



Drive

Digital Diesel Electronics (DDE)

The following engine management systems are used for the M57TU engine:

Control unit designation	Model series/engine
DDE506	E65/M57TU E46/M57TU
DDE508	E60/M57TU

The engine management systems DDE506/508 are based on the engine management DDE5.0 already known from the M47D20TU.

The engine management systems DDE506 and DDE508 differ with regard to their programming and vehicle-specific functions (e.g. air flap control in DDE508 only).

All changes to the DDE506/508 in the M57TU compared to DDE5.0 in the M47D20TU are described in this chapter.



Drive

- Changes

New hot-film air mass meter HFM 6.4.

Use of the preheating system known from the M47TU (see M57TU, Preheating system).

For the purpose of using the M57TU in the E60 the air flap control is activated by the DDE508 (for EU cars only).

Evaluation of the fuel temperature by a temperature sensor in the feed line to the common rail high pressure pump.

The use of the 2nd generation common rail system renders the electric fuel pump relay and the auxiliary electric fuel pump unnecessary.

The energy management software (vehicle electrical system) is integrated in the DDE (see E60, Energy management).

Automatic start function for vehicles with SMG and automatic transmission.

Activation of the DDE main relay.



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System overview

- Inputs/outputs

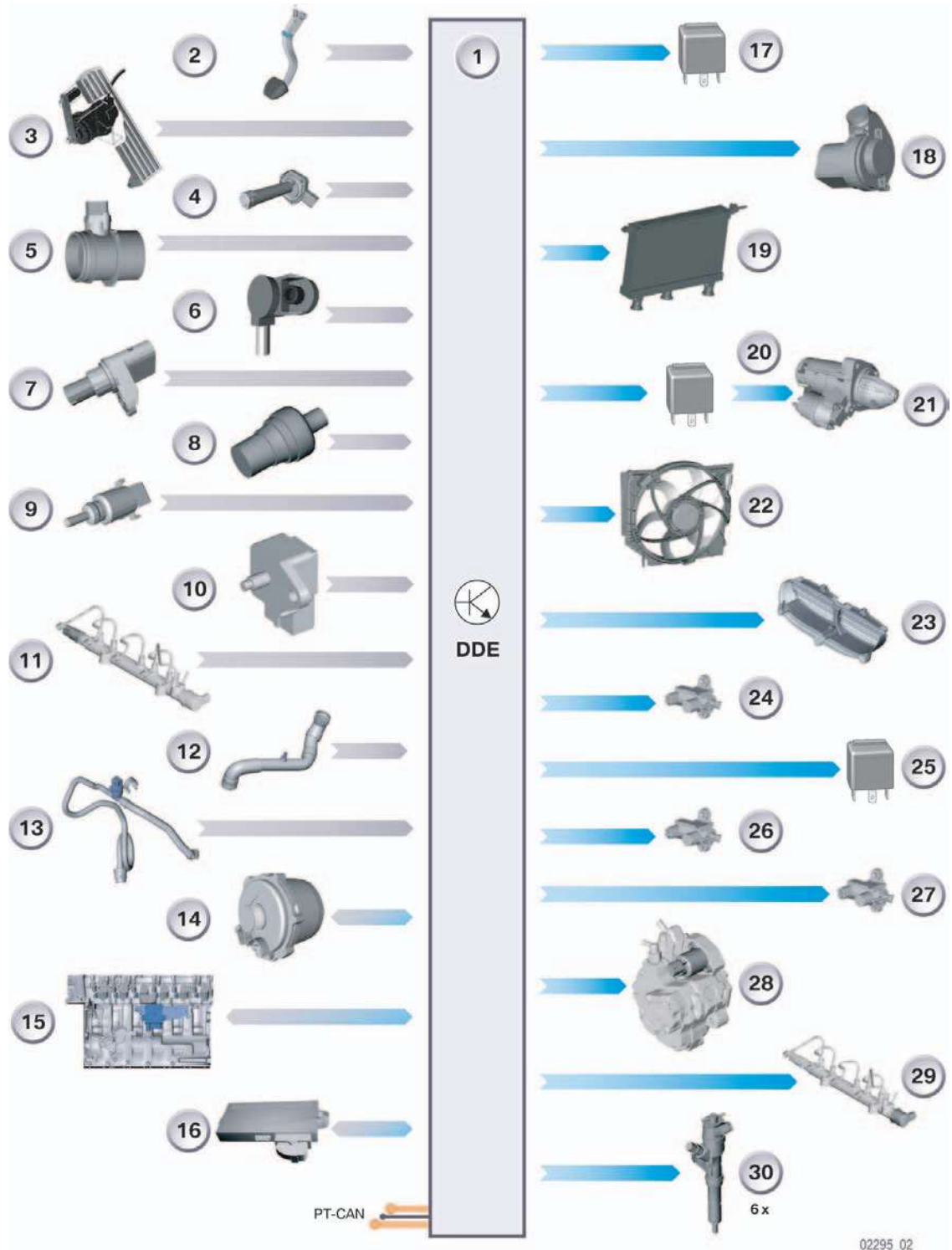


Fig. 25: System overview DDE506/508

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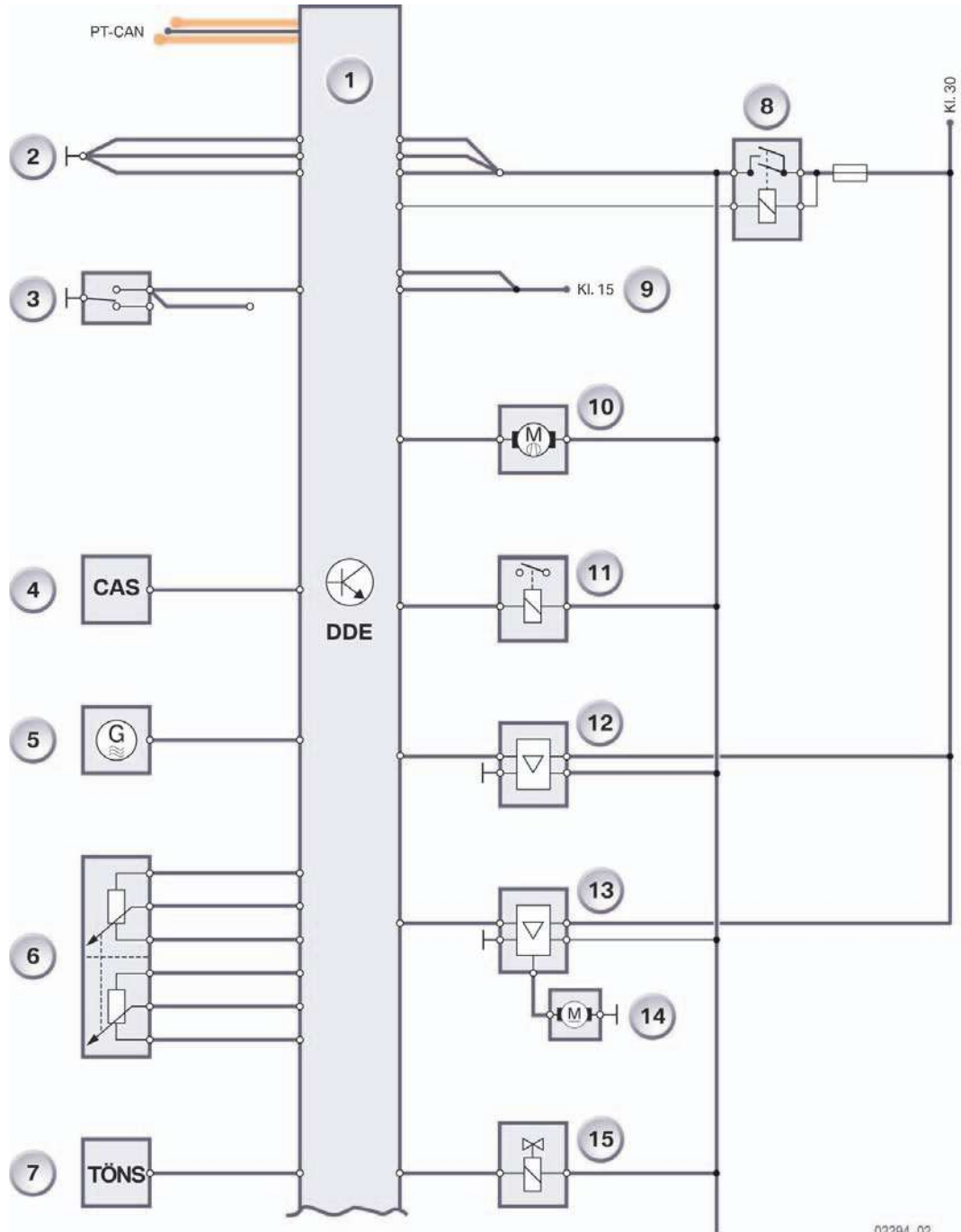
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1	DDE control unit	16	Car access system (CAS)
2	Brake pedal switch (and clutch pedal switch)	17	DDE main relay
3	Accelerator pedal module (FPM)	18	E-box fan
4	Thermal oil level sensor (TÖNS)	19	Auxiliary heater
5	Hot-film air mass meter (HFM)	20	Starter relay (E65 only)
6	Camshaft sensor (NWG)	21	Starter
7	Crankshaft sensor (KWG)	22	Fan activation
8	Oil pressure switch	23	Air flap control (E60 only)
9	Coolant temperature sensor	24	Exhaust gas recirculation valve (EGR)
10	Boost pressure sensor	25	Valve for engine mount control
11	Rail pressure sensor	26	Valve for swirl flaps
12	Charge air temperature sensor	27	Valve for turbocharger (VNT)
13	Fuel temperature sensor	28	Volume control valve
14	Alternator	29	Rail pressure valve
15	Preheating control unit (GSG)	30	Fuel injectors, cylinders 1-6



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- System circuit diagram



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Fig. 26: System circuit diagram DDE506/508, Part 1

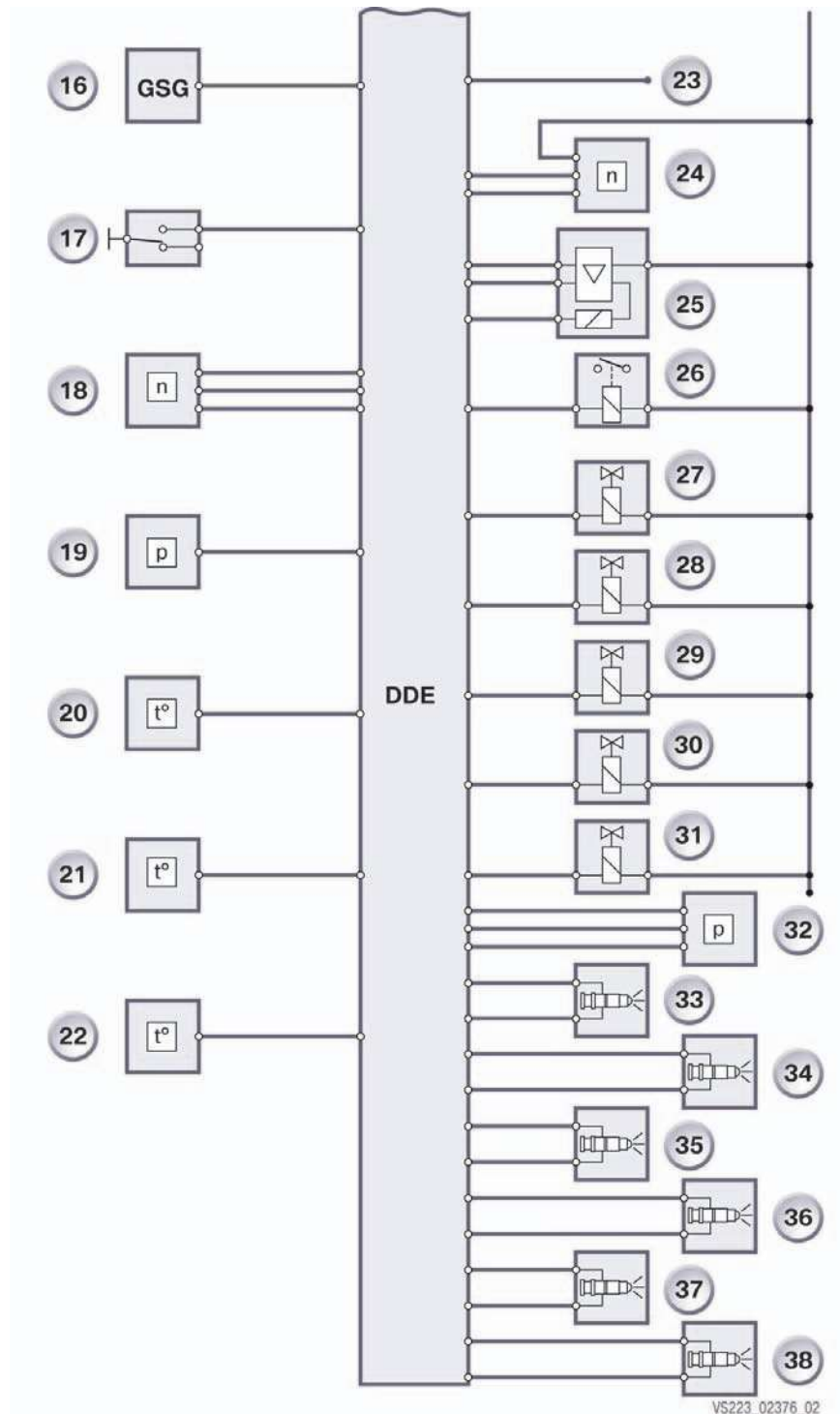
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Fig. 27: System circuit diagram DDE506/508, Part 2

