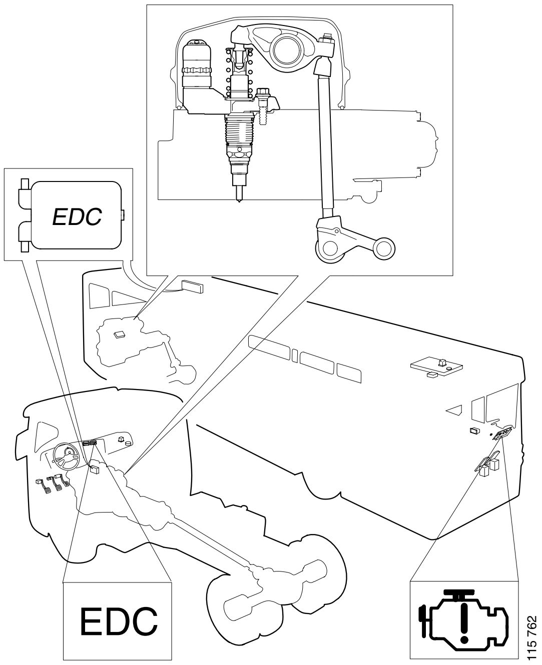
03:04-02

Issue 3 **en**

Fuel system with unit injector PDE and EDC MS6

Function description



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Contents

Important

The safety precautions and warnings in the work description must be read thoroughly before any work is carried out.

Using only the function description as a basis for the work is not permitted.

General

A fuel system with EDC, Electronic Diesel Control, and unit injectors PDE, Pumpe- Düse-Einheit, consists – besides the fuel lines and a fuel tank – of the following parts.

1 A feed pump

2 A hand pump

3 An electronic control unit and a control unit cooler

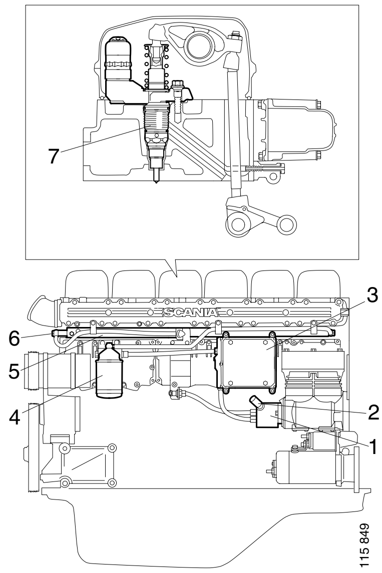
4 A fuel filter

5 One or two fuel manifolds. 6 cylinder engines have one fuel manifold, 8 cylinder engines have two.

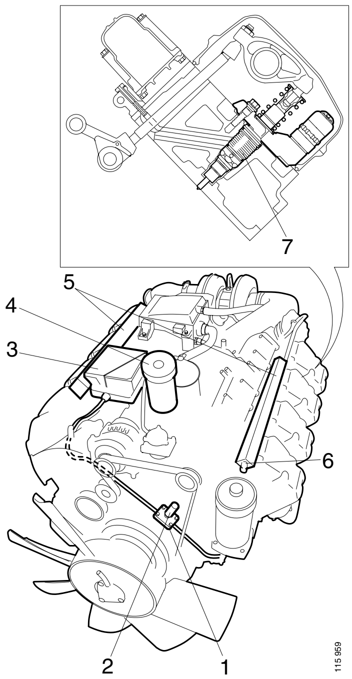
6 An overflow valve

7 One unit injector, of type PDE, per cylinder

The fuel system also includes an electronic control system. The control system consists of – besides the control unit – the unit injector solenoid valves, sensors and other control units, among other things. More information about the electronic control system can be found in the section EDC.



11 and 12 litre engines



16 litre engine

Fuel path

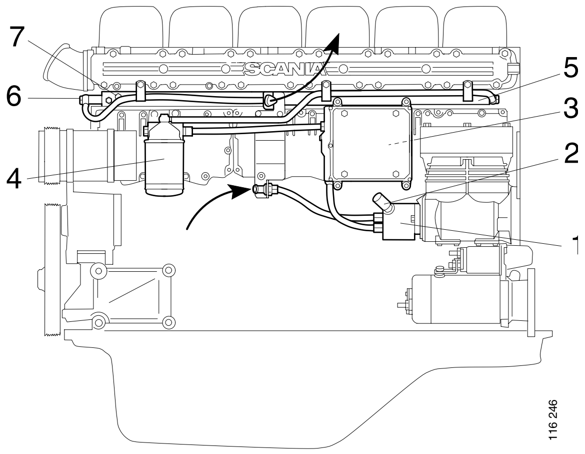
The feed pump 1 draws in fuel from the fuel tank and presses it through the control unit cooler 3, the fuel filter 4 and into the fuel manifold 5, 16 litre engines have two fuel manifolds.

A hand pump 2 is located on the feed pump. The hand pump is used when bleeding the fuel system.

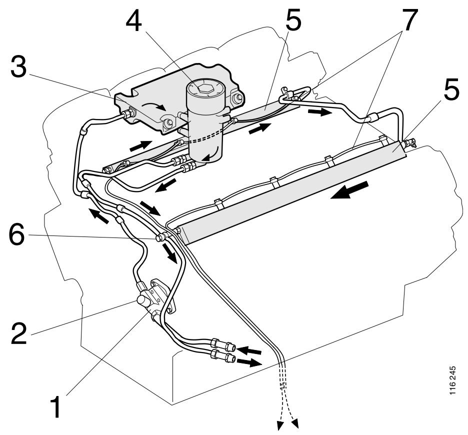
The fuel manifold is fitted with an overflow valve 6. The overflow valve controls the fuel pressure at all times. When the pressure is too high, the overflow valve opens so that the surplus fuel drains back to the fuel tank.

The fuel manifold distributes the fuel to the unit injectors for each cylinder head. The EDC control unit controls when the unit injectors are to inject the fuel into the cylinders.

If the O-rings on the unit injectors are faulty, fuel will leak from the overflow holes 7 and the overflow channels 7. There is an overflow hole in the fuel manifold at each cylinder. In addition, 16 litre engines have overflow channels that drain any fuel leakage away from the overflow holes and the top of the engine.



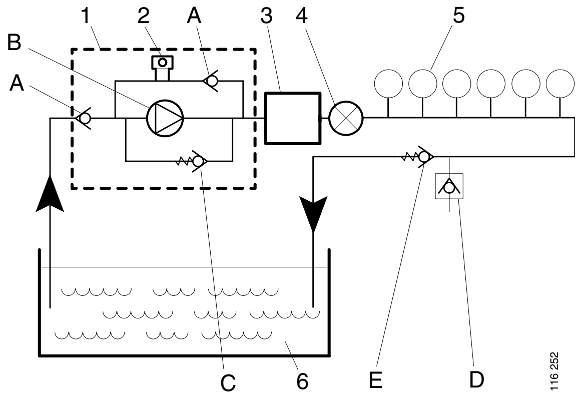
11 and 12 litre engines. References in the text refer to the numbers in the illustration.



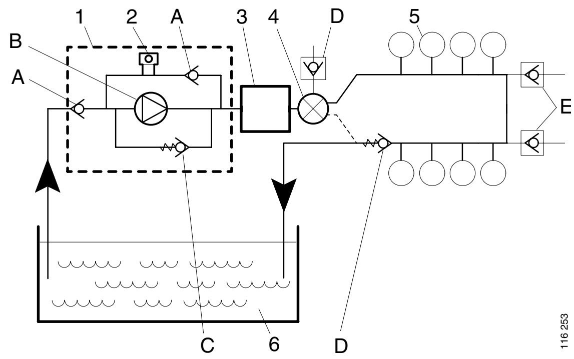
16 litre engine. References in the text refer to the numbers in the illustration.

Skeleton diagram of the fuel system

11 and 12 litre engines



16 litre engine



1 *Feed pump*
2 *Hand pump*
3 *EDC control unit*
4 *Fuel filter*
5 *Cylinders*
6 *Fuel tank*

A Check valve
B Gear pump (feed pump)
C Safety valve
D Overflow valve
E Drain union

Fuel quantity and injection timing

Each unit injector consists of a pump element, a solenoid valve and a nozzle. In this way, it is possible to control the fuel injection for each individual cylinder.

EDC, Electronic Diesel Control, is the electronic system that controls both how much fuel each unit injector should inject into the cylinder and also when the unit injector should inject the fuel. This control of the injection means that we can optimise the combustion, which in turn leads to cleaner exhaust gases and lower fuel consumption. The EDC system described in this booklet is designated MS6.

The control unit is the brain of the EDC system. The control unit processes the information both from the sensors and the components that are part of the EDC system and also from the control units in other systems. When the control unit has processed the information, it then transmits signals to the unit injectors. The signals control the injection of the fuel.

The EDC system makes possible such functions as cruise control, hand throttle, speed limiter, smoke limiter and a special cold start programme.

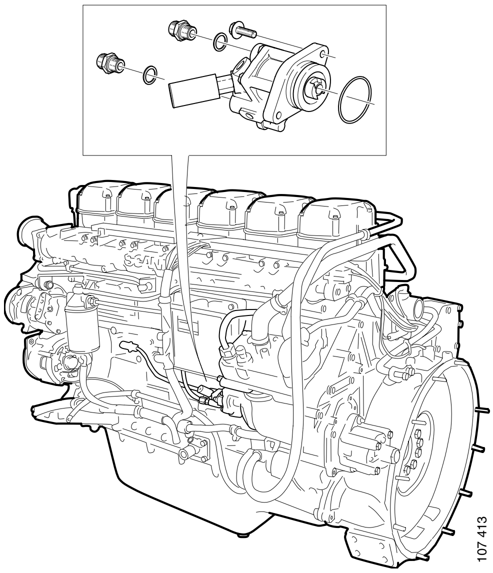
Components in the fuel system

Feed pump

The feed pump is of the gear pump type. On 11 and 12 litre engines, the feed pump is positioned on the rear end of the air compressor and is driven by the crankshaft of the compressor. On 16 litre engines, the feed pump is positioned on the front of the engine and is driven via the left-hand camshaft.

Its capacity is adjusted to deliver the right pressure and flow rate to all unit injectors.

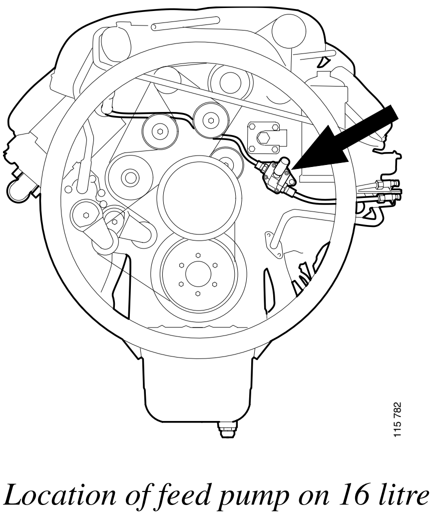
The hole drilled in the flange of the feed pump is used to indicate leaks.



Location of feed pump on 11 and 12 litre engines

Hand pump

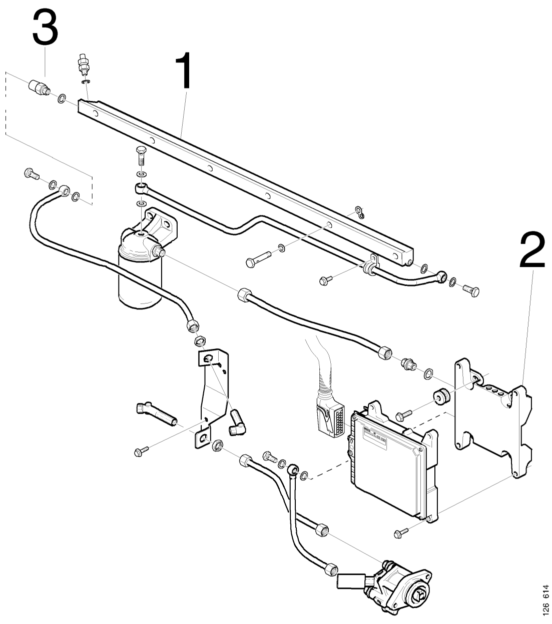
The hand pump is positioned on the rear end of the feed pump and is used for bleeding the fuel system. On buses, the hand pump is positioned so that it is easily accessible through the rear engine compartment door.



