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Care and feeding of your Li-Ion BMS

PDF manual

Warning

You MUST provide a way for the BMS to shut down the charger, and the motor driver, DIRECTLY!

Otherwise,
1) the battery will not be protected, which is a FIRE danger,
2) the BMS will disable itself, requiring factory reactivation.

A DAMAGED CELL BOARD WILL DRAIN ITS CELL!

If a cell board is installed backwards, even momentarily, discard it.

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Install cell boards

Install cell boards onto the cells and wire them

Warning

Li-Ion CELLS CAN CAUSE SERIOUS DAMAGE IF SHORT CIRCUITED!

DANGEROUS VOLTAGES: SHOCK DANGER!

You MUST disconnect the battery from EVERYTHING else before installing a cell board.

Use a safety disconnect to open the battery circuit.

A DAMAGED CELL BOARD WILL DRAIN ITS CELL!

If a cell board is installed backwards, even momentarily, discard it.

Plan

Divide the battery into banks

Divide the battery into banks of contiguous cells (mechanically and electrically contiguous). Each bank of N cells will:

- Need N-2 mid cell boards
- Need a negative end cell board
- Need a positive end cell board
- Use 1/2 of a breakout
- Use 1/2 of an RJ 45 cable

Install cell boards

For each bank:

1. Prepare a Cell Board for each cell in series in that bank
   - Prepare 1 Positive End Cell Board for the most positive cell in the bank
   - Prepare 1 Negative End Cell Board for the most negative cell in the bank
   - Prepare mid-bank end Cell Boards for the the rest of the cell in the bank
2. Orient the Cell Board properly **DO NOT CONNECT BACKWARDS!**
   - The ring terminal that is mounted directly to the Cell Board (labeled 'B-' on the PCB) goes to the negative terminal
   - The ring terminal that is mounted on a red wire (labeled 'B+' on the PCB) goes to the positive terminal
   - The electronic components go towards the cell, the LED towards you
3. Place a Cell Board on the negative terminal of its cell
   - Remove the bolt from the cell's negative terminal, keeping the power connection in place
   - Place the 'B-' ring terminal (mounted directly to the Cell Board) on top of the power connection on the negative terminal
   - Put the bolt back in and secure it
4. Connect the Cell Board to the positive terminal
   - Touch that terminal with the 'B+' ring terminal (mounted on the red wire)
   - The LED will blink twice, repeated a total of 3 times
   - **If the LED doesn't blink when first connected, the board is damaged: discard it**
   - Remove the bolt from a cell's positive terminal, keeping the power connection in place
   - Place the 'B+' ring terminal (mounted on the red wire) on top of the power connection on the positive terminal
   - Put the bolt back in and secure it
5. Repeat with the other cells in the bank

Install wires

For each pair of adjacent cell boards:

1. Point the gray wire towards the negative terminal of the cell
2. Route the orange wire along the power bus bar between cells, and then to the gray wire in the adjacent Cell Board
3. If the orange wire is too long, cut it shorter, so that it ends at the splice on the gray wire
4. Strip the end of the orange wire 0.4" (1 cm)
5. Insert the orange wire in an open slot in the splice at the end of the gray wire, push all the way in
6. If required, secure the orange wire in place (use wire ties; do not twist it around the red wire or the bus bar)

Cut and strip orange wire (left) and insert in splice (right).

Connect banks

For each pair of physically adjacent banks:

1. Install a bank breakout close to those banks.
2. Route the green cables to one bank and the yellow wires to the other bank.
3. For each bank, connect the connector with the wide release tab to the negative end cell board, and the connector with the narrow release tab to the positive end cell board.
4. Use a shielded modular RJ45 connector to connect the breakout to the BMS master.

