

Installation and operating instructions for ThunderStruck Motors BMS-II-DC Battery Management System.

Overview:

The BMS-II-DC battery management system is designed for use with lithium iron phosphate (LiFePO₄) cells (batteries) installed in vehicles. The system includes two basic components: the Cell Module, one for each cell or parallel set in a series string and a Relay Control board, one for each system. The voltage of each cell is monitored, producing a signal indicating either an over- or under-voltage condition. The Relay Control board provides an output to control a solid-state relay that turns a battery charger on and off (AC input switching) and a second output that enables an alarm (beeper/buzzer) when over- or under-voltage is detected. This output may also be used for a motor controller input. **It is extremely important that the alarm always be functional when the vehicle is in use as it is the only way the operator can know when a cell is low.** Each Cell Module also has a green LED that indicates max/over-voltage detection and a yellow LED indicating min/under-voltage.

Contents:

<u>Quantity</u>	<u>Description</u>
# Ordered +1	Cell Modules
1	Relay Control PCB
1	Solid State Relay
1	Buzzer
1	End of Line Jumper
4	2 conductor connectors w/ 24awg pigtail
6	Spade Connectors

Installation:

Cell Module mounting and connection:

Mount each Cell Module on the **NEGATIVE (-)** terminal of each cell using the mounting lug on the module. This may be done at the time the cells are being series connected or after those connections have been made. (See Figure 1 for a photo of a Cell Module.)

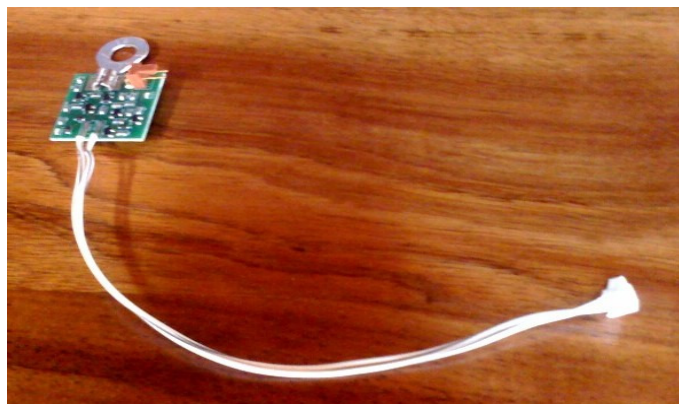


Figure 1: Cell module

After all cell-to-cell jumpers (series connections) have been installed and all cell modules have been mounted, connect the white connector on each module to the module mounted on the next cell in the string, starting with the most negative cell. Note that the white connector (on end of jumper wires) has a key ridge that faces up (away from printed circuit board) to engage a slot on the input header (white connector with pins).

Note: If there are separate battery banks within a vehicle, the cell module interconnect wires will have to be extended. When this is done, it is recommended to use either shielded, 2-conductor cable or a twisted pair to minimize induced signals from stray magnetic fields. The first module in the string (on the most negative cell) requires a jumper connector (provided with kit) plugged into its input header.

NOTE: Before disconnecting any cell-to-cell jumpers, first disconnect the Cell Modules mounted to the cells. Failure to do so may damage cell modules.

Relay control PCB connections:

See Figure 2 for a photo of the Relay Control PCB.
See Figure 3 for BMS wiring diagram, including an example of charger circuit wiring.