Location of feed pump on 16 litre engine

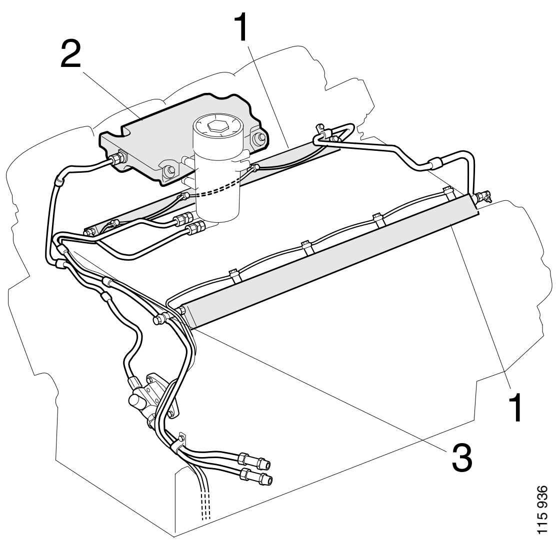
Location diagrams

11 and 12 litre engines



1 *Fuel manifold*
2 *Control unit cooler*
3 *Overflow valve*

16 litre engine



1 *Fuel manifolds*
2 *Control unit cooler*
3 *Overflow valve*

Control unit cooler

The control unit is cooled using fuel that passes through the control unit cooler. The control unit cooler is positioned between the engine and the control unit and mounted on vibration insulators. This is to reduce the amount of vibration to which the control unit is exposed.

The vibration insulators also insulate the control unit electrically from the engine.

Fuel manifold

The fuel manifold distributes the fuel into the unit injectors for each cylinder head. The fuel manifold is fastened with banjo screws that are connected to the overflow line. In this way, it is possible to see if there are any leaks from the O-rings on the unit injectors.

Overflow valve

The overflow valve is positioned in the end of the fuel manifold.

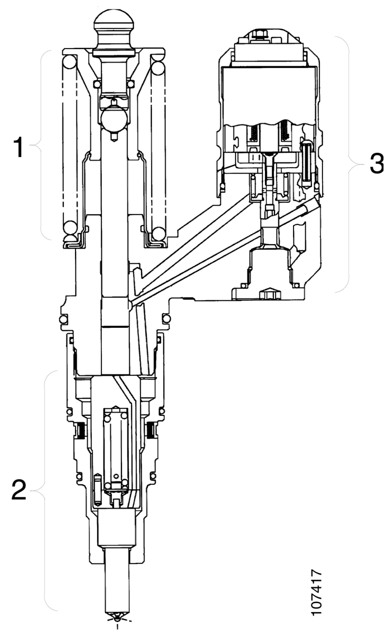
The overflow valve controls the supply pressure in the fuel system.

Unit injector

General

There is one unit injector for each cylinder. The unit injector is positioned in the centre of the cylinder head between the four valves.

The unit injector is a pump element forming a single unit with the injector nozzle. It is driven by the engine camshaft. The drive is transferred from the camshaft via a roller tappet, pushrod and rocker arm to the unit injector.



1 Pump section

2 Injector section

3 Valve housing

The unit injector consists of three main parts.

- Pump section, containing cylinder and plunger, corresponding to the pump element in an injection pump.
- Injector section, with nozzle sleeve, nozzle needle and spring.
- Valve housing, with an electromagnetically controlled fuel valve.

The lower part of the unit injector is fitted in a steel sleeve with copper washer resting against the bottom of the cylinder head, similar to an ordinary injector.

The upper part of the unit injector, with compression spring and valve housing, is located above the cylinder head.

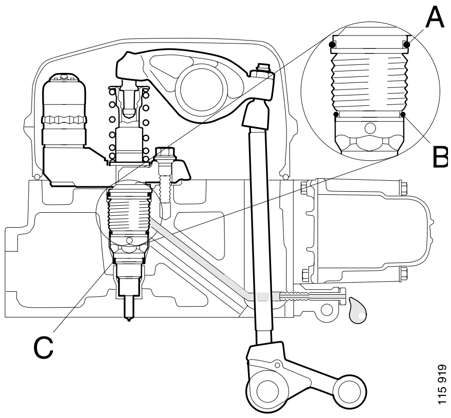
Injection timing and the amount of fuel to be injected are determined by the control unit. The control unit controls the electromagnetic fuel valve in the unit injector valve housing.

The opening duration of the injector (injector timing) determines the amount of fuel that is injected into the cylinder.

Leak indication

An overflow channel runs from the unit injector to the banjo screw in the fuel manifold. If oil leaks from the overflow channel the upper O-ring A is damaged. If fuel leaks from the overflow channel, the central O-ring B is damaged.

The lower O-ring C is fitted for extra safety as a seal against coolant.



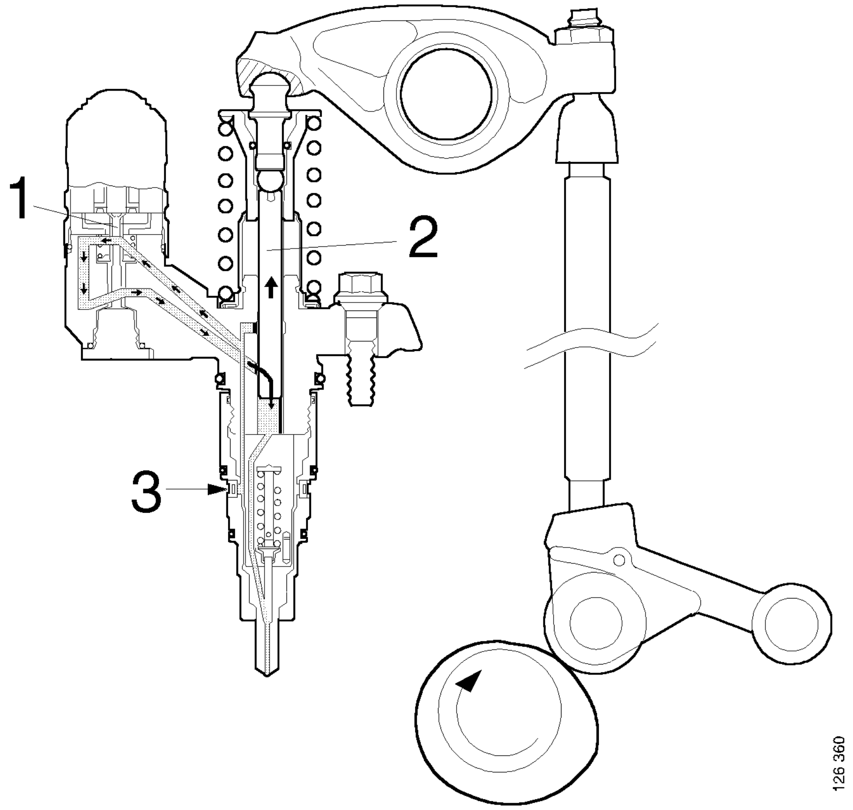
Filling phase

During the filling phase, pump plunger 2 moves up to its highest position.

The highest point of the cam on the camshaft has passed and the roller tappet is moving towards the camshaft's base circle.

Fuel valve 1 is in the open position and fuel can flow into the barrel from fuel duct 3.

Filling continues until the pump plunger reaches its highest position.



1 *Fuel valve*

2 *Pump plunger*

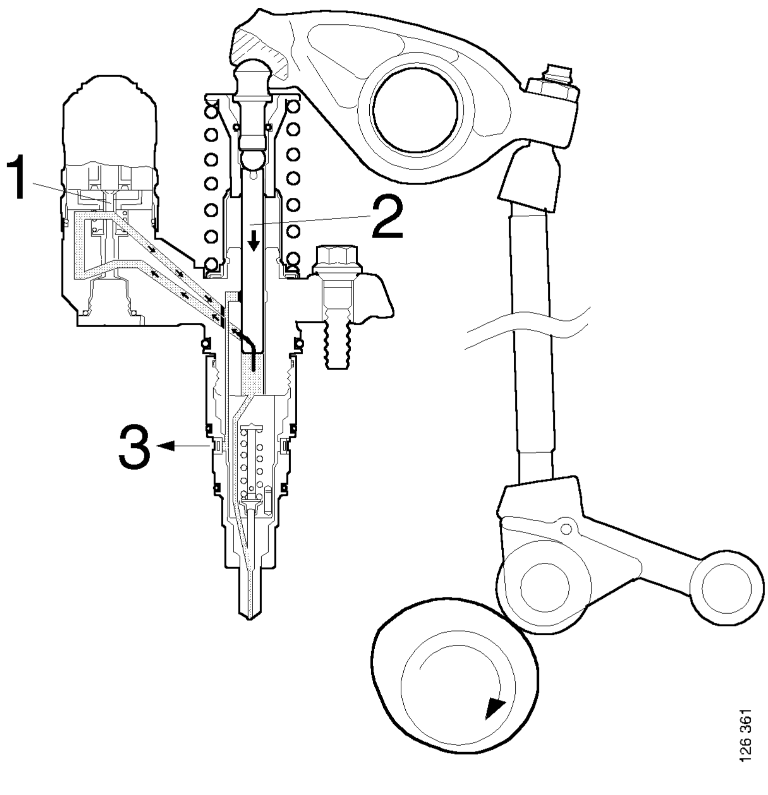
3 *Fuel duct, inlet and outlet*

Spill phase

The spill phase begins when the camshaft has moved on to the position in which the cam on the camshaft starts to press pump plunger 2 down by means of the roller tappet, pushrod and rocker arm.

The fuel can now flow through fuel valve 1, through the hole in the unit injector and out through fuel duct 3.

The spill phase continues as long as fuel valve 1 remains open.



1 *Fuel valve*

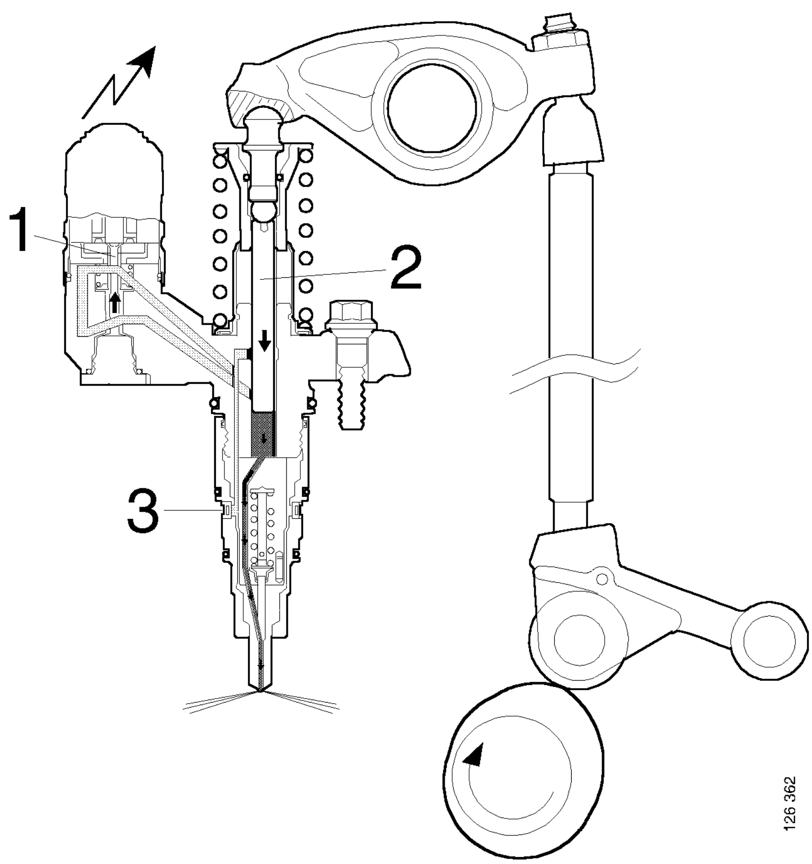
2 *Pump plunger*

3 *Fuel duct, inlet and outlet*

Injection phase

The injection phase begins when fuel valve 1 closes. The fuel valve closes when voltage is applied to the solenoid valve. The cam on the camshaft continues to press pump plunger 2 down by means of the rocker arm and injection takes place since the passage through the fuel valve is closed.

