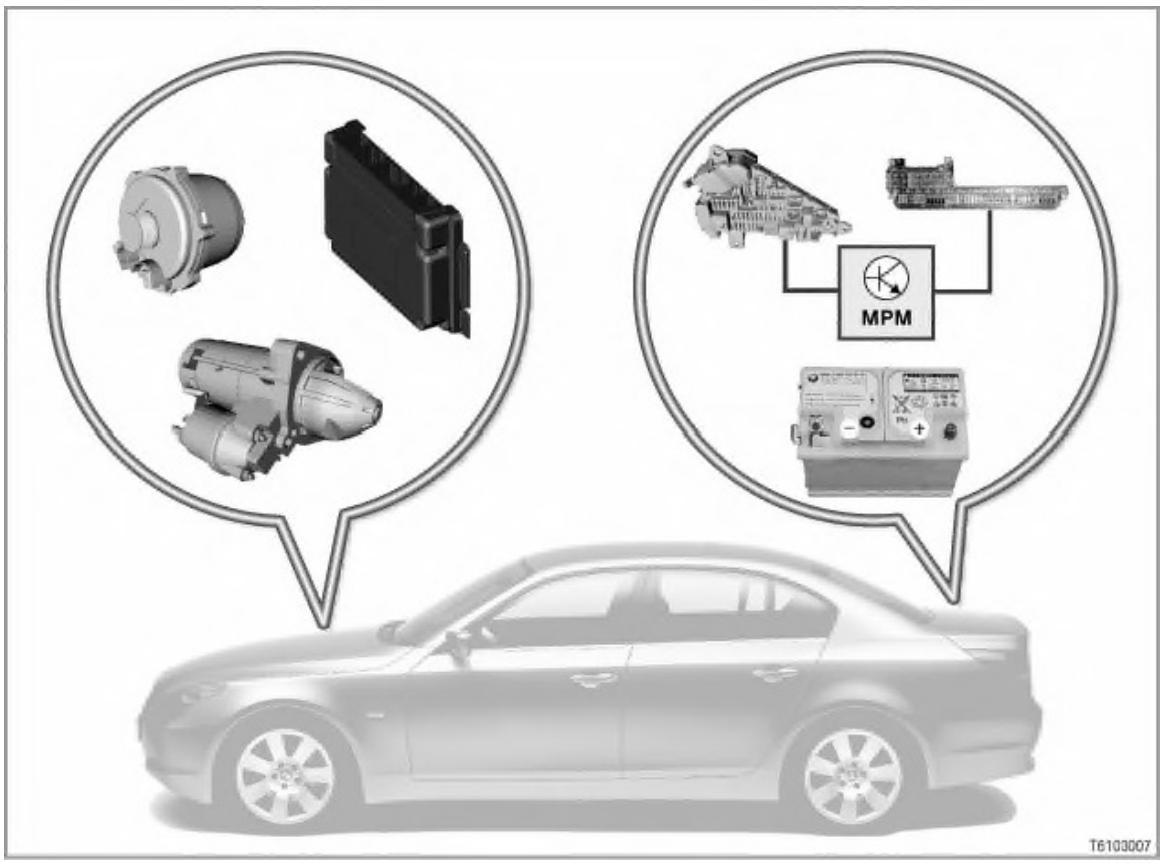
Power supply

E60, E61, E63, E64



Introduction

The power supply on the BMW 5- and 6-Series is similar to that on the E65. However, the 5- and 6-Series do not have the power module from the E65. A network of hardware and software assumes the role of energy management. The energy management system monitors and controls the vehicle's energy requirements, both during a journey and when stationary.
The energy management system comprises the functions of the electric energy management system and the power management functions contained therein.
[system overview ...]

From 09/2005, the vehicle electrical system has been modified. No **byteflight** data bus
This modification means that some control units are discontinued and that some control unit functions are integrated into new control units.
The new body gateway module (KGM) supersedes the safety and gateway module (SGM) previously fitted, the door modules and the micro-power module.
[for more information, please refer to SI Technology (SBT) 61 02 05 143]

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 and the intelligent battery sensor.
- 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. As from 09/2005, MPM function is integrated into the body-gateway module (KGM)

Advantages for the power supply are:

- Precise identification of the battery charge state (SoC: "State of Charge") and battery condition (SoH: "State of Health") by the power management.

- 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 (EMC).
- Greater headroom in the rear seat area. 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

- **IBS: Intelligent battery sensor**

  The IBS is a mechatronic, intelligent battery sensor with its own microcontroller.
  The IBS continuously monitors the battery's:

  - terminal voltage
  - charge current
  - discharge current
  - Acid temperature

  [more ...]

- **MPM: Micro-power module**

  As from 09/2005, MPM function is integrated into the body-gateway module (KGM)
  When the vehicle is at rest, the MPM switches individual consumers off, if:

  - off-load current is high when the charge state is critical
  - 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 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 external-start support point. The micro-power module (MPM) is supplied with power from the rear 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 ...]

- **Power distributor, front**

  The front power distributor is connected to the rear power distributor. The CAS, the starter motor and the KGM are connected to the front power distributor. The body gateway module (KGM) is supplied with power from the front power distributor.

- **Battery cables in outer floor area**

  The battery cable must be monitored on vehicles where the battery cable is installed on the underbody parallel to the fuel line. Depending on the type of vehicle, the battery cable is made from copper or aluminium and insulated with plastic. The insulation is mantled with low-impedance metal braiding. The metal braiding is the monitoring wire. The battery cable is then covered with a second insulation layer made from plastic. This is the external insulation layer.

  A connection line is provided at both ends of the monitoring line.

