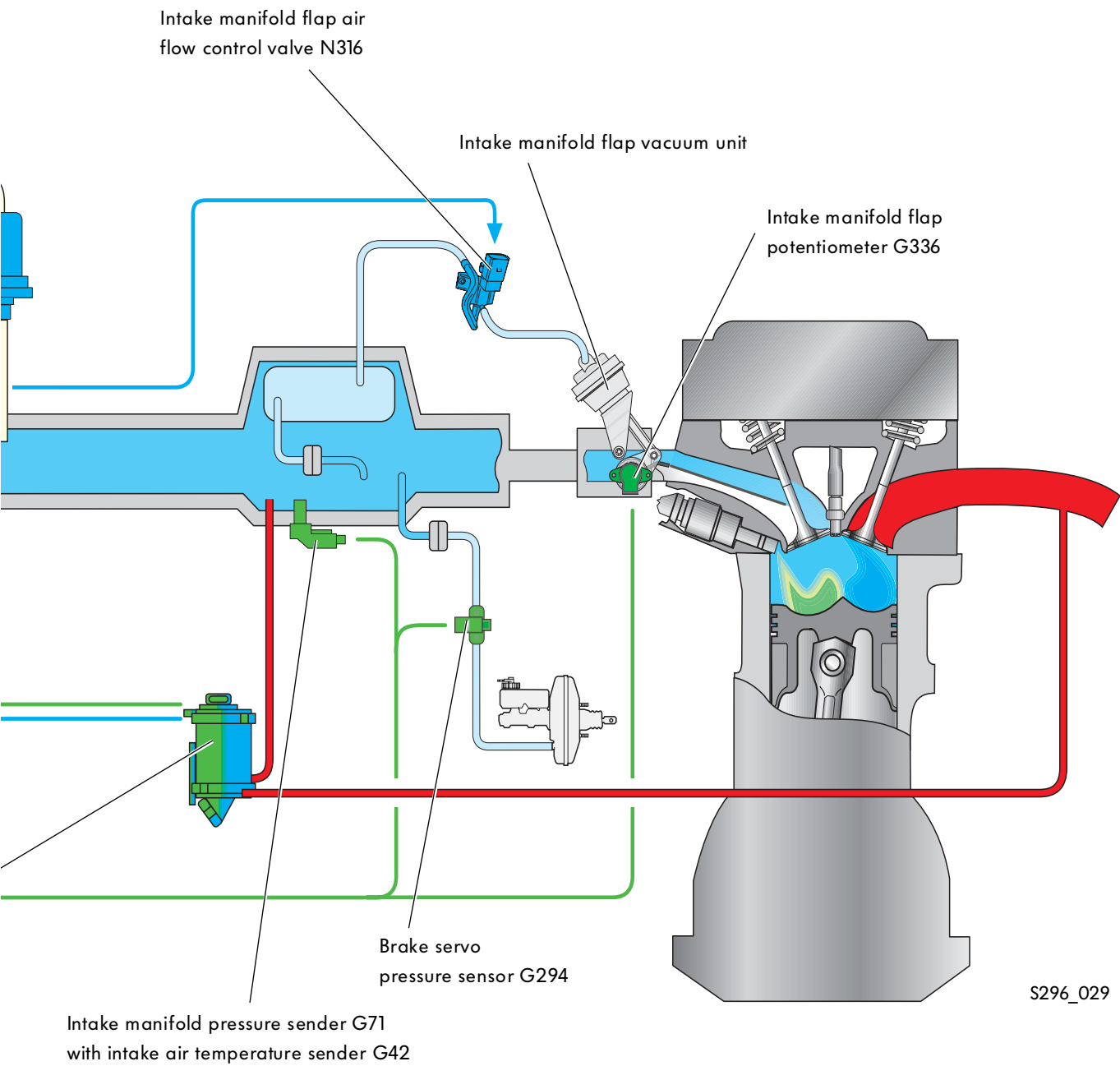


Engine management

Intake system

The intake system has been changed, compared to the Bosch Motronic MED 7.5.10 system, as far as engine load detection is concerned. The hot film air mass meter G70 has been discontinued. For calculation of the engine load, use is made of intake air temperature sender 2 G299 in the engine cover and the ambient air pressure sender in the engine control unit.





Engine management

Engine load detection

On FSI engines, engine load was previously measured using a hot film air mass meter. It is now calculated by the engine control unit as the hot film air mass meter has been discontinued. In place of this component, there is now an air intake temperature sender and an ambient air pressure sender.

Engine load is calculated from the following signals:

- Intake air temperature sender 2 G299
- Ambient air pressure sender (in engine control unit) J220
- Intake manifold pressure sender G71
- Intake air temperature sender G42
- Engine speed sender G28
- Throttle valve drive angle sender 1+2 G187 and G188
- Intake manifold flap air flow control potentiometer G336
- Hall sender G40 (for position of inlet camshaft on 1.6 ltr./85 kW FSI engine)

Intake air temperature sender 2 G299

The sender is installed in the engine cover in front of the throttle valve control unit.

Signal application

It detects the temperature of the fresh air drawn in and passes on this information to the engine control unit.

This then calculates the density of the fresh air.

Ambient air pressure sender

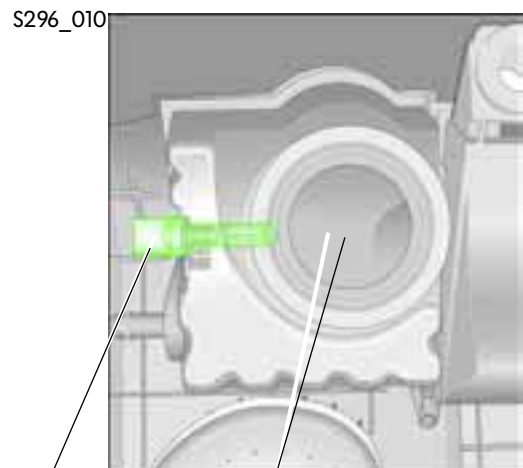
The sender is part of the engine control unit.

