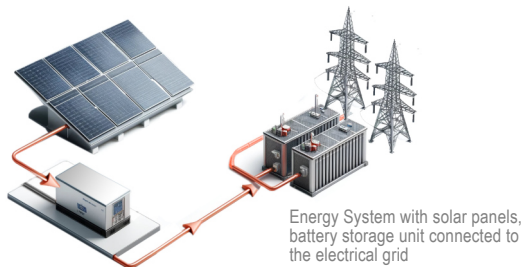


Energy Storage and Fuel Cell Applications: The Role of Battery Management Systems and Hall Effect Current Sensors

SOC and SOH are crucial input parameters for the BMS. They work together to ensure safe and efficient battery operation by monitoring its current state and long-term health.

The complexity of the algorithms used can vary, but the overall concepts are essential for maximizing battery lifespan and performance.

The engineering today is focused on developing better energy storage and fuel cell technologies. These advancements are crucial for progress in renewable energy, electric vehicles, and keeping the power grid stable.



Battery Management Systems play a critical role in monitoring and managing the performance of batteries. They ensure optimal performance by balancing cell charge, protecting against overcharge and over-discharge, and maintaining temperature within safe limits.

Role of Hall Effect Current Transducers

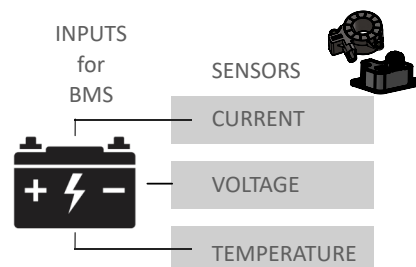
There are two key players: Battery Management Systems (BMS) and Hall Effect Current Sensors. They work together to guarantee that energy storage systems function safely, reliably, and efficiently. In energy storage applications, a well-designed BMS can significantly enhance the lifespan and efficiency of battery packs, making them more reliable for both consumer and industrial applications.

Integration into the BMS

The Hall effect transducer's output voltage is typically conditioned by the BMS through an amplifier and filtering stage. This processed signal is then fed to the BMS microcontroller, which converts it into a current value using the calibration data specific to the transducer.

The BMS software then utilizes this current data for various functions, including:

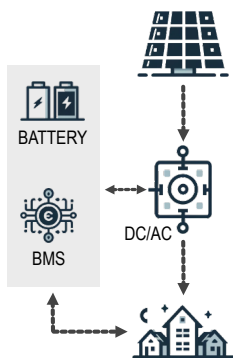
- **State of Charge (SOC):** By integrating the charging and discharging currents over time, the BMS can estimate the remaining battery capacity.
- **State of Health (SOH):** Comparison between the battery's present capacity and its initial capacity at purchase. Offers useful details regarding the battery's life expectancy and potential replacement dates.
- **Over-current and Over-temperature Protection:** The BMS can monitor current and temperature readings to prevent damage caused by excessive current draw or high battery temperatures. In such cases, the BMS can take corrective actions like reducing power output or disconnecting the battery.
- **Cell Balancing:** During charging, the BMS can monitor individual cell voltages and use the current data to balance cells with slightly different capacities, extending battery life.



100% SOC is a fully charged cell, and a 20% SOC cell has very little energy left. If a lithium-ion cell's state of charge drops below 20%, the copper in the current collector can go into solution in the electrolyte, which can cause a short circuit and fire.



Used EV batteries can be used in rechargeable battery systems designed for home energy storage.



HSCP-1BS Hall Effect Current Sensor

The **HSCP-1BS** family of open loop current transducers generates a ratiometric analog output voltage signal proportional to the current flowing through the conductor.

Based on Hall effect technology the sensor withstands working temperatures from -40° to $+125^{\circ}\text{C}$ and has been designed for accurate measurement of AC and DC currents in automotive battery management and motor control applications.



This sensor is available in a variety of current ranges and features busbar mounting for maximum compatibility.

Dual output ready for **maximum versatility** It can measure currents from ± 200 A to ± 1500 A. This sensor is easy to install and calibrate, making it a cost-effective choice.

Main Specifications:

	Unit	Min.	Typ.	Max.
Supply voltage	V	4,5	5	5,5
Supply current	mA	9	12	14
Output voltage	V	0,5		4,5
Offset voltage	V		2,5	
Response time	μsec			3
Frequency bandwidth	kHz	70		250
Operating temperature	$^{\circ}\text{C}$	-40		+125
Typical error (at 25°C ; $V_{cc} = 5\text{V}$)	%	0,65		2,5
Max. error (at -40°C to $+125^{\circ}\text{C}$; $V_{cc} = 5\text{V}$)	%	1		3,5

Other specification on request

HSCP-1W Wire Mount Current Sensor

The **HSCP-1W** is a high-accuracy **dual channel** sensor that is ideal for measuring AC and DC currents in battery management systems, industrial battery chargers and motor control applications.

Installing the sensor directly on the current-carrying conductor, without the need for additional hardware simplifies the installation process and reduces the risk of errors and downtime.



The sensor is available in a variety of current ranges and features a cablemounting option for easy installation. Dual output ready for **maximum versatility and redundant mode**.

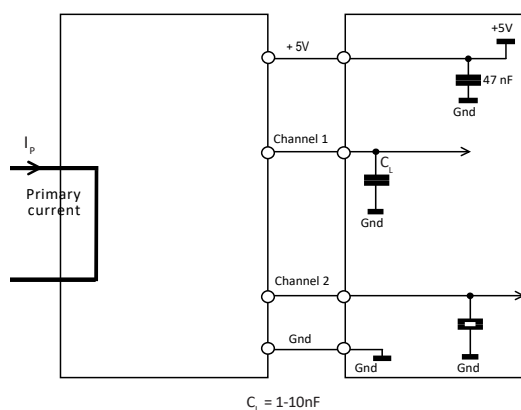
It can measure currents from ± 25 A to ± 1000 A in cables with diameter section up to 22,5mm The sensor is easy to install and calibrate, making it a cost-effective choice.

Main Specifications:

Supply voltage	5 V $\pm 10\%$
Current consumption	Typ. 26 mA
Analog output	0.5 V to 4.5 V
Creepage distance	3.95 mm
Clearance	3.95 mm
Operating temperature	-40°C to $+125^{\circ}\text{C}$
Over voltage protection	+10 V
IP rating	IP67 / IP69K (not considering connector)
Max. Mounting torque	2.5 N.m (M4x, 7mm)

Other specification on request

Scheme Example



$C_1 = 1-10\text{nF}$

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