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Index	Explanation	Index	Explanation
1	DDE5 control unit	20	Coolant temperature sensor
2	Ground connection	21	Charge air temperature sensor
3	Brake pedal switch (and clutch pedal switch)	22	Fuel temperature sensor
4	Car access system (CAS)	23	Output, terminal 15 for other control units
5	Alternator	24	Camshaft sensor (NWG)
6	Accelerator pedal module (FPM)	25	Hot-film air mass meter (HFM)
7	Thermal oil level sensor (TÖNS)	26	Valve for engine mount control
8	DDE main relay	27	Exhaust gas recirculation valve (EGR)
9	Terminal 15	28	Valve for turbocharger (VNT)
10	E-box fan	29	Valve for swirl flaps
11	Starter relay (E65 only)	30	Rail pressure valve
12	Auxiliary heater	31	Volume control valve
13	Fan control unit	32	Rail pressure sensor
14	Fan motor	33	Fuel injector, cylinder 1
15	Air flap control (E60 only)	34	Fuel injector, cylinder 2
16	Preheating control unit (GSG)	35	Fuel injector, cylinder 3
17	Oil pressure switch	36	Fuel injector, cylinder 4
18	Crankshaft sensor (KWG)	37	Fuel injector, cylinder 5
19	Boost pressure sensor	38	Fuel injector, cylinder 6

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Pin assignments of DDE5 M57D30TU

Pin No.	Assignment	Abbreviation	Explanation
1-01	Used	I 4	Injector 4
1-02	Used	I 6	Injector 6
1-03	Used	I 5	Injector 5
1-04	Not used	---	---
1-05	Not used	---	---
1-06	Used	NTC	Charge air temperature sensor
1-07	Used	NTC	Coolant temperature sensor
1-08	Not used	---	---
1-09	Not used	---	---
1-10	Used	MÖ	Oil pressure switch
1-11	Used		Fuel temperature sensor
1-12	Not used	---	---
1-13	Not used	---	---
1-14	Used	NWG	Camshaft sensor "ground"
1-15	Used	KWG	Crankshaft sensor "ground"
1-16	Not used	---	---
1-17	Not used	---	---
1-18	Used	A1	Switch terminal 15 "input"
1-19	Not used	---	---
1-20	Not used	---	---
1-21	Not used	---	---
1-22	Used	TXD2	Diagnosis jumper, "automatic transmission"
1-23	Not used	---	---
1-24	Used		Engine mount control
1-25	Used	I 4	Injector 4
1-26	Used		Injector 6
1-27	Used	I 5	Injector 5
1-28	Not used	---	---
1-29	Not used	---	---
1-30	Used	RDS	Rail pressure sensor U _{supply}
1-31	Not used	---	---

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Pin No.	Assignment	Abbreviation	Explanation
1-32	Used	LD	Boost pressure sensor U_{supply}
1-33	Not used	---	---
1-34	Not used	---	---
1-35	Not used	---	---
1-36	Not used	---	---
1-37	Not used	---	---
1-38	Used	TÖNS	Thermal oil level sensor
1-39	Used	KWG	Crankshaft sensor
1-40	Not used	---	---
1-41	Not used	---	---
1-42	Not used	---	---
1-43	Not used	---	---
1-44	Used	K 1	Main relay "ground"
1-45	Used	HFM	Hot-film air mass meter (HFM6)
1-46	Used	HFM	Hot-film air mass meter (HFM6)
1-47	Used	HFM	Hot-film air mass meter (HFM6)
1-48	Not used	---	---
1-49	Used	I 1	Injector 1
1-50	Used	I 3	Injector 3
1-51	Used	I 2	Injector 2
1-52	Not used	---	---
1-53	Not used	---	---
1-54	Used	LD	Boost pressure sensor
1-55	Used	HFM	Hot-film air mass meter
1-56	Used	RDS	Rail pressure sensor
1-57	Used		Fuel temperature sensor
1-58	Not used	---	---
1-59	Not used	---	---
1-60	Not used	---	---
1-61	Not used	---	---
1-62	Used	NWG	Camshaft sensor
1-63	Not used	---	---
1-64	Used	I 4	Injector 4

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Pin No.	Assignment	Abbreviation	Explanation
1-65	Not used	---	---
1-66	Not used	---	---
1-67	Used	PT-CAN	PT CAN, low
1-68	Used	GSG	Control unit interface to preheating control unit
1-69	Used	BSD	Bit-serial data interface (alternator)
1-70	Used	GSG	Preheating control unit "ground"
1-71	Used	MRV	Volume control valve (CP3+)
1-72	Used	DRV	Pressure control valve, rail
1-73	Used	I 1	Injector 1
1-74	Used	I 3	Injector 3
1-75	Used	I 2	Injector 2
1-76	Not used	---	---
1-77	Not used	---	---
1-78	Used	RDS	Rail pressure sensor
1-79	Not used	---	---
1-80	Used	LD	Boost pressure sensor "ground"
1-81	Not used	---	---
1-82	Used	NTC	Coolant temperature sensor
1-83	Used	NTC	Charge air temperature sensor
1-84	Not used	---	---
1-85	Not used	---	---
1-86	Used	TÖNS	Oil level sensor
1-87	Used	KWG	Crankshaft sensor
1-88	Not used	---	---
1-89	Not used	---	---
1-90	Not used	---	---
1-91	Used	PT-CAN	Powertrain CAN high
1-92	Not used	---	---
1-93	Used	VNT	Variable nozzle turbine actuator
1-94	Used	AGR	Exhaust gas recirculation
1-95	Used	DKS	Swirl control flap actuator
1-96	Not used	---	---

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Pin No.	Assignment	Abbreviation	Explanation
2-01	Used		Battery positive via main relay
2-02	Used		Battery negative
2-03	Used		Battery positive via main relay
2-04	Used		Battery negative
2-05	Used		Battery positive via main relay
2-06	Used		Battery negative
2-07	Used	A 1	Switch terminal 15 / "input"
2-08	Used	TXD 2	Diagnosis
2-09	Used		Terminal 15
2-10	Used	CAS	Car access system
2-11	Not used	---	---
2-12	Used	IHR/IHKA	Request for auxiliary heating
2-13	Not used	---	---
2-14	Used		Bi-directional alternator interface (E60 only)
2-15	Not used	---	---
2-16	Not used	---	---
2-17	Not used	---	---
2-18	Not used	---	---
2-19	Used		E-box fan
2-20	Not used	---	---
2-21	Not used	---	---
2-22	Not used	---	---
2-23	Used	S 2	Brake light test switch
2-24	Not used	---	---
2-25	Not used	---	---
2-26	Not used	---	---
2-27	Not used	---	---
2-28	Not used	---	---
2-29	Used	FPM	Accelerator pedal module
2-30	Used	FPM	Accelerator pedal module
2-31	Used	LKS	Air flap control (E60 only)
2-32	Not used	---	---