The injection phase continues as long as fuel valve 1 remains closed.



1 *Fuel valve*

2 *Pump plunger*

3 *Fuel duct, inlet and outlet*

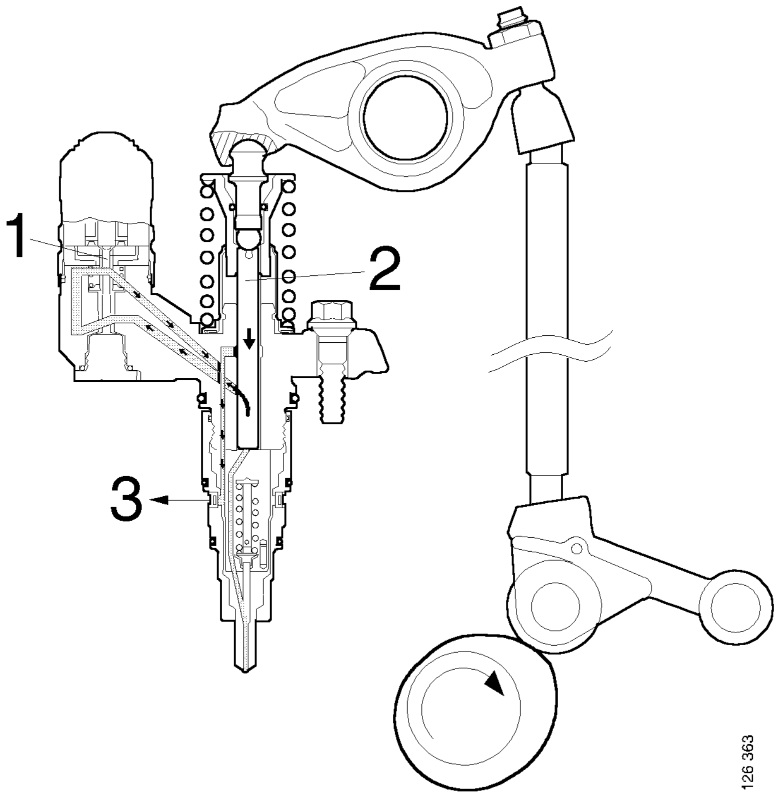
Pressure reduction phase

Injection stops when fuel valve 1 opens and the pressure in the unit injector drops below the nozzle's opening pressure.

The fuel flows through the open fuel valve 1, the hole in the unit injector and out through fuel duct 3.

It is the closed or open position of the fuel valve which determines when injection should begin and end.

The length of time the fuel valve remains closed determines the amount of fuel that is injected during each pump stroke.

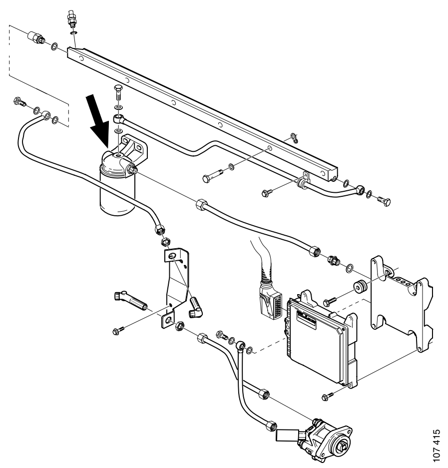


1 *Fuel valve*
2 *Pump plunger*
3 *Fuel duct, inlet and outlet*

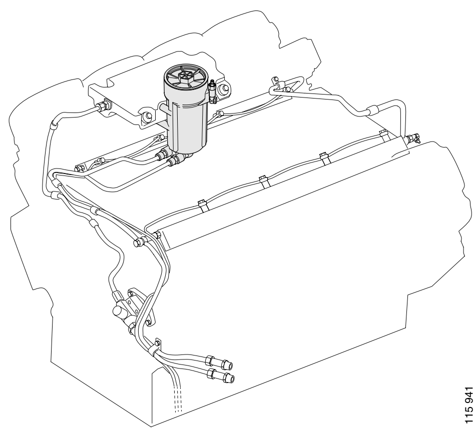
Fuel filter

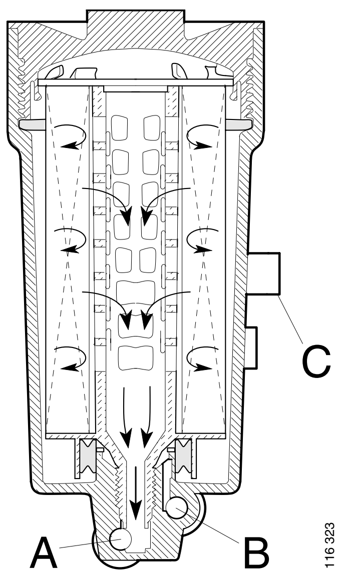
There are two types of fuel filter.

11 and 12 litre engines have a filter that consists of a metal container with spiral wound paper inserts. This cannot be dismantled but must be replaced as an assembly.



The 16 litre engine has a filter assembly containing a filter element. The filter element is secured to the lid and when the filter is removed, the filter housing drains automatically.





Fuel filter for 16 litre engine

A = Outlet

B = Drain channel

C = Inlet, from control unit cooler

EDC

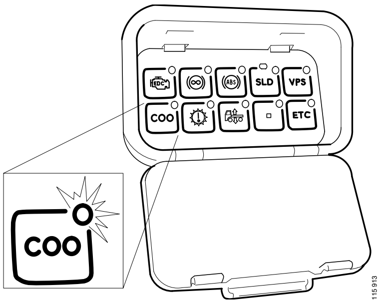
General

On the following page you can see which components and systems the EDC control unit communicates with.

If the vehicle is equipped with a coordinator then the EDC control unit communicates with the following components **via** the coordinator. Otherwise, the components are directly connected to the EDC control unit.

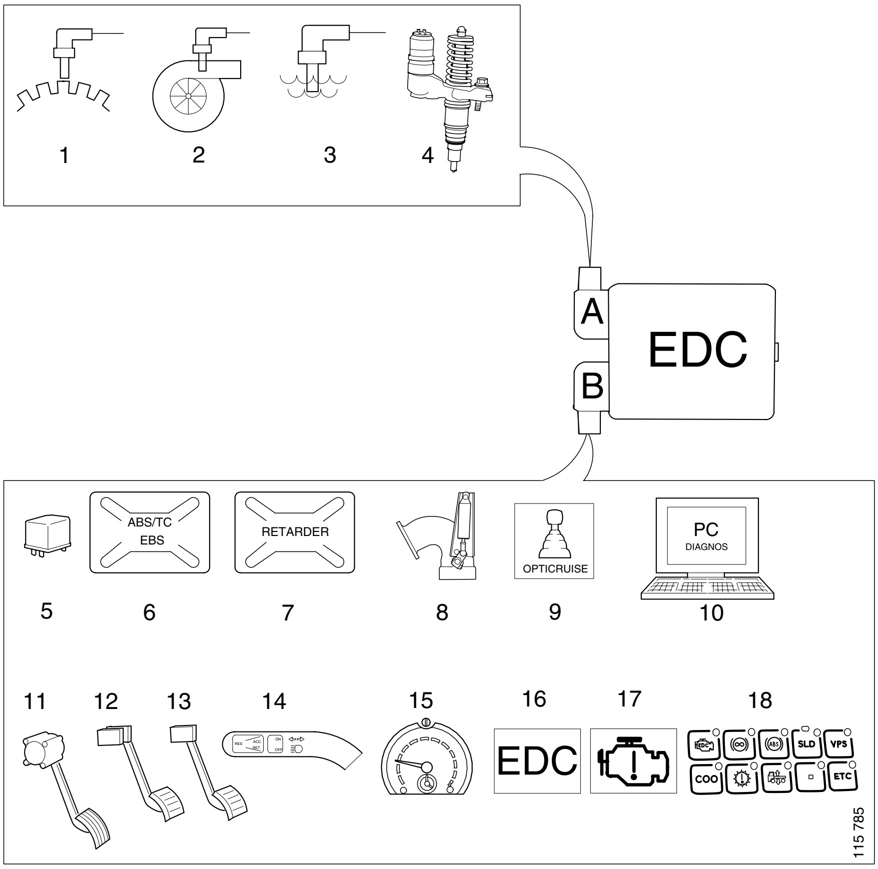
- Accelerator pedal sensor
- Brake pedal switches
- Clutch pedal switch
- Control for the cruise control
- Tachograph
- Warning lamp for EDC
- Diagnostics switch with lamp
- Body builder switch, C271, for activation of special functions

If the vehicle has a coordinator, the lamp in the switch should come on for a few seconds when the power is activated using the starter key.