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Master installation

Mounting the BMS master, connecting it to the battery and to the rest of the EV

Warning

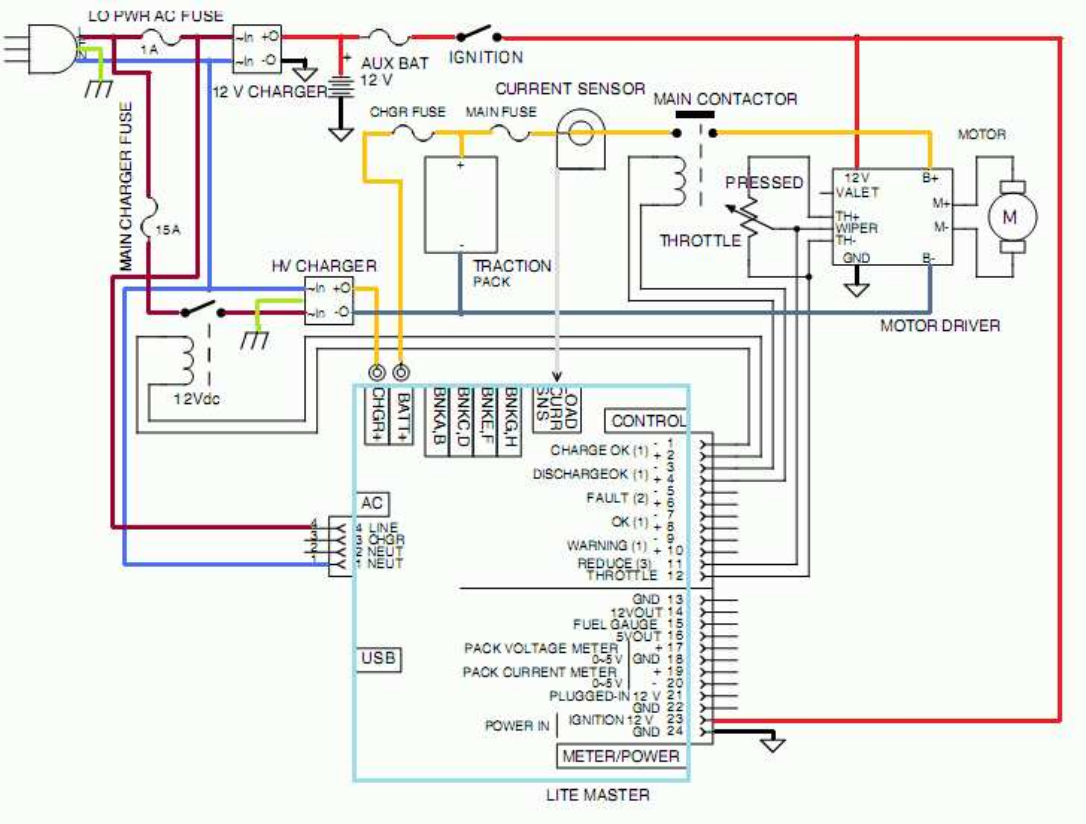
You MUST provide a way for the BMS to shut down the charger, and the motor driver, DIRECTLY!

Otherwise,
1) the battery will not be protected, which is a FIRE danger,
2) the BMS will disable itself, requiring factory reactivation.

The BMS must be powered whenever there is any current in or out of the pack.

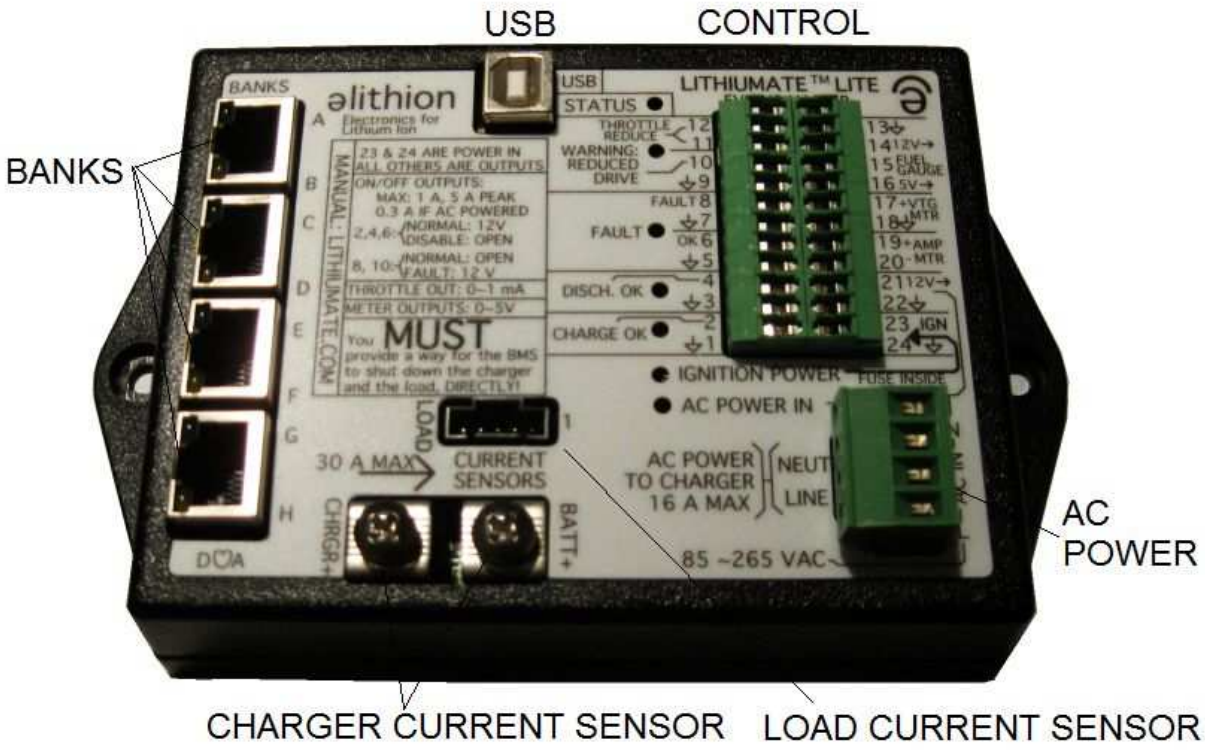
Otherwise the battery will not be protected.

