



# Energy Management System Step-by-Step Setup Guide

February, 2016

2/16/2016

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## 1. Components of the System



### CPU:

- Central hub of the system
- Powered by 12 volts DC
- Controls alarm output signals
- Measures current
- Calculates state of charge
- Outputs video signal
- Detects ground fault conditions
- CAN bus interface (optional)
- QTY: 1 per system



### Four cell sense board string:

- Measures voltage and temperature of each cell
- Performs cell balancing
- Simple easy installation
- QTY: 1 per four cell pack
- Note: Appearance may be different depending on revision.

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## 2. Components of the System



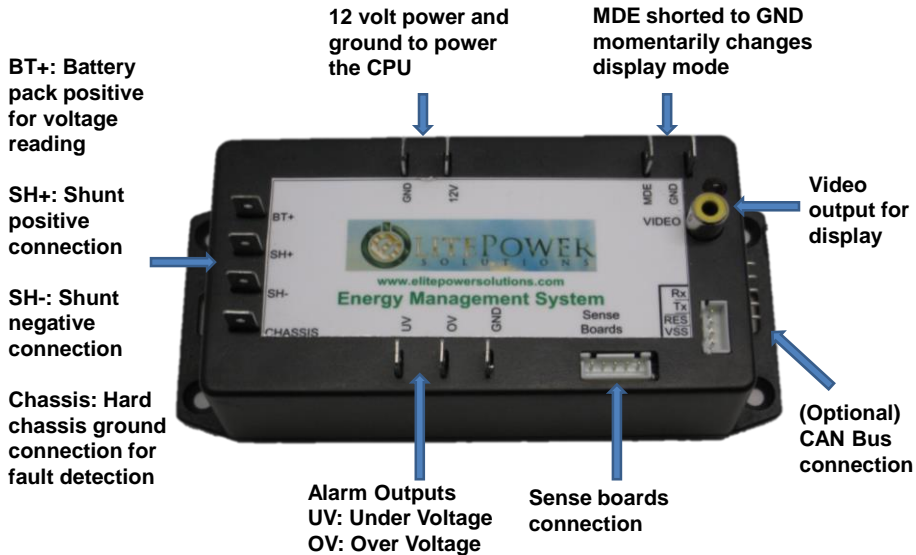
**Shunt:**

- Measures current
- 50mv = 500A
- Must be installed on negative side of battery pack
- QTY: 1 per system

**Harness:**

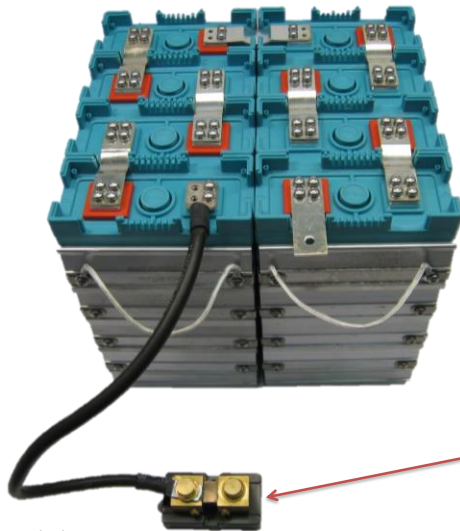
- Connects CPU to sense boards
- QTY: 1 per system

## 3. CPU Overview





## 4. Battery Connections



The next step is to setup the batteries electrical connections. This example shows a 24V 100Ah battery pack.

Install all electrical hardware. Note that this can be either done with supplied jumpers or cable. This example shows all possibilities.

The inner four screws will be removed to install sense boards, so they can be left off during this step as shown.

The shunt must be installed on the negative side of the battery pack.

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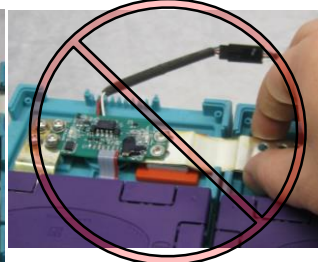
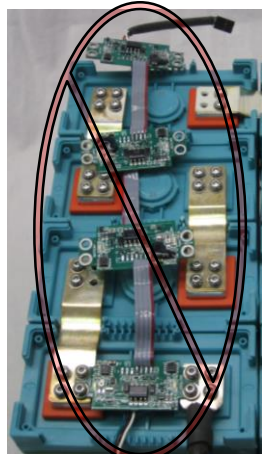
7

## 5. Sense Board Installation

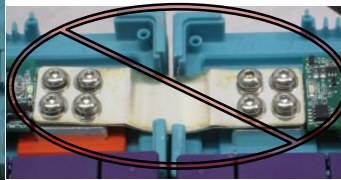


Use Caution when installing sense boards in order to avoid damage

Do not lay sense boards across battery terminals



Do not slide jumpers underneath sense boards.



Do not install jumpers on top of sense boards.

