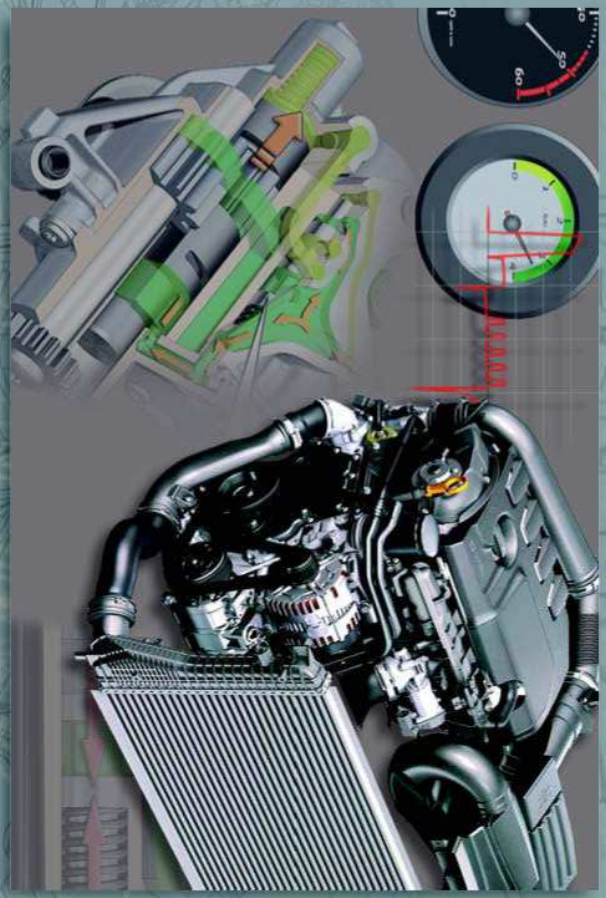
1.8 l and 2.0 l TSI ENGINES. Self Study Programme No. 132



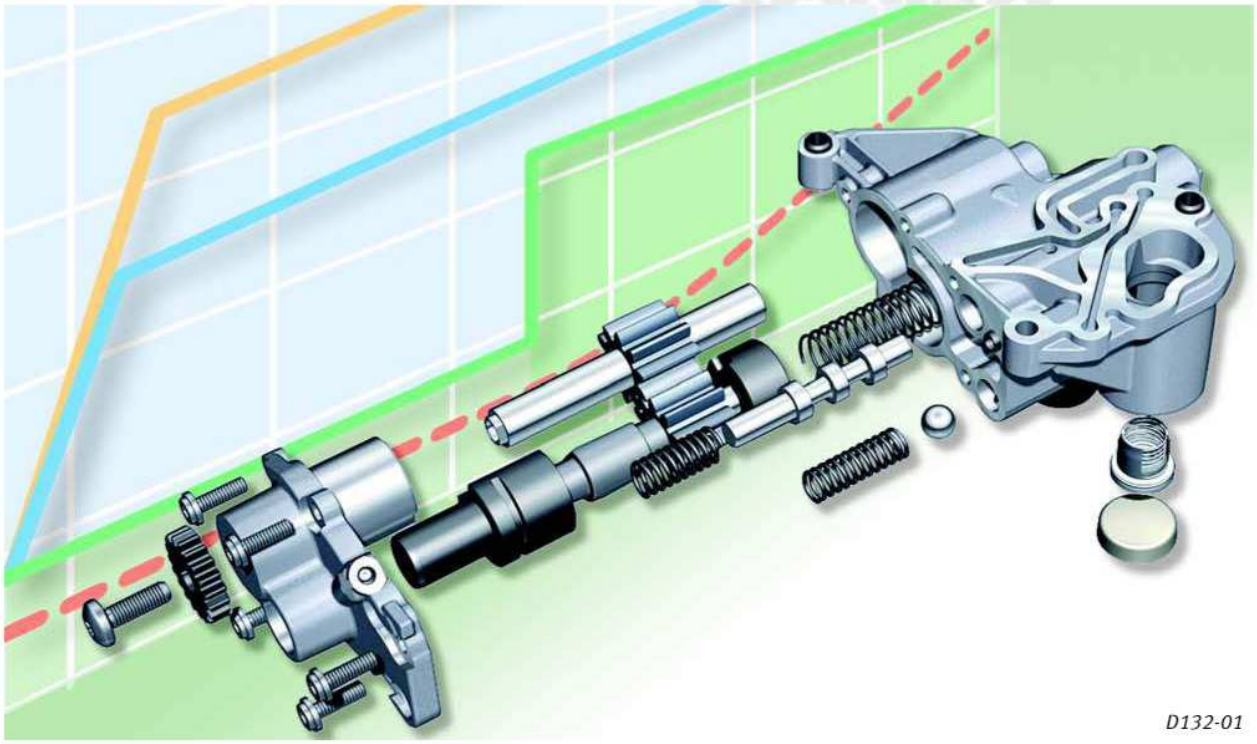
autoemoción

SEAT

SEAT incorporates the new 2.0 TSI powertrain with chain in the Altea, Altea XL and Leon models. This engine, belongs to the EA888 family and is based on the already-known 1.8 TSI with chain (BZB).

This Self-study Programme deals with both engines, the 1.8l and the 2.0l, because the changes the 1.8l engine has been subject to have also been included in the 2.0l engine. Regarding the mechanicals, this Self-study Programme deals with the most remarkable changes that affect the lubrication circuit. About all the electronic management sensors and actuators are described as well as the functions assumed by the control unit.

This new evolution of the EA888 family -in line with the current trend- is aimed at saving on fuel consumption and at reducing polluting emissions. It may be said that the goal has been achieved, as both engines comply with the EU5 emissions standard.



D132-01

Note: *The exact instructions for checking, adjusting and repairing are included in the ELSA application and in the VAS 505X guided diagnostics.*

SUMMARY OF CONTENTS

INTRODUCTION

D132-02

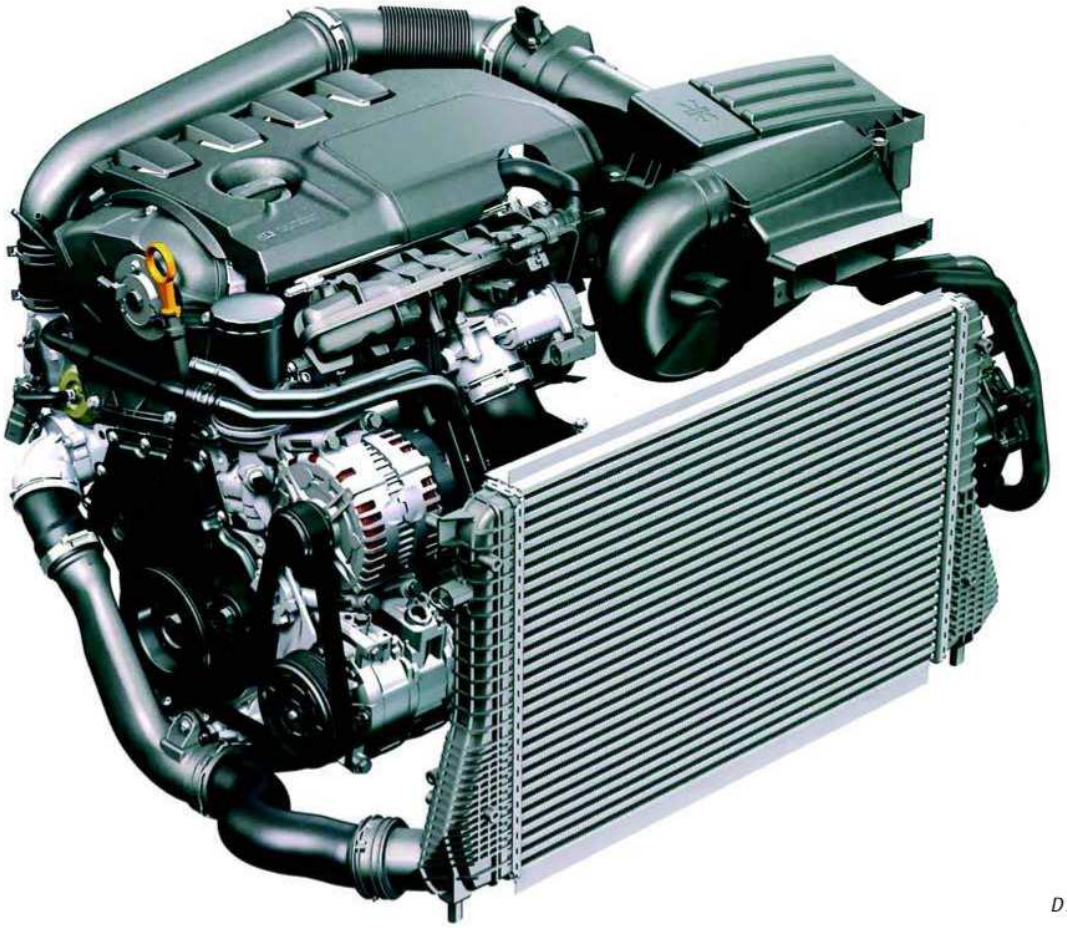
1.8 L TSI ENGINE

The 1.8 l TSI engine with **designation letters CDAA** is the result of introducing a series of changes to the initial version, the BYT engine.

The changes implemented are aimed at reducing internal friction, basically focused on: engine support bearings, pistons, piston rings, oil pump and vacuum pump.

Of all these changes, the oil pump incoporates the most new features, as is explained in this Self-study Programme.

Level of development:	Designation letters:	Emmission standards:
0	BYT	EU 4
1	BZB	EU 4
2	CDAA	EU 2/EU5



D132-03

2.0 L TSI ENGINE

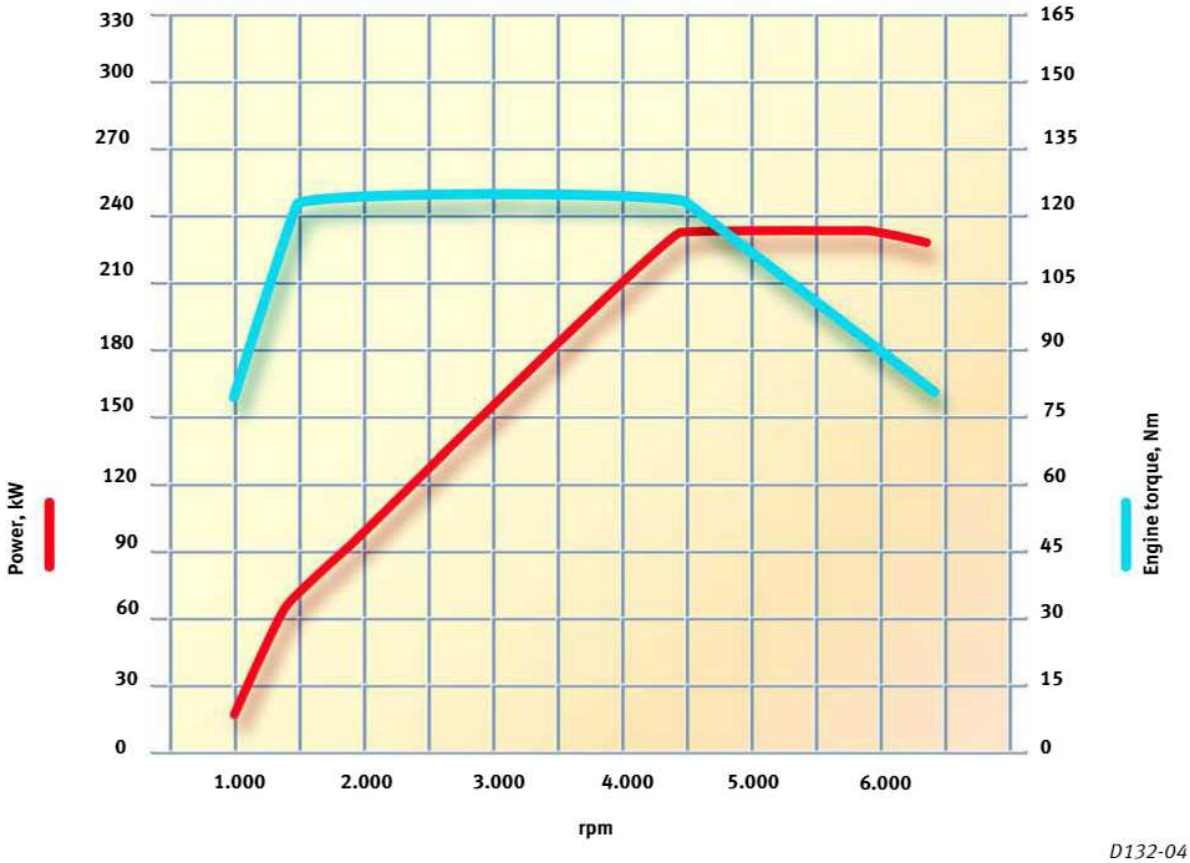
The **engine designation letters** of the 2.0 l TSI engine are **CCZB**.

This engine has been developed form the 1.8 l TSI engine, with which it shares many features such as the oil pump.

Also, the fuel high pressure pump. is different to the one used in the 1.8 l CDAA engine, as described in this Self-study Programme.

Level of development:	Designation letters:	Emmission standards:
-	-	-
-	-	-
2	CCZB	EU5

TECHNICAL DATA



D132-04

TECHNICAL DATA

Designation letters .....**CDAA**

Capacity ..... 1,789 cm^3

Bore x Stroke ..... 82.5 x 84.1 mm

Compression ratio 9.6:1

Maximum torque .... 250 Nm at 1500 - 4500 rpm

Maximum power .....118 kW at 4500-6200 rpm

Injection and ignition system:

Motronic MED 17.5

Firing order 1-3-4-2

Octane rating .....95-98 octanes[1]

Emissions standard: EU2/5

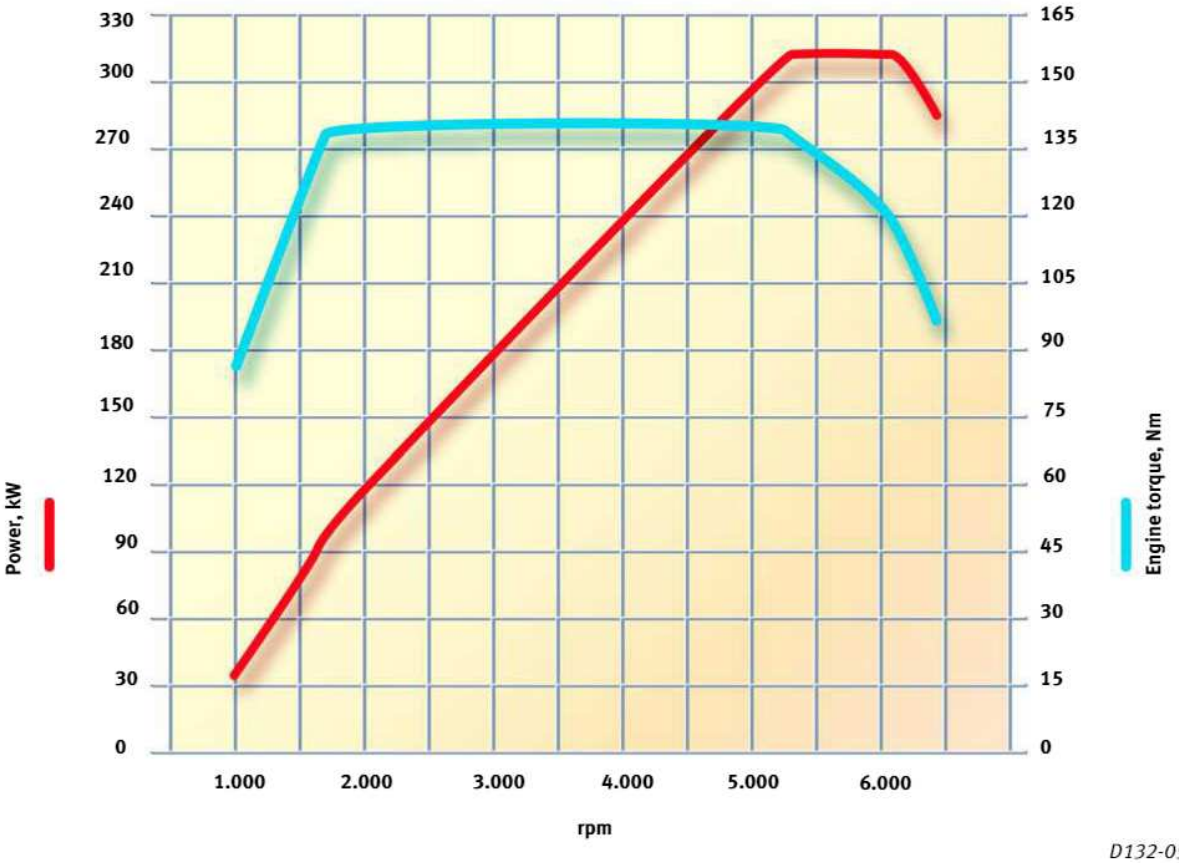
[1] *In exceptional circumstances 91 octane rating can be used, however accepting some power loss.*

The maximum engine torque range **250 Nm**, of the 1.8 l TSI engine runs from 1500 rpm up to 4500 rpm.

Torque delivery at low revs results in a great elasticity engine.

Systems such as the turbocharger, the variable inlet timing, and the direct injection in the combustion chamber allow the engine achieve an optimum torque curve.

The engine reaches a maximum power output of **118 kW** at 4500 rpm, which remains stable up to 6200 rpm, where the injection cut-off takes place.



D132-05

TECHNICAL DATA

Designation letters ..... **CCZB**

Capacity ..... 1,984 cm^3

Bore x Stroke ..... 82.5 x 92.8 mm

Compression ratio 9.6:1

Maximum torque .... 280 Nm at 1700 - 5200 rpm

Maximum power .....155 kW at 5300-6200 rpm

Injection and ignition system:

Motronic MED 17.5

Firing order 1-3-4-2

Octane rating .....95-98 octanes[1]

Emissions standard: EU5

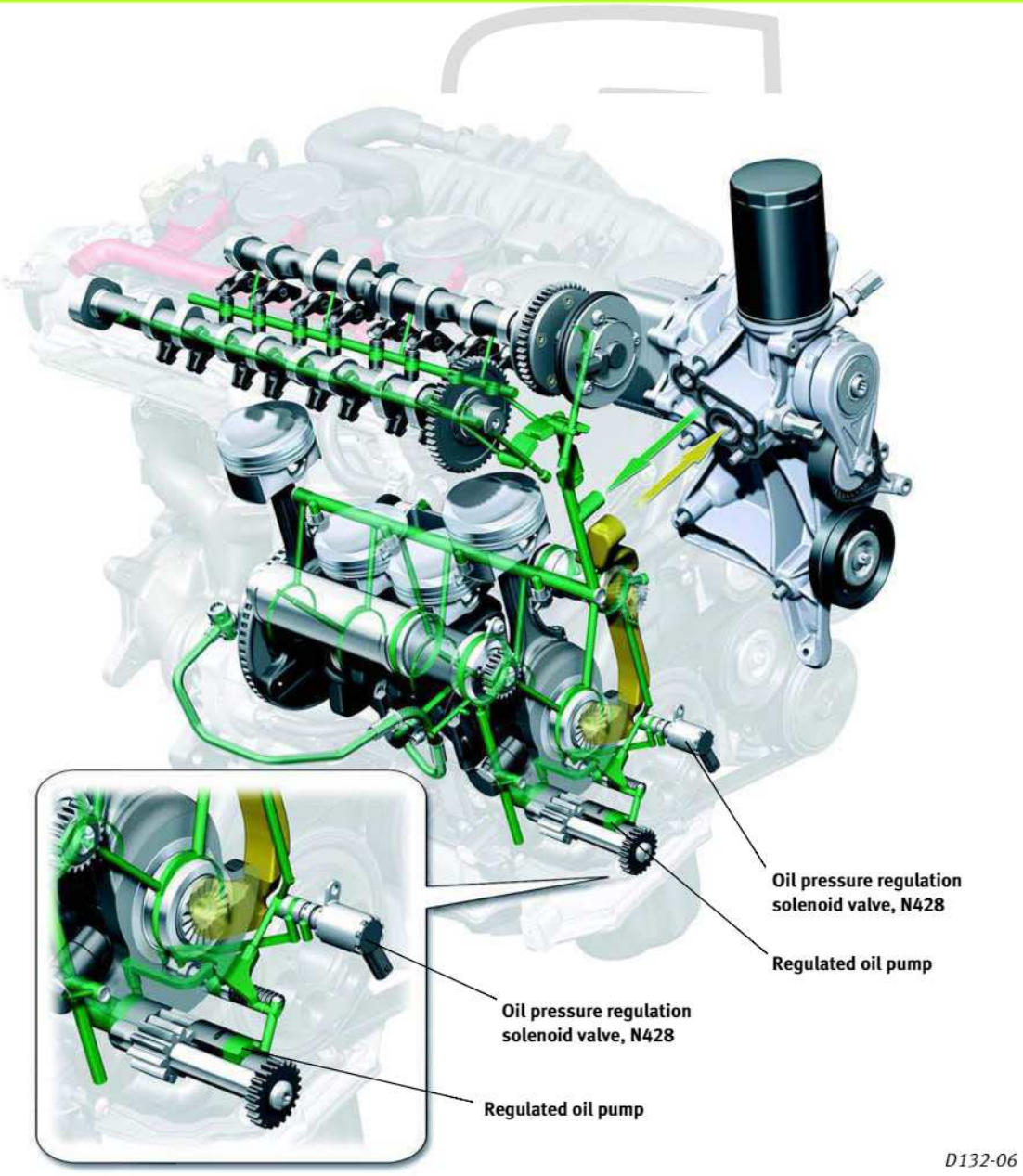
[1] *In exceptional circumstances 91 octane rating can be used, however accepting some power loss.*

The 2.0 l TSI engine is directly based on the 1.8 l TSI engine.

Higher capacity is achieved by increasing the stroke. Such a capacity increase implies higher torque delivery, which in this engine reaches a maximum value of **280 Nm**. This maximum value remains constant from 1700 rpm to 5200 rpm.

Maximum power output of **155 kW** is delivered from 5200 rpm up to the injection cut at 6200 rpm.

LUBRICATION CIRCUIT



The 1.8 l and 2.0 l TSI engines basically have the same oil circuit as its predecesor 1.8 l TSI EVO 1 (BZB), but with an important exception: The oil pump.

The 1.8 l (CDAA) engine and the 2.0 l (CCZB) engine use a **regulated oil pump**.

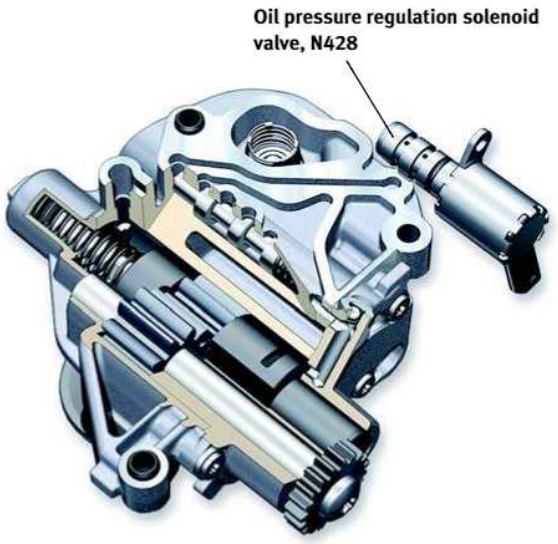
Now, the electronic management of these engines determines the lubrication needs at all times and regulates the flow driven by the pump by energising the **oil pressure regulation solenoid valve, N248**.

This is how optimum lubrication and fuel saving is obtained.

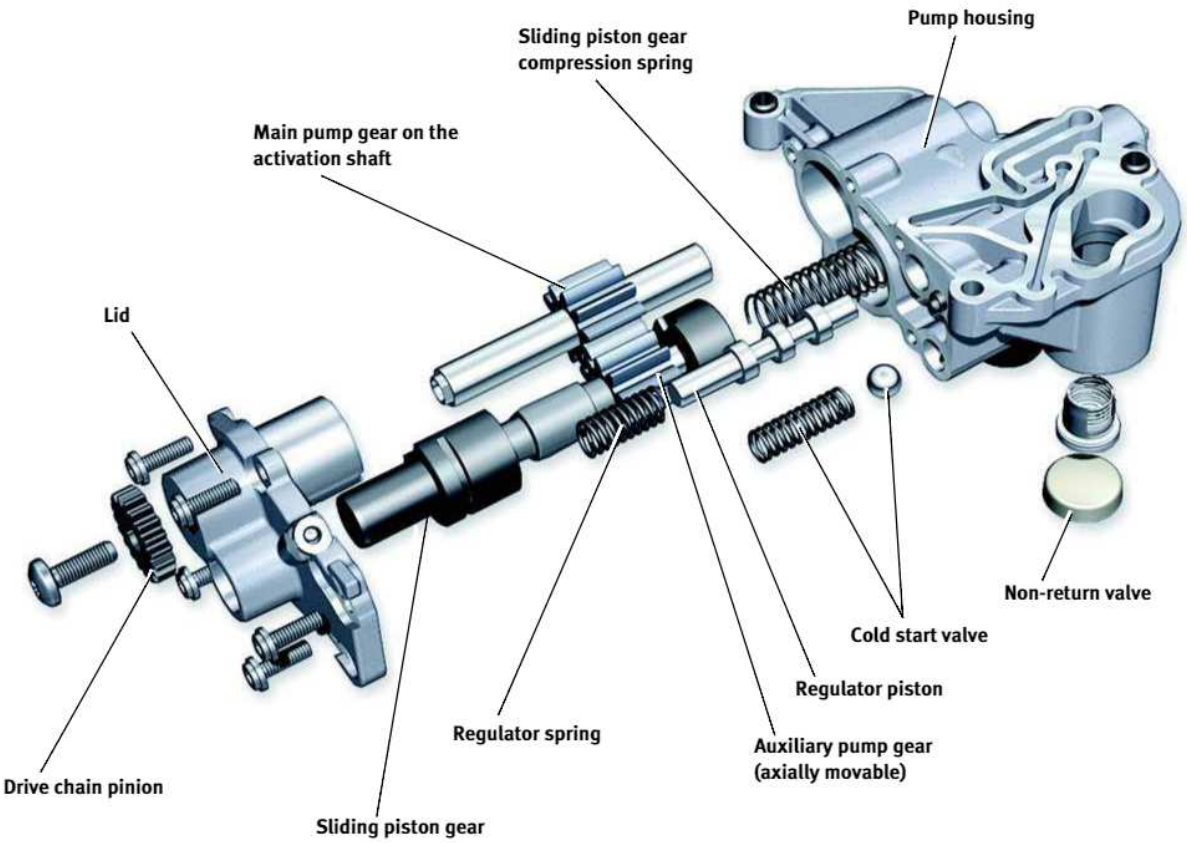
REGULATED OIL PUMP

The new regulated oil pump is driven by a chain, directly from the crankshaft. It is more efficient as it is capable of **adapting the flow** of oil **to the engine operation needs** This contributes to saving fuel.

For more efficient operation, the **secondary gear** of the pump **moves axially**. This is how it is possible to drive a larger or smaller amount of oil, depending on the needs.

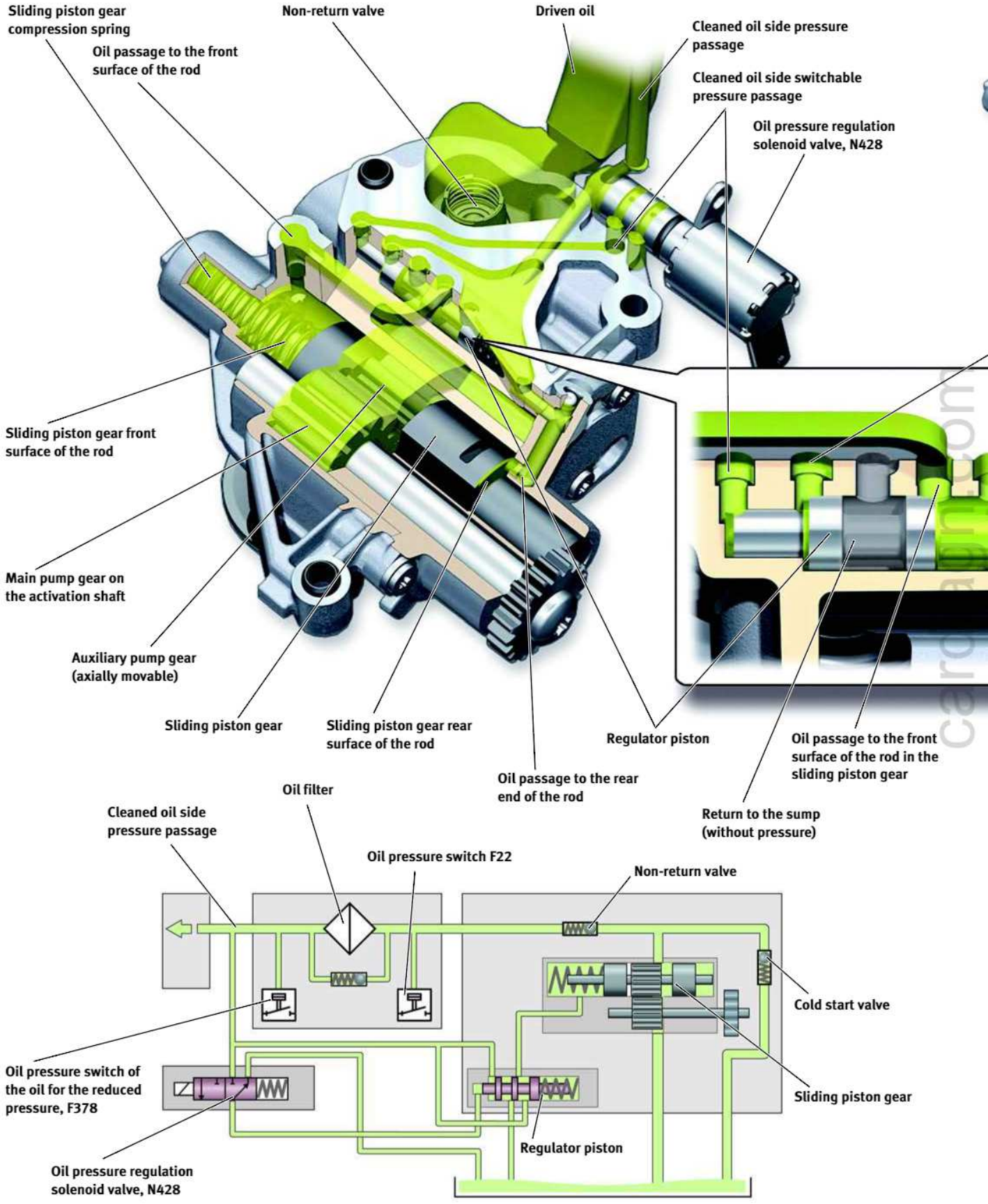


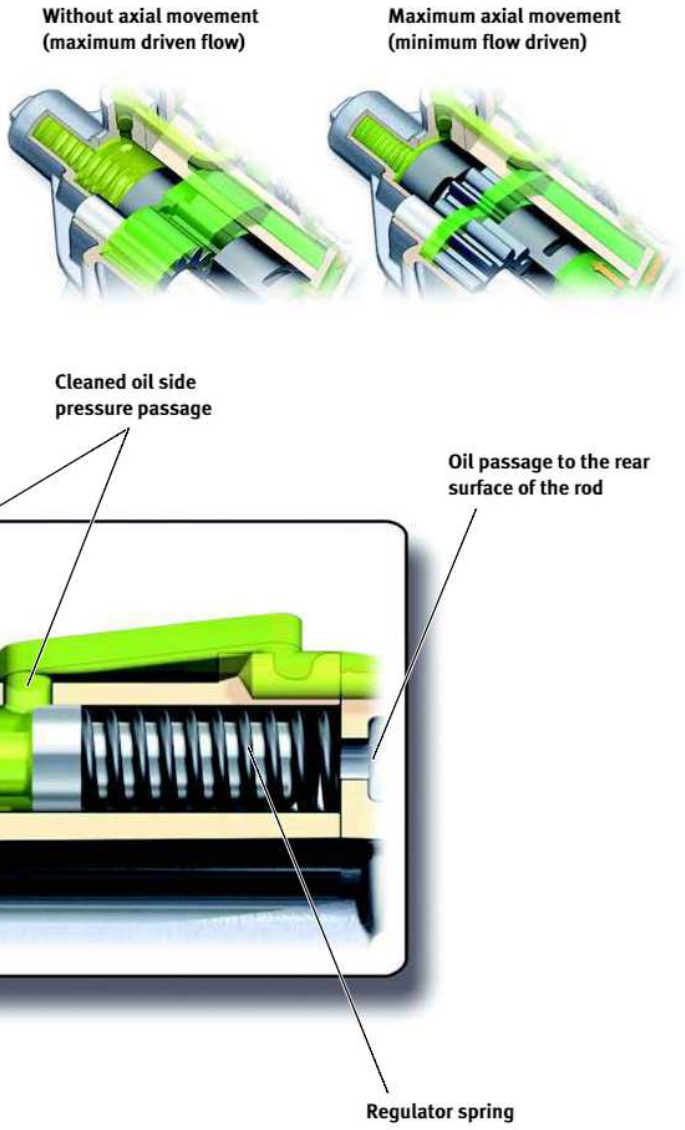
D132-07



D132-08

LUBRICATION CIRCUIT





D132-09

ARCHITECTURE AND OPERATION

The **components** that make up the **regulated oil pump** are:

- One non-return valve.
- One cold start valve.
- One regulator piston.
- One primary pump gear on the activation shaft.
- One secondary pump gear, which moves axially and is a single unit with the sliding piston.
- Numerous internal passages
- And, an oil pressure regulation solenoid valve, N248, screwed onto the engine block.

It **works** as a **two-gear pump** (main and auxiliary gear). The secondary gear is a free-wheeling gear and is driven by the main gear, which is driven by the crankshaft through a chain. As they move, the pinions draw in the oil from the sump and drive it towards the oil filter module.