Signal application

It measures ambient air pressure and passes on a relevant signal to the engine control unit. This then detects the pressure at the throttle valve control unit.

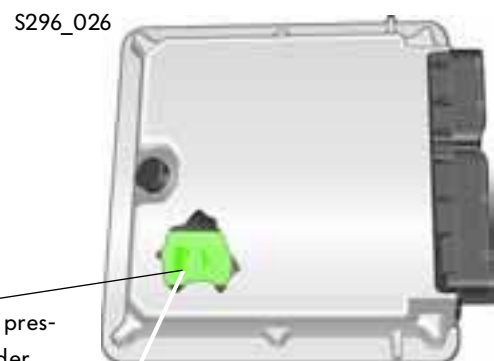
Effects of signal failure

If one or both of the senders fail in their function, emergency running mode is selected, engine load is calculated by the engine control unit using stored values.



Intake air temperature sender 2 G299

Air outlet to throttle valve control unit



Ambient pressure sender

Amount of exhaust gas recirculation

On FSI engines, a high amount of exhaust gas recirculation is necessary to reduce nitrogen oxide emissions. In order that the amount of exhaust gas can be pushed up to its limit, it has to be calculated precisely.

The following information is required for calculation of the amount of recirculated exhaust gas:

- Intake manifold pressure sender G71
- Intake air temperature sender G42
- Ambient air pressure sender (in engine control unit) J220 (to calculate counter pressure of exhaust gas)
- Exhaust gas temperature sender 1 G235
- The calculated engine load

This is how it works:

If exhaust gas is recirculated, intake manifold volume is increased by the recirculated exhaust gas and intake manifold pressure increases. The intake manifold pressure sender detects this pressure increase and sends a relevant voltage signal to the engine control unit. From this signal, the total amount is calculated (fresh air + exhaust gas). It deducts this total amount from the mass of fresh air from the calculated engine load and is thus left with the amount of exhaust gas.

Intake manifold pressure sender G71, intake air temperature sender G42

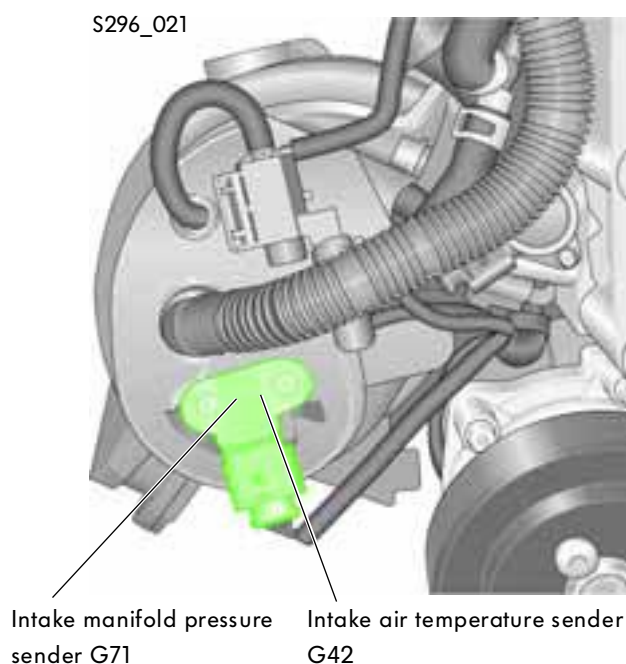
This combined sender is attached on the right (from seated driver's perspective) of the plastic intake manifold.

Signal application

It calculates the pressure and the temperature in the intake manifold and passes on a relevant signal to the engine control unit that, in turn, calculates the intake manifold volume.

Effects of signal failure

If one of the senders should fail in its function, the amount of exhaust gas is calculated by the engine control unit and the amount of recirculated exhaust gas is reduced based on the map.



Engine management

Supply on demand fuel system

The supply on demand fuel system is a further development of the 1.4 ltr./77 kW FSI engine. The electric fuel pump supplies only the correct amount of fuel required by the high pressure fuel pump. In this way, power drawn by the pump is reduced and fuel consumption is reduced.

Low pressure fuel system

In the low pressure fuel system, fuel pressure is at 4 bar during normal operation. For hot and cold starting, the pressure is increased to 5 bar.




It consists of the:

