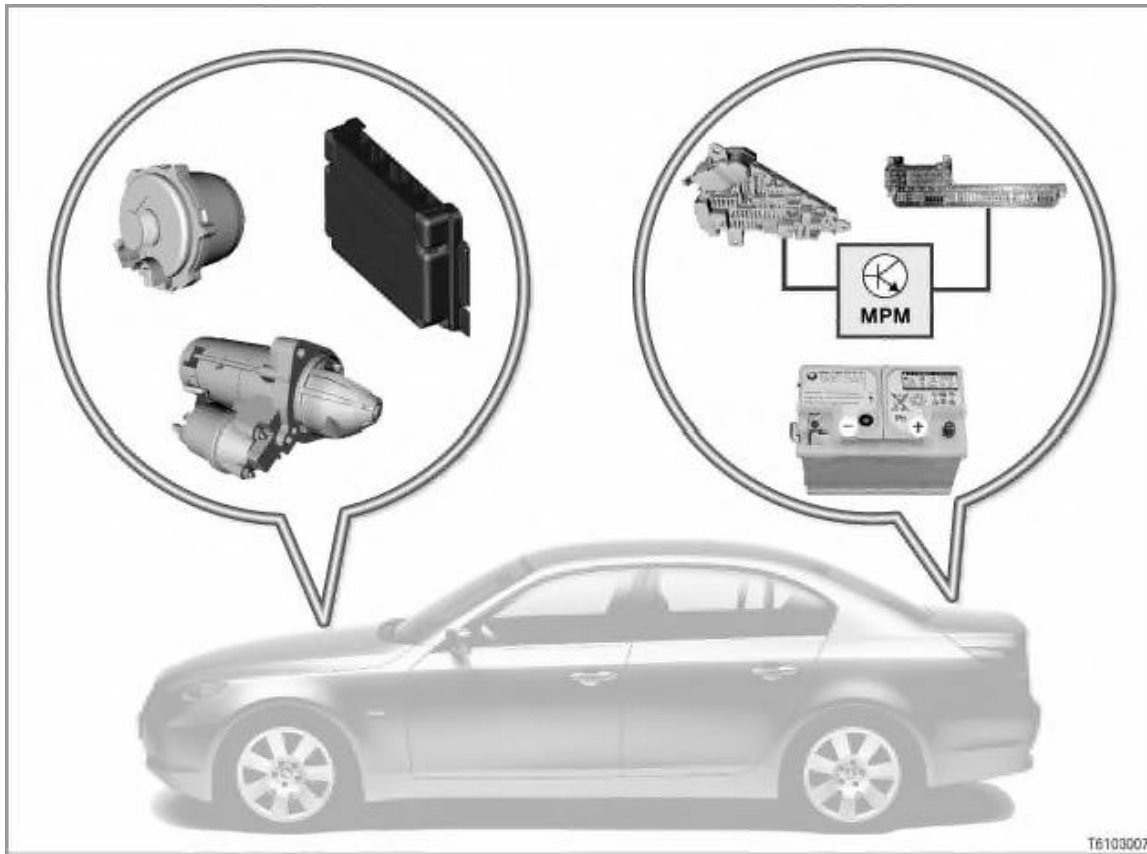


Power supply

E60



Introduction

The power supply on the E60 is similar to that on the E65. However, the E60 does not have a power module like that on the E65. In the E60 a network of hardware and software assumes the role of energy management. The energy management system monitors and controls the energy requirements of the E60, both during a journey and when stationary.

The energy management systems comprises the functions of the electric energy management system and the power management functions contained therein. [system overview ...]

The most important components and functions of the electric energy management system are:

- The intelligent battery sensor (IBS) for continuous measurement of the battery's values.
- The software of the power management system in the digital engine electronics (DME) or digital diesel electronics (DDE) and in the IBS.
- The terminal 30g relay, which is actuated by the Car Access System (CAS).
- The micro-power module (MPM), which is located between the front and rear power distributors.