A feature of the oil pump is that the **auxiliary gear moves axially** to vary the driven flow of oil.

When both gears are lined up the pump drives the maxiumum flow.

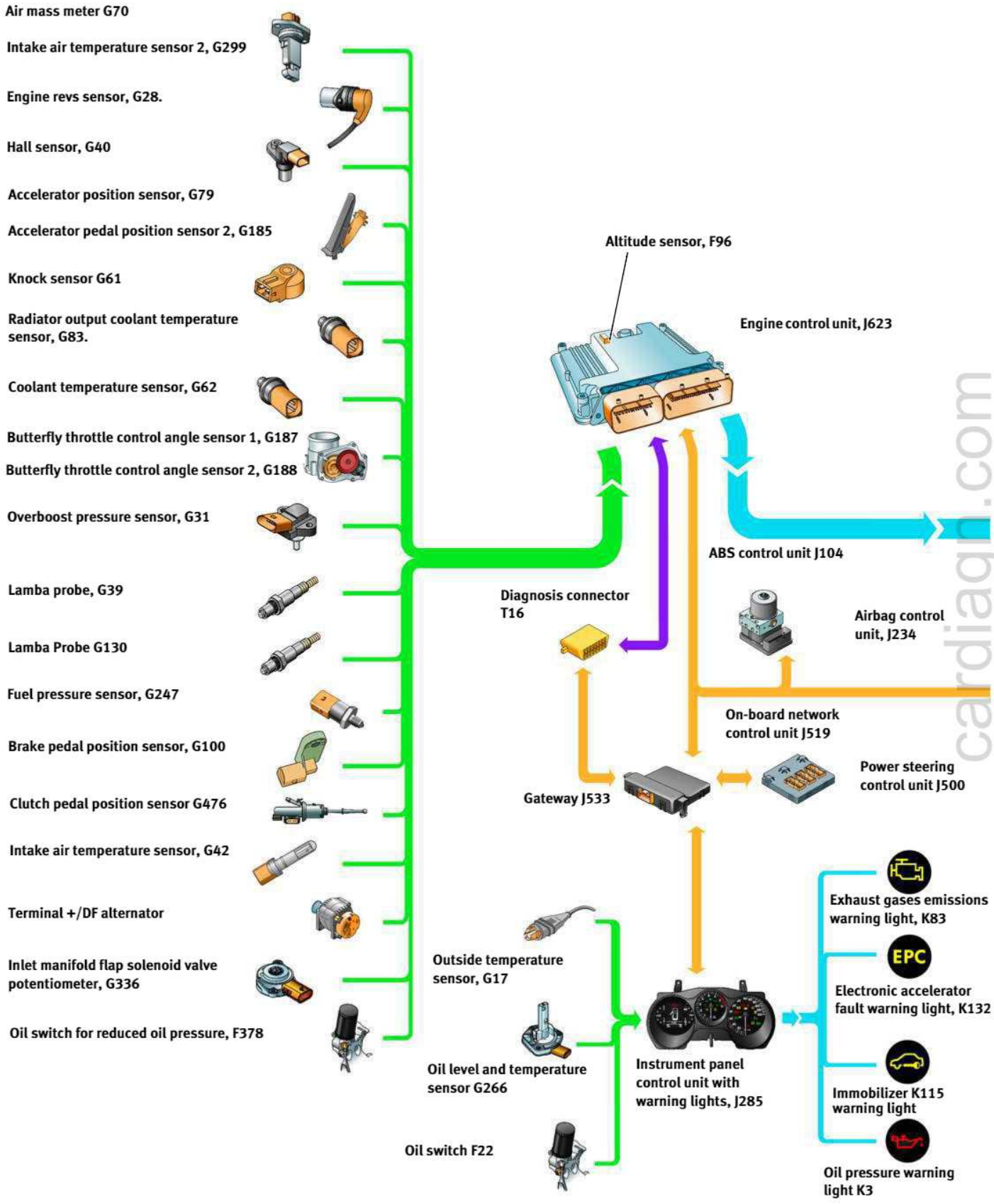
When the auxiliary gear moves to its maximum, the pump drives the minimum flow.

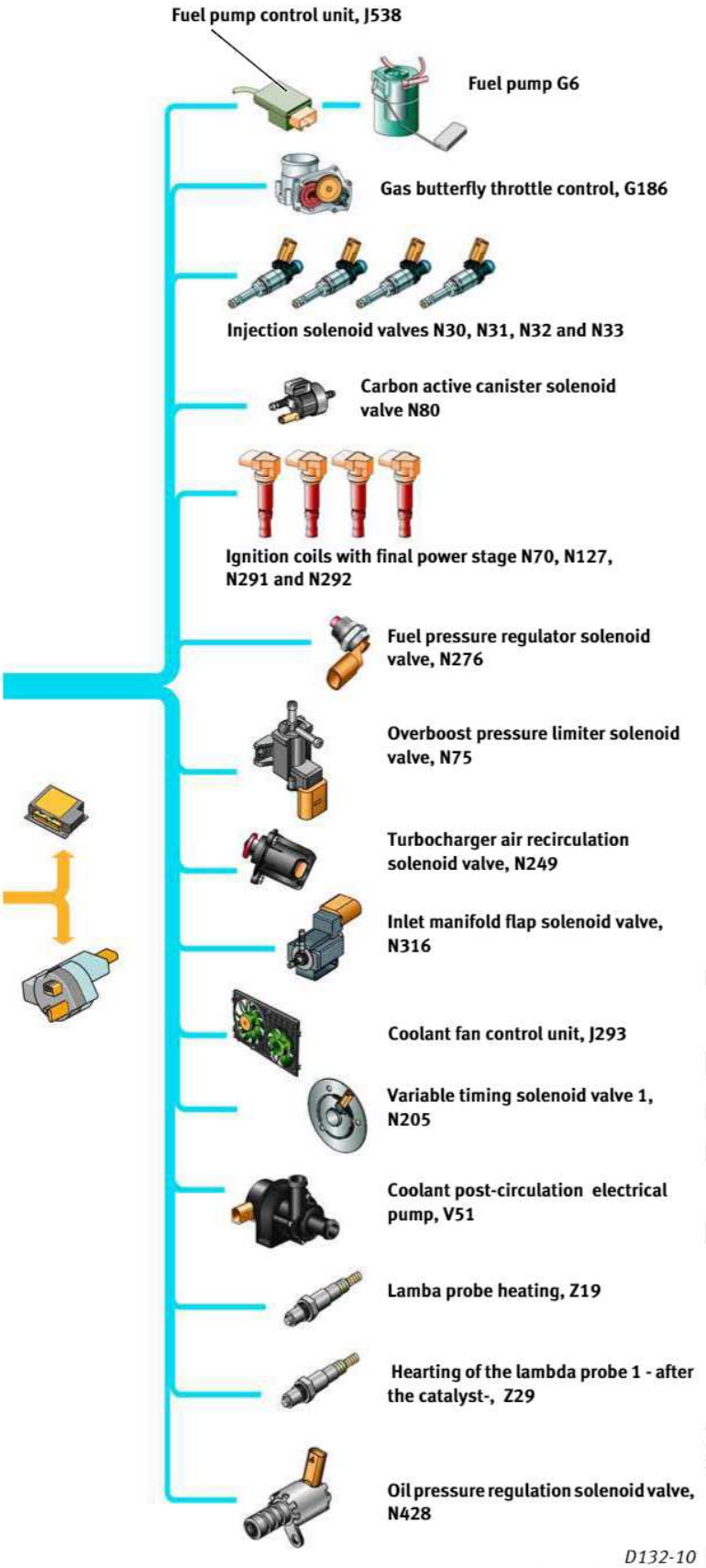
The movement of the auxiliary gear is achieved by the pressure generated by the pump after the oil has been cleaned in the filter. The oil pressure is managed by the engine control unit through the energising of the **oil pressure regulation solenoid valve, N248,** which also acts on the **regulator piston**.

Depending on the driving conditions, the oil pressure reaches the front surface or the rear surface of the **sliding gear piston** in order to vary the axial position of the auxiliary gear and therefore regulate the driven flow.

***Note**: For further information about the mechanicals consult SSP nº 401: "1.8l TFSI engine with chain"*

SYSTEM LAYOUT

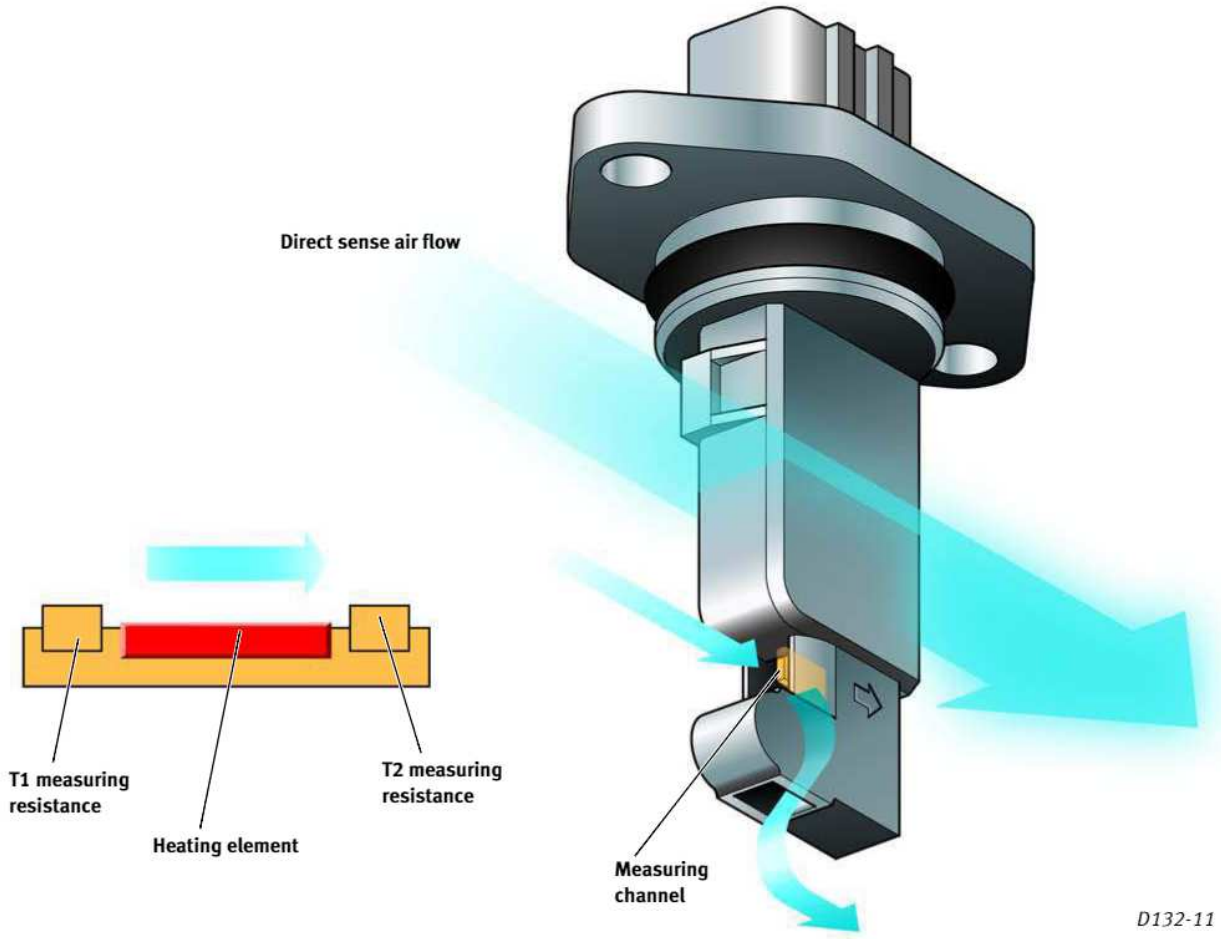




D132-10

The 1.8 and 2.0 TSI engines incorporate the Motronic MED 17.5. engine management system. This management assumes the following functions.

- Fuel injection.
- Ignition.
- Guided air intake.
- Stabilising of idling.
- Carbon active system.
- Variable Timing.
- Overboost pressure.
- Oil pressure regulation.
- EOBD.
- Self-diagnosis.



D132-11

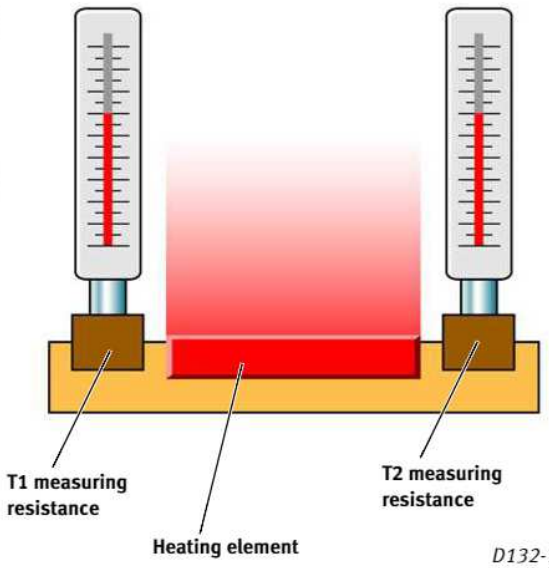
AIR MASS METER, G70

It is a "hot film" air mass meter developed by Hitachi.

It has a measuring channel through which part of the air flows.

The measuring sensor is placed in the channel and it is made of a glass plate with **a heating element** embedded in central position, and **two measuring resistances T1** and **T2** on the sides.

As there is no air current, the temperature generated by the heating element rises lineally to both ends of the plate, and both measuring resistances register the same temperature.



D132-12

As there is a flow of intake air, an air limit layer is generated over the plate, which **absorbs heat from the front zone** of the sensor and transfers it to the rear zone.

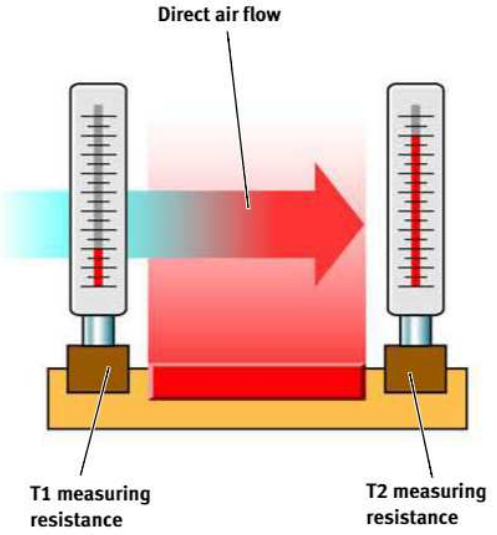
This is how the T1 temperature is reduced, whilst the temperature of the resistance T2 rises slightly.

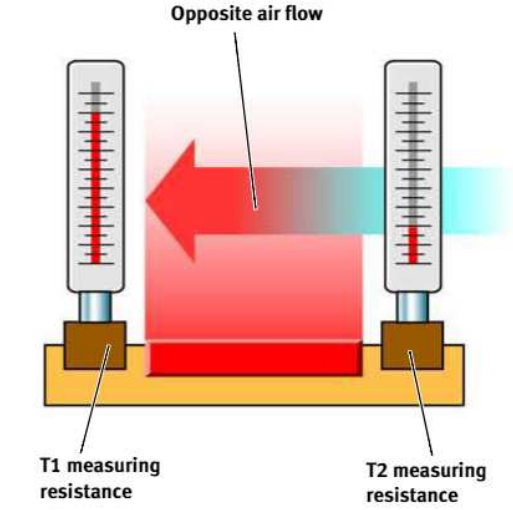
While the engine is running, due to the valves opening and closing, opposing air flows - "backflows"- are generated in the intake passage.

The mass meter is capable of detecting backflows. The air flowing in the opposite direction generates the contrary effect. That is, the **rear part plate releases heat** to the air threshold layer, therefore reducing the T2 temperature notably.

Precise and accurate reading of the total incoming air to the engine carried out by this measuring device allows for an optimum mixture.

Integrated electronics transforms the reading done into a modulated frequency digital signal.





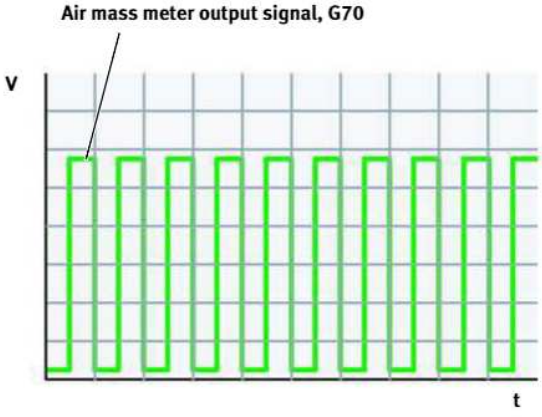
SIGNAL APPLICATION

This signal is used by the engine control unit, for the following functions:

- Injected flow control.
- Moment of ignition.
- Carbon active system.
- Overboost pressure limitation.
- Variable Timing.

REPLACEMENT FUNCTION

If the air mass meter signal is missing, the engine control unit uses the signal from the butterfly throttle control angle sensors 1 and 2, G187 and G188.



D132-13

INTAKE AIR TEMPERATURE SENSOR 2 G299

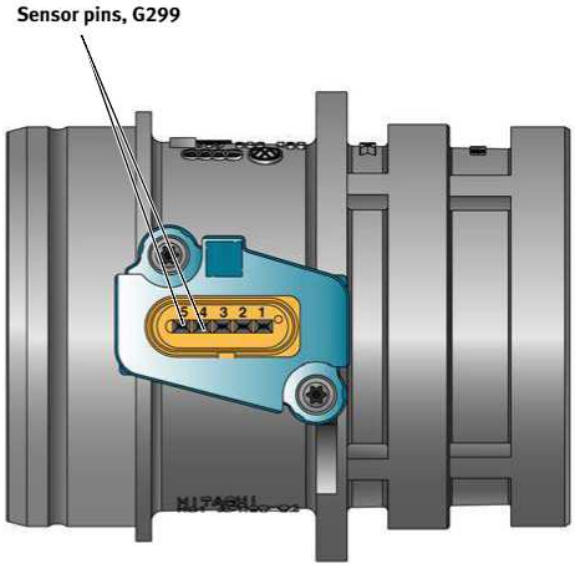
The air mass meter G70 incorporates an air temperature sensor G299 made up by an **NTC** resistor and **electronics** in charge of converting the sensor's reading into a digital signal at the output of the sensor.

SIGNAL APPLICATION

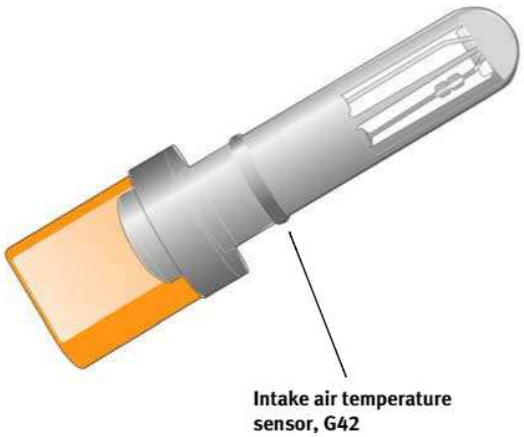
This sensor informs the engine control unit about the air temperature at the engine intake as a correction factor to **limit** the **overboost** pressure.

REPLACEMENT FUNCTION

In the event of lack of signal, the engine control unit uses the temperature value memorised during the last driving cycle.



D132-14



INTAKE AIR TEMPERATURE SENSOR, G42

It is placed in the inlet manifold. It is an **NTC** resistance that measures the temperature of the air just before entering the engine after it has been cooled in the intercooler.

SIGNAL APPLICATION

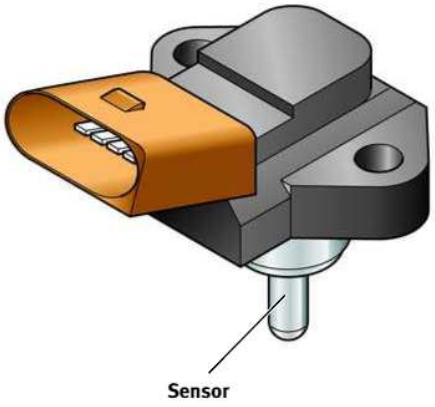
The engine control unit uses this signal as a **correction factor** for:

- Injected flow control.
- Moment of ignition.
- Overboost pressure limitation.

REPLACEMENT FUNCTION

Should this signal not be available, the engine unit will use a replacement value.

D132-15



D132-16

OVERBOOST PRESSURE SENSOR, G31

It is placed in the inlet passage that links the intercooler and the gas butterfly throttle.

It is a **piezoelectric** sensor that varies its signal depending on the flexing the measuring plate is subjected to by the overboost air pressure.

SIGNAL APPLICATION

The engine control unit uses this signal for the **overboost pressure limitation** function.

With this signal the engine control unit compares the theoretical calculation of the overboost pressure, based on the characteristic curve maps, with the real value measured by the G31 sensor.

REPLACEMENT FUNCTION

Should this signal be absent, the engine control unit reduces the overboost presure and therefore the engine power is also reduced.

INLET MANIFOLD FLAP SOLENOID VALVE POTENTIOMETER, G336

It is placed at the end of the inlet manifold flaps activation shaft, on the timing side.

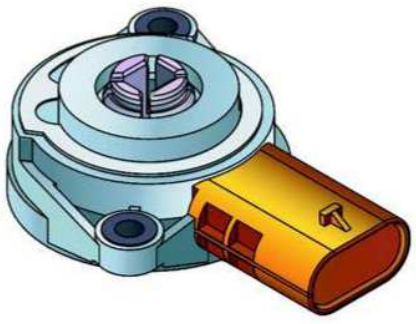
The **potentiometer** informs about two positions, flaps open or closed, because the control unit does not take into account the intermediate positions.

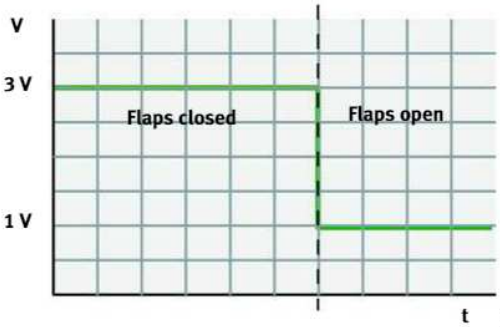
SIGNAL APPLICATION

The control unit uses this signal as **feedback** for knowing the **position** of the inlet manifold flaps.

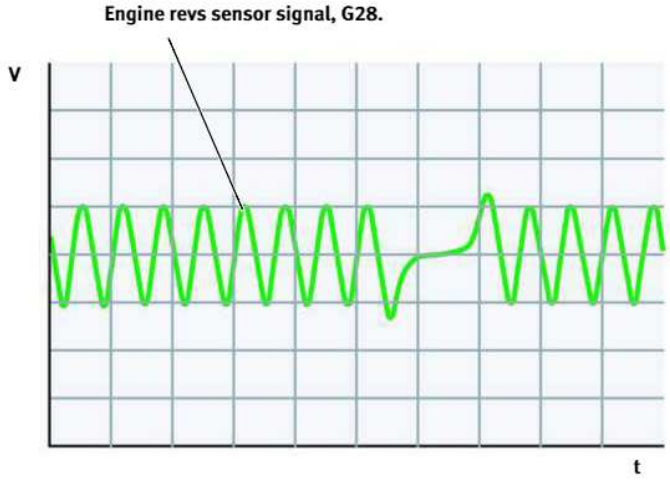
REPLACEMENT FUNCTION

If the signal is not present, the engine control unit interrupts the energising of the inlet manifold flaps control solenoid valve N316, and leaves the flaps in the at rest position, that is, closed.





D132-17



D132-18

ENGINE REVS SENSOR, G28.

It is an **inductive** type of sensor -screwed onto the block- that explores the 58-teeth generator crown and a gap corresponding to two teeth placed at 78º of cylinder 1 TDC. The generator crown is placed in the sealant flange, on the flywheel side. The sensor generates a senoidal signal the frequency of which is proportional to the speed of rotation of the crankshaft.

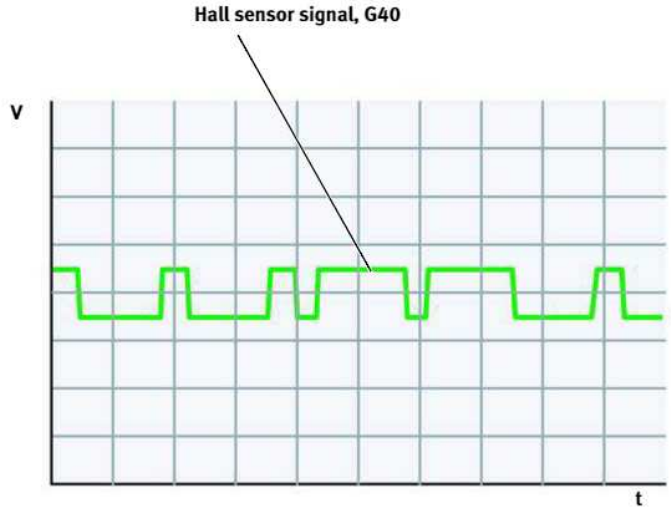
SIGNAL APPLICATION

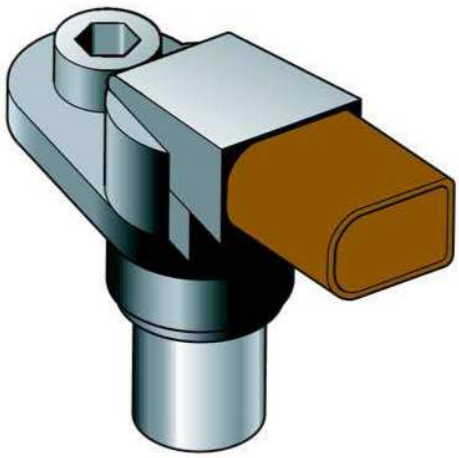
The engine control unit uses this signal to recognise the engine revs and together with the Hall G40 sensor detect the position of the crankshaft in relation to the camshaft. It **participates** in the following functions:

- Injection time control.
- Ignition moment calculation.
- Maximum revs limitation.
- Carbon active canister vapours ventilation.
- Inlet flaps control.

REPLACEMENT FUNCTION

If this signal is missing, the engine takes longer to start. The electronic accelerator warning light, K115, remains activated.





D132-19

HALL SENSOR, G40

It is a **Hall** sensor -screwed onto the cylinder head cover- that explores a toothed crown with four teeth placed on the inlet camshaft. The sensor contains an electronics that generates a square signal depending on the crown's teeth/ gaps and the frequency of which is proportional to the speed of rotation of the inlet camshaft.

SIGNAL APPLICATION

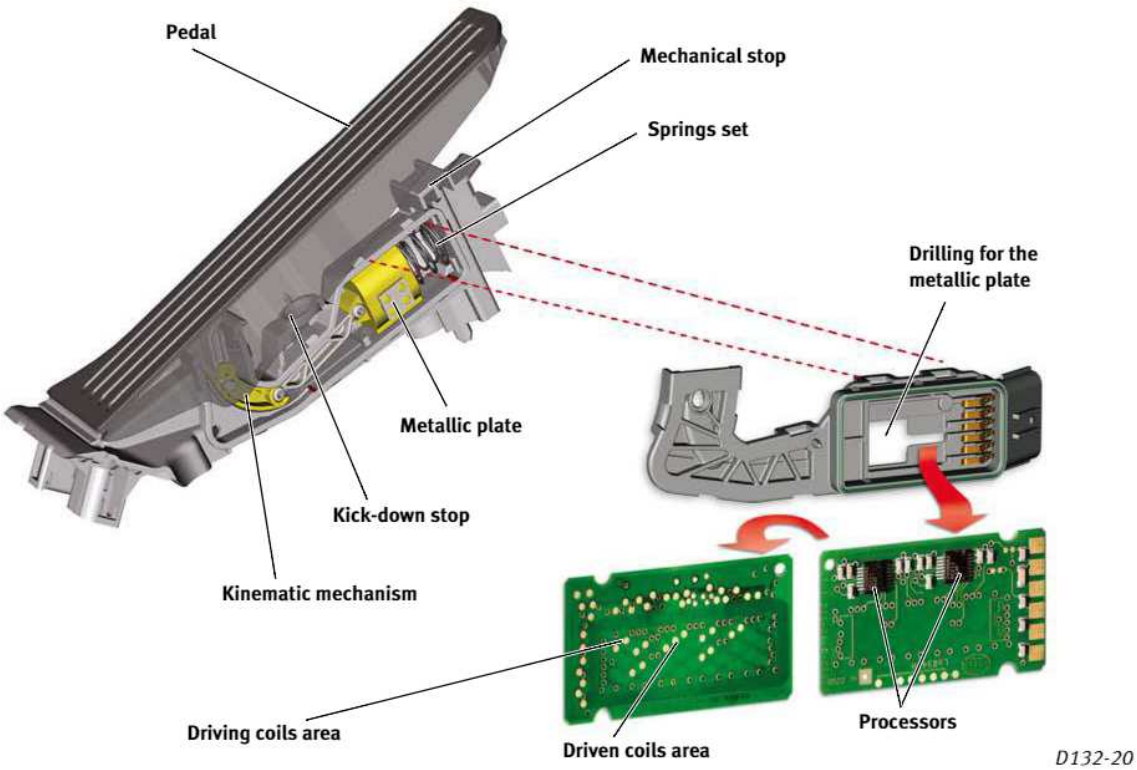
The resulting square signal informs the engine control unit about the inlet camshaft position . The combination of this signal together with the G28 sensor allows calculating:

- the moment of ignition,
- the moment of injection,
- the variable timing regulation.
- and, control the detonating combustions in each cylinder.

REPLACEMENT FUNCTION

If this signal is missing:

- The engine takes longer to start.
- If it is already running, it stops.
- The variable timing is deactivated.
- The electronic accelerator fault warning light, K132, remains activated.



ACCELERATOR PEDAL POSITION SENSORS G79/G185

They are integrated in the accelerator pedal module, which is made up by the pedal, by a set of components for transmission of movement, and by the pedal position sensor.

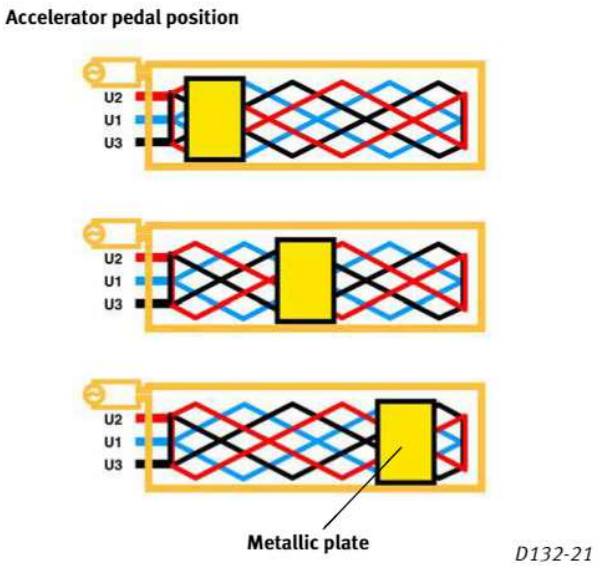
The elements that transmit the movement are a lineal displacement metallic plate, driven by a kinematic mechanism that moves it according to the position of the pedal.

The **sender** is **made of two sensors** that work independently and the **metallic plate**.

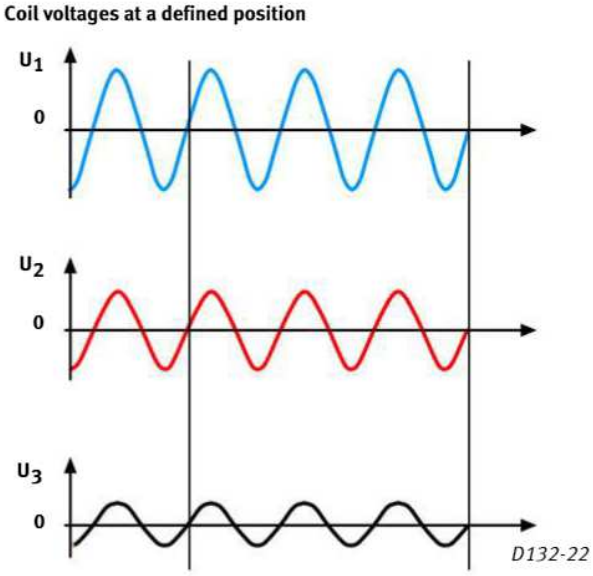
Each sensor is made of a drive coil and three driven coils, as well as an elevation and control electronics.

The **drive coils are rectangular**, inside are the **driven coils which represents a diamond shaped geometry** and are offset with each other.

The fact of not having any physical contact between the sensor elements prevents wear and guarantees reliability.



D132-21



D132-22

OPERATION

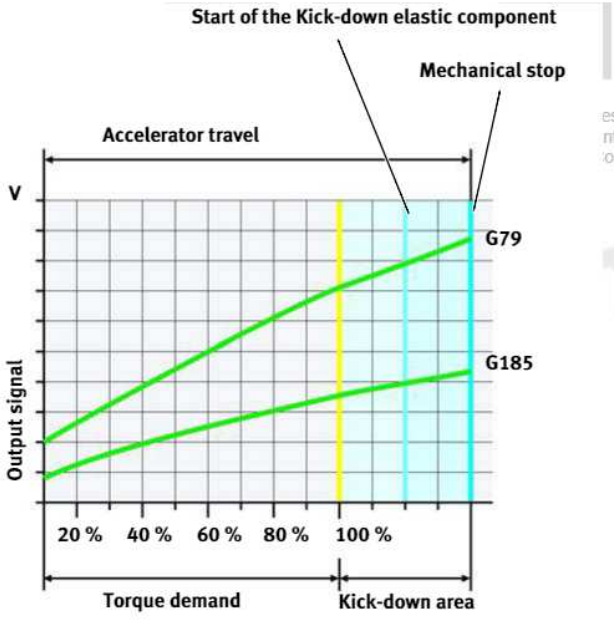
An alternating current flows through the driven coil and generates a magnetic field that flows through the driven coils.