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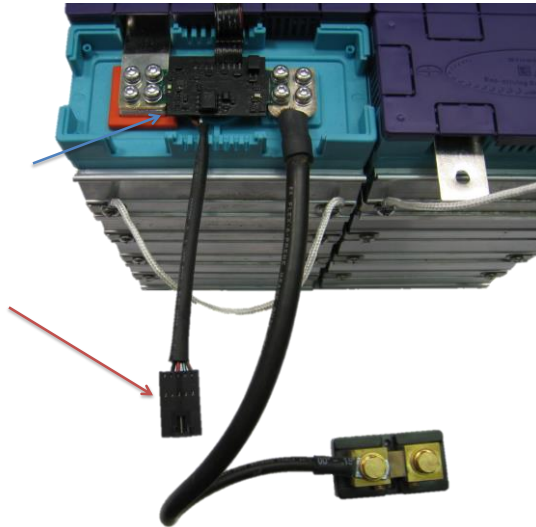


## 6. Sense Board Installation

Before installing plan the route of the sense boards. Although not required, for a typical installation it is recommended that the negative most cell is cell #1, which is the first sense board connected to the CPU.

The male plug on the sense board strings is the input.

The negative most cell must have the shunt connected to it. The shunt cannot be installed on the positive connection of the battery pack.



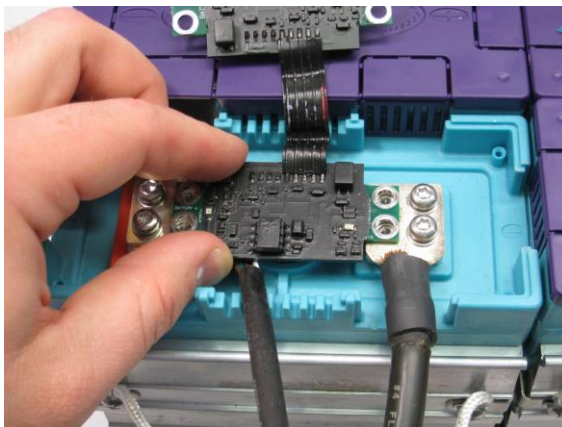
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## 7. Sense Board Installation



Work with all covers installed to avoid any accidental electrical shorts.

Sense board strings have a defined input and output connectors. Male is the input, female is the output. Ensure that the string is oriented correctly before installation.

Remove the inner four screws and install the first sense board by placing it straight down on the terminals inner four screw holes and install the screws.

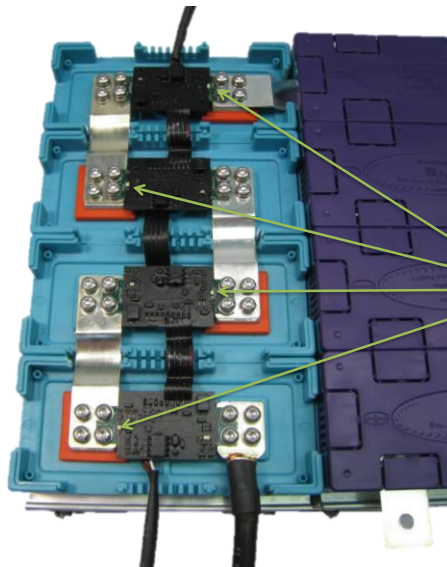
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## 8. Sense Board Installation



Remove the cover for the next cell and repeat the installation process for all four cells. Always work with covers installed.

Green LED's on each board indicates board is connected properly and is receiving power from the battery cell.

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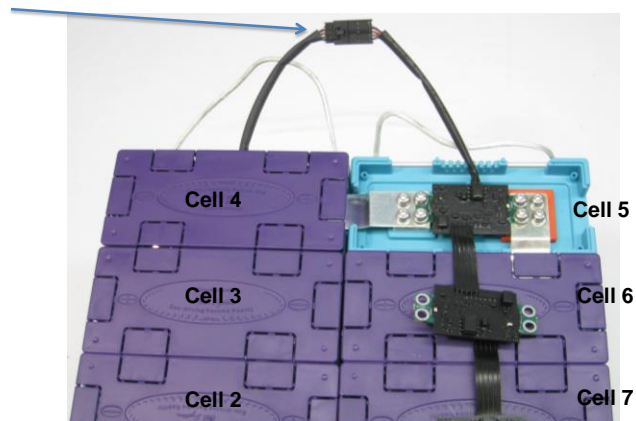


## 9. Sense Board Installation

Ensure ends mate before installing Sense Boards.

Cover the first Sense Board string and continue to the second and install the same as the first.

Up to 100 cells can be connected on one daisy chain of sense boards.



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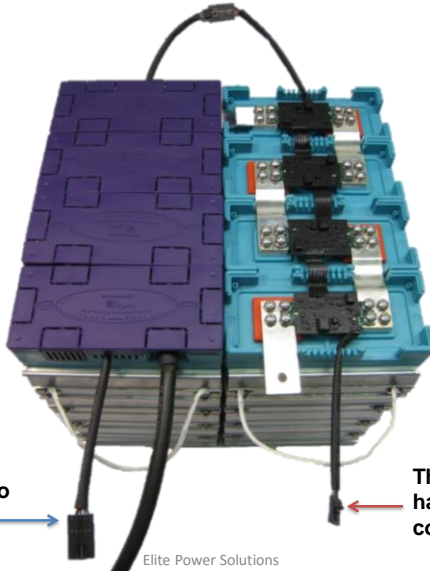
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## 10. Sense Board Installation

Completed Sense Board Installation.