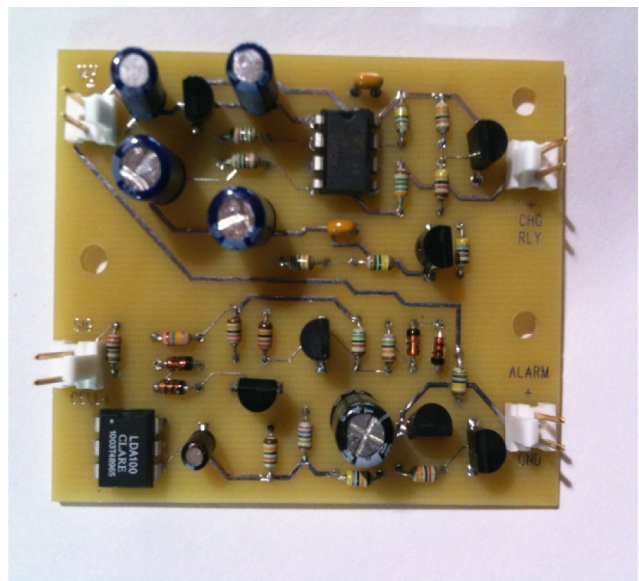
There are four connectors on this PCB. **All connectors require 24 AWG wire.**

J1 in the upper left corner (all positions are as viewed in Figure 2) is a 12V DC input. This is a power input from the vehicle accessory battery and draws from 5 to 20 mA. (At 20 mA, it would use about 0.5 Amp-hours per day from the accessory battery, or 15 A-hrs monthly.)

J3 in the upper right corner connects to the control input of the charger switching relay. This must be a solid-state relay that requires less than 4V DC input to operate and draws no more than 15mA at that voltage (such as Crydom EZ240D18). Observe polarity on this connector; the lower pin is positive (+).

J2 in the lower left corner is the input from the top cell (+) and Cell Module of the BMS. The lower pin connects to the Positive (+) terminal and the upper pin connects to the signal output (Sig. Out) of the Cell Module. See diagram, Figure 3 for these connections.

J4 in the lower right corner is an alarm output that is active whenever a cell falls below 1.90V (or, when charging, a cell exceeds 3.8V). One example of an alarm circuit is also shown in Figure 3. This output provides 12VDC to an alarm or other circuit with a maximum 50 mA (0.05 A) current draw.



It is not advisable to put a switch in series with the alarm to disable it, as it is essential that the vehicle operator be able to hear any indications of a low cell condition.

If banks of cells are separated by any distance or the top cell is more than 12 inches from the Relay Control unit, a longer connecting wire pair will need to be made up. In this case, it is best to use a twisted pair or shielded cable to reduce electrical noise pickup. To make a twisted pair, measure the required length and add about 30%. Cut two wires to that length and twist them together by inserting two ends into a hand drill chuck and clamping the other ends.

Troubleshooting:

If the charger (or charger relay) fails to turn on or if the alarm is constantly on, proceed as follows:

Check Cell Modules to see if any LEDs are lighted, if possible. A yellow LED on means the cell voltage is low (less than 1.9V); the green LED indicates voltage is over 3.8V. When charging, it may take a while after the charger turns off for cell voltage to drop low enough to reset the Cell Module.

If the charger doesn't come on, also check that 12V DC is supplied to the Relay Control PCB.

To determine which Cell Module is generating a fault signal (over- or under-voltage), check the voltage on the Sig. Out connection (see Figure 3) as follows: for any Cell Module, put the negative lead of a voltmeter on the negative cell terminal on which the module is mounted and the positive lead on the Sig. Out connection for that module (It may be necessary to use a sharp probe to penetrate the coating).

Start with a Cell Module near the center of the string (halfway between most negative and most positive). If the voltage on Sig. Out is less than 0.1V, this module and the ones below it are indicating normal condition. Repeat this measurement on a module halfway between the first one checked and the most positive cell. Continue this process moving up the string until a voltage above 0.1V is measured.

If the voltage is greater than 0.1V, there is either a module sensing an over or under-voltage condition or there is a bad connection between Cell Modules below (more negative than) that point. Take measurements on modules down the string (toward the negative end) until a normal voltage (less than 0.1V) is found. The first module that indicates a fault (voltage greater than 0.1V) is either sensing an over- or under-voltage, or there is a bad connection to that module.

The most likely place for a bad connection is a wire not making contact within a connector.

(This is much less likely with our current connectors.)

Figure 3

BMS-II-DC Wiring Diagram