In the zone where the plate is the magnetic field increases; due to the different position of the coils, in each of them a different value field is driven.

The value of the **magnetic field** also **varies due to the variable geometry of the sensor housing** between the plate and the coils.

The processors evaluate these preset values by considering the distribution of voltages in the different coils, the position of the metallic plate, and by assigning to each position a voltage value for the sensor output signal.

The output signals are analogous to the ones transmitted by the sensors known up to now.



D132-23

SIGNAL APPLICATION

The signal is used for the following functions:

- Detecting the load demand.
- Idling regulation.
- Detecting the *kick-down* position for automatic gearbox cases.

REPLACEMENT FUNCTION

If one of the sensors fails, the engine control unit works with the signal from the other sensor.

If both sensors are faulty, the engine revs are set at 1200 rpm.

In both situations the electronic accelerator fault warning light, K132, is activated.

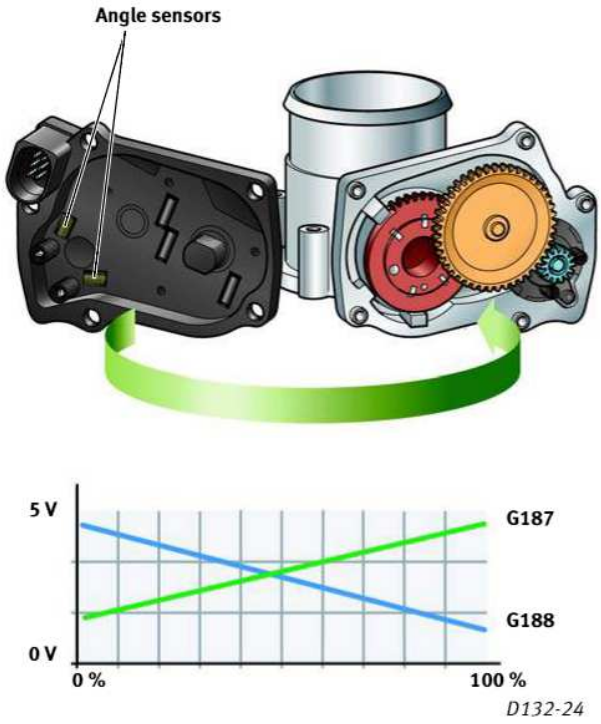
ANGLE SENSORS 1 AND 2 FOR THE GAS BUTTERLY THROTTLE G187 - G188

The G187 and G188 sensors the gas butterfly throttle incorporates are **tipo magneto-resistive** sensors. Magneto-resistive sensors work without any physical contact. Their interior architecture allows measuring a rotation angle from 0º to 180º.

The **advantages** they offer are:

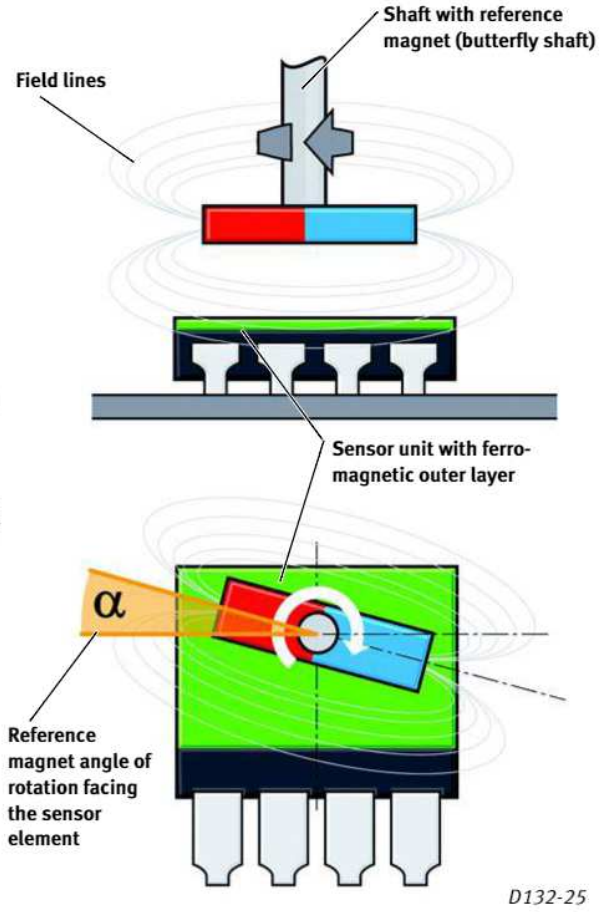
- No sensitivity when the magnetic field intensity varies due to temperature changes.
- No sensitivity when the reference magnet gets older.
- No sensitivity to mechanical tolerances.

The G187 and G188 sensors provide continuous voltage signals that vary lineally depending on the accelerator pedal travel. Both signals are crossed or opposing signals.

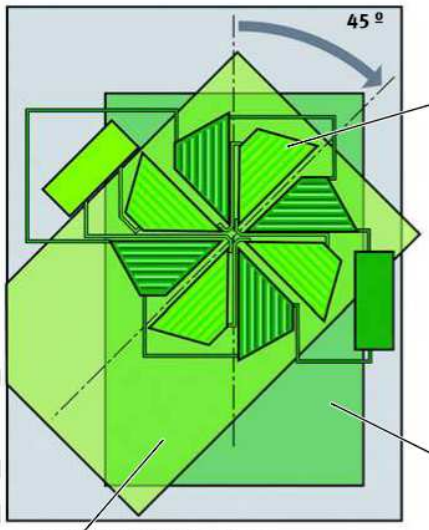


A magneto-resistive sensor **includes** an **electronic sensor** element covered by a ferromagnetic layer and a **reference magnet**.

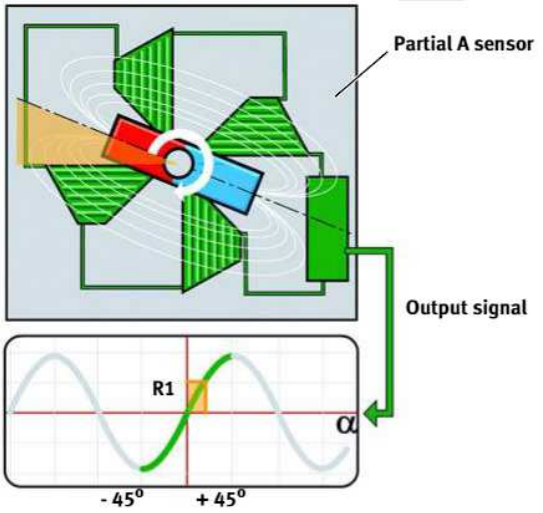
The magnet is a single assembly with the shaft, the rotation angle of which has to be measured. When the shaft rotates with the bar magnet, the position of the magnet field changes in respect of the sensor element and thereofre the sensors element's resistance. Depending on this resistance value, the sensor electronics calculates the absolute angle of rotation of the shaft in relation to the sensor.



There are two partial sensors A and B, offset 45º with each other. Also, each partial sensor has four resistance measuring bridges, which are offset 90º respectively in relation to a common centre.



D132-26



D132-27

When the shaft rotates in relation to a partial sensor, there is a senoidal variation of the resitance value (R) of this partial sensor.

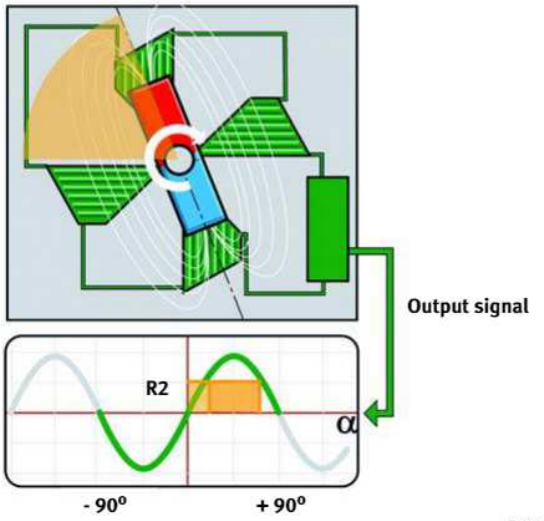
Because of the specific geometry of a senoidal curve a partial sensor is only in conditions of determining an unequivocal angle in a partial zone from -45º to +45º.

Example:

The magnitud of reistance R1 is equal to the angle of alpha rotation equal to 22.5º.

In a zone ranging between -90º y +90º there are two possible angles corresponding to a magnitude of the resistance. A single partial sensor is not prepared to supply, therefore, an unequivocal signal within this measuring margin.

Example: The R2 resistance is equivalent to the alpha rotation angles equal to 22.5º and 67.5º.



D132-28

By using two partial senders and placing them at a 45º offset position, two 45º offset sinusoidal curves are obtained as a measuring signal.

The sender electronics can now calculate an inequivocal angle between 0º and 180º, by applying a mathematical function with both curves, and can transmit the corresponding continuous voltage signal to the control unit .

SIGNAL APPLICATION

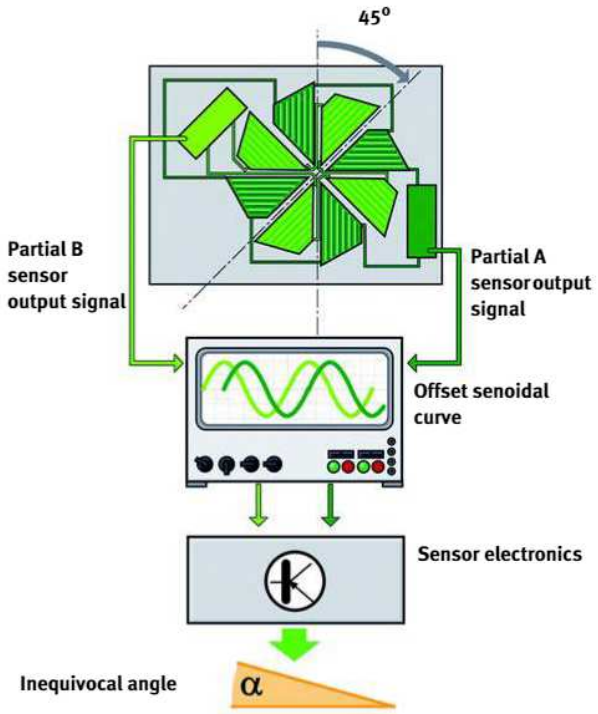
The engine control unit uses these signals as **feedback** to control the gas butterfly throttle control, G186.

REPLACEMENT FUNCTION

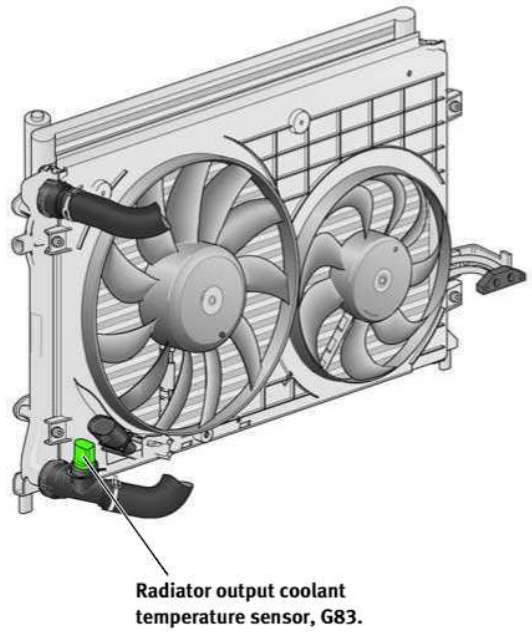
If one of the sensors fails, the **TCS** and **GRA** functions are deactivated.

If the two sensors or the control unit fail, the butterfly is deactivated and the engine runs at **1500** rpm and does not respond to the accelerator pedal demand.

In both cases the instrument panel electronic accelerator warning light, K132, is activated.



D132-29



D132-30

RADIATOR OUTPUT COOLANT TEMPERATURE SENSOR, G83.

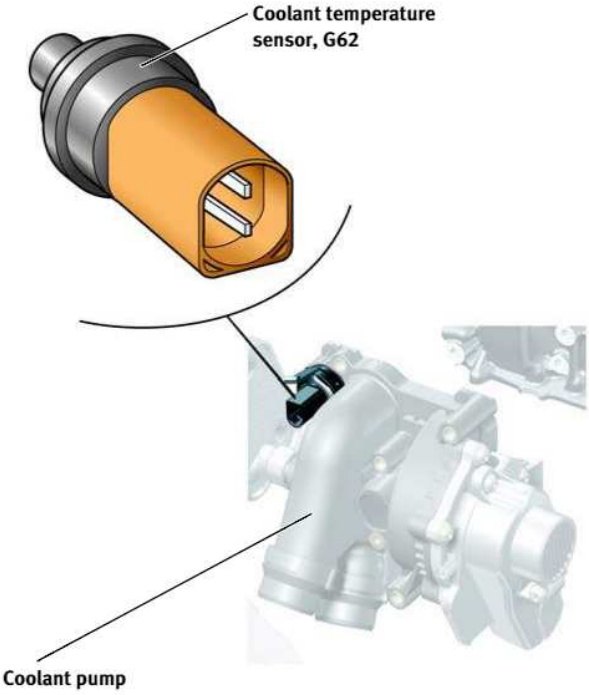
The G83 sensor is an NTC type resistance. It is placed on the radiator output passage and allows knowing the coolant output temperature after being cooled.

SIGNAL APPLICATION

The engine control unit can manage the **fans activation** depending on the signals supplied by the two coolant temperature sensors G62 and G83.

REPLACEMENT FUNCTION

If this signal is missing, the electrical fans are automatically activated when switching the ignition on.



D132-31

COOLANT TEMPERATURE SENSOR, G62

It is placed on the body of the coolant pump. The G62 sensor is an **NTC** resistance that measures the temperature of the coolant in the engine block.

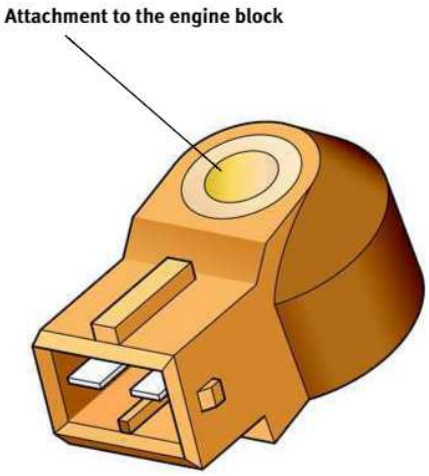
SIGNAL APPLICATION

The coolant temperature is used for the following functions:

- Calculating the amount to inject.
- Moment of ignition.
- Oil pressure monitoring.

REPLACEMENT FUNCTION

If the signal is missing, the engine control unit calculates a temperature by taking into account the family of features.



D132-32

KNOCK SENSOR G61

It has **a** single **knock sensor** -piezolelectric- screwed to the engine block just behind the inlet manifold.

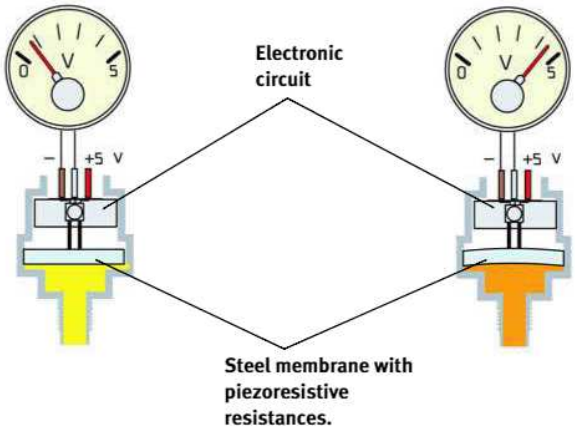
SIGNAL APPLICATION

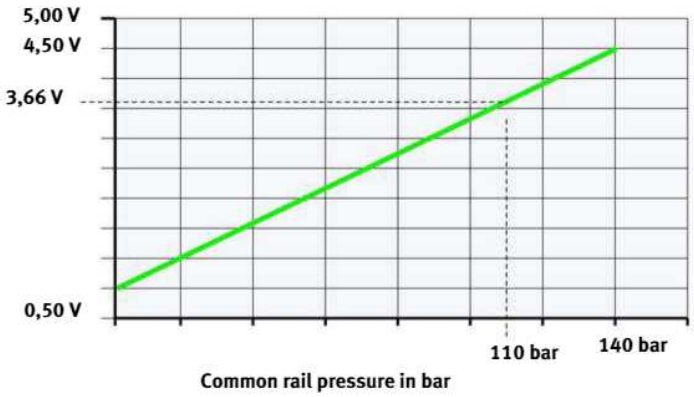
The information provided by the sensor allows the engine control unit calculate the **moment of ignition**.

Through the G61 sensor, the presence of knocking combustions is detected. With this the ignition angle of each cylinder can be corrected and thus prevent “conrod knocking”.

REPLACEMENT FUNCTION

If the signal is missing, as a safety function, the angle of ignition is delayed. This leads to a fuel consumption increase associated to a power and torque drop.





D132-33

FUEL PRESSURE SENSOR, G247

The G247 sensor is housed in the high pressure fuel passage, next to the inlet manifold.

The sensor registers the fuel pressure in the distributor rail of the fuel high pressure circuit by means of **piezoresistive resistances** integrated in a **steel membrane**. An electronic circuit amplifies the outgoing sensor signal to the engine control unit.

The sensor operation is based on the flexing of the steel membrane due to the action of the fuel pressure flowing to it. Under high ressures the membrane suffers **a great deformation**, and reduces the value of the resistances and therefore an **increase of the output voltage**.

Under low pressures the membrane **slightly deforms**, the value of the resistance rises and **reduces the output voltage signal**.

SIGNAL APPLICATION

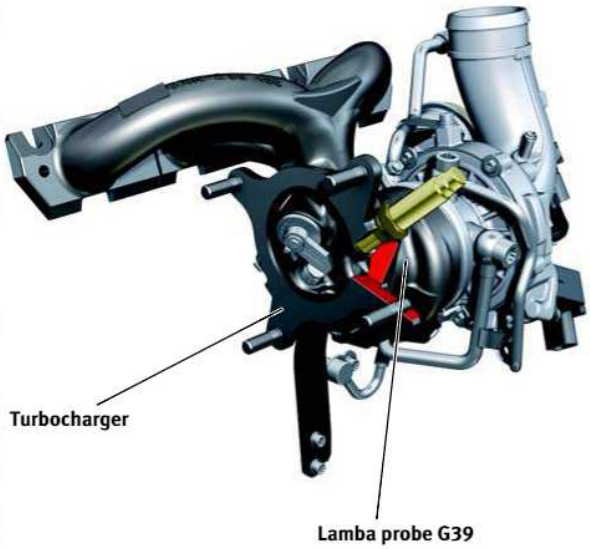
Depending on this signal and on the engine's load needs, the engine control unit regulates the pressure in the distribution passage by means of the fuel pressure regulator solenoid valve, N276.

REPLACEMENT FUNCTION

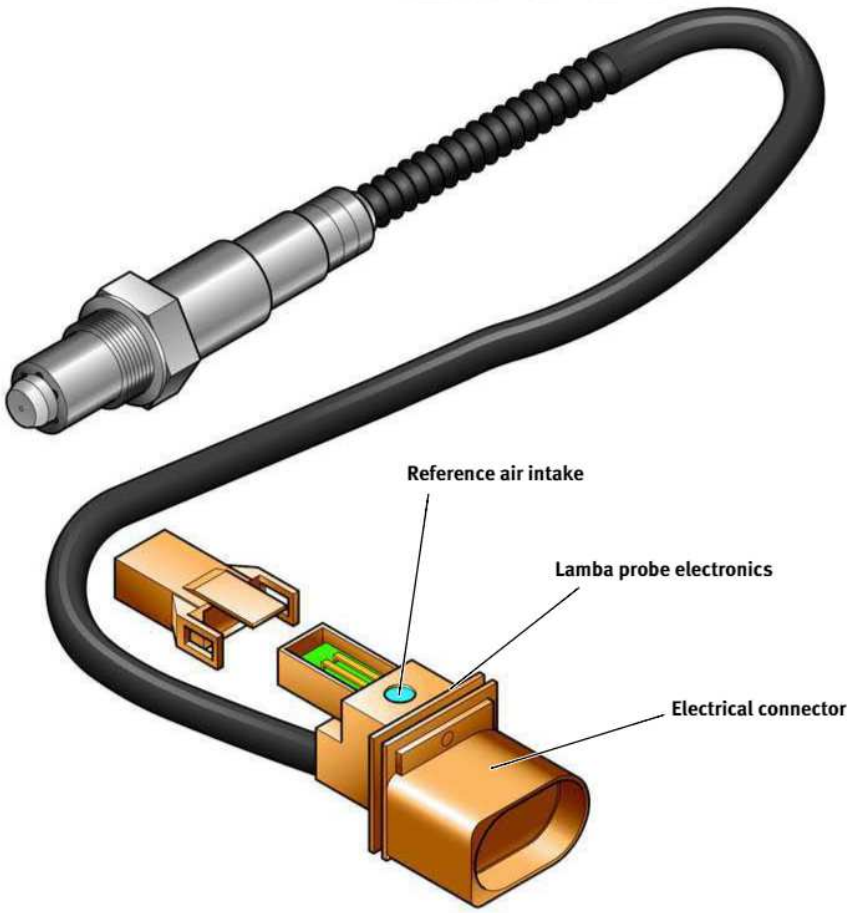
If this signal is missing, the engine control unit stops energising the solenoid valve N276. This is how the pressure downgrades towards the high pressure circuit, and as a result the mix is empoverished and the engine looses power.

LAMBA PROBE G39

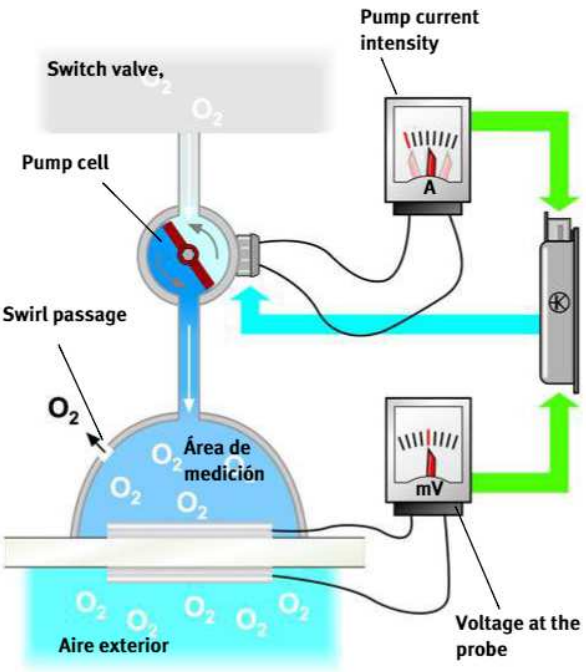
It is a **continuous measuring** lambda probe, which is placed in the turbocharger housing, just at the exhaust manifold output. Its main feature is that it sends a clear signal with the composition of the gases, even when the engine is running on mixes that are distant from lambda=1.



D132-34



D132-35

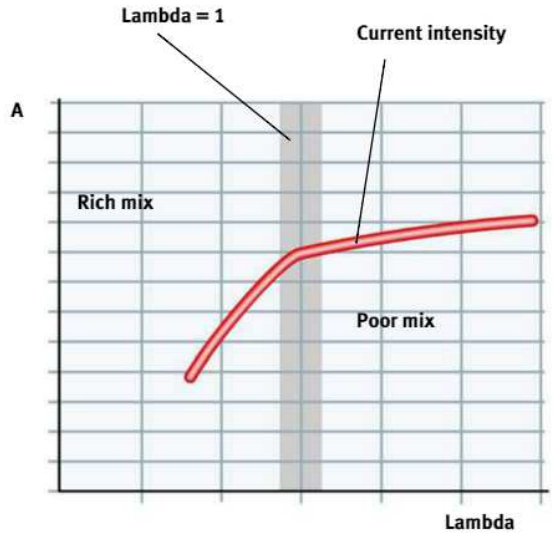


D132-36

The probe generates voltage, with the help of two electrodes, resulting from the difference in oxygen contents.

The **voltage** between this lambda probe electrodes is maintained **constant** thanks to a 'bomb cell' (miniature pump) that supplies the electrode in contact with the exhaust gases with oxigen.

The **current consumption** of the pump is analised by the engine control unit J263 and transformed into a lambda value.



D132-37

SIGNAL APPLICATION

The lambda probe, G39, signal is used for:

- Calculating the flow to inject.
- Calculating the fuel vapours that need to be introduced into the inlet.

REPLACEMENT FUNCTION

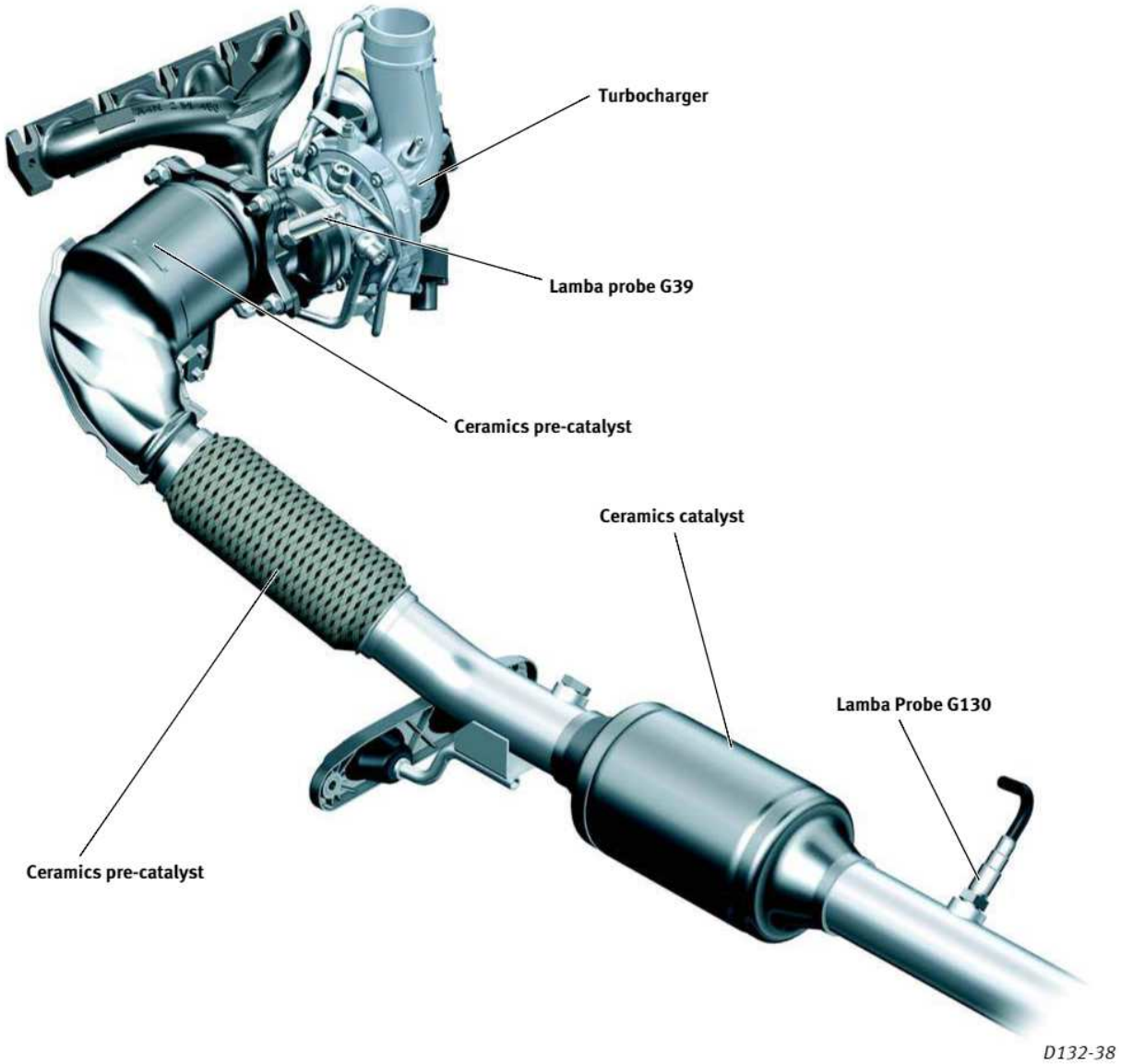
If the signal is missing, the exhaust emissions warning light ,K83, (EOBD) is activated and the lambda regulation is disabled.

LAMBA PROBE G130

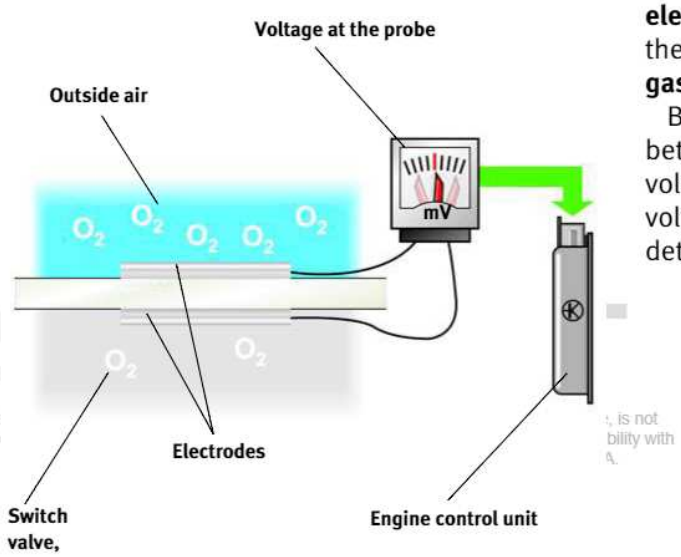
It is a **conventional** or **stepped regulation** lambda probe, placed just after the catalyst.

It is in charge of comparing the amount of residual oxigen in the exhaust gases with the outside air oxigen contents.

Unlike the continuous measuring - broad band- lambda probe, G39, the lambda value of this lambda probe is determined on the basis if a voltage value which is sent to the engine control unit.



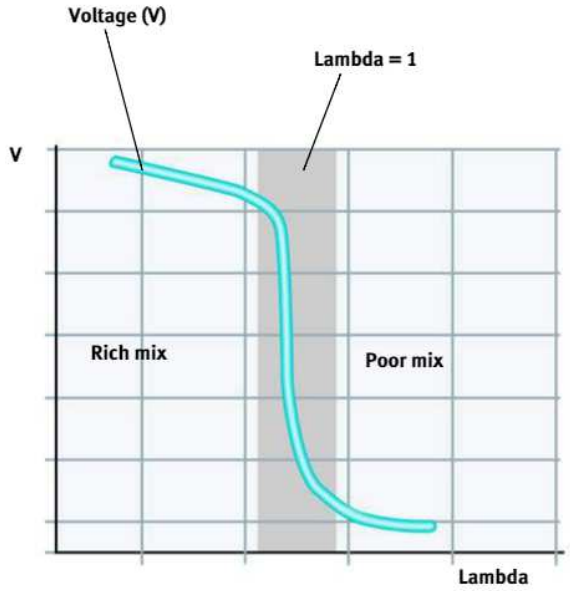
D132-38



D132-39

The main element of this probe is a ceramics body with outer layers on both sides (Ernst cell) These outer layers assume the unction of **electrodes**, of which one layer is in contact with the **outside air** and the other one with the **exhaust gases**.

Because of the difference in oxigen content between the outside air and the exhaust gases a voltage is generated between the elctrodes. This voltage is analyzed in the engine control unit to determine the lambda value.



D132-40

SIGNAL APPLICATION

The signal provided by the lambda probe, G130 is used to control the correct operation of the main catalyst as well as for correcting possible deviations in the G39 probe measuring due to its aging.

REPLACEMENT FUNCTION

If this signal is missing, the engine control unit deactivates the catalyst performance monitoring function. The exhaust gases emissions warning light, K83, remains activated.

OIL SWITCH F22

It is placed in the **lower zone** of the **oil filter** module. It is a pressure switch which is open when at rest. It is activated by the oil pressure when it reaches **2.55 bar**.

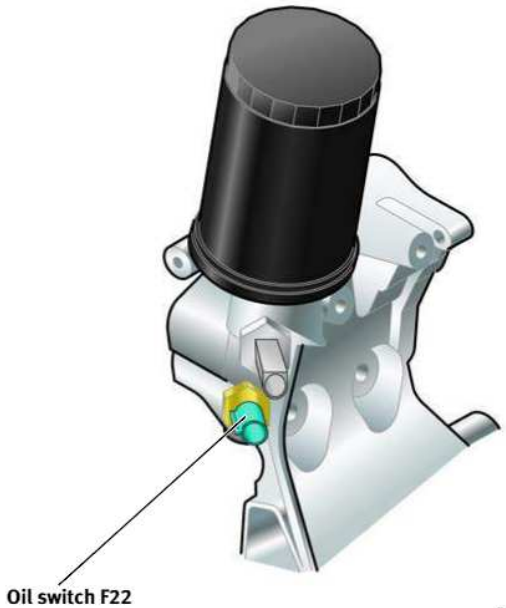
SIGNAL APPLICATION

It is in charge of warning the engine control unit when the oil pressure reaches 2.55 bar. For this it switches over/shorts to earth.

REPLACEMENT FUNCTION

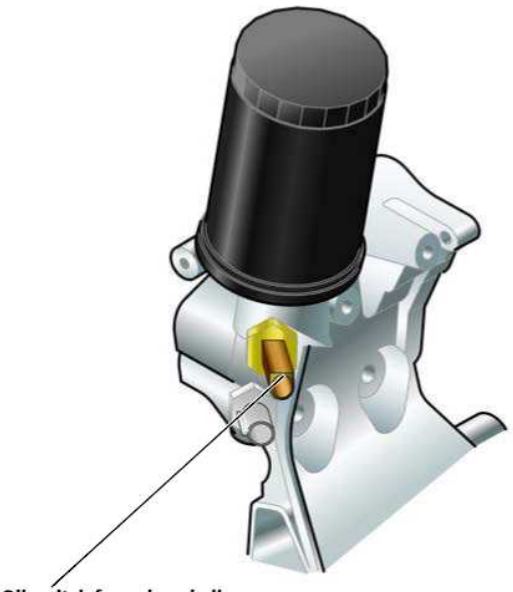
With the engine stopped and terminal 15 on, if the switch is detected to be closed then the red oil pressure warning light, K3, blinks.

