Technical Information

Electronics – Power Management

HELLA®

Ideas today for the cars of tomorrow

Today, 90 % of all vehicle functions are based on electrical solutions. Higher levels of comfort and safety are linked to an increase in power requirements for additional loads. At the same time, battery-capacity availability requirements are rising, in particular with a view to supplying safety-related systems. A vehicle electric system should therefore be complemented by a power management system which sets up the balance between the capacity available and the load requirements. For this purpose, sensors monitor the battery voltage and the battery current as well as further parameters of the vehicle electric system. This information is used to determine the state of the vehicle battery and the complete vehicle electric system at all times.

It is only the measurement of the actual battery state that makes it possible to regulate this state to one predefined and optimized for the respective mode of operation of the vehicle. In addition, the early and correct evaluation of disturbing effects contributes to taking the strain off the driver. This happens by avoiding problems caused by run-down batteries or failures of the vehicle electric system due to prematurely aged batteries or faulty generators. Diagnosis data of the vehicle electric system management makes service work easier.

In addition, powerful starters/generators will offer additional possibilities of intervening in power management and reducing vehicle power consumption in the future due to acceleration support, start/stop function and recirculating of the braking energy. Hella has been quick to recognize this trend and already has tailored solutions available.

Power Management

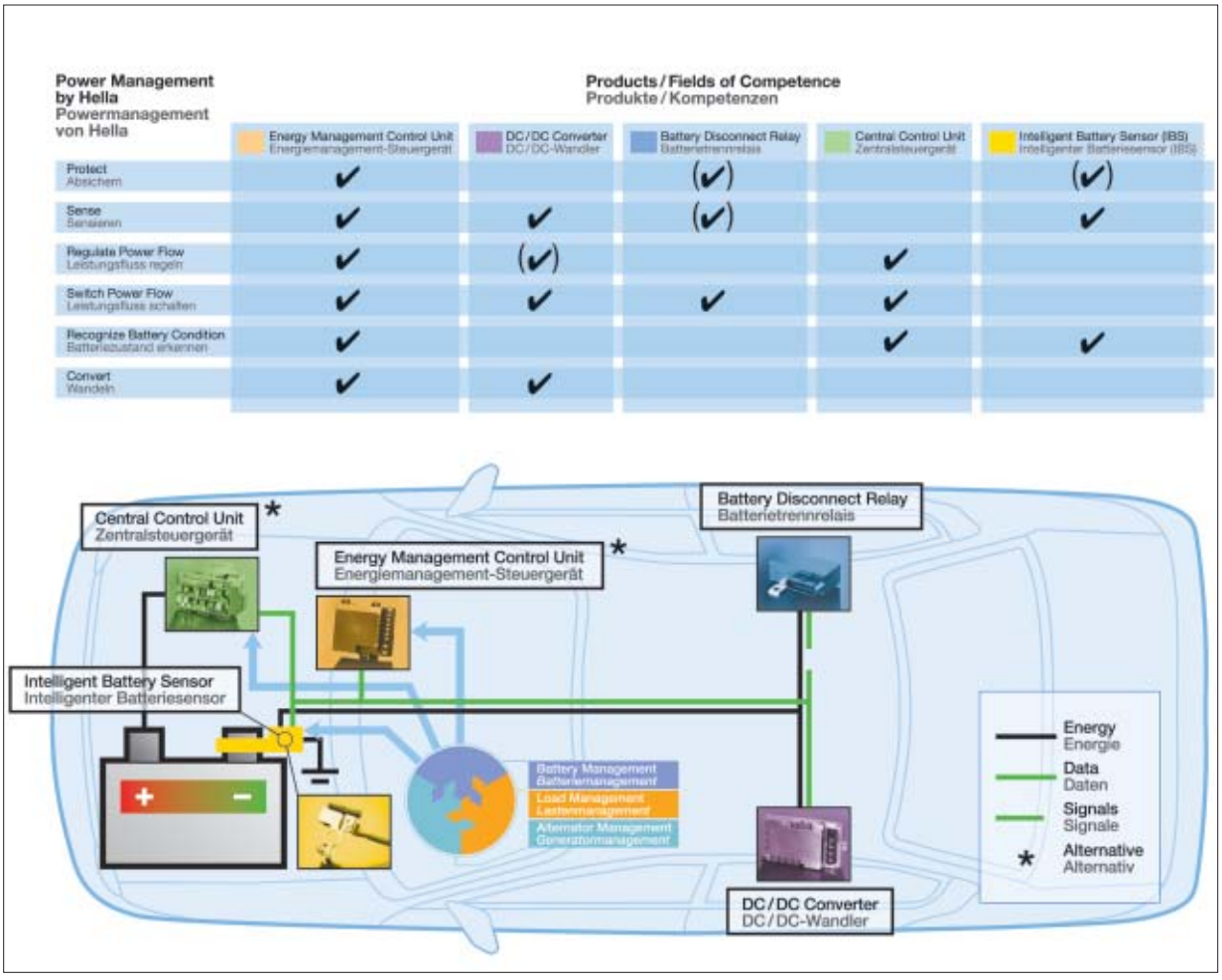
The system properties of power management are characterized by the coordinated regulation of the power flow of the alternator, loads, power stores and converters. With increasing vehicle equipment rate and the requirements for power efficiency, modular extendable vehicle electric systems are used which are structured using voltage converters and power switches. Ensuring the availability of the vehicle functions and starting ability, power-saving operation and comfort requirements are taken into consideration by power management and processed in a coordinated regulation strategy to generate specifications for vehicle operation.