Communication within the different EDC systems

System not equipped with coordinator



1 *Engine speed sensors, Quantity 2*

2 *Charge air pressure and temperature sensor*

3 *Coolant temperature sensor*

4 *Unit injector solenoid valves, one per cylinder*

5 *Supply relay*

6 *Control unit for ABS/TC, EBS*

7 *Control unit for the retarder*

8 *Exhaust brake*

9 *Control unit for Opticruise*

10 *Diagnostic socket for the PC*

11 *Accelerator pedal sensor*

12 *Brake pedal switches*

13 *Clutch pedal switch*

14 *Control for the cruise control*

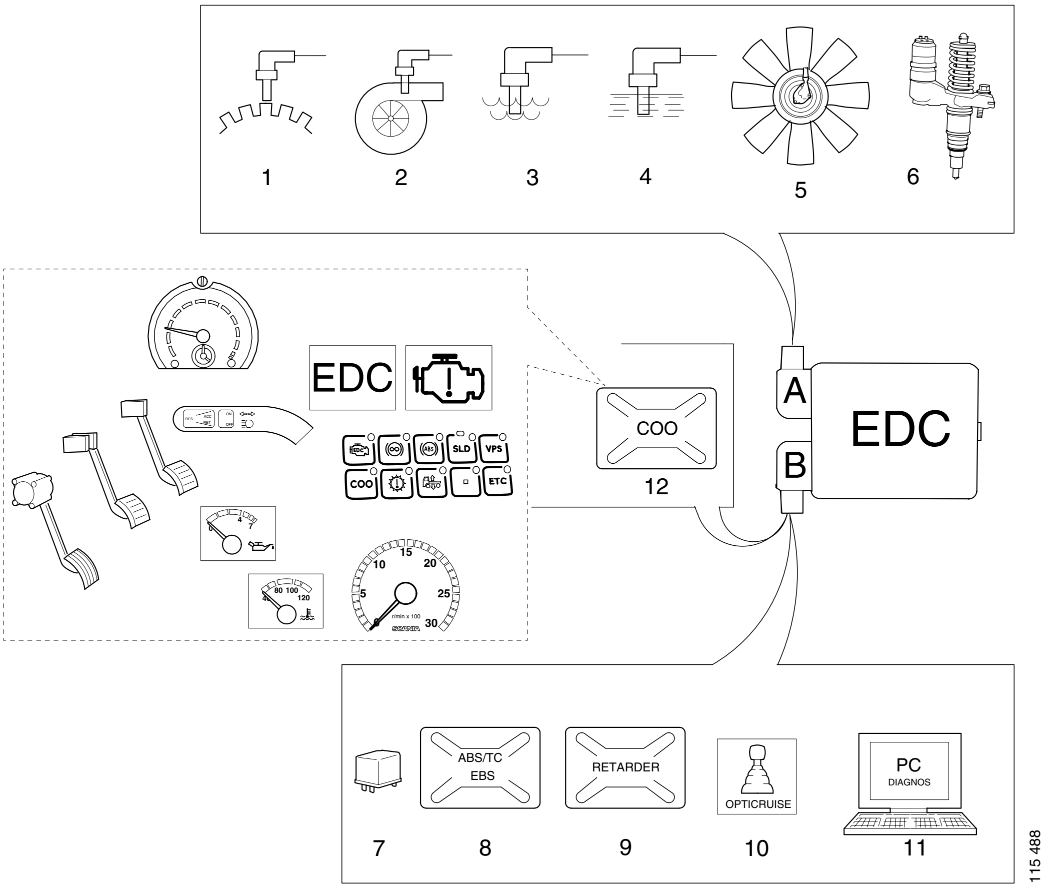
15 *Tachograph (vehicle speed)*

16 *Warning lamp for EDC (truck)*

17 *Warning lamp for EDC (bus)*

18 *Diagnostics switch with lamp*

System with coordinator



Communication with components in the driver area goes via the coordinator (COO).

1 *Engine speed sensors, Quantity 2*

2 *Charge air pressure and temperature sensor*

3 *Coolant temperature sensor*

4 *Oil pressure sensor*

5 *Fan solenoid valve*

6 *Unit injector solenoid valves, one per cylinder*

7 *Supply relay*

8 *Control unit for ABS/TC, EBS*

9 *Control unit for the retarder*

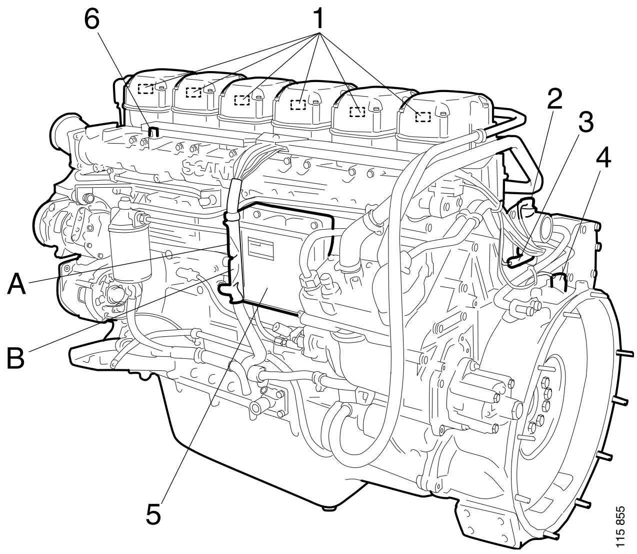
10 *Control unit for Opticruise*

11 *Diagnostic socket for the PC*

12 *Coordinator that connects the EDC control unit to the components in the driver area.*

Components on the engine

Component locations on 11 and 12 litre engines



1 *Unit injector solenoid valves*

2 *Coolant temperature sensor*

3 *Auxiliary engine speed sensor on camshaft gear*

4 *Main engine speed sensor on flywheel*

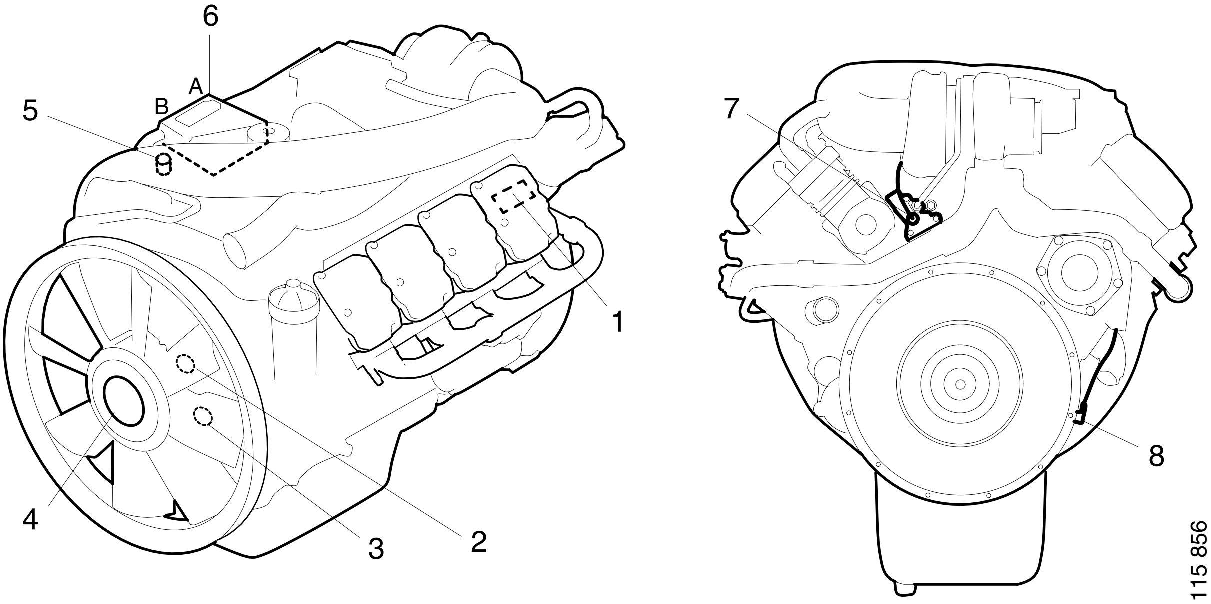
5 *EDC control unit*

6 *Charge air pressure and temperature sensor*

A – connection between engine components and EDC control unit

B – connection between other components and EDC control unit

Component locations on a 16-litre engine



1 *Unit injector solenoid valves, one per cylinder*

2 *Oil pressure sensor*

3 *Coolant temperature sensor*

4 *Fan solenoid valve*

5 *Charge air pressure and temperature sensor*

6 *EDC control unit*

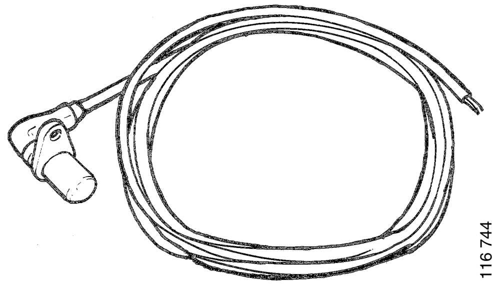
7 *Auxiliary engine speed sensor on camshaft gear*

8 *Main engine speed sensor on flywheel*

A – connection between engine components and EDC control unit

B – connection between other components and EDC control unit

Engine speed sensors T74 and T75



The EDC system contains two engine speed sensors: main engine speed sensor T74 and auxiliary engine speed sensor T75. The sensors are inductive.

If the sensors begin to show different values when the engine is already running, the control unit will work only from the value from the main engine speed sensor – for safety reasons, the engine torque will then be limited.

If the control unit does not receive a signal from one of the sensors, the engine torque will be limited. If the signal returns, the engine will operate normally again.

If the control unit receives no signal from either sensor, the engine will not start; if the engine is running, it will be switched off.

On the following two pages is a more detailed description of both sensors.

Main engine speed sensor T74 (flywheel)

Around the edge of the flywheel are 58 holes (refer to illustration). The main engine speed sensor senses the holes when the flywheel rotates and sends impulses from each hole to the EDC control unit. In this way, the control unit can calculate the position and speed of the engine.

The space between two of the holes is greater than the space between the other holes. When the control unit senses that the sensor has passed this larger space, it then knows that the flywheel is at TDC. In this position, either cylinder 1 or 6 is in the firing position.

If the auxiliary engine speed sensor is faulty at start up, the control unit needs to find out when cylinder 1 is in the firing position. It does this by attempting to inject fuel into cylinder 1 as soon as the flywheel is at TDC. When the control unit notes that the engine speed increases, it realizes that it was cylinder 1 that fired.

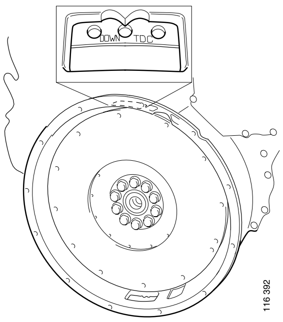
The control unit senses the voltage from the main engine speed sensor between pins A1 and A13.

If the control unit detects a fault, fault code 12 is generated.

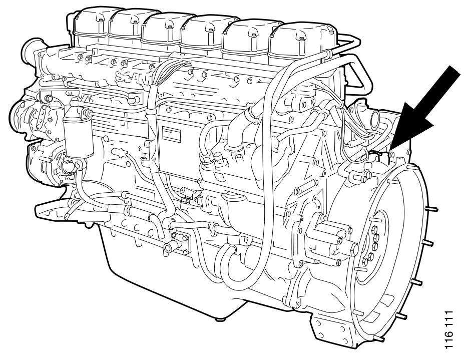
Note: The sensor is sensitive to polarity reversal and the pins must be connected as indicated below.

Pin A1 – signal voltage

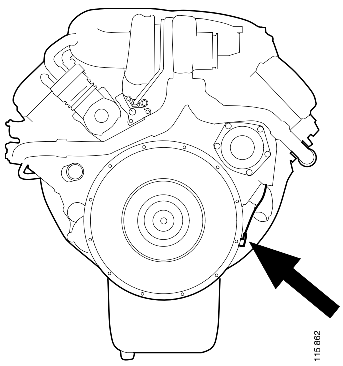
Pin A13 – earth



Flywheel. The detail shows some of the holes that are sensed by the main engine speed sensor.



Location of main engine speed sensor on 11 and 12 litre engines



Location of main engine speed sensor on 16 litre engine

Auxiliary engine speed sensor T75 (camshaft gear)

The auxiliary engine speed sensor senses the raised portions on the camshaft gear – indicated in the illustration. In this way, the EDC control unit knows which cylinder is in the firing position.

The camshaft gear is attached to the camshaft and they rotate at the same speed. In this way, the control unit can also calculate the engine speed.

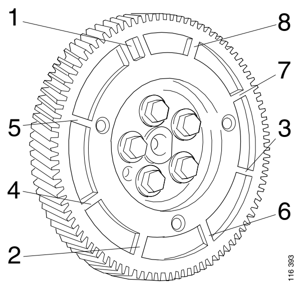
The control unit senses the voltage from the sensor between pins A2 and A14.

If the control unit detects a fault, fault code 13 is generated.

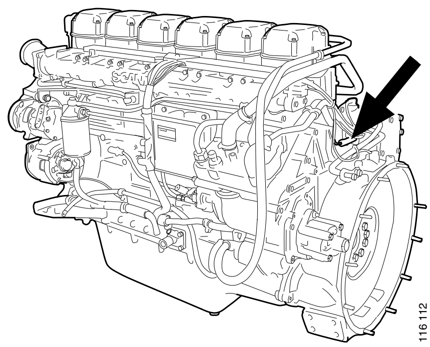
Note: The sensor is sensitive to polarity reversal and the pins must be connected as indicated below.