When the engine is running and the closed switch is not detected the engine revs are limited to about 4000 rpm and the electronic accelerator warning light is activated above certain engine revs (depending on the oil temperature)



Oil switch F22

D132-41



Oil switch for reduced oil pressure control, F378

D132-42

OIL SWITCH FOR REDUCED OIL PRESSURE CONTROL, F378

It is placed in the **upper zone** of the **oil filter module**. It is a pressure switch which is open when at rest. When the pressure in the circuit reaches **0.7 bar** the switch closes.

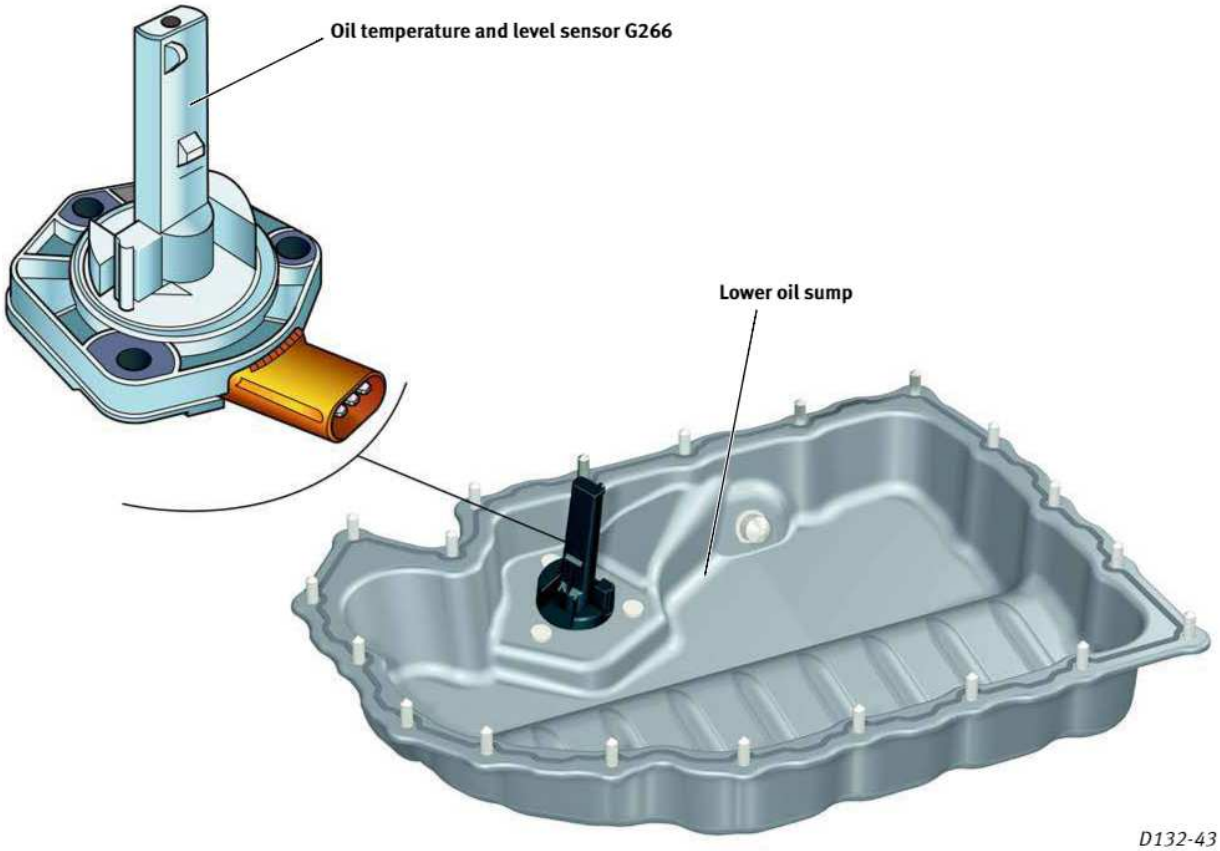
SIGNAL APPLICATION

It is in charge of warning the instrument panel when the oil pressure reaches 0.7 bar. For this it switches over/shorts to earth.

REPLACEMENT FUNCTION

With the engine stopped and with terminal 15 on, if the switch is detected to be closed then the red K3 oil pressure warning light blinks.

When the engine is running, and if the open switch is detected then the red K3 warning light blinks.



D132-43

OIL TEMPERATURE AND LEVEL SENSOR G266

It is screwed onto the lower sump and its is a sender with two sensors: one for detecting the level, and another one for detecting the temperature.

The **level** detection sensor operates under the principle of transmission and reception of **ultrasounds**.

The sensor transmits ultrasound pulses which reflect on the threshold surface between the oil and the air. The oil level is calculated by analyzing the real time between the pulse transmitted and the one received in return.

To recognize the **temperature** the sensor includes an **NTC** resistance.

Both informations are processed by the sensor's internal electronics and transformed into a pulse signal. This signal is sent to the instrument panel J285 and reaches the engine unit through the drive CAN-BUS.

SIGNAL APPLICATION

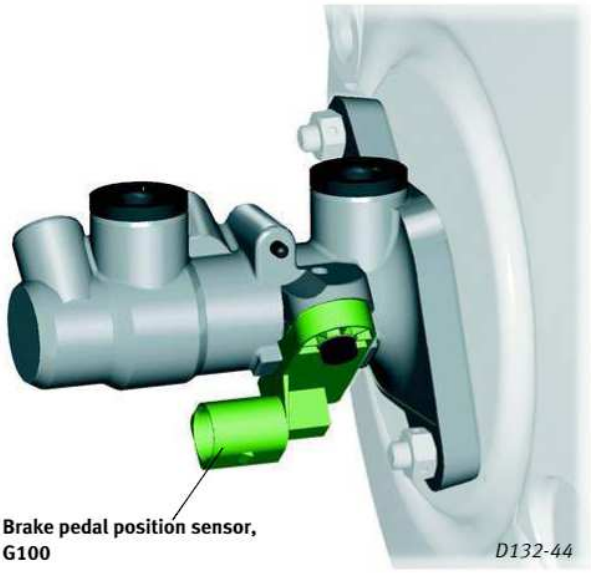
The engine control unit uses this signal for the **oil pressure monitoring**. The engine revs are limited through this function as a protection measure under certain oil level and temperature circumstances.

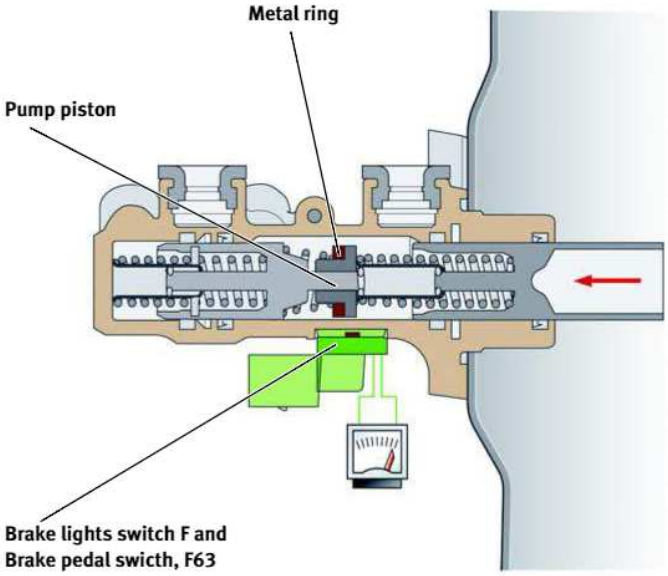
REPLACEMENT FUNCTION

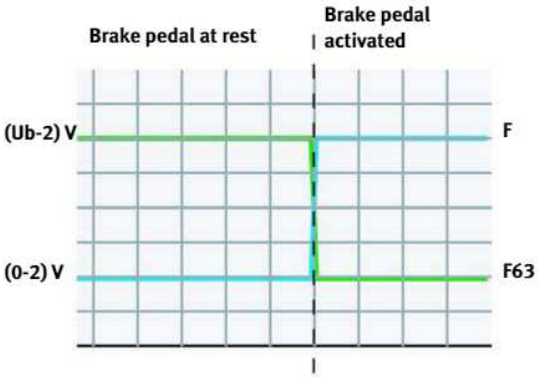
If the signal is missing, the yellow oil pressure warning light, K3, blinks when the ignition is switched on and the engine control unit uses the coolant temperature sensor signal, G62.

BRAKE PEDAL POSITION SENSOR, G100

The sensor is placed in the lower part of the brake pump. It is made of **two Hall sensors** and the electronics.







Inside the brake pump there is a **metallic ring which is a single assembly with the pump piston**; when it moves, it generates a variation of the magnetic field that is picked up by the Hall sensors.

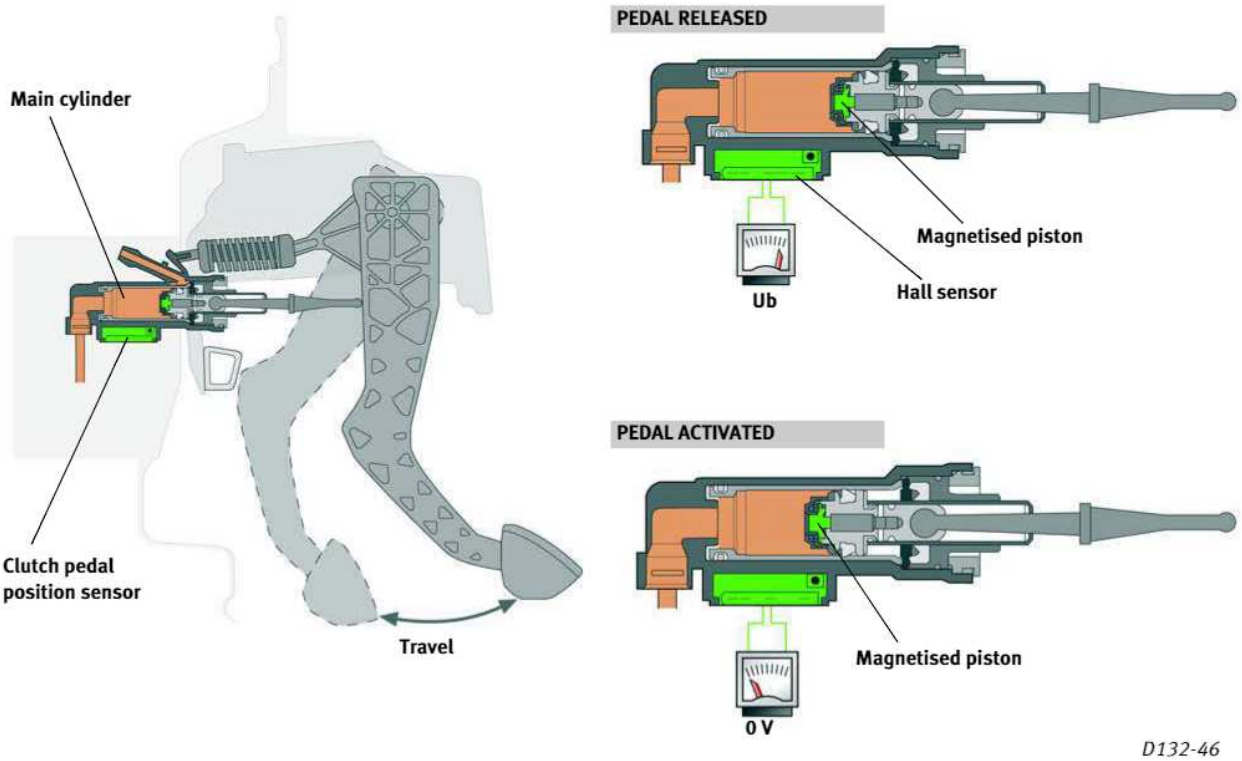
The sensor is supplied by a terminal 15 positive. It generates two signals that can be scoped in pins 1 and 3 to check plausibility of the signals.

SIGNAL APPLICATION

Because of the sensor electronics, the signal is processed and sent top the engine control unit and to the on-board network control unit to activate the brake lights.

REPLACEMENT FUNCTION

If the sensor is faulty or if one of the signals is missing, **the brake light remains on** even if the brake pedal is not activated.



CLUTCH PEDAL POSITION SENSOR G476

It is placed in the clutch pump.

The sensor **is made of** a **Hall sensor** placed on the pump and a **magnet** at the end of the piston.

When the pedal is **at rest position** the sensor sends a **battery voltage** signal.

When pressing the clutch pedal, the magnet moves and is placed over the sensor. In this case, the **output signal is 0V**.

SIGNAL APPLICATION

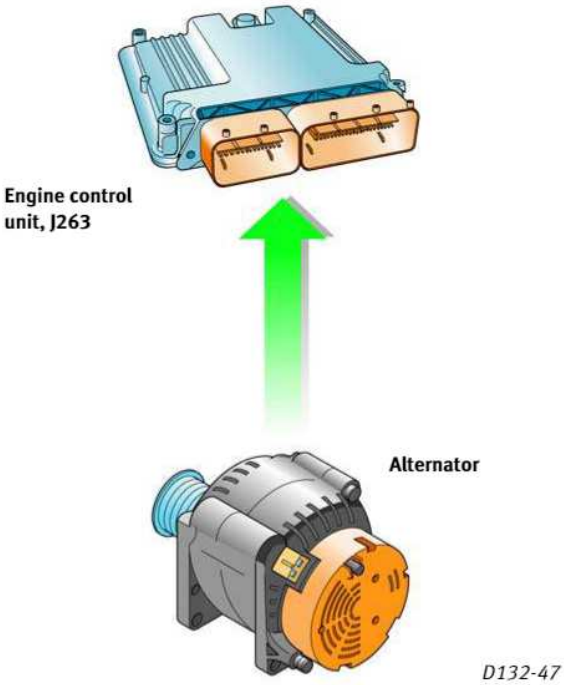
The engine control unit uses the signal for:

- Cruise control disconnection when pressing the cluctch.

-Engine torque reduction so that gear shifting is smoother.

REPLACEMENT FUNCTION

If the signal is missing, the torque will not be reduced and the cruise control will not work properly.



D132-47

TERMINAL DF

The engine control unit gets the DF terminal signal via conventional wire from the alternator. It is a **PWM signal**, the positive duty cycle of which varies depending on the alternator load.

SIGNAL APPLICATION

The engine control unit uses this signal to **stabilise the idling**. The unit recognises through this signal the engine torque absorbed by the alternator and comnpensates it by opening the butterfly with the electronic accelerator. This is how undesired idling fluctuations are prevented.

REPLACEMENT FUNCTION

If this signal is lacking, the stabilising of idling is less precise.

CRUISE CONTROL SIGNAL

The steering column control unit, J527, sends the information about the cruise control switch, E45.

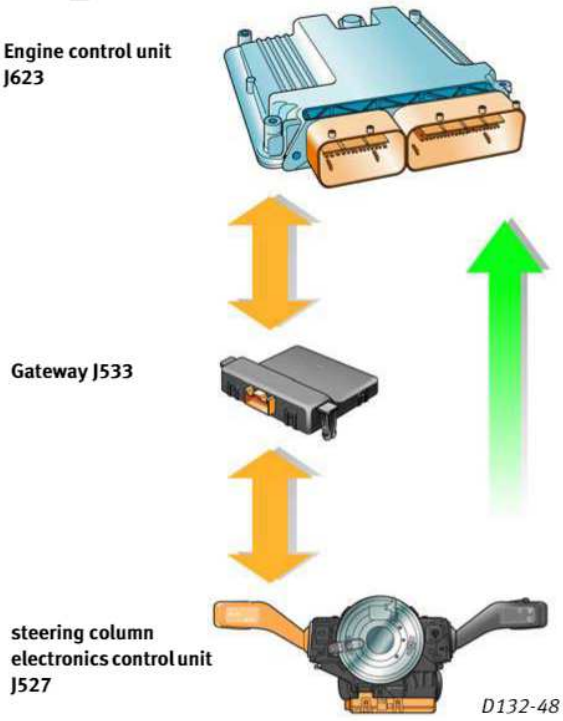
It sends the switch position via CAN-Bus and as a safety measure it duplicates the cruise control on/off signal via conventional cable.

SIGNAL APPLICATION

The engine control unit uses this signal to **adapt the vehicle speed** to that indicated from the regulator system.

REPLACEMENT FUNCTION

If one of both signals is missing, the system works with the other one. If both are missing, the cruise control does not work.



D132-48

ALTITUDE SENSOR, F96

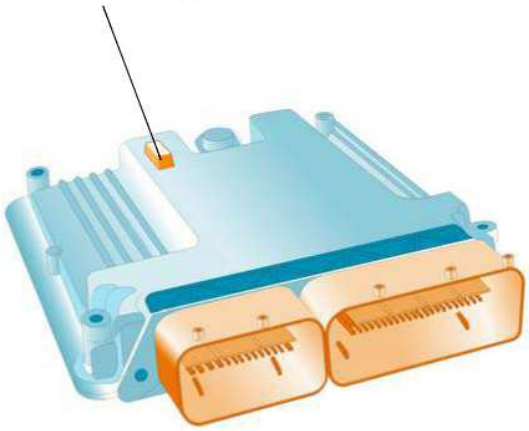
It is integrated in the engine control unit and it measures the atmospheric pressure.

SIGNAL APPLICATION

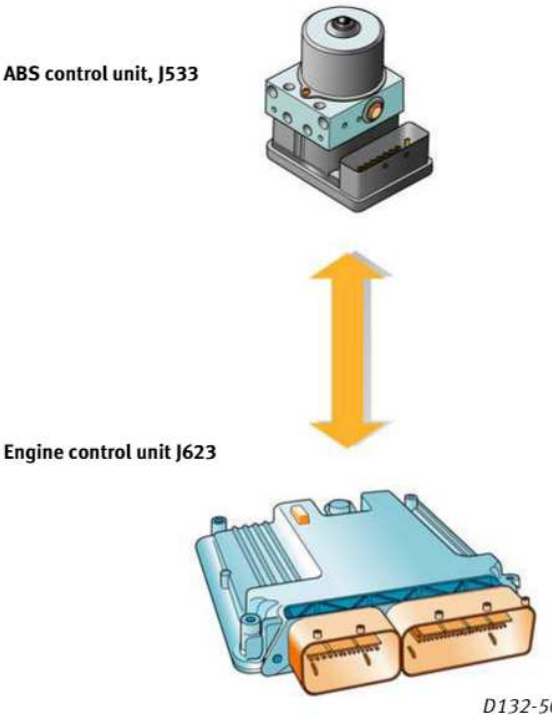
The signal provided is used as a correction value to adjust the maximum overboost pressure. This is how it is possible to compensate for the air density reduction as altitude increases and also to know the exact engine load.

REPLACEMENT FUNCTION

If the sensor fails, the engine control unit uses values stored in memory to carry out the correction;however, there might be more emissions and power output might drop.



D132-49



D132-50

SPEED SIGNAL

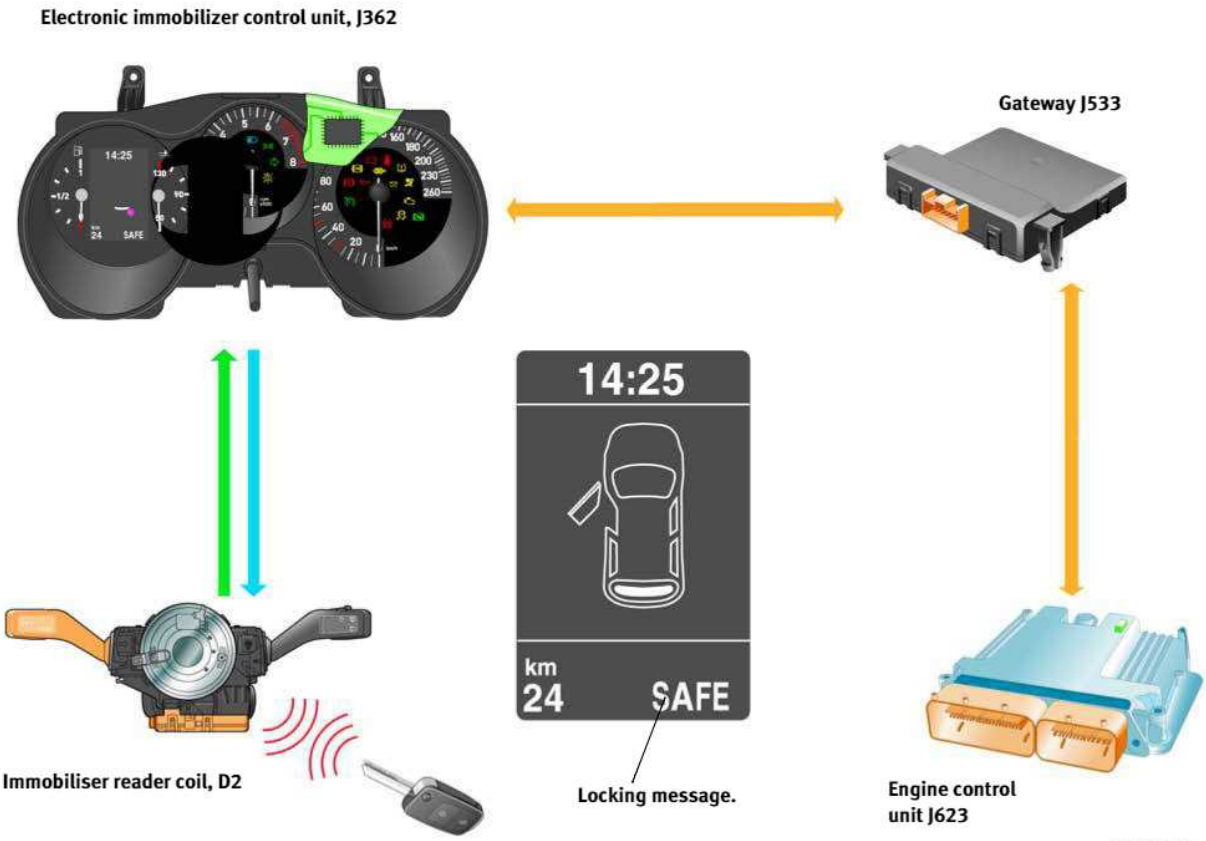
The engine control unit gets the vehicle speed signal through a CAN-Bus message from the ABS.

SIGNAL APPLICATION

This signal is used to adapt the real vehicle speed to that required by the cruise control.

REPLACEMENT FUNCTION

If this signal is missing, the cruise control does not work.



ELECTRONIC IMMOBILISER

The electronic immobiliser message is necessary for starting the engine. It is sent by the instrument panel to the instrument panel CAN-Bus.

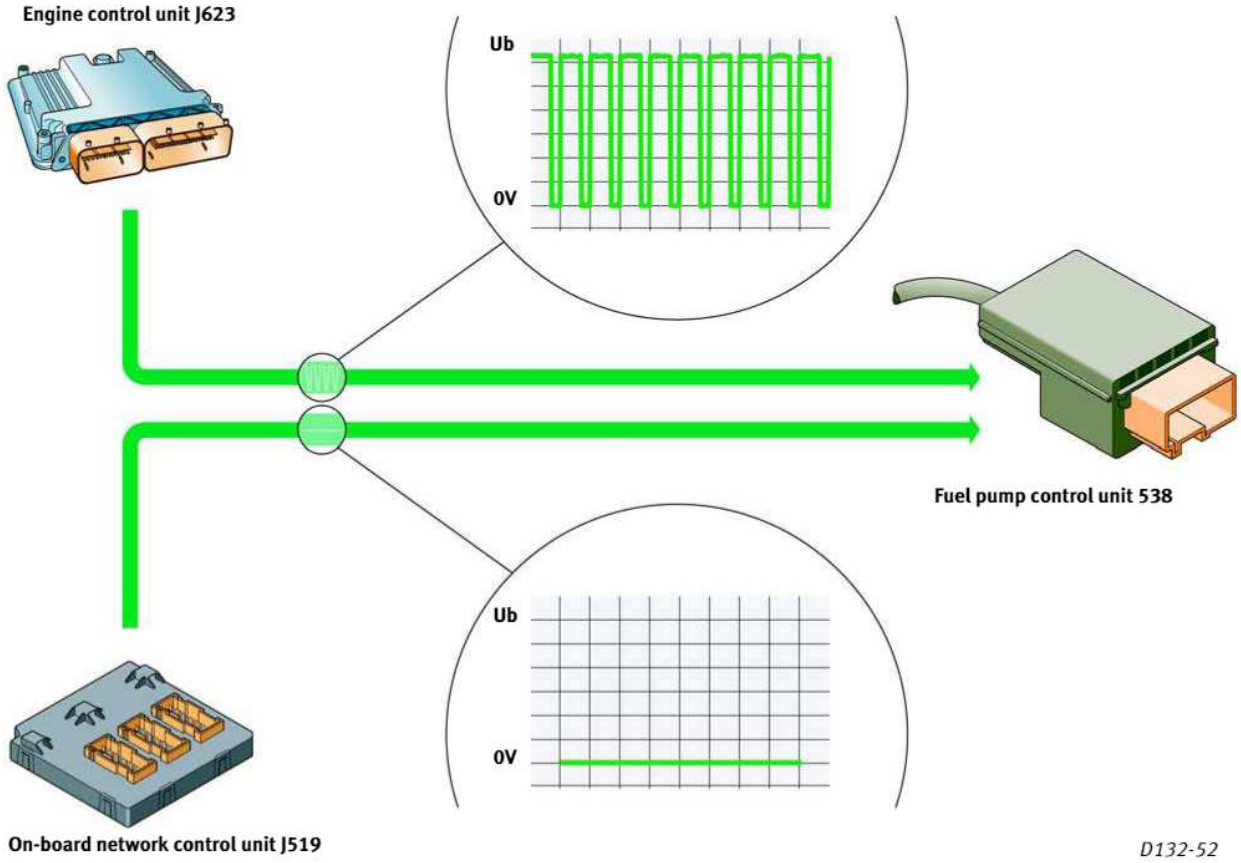
Through the Gateway it reaches the drive CAN-Bus line where it is picked up by the engine control unit.

SIGNAL APPLICATION

The engine unit blocks the **engine start-up** if it does not receive any authorisation code form the electronic immobiliser.

REPLACEMENT FUNCTION

If the immobiliser fails or if the electrical connection is faulty, the engine can not be started up.



FUEL PUMP CONTROL UNIT 538

The fuel pump control unit, J538, is placed under the rear bench, next to the fuel pump, G6.

The unit manages the fuel pump, G6, operation so that it allows modifying the the amount of fuel driven depending on the load and the engine revs.

This is how the electrical current consumption is reduced, and therefore fuel consumption is also reduced.

The fuel pump unit registers the electrical resistance of the fuel gauger and sends this signal to the instrument panel, J285 via a conventional cable.

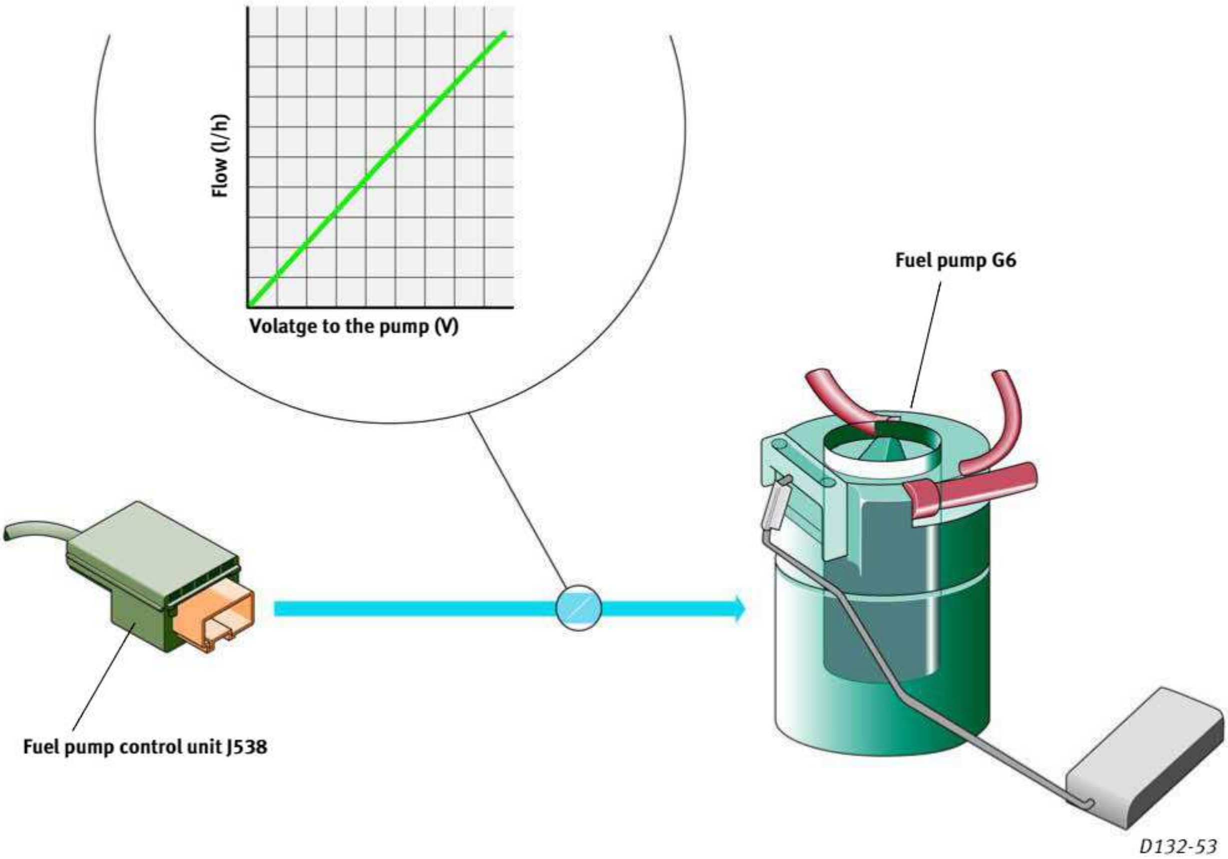
ENERGISING

The **engine control unit** sends a fixed frequency and variable duty cycle signal to inform the pump unit, J538, about the necessary flow.

To carry out the fuel pre-priming function the control unit J538 gets a **negative signal from the on-board network control unit J519** via conventional cable.

REPLACEMENT FUNCTION

If the fuel pump control unit fails, the fuel pressure downgrades and the engine stops.



FUEL PUMP G6

It is made of a **continuous current** motor and is integrated in the fuel supply unit placed in the tank, under the rear bench.

The pump drives the fuel along the low pressure circuit to the high pressure mechanical pump.

ENERGISING

Energising is done with a continuous voltage value from the fuel pump control unit, J538.

Through this voltage the low presure supply flow is adjusted, from 0.6 l/hr to 55 l/hr (corresponding to 1.5 and 6 bar pressure values).

REPLACEMENT FUNCTION

If the fuel electrical pump fails, the engine will not work.

CARBON ACTIVE CANISTER SOLENOID VALVE N80

This solenoid valve is attached to the inlet manifold, next to the gas butterfly throttle.

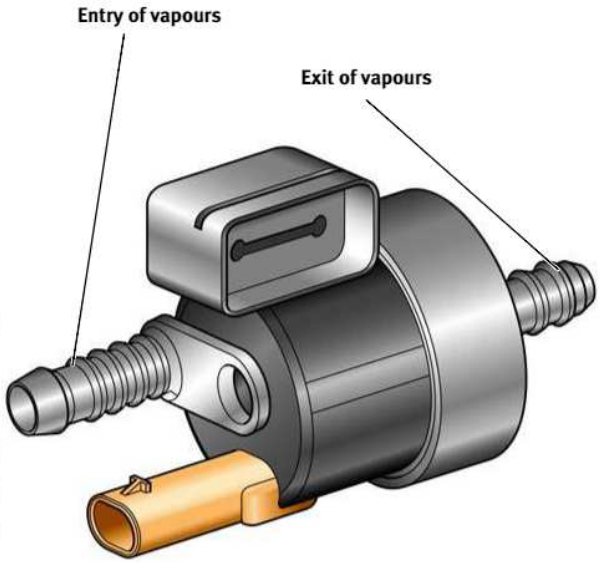
ENERGISING

The solenoid valve is energised with a **PWM signal** and is in charge of releasing the carbon active canister vapours.

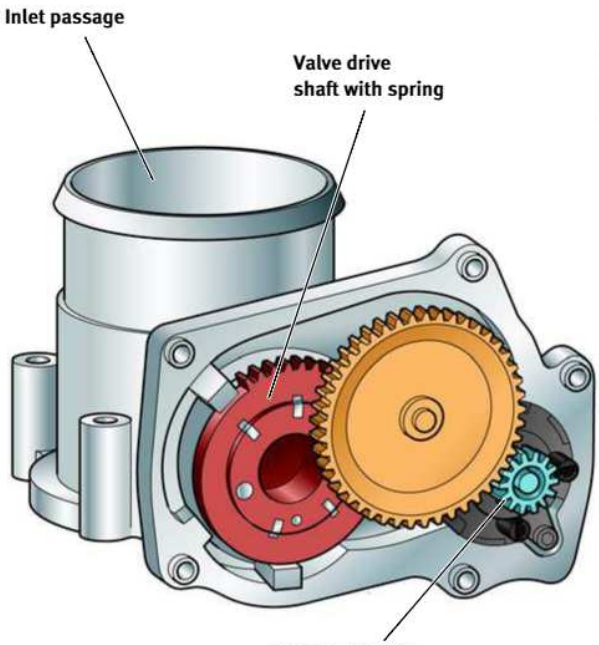
The fuel vapours are sent, depending on the existing vacuum in the inlet manifold, to the suction side of the turbocharger or to the suction passage, just after the gas butterfly throttle.

REPLACEMENT FUNCTION

If the energising is interrupted, the solenoid valve remains closed. If this is the case, the fuel tank ventilation stops and fuel odours can be smelled inside the passenger compartment.