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Drive

Pin No.	Assignment	Abbreviation	Explanation
2-33	Used	PT-CAN	Powertrain CAN low
2-34	Used		Starter relay, automatic start
2-35	Not used	---	---
2-36	Used	S 2	Brake light switch
2-37	Not used	---	---
2-38	Not used	---	---
2-39	Used	FPM	Accelerator pedal module
2-40	Used	L	Engine fan control
2-41	Not used	---	---
2-42	Not used	---	---
2-43	Used	FPM	Accelerator pedal module
2-44	Used	EDH	Auxiliary heater activation (E60 only)
2-45	Not used	---	---
2-46	Used	PT-CAN	Powertrain CAN high
2-47	Not used	---	---
2-48	Not used	---	---
2-49	Not used	---	---
2-50	Used	S 1	Clutch switch
2-51	Not used	---	---
2-52	Used	FPM	Accelerator pedal module
2-53	Used		Engine speed signal
2-54	Not used	---	---
2-55	Not used	---	---
2-56	Used	FPM	Accelerator pedal module
2-57	Not used	---	---
2-58	Not used	---	---



Drive

Components

Sensors

- Accelerator pedal module (FPM)
- Hot-film air mass meter (HFM)
- Boost pressure sensor
- Coolant temperature sensor
- Fuel temperature sensor
- Rail pressure sensor
- Charge air temperature sensor
- Camshaft sensor (NWG)
- Thermal oil level sensor (TÖNS)
- Crankshaft sensor (KWG)

Actuators

- Fuel injectors 1-6
- Volume control valve
- Pressure control valve
- Solenoid valve for turbocharger (VNT)
- Solenoid valve for exhaust gas recirculation (EGR)
- Solenoid valve for swirl flaps
- Solenoid valve for engine mounts
- Electric magnet for air flap control (E60 only)
- E-box fan



Drive

Switches

- Brake light switch/brake light test switch
- Oil pressure switch
- Clutch switch

Relays

- Main relay
- Starter relay (E65 only)

Interfaces

- BSD interface (generator, preheating control unit)
- PT CAN



Drive

- Hot-film air mass meter (HFM 6.4)

The hot-film air mass meter HFM 6.4 is used together with DDE506/508 (M57TU). The HFM 6.4 is designed for an air throughput rate of up to 640 kg air/h.

The HFM 6.4 measures the air mass intake within very close tolerances so as to permit precise control of the exhaust gas recirculation as well as optimum configuration of the smoke limit. This is important for complying with current and future emission limits.

Functional principle

The principle design of the HFM 6.4 corresponds to that of the HFM 5 previously used. The hot-film air mass meter HFM 6.4 is powered with system voltage.

A new feature is that the sensor signal is digitized already in the HFM 6.4. The digitized signal is transferred frequency-modulated to the DDE.

In order to be able to compensate for the temperature influences, the air mass signal is referred to the changing temperature signal.

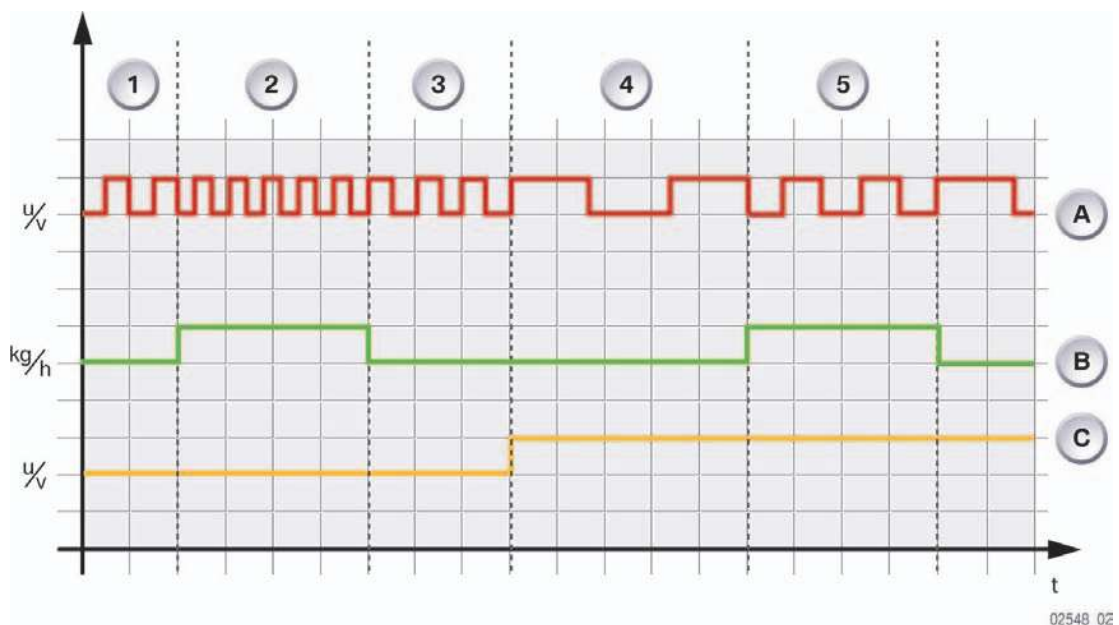


Fig. 28: Signal progression HFM 6.4

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Drive

Position	Explanation
A	Air mass signal
B	Air mass
C	Temperature signal
1	Air mass signal (A) referred to air mass (B) and temperature signal (C).
2	The period duration of the air mass signal (A) is shortened at increased air mass (B).
3	The period duration of the air mass signal (A) is extended at decreased air mass (B).
4	The period duration of the air mass signal (A) is extended in connection with temperature increase (C) and constant air mass (B) in order to compensate for temperature influences.
5	At increased air mass (B), the period duration of the air mass signal is shortened while taking the temperature signal (C) into consideration.

The HFM 6.4 features a 4-pin connector. The input and output signals are listed in the following table.

Pin	Explanation
1	Input for supply voltage/system voltage
2	Output for air mass signal (period duration)
3	Output for air temperature signal (pulse duty factor) and reference frequency (period duration)
4	Ground connection HFM 6.4 (signal and power ground)



Drive

- Air flap control

The electric magnet for the air flaps (for controlling the fresh air supply to the cooling module) is actuated by the DDE.

Functional principle

The electric magnet is activated by the DDE on the ground side. The voltage is supplied via terminal 87.

The air flaps are held closed when the electric magnet is energized.

The flaps are no longer held closed when the electric magnet is deactivated by the DDE. The flaps can now be opened by the air-stream or by the air flow of the sucking electric fan.

The electric magnet is de-energized by the DDE when one of the following values is reached.

Index	Value
Engine speed	< 192 1/min
Road speed	0
Radiator outlet temperature	90°
Transmission fluid temperature (automatic transmission)	110°
Electric fan request by IHKA	Stage 5 (of 16)
Intake air temperature (from HFM)	60°
Engine oil temperature	130°
Engine load	100% (curve 98.83%)



Drive

- Fuel temperature sensor

Installation location

The fuel temperature sensor is located in the feed line between the fuel filter and high pressure pump.

Functional principle

The high pressure pump produces pressure waves while delivering fuel to the fuel rail. These pressure waves have an effect on the injection volume and must therefore be taken into consideration when calculating the injection time.