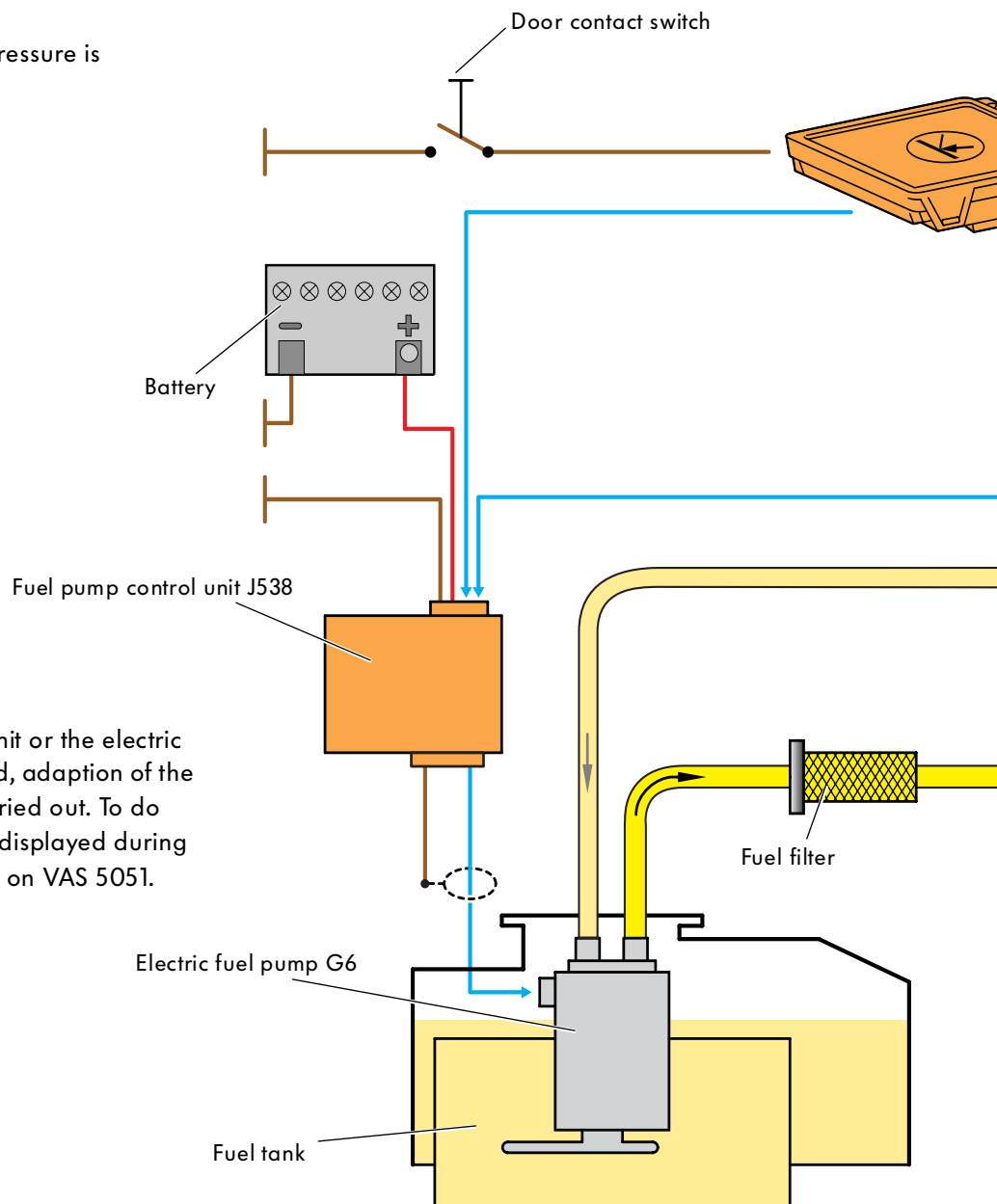
- Fuel pump control unit J538
- Fuel tank
- Electric fuel pump G6
- Fuel filter
- Fuel pressure sender, low pressure G410



If the engine control unit or the electric fuel pump are renewed, adaption of the new parts must be carried out. To do this, refer to the notes displayed during "Guided fault finding" on VAS 5051.

Colour codes/key

	No pressure
	4 to 5 bar
	50 to 100 bar

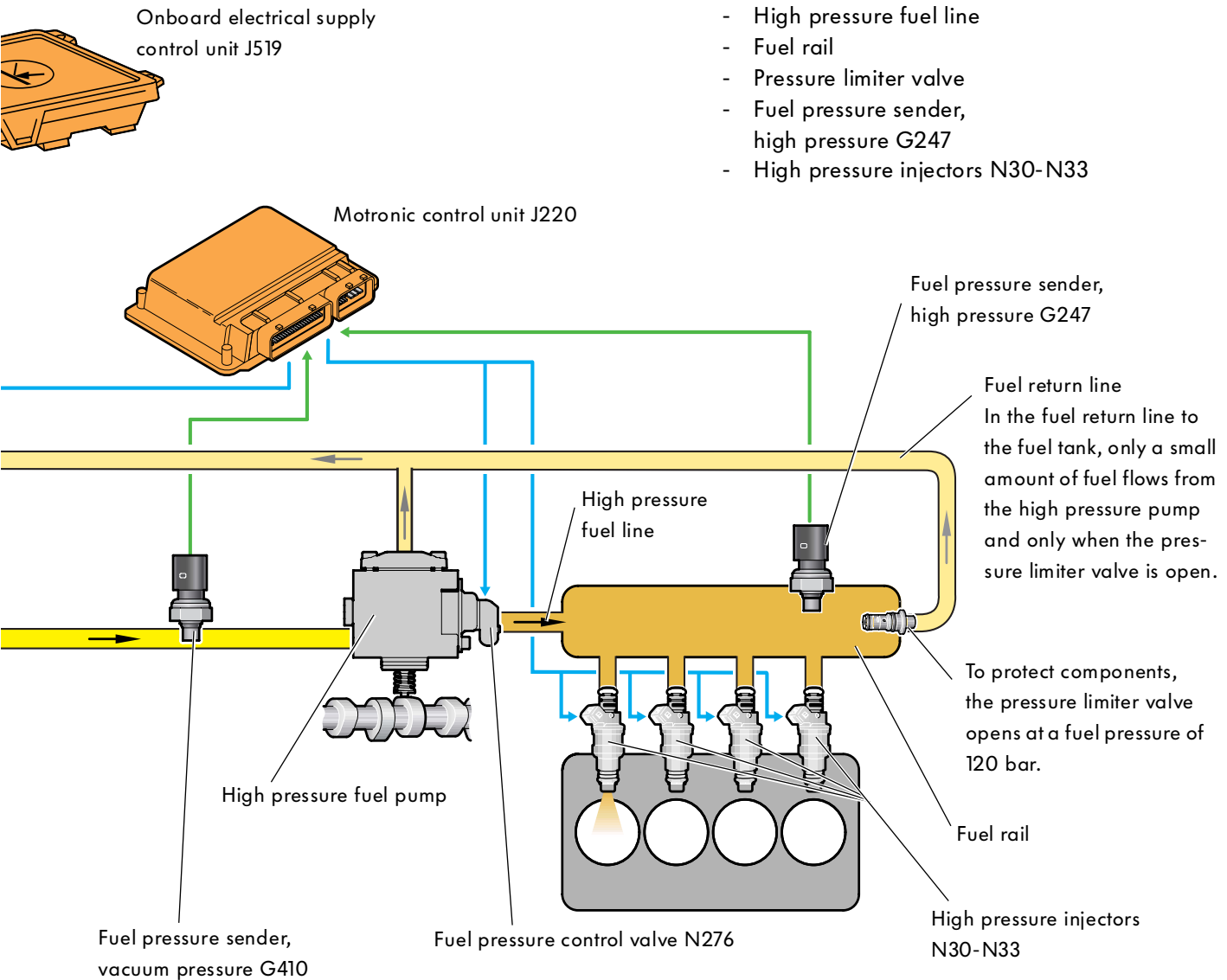


High pressure fuel system

In the high pressure fuel system, fuel pressure is between 50 and 100 bar.

