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## **Energy Management**

### *Technical Information*



*Ideas today for  
the cars of tomorrow*



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the cars of tomorrow*



Intelligent Battery Sensor (IBS)

## Energy Management

### To manage successfully means to delegate efficiently

More power, greater comfort, improved safety – these are mandates and goals that are met time and again thanks to innovations in the field of automotive engineering. Added to these are regulatory demands for lower CO<sub>2</sub> emissions as well as specific requirements for safety critical systems. The result is a complex structure of the most diverse mechatronic and electronic loads whose energy supply has to be not simply ensured but balanced out reliably. This takes place through consistent monitoring and strategic controls, which occurs in the interest of efficiency and exactly the way the driver likes it.

These are high demands, and Hella can offer intelligent solutions to meet them: energy management that reliably and efficiently coordinates the vehicle electric system. This specifically includes the regulation of the power flow of the alternator, loads, power stores and converters which ensure the starting ability and the availability of the vehicle functions. Naturally, aspects such as power saving operation and comfort requirements are

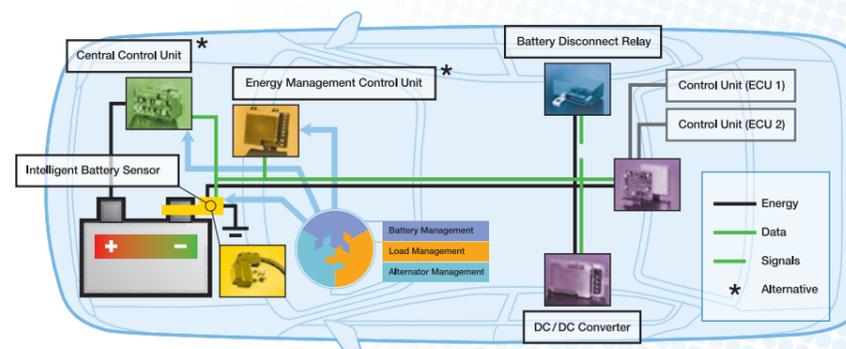
being taken into consideration in this context and processed in a coordinated regulation strategy to generate specifications for the operation of the vehicle.

The goal is clear: to ascertain complete availability of electrical power for all operating states. This is needed not only within the usual vehicle electric systems but also for new power supply systems with more than one power generator and power store. Hella power management supports the attainment of this goal and takes on the best possible coordination between available and needed capacities. This

takes place in particular through in-depth analysis, development and optimization of all crucial components of successful power management in vehicles.

Besides the system components of power management available today, Hella is currently also working on tailored solutions for future alternator and starter generations which offer additional means for intervening in the power management and for reducing vehicle fuel consumption due to acceleration support, start and stop functionality and recirculation of the braking energy.

Power Management by Hella	Products / Fields of Competence				
	Energy Management Control Unit	DC/DC Converter	Battery Disconnect Relay	Central Control Unit	Intelligent Battery Sensor (IBS)
Protect	✓		(✓)		(✓)
Sense	✓	✓	(✓)		✓
Regulate Power Flow	✓	(✓)		✓	
Switch Power Flow	✓	✓	✓	✓	
Recognize Battery Condition	✓			✓	✓
Convert	✓	✓			



## Intelligent Battery Sensor

### The basis has to be correct

The Intelligent Battery Sensor (IBS) takes on a key functionality in successful power management. The sensor systems that ascertain the necessary battery state variables provide the vehicle battery's precise power, voltage, and temperature values. Without this data, power management cannot adequately control and monitor the system's energy budget.

With the information supplied by the IBS, the system can efficiently generate the exact amount of electrical energy needed at any time, distribute it intelligently, and ultimately store it in the best possible way. This ascertains a maximum availability and reliability of the vehicle's functionality and makes sure that sufficient power is available the next time the engine is started.

The IBS collects the data with resolution accuracies of < 1 mV for voltage measurements and a maximum of 1 % for the entire measuring range when measuring the current. Based on these measurements, the ASIC (Application Specific Integrated Circuit) computes the current service capability based on battery parameters such as State of Charge (SoC), State of Health (SoH) and State of Function (SoF) of the battery state detection.

The IBS's sensory system is integrated into the battery clamp on the negative terminal. This compact mechanical assembly enables a perfect fit into the terminal recess of any standard vehicle battery. The core of the assembly located on the circuit board is the ASIC. With its two independent 16 bit A/D converters, an internal current reference of generally 5 ppm/°C and corresponding mechanisms for offset compensation, the required accuracy and resolution are reached while measuring voltage and current at the same time.

