ittyBMS Instruction Manual

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Proper Installation Order

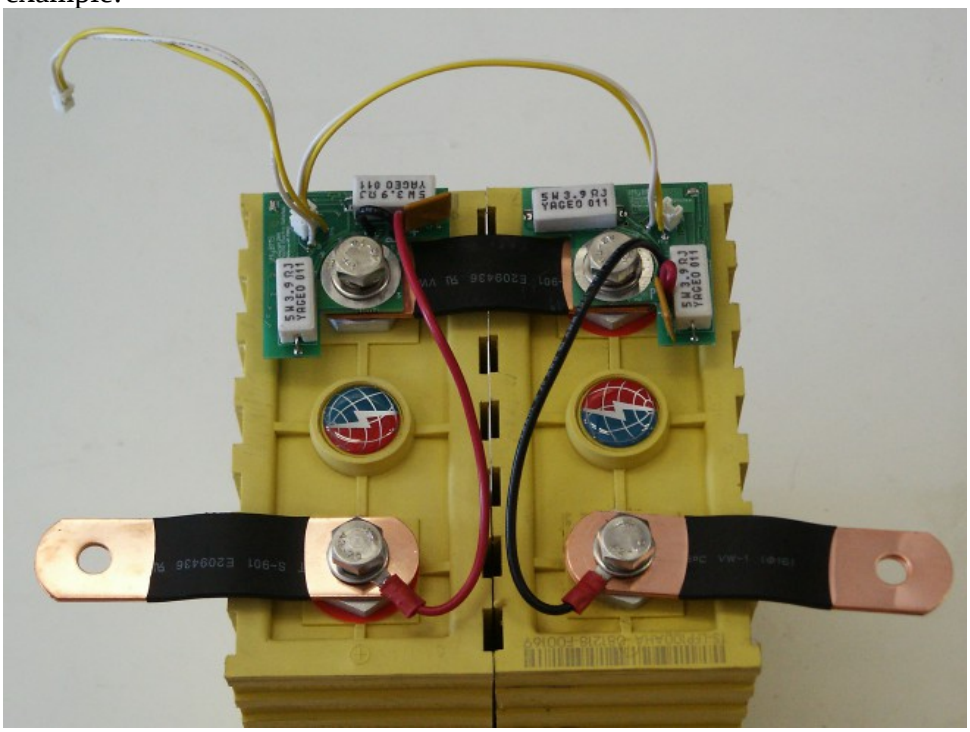
When physically installing the ittyBMS, you must be mindful of the order you install all the connections. If you do not have the battery pack completely disconnected from any type of load, you could damage the last ittyBMS you install. Fortunately, the solution is very easy! When you are installing the ittyBMS power connection, always hold the main power cable to the battery terminal before you allow the ittyBMS to touch it. Another technique is to make the last installed link in the center of the battery pack, so the busbar already sits in place to make the connection.

If, when the last connection is being made, the ittyBMS touches the terminal before the power wire, it will try to power your load *through* the circuitry on the ittyBMS. Ouch!

After all the power connections are made, install the data cables. The cable always plugs into the cell that is at a higher voltage.

Connecting Your ittyBMS to the Rest of Your System

As the other manuals show, each ittyBMS cell module's data cable plugs into the module of higher voltage. For example:



In the above picture, the left cell is at a higher voltage than the right cell. So the cell module on the right plugs into the cell module on the left. There could be 100 cells or no cells in between, but for the purposes of connecting the ittyBMS to other equipment (like our EVCM), the only cells that matter are the most positive and the most negative.

The cell on the left is the Most Positive cell module. It has the white/yellow data cable sticking out. The data cable gets plugged into the positive BMS breakout board (shown below). In addition, the red wire extending from the "Most Positive Post" location must be attached to the most positive battery post, which is the positive terminal of the most positive cell module.

When all the cells are fully charged, the full-charge output will be closed (+ pulled to -). For use with an EVCM, please see the EVCM manual and example wiring diagrams. The FFS signal is broken out to connect to your interface (typically an EVCM).

For the most negative module, another pigtail plug must be plugged in. The white wire must be attached to the negative terminal of the most negative cell module. The yellow wire is the other side of the FFS signal.

