

FUB-FUB-FB-610013-K10 Power management&comma,

ISTA system version	3.53.13.15645	Data version	R--	Programming data	-
VIN		Vehicle	4*/F82/COUPE/M4/S55/MANUAL/USA/LL/2015/06		
Integration level factory	-	Integration level (current)	-	Integration level (target)	-
Mileage	0 km				

Advanced Power Management, APM

The power management a subsystem of the energy management. Power management is carried out by the engine control unit.

Power management seeks to ensure that the battery is sufficiently charged and therefore maintain vehicle starting capability for as long as possible.

While driving, the power management regulates power consumption of the most important electrical consumers and the power output of the alternator (if installed), as well as the battery charge.

Brief component description

The following components for voltage supply are described:

- Battery
- Generator (not installed in I01 and I12)
- Intelligent battery sensor
- Engine control unit

Battery

The capacity of the built-in battery depends on the engine used and the vehicle equipment. Selection criteria for the required capacity are:

- the cold-start behaviour of the engine
- the standby current consumption of the vehicle
- the energy requirement of the auxiliary consumer units (auxiliary heater, telephone, etc.)

Generator (not installed in I01 and I12)

With the engine running, the alternator generates a variable charging voltage for battery charge. The variable charging voltage is influenced by the power management depending on the temperature and current by the DME/DDE raising the engine speed.

IBS: Intelligent battery sensor

The intelligent battery sensor (IBS) is a mechatronic component with its own microprocessor which monitors the battery condition. The IBS continuously measures the following values on the battery:

- Voltage
- Charge and discharge current
- Battery temperature

The IBS is connected with the engine control unit via a local interconnect network bus (LIN bus) for data transfer. The IBS is installed in the battery in the case of the 12 V lithium ion battery.

Engine control unit

The engine control unit contributes to the voltage supply as follows: If the alternator voltage falls, the engine speed increases depending on the requirement. The software for this is called "power management".

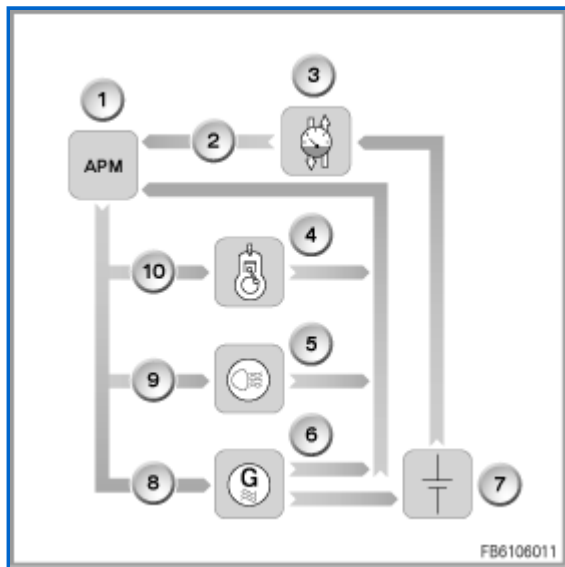
For I01 and I12, the voltage of the DC/DC converter is monitored in the EME by the power management.

System functions

The following system functions are described for power management ("Advanced Power Management"):

- Reduction or shutdown of individual electrical consumer
- Control of the electric auxiliary heater.
- Idle speed increase.
- Optimised charging voltage and vehicle voltage.
- Identification of poor charge balance.

See the following functional description for the state of charge, battery condition and startability limit functions: [Intelligent battery sensor and battery](#)



Item	Explanation	Item	Explanation
1	Advanced Power Management (APM)	2	Battery data (current, voltage and temperature)
3	Intelligent battery sensor (IBS)	4	Engine
5	Consumer	6	Alternator (G) / DC/DC converter
7	Battery	8	Specified setpoint value for charging voltage
9	Reduction of the power consumption or deactivation of individual electrical consumers	10	Idle speed increase

Reduction or shutdown of individual electrical consumer

Switching off individual consumers or reducing power consumption ensures optimum distribution of the power available depending on the vehicle condition and the battery state of charge:

- Ensuring sufficient battery charge while driving (charge balance).