It consists of the:

- High pressure fuel pump
- Fuel pressure control valve N276
- High pressure fuel line
- Fuel rail
- Pressure limiter valve
- Fuel pressure sender, high pressure G247
- High pressure injectors N30-N33



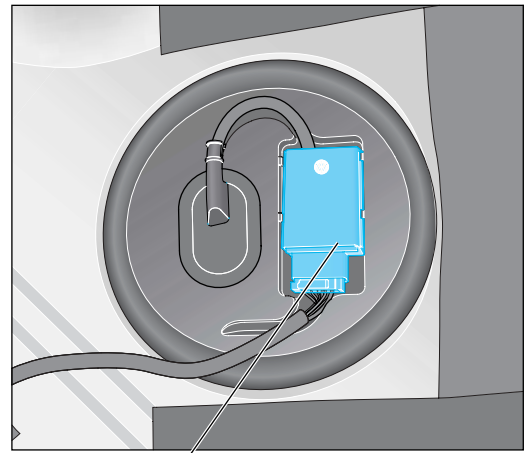
Engine management

Fuel pump control valve J538

The control unit can be found under the rear bench seat in the cover of the electric fuel pump.

Task

The control unit J538 actuates the electric fuel pump and regulates the pressure in the low pressure fuel system at a constant 4 bar. For hot and cold starting, the pressure is increased to 5 bar.



S296_031

Fuel pump control valve J538

Effects of signal failure

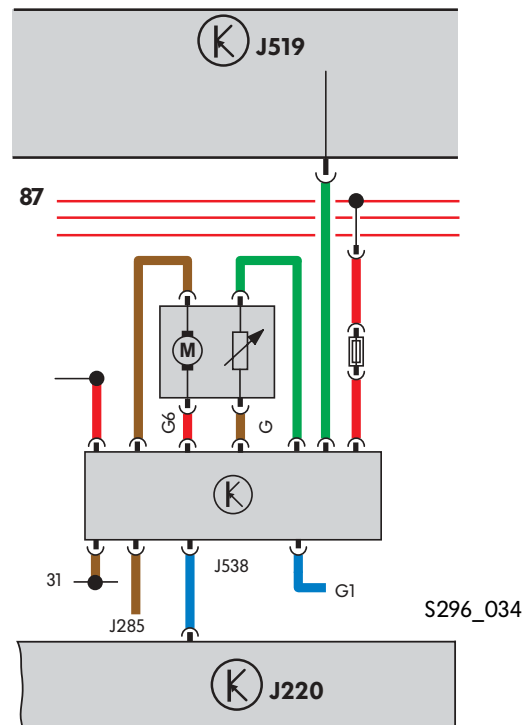
If the fuel pump control unit should fail in its function, the engine will not run.

Terminal diagram

- G Fuel gauge sender
- G1 Fuel gauge sender
- G6 Fuel pump

- J220 Engine control unit
- J285 Control unit with display unit in dash panel insert
- J538 Control unit for fuel pump
- J519 Onboard electrical system control unit

The fuel gauge sender is supplied with earth from the control unit with display unit in dash panel insert J285.



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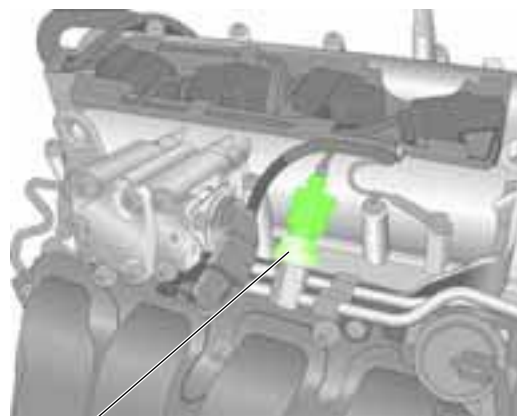
Fuel pressure sender, vacuum pressure G410

The sender is installed in the presupply line to the high pressure pump. It measures fuel pressure in the low pressure fuel system and sends a signal to the engine control unit.

Signal application

Use is made of this signal to regulate pressure in the low pressure fuel system.

- In normal operation to 4 bar and
- during cold and hot starting to 5 bar



S296_004

Fuel pressure sender, vacuum pressure G410

Effects of signal failure

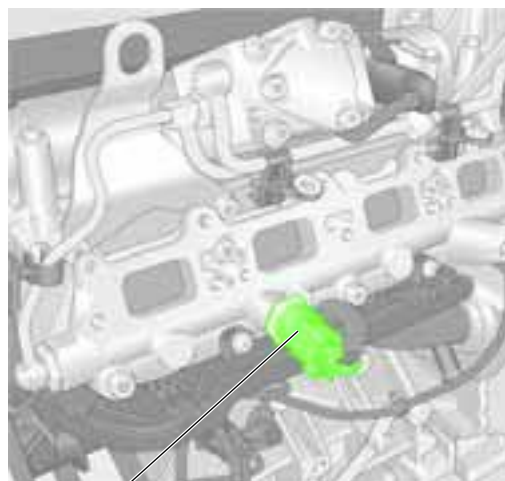
If the fuel pressure sender should fail in its function, the electric fuel pump will be actuated with a fixed PWM signal and the pressure in the low pressure fuel system is increased.

Fuel pressure sender, high pressure G247

The sender can be found on the intake manifold lower part and is screwed on the fuel rail. It measures fuel pressure in the high pressure fuel system and sends the signal to the engine control unit.

Signal application

The engine control unit evaluates the signals and, via the fuel pressure control valve, regulates the pressure in the fuel rail.



