Battery management systems libreville

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A Battery Management System (BMS) is an electronic circuit to monitor and protect rechargeable battery cells.

The BMS monitors the current going into and out of the cells determines when to stop dis-/charging based on the state of charge (SOC).

The SOC of the cells is calculated by combining current and voltage measurements, sometimes temperature.

The most simple SOC determination is done with an open circuit voltage (OCV) lookup table can have a significant deviations from the actual SOC due to the OCV not being accurately measurable during current flow. An improved algorithm consists of combining the voltage measurement with a current measurement, accumulating the current into or out of a cell, also known as coulomb counting.

As described in chapter "Battery", different cells have different minimum and maximum voltage levels as well as different phases while charging/discharging.

The BMS is responsible to measure the voltage, current and temperature and stop or reduce dis-/charging in order to stay within defined safety limits of the cells.

To disconnect the battery from the load/charger, different types of switches can be used. For low current systems, a MOSFET switch is often easiest to use, while a mechanical or solid state relais can be necessary to switch higher voltages and currents.

In order to keep the battery in a safe operational state, a thermal managmenent is required. The system can either be active or passive, using mostly air or another liquid coolant. The necessary hardware like fans and their electronics are mostly not considered part of the BMS but are controlled by it.

To optimize performance and lifetime of battery packs, balancing is used to compensate deviations in cell capacity and prevent localized over- or under-charging of cells. Since cells differ slightly in capacity depending on the quality of the manufacturing process and used materials or by cell aging, cells connected in series can show different voltages.

To normalize the SOC for each cell, a BMS can either actively transfer energy from higher charged cells to those with lower SOC or passively by converting energy from cells with high SOC into heat through a resistor. The resistor is connected in parallel to the cell and switched on with a transistor for the cells with

higher voltage, thus having excessive charge in comparisons to the other cells in series. Passive balancing slightly increases the thermal energy dissipated by the pack and decreases the overall efficiency.

Active balancing aims to distribute the energy better while charging and discharging, but is more complex and needs more expensive circuitry.

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