This end connects to the CPU.

The last connector will have nothing connected to it.

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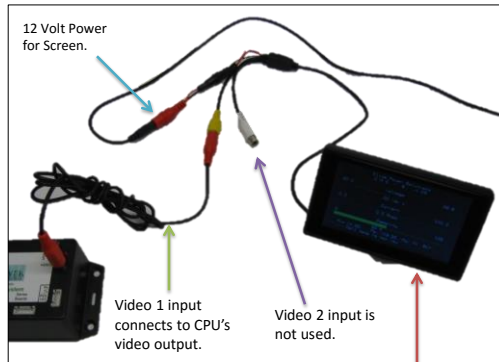
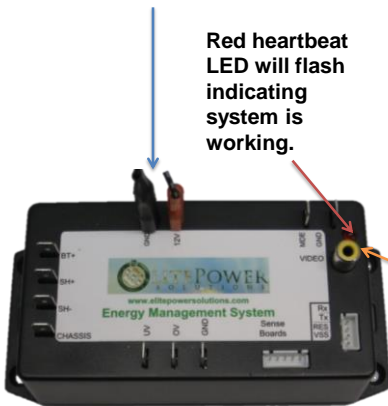
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## 11. CPU Connections – Power and Video

Connect a 12 volt power source to the 12V and GND pins. Do not tap four cells in a battery pack as this will cause an imbalance.

Red heartbeat LED will flash indicating system is working.



Connect the video output to a screen.

Screen will turn on.

Always use insulated ¼" female spade connectors to make connections to the CPU. Uninsulated connectors can result in short circuits not covered under warranty.

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## 12. Mode Button



Install a normally open momentary switch (not included) between the MDE and GND pins on the CPU. This will be used to change the page that the screen displays.

In this example the switch is located directly on the CPU. It will be convenient to have this switch located near the display for easy viewing of all system parameters.

If the CPU is installed on a system where the 12 volt power is grounded then only one wire needs to be ran to the MDE pin and the other side of the switch can be grounded to complete the circuit.

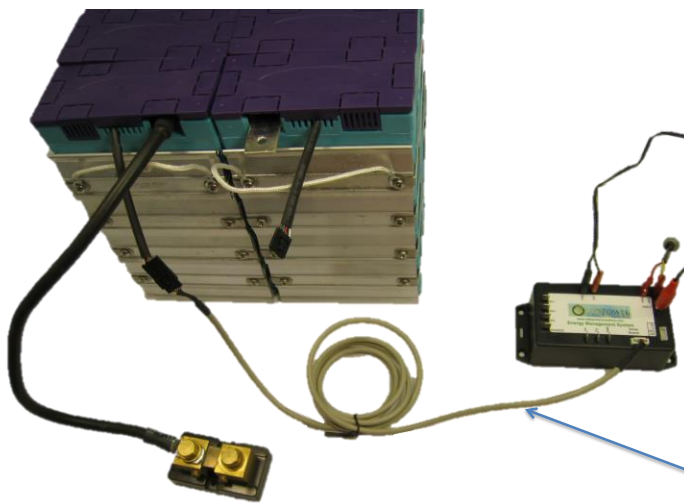
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## 13. CPU Connection



Connect the sense board string to the CPU with the provided harness.

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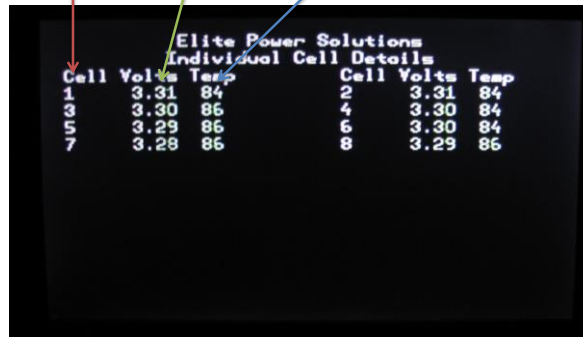
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## 14. Individual Cell Screen

Press the Mode button and release. The screen should change to the individual cell detail page. This page shows the voltage and temperature of each individual cell. Confirm that all cells are shown. Up to 20 cells will be shown on each screen, if more than 20 cells are connected press the button again to toggle to additional screen(s). Once the last screen is reached pressing the button again will return it to the main screen.

