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

Overview:

The BMS-X battery management system is designed for use with lithium iron phosphate ($LiFePO_4$) 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. Each Cell Module also has a green LED that indicates max/over-voltage detection and a yellow LED indicating min/under-voltage.

Contents:

Quantity	description
Ordered +1	Cell Modules
1	Relay Control PCB
1	Solid State Relay
1	Buzzer
1	End of Line Jumper
2	2 conductor connector w/ 24awg pigtail
1	3 conductor connector w/ 24awg pigtail
1	2 conductor connector w/ 22awg 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.)

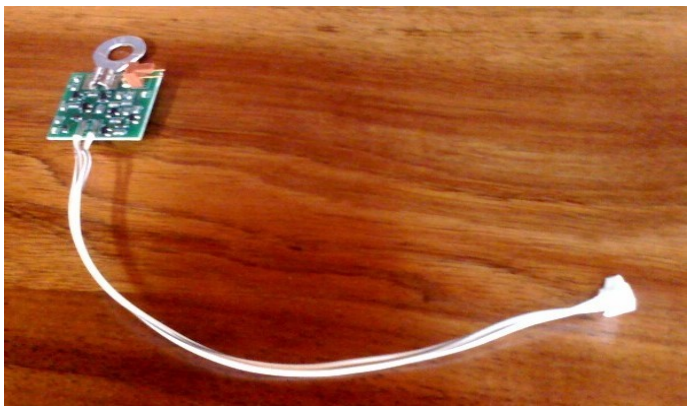


Figure 1: Cell module

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 barb that faces up (away from printed circuit board) to engage a friction lock on the input header (red connector with pins).

The first module in the string (on the most negative cell) requires a jumper connector (provided with kit) plugged into it's input header.

NOTE: Before disconnecting any cell-to-cell jumpers, first disconnect the Cell Modules mounted to the cells.

Relay control PCB connections:

See Figure 2 for a photo of the Relay Control PCB.
See Figure 3 for BMS wiring diagram

There are four connectors on this PCB. **All connectors except J1 require 24 AWG wire; J1 uses 22 AWG.**

J1 in the upper left corner (all positions are as viewed in Figure 2) is a 120V AC input. This input ensures that the charger control function is only active when 120V AC is connected. This input draws less than 50 mA (0.05 A). **This connector requires 22 AWG wire.**

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 (+).

Figure 2

J2 in the lower left corner is the input from the top cell and Cell Module of the BMS. The bottom pin connects to the Negative (-) terminal of the cell, the top pin to the Positive (+) terminal and the center 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). It's connections are also shown in Figure 3. This is an optically isolated output, so the DC voltage can be referenced to any cell in the string. The maximum alarm current should not exceed 500mA (0.5A) and maximum off-state voltage must be less than 60V.
A switch may be added in series with the alarm if desired.

If banks of cells are separated by any distance, a longer connecting wire pair will need to be made up. In this case, it is best to use a twisted pair to reduce electrical noise pickup. Measure out 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.

(Continued on next page)

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 120V AC is supplied to the Relay Control PCB.

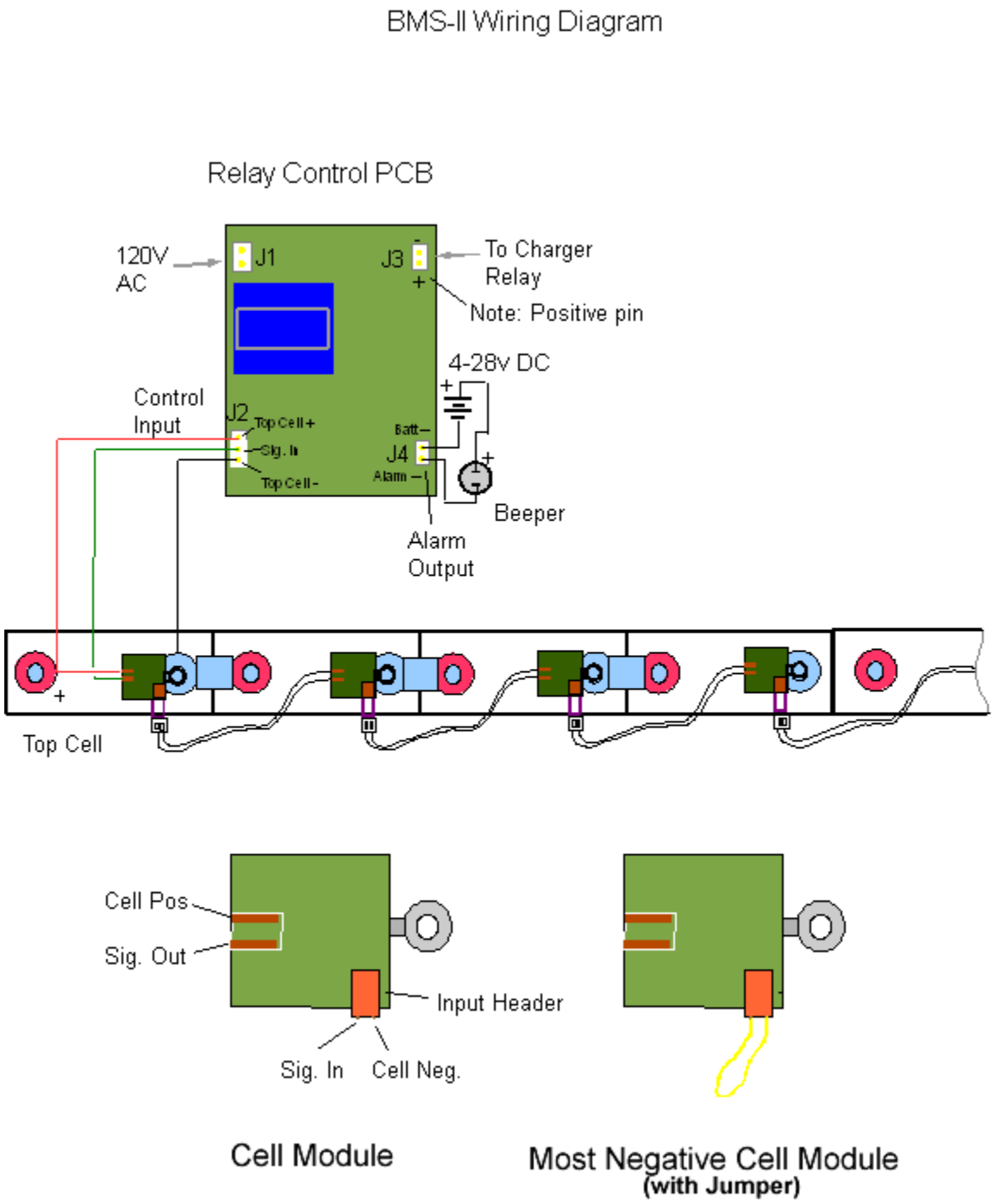
To determine which Cell Module is generating a fault signal (over- or under-voltage), check the voltage on the Sig. Out connection (see Figure 3) as follows: for any Cell Module, put the negative lead of a voltmeter on the negative cell terminal on which the module is mounted and the positive lead on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

Figure 3


BMS-II Wiring Diagram
Relay Control PCB
120V
AC
J1
J3
To Charger
Relay
Note: Positive pin
4-28v DC
Control
Input
J2
Top Cell +
Sig. In
Top Cell -
Batt –
J4
Alarm –
Beeper
Alarm
Output
+
Top Cell
Cell Pos
Sig. Out
Input Header
Sig. In
Cell Neg.
Cell Module
Most Negative Cell Module
(with Jumper)