Pin A2 – signal voltage

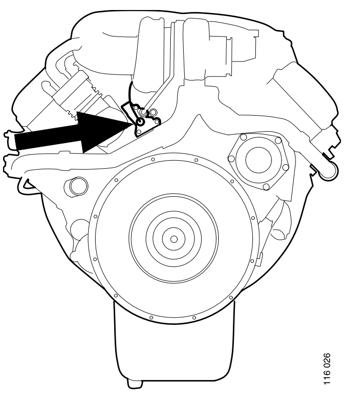
Pin A14 – earth



Camshaft gear on 16 litre engine. The numbers indicate the raised portions where the auxiliary engine speed sensor senses the firing position of each cylinder.



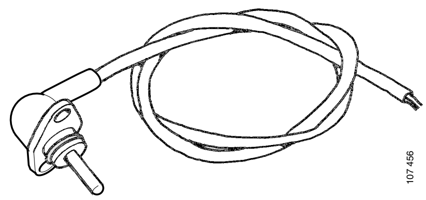
Location of auxiliary engine speed sensor on 11 and 12 litre engines

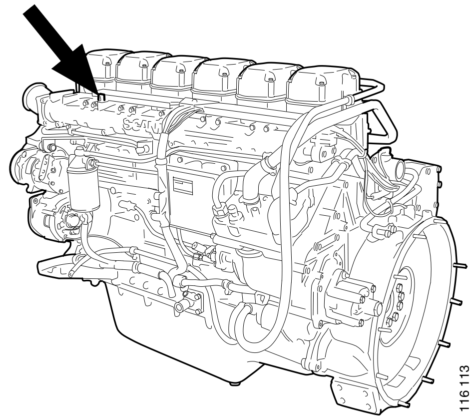


Location of auxiliary engine speed sensor on 16 litre engine

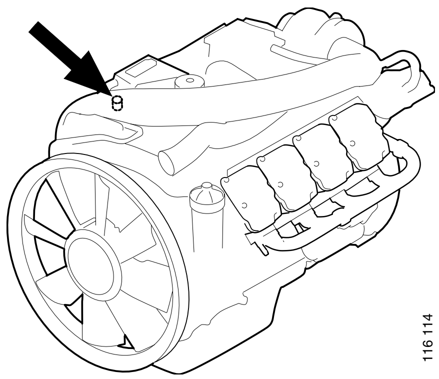
Charge air pressure and temperature sensor, T47

The sensors for charge air pressure and temperature are integrated into one single component. Both sensors are described in more detail on the next page.





Location of sensor on 11 and 12 litre engines



Location of sensor on 16 litre engine

Charge air pressure sensor

The charge air pressure sensor detects the absolute pressure in the intake manifold, i.e. the atmospheric pressure plus the positive pressure provided by the turbocharger.

The EDC control unit uses the signal from the sensor to limit the fuel quantity when the charge air pressure is under a certain level. The lower the pressure, the less fuel the control unit allows to go out to the unit injectors. In this way black smoke is avoided.

The sensor receives a supply voltage of +5 V from the EDC control unit pin A23 and is earthed through pin A17.

The control unit pin A12 receives a signal voltage from the sensor. The signal voltage is directly proportional to the charge air pressure. High pressure gives high voltage and vice versa.

If there is a fault with the signal, the control unit operates after a preset pressure value – while at the same time generating fault code 16.

As a safety precaution, the engine torque is then limited.

Charge air temperature sensor

The charge air temperature sensor detects the temperature in the intake manifold. The EDC control unit uses the signal from the sensor to finely adjust the fuel quantity so that black smoke is not produced. The warmer the charge air, the less fuel the control unit allows to go out to the unit injectors.

The sensor is of the NTC type, which means that its resistance is temperature dependent. If the temperature increases, the resistance in the sensor drops.

The sensor is earthed via pin A17. The control unit senses the voltage level across pins A17 and A21.

If the voltage is outside a given range, the control unit operates after a preset temperature value– while at the same time generating fault code 15.

The engine will then react more slowly than normal when actuating the throttle in cold weather, as the EDC control unit thinks that the air is warmer than it really is.

Coolant temperature sensor T33

The coolant temperature sensor sends a signal to the EDC control unit which controls the fuel quantity when the engine is started. It also influences the EDC control unit so that it controls the engine idling speed and maximum engine speed when the engine is cold and the engine power when it is too warm.

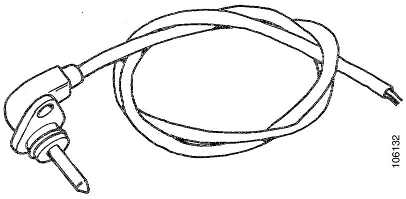
If the EDC control unit receives a signal from the coolant temperature sensor that the engine is cold when attempting to start (cold start), the following will occur. If the engine does not start within 2 seconds, the fuel quantity injected will successively increase until the engine starts.

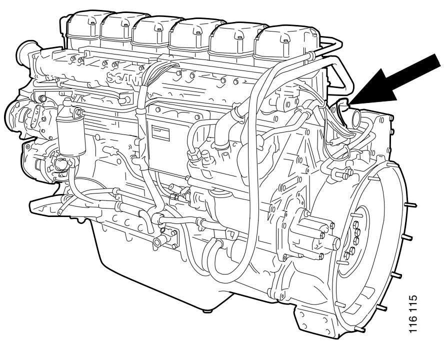
Directly after a cold start, the engine speed is limited to 1000 rpm in order to protect the engine - the engine idling speed is raised to 600 rpm.

The length of time engine speed limitation is engaged varies depending on the coolant temperature:

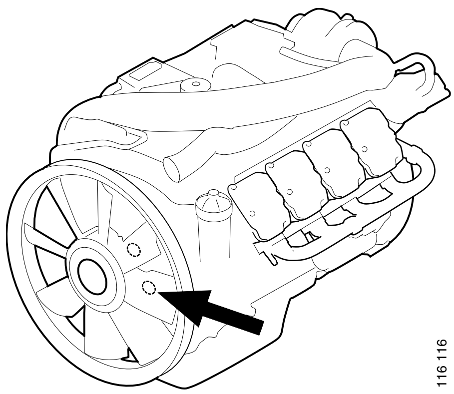
Below +10°C	30 seconds
Above +20°C	3 seconds

The engine idling speed returns to normal when the coolant has reached 20 - 60°C (the temperature limit differs between engine types).

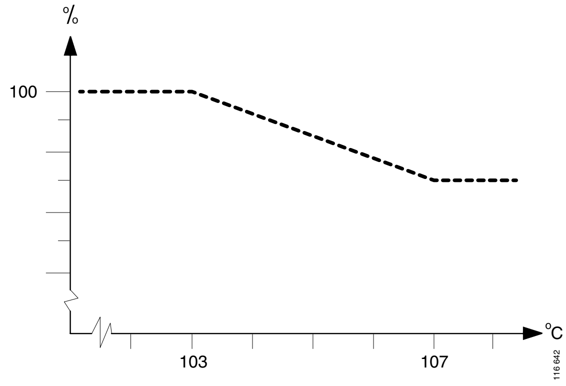




Location of coolant temperature sensor on 11 and 12 litre engines



Location of coolant temperature sensor on 16 litre engine



On certain engines – e.g. the 16 litre engine – the engine power is limited when the coolant temperature exceeds 103°C. Refer to diagram. The engine power is limited to prevent the engine from overheating.

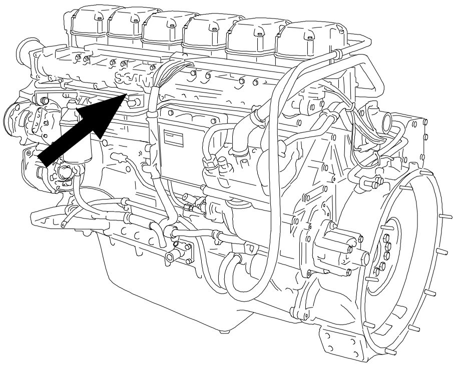
The sensor is earthed via pin A5. The EDC control unit detects the voltage level between pins A5 and A22.

If the voltage is outside a given range, the control unit operates after a preset temperature value – while at the same time generating fault code 14.

The engine will then have poorer cold start characteristics, the engine idling speed is raised to 600 rpm and it cannot be adjusted.

Oil pressure sensor T5

The oil pressure sensor senses the absolute pressure of the engine oil, i.e. atmospheric pressure plus the positive pressure from the oil pump.



Location of oil pressure sensor on 11 and 12 litre engines

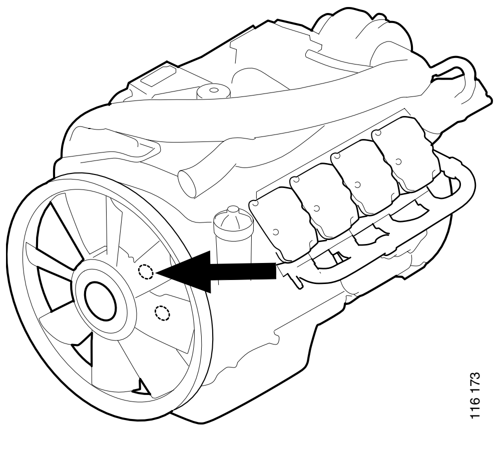
Engines with coordinator

- Oil pressure sensor T5 is directly connected to the EDC control unit. The EDC control unit does not use this value but simply sends it on to the coordinator.

The sensor receives a supply voltage of +5 V from the control unit pin A8 and is earthed through pin A6.

The sensor sends a signal voltage to control unit pin A9.

If the signal voltage is outside a given range, the control unit sends a preset pressure value to the coordinator – while at the same time generating fault code 18.



Location of oil pressure sensor on 16 litre engine

Fan solenoid valve V56

The fan is mechanically driven by the crankshaft via the outer belt transmission. It is either mechanically or electrically controlled.

We know that on a mechanically controlled fan, it is a bimetallic spring that controls the slip in the viscous coupling of the fan.

On an electrically controlled fan, the bimetallic spring is replaced by a solenoid valve. The EDC control unit controls the solenoid valve using a PWM signal of +24 V (more detailed information on PWM signals can be found in the section PWM signals). In this way, the control unit can control the speed of the fan.

One of the advantages with an electrically controlled fan is that the idling speed of the fan is lower than with a mechanically controlled fan. In this way, fuel consumption will be less.

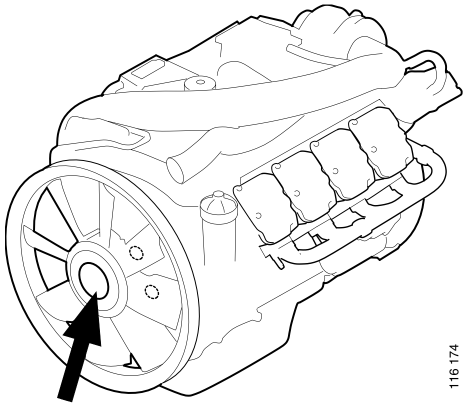
Another advantage is that the electrically controlled fan can be more precisely controlled than the mechanically controlled fan. During retarder braking, the retarder control unit can request, for example, the EDC control unit to increase the fan speed to maximum. In this way, the cooling capacity is increased and the driver can brake longer with the retarder before it starts to deregulate due to the temperature being too high.

If the solenoid valve does not receive a signal from the control unit then the fan is fully engaged and follows the engine speed. This is done to ensure that the engine is cooled even if there is a fault with fan control.

The control unit processes the signals from the following components – before it decides how it should control the fan:

- Coolant temperature sensor
- Charge air temperature sensor
- Retarder control unit
- Engine speed sensors

The solenoid valve is earthed at control unit pin A16 and it receives the PWM signal from pin A10.