Wiring diagram



Basic EV schematic with a Lithiumate Lite BMS.
For simplicity, the connections to the cell boards are not shown.

Connectors



Connectors on Lithiumate Lite BMS master

Input power connection

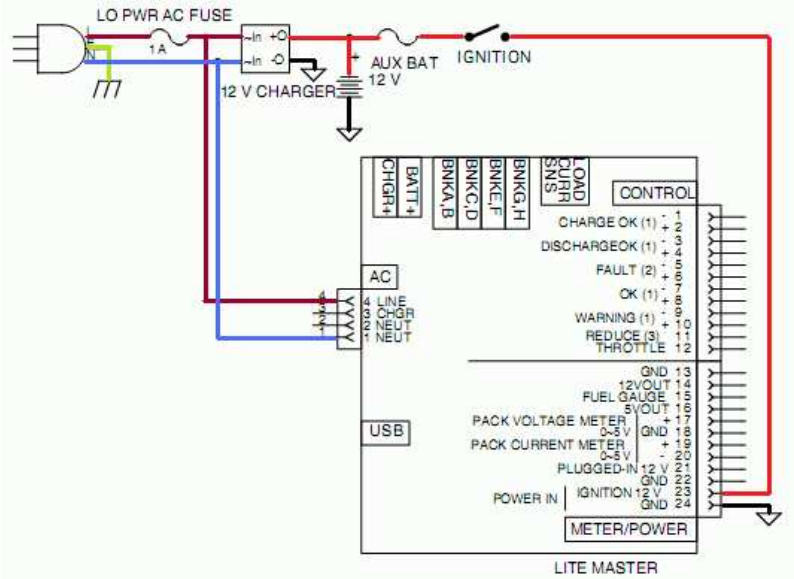
Note: use a 12 V auxiliary battery and a 12 Charger. Don't use a DC-DC converter to provide the 12 V.

Connect the AC power to the BMS master:

1. Earth (green / yellow):
   - Run a line from the Earth contact of the AC inlet to the chassis
2. Neutral (blue or white):
   - Run a line from the the Neutral contact of the AC inlet to the AC inputs of the BMS controller and the 12 V charger
3. Hot (brown or black):
   - Run a line from the the Hot (Line) contact of the AC inlet, to a 1 A fuse rated 250 Vac
   - Run a line from the other end of the fuse to the AC inputs of the BMS controller and the 12 V charger

Connect the ignition power to the BMS master:

1. +12 V (red):
   - Find a +12 V line that is fused, and switched by the ignition switch
   - Wire it to the BMS master, control connector, pin 23 ("IGN")
2. ground (black):
   - Find a ground line (a.k.a: "12 V common", or "12 V return", or" 12 V negative")
   - Wire it to the BMS master, control connector, pin 24 ("GND" symbol)



Lithiumate Lite master input power connections

Charger connections

Connect the AC power to the High Voltage charger AC input:

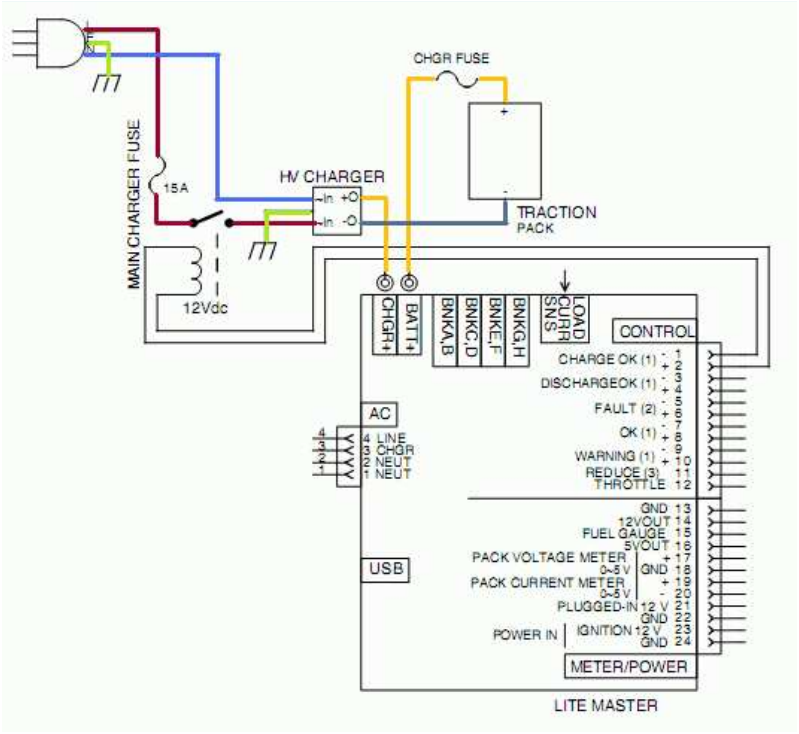
1. Earth (green / yellow):
   - Run a line from the Earth contact of the AC inlet and the chassis to the Earth connection of the High Voltage charger
2. Neutral (blue or white):
   - Run a line from the the Neutral contact of the AC inlet to the AC inputs of the High Voltage charger
3. Hot (brown or black):
   - Run a line from the the Hot (Line) contact of the AC inlet, to a fuse rated 250 Vac, 15 A or higher, as appropriate for the AC source
   - Run a line from the other end of the fuse to a contact of a relay such as this one, rated for the load
   - Run a line from the other contact of the relay to the AC input of the High Voltage charger

Connect the High Voltage charger DC output to the battery:

1. B+ (orange or red):
   - Wire the battery '+' terminal, through a DC rated fuse, to the "Battery+" screw on the master (use a ring terminal)
   - Wire the charger's '+' output, to the "Charger+" screw on the master (use a ring terminal)
2. B- (orange or black):
   - Wire the battery '-' terminal to the the charger's '-' output

Connect the charger relay coil:

1. Wire the coil terminals of the charger relay to the "Charge OK" terminals of the master (pins 1 and 2)



Lithiumate Lite master charger connections

Motor driver connections

Connect the battery to the motor driver:

1. B+ (orange or red):
   - Wire the battery '+' terminal, through the DC-rated. Main Fuse, and through the load current sensor, to the '+' contact of the Main Contactor
   - Wire the '-' contact of the Main Contactor to the "B+" input of the Motor Driver
2. B- (orange or black):
   - Wire the battery '-' terminal to the "B-" input of the Motor Driver

Connect the Main Contactor coil:

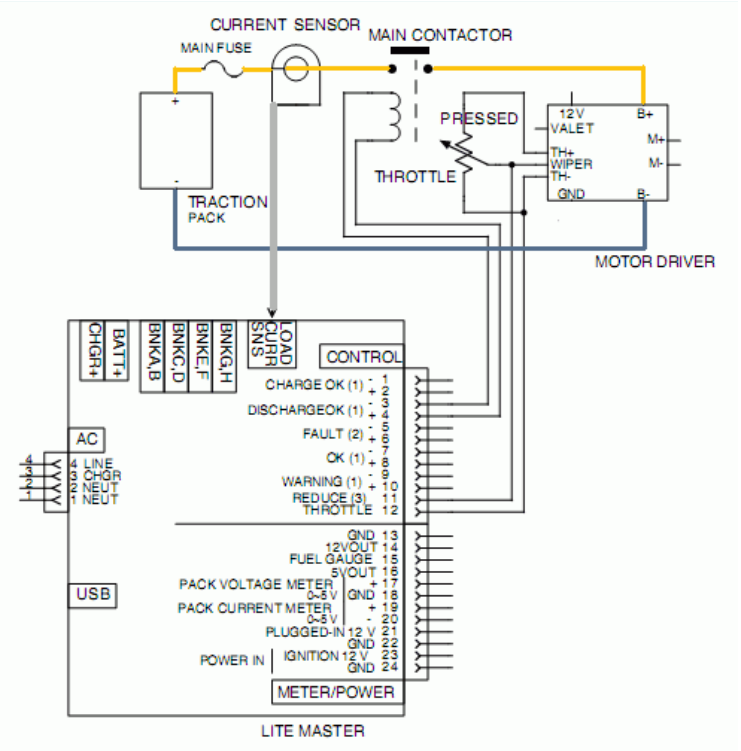
1. Wire the coil terminals of the Main Contactor to the "Discharge OK" terminals of the master (pins 3 and 4)

Connect the throttle reduce:

1. Wire the "Wiper" and "-" terminals of the throttle pot to the "Throttle Reduce" terminals of the master (pins 11 and 12)

Connect the load current sensor:

1. Plug in the load current sensor (black connector) into the master



Lithiumate Lite master motor driver connections

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▼ Warning ▼ Application ▼ Check AC power ▼ Check ignition

Hardware test

Test the installation

Warning

Once the BMS is installed, you'll be tempted to take your EV for a spin right away, under a false sense of security because a BMS is present.

Resist the temptation! Test first!

Set-up the Lithiumate Lite application

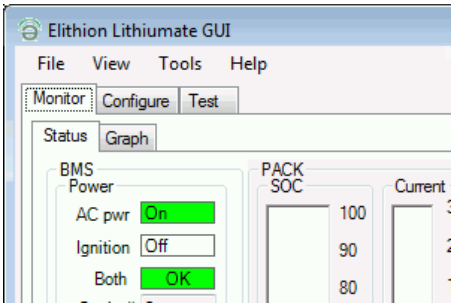
To use the Lithiumate Lite application:

- Install the Lithiumate Lite GUI application on your PC running Windows
- Connect the BMS master to the computer using a USB cable

Check AC power

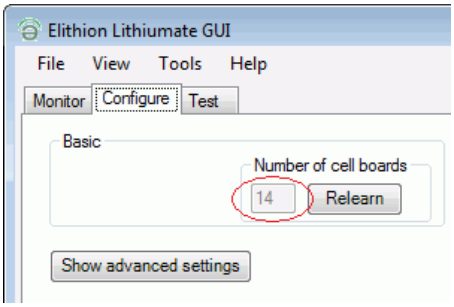
Check that the BMS can be powered by the AC:

1. Plug in the EV into the AC power
2. Check that the BMS master comes on: the "AC power in" LED comes on
3. Launch the Lithiumate Lite GUI application
4. Go to the "Monitor" tab, and the "Status" tab
5. Check that "AC Power" label is lit (green)
6. Unplug the EV from the AC power



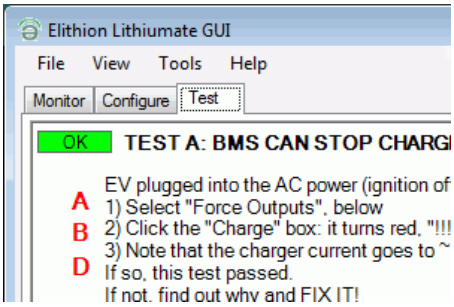
Check that the BMS sees all the cells:

1. In the Lithiumate Lite GUI application, go to the "Configure" tab
2. Check that the BMS sees all the cells



Check that the BMS controls the charger:

1. In the Lithiumate Lite GUI application, go to the "Test" tab
2. Follow the instructions for test "A": test that the BMS controls the charger