The pressure wave period from the rail to the fuel injectors is dependent on the fuel temperature. A fuel temperature sensor is used to facilitate inclusion of the pressure wave period in the calculation of the injection time.

The fuel temperature sensor receives its 5 Volt voltage supply from the DDE.



Drive

- Preheating system

The preheating system for the M57TU has been fundamentally re-engineered in order to meet the more stringent legal requirements and customer expectations. The emission behaviour of the noise quality and starting performance have been improved.

The preheating system was essentially adopted from the M47TU and adapted to the M57TU (number of cylinders).

Changes

The M57 preheating system was changed in the following areas to suit the M57TU:

- Preheating control unit with bi-directional interface with digital diesel electronics (DDE).
- The preheating control unit is mounted on the engine.
- Performance-optimized sheathed-element glow plugs with increased preheating temperature.

Advantages

The short preheating time makes it possible for the driver to start the engine "free of preheating."

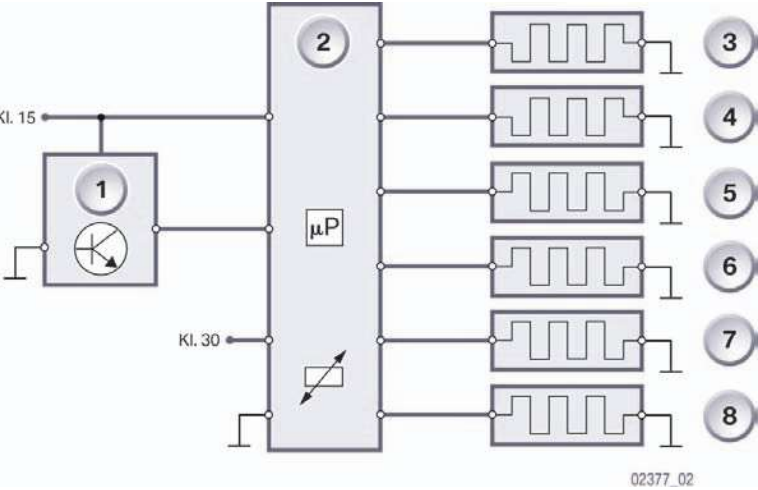
Spontaneous starting is possible at temperatures of up to -5 °C. At -20 °C a time of only 2 seconds is required before starting the engine. With regard to the starting characteristics, there is no noticeable difference compared to the petrol engine.

Thanks to the new preheating system, the automatic start function can be used for the first time on a diesel engine vehicle.



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System overview



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Fig. 29: Block diagram of preheating system

Index	Explanation	Index	Explanation
1	DDE506/508 control unit	5	Glow plug 3
2	Preheating control unit	6	Glow plug 4
3	Glow plug 1	7	Glow plug 5
4	Glow plug 2	8	Glow plug 6



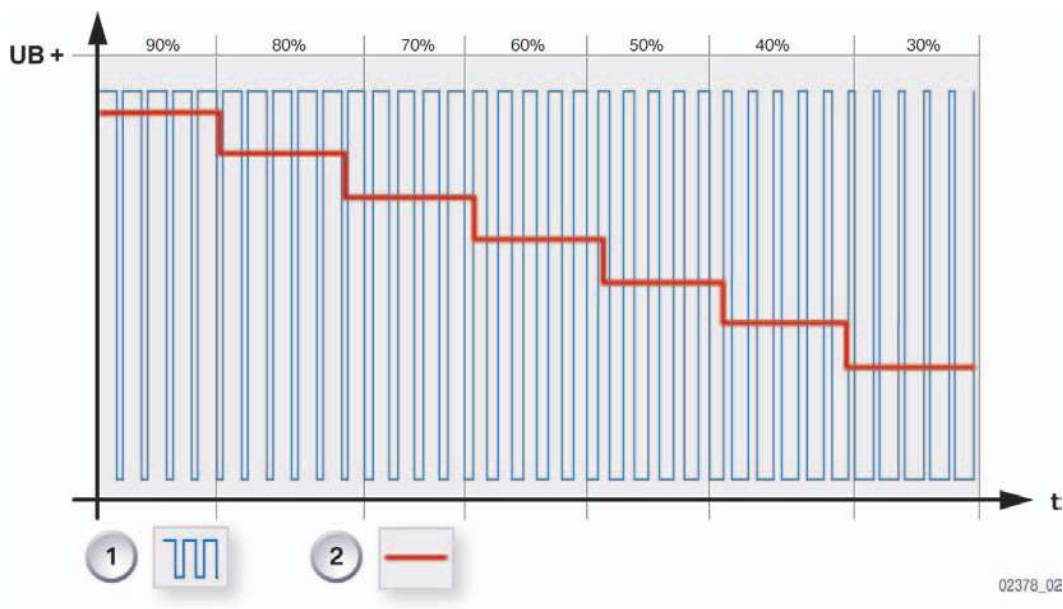
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System function

In the preheating systems used to date, the load current of the glow plug is switched on and off via the preheating relay.

The glow plugs of the M57TU are actuated by a pulse width-modulated (PWM) signal. Each glow plug is switched on and off individually by its own output stage.

Due to the pulse width modulation, the effective voltage at the glow plugs can be varied such that a constant temperature of approx. 1000 °C is established over the entire operating range. An additional advantage is that each glow-plug circuit can be diagnosed individually.



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Fig. 30: PWM activation of the glow plugs

Index	Explanation
1	PWM signal
2	Effective voltage

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The preheating system consists of the DDE control unit, an electronic glow plug control unit and power-optimized quick-start glow plugs.

There is no preheating relay. In contrast with the standard glow plugs used in other engines, these quick-start glow plugs are designed for a voltage range from 5.3 to 7.8 Volts.

Vehicle system voltage can even be applied for a brief period during prestart heating. The quick-start glow plugs need approximately 60% less energy to reach a temperature of approximately 1000 °C. By the same token, power consumption during heating is down by 60% and this in turn significantly reduces the load on the vehicle's electrical system.

Important features distinguishing this system from conventional preheating systems include:

- When the engine is running, the glow plugs are actuated in pulse-width-modulated mode in a voltage range from 5.3 to 7.8 Volts
- Output stages in the preheating control unit assume the function of the preheating relay
- An emergency heating function is implemented
- The system uses quick-start glow plugs
- Each of the six preheating circuits can be diagnosed individually



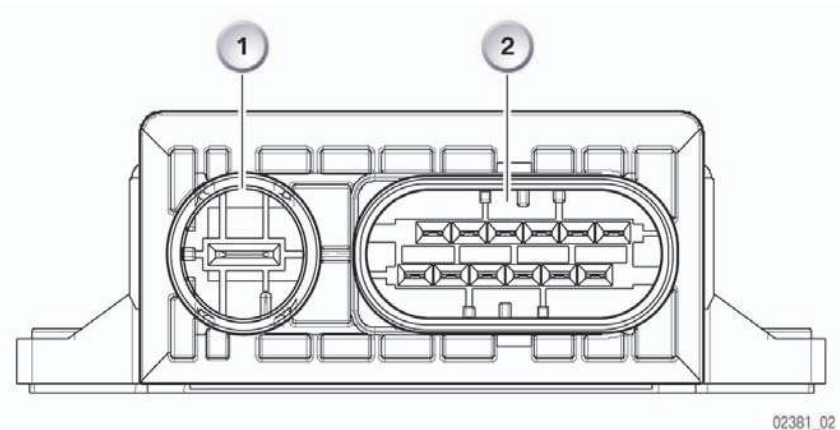
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Components

Preheating control unit

The preheating control unit with diagnostic capabilities mounted on the engine communicates with the DDE control unit via the bi-directional data interface.