Location of solenoid valve on 16 litre engine

If the control unit cannot control the solenoid valve correctly, then fault code 39 is generated.

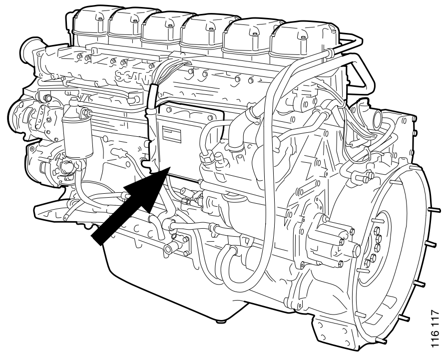
EDC control unit E12

Location of EDC control unit

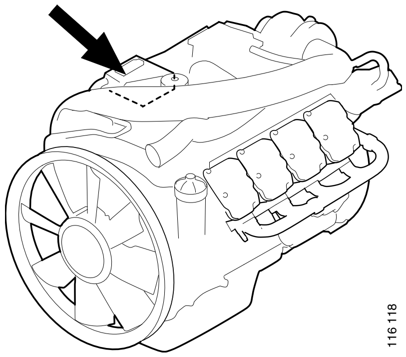
The EDC control unit is attached to a control unit cooler on the engine. The fuel flowing through the control unit cooler cools the control unit.

The control unit is attached to the engine with vibration insulators to protect the control unit. The vibration insulators also insulate the control unit electrically from the engine.

It is important to ensure that the control unit casing is not earthed to the engine. The control unit may only be earthed to the chassis via the cab and chassis wiring. Inside the control unit is an interference suppressor that requires perfect earthing in order to function correctly.



Location of EDC control unit on 11 and 12 litre engines



Location of EDC control unit on 16 litre engine

Function of the EDC control unit

The EDC control unit collects information and then processes it into signals which control the solenoid valves on the unit injectors.

We know that the electrical system of the vehicle has a system voltage of +24 V and is earthed via the chassis.

The control unit converts the system voltage to a lower voltage of approximately 5 V, which it then supplies to the sensors, etc. These sensors are always earthed through the control unit.

The control unit can be configured using Scania Programmer. For example, a maximum speed can be set up.

Every time the control unit is configured, the date and VCI identification number are stored in the memory of the control unit. This is the equivalent of security sealing.

EDC control unit, integrated atmospheric pressure sensor

Some EDC control units have an integrated atmospheric pressure sensor.

When the control unit senses that the atmospheric pressure is low – i.e. at high altitude – the control unit will then limit the maximum amount of injected fuel. It does this to protect the turbocharger from overrevving.

The control unit interprets the voltage from the sensor according to the following.

- 0,2–2.36 V = 0.6 bar
- 2,37–4.74 V = 0.6–1.2 bar

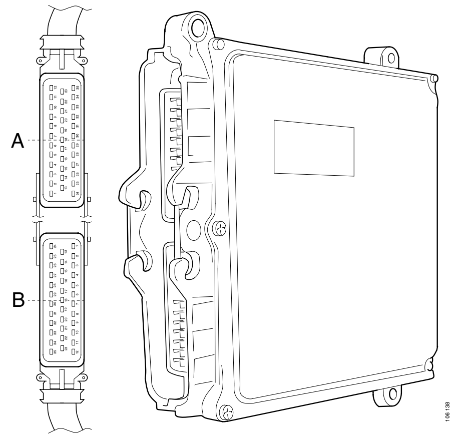
If the voltage is outside the above voltage ranges, the control unit operates according to a preset pressure value – while at the same time generating fault code 29.

EDC control unit, connections

The EDC control unit is connected to the other EDC systems in the vehicle via the two 35-pin connectors A and B. See illustration.

The connector A is connected to the engine components.

The connector B is connected to the other EDC components in the vehicle. In vehicles equipped with a coordinator, the control unit communicates with the components in the driver area via the coordinator. Communication with the coordinator is through CAN communication via pins B11and B12.



How the pins are connected is shown below.

A1	Input signal from the main engine speed sensor.
A2	Input signal from the auxiliary engine speed sensor.
A3	Not used.
A4	Not used.
A5	Earth for coolant temperature sensor.
A6	Earth for oil pressure sensor.
A7	Not used.
A8	Supply voltage +5 V to the oil pressure sensor.
A9	Input signal from the oil pressure sensor.
A10	Supply voltage +24 V to the fan solenoid valve.
A11	Not used.
A12	Input signal from the charge air pressure sensor.
A13	Earth for main engine speed sensor.
A14	Earth for auxiliary engine speed sensor.
A15	Not used.
A16	Earth for fan solenoid valve.
A17	Earth for charge air pressure sensor.
A18	Not used.
A19	Not used.
A20	Not used.
A21	Input signal from the charge air temperature sensor. The control unit senses the voltage level across pins A21 and A17.
A22	Input signal from the coolant temperature sensor. The control unit senses the voltage level across pins A22 and A5.
A23	Supply voltage +5 V to the charge air pressure sensor.
A24	Supply voltage to the solenoid valves in the following cylinders. 6 cylinder engine: 1, 2 and 3. 8 cylinder engine: 1, 4, 6 and 7.
A25	Supply voltage to the solenoid valves in the following cylinders. 6 cylinder engine: 4, 5 and 6. 8 cylinder engine: 2, 3, 5 and 8.
A26	Earthing of the solenoid valves in the following cylinders. 6 cylinder engine: 3. 8 cylinder engine: 5.
A27	Earthing of the solenoid valves in the following cylinders. 6 cylinder engine: 2. 8 cylinder engine: 2.
A28	Earthing of the solenoid valves in the following cylinders. 6 cylinder engine: 1. 8 cylinder engine: 3.

A29 Used only on 8 cylinder engines.
Earthing of the solenoid valve in cylinder 8.

A30 Not used.

A31 Not used.

A32 Used only on 8 cylinder engines.
Earthing of the solenoid valve in cylinder 7.

A33 Earthing of the solenoid valves in the following cylinders.
6 cylinder engine: 4.
8 cylinder engine: 6.

A34 Earthing of the solenoid valves in the following cylinders.
6 cylinder engine: 6.
8 cylinder engine: 4.

A35 Earthing of the solenoid valves in the following cylinders.
6 cylinder engine: 5.
8 cylinder engine: 1.

B1 Earth connection for the control unit to chassis.

B2 Earth connection for the control unit to chassis.

B3 Supply voltage +24 V from the supply relay to the control unit.

B4 Supply voltage +24 V from the supply relay to the control unit.

B5 Not used (output signal for engine speed).

B6 Earthing input signal from the diagnostics switch. Earthing output signal for activation of the diagnostic and warning lamps.

B7 PWM signal. Output signal for throttle actuation.

B8 Input signal from the control for the cruise control. The control unit senses the voltage level across pins B8 and B25.

B9 Not used.

B10 Not used.

B11 CAN communication, L lead

B12 CAN communication, H lead

B13 Diagnostic cable K.

B14 Not used.

B15 Input signal +24 V from the starter lock (when the key is in the drive position).

B16 Supply voltage +5 V to the potentiometer in the accelerator pedal sensor.

B17 Input signal from the throttle actuation switch. If the pin is earthed, the control unit interprets the accelerator pedal as being depressed.

B18 Not used.

B19 Input signal for the Torque limiter 2 function. Earthed pin gives the Torque limiter 2 function (the pin B28 must not be earthed). If pin B28 is grounded at the same time, the Torque limiter 3 function is activated instead.

B20 Input signal from the clutch pedal switch. If the pin is earthed, the control unit interprets the clutch pedal as being depressed.

B21 Input signal for the Limited hand throttle function. Earthed pin gives the Limited hand throttle function (the pin B32 must not be earthed). If pin B32 is earthed at the same time, the Fixed engine speed function is engaged instead.

B22 Input signal for the Emergency stop function. The function is activated when the pin is earthed.

B23 Input signal from the potentiometer in the accelerator pedal sensor. The pin receives a signal voltage of 0.25–4.00 V, depending on how far the accelerator pedal is depressed.

B24 Not used.

B25 Earthing of the control for the cruise control.

B26 Input signal from brake pedal switch 1. If the earthing connection is broken, the control unit interprets the brake pedal as being depressed.

B27 Output signal for activation of the supply relay. The pin earths the relay.

B28 Input signal for the Torque limiter 1 function. Earthed pin gives the Torque limiter 1 function (the pin B19 must not be earthed). If pin B19 is earthed at the same time, the Torque limiter 3 function is activated instead.

B29 Speed signal from tachograph output D3.

B30 Not used.

B31 Input signal from brake pedal switch 2. If the pin is earthed, the control unit interprets the brake pedal as being depressed.

B32 Input signal for the Raised idling speed function. Earthed pin activates the Raised idling speed function (the pin B21 must not be earthed). If pin B21 is earthed at the same time, the Fixed engine speed function is activated instead.

B33 Input signal for cruise control disengagement. +24 V applied to the pin disengages the cruise control.

B34 Input signal for the Speed limiter 2 function. +24 V applied to the pin engages the Speed limiter 2 function.

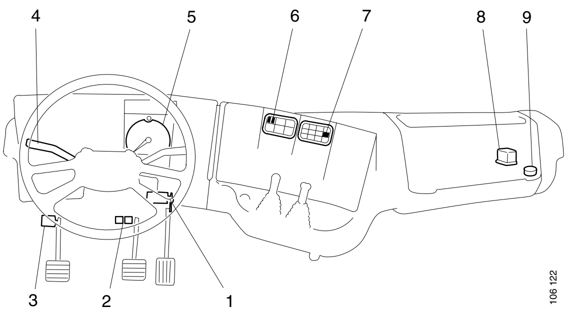
B35 Earthing of the potentiometer in the accelerator pedal sensor.

Components in the driver area

If the vehicle is equipped with a coordinator, refer to the function description of the coordinator to read about the components in the driver area. The supply relay is an exception; this is always controlled by the EDC control unit.

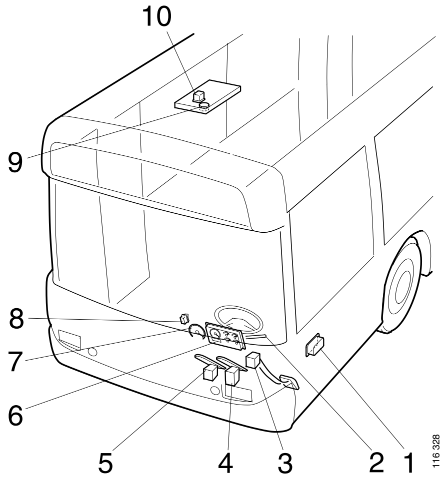
In the EDC section General, there is a description of how to check if the vehicle is equipped with a coordinator.