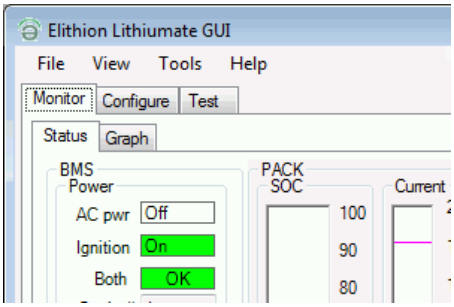


Unplug the EV from the AC power

Check ignition

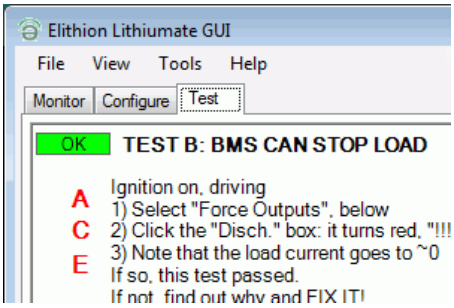
Check that the BMS can be powered by the ignition:

1. Turn on the ignition
2. Check that the BMS master comes on: the "Ignition" LED comes on
3. Launch the Lithiumate Lite GUI application
4. Go to the "Monitor" tab, and the "Status" tab
5. Check that the "Ignition" label is lit (green)



Check that the BMS controls the load:

1. In the Lithiumate Lite GUI application, go to the "Test" tab
2. Follow the instructions for test "B": test that the BMS controls the load



Turn off the ignition

Do a basic configuration

Configure

Configure the BMS

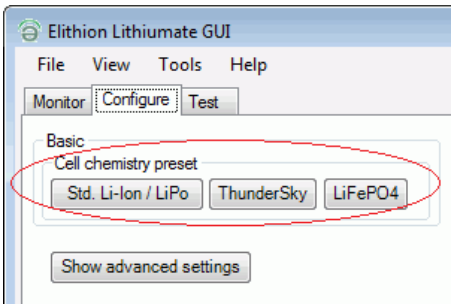
Do a basic configuration

To configure the BMS is 4 easy steps:

1. Click "Update".

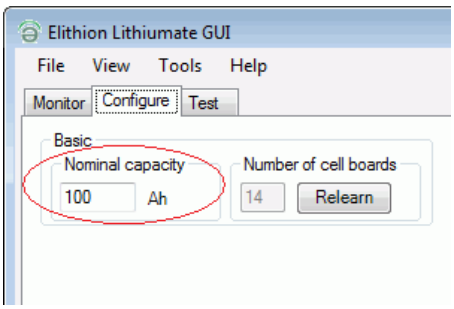
Set the cell chemistry:

1. In the Lithiumate Lite GUI application, go to the "Configure" tab
2. Press the button for the chemistry of the cells



Set the cell capacity:

1. Enter the capacity of the battery



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Test

Test that the BMS is protecting the system

Monitor first charge cycle

Closely monitor the pack during its first charge cycle, to make sure the pack gets fully charged, and it is not overcharged.

Procedure:

1. Connect the BMS master to a PC computer with a USB cable
2. Plug the EV into the AC power, and start charging the pack from the charger
3. Run the Lithiumate Lite application
4. On the Lithiumate Lite application, select the "Status" tab
5. Monitor the range of cell voltages, noting that the max never exceeds the Vcell-max setting
6. Monitor the current, checking its value is correct
7. Note that the charger shuts off and the current goes to 0 when the voltage of the most charged cell reaches the Vcell-max setting

Monitor first discharge cycle during a test drive

Closely monitor the pack during its first discharge cycle, to make sure the pack is not over-discharged.

This test takes 2 people: a driver and someone else with a laptop computer monitoring the BMS.

Procedure:

1. Connect the BMS master to a PC computer with a USB cable
2. Turn on the ignition and start driving
3. Run the Lithiumate Lite application
4. On the Lithiumate Lite application, select the "Status" tab.
5. Check that current is flowing and that the reported value makes sense
6. Note that the SOC drops gradually down from 100 % as the battery is depleted
7. Note that the available torque is reduced whenever a cell is below the Vcell-min setting
8. Note that the current goes off when the minimum cell voltage reaches the Vcell-min setting (and comes back on should that voltage go back up above the Vcell-low setting)

Completion

Congratulations: your BMS has been successfully deployed.

Help

Help with the BMS

Self help:

- Troubleshooting
- Full version of this manual (Right now you are reading the basic manual.)

Find help:

- Forum **NOTE:** to register, send us an email to request it.

Tech Support, repair, contact:

- EVolve Electrics
- Do not contact Elithion: the Lithiumate Lite is completely handled by EVolve Electrics

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