All electrical connections are carried by a two-part connector system integrated into the housing.



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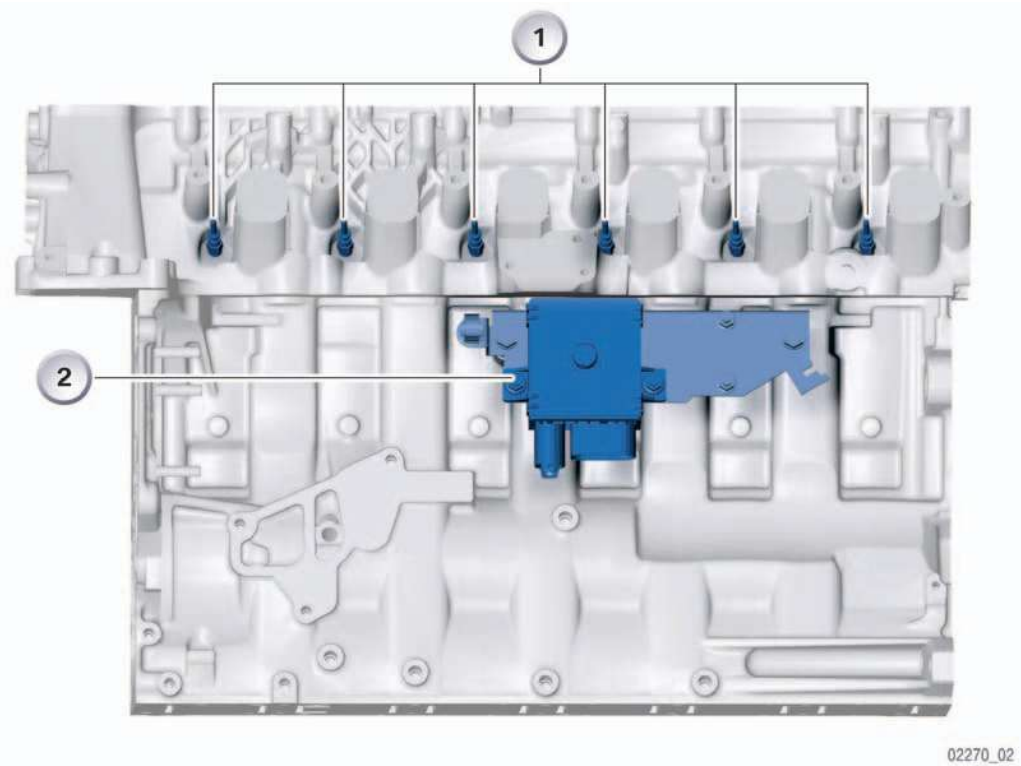
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Fig. 31: Connector of the preheating control unit

Index	Explanation
1	High current connection (terminal 30)
2	Connection for voltage supply, control signals and glow plugs



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Fig. 32: Location of preheating control unit on engine block

Index	Explanation
1	Glow plugs
2	Preheating control unit

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With regard to its mechanical and electrical layout, the preheating control unit is designed so as to facilitate direct mounting on the engine.

Advantage:

- Shorter high current connection between the preheating control unit and quick-start glow plugs.

The heating power is determined by the DDE as a function of defined operating statuses, e.g. temperature, engine speed and load status, and transferred via the bi-directional interface to the preheating control unit. The preheating control unit implements the request and sends diagnosis and status information back to the DDE on request.



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Glow plug activation

The preheating control unit receives the preheating requests (activation profile) for the various preheating functions such as start, operational or diagnosis preheating from the DDE. The illustration below shows a typical activation profile and the corresponding temperature progression of the glow plugs.



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Fig. 33: Activation profile and temperature progression of glow plugs

Index	Explanation	Index	Explanation
1	Temperature	4	Voltage (V)
2	Temperature progression	5	Time (s)
3	Current (A)	6	Current (A); voltage (V)



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In clocked operation, not all the glow plugs are activated and deactivated simultaneously but rather in succession. This prevents faults in the vehicle electrical system caused by the periodic activation and deactivation of very high currents (up to 120 A).

Switching loads on and off can produce fluctuations in the system voltage.

In the case of conventional glow plug systems, this can result in the glow plugs failing to achieve the required operating temperature.

In the new preheating system, the voltage at the glow plugs is kept constant on the account of pulse-width-modulated activation. Voltage fluctuations in the vehicle electrical system thus have no effect on the glow plugs and their temperature.

Precondition:

The system voltage must be higher than the rated voltage of the glow plugs.

Quick-start glow plugs

The power-optimized quick-start glow plugs are characterized by low power requirements together with shortened response times.

The reduction in power requirements and associated operation in the low voltage range are achieved by the fact that only the tip of the glow tube protruding into the combustion chamber burns.

To ensure that only the tip glows, these quick-start glow plugs have much shorter heating and control coils than conventional glow plugs (see following illustration).