  >up to 09/2005:
  The battery cables are monitored by the passive safety system ASE (advanced safety electronics) via satellites in the B-pillars. The end of the monitoring wire leads to the left-hand B-pillar satellite. The other end

of the monitoring wire leads to the right-hand B-pillar satellite.

>from 09/2005:
The ASE is superseded by the ACSM ("Advanced Crash Safety Module", usually referred to as the "crash safety module").
The battery cable is monitored by the crash safety module. Both ends of the monitoring wire are connected to the crash safety module.

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

- **Starting-aid terminal**

  The starting-aid terminal in the engine compartment is extension of the positive terminal of the battery to an easily accessible point.
  [more ...]

- **Ignition starter switch / START/STOP button**

  >Up to 09/2005:
  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.

  > from 09/2005:
  The ignition starter switch is superseded by the START/STOP button and the insert compartment for the remote control.
  [for more information, please refer to SI Technology (SBT) 61 03 03 019]

- **CAS: Car access system**

  The CAS includes the following functions:

  - Terminal control
  - Electronic vehicle immobiliser (EWS)
  - Evaluation of radio signals from remote control

  The CAS is directly connected to ignition starter switch or insert compartment by wires. The DME / DDE and the starter motor are connected to the CAS. The CAS is part of the K-CAN bus network.

  [for further information, please refer to SI Technology (SBT) 61 03 03 019]

- **DME or DDE: Digital engine electronics or digital diesel electronics**

  The DME/DDE is the engine control unit. The DME/DDE contains the electronic immobiliser (EWS). The DME/DDE is also used as a secondary (backup) data store. The DME/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

  - >up to 09/2005:

    The ignition starter switch is in switch position 2,

    >from 09/2005:

    The appropriate terminal is activated with the START/STOP button
  - The CAS receives the correct information and transmits this to the DME / DDE via the K-CAN
  - The electronic immobiliser (EWS) actuates the starter relay

- **Starter motor**

  >up to 09/2005:

  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.

  >from 09/2005

  The START/STOP button can be used to switch the terminals in sequence (0, R, 15, R, 0).

- **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 DME or DDE to increase the engine speed.

- **Earth point on lightweight aluminium front end**

  The earth point on the lightweight aluminium front end (GRAV) is the place where steel body has its earth connection.
  [more ...]

System functions

The power supply system 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 functions are performed by the interconnection of various components. The energy management links functions, signals and maps for generating and outputting control signals.

- Components of the energy management system:
  - Battery
  - Intelligent battery sensor (IBS)
  - Bit-serial data interface (BSD)
  - DME or DDE
  - Engine
  - Power management (microcontroller)
  - Micro-power module (MPM)
    From 09/2005, MPM function is integrated into the body-gateway module (KGM)
  - 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
  - Reduced fuel consumption
  - Terminal 15 wake-up wire

Power management

The power management is on the one hand part of the electrical energy management system. Power management is software stored in the DME or DDE and in the intelligent battery sensor that is used for controlling the vehicle's energy requirements.

Power management comprises the functions controlled by the software in the DME / 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 (Erasable Programmable Read-Only Memory) and generates the output signals to control energy requirements.

- Power management components:
  - DME or DDE
  - EPROM
  - Microcontroller

- Power management input signals:
  - Battery voltage (U)
  - Current (I ±)
  - Temperature (T)

- Characteristic curves
  - Battery voltage (U)
  - Current (I ±)
  - Temperature (T)

- Output signals
  - Idle-speed control
  - Nominal value for charging voltage
  - Auxiliary consumer shutdown
  - Load peak reduction

Power management registers the battery charge state and the battery condition.

- **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 of the counters counts the charge quantity taken up by the battery. Another counter counts the charge quantity discharged from the battery. At the factory, the counters are calibrated for the battery fitted. The IBS transmits the data to power management in the DME / DDE. Data is transmitted via the bitserial data interface (BSD).
  The difference between the two charge levels is the battery charge state (SoC: "State of Charge"). Following an engine shutdown, the power management computes the current battery charge state for the next engine start.
- **Battery condition**
  The battery condition (SoH: "State of Health") is derived from the drop in battery voltage and the current drawn during engine start. 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 DME / 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 DME / 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. Conclusions about the battery's condition can be drawn from its internal resistance.

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.
Moreover, 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 DME / 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 charge state 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 (PWM) signals
  In this process, consumers (e.g. the electric auxiliary heater) are switched on and off for defined times.
  To pulse the electric auxiliary heater, the power management outputs a PWM signal in the DME / DDE, depending on the energy available. The PWM signal contains the information for the maximum switch-on power available for the electric auxiliary heater. The frequency of the PWM signal is fixed at 160 Hertz (Hz).
- Power draw reduced to a certain percentage.
- Individual consumers are switched off in extreme 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	SM
Seat heating	50 %	SM
Active seat	Off	SM

Heater blower	75 %	IHKA
Steering wheel heating	Pulsing	SZL
Heater blower	50 %	IHKA
Mirror heating	Off	TM >from 09/2005: KGM
Heated rear window	Off	IHKA
Seat heating	Off	SM
Steering wheel heating	Off	SZL
Active seat ventilation	Off	SM
Heater blower	25 %	IHKA

Consumer shutoff

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

- Convenience consumers
  - Heated rear window
  - 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

  The auxiliary consumers listed can still be switched on after the engine has been switched off. The auxiliary consumers are automatically switched off when the battery reaches its limit of starting capability. A CAN message from the DME / 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 vehicle is out of use (from 68 minutes after terminal R OFF) and the battery current exceeds 80 milliampères (mA) (default setting), a fault memory entry is stored in the DME / 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 that are switched on and off through the terminal 30g relay 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 ...]

Subject to change.