

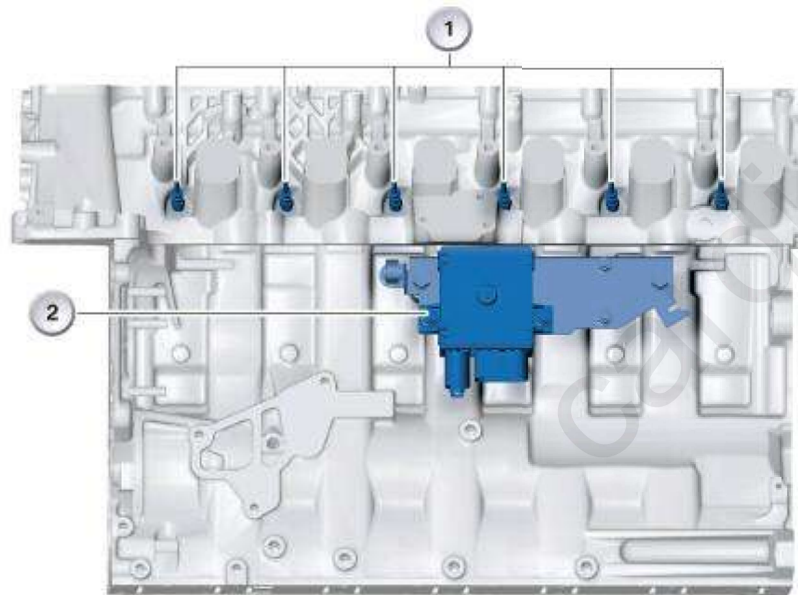
Diesel Auxiliary Systems

Glow-plug System

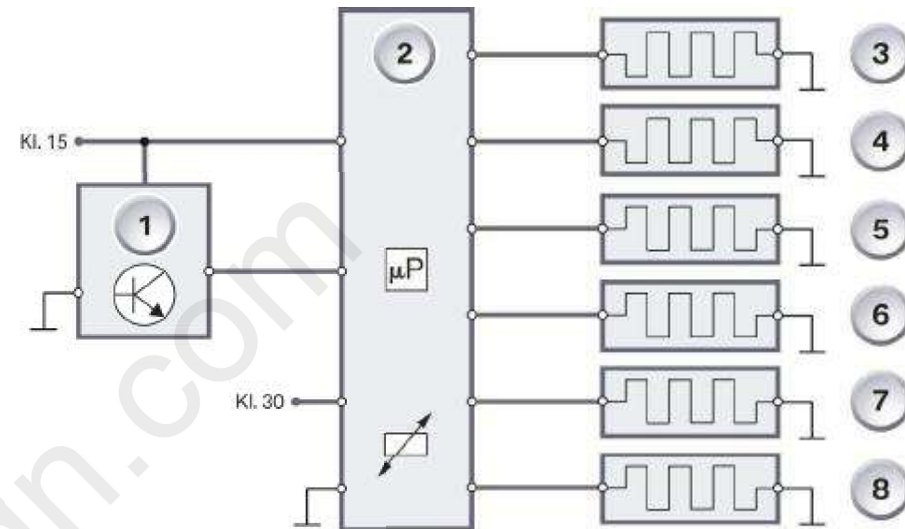
The glow-plug system is responsible for providing reliable cold start properties and smooth operation when the engine is cold.

The DDE control module sends the temperature requirement of the heater plug to the heating control unit. The heating control unit implements the request and actuates the heater plugs with a pulse-width modulated signal.

The heating control unit additionally sends diagnosis and status information via the LIN-bus connection back to the digital diesel electronics.



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The LIN-bus is a bi-directional data interface that operates in accordance with the master/slave principle. The DDE control unit is the master.

Each of the six heating circuits can be diagnosed individually.

When the heating control unit is switched on for the first time, the electrical resistance of the heater plugs is evaluated at the start of the heating process. A hot heater plug has a much higher resistance than a cold plug. If hot heater plugs are detected based on their resistance, less power is applied to the heater plugs at the start of the heating cycle.

If, on the other hand, cold heater plugs are detected, the maximum power is applied to the heater plugs at the start of the heating cycle. This function is known as dynamic repeat heating. This function avoids the situation where too much power is applied to a heater plug, which is already hot, as the result of a second heating cycle following shortly after the first, and therefore overheats.

The DDE control unit determines the necessary heater plug temperature as a function of the following operating values:

- Engine speed
- Intake air temperature
- Injected quantity
- Ambient pressure
- System voltage
- Status signal, starter enable.

The digital diesel electronics sends the required heater plug temperature to the heating control unit to activate heating.

The heating system assumes various operating modes that are explained in the following.

Preheating

Preheating is activated after terminal 15 has been switched on.

The heater system indicator in the instrument cluster is activated at a coolant temperature of $\leq 10^{\circ}\text{C}$.

Preheating is finished when:

- The engine speed threshold of 42 rpm is exceeded (starter is operated) or
- the preheating time has elapsed. The preheating time is dependent on the coolant temperature and is defined in a characteristic curve.

Coolant temperature in $^{\circ}\text{C}$	Preheating time in seconds
< - 35	3.5
- 25	2.8
- 20	2.8
- 5	2.1
0	1.6
5	1.1
30	1.1
> 30	0

Start Standby Heating

Start standby heating is activated when the preheating process is terminated by the preheating time elapsing. Start standby heating is terminated:

- After 10 seconds or
- when the engine speed threshold of 42 rpm is exceeded.

Start Heating

Start heating is activated during every engine start procedure when the coolant temperature is below 75°C . Start heating begins after the engine speed threshold of 42 rpm has been exceeded.

Start heating is terminated:

- After the maximum start heating time of 60 seconds has elapsed or
- after the engine start operation has been completed or
- when the coolant temperature of 75°C is exceeded.

Emergency Heating

Emergency heating is triggered for 3 minutes in the event of communication between the DDE control unit and heating control unit failing for more than 1 second.

The heating control unit then uses safe values so as to prevent damage to the heating system.

Concealed Heating

Preheating and start standby heating are activated as so-called concealed heating up to a coolant temperature of 30°C.

Concealed heating is triggered a maximum of 4 times and is then not enabled again before the engine is restarted.

Concealed heating is triggered by the following signals:

- Driver's seat occupancy
- Driver's seat belt buckle
- Valid key
- Terminal R
- Clutch operated.

Partial Load Heating

Partial load heating can occur at coolant temperatures below 75°C after starting the engine. Actuation of the heater plugs depends on the engine speed and load, thus improving the exhaust gas characteristics.

Actuation and Fault Detection

The power output stages for heater plug actuation are located in the heater control unit. The heater control unit does not have its own fault code memory. Faults in the heating system detected by the heater control unit are signalled via the LIN-bus to the digital diesel electronics.

The corresponding fault codes are then stored in the DDE fault code memory.

To avoid damage, the heater control unit shuts down all heating activities when the permissible operating temperature of the heater control unit is exceeded.

The ceramic heater plugs are designed for an operating voltage of 7.0 to 10.0 V. A voltage of 10 V can be applied to heat up the plug at a faster rate during the heating process. A PWM signal is applied to the heater plugs for the purpose of maintaining the heater plug temperature.

Consequently, an effective voltage is established at the heater plugs that is lower than the system voltage.

Note: The ceramic heater plugs are susceptible to impact and bending loads. Heater plugs that have been dropped may be damaged.

Note: A maximum voltage of 7 V may be applied to the heater plugs when removed. Higher voltages without cooling air movement can irreparably damage the heater plugs.

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