New features of the power supply in the E60 are:

- IBS
- Terminal 30g relay (terminal 30 active)
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- Earth point on "reduced-weight aluminium front end" (GRAV)

Advantages of the power supply in the E60 are:

- Precise identification of the "State of Charge" (SoC) and "State of Health" (SoH) of the battery by the power management system.
- IBS designed for use with different assembly groups.
- Reduced off-load current: The consumers on terminal 30g are switched off in a defined manner by the terminal 30g relay.
- A defined connection between the aluminium front end and the steel bodywork with the GRAV earth point in the engine compartment.

The GRAV earth point improves the vehicle's electromagnetic compatibility

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C).
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ore headroom in the rear of the vehicle. The routing of the battery cables in the outer area allows the seats and carpets in the rear of the vehicle to be installed with reduced height.

Brief description of components

- **Intelligent battery sensor (IBS)**

The IBS is a mechatronic, intelligent battery sensor with its own microcontroller (μ C). The IBS continuously monitors the battery's

- terminal voltage
- charge current
- discharge current
- fluid temperature [more ...]

- **Micro-power module (MPM)**

When the vehicle is at rest, the

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switches individual consumers off, if:

- the off-load current is too high when the critical "State of Charge" (SoC) is reached
- undervoltage occurs
- too many "wake-up" circuits are activated in the K-CAN
- the vehicle fails to go into sleep mode

The micro-power module

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) is connected to the K-CAN. [more ...]

- **Rear power distributor with terminal 30g relay**

The rear power distributor is installed on the right-hand side of the luggage compartment. The rear power distributor is connected to the positive terminal of the battery, the front power distributor and the

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terminal-start support point. The

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is connected to the rear power distributor (and to the front power distributor). [more ...]

- **Terminal 30g relay**

The terminal 30g relay is actuated by the Car Access System (CAS) and prevents increased off-load current by switching off individual consumers. [more ...]

- **Front power distributor**

The front power distributor is connected to the rear power distributor. The CAS and the starter motor are connected to the front power distributor.

- **Battery cables in outer floor area**

The battery cables are routed in the outer floor area, which allows greater headroom in the rear of the vehicle. The battery cables are monitored by the passive safety system ASE (advanced safety electronics) via satellites in the B-pillars. [more ...]

- **Handover point in luggage compartment floor**

At the handover point in the luggage compartment floor, the sensor wire is routed to the battery cable in the luggage compartment. [more ...]

- **Battery**

The battery is installed on the right-hand side of the luggage compartment. The battery condition is continuously monitored by the IBS. [more ...]

- **External-start support point**

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terminal-start support point in the engine compartment is

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tension of the positive terminal of the battery to an easily accessible point. [more ...]

- **Ignition starter switch**

The ignition starter switch is located on the right-hand side of the steering column. The ignition starter switch is directly connected to the Car Access System (CAS).

- **CAS**

The CAS comprises the functions

- terminal control
- electronic immobiliser (EWS)
- evaluation of radio signals from remote control

The CAS is directly connected to ignition starter switch by cables. The

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E / DDE and the starter motor are connected to the CAS. The CAS is part of the K-CAN bus network.

- **Digital engine electronics (DME) / digital diesel electronics (DDE)**

The digital engine electronics

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E) or digital diesel electronics (DDE) are the engine's control unit. The

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E / DDE includes the electronic immobiliser (EWS) and is also used for redundant (2-fold) data storage. The

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E / DDE is connected to the powertrain CAN (PT-CAN) data bus to allow it to communicate with other control units in the vehicle.

- **Starter relay**

The starter relay switches the battery voltage to the starter motor, when

- the ignition starter switch is in switch position 2,
- the CAS receives the correct information and transmits this to the
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E / DDE via the K-CAN,
- the electronic immobiliser (EWS) actuates the starter relay.

- **Starter motor**

Battery voltage is fed to the starter motor via the starter relay to start the engine when the ignition starter switch is turned to position 2.