D132-54



D132-55

GAS BUTTERFLY THROTTLE CONTROL, G186

It is a **continuous current** electrical motor, energised by the engine control unit, and it is in charge of regulating -in a non-stepped way- the degree of opening of the butterfly, from the idling position to the full load position.

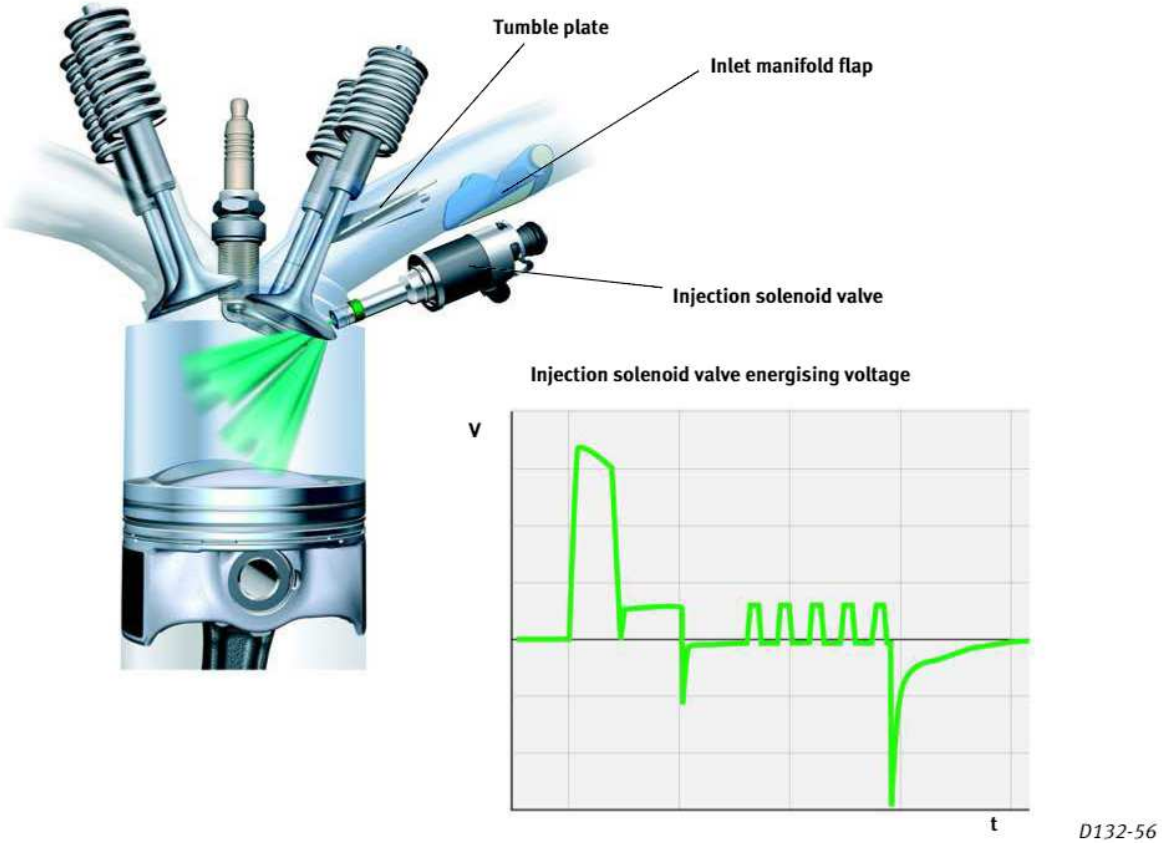
ENERGISING

The engine control unit supplies the electrical motor with two cables, **regulating the direction of rotation** by reversing polarity.

REPLACEMENT FUNCTION

If the butterfly actuator fails, the engine does not respond to the accelerator pedal demand and it is set at a fixed 1500 rpm, because when the butterfly is at rest it is not fully closed, however, mechanically it always maintains an opening of 7 degrees.

The electronic accelerator warning light, K132, is activated on the instrument panel.



INJECTION SOLENOID VALVES N30, N31, N32, N33

The injectors used in the 1.8l and 2.0l TFSI engines have **six fuel output drillings** and inject fuel in six conic jets with an output angle greater than 50º.

This design allows for **better mix** preparation inside the combustion chamber.

These measures contribute to **reducing hydrocarbons** emissions, generating of soot, and oil dilution. Also, the tendency to knocking is also reduced.

The injectors, as with the previous direct injection engines, have been designed to carry out a double injection, at intake and at compression, in order to rapidly increase the temperature of the catalyst.

ENERGISING

The mode of activation of the injectors has not been modified, they are energised at an approximate voltage of 65 volts.

Once the injector needle has lifted, it is enough to apply a pulse energising voltage of approximately 15 volts in order to keep it open.

REPLACEMENT FUNCTION

If any of the injectors fails, the engine control unit detects the affected injector and cuts off its energising.

IGNITION COILS WITH FINAL POWER STAGE N70, N127, N291, N292

The ignition coils, placed over the spark plugs, incorporate a final power stage that gets positive from "15", and working negative.

ENERGISING

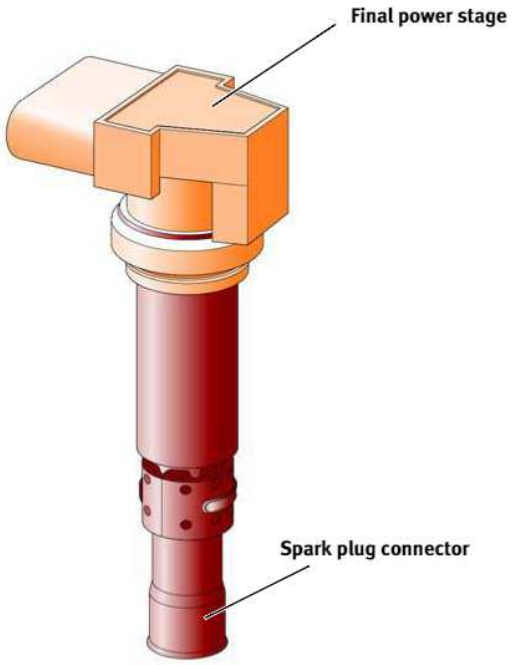
The control unit sends the activation signal of approximately **4 V** in order to energise the transformer. When this signal is interrupted, it generates the spark jump which ignites the mix stored in the combustion chamber.

REPLACEMENT FUNCTION

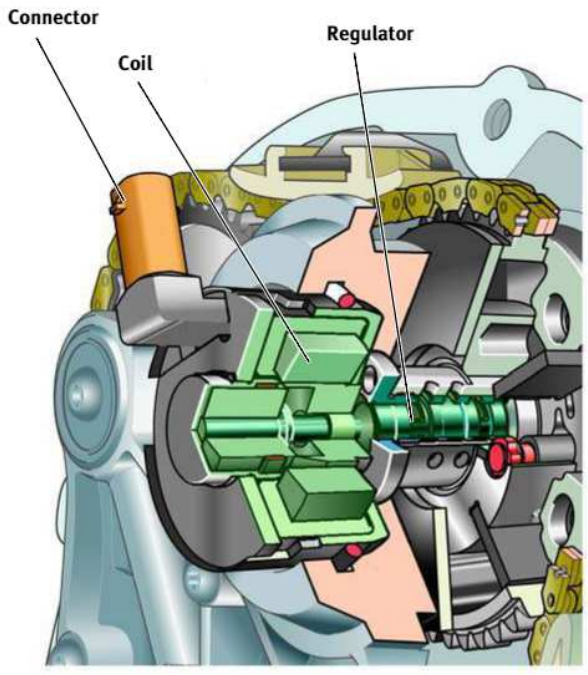
If one of the transformers is faulty, the corresponding cylinder cannot carry out the combustion.

The engine control unit detects this situation, deactivates the injection of that cylinder and activates the EOBD warning light, K83.

If two or more coils fail, the engine will not start.



D132-57



D132-58

VARIABLE TIMING SOLENOID VALVE, N1

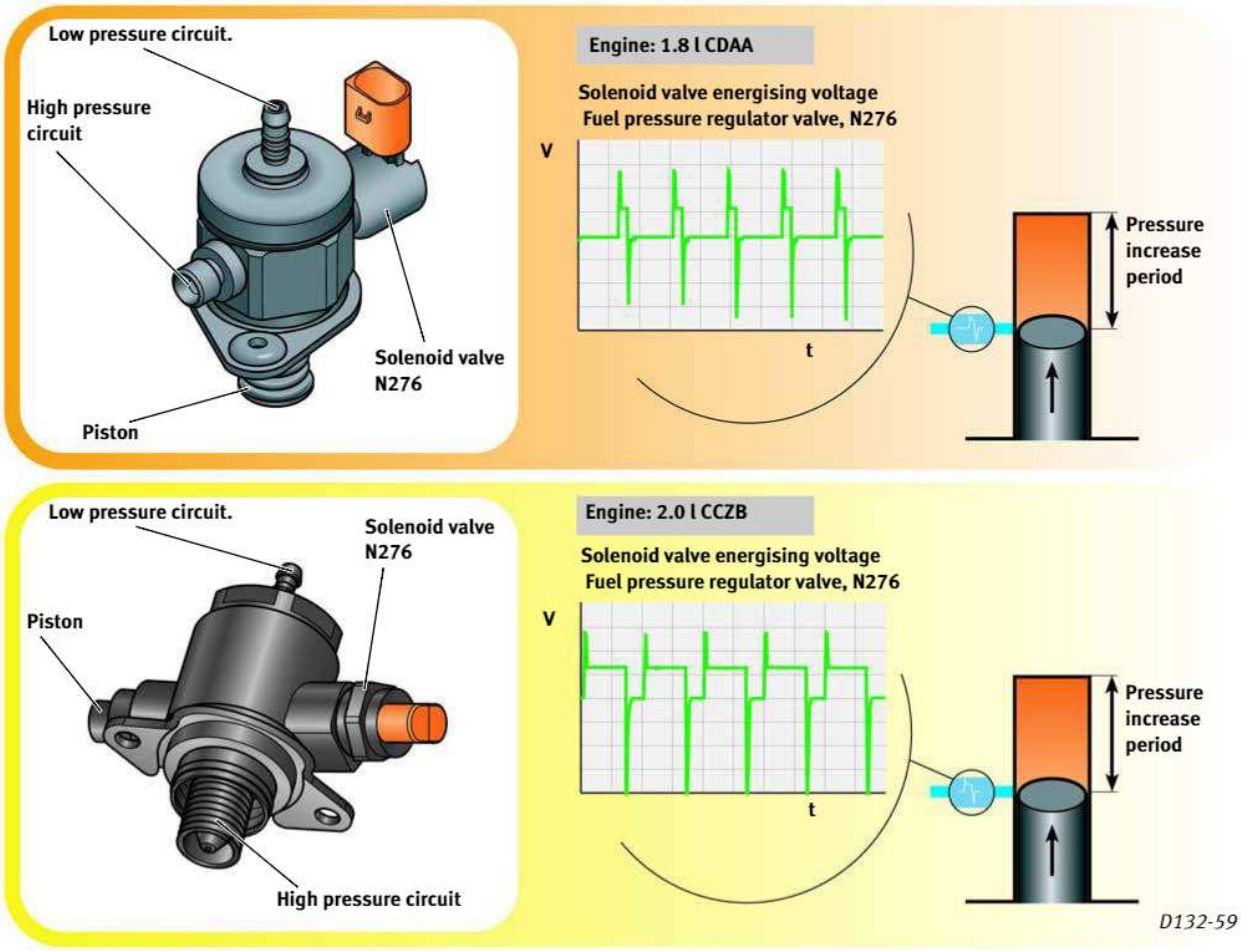
The solenoid valve is screwed on with three screws to the oil distributor bracket on the side of the cylinder head. It participates in the variable timing. Depending on the position of the solenoid valve driven element the passage of the oil is opened to the corresponding variator chamber. This is how, it is possible to **offset the inlet camshaft position** and thus improve engine torque delivery.

ENERGISING

The engine control unit is in charge of energising it by means of a **PWM signal**.

REPLACEMENT FUNCTION

If the solenoid valve is faulty, the inlet camshaft cannot be regulated and it remains blocked in the delayed position, which generates a drop of engine torque.



FUEL PRESSURE REGULATOR SOLENOID VALVE, N276

In both engines the solenoid valve is integrated in the high pressure pump.

The high pressure pump for the 1.8i engine is a Hitachi pump, and the one for the 2.0l engine is a Bosch pump. Operation is very similar in both cases.

ENERGISING

In both cases , the engine control unit energises with negative the solenoid valve N276.

In the 1.8l engine the soleniod **energising** period is **minimum** in order to close the inlet valve during the piston drive stroke and thus make the **pressure increase** fast.

In the 2.0 l engine the energising period is longer so that the inlet valve remains open, in the exact moment of the piston drive stroke the soleoid valve **stops being energised**, the inlet valve closes and the **pressure increases**.

REPLACEMENT FUNCTION

In the 1.8 l engine, is the solenoid valve stops being energised the pressure downgrades, the mix is empoverished and the engine looses power.

FIGURE 1

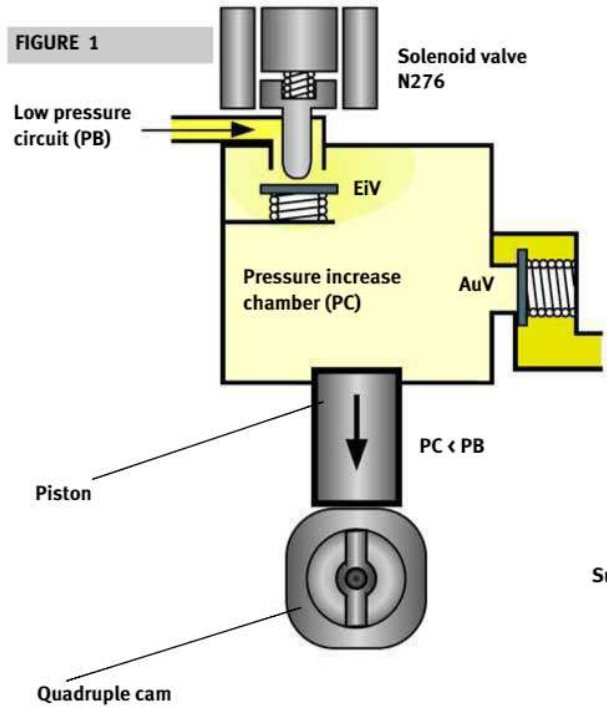
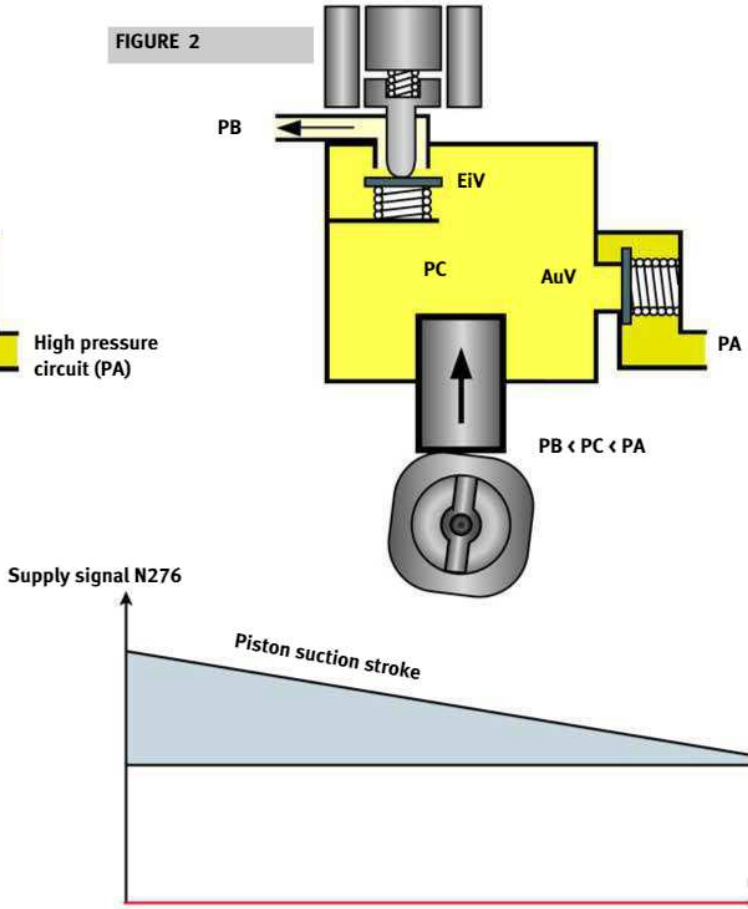


FIGURE 2



The graph shows the high pressure pump operation in the 1.8 l engine. This action takes place **four times** per every **camshaft rotation**. For the 2.0 l engine the operation is the same, except for the energising of the solenoid valve N276, which is energised in all cases except in figure 3, where it stops being energised.

The high pressure and also the amount of fuel are regulated by means of the fuel pressure regulator solenoid valve, N276. The signal from the fuel pressure sensor, G247, placed in the distributor rail is used as a measuring magnitude so that the engine control unit regulates the pressure in the distributor rail.

FIGURE 1, PUMP PISTON IN SUCTION STROKE,

The fuel flows from the low pressure passage to the lifting chamber.

The solenoid valve N276 has no current.

The **intake valve** (EiV) is **open**, because the force of the spring is smaller than the force of the fuel pump, G6, flow (less than 6 bar).

The pressure inside the lifting chamber is regulated because of the existing vacuum.

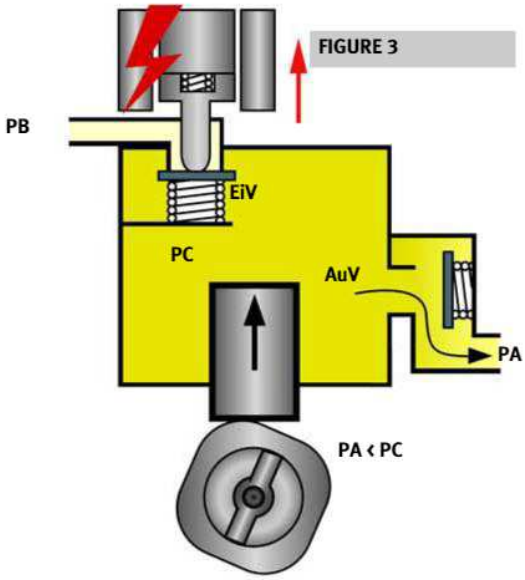
The output valve (AuV) is closed .

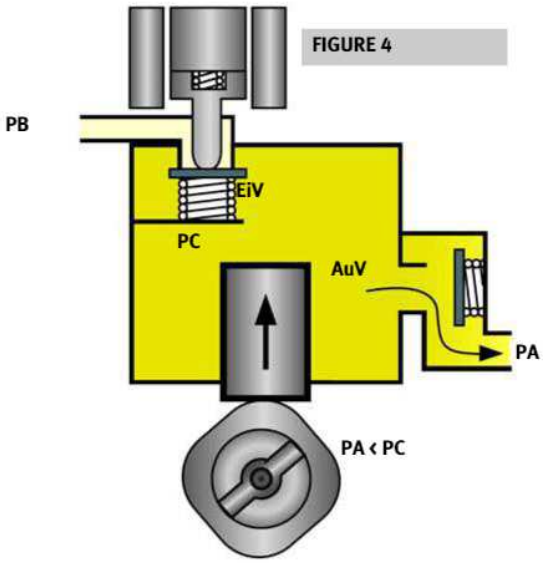
FIGURE 2, PUMP PISTON IN DRIVE STROKE.

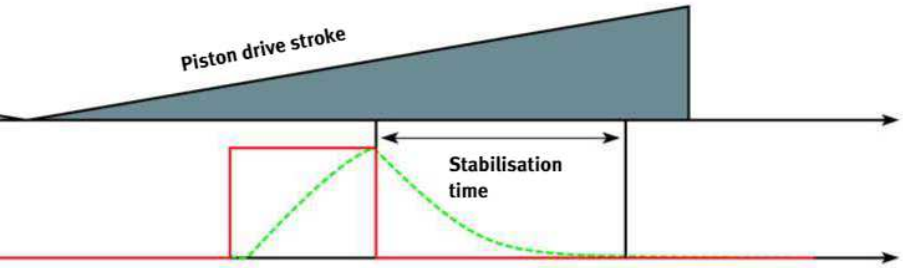
The solenoid valve N276 does not have any current applied to it.

The **inlet valve** (EiV) **tends to close** because of the pressure inside the chamber increases and overcomes the pressure in the low pressure circuit.

However, the N276 solenoid valve holds it slightly open so that there is a small leak of fuel to the low pressure circuit. In spite of the piston generating a pressure increase inside, the leak of fuel does not allow for the pressure to overcome the pressure in the distributor rail thus







D132-60

guaranteeing that the **output valve** (AuV) remains **closed**.

FIGURE 3, PUMP PISTON IN DRIVE STROKE.

The **N276** valve gets a brief current **pulse** from the engine control unit. The Solenoid valve N276 needle moves back and the **inlet valve** (EiV) **closes**.

Because of the upwards movement of the piston, the pressure in the lifting chamber increases immediately.

As soon as the pressure inside the chamber overcomes the pressure in the high pressure passage, the output valve (AuV) opens and the pressure inside the fuel distributor rail increases.

FIGURE 4, PUMP PISTON IN DRIVE STROKE.

Fuel flows to the distributor rail until the piston begins its suction stroke.

The solenoid valve N276 has no current.

The **intake valve** (EiV) is **closed** until, in the suction stroke, the pressure in the lifting chamber is lower to the force of the spring of the N276.

The (AuV) **output valve** remains **open** until -in the suction stroke- the lifting chamber pressure is lower than the pressure in the distributor rail.

Next, one cylinder injection takes place.

OVERBOOST LIMITER SOLENOID N75

The solenoid valve is placed in the turbocharger and is in charge of regulating the overboost value generated by the turbocharger.

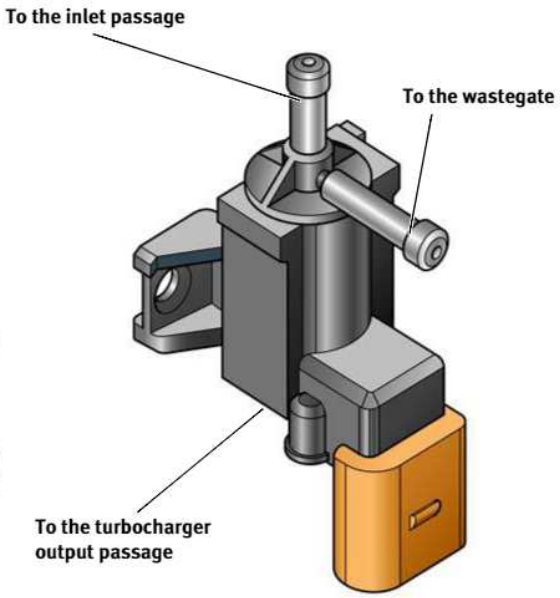
ENERGISING

The engine control unit energises the solenoid valve with a PWM signal. This is how the existing pressure in the gauger capsule is controlled, and with it, the release valve degree of opening.

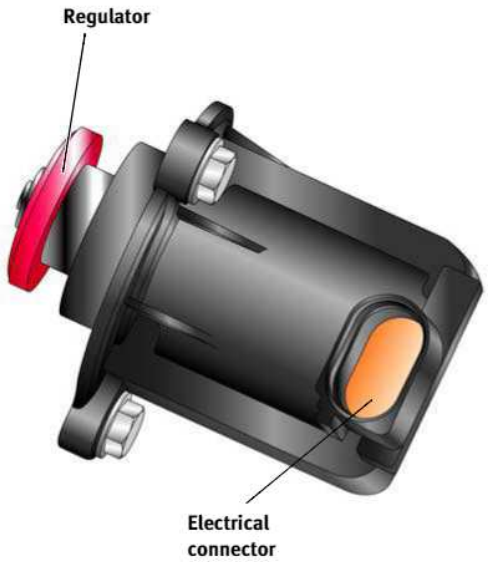
The wastegate diverts part of the exhaust gases to the pre-catalyst thus reducing the turbocharger rotations.

REPLACEMENT FUNCTION

In the event of a fault, the gauger capsule is connected to the pressure at the turbocharger output. This generates an engine power output drop.



D132-61



D132-62

TURBOCHARGER AIR RECIRCULATION SOLENOID VALVE N249

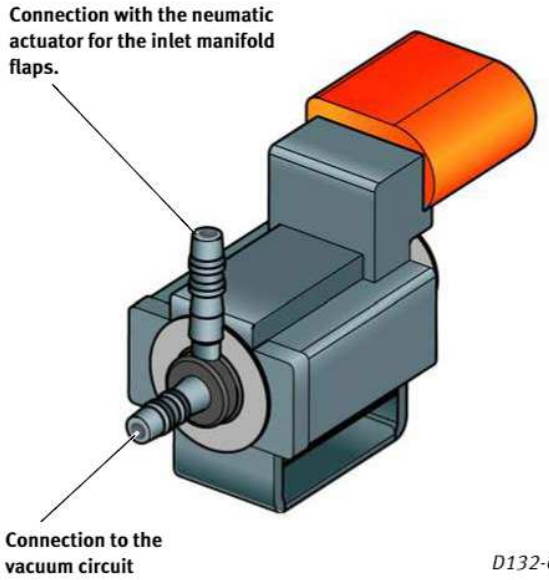
The solenoid valve is screwed to the turbocharger housing. It communicates the air intake and the turbo air output on the inlet side in order to avoid the turbo "drop" during the deceleration phase.

ENERGISING

The engine control unit energises the solenoid valve, which makes the impelled air return to the suction side and maintains the blower fan revs stable for delivering a good vehicle response in the moment of acceleration.

REPLACEMENT FUNCTION

If there is a fault the driver feels a lack of engine response when accelerating after a period of deceleration.



D132-63

INLET MANIFOLD FLAP SOLENOID VALVE, N316

It is placed in the in the inlet manifold and connects the vacuum circuit with the neumatic actuator for the inlet manifold flaps. In such a way that the flaps can be activated.

ENERGISING

The engine control unit activates the solenoid valve with **negative**. When the engine revs sensor, G28, informs that 300 rpm have been surpassed.

REPLACEMENT FUNCTION

In the event of a fault the inlet flaps remain closed, at rest position, and a drop in performance can be felt at over 3000 rpm.

COOLANT FAN CONTROL UNIT, J293

The control unit is placed on the V7 fan.

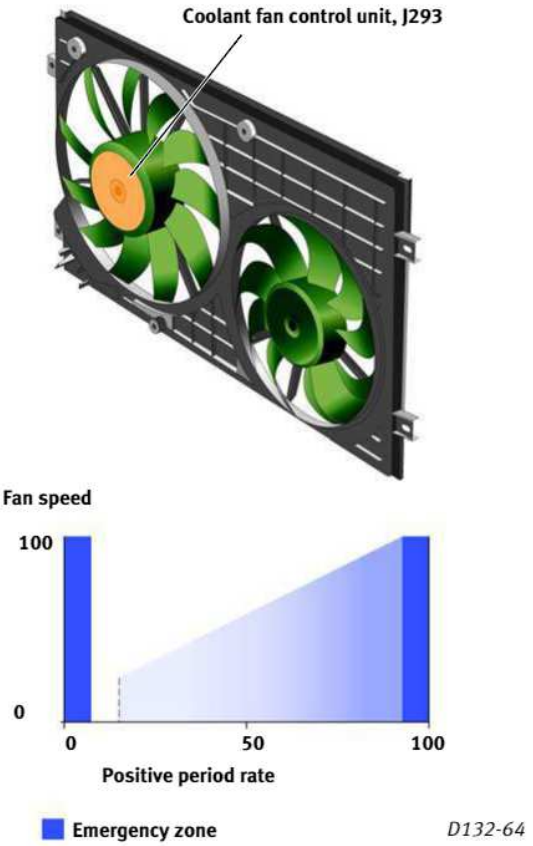
ENERGISING

It gets **a PWM signal** from the engine control unit. When increasing the positive duty cycle of the signal the speed of rotation of the coolant fans, V7 and V177, increases progressively and in a non-stepped manner.

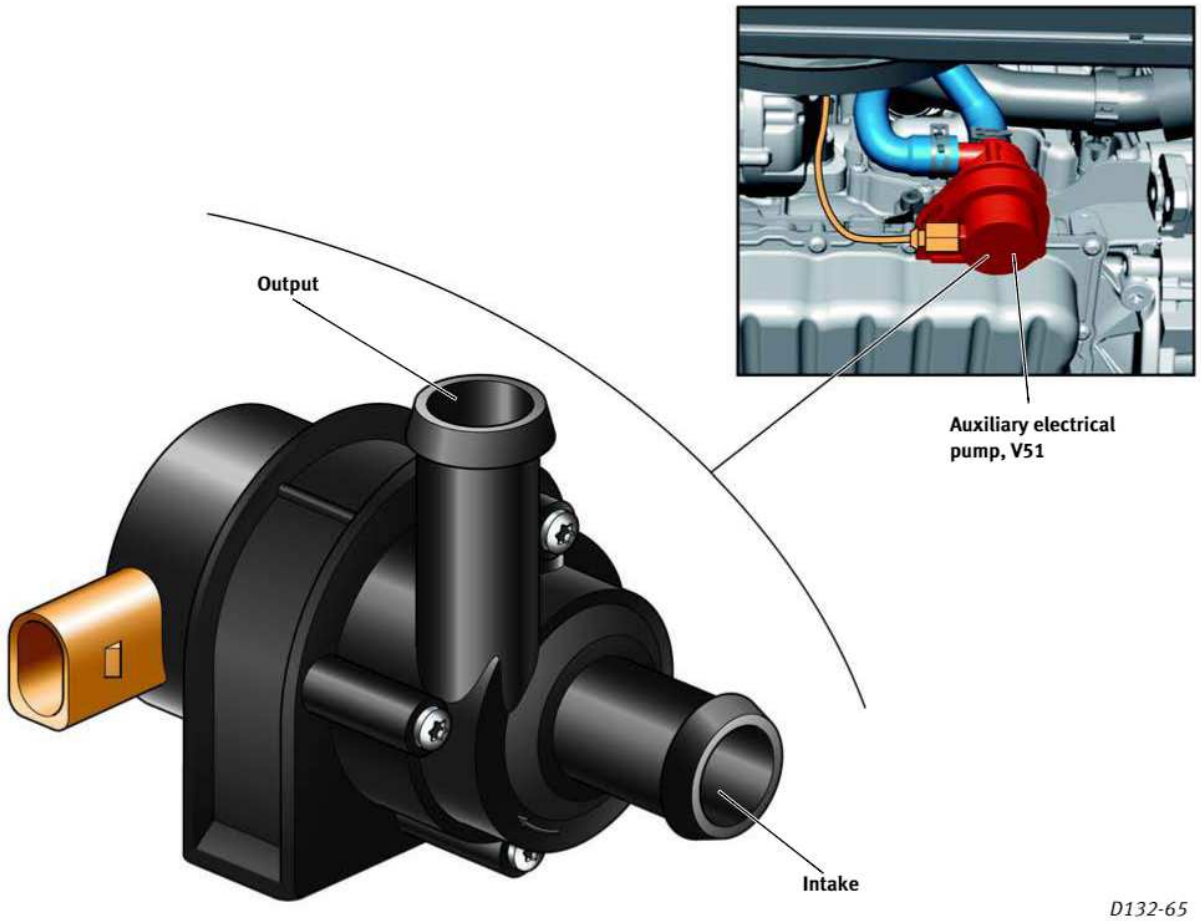
REPLACEMENT FUNCTION

The fans control unit has two emergency performance zones. The first zone is when the duty cycle of the signal received is bleow 8%. The second one includes the zone where the positive duty cycle of the signal is higher than 95%. When the signal is in any of these two zones, the unit activates the fans maximum speed permanently.

This guarantees engine cooling in any fault situation.



D132-64



AUXILIARY ELECTRICAL PUMP, V51

The V51 pump is in charge of forcing the coolant circulation to **cool the turbocharger** after the engine has stopped.

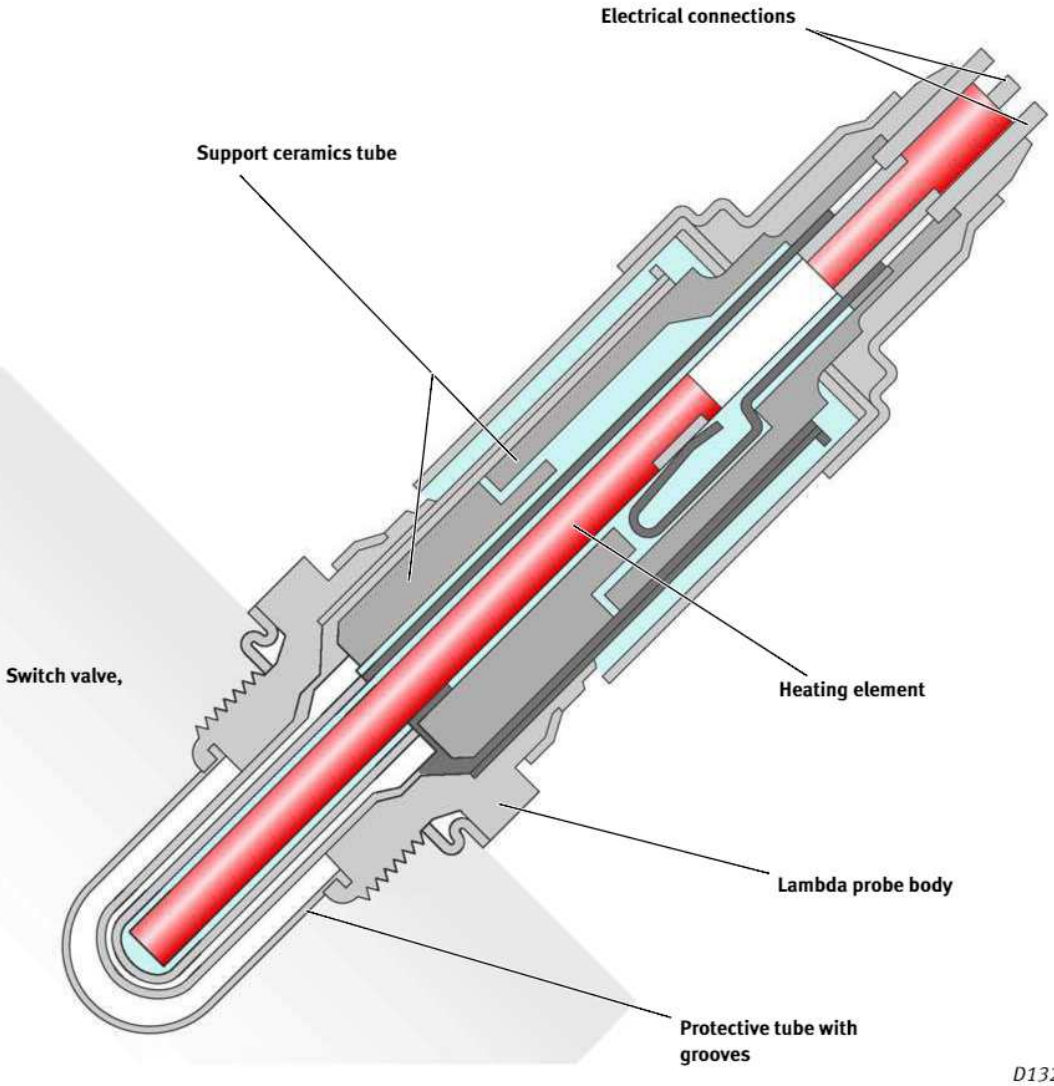
ENERGISING

The engine control unit energises the V51 pump through the coolant postcirculation relay, J151. Once the engine has stopped and the ignition switched off, the engine control unit sends negative to the relay J151 to activate the pump V51.