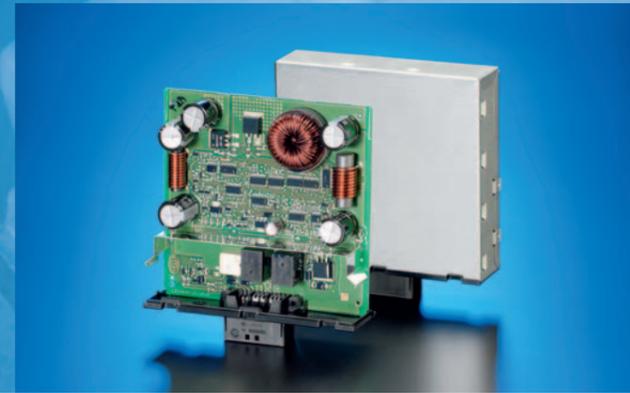
### Hella's Intelligent Battery Sensor

- ensures maximum capacity and the highest level of accuracy with the help of an ASIC specifically developed for Hella
- takes on central functions in the automotive production, operation and service based on its extensive and accurate battery diagnosis
- increases the quality of the vehicle power system through continuous monitoring of the quiescent current as early as during vehicle production
- supplies detailed information on the charge and aging state of the vehicle electric system's battery and increases the battery's lifespan by charging and discharging it gently
- supports quick and safe detection of defective control units within the vehicle

- reduces vehicle consumption values through precise battery monitoring and captures the actual state of the control circuits of the vehicle electric system management (especially alternator control); together with a load control allows for adhering to more stringent emission requirements (CO<sub>2</sub> emission)
- presents the most cost-effective solution for precise battery management based on its high degree of integration and has proved its value as part of several vehicle platforms of different manufacturers since 2003
- ensures the vehicle's ability to start with excellent battery management, thus creating higher customer satisfaction
- is one of many Hella products that have convinced consumers for years as professional and flexible solutions for all kinds of customer requirements.



DC/DC converter



Voltage stabilizer



Charge converter from Hella in a vehicle electric control system unit

## Vehicle electric system architecture

### For correct voltage

Automotive electronics are becoming increasingly complex, and the equipment rate increases. This makes the vehicles safer, more economical and better for the environment. With an increase in the number of loads, more than one level of voltage needs to be supplied with the vehicle electric system. The solution is either a dual vehicle electric system or the use of a modern high performance vehicle electric system.

The use of voltage converters in vehicles embedded in the respective vehicle electric system structures enables new approaches to reducing fuel consumption. This goal takes the environment into consideration, in particular with an eye on federal regulations. It focuses on the speedy introduction of measures to increase power efficiency in vehicles on the basis of the existing vehicle electric system. But it also mitigates the effect of increasing fuel prices for the driver and enables new, innovative applications.

Hella develops and provides the following for the requirement related supply of various vehicle electric system architectures:

- voltage converters
- voltage stabilizers
- charge converters
- equalizers.

### Voltage converters

Voltage converters are needed wherever the electric power source in the vehicle supplies a higher vehicle voltage than the standard loads. In vehicles with different voltage situations, these converters transfer power from the higher to a lower power level and vice versa. The supply of this voltage can thus originate from a 12 V vehicle electric system, an alternator, a fuel cell or a high voltage battery.

Hella developed the bi-directional voltage converter specifically for applications with an output capacity of 1000 W and an efficiency of 93 % for a maximum input voltage of up to 60 V.

### Voltage stabilizers

Voltage stabilizers enable the operation of voltage critical loads in vehicles with a high voltage dynamic. The stabilizers balance out voltage fluctuations in the main network and function as boost converters when drops in vehicle electric system power occur. The sensitive load therefore has a constant output voltage available at all times. This is particularly useful for vehicles where the internal combustion engine is turned off during idling in the start and stop operation, since in these cases the supply of the audio system or a constant level of lighting can be ensured even during voltage drops. Hella can provide the correct voltage stabilizer with a load power between 70 W and 350 W.

### Charge converters

The use of charge converters is advisable in vehicles with different or the same voltage levels. On the one hand, charge converters support a redundant power supply. On the other hand, the charge of the power stores is optimized and their lifespan and the system availability are enhanced. This will ensure the vehicle's ability to start at all times.

If desired, the charge converters can be combined in one unit with vehicle electric control units or power stores. This will save not only space, but also money.