- **Alternator**

When the engine is running, the alternator generates a variable charge voltage for battery charging. The power management system influences the variable charge voltage, depending on temperature and current, by causing the

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E or DDE to increase the engine speed.

- **Earth point on reduced-weight aluminium front end (GRAV)**

The earth point

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ed to the reduced-weight aluminium front end (GRAV) is the point for the earth connection to the steel body.

[more ...]

System functions

The power supply system of the E60 comprises the following functions:

- Electric energy management
- Power management
- Variable charge voltage
- Idle-speed increase
- Reduction of load peaks
- Consumer shutdown
- Off-load current monitoring
- Terminal 30g relay

Electric energy management

The electric energy management monitors and controls the vehicle's energy requirements. The monitoring and control are achieved through the interconnection of different components, the linking of functions and systems, and through signals and characteristic curves used to generate and output control signals.

- Components of the energy management system:
 - Battery
 - IBS
 - Bit-serial data interface (BSD)
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 - Power management (microcontroller, μC)
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)
 - Alternator
 - Terminal 30g relay
 - Consumers on terminal 30/terminal 30g
- Function/systems involved in energy management:
 - Power management
 - Car Access System (CAS)
- Signals/characteristic curves in energy management system:
 - Current flow to consumers
 - Increased idling speed
 - Battery charge current
 - Nominal value for charge voltage
 - Consumer reduction
 - Terminal 15 wake-up wire

Power management

Power management is on the one hand part of the electric energy management system and on the other hand software stored in the

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E / DDE and in the intelligent battery sensor (IBS) for controlling energy requirements.

Power management comprises the functions controlled by the software in the

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E / DDE and in the IBS:

- Variable charge voltage for the battery by adapting the charge voltage from the alternator to that required by the battery

- Increased idling speed to boost the alternator's output
- Reduction of load peaks through power reduction when the vehicle's electrical system is unable to provide the energy needed (vehicle electrical system deficiency)
- Auxiliary consumers switched off via CAN messages when engine has reached its limit of starting capability
- Off-load current monitoring

Power management links the input signals with the characteristic curves stored in an EPROM

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(Erasable Programmable Read-Only

Memory)

and generates the output signals to control energy requirements.

- Power management components:
 - DME or DDE
 - EPROM
 - Microcontroller (μC)
- Power management input signals:
 - Battery voltage (U)
 - Current ($I \pm$)
 - Temperature (T)
- Characteristic curves
 - Battery voltage (U)
 - Current ($I \pm$)
 - Temperature (T)
- Output signals
 - Idle-speed control
 - Nominal value for charging voltage
 - Auxiliary consumer shutdown
 - Load peak reduction

The power management system measures the "State of Charge" (SoC) and the "State of Health" (SoH) of the battery.

Battery charge balance

The charge balance of the battery is determined by the charge quantity flowing into and out of the battery. Two counters are provided in the power management to give a running balance of the battery's charge state. One counter measures the charge quantity flowing into the battery, the other measures the charge quantity flowing out of the battery. At the factory, the counters are calibrated for the battery fitted. The IBS transmits the data to power management in the

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E / DDE. The data are transmitted via the bit-serial data interface (BSD).

The difference between the two charge quantities is the battery's state of charge (SoC). After the engine has been shut down, the power management will calculate the current SoC value when the engine is restarted.

State of health of the battery

The battery's state of health is derived from the drop in battery voltage during the starting procedure and from the starting current. These data are measured by the IBS during the starting procedure. The average value of the starting current in the start phase and the value of the voltage dip are transmitted to the

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E / DDE via the bit-serial data interface (BSD). The starting procedure is indicated to the IBS by currents greater than 200 ampères (A). The "engine running" signal is output by the

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E / DDE as soon as the engine starts.

The power management system calculates the battery's internal resistance from the average value of the starting current and the value of the voltage dip. The internal resistance of the battery gives a good indication of the battery's state of health (SoH).