Cell Number    Cell Voltage    Cell Temperature



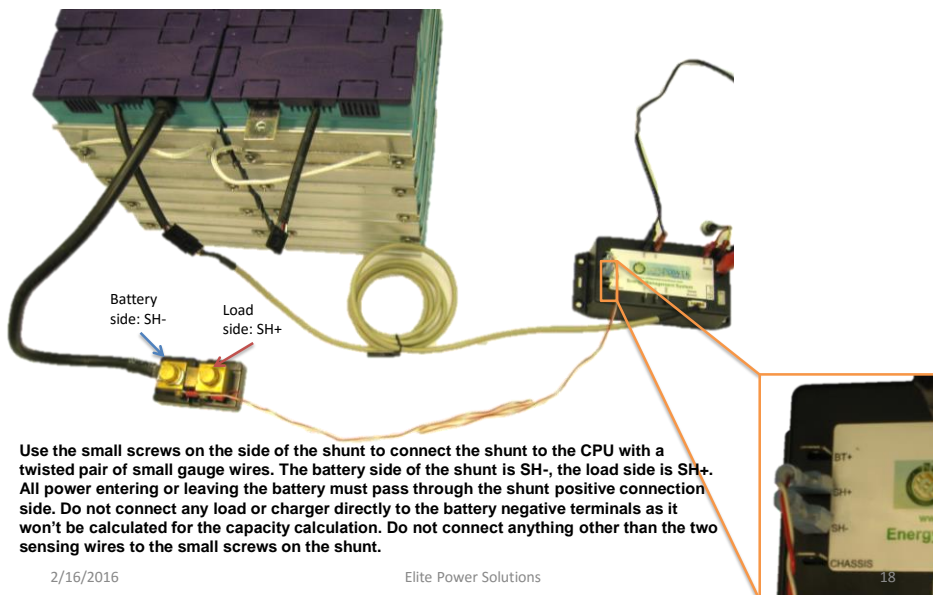
| Cell No | Cell Volts | Temp | Cell No | Cell Volts | Temp |
|---------|------------|------|---------|------------|------|
| 1       | 3.31       | 84   | 2       | 3.31       | 84   |
| 3       | 3.30       | 86   | 4       | 3.30       | 84   |
| 5       | 3.29       | 86   | 6       | 3.30       | 84   |
| 7       | 3.28       | 86   | 8       | 3.29       | 86   |

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## 15. Shunt Connection



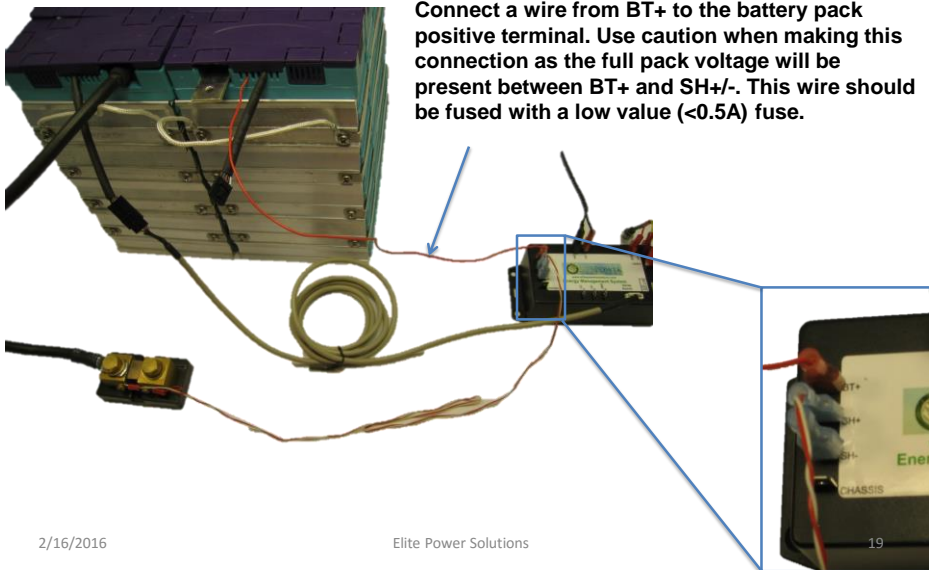
Use the small screws on the side of the shunt to connect the shunt to the CPU with a twisted pair of small gauge wires. The battery side of the shunt is SH-, the load side is SH+. All power entering or leaving the battery must pass through the shunt positive connection side. Do not connect any load or charger directly to the battery negative terminals as it won't be calculated for the capacity calculation. Do not connect anything other than the two sensing wires to the small screws on the shunt.

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## 16. BT+ Connection



## 17. Chassis Connection



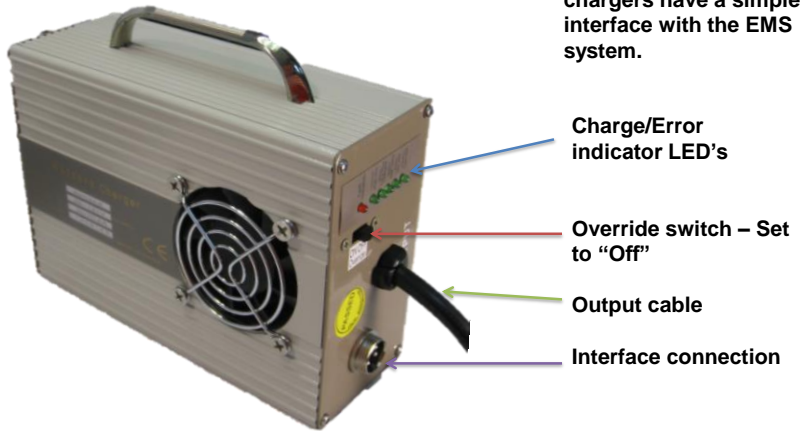
The Chassis pin is used for the ground fault detection circuit integrated in to the EMS CPU. For vehicles with high voltage electrical systems this feature will be useful. To implement it connect this pin to a dedicated chassis ground wire separate from the GND pins.