S296_027

Fuel pressure sender, high pressure G247

Effects of signal failure

If the fuel pressure sender should fail in its function, the control valve is actuated from the engine control unit with a fixed value.



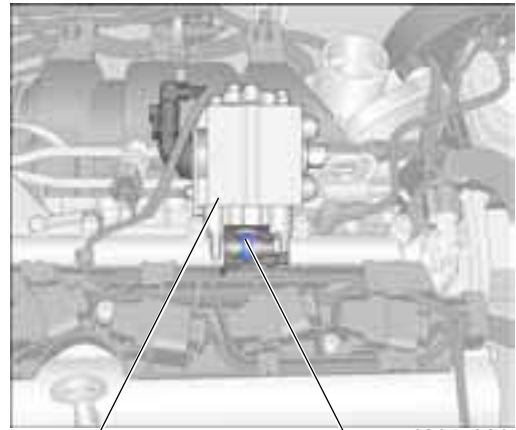
Engine management

High pressure fuel pump

It is screwed into the camshaft housing and is operated by a double cam on the inlet camshaft.

It has the task of building up fuel pressure in the high pressure fuel system by up to 100 bar.

The component consists of a quantity-controlled single cylinder high pressure pump. It pumps just the required amount of fuel to the fuel rail depending on a map, and just the required amount of fuel for injection. In this way, the output of the high pressure pump is reduced, which contributes to a saving in fuel.

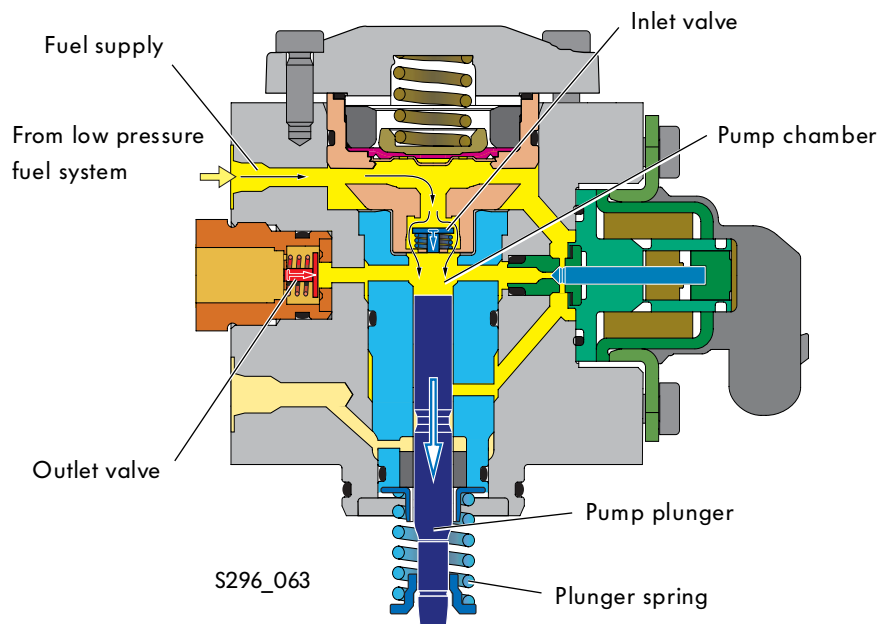


Single cylinder high pressure fuel pump

Double cams on the inlet camshaft

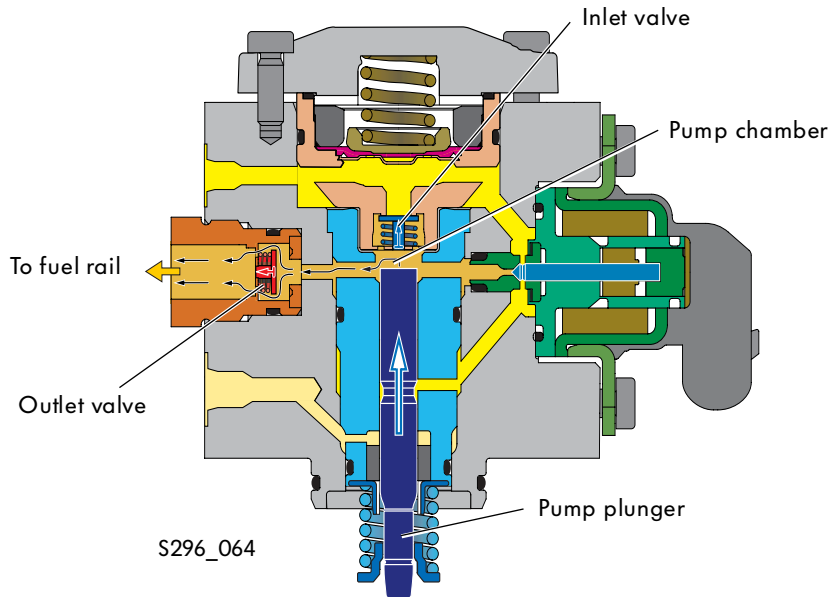
Suction stroke function:

The pump plunger is moved down by means of the plunger spring. In this way, volume is increased in the pump chamber and pressure is decreased. As soon as the pressure in the low pressure fuel system is greater than the pressure in the pump chamber, the inlet valve will open and fuel will begin to flow. The outlet valve is closed because fuel pressure is greater in the fuel rail than in the pump chamber.