The period of pump activation depends on the temperature achieved by the engine and can last up to a maximum of 15 minutes.

REPLACEMENT FUNCTION

If the pump fails, the post-circulation cycle of the coolant is not possible and turbocharger overheating might occur.



D132-66

LAMBDA PROBE HEATING, Z19, AND LAMBDA PROBE 1 HEATING AFTER CATALYST, Z29.

The heatings for the lambda probe are a **PTC resistances** integrated inside each lambda probe.

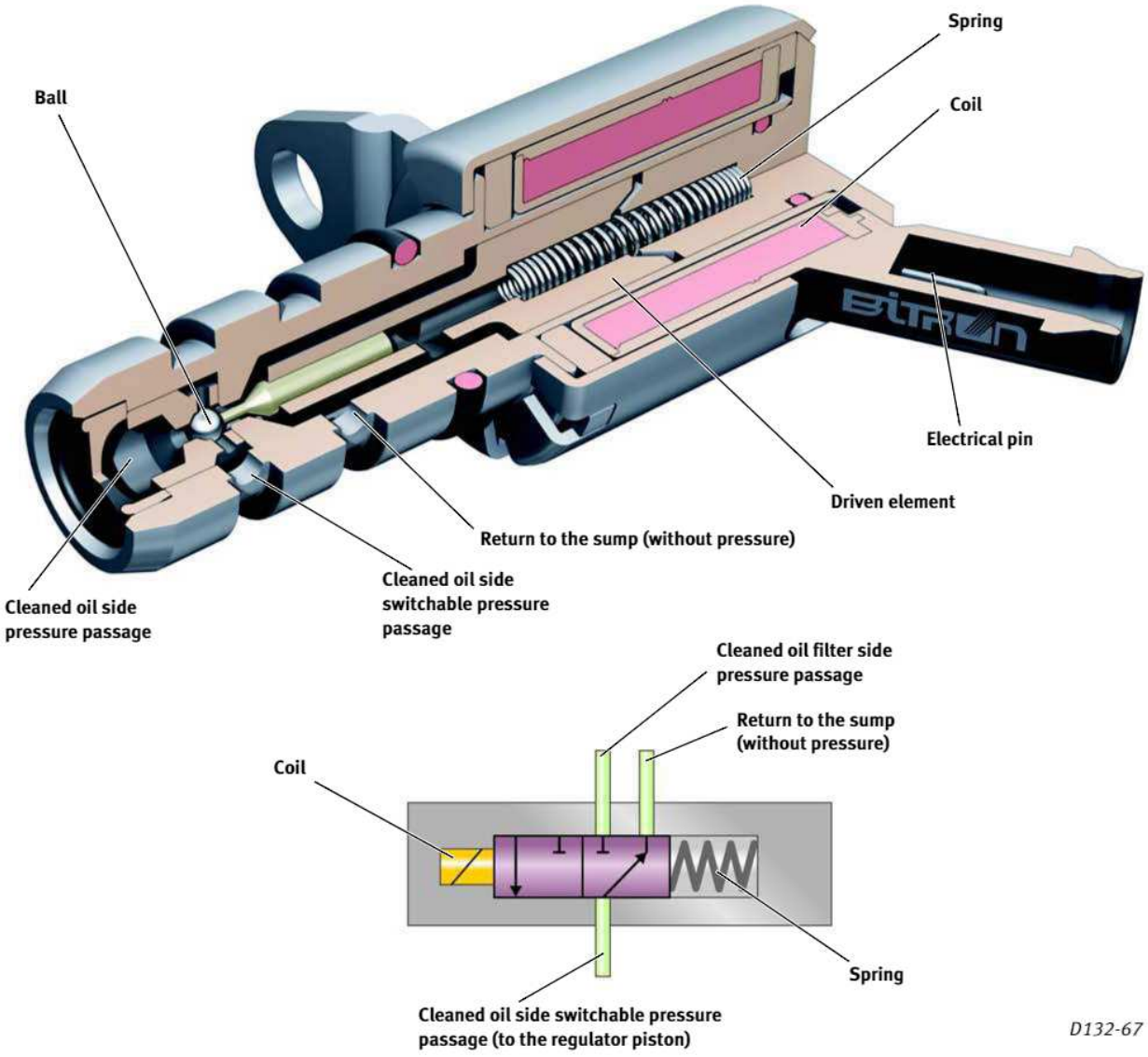
The purpose of the heating is to heat up the probe so that it rapidly reaches its minimum service temperature. It also allows extending the useful life of the lambda probe, as it is not fitted so close to the engine.

ENERGISING

The heatings are supplied with **negative** by the engine unit during the engine heating phase.

REPLACEMENT FUNCTION

If the heating energising signal is missing, the lambda regulation stops, the lambda self-adaptation is blocked, and the amount to be injected is less adjusted.



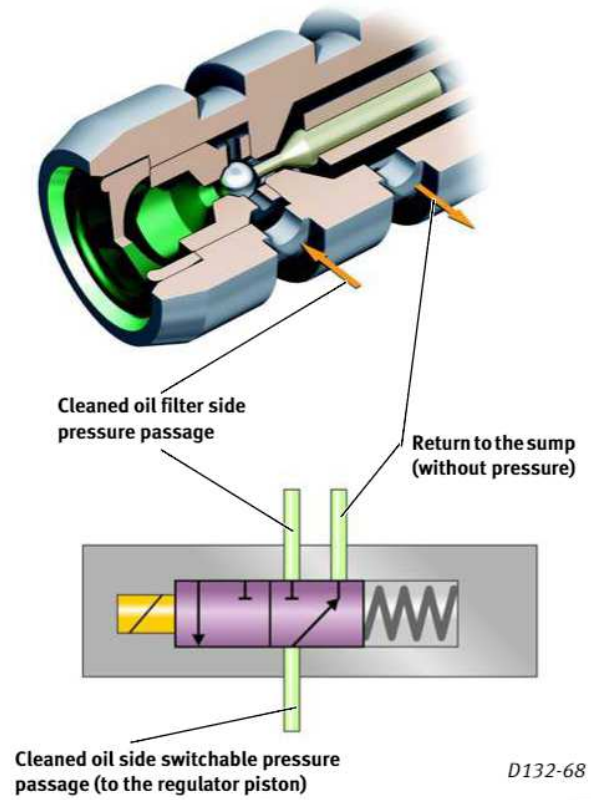
OIL PRESSURE REGULATION SOLENOID VALVE, N428

It is a solenoid valve with three passages, where two of them are always communicated.

It is an electromagnetic activation solenoid valve, and it is screwed onto the engine block next to the oil pump.

The solenoid is used for regulating the oil pressure.

The solenoid valve is basically **made of**:
- a coil,
- a drive element with a ball,
- and a spring.

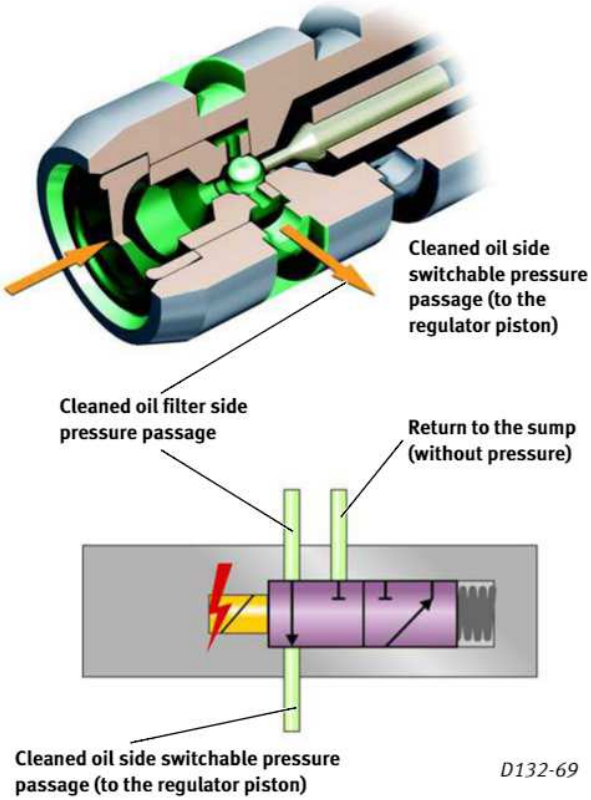


D132-68

ENERGISING

The engine control unit assumes the energising of the solenoid valve through the negative control.

When **at rest**, without electrical energising, the switchable pressure passage is hydraulically connected from the side of the cleaned oil (to the regulator piston) with the sump return passage.



D132-69

When **energised**, the engine control unit sends earth to the solenoid valve, the driven element and the ball move back and the cleaned oil side pressure passage (from the filter) is communicated with the switchable pressure passage of the side of the cleaned oil (to the regulator piston).

REPLACEMENT FUNCTION

If the solenoid valve is faulty, the oil pressure regulation cannot be carried out.

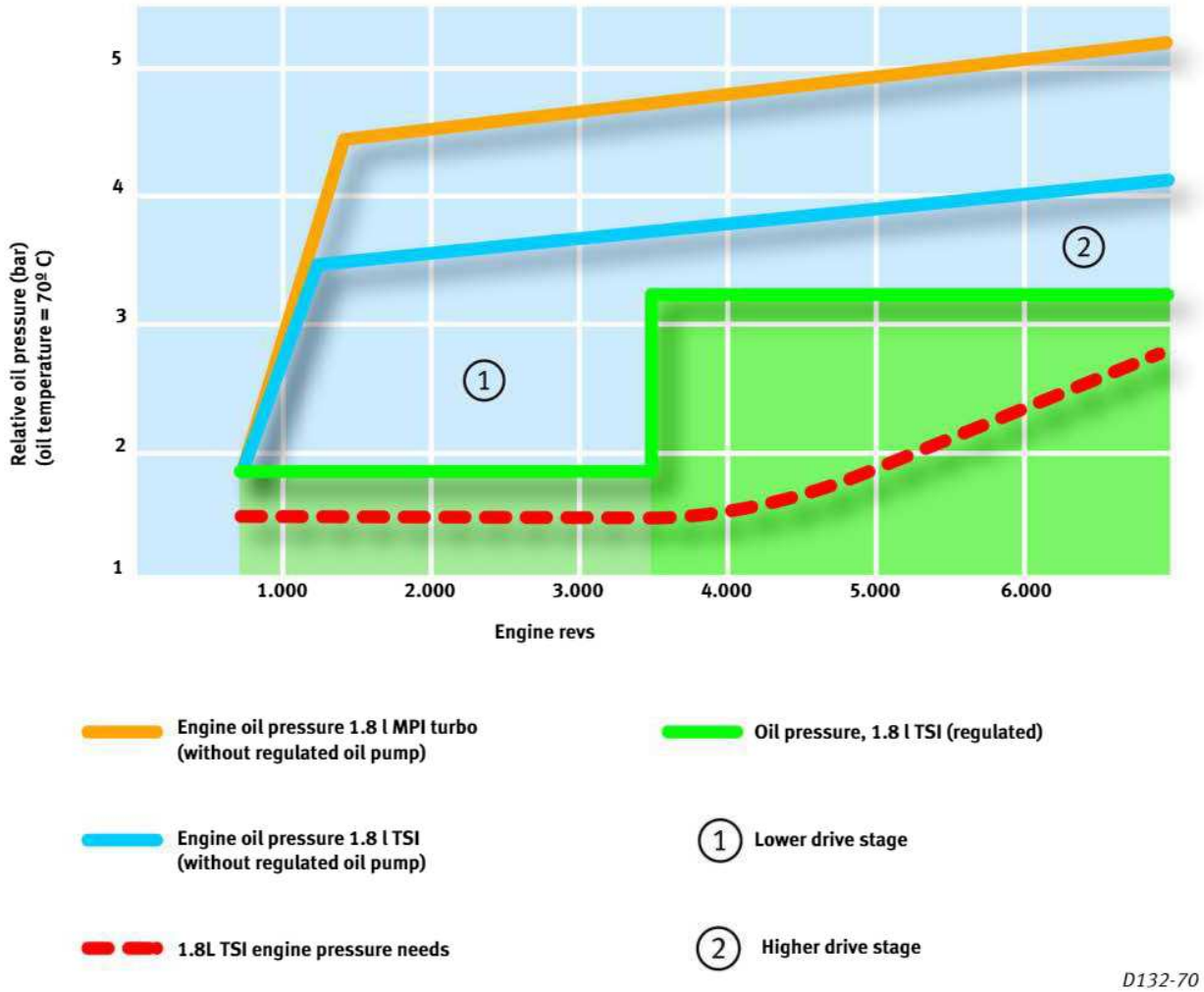
OIL PRESSURE REGULATION

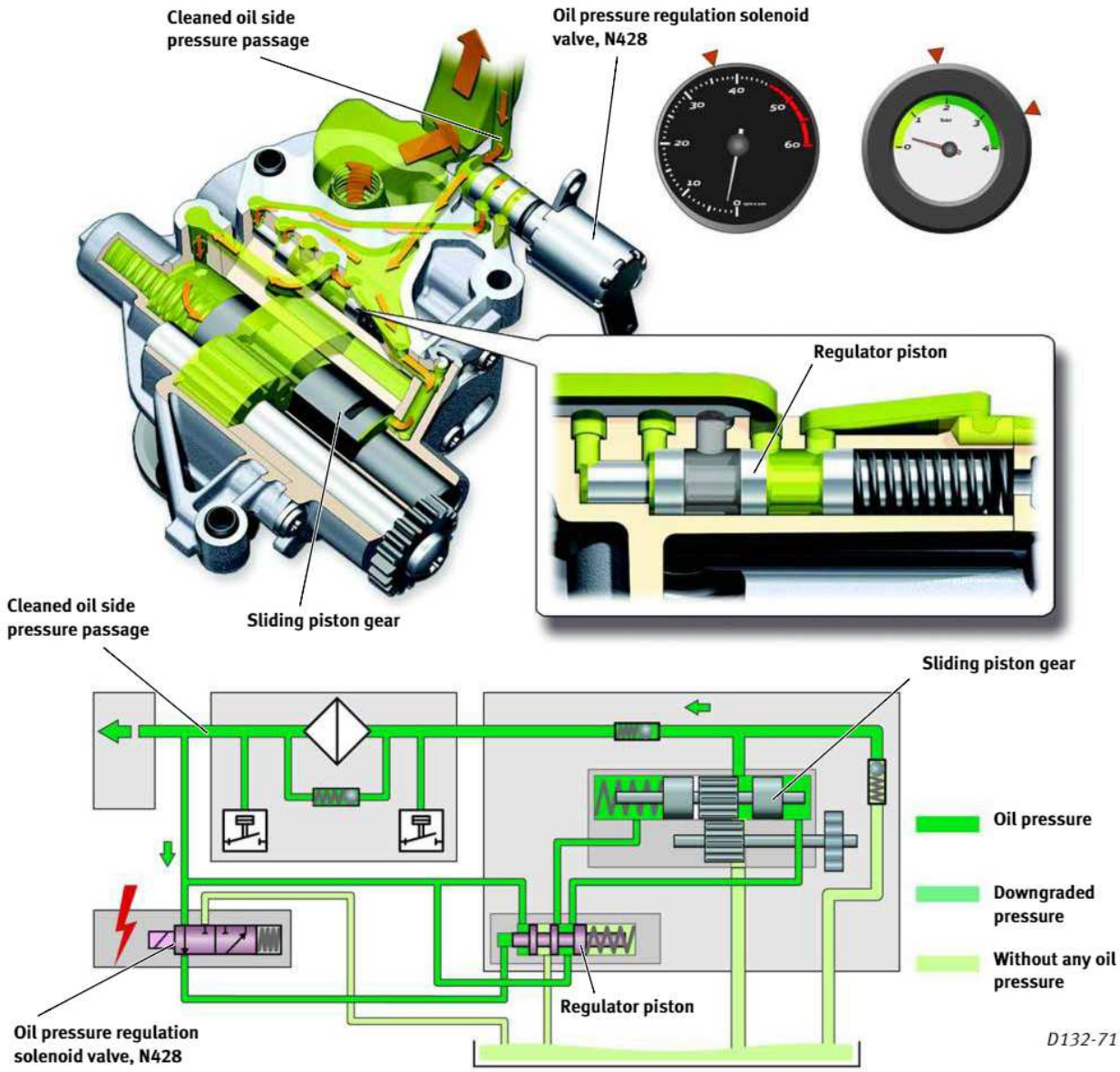
There are two stages of oil pressure regulation:

- **Lower drive stage**: includes the range of revs from idling to 3500 rpm. The oil pressure in this period is approximately 1.8 bar.
- **Higher drive stage**: includes the range of revs from 3500 rpm to the injection cut. The oil pressure in this period is approximately 3.3 bar.

As can be observed in the graph, the flow and the pressure provided by the regulated oil pump is better adjusted to the real needs of the engine, which contributes to a more efficient operation and therefore lower fuel consumption.

Note: *During the first 1000 km, the control unit does not regulate the oil pressure, behaving just like during the higher drive stage.*





ENGINE START

When starting the engine it is necessary to drive the maximum flow of oil so that the mechanical components are lubricated as soon as possible.

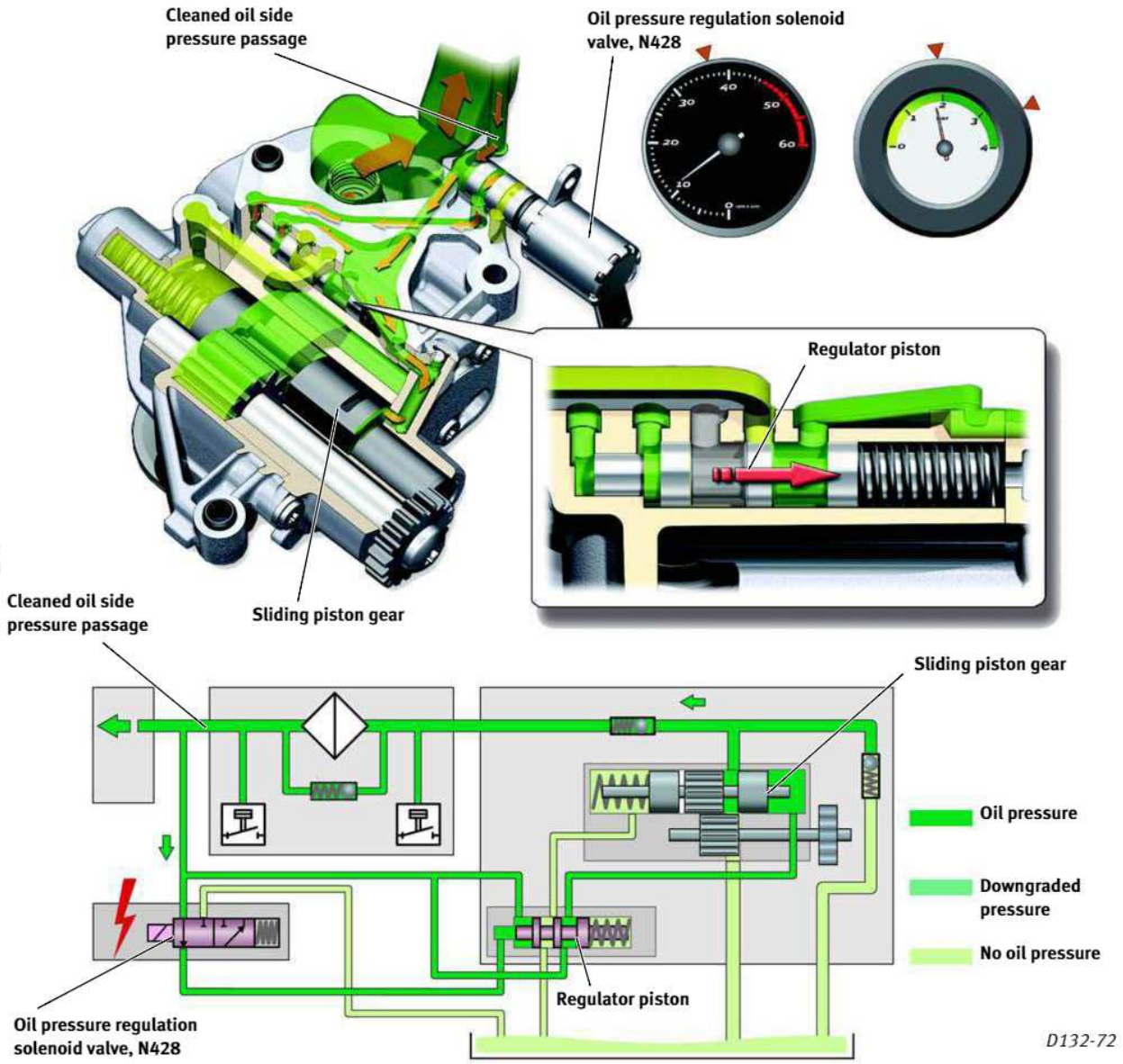
The oil flows through the pressure passage from the cleaned side and reaches all the surfaces of the regulator piston and to both sides of the sliding gear unit.

The engine control unit **energises the solenoid valve** N428 so that it keeps the switchable pressure passage open. Thus, all the regulator piston surfaces are subject to oil pressure.

This is how the **sliding gear unit** remains in the **initial position**.

Thus, the pump supplies with maximum flow until it reaches the lower drive stage (approximately **1.8 bar**, which are reached at about 1100 rpm).

OIL PRESSURE REGULATION



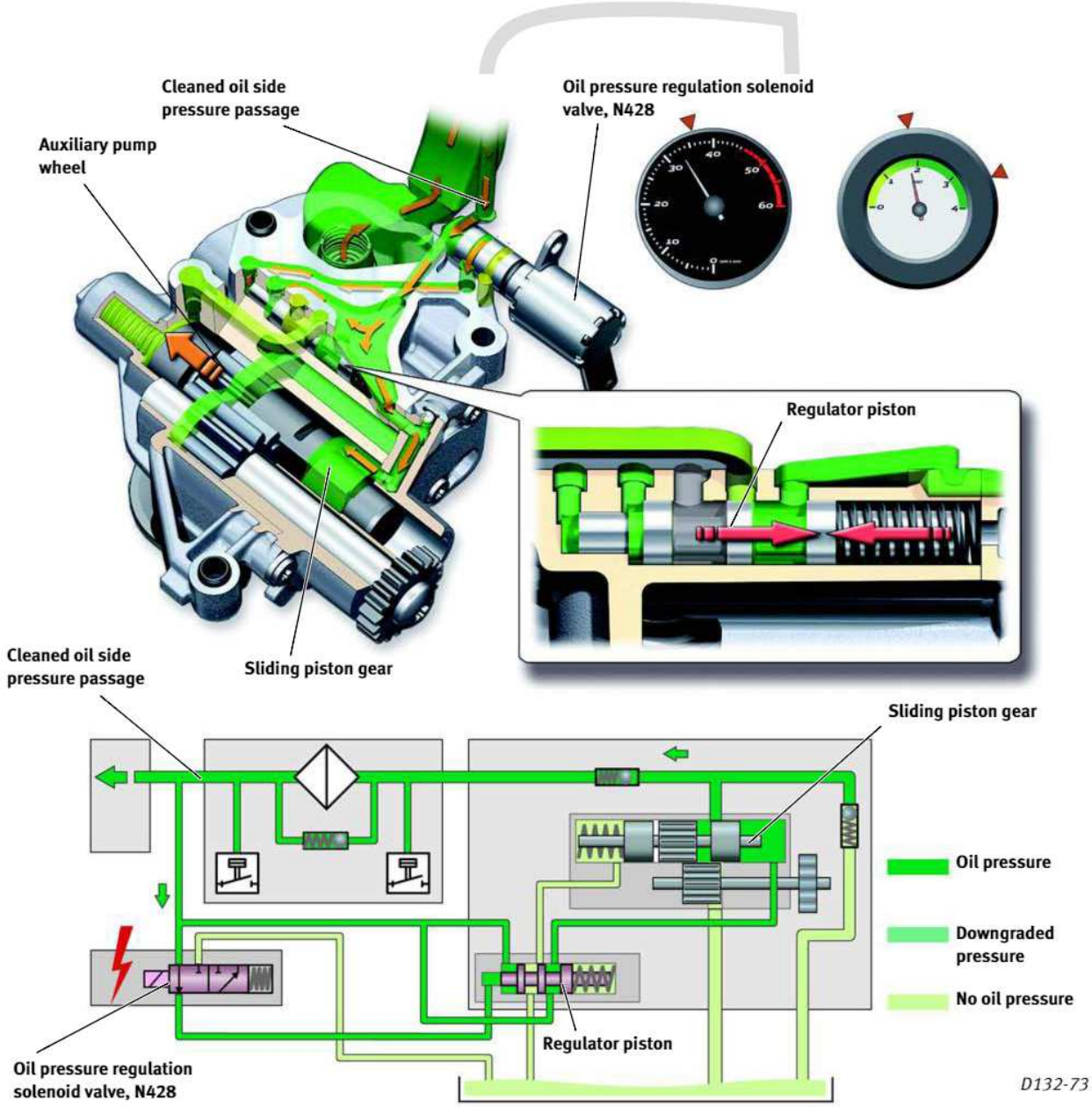
LOWER DRIVE STAGE: BETWEEN IDLING AND 3500 RPM

Once 1.8 bar are reached at approximately 1100 rpm, if the revs continue rising in a regulated pump (the two gears are lined up and facing each other) the pressure rises rapidly when it is not necessary.

To prevent this undesired effect the regulated pump acts as follows:

The **solenoid valve,** N428, **is energised**, when the revs increase the pressure also rises and makes the regulator piston move against the force of the spring. The presure passage to the front end of the piston closes in the sliding gear unit and at the same time sends return oil to the sump.

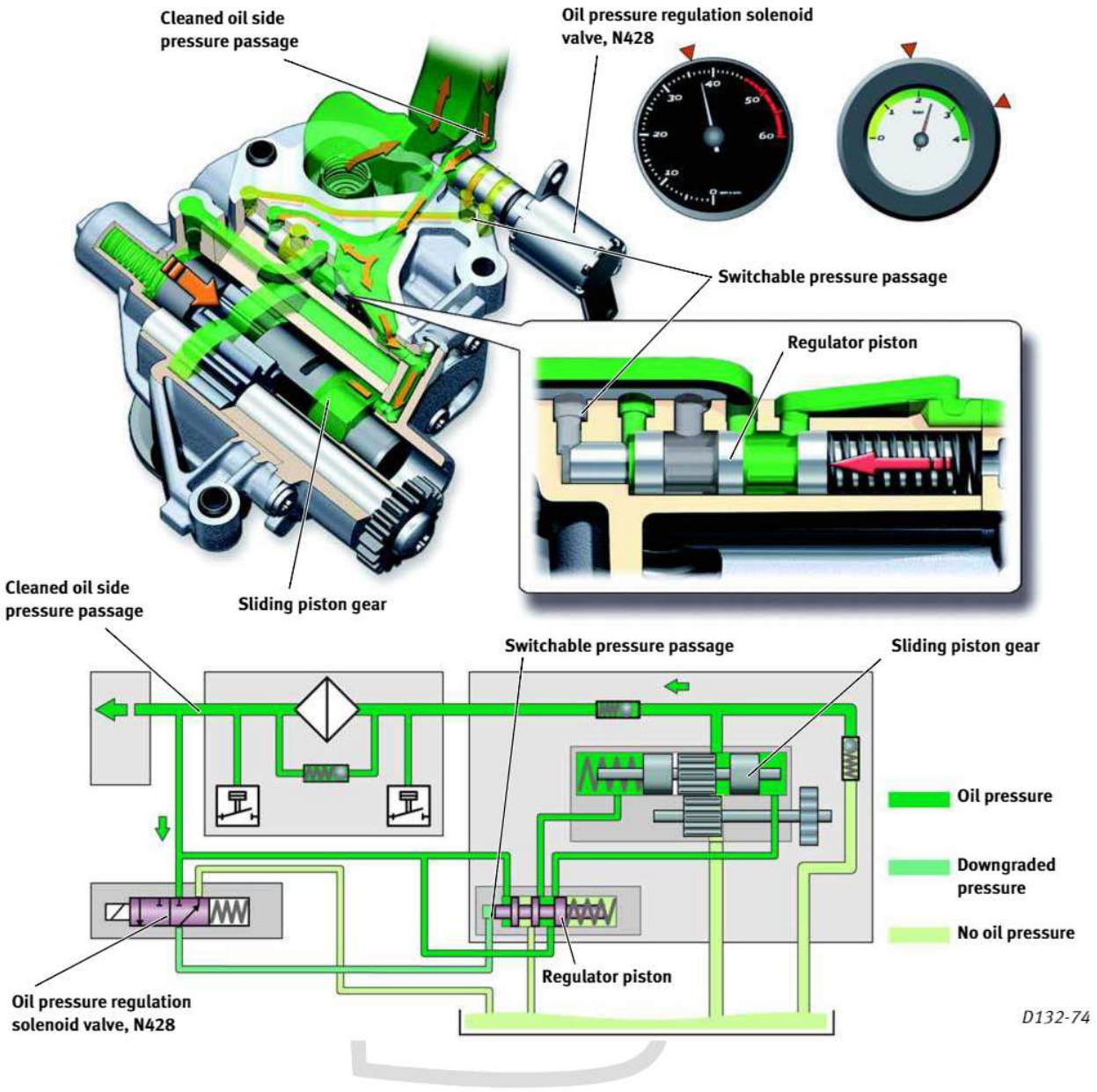
The hydraulic pressure rises on the rear surface of the **sliding unit piston** and overcomes the spring force and the auxiliary gear moves axially in relation to the main gear. This is how less flow is driven and the **pressure** remains relatively constant a **1.8 bar**.



JUST BEFORE SWITCHING OVER TO THE HIGHER DRIVE STAGE

The auxiliary gear is moved to the maximum so that for these revs the minimum possible flow is driven to compensate for the pressure increase generated when the engine revs increase.

OIL PRESSURE REGULATION



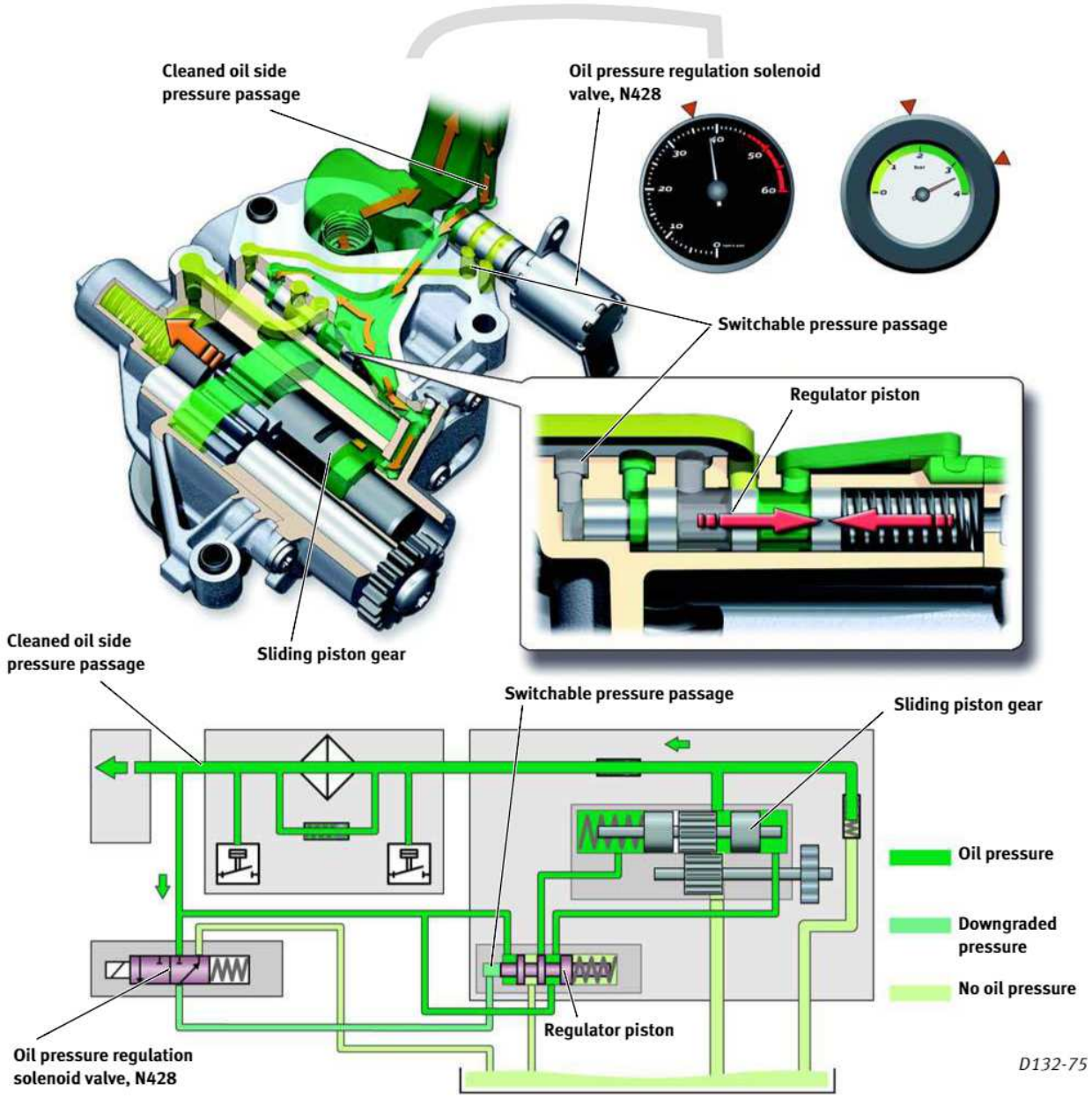
HIGHER DRIVE STAGE

In this stage the oil pressure reaches its maximum value. There are three stages:

- Switching
- Between 3500 rpm and maximum revs.
- At maximum revs.