Note that this pin will induce a very small, non dangerous, current to the chassis. When performing any work to the battery system this pin should temporarily be removed.



For low voltage applications this feature may not be beneficial, or the application may have the battery grounded, in which case if the chassis pin is implemented it will always show an alarm message on the screen. Simply do not connect anything to this pin to disable this feature.

## 18. Charger Connection



PFC and EMC series chargers have a simple interface with the EMS system.

Charge/Error indicator LED's

Override switch – Set to “Off”

Output cable

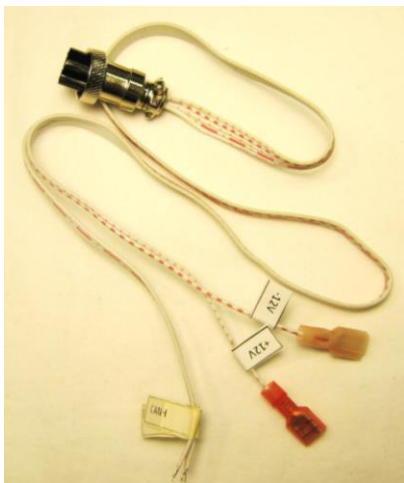
Interface connection

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## 19. Charger Connection



The charger comes supplied with this interface cable. Use the two wires marked “+12V” and “-12V”. These are the wires used for the 12 volt digital control of the EMS CPU. When the CPU signals an overvoltage cell the charger will automatically pause charging to protect the batteries.

The three wires marked “CANH”, “CANL” and “CAN GND” are used to make a CAN communications connection. Refer to the EMC/PFC series charger users manual for more information on making this connection.

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## 20. Charger Connection



Connect the +12V wire to the OV pin on the CPU.  
 Connect the -12V wire to the GND pin on the CPU.  
 Connect the interface cable to the charger.



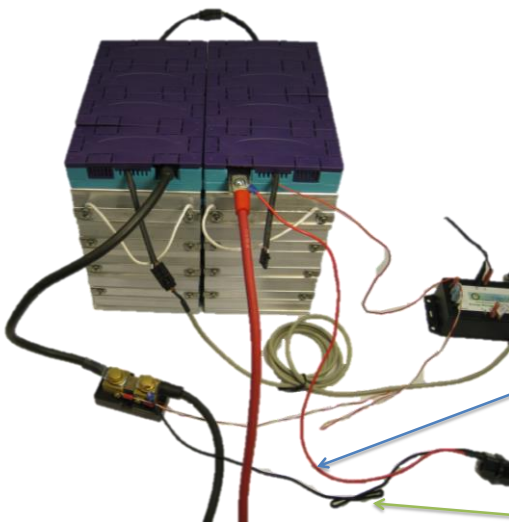
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## 21. Charger Connection



Connect the output of the charger to the battery pack positive and shunt negative.

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Main power cables

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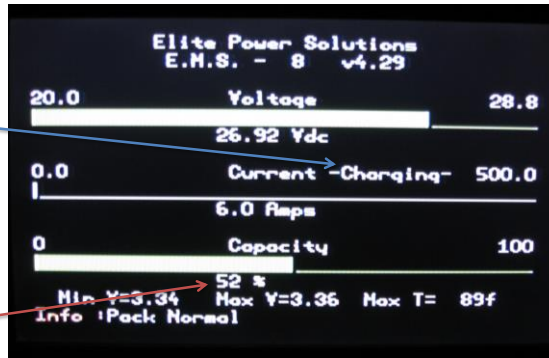
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## 22. Test the Charger



Plug the charger in to a 120VAC outlet and observe the screen. The current bar will turn white and should indicate “-Charging-” and the current is indicated numerically below the bar. If “-Charging-” is not indicated the shunt SH+ and SH- wires are reversed.

Capacity bar will gradually increase.



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## 23. Alarm Outputs



The alarm outputs are an integral part of the EMS system to provide automatic protection against over discharge and over charge damage to the batteries and are essential to provide safe use of lithium ion batteries.

Failure to properly implement the alarm outputs will void the warranty on your batteries.

The alarm outputs will be 12 volts when all cell voltages are within the normal voltage range. When any cell goes below the low voltage threshold the UV alarm pin will switch to 0 volts. When any cell voltage goes above the high voltage alarm threshold the OV alarm pin will switch to 0 volts.



The alarm outputs can drive up to 2A continuous with a 4A surge for 100ms or less. Do not exceed these limits or damage to the CPU may result.

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## 24. Alarm Outputs

If your system uses an EPS provided charger, and there is no other charging source used, the 12V digital control connection to the charger is all that is required for fully controlled charging. If a non-EPS charger is used it must be controlled by either the OV alarm output or via CAN communications.

The UV, under voltage, alarm must be implemented to protect against over discharge. An example is provided of using a main contactor in the EMS users manual.

These outputs can directly drive relay or contactor coils. It is important that when these outputs are triggered that they are a true zero current cut off. Pay close attention to hidden loads such as controller pre-charge resistors, DC/DC converters, lights etc.. If a battery is allowed to continue discharging after the low voltage alarm is triggered it will cause permanent damage to it.