- Reducing power consumption when an undervoltage is detected.
- Reducing power consumption when a minimum voltage is requested for the electromechanical power steering.
- Reducing power consumption to reduce battery discharge when vehicle is not moving (engine shutdown due to automatic engine start-stop function).

The power management controls the switch-off of individual consumers or reduction in the power consumption using requests (messages) to the relevant control units.

With the engine running

With the engine running, individual functions are divided into two classes:

- Class A: A reduction in the power consumption or a shutdown of these consumers is only perceived by the driver to a limited extent or after a delay.
Only in the event of the following preconditions are individual Class A consumers switched off or power consumption reduced:
 - Battery charge state in the critical range
 - High utilisation of capacity of the alternator or reduced utilisation of capacity of the alternator due to excess temperature.
 - Relieve the battery when the alternator torque is reduced to relieve the combustion engine.
 - High necessary steering power for the electromechanical power steering.
 - ECO PRO program is switched on.
 - Relieve the hybrid DC/DC converter (hybrid cars only).
- Class B: A reduction in the power consumption or a switch-off of these functions is detected by the driver immediately.
Only in the event of the following preconditions are individual Class B consumers switched off or power consumption reduced:
 - Battery charge state in the critical range (close to the startability limit).
 - A poor charge balance is detected.

In the event of alternator fault

- In the event of an electrical or mechanical fault on the alternator (reduced alternator availability), the power consumption of Class A consumers is reduced by the maximum allowable amount and the power consumption of Class B consumers is lowered to reduction number 2 (see table below) in order to lower the power demand from the vehicle electrical system.
- If alternator load is reduced due to excessive temperature (protective function), only the power consumption of Class A electrical consumers is reduced by the maximum amount allowable.

In the event of an engine shutdown (MSA)

To prevent excessive power consumption when the engine is switched off (MSA function), power consumption of Class A electrical consumers is reduced by the maximum amount allowable and that of Class B consumers by Reduction no. 1 (see table below).

When ECO PRO program is switched on

When the ECO PRO program is switched on, only the power consumption of the washer jet heating, mirror heating and seat heating is reduced. This corresponds to reductions number 3 and 7 (see table below for Class A electrical consumers).

With the engine off and the ignition switched on

With the engine off and the ignition switched on, consumers are not switched off or their power consumption is not reduced.

When engine and ignition are both off

The power consumption of all consumers is reduced to the lowest possible amount when both the engine and ignition are off.

Class A electrical consumers

Under the conditions described, the following measures for class A consumers are executed in succession:

No.	Function	Operation	Control unit(depending on version)
1	Heated rear window	Pulsing	REM
2	Rear seat heating	Stage 2	REM
3	Seat heating, front	Stage 2	Front seat module or front electronic module

	Rear seat heating	50 %	REM
4	- not used -		
5	Seat heating, front	50 %	Front seat module
	Seat heating, front	Level 1	Front electronic module
6	Steering wheel heating	50 %	Front electronic module
7	Washer jet heating	Off	Front electronic module
	Mirror heating	Off	Front electronic module
8	Steering wheel heating	Off	Front electronic module
9	Seat heating, front	Off	Front seat module or front electronic module
	Rear seat heating	Off	REM
10	Heated rear window	Off	REM
	Top HiFi system	Max. 30 A power consumption after engine start	AMPT

Class B electrical consumers

Under the conditions described, the following measures for class B consumers are executed in succession:

No.	Function	Operation	Control unit(dependent on version)
1	Top HiFi system	Max. 30 A power consumption	AMPT
	Heater blower, front and rear	75 %	IHKA or IHKR
2	Heater blower, front and rear	50 %	IHKA or IHKR
3	Heater blower, front and rear	25 %	IHKA or IHKR

The functions are fully restored once the battery state of charge exits the critical range or the charge balance improves.

Important! Display

When the shutdown of individual consumer units or the reduction of power consumption is activated, the displays remains active (LEDs remain lit).

Notice! Power consumption of the electromechanical power steering and the Top HiFi amplifier

Depending on the battery power, the power management communicates the maximum permitted power consumption for the electromechanical power steering and the Top HiFi amplifier via a message. If the battery power cannot be determined due to an intelligent battery sensor fault, a maximum fixed value is specified instead.