### Equalizers

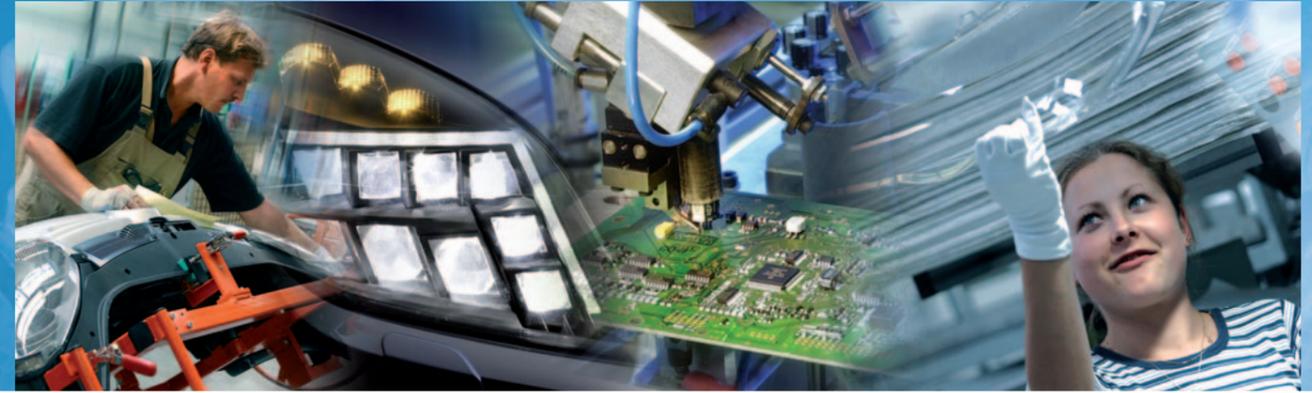
Equalizers create a balance of charges between several storage cells and batteries. This solves the problem of having different charge amounts in individual cells which are caused when storage cells are connected in series due to the great cyclical strains, such as in hybrid applications. The charge equalization ensures not only the functionality and the storage ability of the cells, however. In a 24 V vehicle electric system of commercial vehicles or busses, the equalizer also enhances the lifespan of the 12 V batteries connected in series, while at the same time making a 12 V partial electric grid for selected loads available.

### Hella's converter portfolio

- proven products from an established manufacturer
- integration in existing vehicle electric systems
- reliable unit concepts for future vehicle electric systems
- power density thanks to innovative converter topology
- can be used for several different applications
- optimal use of energy storage capabilities
- effective contribution to reducing fuel consumption and CO<sub>2</sub> emissions
- application across platforms.



Control unit



## **Energy management control unit**

### **Integrated enhanced safety**

The energy management control unit kicks in as an additional safety device in situations where the power supply of primary loads is in danger. This can occur in excess load situations, for example, where the targeted separation of individual load branches from the battery is needed in order to ensure steady supply. Special power semiconductors and electromagnetic switches within the control unit carry out the separation reversibly. In addition, pyrotechnical disconnecting elements can be used to protect high-current paths. The selection of protection methods enables flexible vehicle electric system designs.

### **Hella's energy management control units**

- offer additional safety for driver and vehicle in accidents
- are based on a current sensor system that operates independently from physical characteristics of conventional fuses.
- enable an individual adaptation of the switch-off strategy to the vehicle electric system components together with software algorithms stored in the control unit.

## **Hella KGaA Hueck & Co., Lippstadt:**

The automotive parts supplier develops and manufactures components and systems for lighting technology and electronics for the automotive industry. In addition, joint venture companies also produce complete vehicle modules, air conditioning systems and vehicle electric systems. Hella has one of the largest aftermarket organizations in the world for automotive parts and accessories, with its own sales companies and partners in more than 100 countries. Hella is one of the top 50 automotive parts suppliers in the world and one of the 100 largest industrial companies in Germany. More than 25,000 people work in 70 manufacturing facilities, production subsidiaries and joint ventures all over the world. Almost 3,000 engineers and technicians work in research and development throughout the company group. Customers include all leading vehicle and system manufacturers, as well as the automotive parts aftermarket.

### **Network creates added value**

Cooperation rather than concentration: In line with this aim, Hella enters project-related co-operations and works in joint ventures with independent suppliers, enabling the company to offer vehicle manufacturers an attractive alternative to mega suppliers in terms of innovative ability and global presence.

Hella's decades of know-how in the field of body electronics links favorably for automakers with the vehicle-electric-system competence of Leoni. Thus, from many years of cooperation, the joint venture Intedis in Würzburg (Integrated Electronic Distribution Systems) arose. The aim of the cooperation is to offer automakers complete solutions for the vehicle electric system of the future. Here, through integral consideration of the system, consisting of control units, harnesses and lighting, the aim of cost and weight reduction (for example through fewer interfaces) is pursued while keeping functionality reliable and at a high level.

Hella cooperates with the Japanese supplier Stanley and the Korean supplier SL (formerly Samlip), in the field of lighting technology for example.

HBPO GmbH is the only joint venture of its kind in the world and is extremely successful in the area of design, development, production and logistics for complete front-end modules with the suppliers Behr, Stuttgart/Germany, and Plastic Omnium, France.

These examples demonstrate how Hella defines the term "customer benefit": Expert knowledge is linked and brought together in lean organizations with short decision paths. Hella is always open for new or extended partnerships, to be able to offer vehicle manufacturers optimum solutions with just the right partners.