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## 25. CAN Connection (Optional)



CANH and CANL transmit data packets

The Communications Area Network (CAN) is used to send out the BMS data to other integrated systems. Please see separate documentation for a full spec list of the information available from the unit.

CAN High – CANH, CAN Low –CANL and ground are the primary used connections. 12V supplies power if needed.

Non-CAN units can be upgraded to have this option. Please contact Elite Power Solutions for more information.

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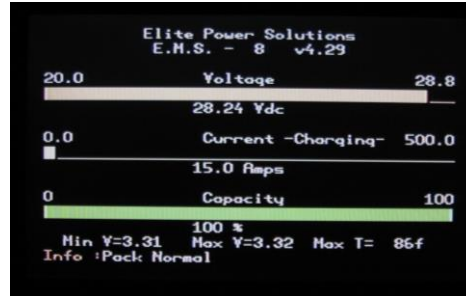


## 26. Using the System

Upon initial power up the system defaults to 50% capacity. The battery pack will need to be fully charged prior to first use and in order to sync the capacity measurement with the actual battery capacity. When the system sees total pack voltage which averages 3.52 volts per cell, and charging current is in a normal charging range, it will default to 100%.

The various bars will change colors when they are nearing their limits. This does not indicate a problem or error condition.

After the initial capacity sync the capacity is calculated by how many amp hours are counted being discharged and charged.



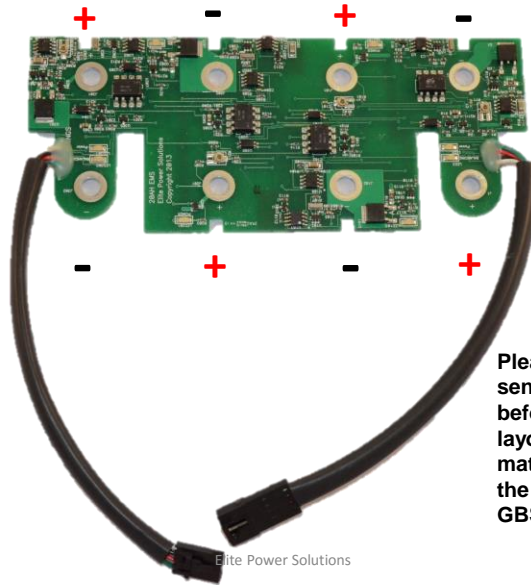
Thank you for purchasing our energy management system.

## 27. 20Ah Sense Board Installation Supplement

### Elite Power Solutions EMS Setup Guide 20Ah Sense Board



## 28. 20Ah Sense Board Layout



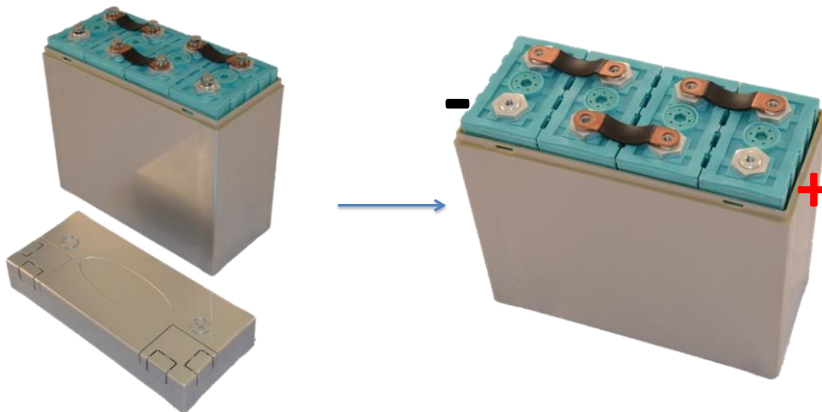
Please note the 20Ah sense board layout before continuing. The layout is intended to match the polarity of the standard 20Ah GBS battery pack only.

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## 29. 20Ah Sense Board Installation



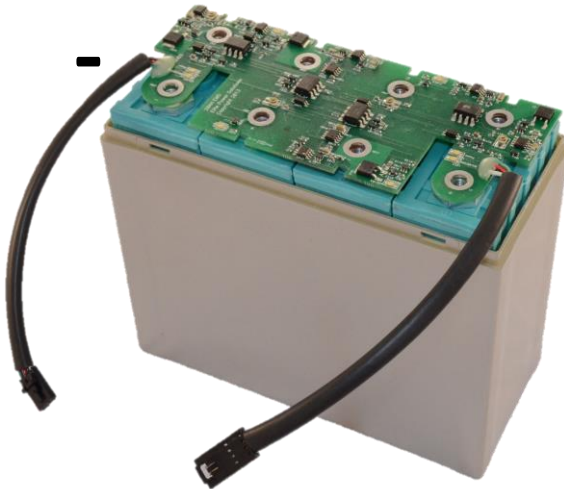
Remove the battery cover by pulling up on it, a flat head screw driver can be used to gently pry open at the seam. Remove all eight bolts leaving the copper jumpers in place. Use caution to not cause a short circuit on the battery during this step.

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## 30. 20Ah Sense Board Installation



Carefully lay the sense board straight down on top of the jumpers and ensure the holes align.