Variable charging voltage

The variable charging voltage for the battery ensures that an optimal battery charge state is maintained, even in unfavourable driving situations. Unfavourable driving situations are, e.g. city traffic and driving in congested traffic.

The charging voltage varies, depending on

- Battery temperature and
- Consumer current.

Battery temperature

The temperature-dependent adjustment of the battery charging voltage prevents an undesirable increase of the battery temperature during recharging.

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oreover, the battery temperature remains lower, even at higher ambient temperatures. This reduces the amount of gas generated during charging and the amount of distilled water consumed.

Consumer current

The level of consumer current is measured by the IBS and transmitted to the power management via the bit-serial data interface (BSD). From this, the power management derives the charging voltage level to be generated by the alternator. This charging voltage nominal value, as derived by the power management, determines the level of the charging voltage generated by the alternator. This determines the battery charge current, which in turn influences the battery charging process, and ultimately the vehicle's consumer current.

Idling speed increase

The idling speed of the engine is raised by the

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E / DDE to 750 rpm if the specified battery charging voltage level is not achieved.

The idling speed is raised when

- the alternator is at full capacity
- and
- the battery's state of charge is too low.

Load peak reduction

If the charge state of the battery does not improve, even after the idling speed has been increased, the peak load in the vehicle electrical system is reduced. The peak load reduction is achieved by the following actions:

- Pulsing the load with pulse width modulation (PW

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) signals
 In this process, consumers (e.g. the electric
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 iliary heater) are switched on and off for defined times.
 To pulse the electric

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 PW

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- Power draw is reduced to a certain percentage.
- Individual consumers are switched off in
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 treme situations when the power reduction achieved through pulsing and reduced consumption is insufficient.

The load on the vehicle electrical system is reduced according to the table:

Priority of consumers	Power reduction	Control unit
Heated rear window	Pulsing	IHKA
Seat heating	Level 2	S M
Seat heating	50 %	S M
Active seat	Off	S M

Heater blower	75 %	IHKA
Steering wheel heating	Pulsing	SZL
Heater blower	50 %	IHKA
Mirror heating	Off	T M
Heated rear window	Off	IHKA
Seat heating	Off	S M
Steering wheel heating	Off	SZL
Seat climate	Off	S M
Heater blower	25 %	IHKA

Consumer shutoff

Consumers on the E60 are switched off according to different criteria and are split into the following categories:

- Convenience consumers
 - Window heating
 - Seat heating
 - Steering wheel heating

The convenience consumers are automatically switched off when the engine is switched off. The convenience consumers can only be switched on again after the engine has been restarted.

- Legally prescribed auxiliary consumers
 - Parking lights
 - Hazard warning lights

Legally prescribed auxiliary consumers must still be operational when the engine has been switched off, as long as this is possible. These auxiliary consumers are not deactivated, even if the battery's limit of starting capability has been reached.

- Auxiliary consumers
 - Independent heating
 - Independent ventilation
 - Communications components
 - Displays

- Terminal 30g
- Telematic services

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iliary consumers listed can still be switched on after the engine has been switched off. The

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iliary consumers are automatically switched off when the battery reaches its limit of starting capability. A CAN message from the

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E / DDE prompts the shutdown.

- System-related run-on
 - Electric radiator fan

System-related run-on components can remain operational for a certain time after the engine has been switched off.

Off-load current monitoring

If the battery current

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ceeds 80 milliampères (mA) in off-load state (setting programmed at factory), a fault entry will be stored in the

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E / DDE.

Terminal 30g relay

The terminal 30g relay prevents a higher off-load current, e.g. one caused by a defective consumer, with a predefined consumer shutoff. The terminal 30g relay is actuated by the CAS. The "g" indicates that terminal 30g is an active terminal.

The connections switched on and off with the terminal 30g relay on the rear power distributor are shown on the system circuit diagram. [system overview ...]

Notes for service staff

Service staff should note the following points:

- General information: [more ...]
- Diagnosis: [more ...]
- Encoding/programming: [more ...]
- Car & Key
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Subject to change.