Component locations, truck



1 *Accelerator pedal sensor*
2 *Brake pedal switches*
3 *Clutch pedal switch*
4 *Control for the cruise control*
5 *Tachograph (vehicle speed)*
6 *Diagnostics switch with lamp*
7 *Warning lamp for EDC*
8 *Supply relay*
9 *Diagnostic socket for the PC*

Component locations, bus

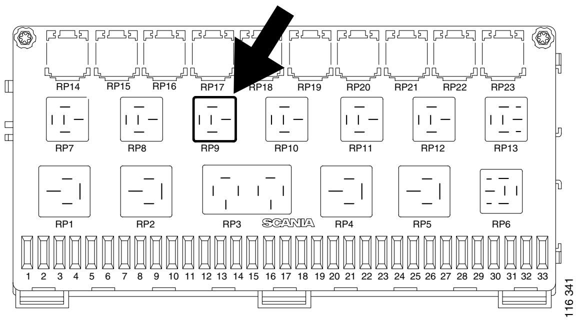


1 *Diagnostics switch with lamp*
2 *Control for the cruise control*
3 *Clutch pedal switch*
4 *Brake pedal switches*
5 *Accelerator pedal sensor*
6 *Warning lamp for EDC*
7 *Tachograph (vehicle speed)*
8 *Switch for temporary raising of the engine speed (engine speed function Fixed engine speed)*
9 *Diagnostic socket for the PC*
10 *Supply relay*

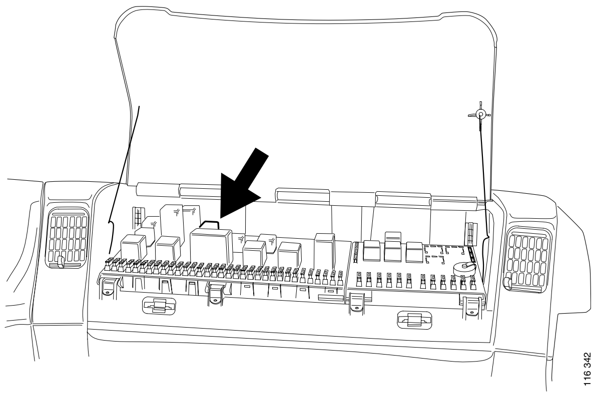
Supply relay R34

The supply relay acts as the main switch for the EDC system. The EDC control unit is supplied with voltage by the supply relay. The control unit controls the relay itself and this gives it control over the system. If the relay releases, the engine will stop.

When the starter voltage is turned on using the starter key, voltage is applied to the control unit pin B15 with the battery voltage of +24 V. The control unit then earths pin B27, the supply relay is activated and the control unit is supplied with +24 V on pins B3 and B4.



Location of supply relay in central electric unit. The central electric unit is the same in both trucks and buses.



Location of supply relay and central electric unit, truck. The location of the central electric unit varies in buses.

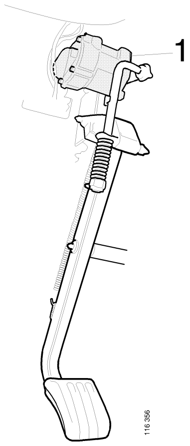
Accelerator pedal sensor – B25, B26 and D35

Note: If the vehicle is equipped with a coordinator, the component is associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.

The accelerator pedal sensor consists of the following three components.

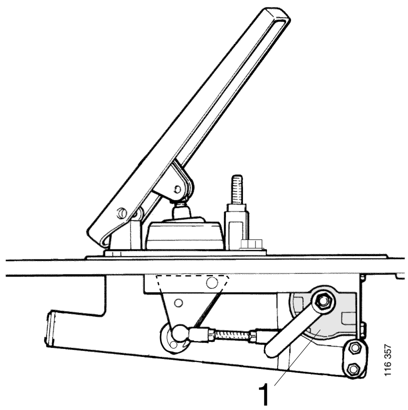
- A potentiometer.
- A throttle actuation switch
- A kick-down switch

Accelerator pedal and accelerator pedal sensor, truck



1 *Accelerator pedal sensor*

Accelerator pedal and accelerator pedal sensor, bus



1 *Accelerator pedal sensor*

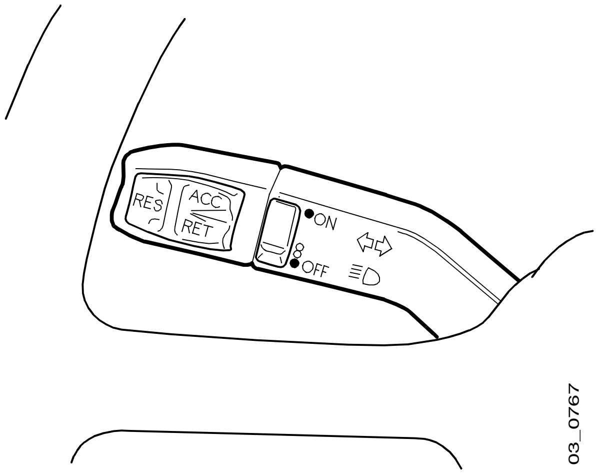
The potentiometer informs the EDC control unit of the accelerator pedal position. The potentiometer receives a supply voltage of approx. +5 V from control unit pin B16 and is then earthed via pin B35. The sensor supplies a signal voltage to control unit pin B23. The voltage is directly dependent on how much the accelerator pedal is depressed. At 2.7 V, the control unit interprets the voltage as a request for full throttle. Voltages above 2.7 V do **not** result in higher engine power.

The throttle actuation switch informs the control unit pin B17 if the accelerator pedal is fully released or depressed. When the pedal is fully released, the throttle actuation switch is open. The control unit interprets this as a request for idling speed. The throttle actuation switch closes when the pedal is pressed down and earths pin B17 on the control unit.

The kick-down switch is activated when the accelerator pedal is pressed from full throttle to the kick-down position. However, the EDC system does not utilise the signal from the kick-down switch. The signal can be used by other systems however – for example Opticruise.

Control for the cruise control S51

Note: If the vehicle is equipped with a coordinator, the component is associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.



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Using the control for the cruise control system, the EDC control unit is informed of the speed the vehicle is required to hold. The control unit receives continuous information on vehicle speed from the tachograph.

The control for cruise control is also used when adjusting idling speed or using the functions for the control of engine speed.

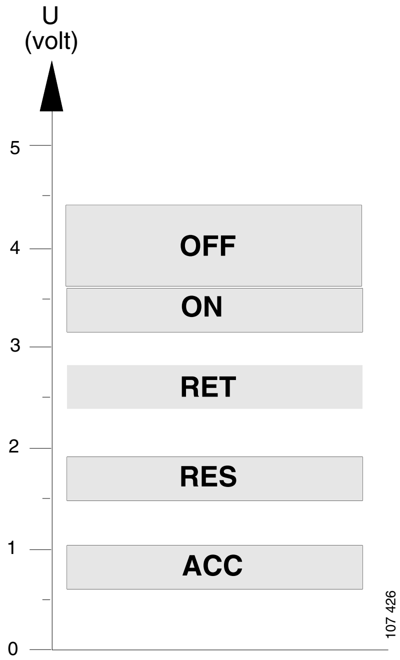
The control for cruise control has the following five functions.

- ON
- OFF
- ACC (accelerate, the speed of the vehicle increases)
- RET (retard, the speed of the vehicle decreases)
- RES (resume, the vehicle returns to the previously selected speed)

There are only two cables between the control and the control unit. The cables are connected to the control unit pins B8 and B25. Each function gives a certain voltage level (refer to graph) which the control unit senses across the pins.

The voltage levels are created when the resistance in the circuit changes depending on which function is engaged.

The control receives a supply voltage of approximately +5 V from control unit pin B8 and is then earthed via pin B25.



Different voltage levels of cruise control functions

Brake pedal switches B1 and B34

Note: If the vehicle is equipped with a coordinator, the components are associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.

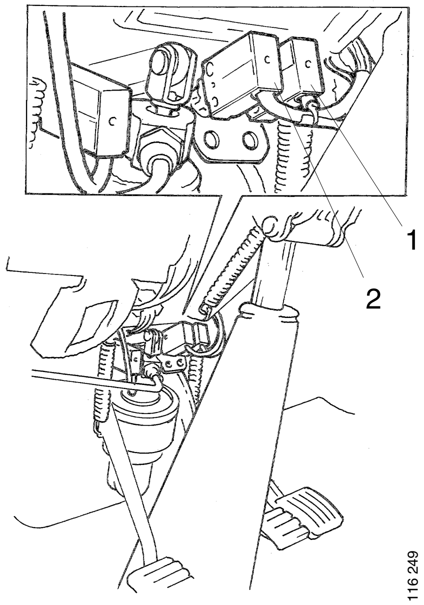
Two brake pedal switches sense when the brake pedal is depressed. The switches are connected so that one opens and the other closes when the pedal is depressed. They switch at the same time when the pedal is lightly pressed, i.e. at the start of pedal travel.

The switch that opens when the pedal is depressed is called brake pedal switch 1 and the switch that closes is called brake pedal switch 2.

Brake pedal switch 1 is connected between the EDC control unit pin B26 and chassis earth. When the brake pedal is pressed down, the ground connection to pin B26 is broken.

Brake pedal switch 2 is connected between control unit pin B31and chassis earth. When the pedal is depressed, pin B31 is earthed.

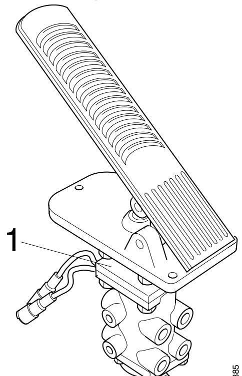
Pedals, truck



1 Brake pedal switch 1

2 Brake pedal switch 2

Brake pedal and service brake valve, bus



1 Service brake valve containing brake pedal switches 1 and 2

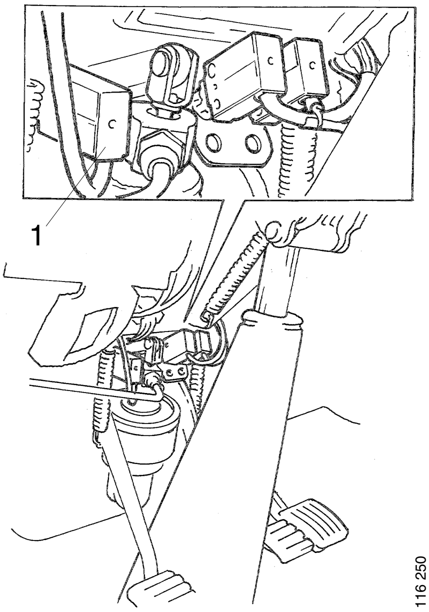
Clutch pedal switch B32

Note: If the vehicle is equipped with a coordinator, the component is associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.

The clutch pedal switch senses when the clutch pedal is depressed.

The switch is connected between the EDC control unit pin B20 and chassis earth. When the pedal is depressed, the switch closes and earths pin B20.

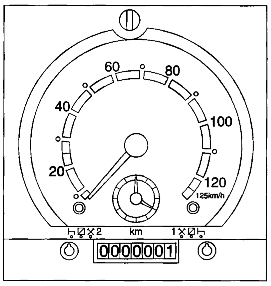
Pedals, truck



1 Clutch pedal switch. The clutch pedal and its switch look the same in buses.

Tachograph O4

Note: If the vehicle is equipped with a coordinator, the component is associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.



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The tachograph gives the EDC control unit information about vehicle speed. Vehicle speed sensing is a prerequisite for certain functions such as cruise control, speed limiter and engine speed control.

If the control unit does not receive a signal from the tachograph, it will then operate according to the preset speed 15 km/h.

The speed signal is applied to control unit pin B29.

Warning lamp for EDC, W27

Note: If the vehicle is equipped with a coordinator, the component is associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.

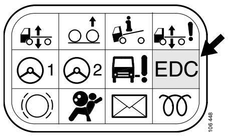
The EDC warning lamp comes on for a few seconds when the starter voltage is switched on with the starter key and also when the engine is switched off.

When starter voltage is switched on, the warning lamp comes on for a few seconds to check that it is intact.

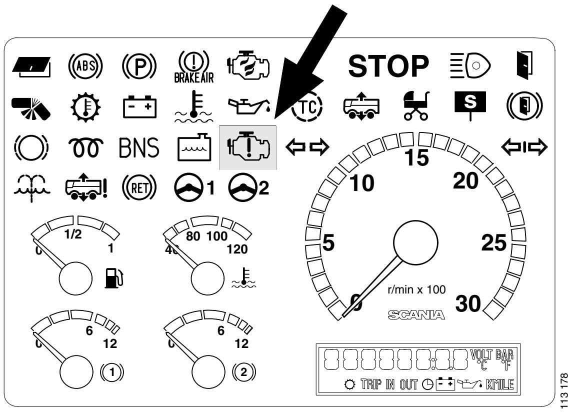
When the engine is switched off, the warning lamp comes on while the EDC control unit carries out a functional check of the EDC system. When the check is completed, the supply relay releases and the warning lamp goes out. Sometimes, the warning lamp may flash as part of the functional check; this is not a fault.