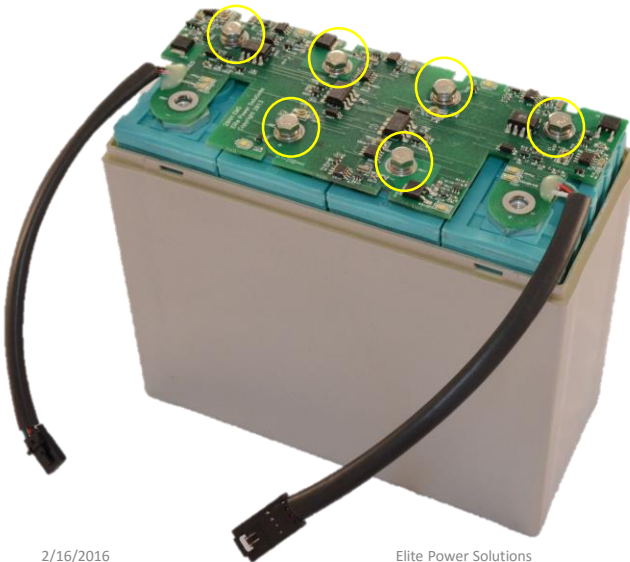
Use caution during this step to not cause a short circuit with the copper jumpers.

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## 31. 20Ah Sense Board Installation



Install these six bolts. Do not install the main positive and negative bolts at this time.

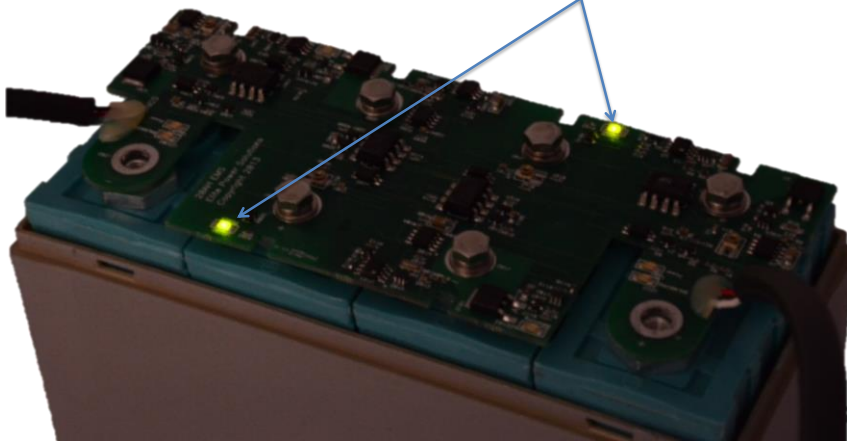
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## 32. 20Ah Sense Board LED Check

Ensure that these two green LED's are lit at this point.



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## 33. 20Ah Battery Cover



Press here to remove terminal covers.

- To install sense boards with covers
- Remove the main terminal covers by pressing out from the bottom side.
  - Feed the data wires through the holes and press the cover in place.



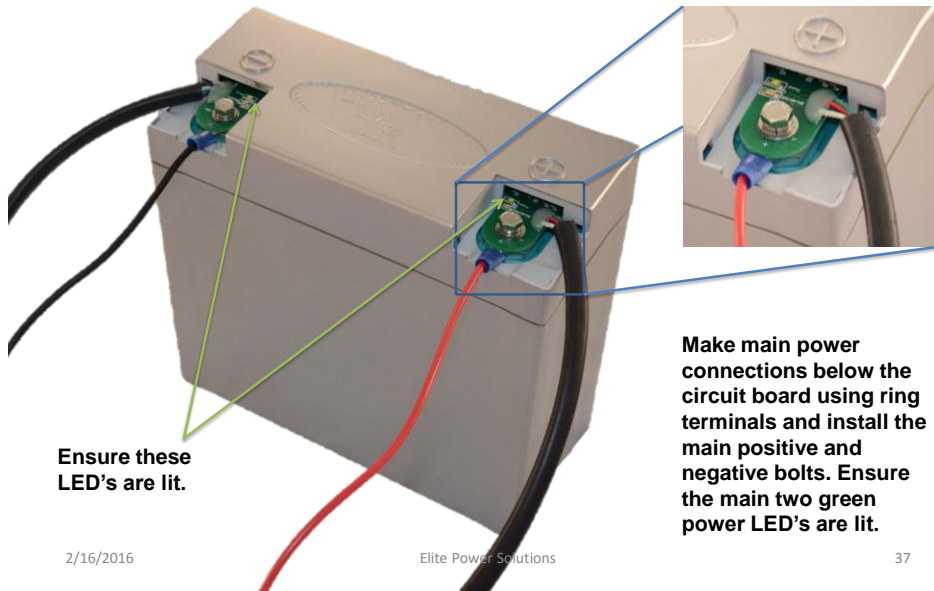
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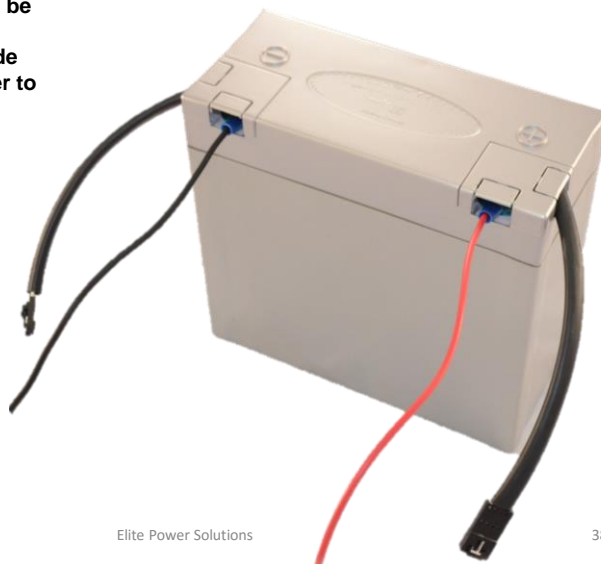
## 34. 20Ah Main Connections