Delivery stroke function:

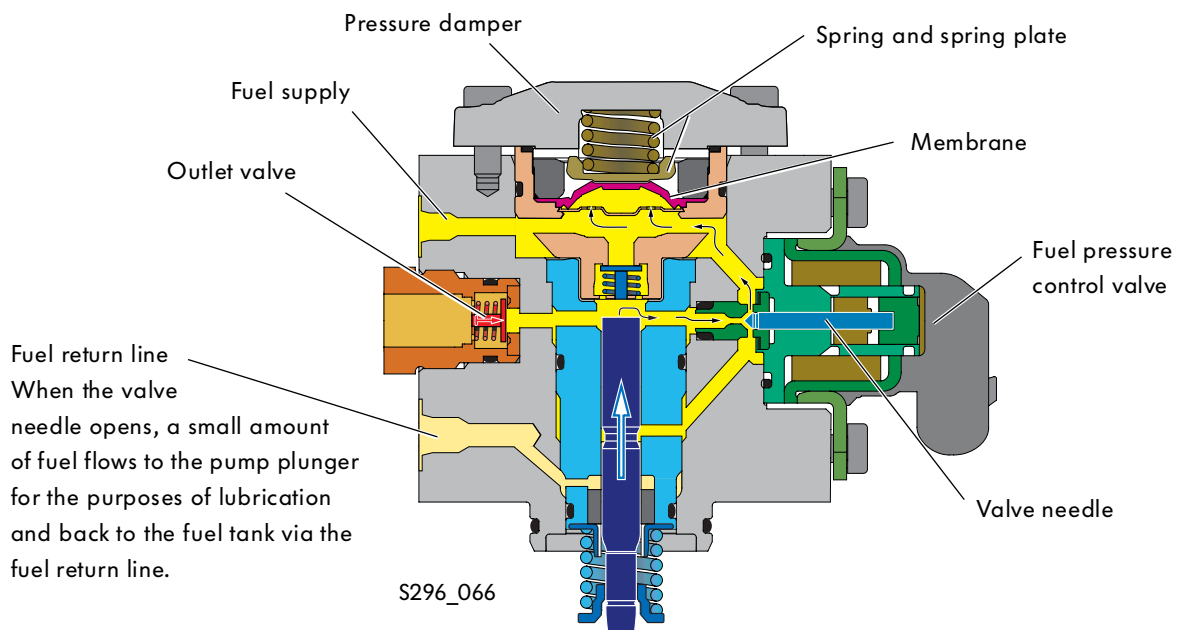
Once the pump plunger begins to rise, pressure increases in the pump chamber and the inlet valve closes. If pressure in the pump chamber is greater than pressure in the fuel rail, the outlet valve will open and fuel will be pumped to the fuel rail.



Fuel pressure regulation:

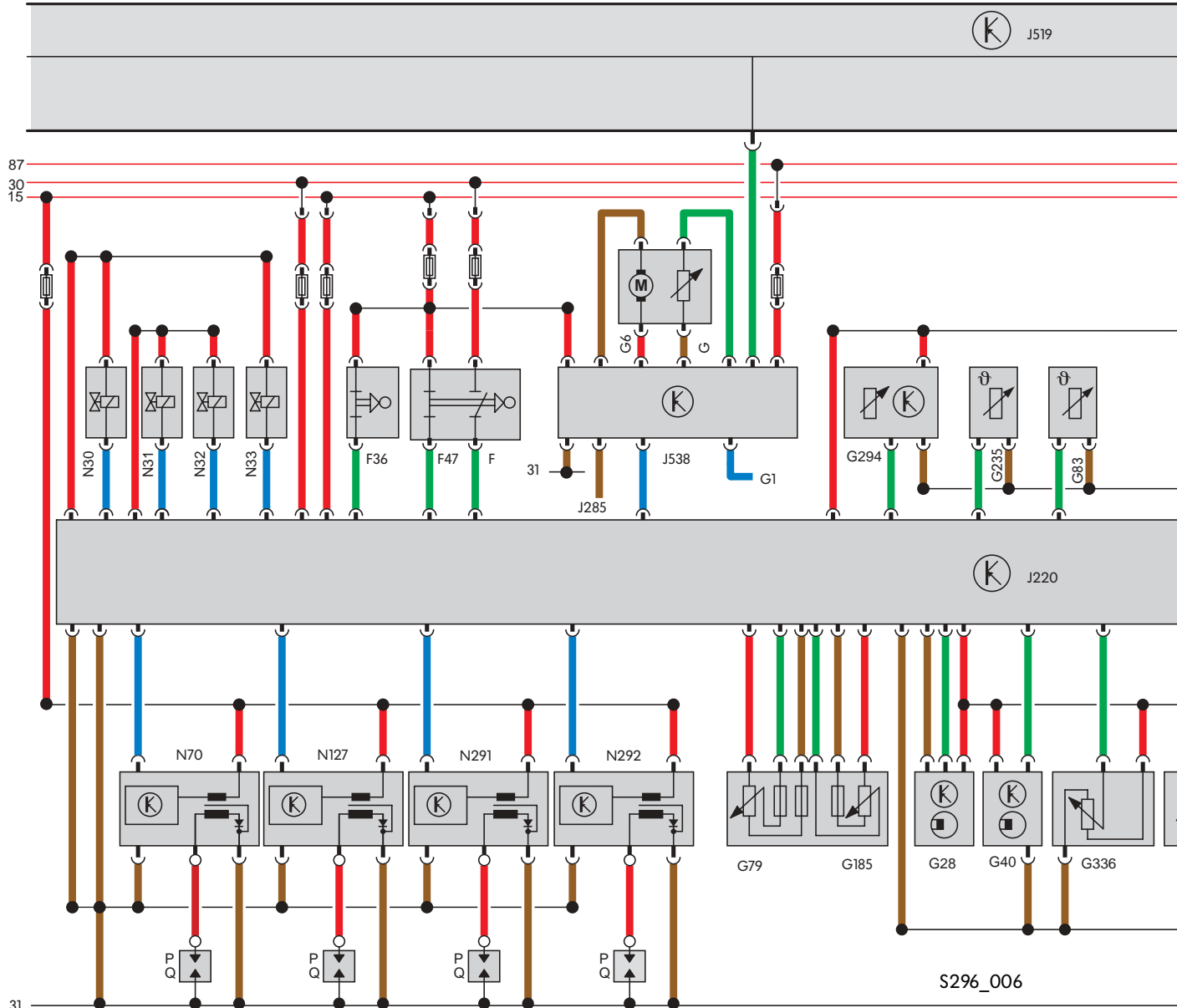
Once the required fuel pressure has built up, the fuel pressure control valve is charged and the valve needle is actuated electro-magnetically. This frees the way for fuel supply, high fuel pressure in the pump chamber is reduced and the outlet valve closes.