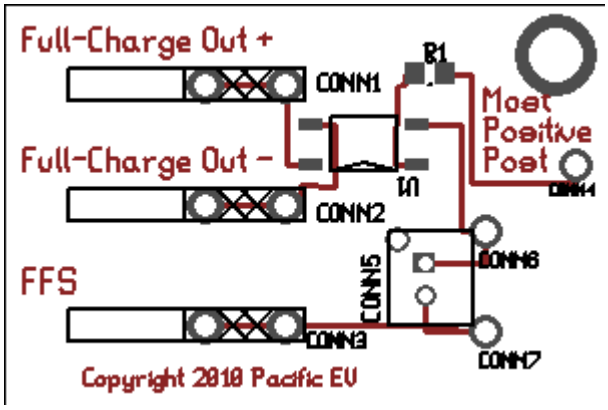


Figure 1: BMS Breakout Board

How Charging Works

A properly-working system will charge each and every cell to 100% SoC, without any overcharging and without charging any longer than necessary. The ittyBMS prevents overcharging by bleeding excessive charge using its bypass resistors and by opening the FFS line if the charge current is too much for it to bypass, which is the signal to the rest of the system to momentarily stop charging so the bypass circuit can catch up. The ittyBMS ensures every cell is full and prevents charging any longer than necessary by indicating when all cells are full using the full-charge signal. The rest of the system reacts by terminating the charger until the cells have been discharged and are ready to charge again.

To tie everything together, here is the description of a typical charge cycle. The charger goes into bulk charge mode. As the fullest cells approach 100%, the bypass circuitry starts passing current past the cell. The charge current typically exceeds the bypass current, so the cell continues filling until its voltage reaches a high (but safe) level. The FFS line opens, the EVCM detects this and shuts off the charger. Once the voltage drops below the cut-off, the FFS closes and the EVCM waits for a short period of time, typically one to four minutes, before turning the charger back on. This cycle repeats until all cells have reached the threshold defined by the Full Charge level. Each ittyBMS module detects an incoming Full Charge signal and determines its own cell has reached full, it passes on the Full Charge signal. The signal “bubbles up” to the most positive cell, where it is sent to the EVCM. At this point, the EVCM shuts off the charger and keeps it off.

Another charge cycle occurs when all the cells are already balanced. This is the typical charge cycle on a vehicle used daily. The charger runs at bulk charge. All batteries reach full at very close to the same time, so they start activating their full-charge signals. This bubbles up to the most positive ittyBMS, which signals the EVCM, which turns off the charger. In this circumstance, the EVCM does not need to cycle the charger because the small amounts of daily imbalance were easily corrected by the bypass circuitry.

Connecting Across a Pack Disconnect

On the ittyBMS system, the FFS line is completely isolated from the control electronics, so it is unaffected by where you decided to place pack disconnects or the order packs are assembled. However, the full-charge line is sensitive to those two circumstances, so you need to follow one of these three options:

1. Always connect the main power connections first, then the ittyBMS power connections, followed by the data cables last. When disconnecting, always disconnect the data cables first, then the ittyBMS power connection, then the main power connections.
2. Use an BMS Breakout Board between the ittyBMS units sitting on each side of a pack disconnect. We can supply this with the appropriate connection, ready to plug in.
3. Do not connect the full-charge signal

Using a BMS Breakout Board to Bridge a Pack Disconnect

Just like the FFS signal, the Full-Charge signal passes through each ittyBMS module. It has different electrical requirements though, which require compensation when passing the signal between two ittyBMS modules with a pack disconnect in between. The BMS Breakout Board meets these requirements. A couple terms are introduced to make using the BMS Breakout Board easier:

- The cell whose positive connection is attached to the pack disconnect is known as the “More Negative Cell”, because it is at a lower voltage compared to the cell on the other side of the pack disconnect. The ittyBMS sitting on this cell will be referred to as the “More Negative ittyBMS”.
- The cell whose negative connection is attached to the pack disconnect is known as the “More Positive Cell”. The ittyBMS sitting on this cell will be referred to as the “More Positive ittyBMS”.
- Without a pack disconnect, the ittyBMS on the More Negative cell would have plugged straight into the More Positive ittyBMS.

The connections to the BMS Breakout Board are as follows:

- The data cable from the More Negative ittyBMS plugs into the BMS Breakout Board.
- The wire labeled “Most Positive Post” instead connects to the positive post of the More Negative Cell. Future versions of this product will have a better label, I apologize for the confusion.
- The connection labeled “FFS” attaches to the yellow wire of a new data cable.
- The connection labeled “Full-Charge Out +” goes to the white wire of a new data cable.
- The new data cable plugs into the More Positive ittyBMS.
- The connection labeled “Full-Charge Out -” goes to the negative terminal of the More Positive Cell.

While all the above is included for completeness, **we will provide a plug-in version** of the BMS Breakout Board so you don't have to make the connections yourself at no extra charge.