Drive

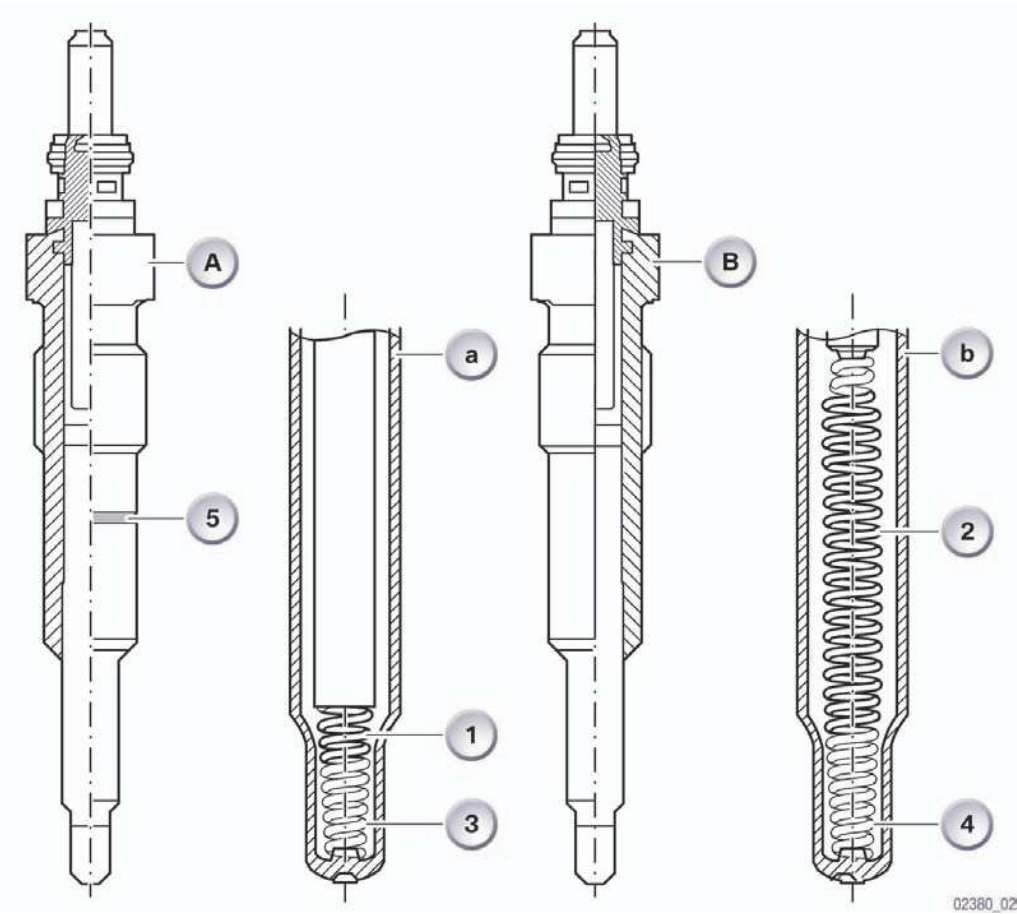


Fig. 34: Comparison of M57TU and M57 glow plugs

Index	Explanation	Index	Explanation
A	Quick-start glow plug	B	Glow plug (standard)
a	Tip of glow plug tube	b	Glow tube (standard)
1	Shorter control coil	2	Control coil (standard)
3	Heating coil	4	Heating coil (standard)
5	Identification groove		

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The quick-start glow plugs differ in appearance from the glow plugs of the M57 by their identification groove in the housing and their silver-coloured surface (see previous illustration).

Other advantages include:

- Longer service life
- Good load bearing characteristics
- Higher oxidation resistance



Drive

System statuses

Defective output stages in the preheating control unit

A corresponding fault code is entered in the DDE fault code memory if an output stage in the preheating control unit is permanently defective. If an output stage is permanently conductive, its glow plug acts like a fuse and blows after a few seconds. This prevents the battery from running flat.

Open load circuit

The power consumption of the glow plugs is monitored in the preheating control unit. If actuation is correct and the monitored current drops below a defined threshold, the glow plug circuit in question is flagged as "open."

Short-circuited load circuit

In the event of a short-circuit to ground, the load circuit is deactivated by the output stage (Mosfet) of the corresponding circuit. The fault condition is detected by the system. After a brief pause, pulse-width-modulated current is again applied to the load circuit. If the same fault condition persists, the load circuit is shut down completely. This precaution ensures reliable diagnosis of a short-circuit by suppressing reactions to sporadic faults. The entry in the fault code memory is deleted when the DDE control unit has been read.

Housing temperature exceeded

The temperature of the preheating control unit is constantly monitored by means of a temperature sensor mounted on the circuit carrier. If the temperature exceeds the permissible value of approx. 120 °C, the load circuits are deactivated and the "overtemperature" information is stored in the fault code memory.



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Overvoltage protection

In the event of a supply voltage that is above the maximum operating voltage even after several measurements, the output stages are no longer switched until the voltage at terminal 30 of the preheating control unit has again reached the specified supply voltage level.

No supply voltage

The supply voltage at terminal 30 is constantly monitored by the preheating control unit. If the preheating control unit detects voltage too low or no voltage "open circuit" is entered in the fault code memory of the DDE control unit.

No communication with DDE

- While starting:

The emergency preheating function is started automatically if the preheating control unit detects no activity on the communication line within one second after activation by terminal 15.

- During operation:

Preheating is terminated automatically if the preheating control unit receives no feedback (4 synchronization signals) from the DDE within 33 seconds during normal operation.



Drive

Heating functions

Start heating

In order to start the engine, system voltage is briefly applied to the glow plugs (approx. 1 - 2 seconds) at a current of 10.5 amps. This is long enough to bring the glow plugs up to a temperature of approximately 1000 °C. Subsequently, the effective voltage at the glow plugs is reduced to approximately 5.3 Volts by pulse width modulation. This voltage is sufficient to maintain the glow plug tips at an operating temperature of 1000 °C.

Diagnosis heating

In "diagnosis heating" mode, all the glow plugs are operated at reduced heating power. The "diagnosis" command from the DDE control unit starts a continuous power supply to the glow plugs.

Emergency heating

The emergency heating function makes it possible to start the engine relatively quickly if communication fails, e.g. a line break (open circuit) between the preheating control unit and the DDE. The emergency heating function is started when terminal 15 is active and there is no control signal from the DDE. Under these conditions the glow plugs are actuated regardless of the engine's operating state.

Diagnosis

Diagnosis is handled by the DDE. Each glow plug circuit can be diagnosed individually.



Drive

- Automatic start

For the first time on diesel engines, the digital diesel electronics (DDE) system now features the automatic start function. The automatic start function will be fitted on all diesel engines in connection with SMG and automatic transmission.

With the automatic start function, the start relay is activated by the DDE until the engine reaches a defined speed (temperature-dependent).

The DDE requires the start enable (terminal 50) from the car access system (CAS) to start the engine. The electronic vehicle immobilizer (EWS) is also integrated in the CAS.

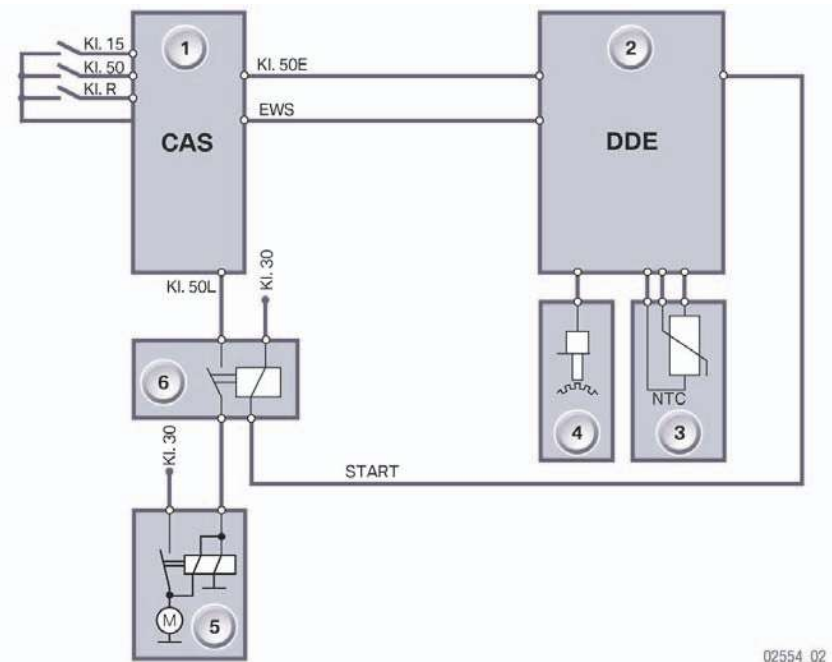
The start relay is activated by the DDE, taking the engine speed and temperature into consideration. On the E60, the start relay is integrated in the CAS (see CAS system overview). Activation of the start relay, however, is the same on both vehicles.