SWITCHING

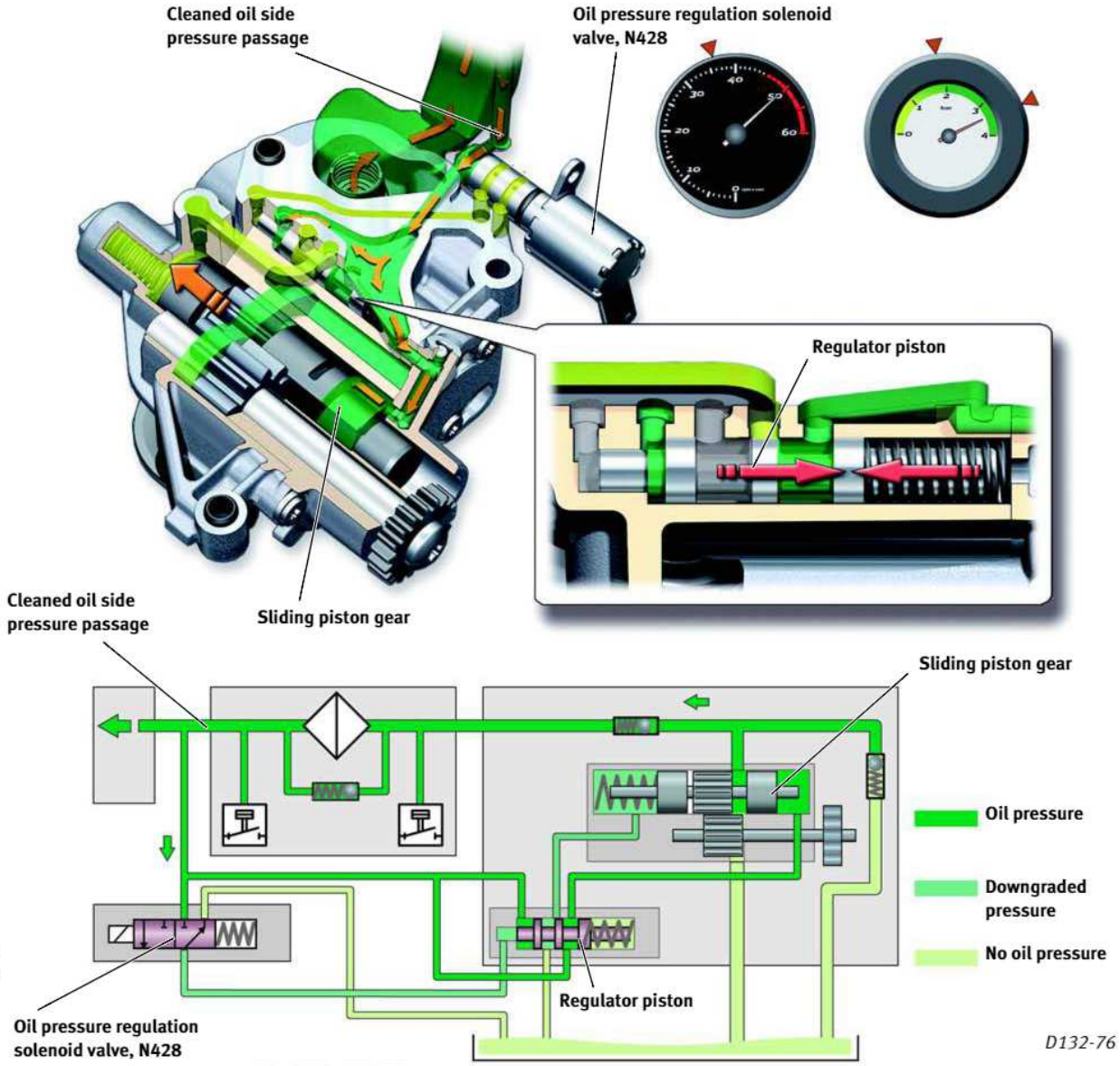
From 3500 rpm it switches to the higher drive stage. For this, the **ebergising** of the **solenoid valve** N428. As there is no oil pressure in the switchable pressure passage it closes due to the action of the regulator spring, at the same time as the passage opens to the front surface of the piston and the pressure downgrades. This is how the pressure increases on the front of the **piston in the sliding gear unit** and the auxiliary gear moves back and faces the main gear and drives the **maximum flow**. The sliding gear unit remains in this position until an approximate **oil pressure** of **3.3 bar** is reached.



BETWEEN 3500 RPM AND MAXIMUM REVS

The **solenoid valve,** N428, continues **unenergised**, therefore, the switchable oil passage remains closed. If the engine revs increases, the oil pressure increases through the pressure passage on the cleaned oil side. This makes the pressure increase on the rear end of the **piston in the sliding gear unit**, and the pressure in the circuit is **3.3 bar**. So as the revs increase the pressure increases and the auxiliary shaft moves and drives less oil flow. The oil switch, F22, registers switching to the higher drive stage.

OIL PRESSURE REGULATION



AT MAXIMUM REVS

When the **solenoid valve**,N428, is at **rest**, it is never energised.

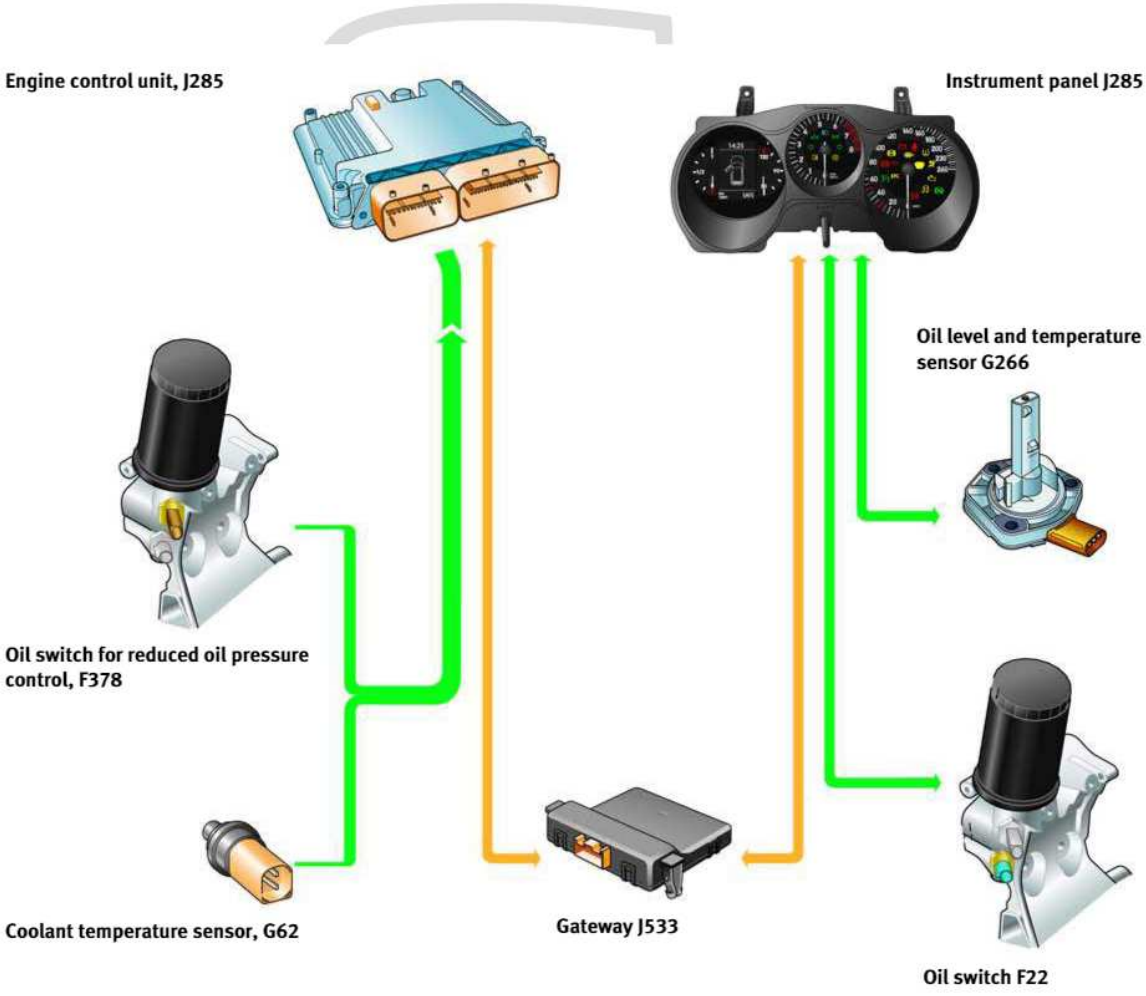
To limit the **pressure at 3.3 bar** and **prevent** the pressure fom rising with the engine revs **increase**, the piston and the sliding gear unit work together.

That is, when the regulator piston reaches the maximum pressure it compresses the spring even more, and the oil passage to the front surface of the piston are communicated with the sump return passage. The result is a small pressure drop on the front surface of the sliding unit, the pump auxiliary gear moves and drives **less flow**.

As the oil pressure drops slightly the spring moves the regulator piston and sends pressure again to the front surface of the sliding gear unit, the auxiliary gear of the pmp moves in the opposite direction and drives **more flow**.

This is a **continuous regulation**, meaning that the circuit pressure remains stable at 3.3 bar independently of what the engine revs are.

OIL PRESSURE MONITORING



The engine control unit evaluates the signal from the switches F22 and F378 when the engine is running and when the engine is stopped.

The switch F78 signal is directly sent to the engine control unit.

The switch F22 signal is sent to the instrument panel where it is transformed into a CAN message and sent into the instrument panel CAN-Bus line. The message travels through the Gateway to the drive CAN-Bus so that it is picked up by the engine control unit.

The control unit uses the signal from the **oil switch F22** as a **plausability** signal to confirm when the regulated oil pump **change** of stage takes place.

Depending on the oil temperature (oil level and temperature sensor G266), the engine control unit adapts the solenoid valve N428 switching to diferent revs.

The coolant temperature sensor, G62, is used as a replacement signal if the G266 sensor fails.

OIL PRESSURE MONITORING

PLAUSIBILITY WHEN THE ENGINE IS STOPPED

When the engine is stopped there shouldn't be any oil pressure in the circuit. This is why, if it is detected that any of the two switches is closed, the system understands that there is an electrical fault and when connecting terminal 15 the **red** instrument panel oil pressure warning light, K3, **blinks**.

If the instrument panel includes a TFT display the warning light is activated on the display.

D132-78

WARNING WHEN THE ENGINE IS RUNNING

The switch F378 monitoring is carried out independently from the engine temperature, oil temperature and revs.

If it is detected that the switch is opne when the engine is running, the **red** oil pressure warning light, K3, **blinks**.

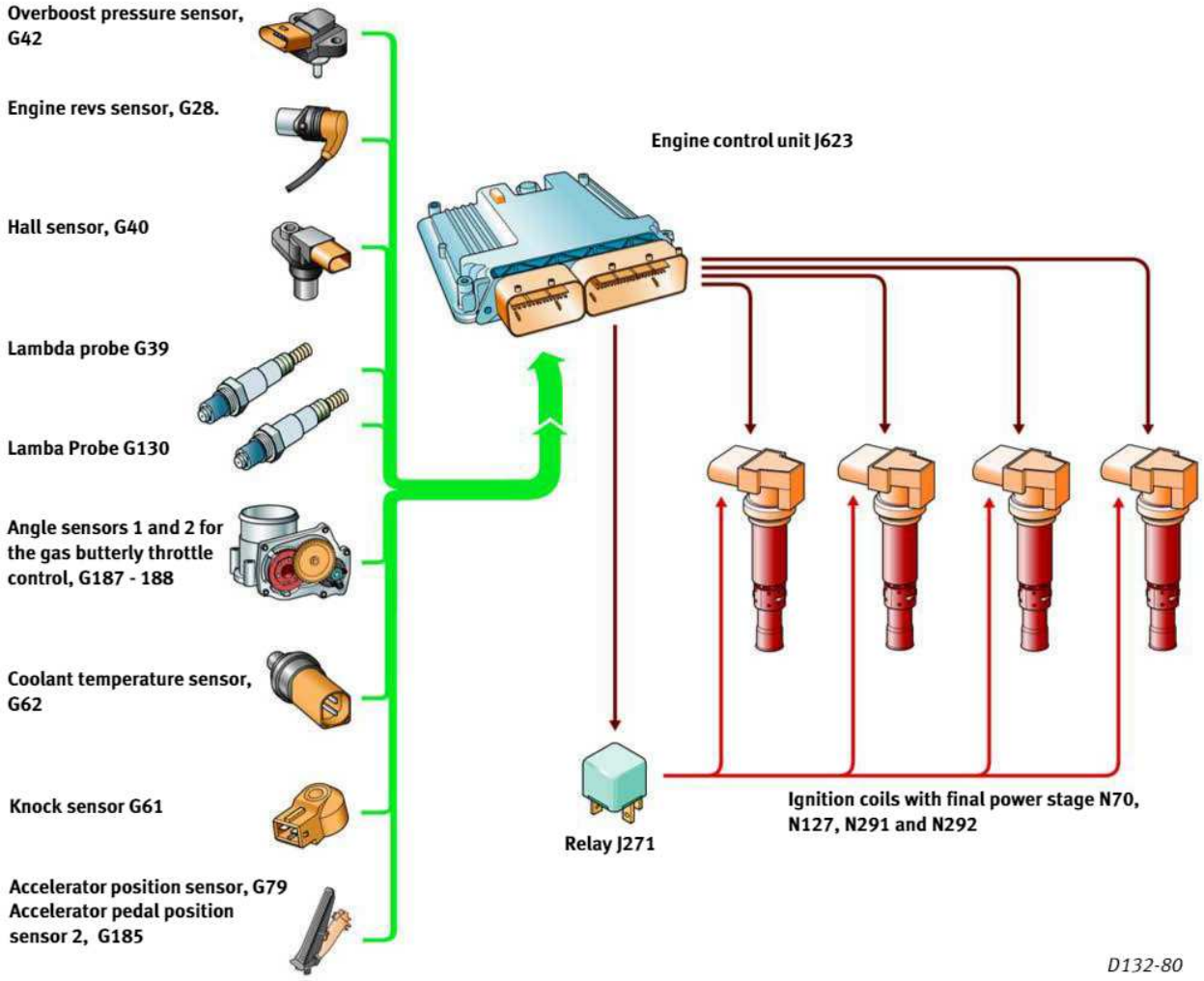
The switch F22 warning is activated when the pump is in the higher drive stage (+3.500 rpm) and the engine revs surpasses a value calculated depending on the oil temperature.

Once this has happened the electronic accelerator warning light, K132, is activated on the instrument panel and the engine revs are limited to about 4000 rpm.

The oil temperature sensor, G266, and the coolant temperature sensor, G62, readings are taken although the yellow warning light, K132, blinks three times when switching on the ignition.

D132-79

IGNITION



Ignition is takes place independently in each of the cylinders.

The control unit calculates the moment of ignition by taking into consideration two basic signals, engine revs and load.

As correction signals it uses information about the coolant temperature (G62), intake air temperature (G42), and the lambda value (G39).

Once the exact moment of the spark has been defined, this value can be modified in the following situations:

knock regulation,

and, rapid catalyst heat-up.

Knock regulation allows delaying the moment of ignition selectively in each cylinder; for this, it uses the information from the knock sensor, G61, which together with the engine revs sensor, G28, and the Hall sensor G40 allow determining in which of the cylinders knocking is taking place.

During the catalyst heat-up phase, the engine control unit as well as empoverishing the mix also delays the moment of ignition in order to increase the temperature of the exhaust gases and contribute to heating up the catalyst.

FUEL INJECTION

To define the amount of fuel to inject, the engine control unit modifies the opening time of the injectors and the distributor rail fuel pressure with the fuel pressure regulator valve, N276.

The **amount** of fuel to be injected is **calculated** by taking into consideration the actual **mass** of **air** drawn in. The real amount of air drawn in is obtained through the air mass meter, G70.

There are other corrective signals such as the intake air temperature (G42) and the coolant temperature (G62).

The engine control unit carries out a last correction of the flow to be injected by taking into consideration the information from the lambda probe before the catalyst, G39.

Once the necessary amount of fuel for each situation has been defined, the fuel is injected sequentially.

However, if the engine revs are above 1800 rpm and the accelerator pedal is not activated, the control unit understands the engine is in retention phase and activates the **inertia disengagement**, that is, it cuts off the injection, thus reducing fuel consumption and the emission of polluting gases. For this it uses the accelerator position sensor, G79, signal and the accelerator pedal position sensor 2, G185, signal.

Limiting the maximum engine revs is done by deactivating the injection of each of the cylinders independently.

The Hall sensor, G40, and the engine revs sensor, G28,signals are used for calculating the moment of injection.

If the airbag control unit deploys any airbag, this unit sends into the drive CAN-Bus line a message that is picked up by the engine control unit so that it cuts off the ful pump energising.

Air mass meter G70

Engine revs sensor, G28.

Hall sensor, G40

Lambda probe G39

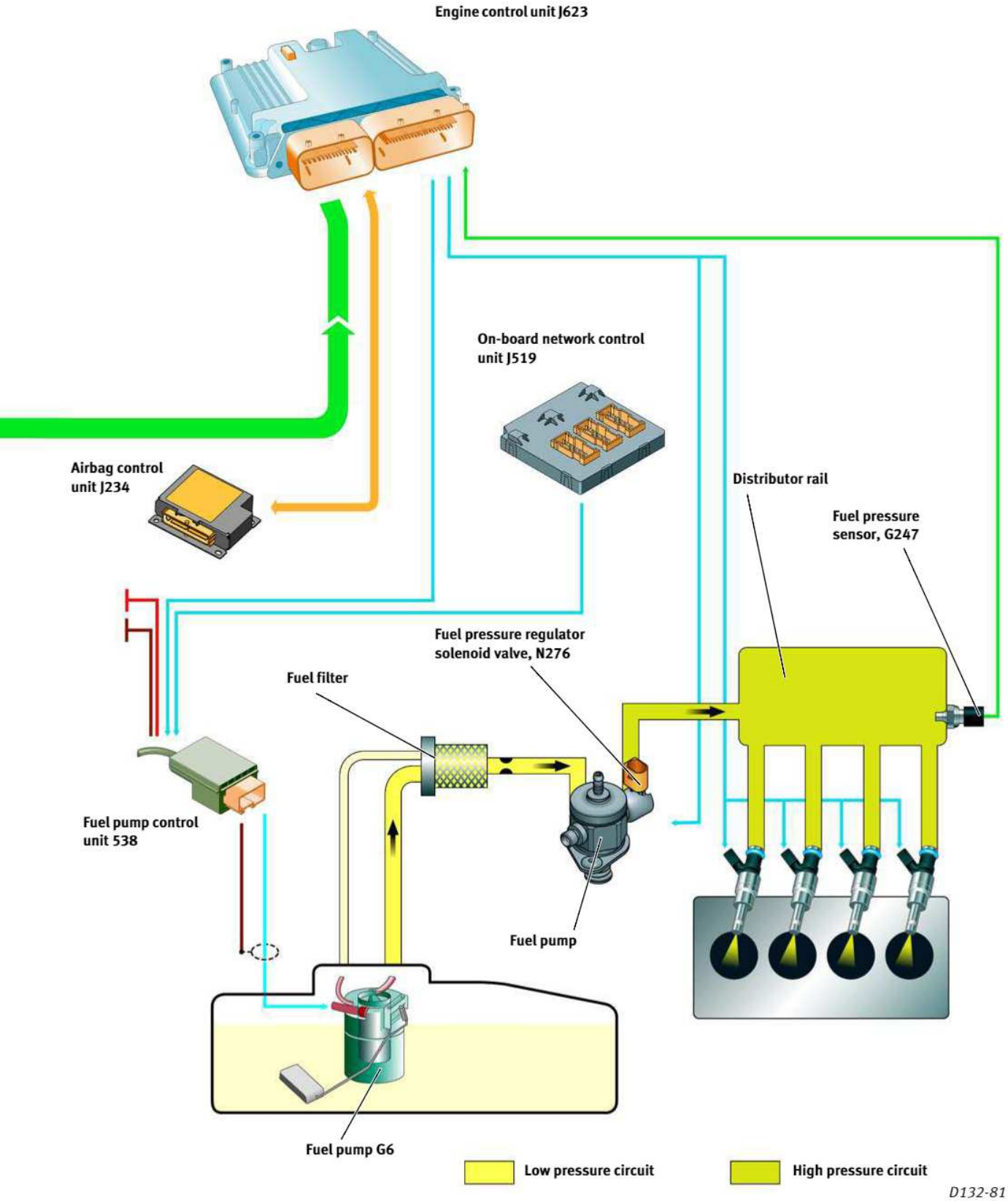
Lamba Probe G130

Angle sensors 1 and 2 for the gas butterly throttle control, G187 - 188

Accelerator position sensor, G79
Accelerator pedal position sensor 2, G185

Coolant temperature sensor, G62

Radiator output coolant temperature sensor, G83.



INJECTION MODES

There are **two injection modes** for the 1.8 and 2.0 TSI engines: one for the cold start and another one during normal operation.

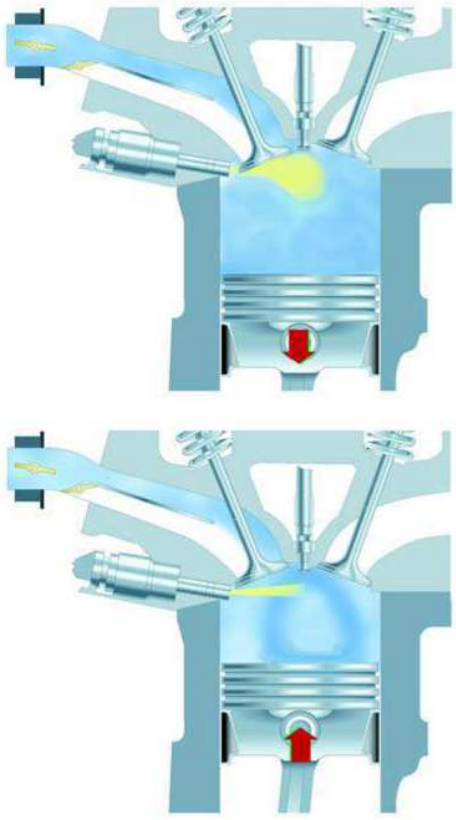
DOUBLE INJECTION MODE

This operation mode **is aimed at fast heating of the catalyst** during the cold phase.

Fuel is injected during inlet, approximately 300º crankshaft degrees before TDC. With this advance the time for the fuel and the air to mix is increased, resulting in a more homogeneous mix. After; already in compression, a second injection of a small amount of fuel takes place at 60º before TDC. This is how the mix is slightly richer in the sparkplug zone, which **allows delaying the ignition**. Both injection cycles result in a lambda value slightly below 1, that is, a slightly rich mix.

Because of the ignition delay the mix ignites, with the valve already open, so that **very hot exhaust gases reach the catalyst** allowing it to rapidly reach its service temperature.

COLD START

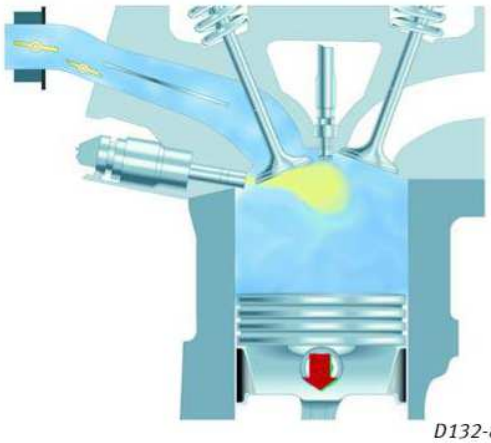


D132-82

INJECTION MODE WITH THE CATALYST AT SERVICE TEMPERATURE

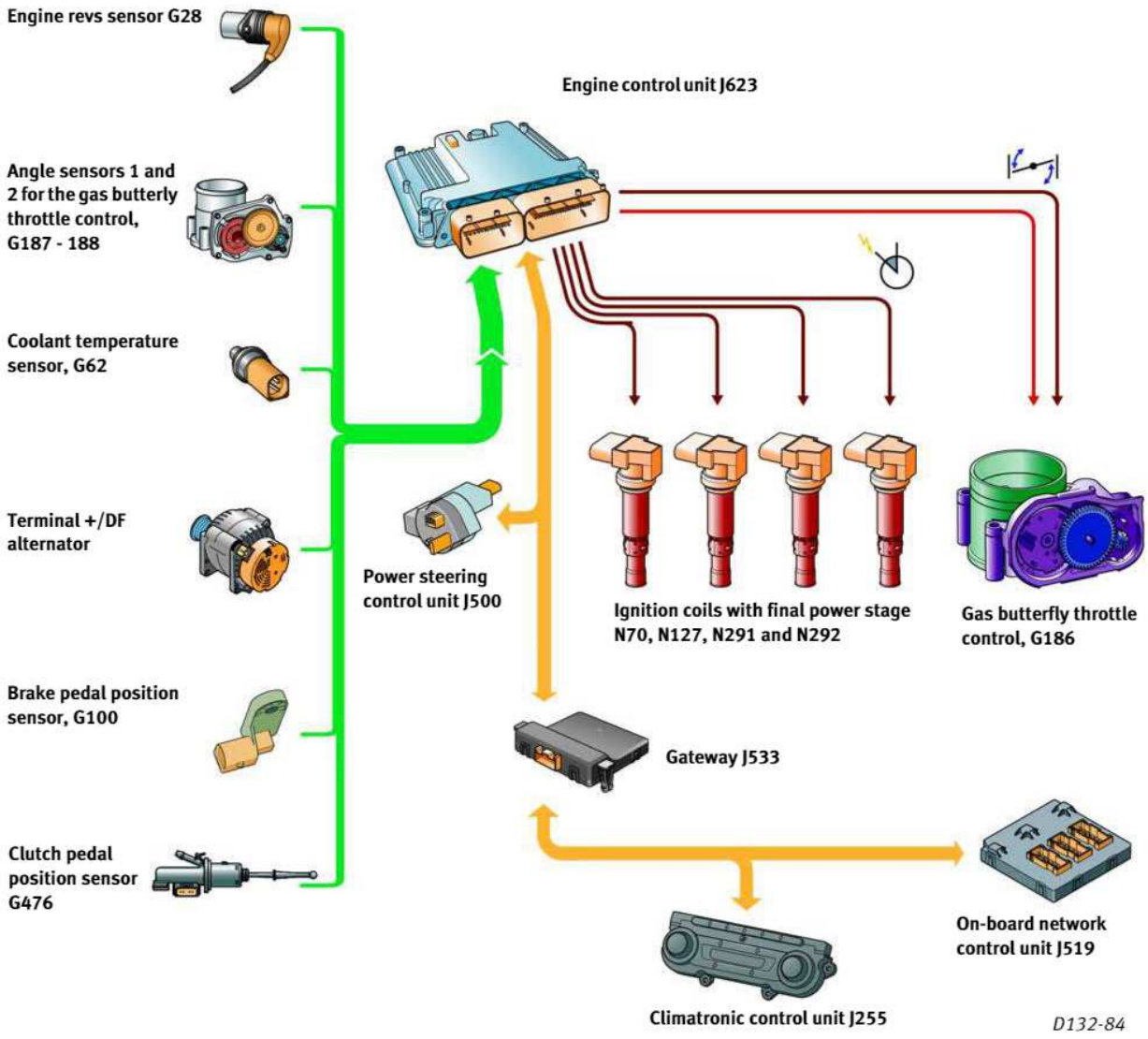
This is how, **a single injection takes place in the sparkplug zone**, because of the aiming of the injector output drill and with an advance determined by the control unit depending on the signals received form the sensors.

NORMAL OPERATION



D132-83

STABILISING OF IDLING



The engine control unit controls the opening of the butterfly to establish a stable idling regime under all the engine working conditions.

The **idling revs** are regulated only when the engine control unit detects that the butterfly throttle angle sensors 1 and 2, G187 and G188, have recognised the idling position.

To obtain a rapid adjusting of the idling, the engine control does not only manage the opening of the butterfly, but it also modifies the ignition advance to compensate for any small fluctuations of the idling. This function, named **digital stabilising of idling**, allows obtaining a much stabler idling.

In order to prevent a sudden deceleration of the vehicle when the accelerator is released the closing dampening is activated to open slightly the butterfly during the engine deceleration phase.

VARIABLE TIMING

The purpose of the variable timing is to achieve an optimum engine torque for the different engine running phases, improved running smoothness and quality of exhaust gases.

The variable timing acts on the **inlet camshaft** and can outphase it 30º, which is like saying 60º in relation to the crankshaft.

The control unit uses the signals from the air mass meter G70 and from the engine revs sensor G28, as basic signals for calculating the desired advance, and the coolant temperature sensor, G62, signal as a correction signal. The Hall sensor, G40, signal is used as feedback information in order to know the position of the inlet camshaft.

The position of the variator is defined by the **variable timing solenoid valve 1,** N205, which is controled by the engine control unit with a **PWM signal**.

After engine stop, the variator is blocked at the delay position. This function is carried out by means of a locking pin under the pressure of a spring. The system unlocks when the oil pressure overcomes 0.5 bar.

The variator is made up by a rotor, a stator, an oil pressure distributor valve and a locking pin. The rotor is welded to the inlet cams and the stator activates the timing chain directly. The distributor valve is screwed to the camshaft anticlockwise.

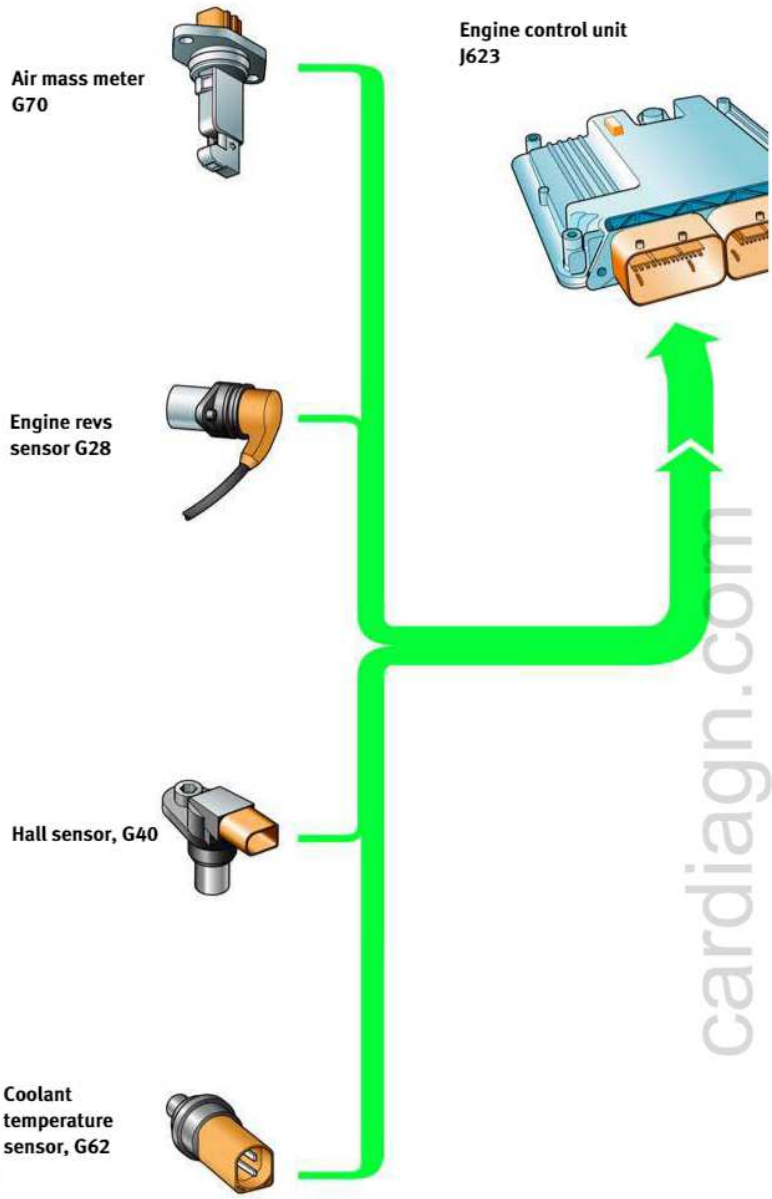
Depending on the magnetic field, the solenoid valve driven element, N205, pushes the distributor valve and opens the oil passage to the corresponding variator chamber.

With the engine idling, or at **revs below 1800 rpm** and **low load demand**, the engine control unit does not energise the variable timing solenoid valve and the **variator** remains in the **'at rest'** position.

