Minsk battery management systems

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A BMS may monitor the state of the battery as represented by various items, such as:

Liquid cooling has a higher natural cooling potential than air cooling as liquid coolants tend to have higher thermal conductivities than air. The batteries can either be directly submerged in the coolant or the coolant can flow through the BMS without directly contacting the battery. Indirect cooling has the potential to create large thermal gradients across the BMS due to the increased length of the cooling channels. This can be reduced by pumping the coolant faster through the system, creating a tradeoff between pumping speed and thermal consistency.[6]

Additionally, a BMS may calculate values based on the items listed below, such as:[1][4]

The central controller of a BMS communicates internally with its hardware operating at a cell level, or externally with high level hardware such as laptops or an HMI.[clarification needed]

High level external communication is simple and uses several methods:[citation needed]

Low-voltage centralized BMSes mostly do not have any internal communications.

A BMS may protect its battery by preventing it from operating outside its safe operating area, such as:[1][10]

A BMS may also feature a precharge system allowing a safe way to connect the battery to different loads and eliminating the excessive inrush currents to load capacitors.

The connection to loads is normally controlled through electromagnetic relays called contactors. The precharge circuit can be either power resistors connected in series with the loads until the capacitors are charged. Alternatively, a switched mode power supply connected in parallel to loads can be used to charge the voltage of the load circuit up to a level close enough to the battery voltage in to allow closing the contactors between the battery and load circuit. A BMS may have a circuit that can check whether a relay is already closed before recharging (due to welding for example) to prevent inrush currents from occurning.

In order to maximize the battery"s capacity, and to prevent localized under-charging or over-charging, the BMS may actively ensure that all the cells that compose the battery are kept at the same voltage or State of Charge, through balancing. The BMS can balance the cells by:

Some chargers accomplish the balance by charging each cell independently. This is often performed by the

BMS and not the charger (which typically provides only the bulk charge current, and does not interact with the pack at the cell-group level), e.g., e-bike and hoverboard chargers. In this method, the BMS will request a lower charge current (such as EV batteries), or will shut-off the charging input (typical in portable electronics) through the use of transistor circuitry while balancing is in effect (to prevent over-charging cells).

BMS technology varies in complexity and performance:

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Web: https://kary.com.pl/contact-us/
Email: energystorage2000@gmail.com
WhatsApp: 8613816583346