## 35. Terminal Covers



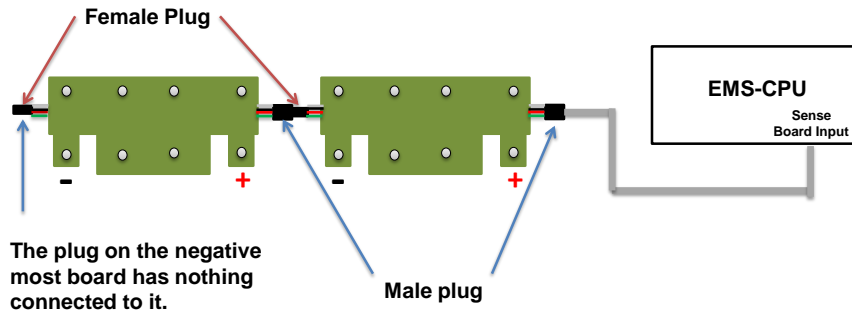
Terminal covers should be re-installed for safety. Knockouts on either side can be removed in order to accommodate data and power wires as shown.



## 36. Data Wire Connection Path



- Daisy chain connections for data wires will be the same as other size sense boards, except 20Ah boards will connect from positive most to negative most.



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## 37. 200Ah Sense Board Installation Supplement



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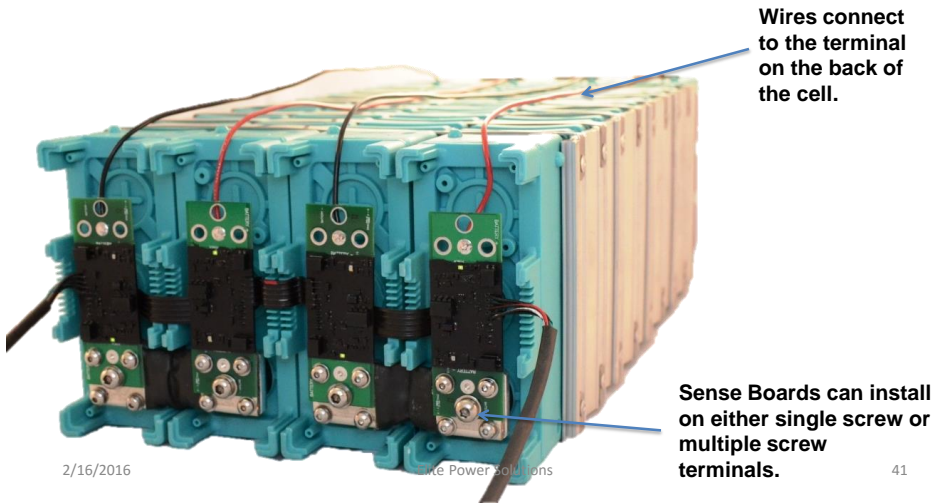
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## 38. 200Ah Sense Board Installation



Use the same precautions as with any other sense board installation. The 200Ah sense boards have a wire to connect to the terminal on the back of the cell.



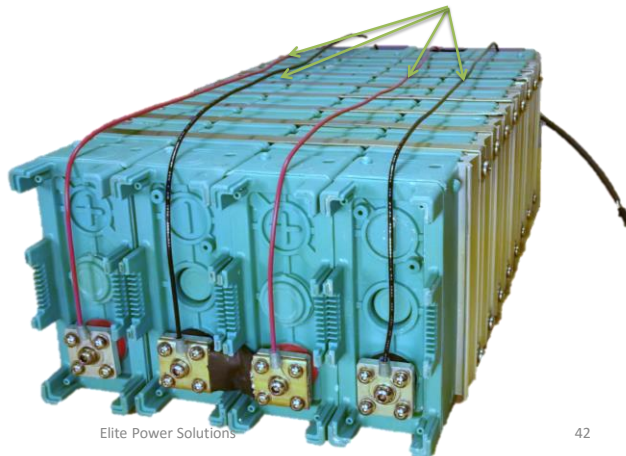
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## 39. 200 Ah Sense Board Installation Rear View



Wires on Sense Boards Connect to the terminal on the back of the cell. Either size screw/bolt may be used

Ensure the wire is connected to the same cell that the sense board is installed on, otherwise damage can occur to the sense board from being exposed to too high of a voltage.



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