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SMART BATTERY OVERVIEW

Rev 2.0

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Working document. Please mark all corrections in RED pen.

Introduction

The smart battery consists of a large Lithium-Polymer battery with an intelligent battery board controller. The battery board switches the power port to allow charging and discharging as well as conditioning and monitoring several vital statistics for the battery. The battery board also implements several protection mechanisms in hardware and firmware to protect the battery and the user from damage.

Operation

Connect the switch loop to battery negative to enable the battery. When this is done, the battery board wakes up and can be communicated with through its serial port to poll its sensors and to set it to charge or discharge. In the case of a master pack, enabling the battery also causes it to begin discharging.

The battery's internal electronics draw about 7ma (Wrong) directly off the battery. To prevent the battery running flat, the battery should be disabled (??uA) (enable line floating) when not in use. A fully charged battery can run in this state for (multiple days).

Master Packs

The vehicle can only be powered up when one or more batteries are discharging, but the vehicle cannot tell the batteries to discharge until it is powered up. To solve this “chicken and egg” problem, packs can be specified as a “master” by connecting to the battery through its serial port and placing it into master mode (see firmware document).

Master packs discharge automatically and immediately when enabled, allowing the vehicle to be booted up. There is no limit on the number of master packs one can have connected – but it is firmly suggested that only one pack be designated a master. With one master, the maximum fault current is around 30 amps and the pack will turn off (electronically) should there be a fault. With three packs, the maximum current without fault is 90 Amps.

The intention is that once the vehicle is working reliably on one pack, the battery driver turns on the remaining packs.

When communicating with a master pack, each battery summary query response will have the word “master” appended to it. There is no obvious external indication that a pack is a master.

Communications

Communication with the smart battery takes place over an RS485 serial bus. This communications link allows the user to control the battery and to query its state.

Since multiple batteries may be connected to the same RS485 bus, each battery has a programmable 2 digit hexadecimal (8 bit) address that allows them to be distinguished from one

another. Addresses can be changed through the serial port (see firmware document) if necessary. For convenience, all batteries respond to the address 00.

Protections

The most important function of the battery board is to protect the battery and its operator from damage or injury. To do this, the battery board has hardware and firmware mechanisms that monitor the vitals of the battery and shut off charging or discharging if a fault occurs. Among the conditions that the board prohibits are over-current, under-voltage, over-voltage and over-temperature.

As a general rule, the firmware provides the first line of defense against faults. When it detects that one of the vitals has violated a previously specified limit, it turns off the pack and flags an error to the operator. For sudden faults and as a backup for the firmware, there are also hardware mechanisms that have the power to deactivate the battery when triggered. The user is informed whether a hardware or firmware fault has been triggered.

Once a safety mechanism is tripped (either firmware or hardware), the battery must be issued the off command to reset the fault system before the battery can be used again.

Protection	Error state	Limit
Battery over-voltage	V	34.0V (4.25V/cell)
Battery under-voltage	v	26.0V (3.25V/cell)
Battery over-current	I	30.0A
Cell over-voltage	C	4.25V
Cell under-voltage	c	3.15V
Over-temperature	T	48C
Water Leak	W	Any
Hardware protection	H or h	Any
MVC watchdog	m	60 seconds