When the engine is running, the warning lamp should normally be off. If there is a fault in the EDC system, the warning lamp comes on.

The warning lamp receives the voltage +24 V from the supply relay and is earthed via control unit pin B6.



Warning lamp for EDC (truck)



Warning lamp for EDC (bus)

Diagnostics switch with lamp, S52

Note: If the vehicle is equipped with a coordinator, the component is associated to the coordinator. The EDC control unit will then only receive a CAN message about the status of the component.

Using the diagnostics switch, it is possible to extract fault codes that may be stored in the EDC control unit memory. The fault codes are flashed out by the lamp. This switch is also used to clear fault codes.

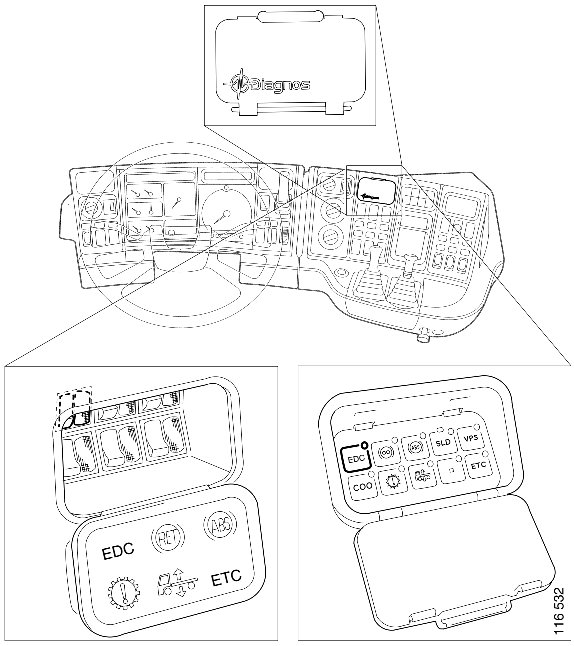
The switch is connected between control unit pin B6 and chassis earth. The switch, which is spring-loaded, closes when pressed.

The diagnostics lamp receives +24 V from the supply relay and is earthed via control unit pin B6.

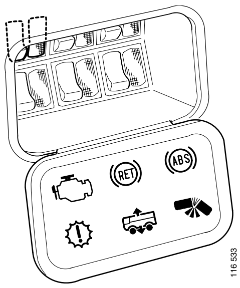
When the switch is pressed, it earths the lamp.

More about the diagnostics switch, e.g. how to interpret the flash codes, can be found in the section Warning system.

The diagnostics lamp is connected in parallel with the EDC warning lamp and therefore, both lamps are always on at the same time.



Two types of diagnostics switch, truck



Diagnostics switch, bus

Type of regulator

There are two different types of governor: RQ and RQV. When choosing governor type it must be decided how the EDC control unit should interpret the signals or messages from the accelerator pedal. Below is an explanation of the difference between RQ and RQV.

- RQV = the throttle pedal requests a certain engine speed. RQV is used in most vehicles and is also preset in control units that are ordered as parts.
- RQ = the throttle pedal requests a certain torque. RQ is used in buses equipped with automatic gearbox. If a new control unit is ordered, it must be reprogrammed to RQ.

The governor type can be programmed into the control unit using Scania Programmer.

Warning system

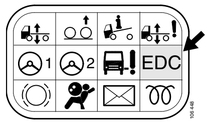
If a fault occurs in the EDC system, one or more of the following measures will be carried out by the EDC control unit, depending on what the fault is.

- The warning lamp for EDC comes on. It will often go out on its own when the fault ceases. Sometimes, however, it may be necessary to switch the starter voltage off and on to get the lamp to go out.
- Functions like cruise control and hand throttle are disengaged.
- Torque is limited.
- The defective unit injector (cylinder) is turned off.
- When idling, the engine runs at a slightly higher engine speed than normal.
- The engine is switched off.

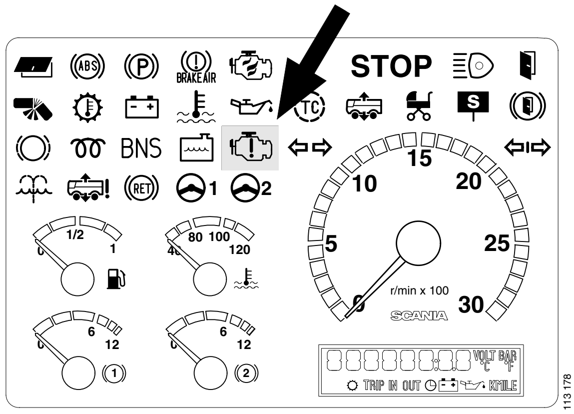
The control unit carries out the above measures in order to prevent the fault causing expensive damage and at worst leading to uncontrolled throttle actuation.

If the engine is not turned off, the vehicle can often be driven to a workshop. It should be remembered, however, that the system has less than normal safety margins, especially if engine output is reduced.

General



Warning lamp for EDC (truck)



Warning lamp for EDC (bus)

Shutdown test

Every time the engine is switched off, the EDC control unit carries out a special test of the EDC system. While this shutdown test is running, the warning lamp is lit. When the check is complete, the following occurs: the supply relay releases, the lamp goes out and there is no power to the control unit.

If the control unit discovers a fault during the shutdown test, the warning lamp will come on the next time the engine is started, even if the fault is no longer present. The control unit must carry out a fault-free shutdown test before the warning lamp goes out.

Fault codes

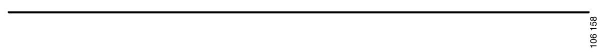
When the control unit discovers a fault, or something which it interprets as abnormal, it generates a fault code. The warning system can generate approximately 30 different fault codes.

Arrangement of flashing codes

The fault codes are flashed out by the diagnostics lamp and are arranged in a certain way. The long flashes – of 1 second – that come first represent units of ten. The short flashes – of 0.3 seconds – that follow represent units of one.

The example on the right signifies fault code 25.

A single very long flash of 4 seconds indicates that no fault codes are stored in the memory.



Fault code memory

The EDC control unit memory has sufficient space to store all the fault codes.

The fault codes are stored in two different places in the control unit. Erasing with the diagnostic switch erases the fault codes that are flashed on the diagnostic lamp.

However, the fault codes will remain stored in another memory that can only be accessed using Scania Diagnos. Scania Diagnos can be used to see how many times each fault has occurred; this information can be valuable with a loose connection for example. Scania Diagnos is used to erase both fault code memories at the same time.

Limp-home mode

If the potentiometer in the accelerator pedal sensor is faulty, fault code 25 is generated. The vehicle can, however, be driven to the nearest workshop in limp-home mode. Limp-home mode is activated by releasing the accelerator pedal once so that the EDC control unit is aware that the throttle actuation switch works.

When the accelerator pedal is then depressed the throttle actuation switch is closed. The closed throttle actuation switch gives a throttle actuation equal to half of full throttle.

When the accelerator pedal is released, the engine will run at idling speed.

Interaction with other systems

ABS/TC and EBS

The ABS/TC system influences the EDC system and vice versa.

The ABS/TC control unit continuously senses if one of the driving wheels is spinning. TC engine control is activated when the driving wheels spin and the throttle actuation is then reduced, irrespective of the accelerator pedal position, until the driving wheels cease to spin.

The EDC control unit continuously sends information on the accelerator pedal position to the ABS/TC control unit.

The EBS and ABS/TC control units communicate with the EDC control unit in the same way.

Opticruise

Opticruise influences the EDC system and vice versa.

The Opticruise control unit continuously receives information from the EDC control unit about data such as engine speed or accelerator pedal position.

During gear changing, the Opticruise control unit takes over control of the EDC system and controls throttle actuation.

Exhaust brake

The exhaust brake influences the EDC system, but not vice versa.

When the exhaust brake is activated, a message is sent to the EDC control unit, which then deactivates the cruise control.

If the exhaust brake is activated using the brake pedal, the throttle actuation is reduced to idling speed.

Retarder

The retarder influences the EDC system and vice versa.

When the retarder is activated, a message is sent to the EDC control unit, which then deactivates the cruise control.

If the accelerator pedal is depressed while the retarder is activated, the retarder will immediately be de-activated and the vehicle will respond to the accelerator pedal.

When the retarder is active, it can request a certain speed for the electrically controlled fan.

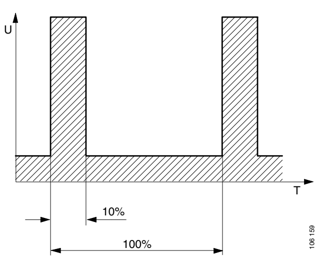
PWM signals

Note: A PWM signal cannot be measured – in a reliable way – using a normal multimeter. Instead, use the fault codes to locate the cause of any possible malfunctions.

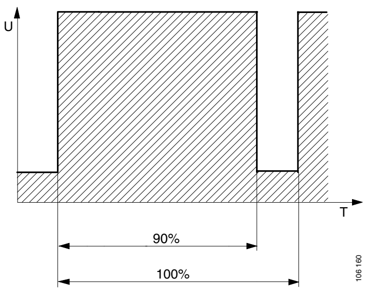
PWM means that a signal is Pulse Width Modulated. The pulse width may, for example, become greater when the throttle actuation increases.

The PWM signal is a square wave with a constant frequency (T). The voltage level (U) is also constant; the variable is the activation time – calculated as a percentage – of each cycle (the cycle is shown as 100% in the illustrations).

The PWM signal transmits very accurate information.



PWM signal at idling speed.



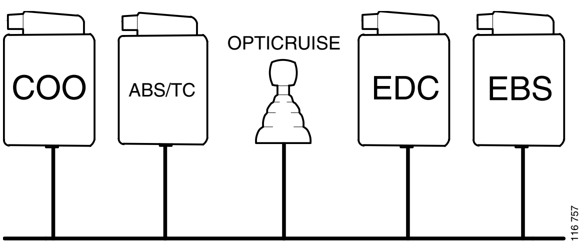
PWM signal at full throttle.

CAN communication

Note: Bodywork builders and coachbuilders must not connect their own systems to the CAN network without the approval of Scania. If any other equipment other than the factory fitted equipment is connected, safety and reliability can be affected.

Note: It is not possible to measure or check CAN messages with a multimeter either. Use the fault codes to locate the cause of any possible malfunctions.

CAN is an abbreviation of Controller Area Network. CAN communication is used to reduce the number of cables in the vehicle and at the same time increase reliability. The communication circuit consists of two cables, CAN H (High) and CAN L (Low).



Several different systems are connected to these two cables and in this way form a network. CAN communication is used for example between EDC, ABS/TC, EBS, the retarder, Opticruise and the coordinator.

In simple terms, CAN communication is rather like radio. The data messages that travel along a CAN cable can be compared to radio waves that travel through the air.

When listening to the radio, the receiver is set so that one radio station is heard at one time. Only one station is heard, even though many other radio stations are transmitting simultaneously.

A control unit does approximately the same with the messages that travel through a CAN cable. It listens, for example, for information from the EDC control unit concerning the coolant temperature, receives this value and uses it in its calculations.

The control unit receives all the CAN messages – that are sent through the communication circuit – in a special memory. This memory may be compared to a number of radio receivers that are all on but set to different radio stations to listen to several radio programmes simultaneously. In this way, the control unit always knows what is going on.