M57TU Engine

Background Material



Drive



KT-11114

02554_02

Fig. 35: System overview, automatic start E65M67/M57TU

Index	Explanation	Index	Explanation
1	Car access system (CAS)	5	Starter (solenoid switch)
2	Digital diesel electronics (DDE)	6	Starter relay
3	Coolant temperature sensor (engine temperature)	START	Activation of starter relay by DDE
4	Crankshaft sensor (engine speed)	EWS	Electronic vehicle immobilizer



Drive

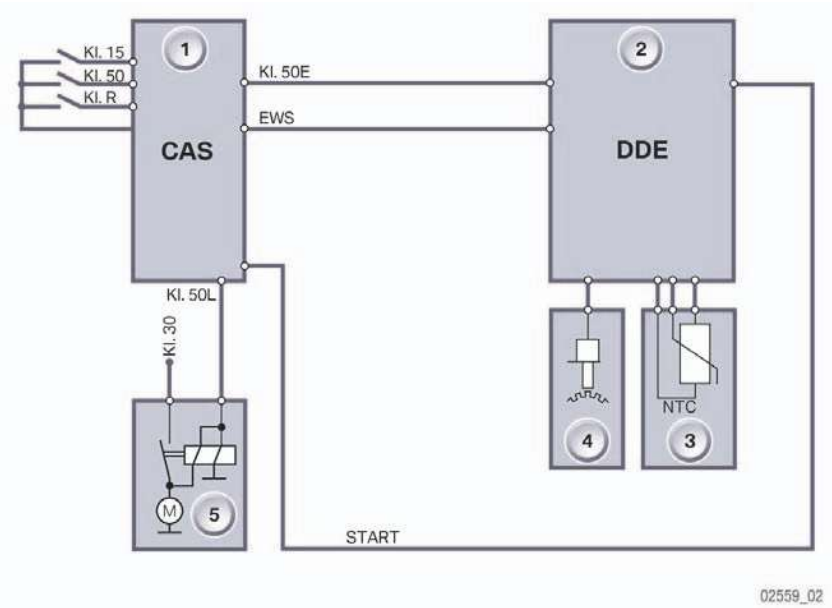


Fig. 36: System overview, automatic start E60M57TU

Index	Explanation	Index	Explanation
1	Car access system (CAS)	5	Starter (solenoid switch)
2	Digital diesel electronics (DDE)	START	Activation of starter relay by DDE
3	Coolant temperature sensor (engine temperature)	EWS	Electronic vehicle immobilizer
4	Crankshaft sensor (engine speed)		



Drive

CAS functions

Terminal 50 activation: engine start

Terminal 50 is used to start the engine. Terminal 50 is activated by pressing the start/stop button (E65) or turning the ignition key (E60).

- The start procedure is subject to following preconditions:
- Remote control is valid and locked in position (transponder authorization).
- Brake operation: When active, the brake is detected either via the direct line of the brake light switch or redundantly via the CAN signal from the dynamic stability control (DSC). An incorrect brake signal from a defective or disconnected brake light switch is interpreted as a "plausibility fault" as soon as the brake pressure is greater than 10 bar.
A check control message is output if one of the two signals fails.
Engine start is enabled by pressing the start/stop button again.
- Selector lever of automatic transmission in position P and N (park and neutral): The selector lever position is detected by the direct P-signal or via a CAN signal.
The engine can be started when at least one of these signals is applied.
- No start repeat lock (start repeat lock cuts in at an engine speed higher than 1000 rpm).

The start lock is activated if these preconditions are not fulfilled. The engine cannot be started.



Drive

Terminal 50 activation: start termination

The start termination function serves the purpose of protecting the starter: The starter does not turn in or with the engine when already running.

Start termination is activated when the starter solenoid switch is deactivated.

The following terminal 50 termination criteria apply for CAS:

- No "brake operated" message: Engine start is terminated if no "brake operated" message is received within max. 200 milliseconds after pressing the start/stop button. The engine can be started if only **one** of the two redundant brake operating signals is applied (see above "Terminal 50 activation").
- No continuous "brake operated" message: The engine start is terminated if the brake is not operated continuously during the start procedure.
- Timeout elapsed: The maximum starter running time of 21 seconds has elapsed.
- Selector lever in invalid position: not in P or N.
- The start/stop button is pressed repeatedly:
The engine starts the first time the start/stop button is pressed. The start procedure is terminated the second time the start/stop button is pressed.
- The engine speed is higher than 1000 rpm.
- DDE signals "engine running" status.
- Starter short-circuit/overload detected by CAS.



Drive

Terminal 50 activation times

The monitored activation times of terminal 50 protect the starter from overload. The activation times of terminal 50 are:

- Max. 21 seconds. A repeated attempt is immediately possible.
- The activation time is reduced by 2 seconds after each repeated attempt until a minimum activation time of 3 seconds is reached.
- The activation time is increased again by 2 seconds (up to maximum 21 seconds) if the start/stop button is pressed for longer than the previous activation time.

Terminal 50 E activation: transfer of start request to DDE

Terminal 50 E is activated in order to transfer the start request to the DDE.

The signal of terminal 50 E is logically identical to the signal of terminal 50.

Terminal 50 L activation: starter solenoid switch

Terminal 50 L is activated in order to switch on the starter solenoid switch. The signal of terminal 50 L is logically identical to the signal of terminal 50 (except for an afterrunning function when switching off to allow for disengagement for the pinion).



Drive

Start repeat lock

The start repeat interlock prevents the starter motor engaging in the engine while already running. Supplementary to the start lock, the start repeat interlock is effective at terminal 15 status "on" under following circumstances:

- Terminal 50 start position was activated once.
- Engine speed is higher than 1000 rpm.
- The start repeat interlock is cancelled by:
 - Engine speed lower than 1000 rpm.
 - Return to terminal R status "on" (by turning off the engine).

- DDE main relay

The DDE main relay in the E60 is supplied with power by the DDE throughout the bus activity. Voltage is thus applied at all the actuators which are supplied with power via terminal 87 throughout the bus activity.

This activation of terminal 87 is necessary for the function of the bit-serial data interface (BSD). The BSD is supplied with power by the DDE via terminal 87 and a pull-up resistor.

The following components communicate with the DDE via the bit-serial data interface:

- Alternator
- Intelligent battery sensor (IBS)