The pressure damper serves as a means of rapidly breaking down peaks in pressure when the control valve is opened and it prevents surges in pressure in the low pressure fuel system.



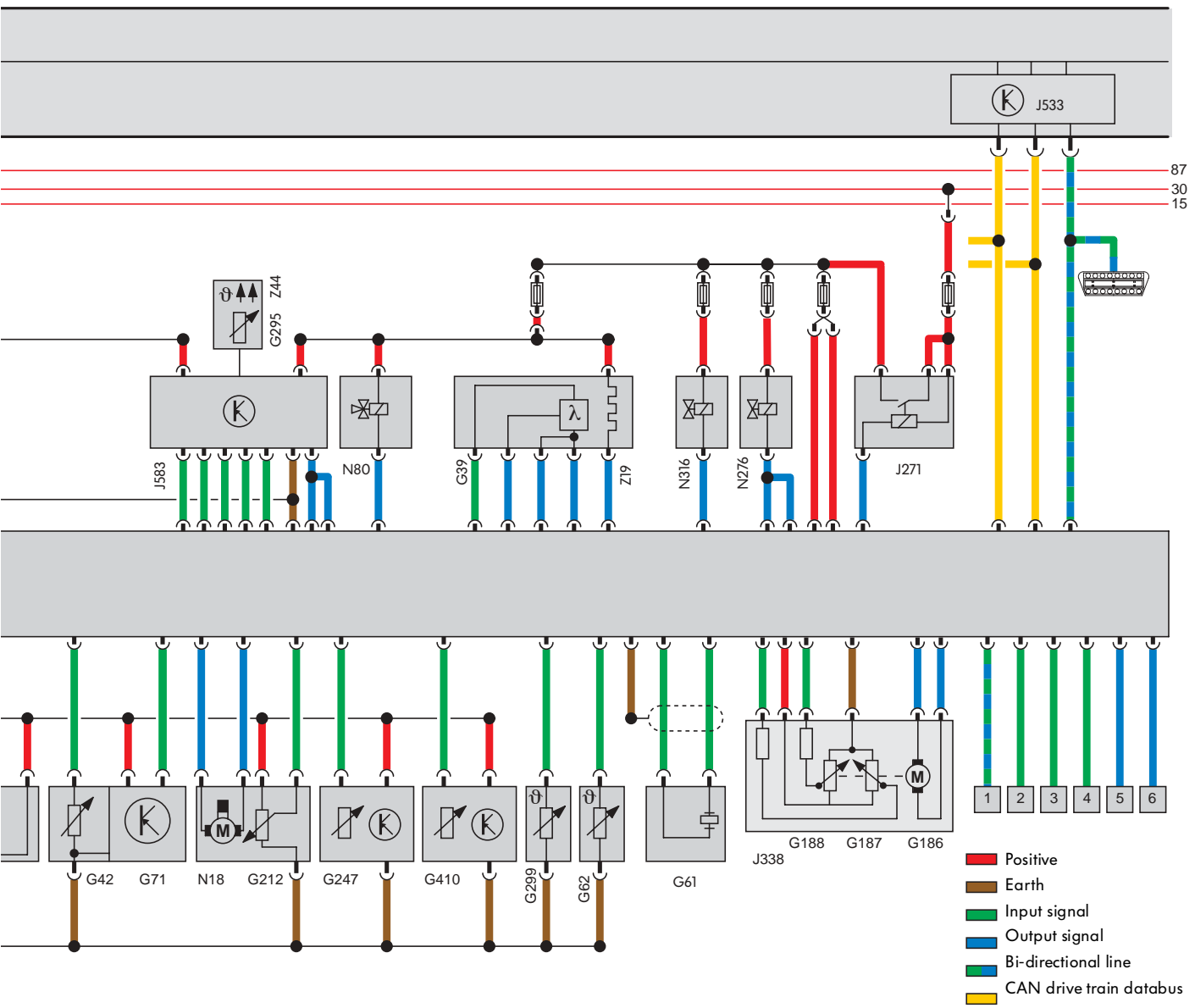
Engine management

Functional diagram (1.4 ltr./63 kW FSI engine)



- | | | | |
|------------|--|-------------|---|
| F | Brake light switch | G185 | Accelerator position sender 2 |
| F36 | Clutch pedal switch | G186 | Throttle valve drive |
| F47 | Brake pedal switch for CCS | G187 | Throttle valve drive angle sender 1 |
| G | Fuel gauge sender | G188 | Throttle valve drive angle sender 2 |
| G1 | Fuel gauge | G212 | Potentiometer for exhaust gas recirculation |
| G6 | Fuel pump | G235 | Exhaust gas temperature sender 1 |
| G28 | Engine speed sender | G336 | Intake manifold flap potentiometer |
| G39 | Lambda probe | G247 | Fuel pressure sender, high pressure |
| G40 | Hall sender | G294 | Brake servo pressure sensor |
| G42 | Air intake temperature sender | G295 | NOx sender |
| G61 | Knock sensor 1 | G299 | Air intake temperature sender 2 |
| G62 | Coolant temperature sender | G410 | Fuel pressure sender, vacuum pressure |
| G71 | Intake manifold pressure sender | J220 | Motronic control unit |
| G79 | Accelerator pedal position sender | J285 | Control unit with display unit in dash panel insert |
| G83 | Coolant temperature sender - radiator outlet | J338 | Throttle valve control unit |