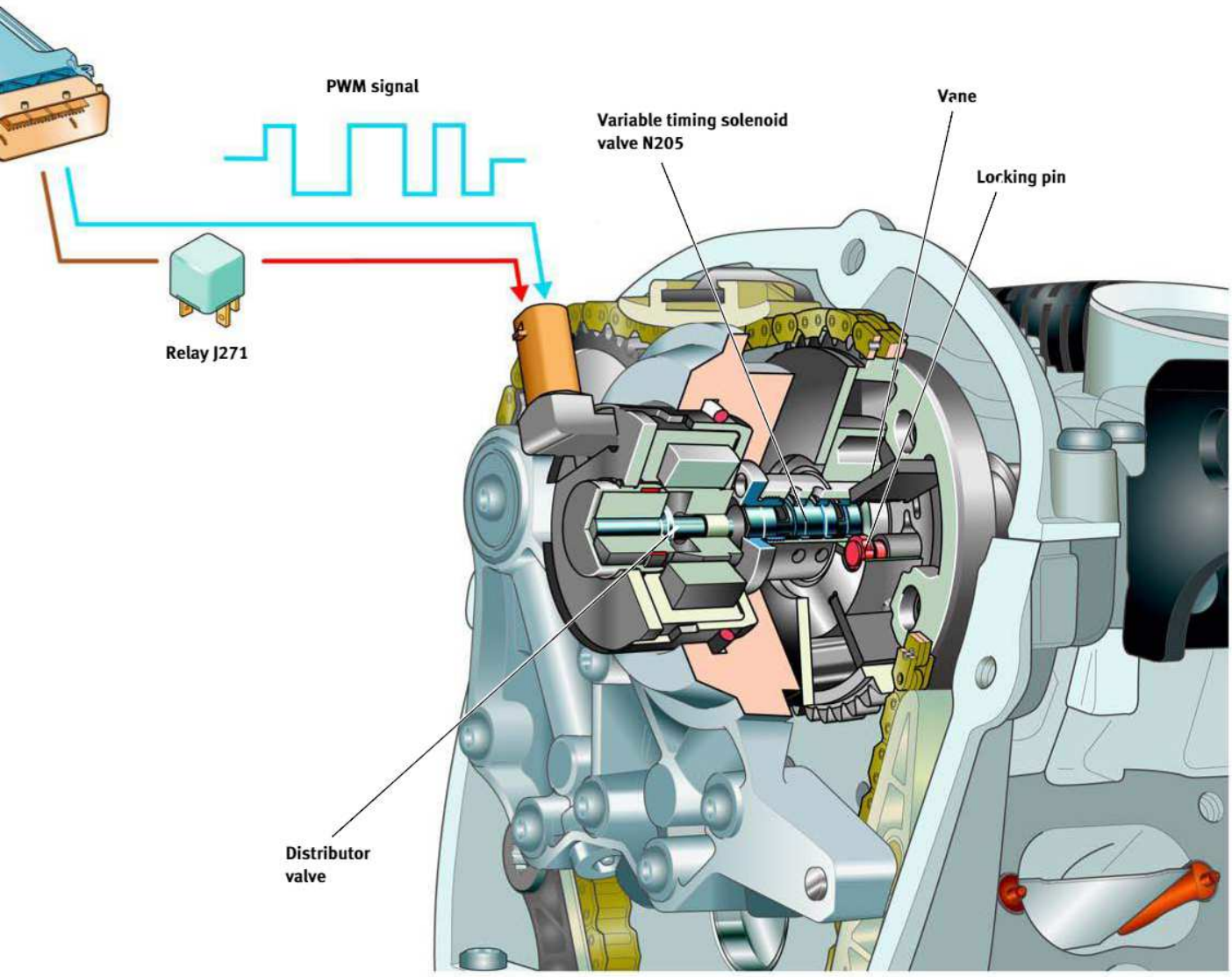
When the engine is running at over 1800 rpm and with load demand, the control unit modifies the inlet camshaft position by advancing the moment of opening and closing the valves to optimise fill-up of cylinders.

The **inlet camshaft adjusting** takes place by taking as a reference the **family of features** stored in the engine control unit.

In the event of a system fault, the camshaft remains in the delay position reducing the engine torque.



En caso de avería en el sistema, el árbol de levas de admisión permanece en la posición de retardo, provocando una disminución del par motor.



D132-85

POSITION SENSOR

OVERBOOST PRESSURE LIMITER

The purpose of the overboost pressure is to limnit the maximum overboost pressure in the different states of engine running.

The control unit calculates a theoretical overboost value **basically** depending on the engine**l oad** and **revs**. This value can be **corrected** depending on:

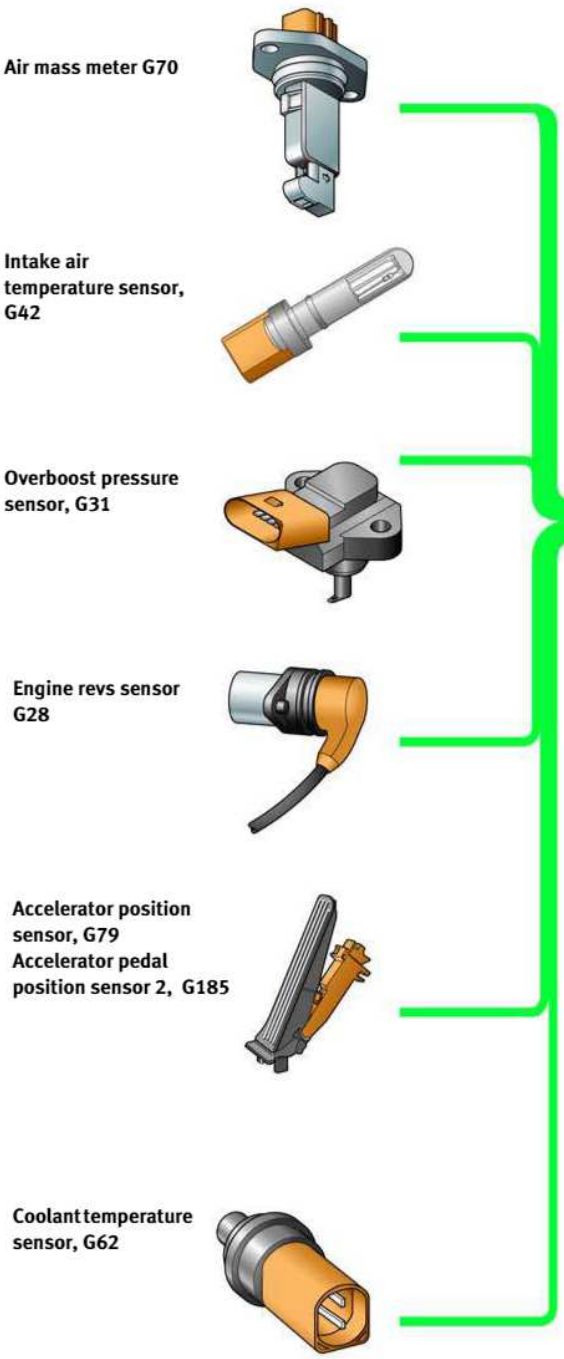
- the coolant temperature (G62), from the altitude sensor (F96).
- G79 and G185 accelerator pedal position sensors,
- and the **drawn in air** temperature (G299).

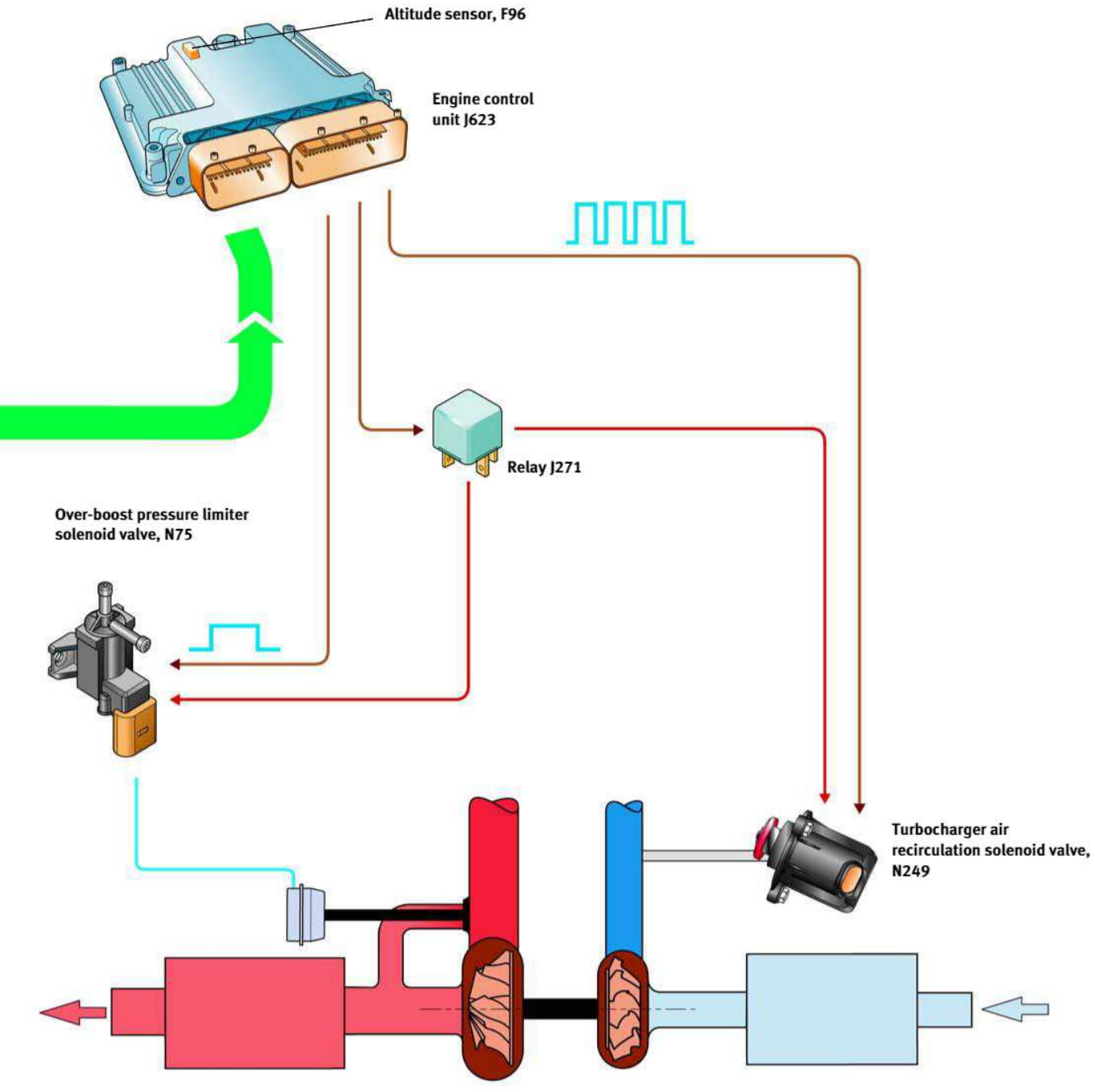
Once the overboost value has ben calculated it compares it against the real value and depending on the difference the necessary turbocharger limiter valve activation signal is determined. This is a fixed frequency and variable duty cycle signal, and when the positive duty cycle increases it allows increasing progressively the overboost value.

The overboost pressure sensor, G31, signals and the coolant temperature sensor, G62, signals are used to know the real overboost pressure and as a result carry out the regulation.

AIR RECIRCULATION IN DECELERATION

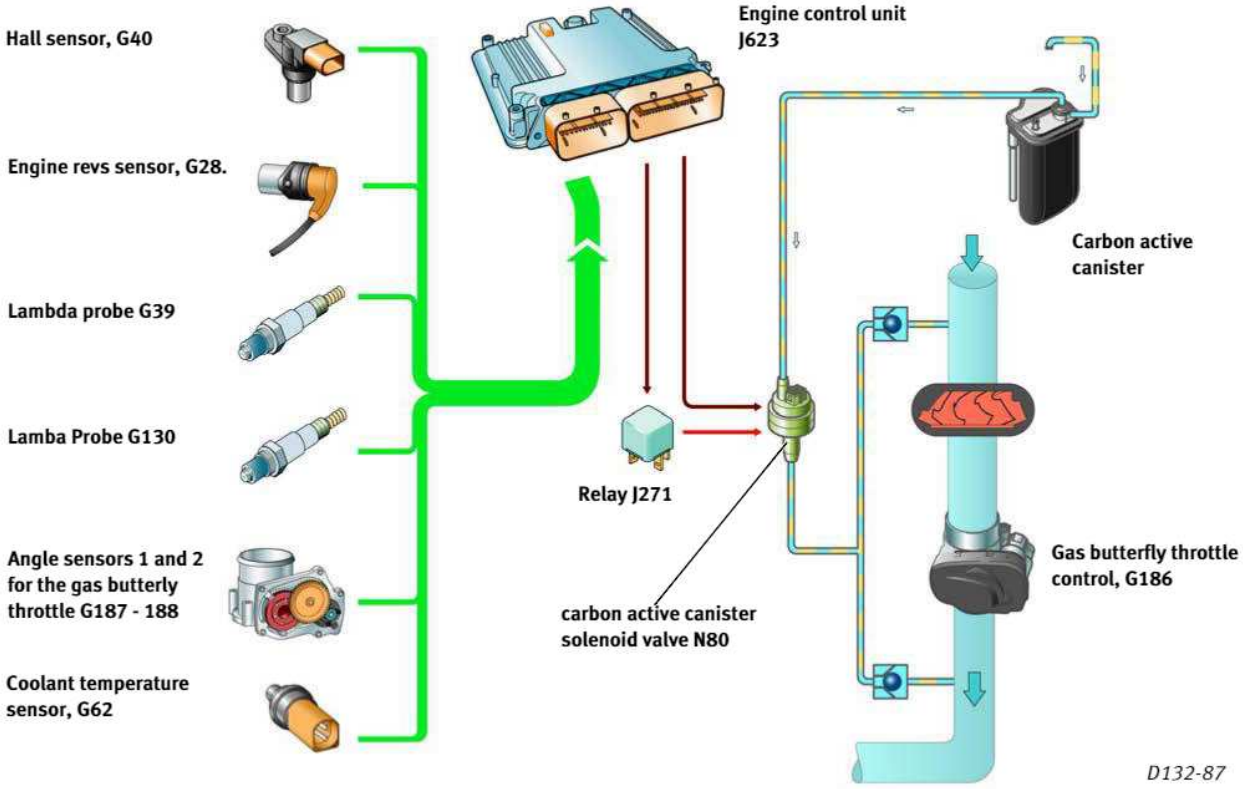
In the engine deceleration phase, the engine control unit supplies the air recirculation solenoid valve for the turbocharger, N249, in order to prevent the blower fan loosing speed (drop effect), and to improve the turbocharger's response when demanding engine load again.





D132-86

CARBON ACTIVE SYSTEM



The purpose of the carbon active system is to prevent the fuel vapours generated inside the tank from being expelled to the exterior.

So, these vapours are stored in the carbon active canister and are then introduced into the engine inlet circuit to be burnt during the combustion process.

The flow of vapours to the inlet is managed by the engine control unit **depending on**:

- the revs
- the coolant temperature,
- and, the inlet air temperature.

For this, the control unit **energises** the carbon active canister solenoid valve, N80, with a **PWM signal**.

The flow of vapours is only carried out if the coolant temperature is above 40^0C and the inlet air temperature is above -10°C.

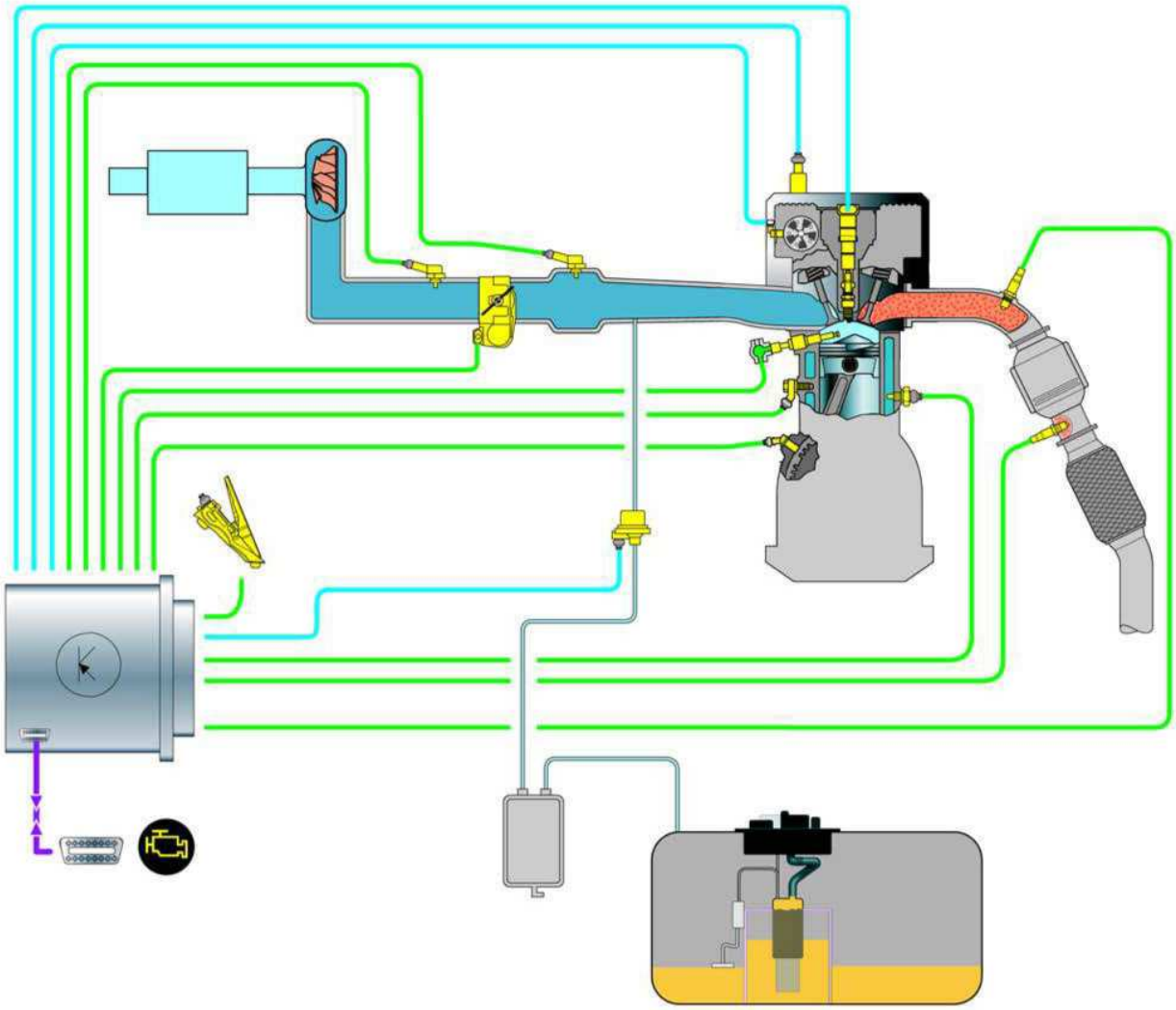
Depending on the overboost pressure generated by the turbocharger, the fuel vapours are introduced into the inlet manifold or to the suction side of the turbocharger.

The engine control unit corrects the calculated energising values (time and duty cycle) for the carbon active solenoid valve depending on the lambda probe signal.

The unit evaluates the enriching the vapours generate in the combusted mixture by comparing the signal transmitted by the lambda probe with the one transmitted when the fuel vapours are introduced. This is how the drgree of saturation of the canister is known and is adapted to the energising of the solenoid valve by extending or shortening its time of energising.

This correction allows achieving a carbon active canister average degree of saturation.

Components involved in the EOBD function



D132-88

The main purpose of **the EOBD function is to monitor the exhaust gases emissions related components**.

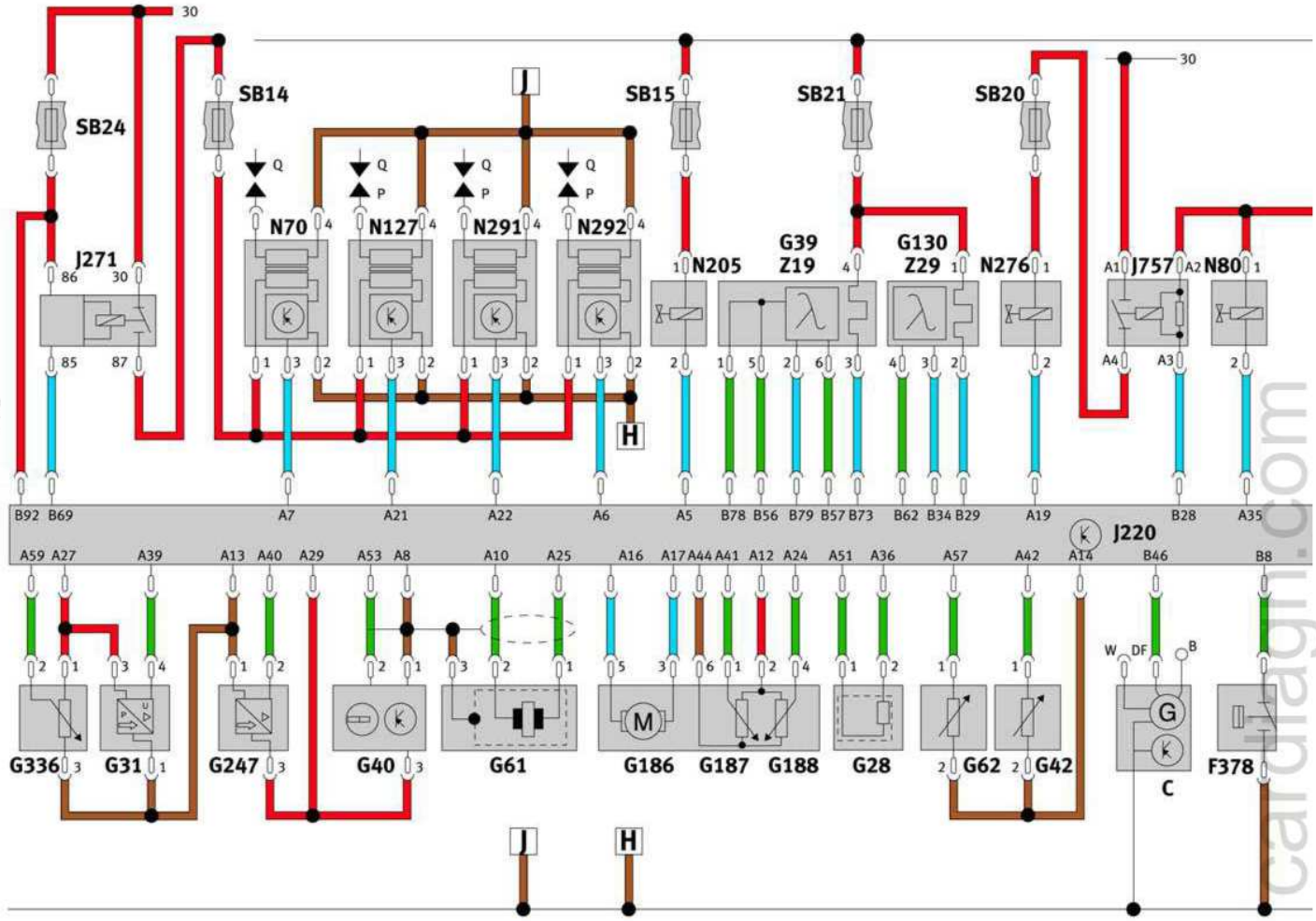
It also checks the following functions

- lambda regulation monitoring,
- monitoring of catalyst,
- monitoring of the carbon active circuit,
- and, monitoring of combustions.

If it detects a fault or malfunction of any of the sensors, actuators or functions checked, it saves the fault in the memory and activates the instrument panel exhaust emissions warning light, K83.

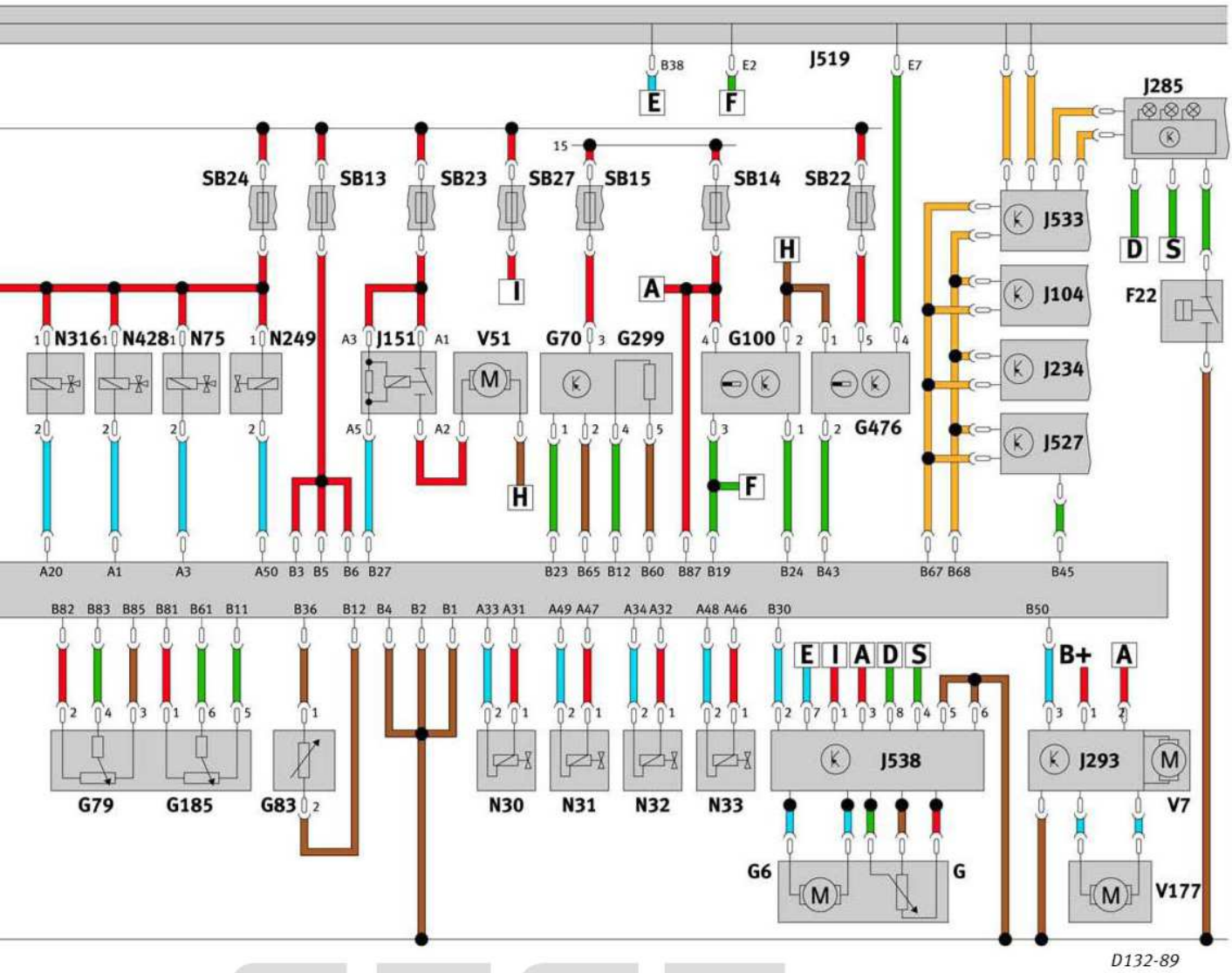
If the EOBD **warning light K83** blinks, this indicates that there is a fault which might damage the catalyst; if the warning light remains permanently activated, this means that there is a fault affecting the emission of polluting exhaust gases.

FUNCTIONS WIRING DIAGRAM



HEADIN

C	Alternator
F	brake lights switch
F22	Oil switch
F63	Brake pedal swicth
F378	Oil switch for reduced oil pressure
G	Fuel level sensor.
G6	Fuel pump.
G28	Engine revs sensor.
G31	Overboost pressure sensor.
G39	Lambda Probe.
G40	Hall sensor.
G42	Intake air temperature sensor.
G61	Knock sensor.
G62	Coolant temperature sensor.
G70	Air mass meter
G79	Accelerator position sensor.
G83	Radiator output coolant temperature sensor.
G130	Lambda Probe.
G185	Accelerator pedal position sensor.
G186	Gas butterfly throttle control
G187	Butterfly throttle control angle sensor 1.
G188	Butterfly throttle control angle sensor 2.
G247	Fuel pressure sensor.
G299	Intake air temperature sensor 2.
G336	Inlet manifold flap solenoid valve potentiometer.
G476	Clutch pedal position sensor.
J104	ABS control unit.
J151	Coolant post-circulation relay.
J234	Airbag control unit.
J271	Motronic power supply relay.
J285	Instrument panel control unit with warning lights .
J293	Coolant fan control unit.



J519	on-board net control unit
J523	Engine control unit.
J527	Steering column control unit.
J533	Gateway
J538	Fuel pump control unit.
J757	Engine components supply relay.
N30/31/32/33	Injection solenoid valves.
N70/127/291/292	Ignition coils with final power stage
N75	Overboost pressure limiter solenoid valve.
N80	Carbon active canister solenoid valve.
N205	Variable timing solenoid valve.
N249	Turbocharger air recirculation solenoid valve.
N276	Fuel pressure regulator solenoid valve.
N316	Inlet manifold flap solenoid valve
N428	Oil pressure regulation solenoid valve
V7	Radiator fan.
V51	Coolant post-circulation pump.
V177	Radiator fan 2
Z19	Lamba probe heating.
Z29	Post catalyst lamba probe heating 1

COLOUR CODING

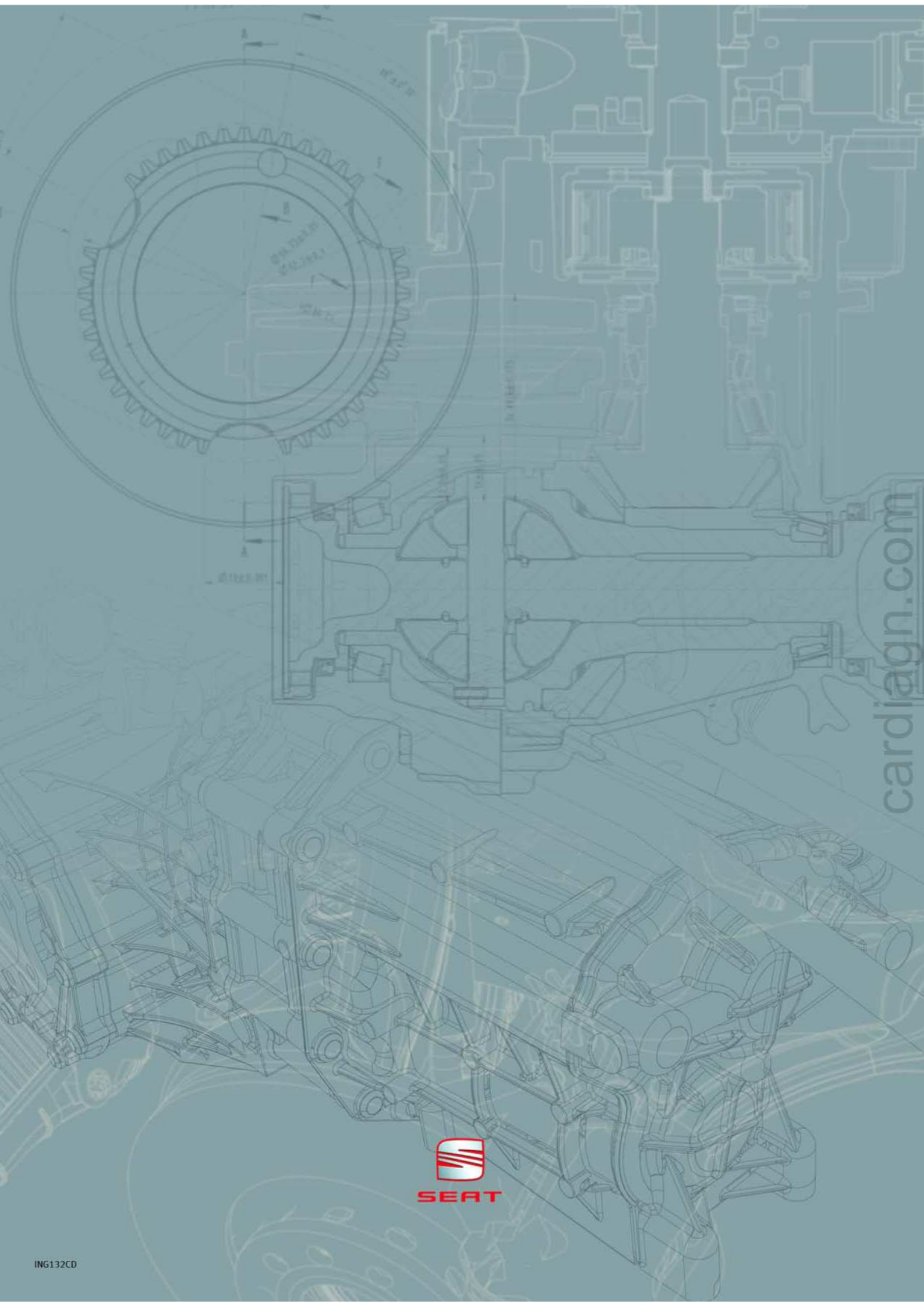
- Input signal.
- Output signal.
- Positive supply.
- Earth.
- K diagnosis line.
- CAN-Bus signal.

NOTES:

Technical status 05.09. Due to constant product development and improvement, all data displayed is subject possible changes.

TITLE: 1.8 l and 2.0 l TSI Engines
AUTHOR: Instituto de Servicio
Autovía A-2, Km 585 - 08760 - Martorell, Barcelona (españa)
1st. edition

DATE OF PUBLISHING: July 09
LEGAL REGISTER: B-28.567- 2009
Pre-printing and printing: GRAFICAS SYL - Silici, 9-11
Pol. Industrial Famadas - 08940 Cornellá - BARCELONA



SEAT

ING132CD