Different general conditions apply depending on the vehicle operating state. When the vehicle is being driven, the main concern is optimum charging strategy and energy efficiency. For this purpose, the generator voltage is adapted to the battery requirements depending on the battery temperature and charge state. While idling, engine speed can be changed without influencing vehicle speed, enabling the operating state of the generator to be adapted to power requirements. If the battery management determines a sufficient charge state, the idling speed can be lowered in order to reduce fuel consumption and engine noise. The controlled triggering of the generator ensures optimum battery charging and thus contributes to improved start-up ability. In addition, vehicle standing time at rest is extended and fuel consumption reduced.

In borderline situations where not enough power is provided by the alternator, the power management system stabilizes the state of the vehicle electric system, by adjusting the load to the required level through a reduction of load power. Here, a requirement-based balance is set up between the power consumption of the various loads in the vehicle so that the necessary loads are still supplied with enough power. This regulation behavior retains the functionality of the vehicle and the comfort functions.

Higher quality power-supply systems include several power generators and stores connected to one another by voltage converters and power switches. The power management system monitors these sections of the vehicle electric system and controls the power flow using the voltage converters. In this way, power exchange between the power stores is minimized and requirement-related supply of the loads is guaranteed.

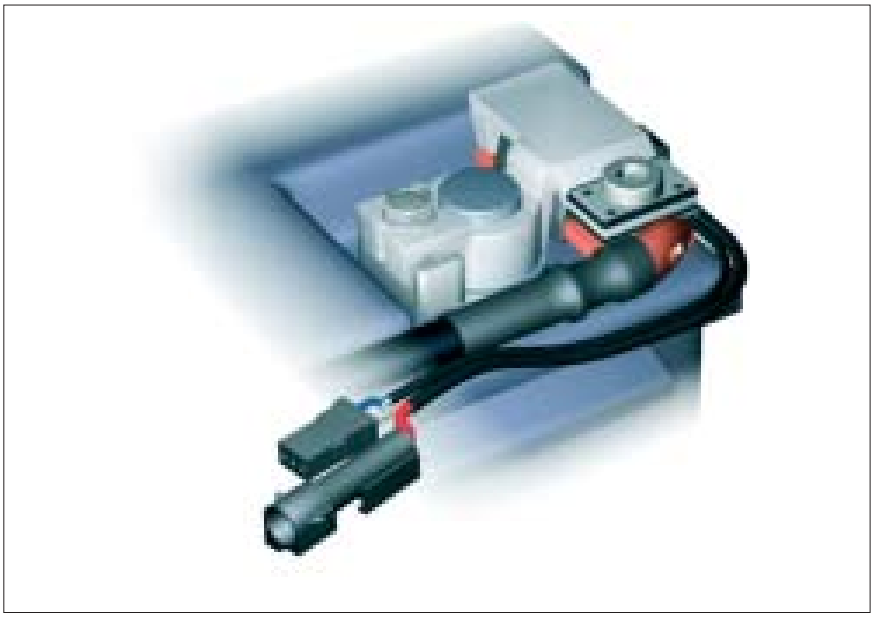
Hella has several key components for power management in its portfolio. These include the intelligent battery sensor, the energy management control unit and the DC/DC converter.



Intelligent Battery Sensor (IBS)

Effective control of the vehicle electric system is only possible when battery parameters are measured extremely accurately, allowing a precise charge balance. The resolution accuracies required by sensor systems are in the range of only 10 mV for voltage measurements, and in the case of current measurement are a maximum of 1 % for the entire measuring range.

These requirements can be met economically using the shunt sensor developed by Hella, which has a typical resistance value of only 100 µΩ. A sensor ASIC with two 16 Bit AD converters and a powerful controller core allow extremely precise recording of the battery voltage and battery current as well as the integration of further important power management functions such as software for the signal processing of cyclic timers, current-limit monitoring and temperature measurement. Together with optimized communication to the energy management control unit, this solution allows the minimization and permanent monitoring of the quiescent current. Depending on the vehicle electric system structure, the battery sensor can either be installed in an energy management control unit or integrated directly in the battery-terminal clamp. Hella is the first series supplier on the market to offer this application with optimum utilization of design space.



Intelligent Battery Sensor (IBS)

Energy management control unit

In some excess load situations, the specific disconnection of individual load branches from the battery is necessary. The disconnection of high-current paths can be carried out reversibly in an energy management control unit due to special power semiconductors and electro-magnetic switches. Pyrotechnical disconnecting elements can also be used to protect high-current paths. The selection of protection methods makes flexible vehicle electric system design possible.

The current sensor system, together with the software algorithms stored in the control unit, allow a switch-off strategy which is no longer dependent on the physical properties of conventional melting fuses but can be adapted with low tolerances to the characteristics of vehicle electrical system components.

These disconnecting methods are particularly advantageous for vehicle electric systems with higher voltages. Hella is preparing these future technologies for series applications in cooperative partnerships with customers and sub-suppliers.

DC/DC converter

A power management system is usually also used for vehicle electric system structures with two separate 14 V vehicle electric systems or dual systems with different voltages. Hella is developing DC/DC converters, charge converters and voltage stabilizers in a power range from 25 W to 1000 W for these types of vehicle electric systems. The converters enable optimum battery charge in the vehicle electric system and ensure the availability of the different voltage levels. At low output capacities, the converters can be integrated in vehicle electric system control units.

For the dual 42 V/14 V vehicle electric system, Hella has developed a bi-directional DC/DC converter with an output capacity of 1000 W and an efficiency of 93 %. Higher output capacities can be achieved through parallel converter connection if necessary. The DC/DC converter is also used by our customers in vehicle electric systems with fuel cells or in mild hybrid applications.

DC/DC converter

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