S296_006



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- | | | | |
|-------------|---|------------|-------------------------|
| J271 | Motronic current supply relay | P | Spark plug connector |
| J519 | Onboard electrical supply control unit | Q | Spark plugs |
| J533 | Diagnosis interface for databus | Z19 | Lambda probe heating |
| J538 | Fuel pump control unit | Z44 | NOx sender heater |
| J583 | NOx sensor control unit | | |
| N18 | Exhaust gas recirculation valve | 1 | K/W lead |
| N30- | Injectors 1 - 4 | 2 | Heater actuation |
| N33 | | 3 | CCS switch |
| N70 | Ignition coil 1 with final output stages | 4 | Alternator terminal DFM |
| N80 | Solenoid valve 1 for activated charcoal filter system | 5 | Radiator control 1 |
| N127 | Ignition coil 2 with final output stages | 6 | Radiator control 2 |
| N276 | Fuel pressure control valve | | |
| N291 | Ignition coil 3 with final output stages | | |
| N292 | Ignition coil 4 with final output stages | | |
| N316 | Intake manifold flap air flow control valve | | |

Service

Self-diagnosis

Diagnosis

On vehicle diagnosis, testing and information system VAS 5051 or vehicle diagnosis and service information system VAS 5052, the following modes of operation are available to you:

- Guided fault finding (VAS 5051 only)
- Vehicle self-diagnosis

"Guided fault finding" checks, specific to the vehicle, all installed control units for fault entries and automatically creates an individual test chart.

This guides you to the cause of the fault with the help of ELSA information, such as current flow diagrams or workshop manuals.

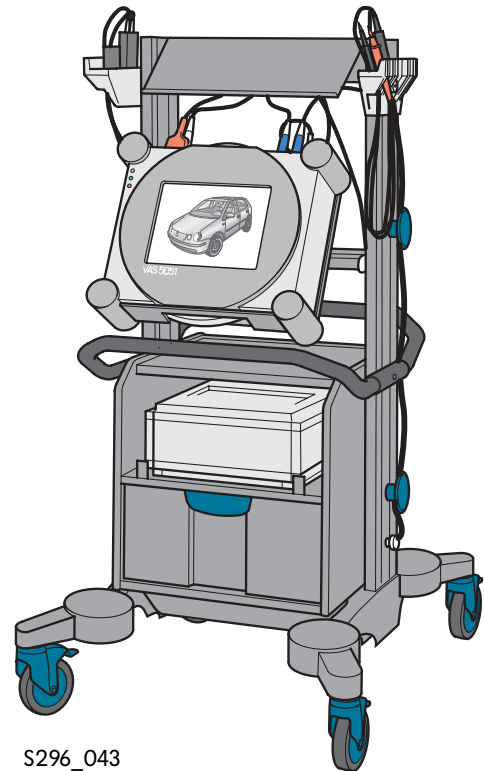
As an alternative, you also have the opportunity of creating your own test chart.

Via the function and component selection, the tests chosen by you will be included in the test chart and can be run through the diagnosis in any order.

"Vehicle self-diagnosis" can still be used in the normal way, but more detailed information via ELSA is not available.



S296_042










S296_043



Further information regarding "Guided fault finding" can be found in the VAS 5051 instruction manual.

Special tools

Designation	Tool	Application
T 10133/1 Puller	 S296_044	Together with the slide hammer, the puller serves as a means of removing the injectors.
T 10133/3 Slide hammer	 S296_046	
T 10133/4 Nylon cylinder brush	 S296_048	For cleaning cylinder head drilling.
T 10133/5 Taper tool	 S296_045	For fitting new seals on injectors.
T 10133/6 Assembly sleeve	 S296_047	The assembly sleeve is used to fit the seal over the taper tool onto the injector.
T 10133/7 Calibration sleeve	 S296_053	For adapting the seal to the injector.
T 10133/8 Calibration sleeve	 S296_054	For adapting the seal to the injector.



Test yourself

1. Which components are integrated in the engine cover?

- A. Hot film air mass meter G70
- B. Intake air temperature sender 2 G299
- C. Ambient air pressure sender in engine control unit J220
- D. Intake manifold pressure sender G71

2. Name the advantages of a dual circuit cooling system?

3. How many thermostats are installed in the coolant distribution housing and what are their function?

- A. One. Once the operating temperature has been reached, coolant flows through the radiator.
- B. Two. For separated flow of coolant, two thermostats are required, one for the cylinder block and one for the cylinder head.
- C. Three. In addition to the thermostats for the cylinder block and cylinder head, another thermostat is required for cooling of the electric exhaust gas recirculation valve.

4. What are the advantages of the regulated Duocentric oil pump?

- A. The output of the oil pump is reduced by up to 30 %.
- B. Wear in the oil is reduced as less oil is circulated.
- C. Build up of oil foam in the oil pump is minimised as oil pressure remains constant across the entire engine speed range.



5. Which additional operating mode is there when the 1.6 ltr./85 kW FSI engine is compared with the 1.4 ltr./63 kW FSI engine?
- A. Stratified injection
 - B. Homogeneous-lean
 - C. Homogeneous
 - D. Double injection, catalyst warm-up
 - E. Double injection, full throttle
6. Which component is not part of the high fuel pressure system?
- A. High pressure fuel pump
 - B. Fuel pressure control valve N276
 - C. High pressure fuel line
 - D. Fuel pump control unit J538
 - E. Fuel rail
 - F. Pressure limiter valve
 - G. Fuel pressure sender, high pressure G247
 - H. High pressure injectors N30-N33
7. Which components belong to the low fuel pressure system?
- A. Fuel pump control unit J538
 - B. Fuel tank
 - C. Pressure limiter valve
 - D. Electric fuel pump G6
 - E. Fuel filter
 - F. Fuel pressure sender, low pressure G410
8. Which statement is true?
- A. The fuel pressure control valve N276 is screwed into the plastic fuel rail and regulates fuel pressure in the high fuel pressure system.
 - B. The fuel pressure control valve N276 is screwed into the plastic fuel rail and regulates fuel pressure in the low fuel pressure system.
 - C. The fuel pressure control valve N276 is screwed into the single cylinder high pressure fuel pump and regulates fuel pressure in the high pressure fuel system.

The cylinder block is warmed up faster.
There is less friction in the crankshaft drive.
Cooling in the combustion chambers is better.

1. B.; 3. B.; 4. A., B., C.; 5. E.;
6. D.; 7. A., B., D., E., F.; 8. C.





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