Control of the electric auxiliary heater

On vehicles with diesel engines and without independent heating, the heat exchanger for the heating system is heated additionally with an electric auxiliary heater based on the PTC principle. The electric auxiliary heater is one of the consumer units that need a relatively high amount of power (up to 1300 W) and it is thus regulated by power management. These high electrical loads are regulated as follows:

- The IHKA control unit controls the electric auxiliary heater (via local interconnect network bus).
- The power management in the DDE regulates the maximum electrical power output of the electric auxiliary heater (signal in a CAN signal).
The maximum power of the electric auxiliary heater depends on the alternator load and the vehicle condition (high necessary steering power for the electromechanical power steering, lowering of alternator torque to relieve the combustion engine, high necessary power consumption by the electric fan).
- The electric auxiliary heater regulates the heater output of the heating register depending on the specifications of the power management.

Idle speed increase

To prevent a negative charge balance of the battery, the power management can request an increase in the idle speed of the combustion engine. Depending on the engine version, the idle speed is raised by up to 200 rpm. An idle speed increase is activated under the following preconditions:

- Quality of the calculated battery charge state adequate and battery charge state below a specified limit.
- High utilisation of capacity of the alternator for a certain period.
- Identification of poor charge balance.
- High necessary steering power for the electromechanical power steering.

Optimal charge and vehicle voltage

Vehicle without intelligent alternator control (IGR)

The power management controls the alternator voltage as a function of the following criteria:

- Battery temperature: A cold battery is charged less efficiently, therefore the charging voltage has to be higher than for a warm battery. The battery temperature is determined by the intelligent battery sensor and communicated to the DME or DDE via the Local Interconnect Network bus.
- Protection of the battery against sustained excessive voltage and sustained discharge in the case of a poor state of charge.
- Request from components of the vehicle electrical system and functions (e.g. exterior lights or Dynamic Stability Control): minimum or maximum necessary voltage. These limit values must not be undershot or exceeded, as otherwise there can be functional limitations or function failures.

This rule is to ensure adequate charge of the battery. The aim is a charge of 100 %.

Vehicle with intelligent alternator control (IGR)

Unlike the normal control of the battery charge, the intelligent alternator control prevents 100 % charging of the battery. The battery charge goes to the range of 75 - 85 % of the maximum possible charge. This means that the battery remains "chargeable" to permit energy recovery in the vehicle overrun phase.

The power management co-ordinates the various requirements for the vehicle voltage:

- Battery: Nominal voltage depends on the temperature of the battery. Minimum and maximum voltage to permanently protect against excessive voltage and discharge with poor state of charge. In cycles, the intelligent alternator control is suppressed; this permits 100 % battery charge to achieve full battery capacity for a sustained period (regeneration).
- Components of the vehicle electrical system and functions (e.g. exterior lights or Dynamic Stability Control): minimum or maximum necessary voltage. These limit values must not be undershot or exceeded, as otherwise there can be functional limitations or function failures.
- Operating condition of the IGR: Energy recovery in the overrun phases, partial alternator relief (no battery discharge permitted) or alternator relief (return of the energy from the battery into the vehicle electrical system).

Identification of poor charge balance

With high specification vehicles with high load on the vehicle electrical system, the vehicle electrical system can be suppressed, particularly at excessively high ambient temperatures. The following reasons are possible:

- High power requirements for the electric fans from the heating and air conditioning system and the heat management

system.

- Reduced performance of the alternator at high temperatures.

The APM monitors the charge balance continuously by integrating the battery current measured by the IBS. If a bad charge balance is detected, then take the following action:

- Idle speed increase.
- Reduce the class B electrical consumer (heating fan to 75% or 50%).

Notes for Service department

General notes

Notice! Procedure in the event of a customer complaint with regard to malfunctions

In the event of customer complaints with regard to malfunctions related to the reduction in power consumption or shutdown of individual electrical consumers, use the following procedure:

- Run the "Reduction of electrical consumers" testing procedure. Information on the reduction or shutdown (point in time, duration and functions concerned) is shown in the testing procedure.
- Check the function with activation via diagnosis (component activation or testing procedure for function check).
- If appropriate, inform the customer regarding the situation.

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