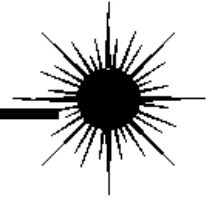




Hot Juice Electric

BEQ1 LiFePO4



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For best results, please read this manual and all applicable supplements completely before installation.

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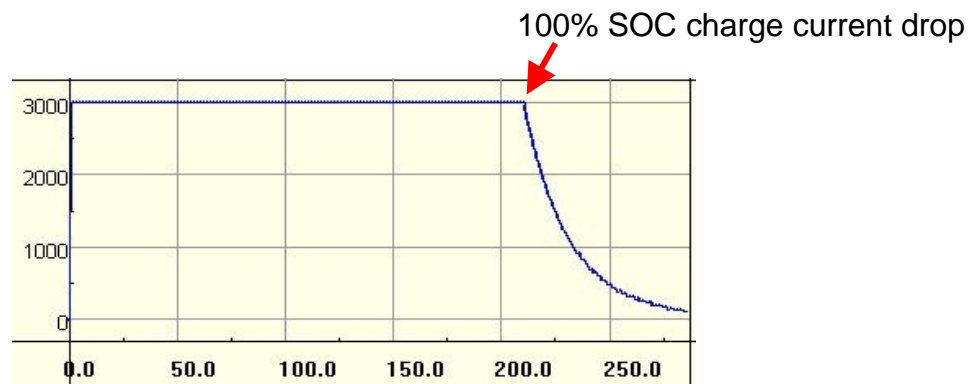
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The **BEQ1 LiFePO4** is a rugged, simple to use, economical shunt regulator that is designed to keep a series string of Lithium Iron Phosphate cells equalized.

How does the BEQ1 work?

A characteristic of Lithium Iron Phosphate cells is their abrupt drop in charging current when they reach 100% State Of Charge (SOC). See graph below. This poses a problem when the cells are charged in a series string with a single charger. Even with a perfectly balanced pack, the cells do not all reach 100% SOC at exactly the same time. The first cell to reach 100% SOC will drop its current (see graph below). Since the cells are wired in series, this will also drop the current through all the other cells. Since the other cells have not reached 100% SOC their impedance will be lower than the 100% SOC cell. This will cause the voltage across the 100% SOC cell to exceed damaging levels in addition to preventing the remaining cells from completing their charge.

A **BEQ1 LiFePO4** is installed across the terminals of each cell. When a cell reaches 100% SOC and its charge current abruptly drops, the BEQ1 turns on to continue the charging current across that cell and onto the remaining cells in the pack. This keeps the voltage across that cell within safe levels as well as completing the charge of the rest of the pack.



BEQ1 Operation

When a cell reaches 100% SOC the BEQ1 will turn on and conduct up to 3 amps of charging current. The yellow **LIMIT** LED on the BEQ1 will illuminate indicating the BEQ1 is on.

The red **OVER TEMP** LED will illuminate if the BEQ1 temperature exceeds 100° C. This can occur if:

- The cell's impedance is too high (bad cell or loose terminal).
- The State of Charge of another cell(s) in the string is too low compared to the rest of the cells in the string.
- Another cell(s) in the string has internal leakage (bad cell).
- Insufficient airflow around the BEQ1.

Once tripped, the **OVER TEMP** circuit reduces the shunt current and is latched on until the voltage drops below the BEQ1's set point. This means the charger should be **immediately** turned down or off until the cause of over heating is determined.

Limitations:

The BEQ1 is a minimal Battery Management System (BMS). It is the original proof of concept test version. While it will keep a balanced pack of healthy cells balanced, it cannot compensate for compromised cells or bring into balance a badly out of balance pack.

Instrumentation is limited to the LED's on the BEQ1 itself. Careful observation should be practiced. You can assume proper operation as long as no red LED's are lit. Charging should be aborted immediately if a red LED is observed.

Additionally, the BEQ1 cannot compensate for an inappropriate charger. The charger should have a constant voltage finish phase that equals 3.65 Volts times the number of cells in the pack.

Installing the BEQ1's

Warning! Ensure the battery pack disconnect is Open! If the pack does not have a safety disconnect, remove and tape a battery terminal in the center of the pack. Always remember, Safety First!

1. Confirm placement of the BEQ1 module on a flat visible surface. The location should be as close to the battery terminals as possible and well ventilated. **Do not mount the BEQ1 at this time.**
2. Install the connection leads on the BEQ1 as shown in **Fig. 1**.
 - Connect the Red lead to the positive (+) terminal.
 - Connect the black lead, with the in-line fuse*, to the negative (-) terminal.
 - Note the order of washers, ring terminal and nut. See **Fig.1**.
 - **CAUTION:** the bottom nut (See **Fig.1**) must never be loosened. Internal damage may result.
 - Ensure that the smooth sides of the washers face the ring terminal.
 - At this point, the nut should be screwed on but not tight. You should be able to easily move the terminal leads around.
3. Clean the mounting area with denatured alcohol or appropriate cleaner that does not leave a residue.
 - Reaffirm the BEQ1 position to ensure the red lead will connect to the positive cell terminal, and the black (fuse) lead will connect to the negative terminal.
4. Peel the protective cover from the adhesive mounting square on the bottom of the BEQ1 and press the BEQ1 onto the mounting surface.
5. Connect the BEQ1 lead ring terminals under the cell terminal bolts.
6. **Refer to Fig 2.** Using a ¼" hex nut driver with a small diameter handle, tighten the BEQ1 terminal nuts.
 - **CAUTION:** It is important to hold the terminal lead while tightening the nut to ensure proper placement of the lead and to avoid excessive torque applied to the terminal stud. (See **Fig. 2**)
 - Do not over tighten the nut. It should be finger tight.
 - Re-check tightness after a few days. The nut should stay tight after the first re-tightening.
7. Repeat steps 1 through 6 for all cells in the pack.

IMPORTANT! Periodic voltage checks at the BEQ1 terminals will confirm connection and the fuse condition for each BEQ1. A blown fuse will result in zero volts across the BEQ1 terminals. A blown fuse indicates the voltage across the BEQ1 has exceeded its maximum rated terminal voltage or the voltage across the BEQ1 has been reversed.

* The in-line fuse is required. Connecting the BEQ1 improperly can blow the fuse. Omitting the fuse can cause permanent damage to the BEQ1. Replacement fuses are available from **Hot Juice Electric**.

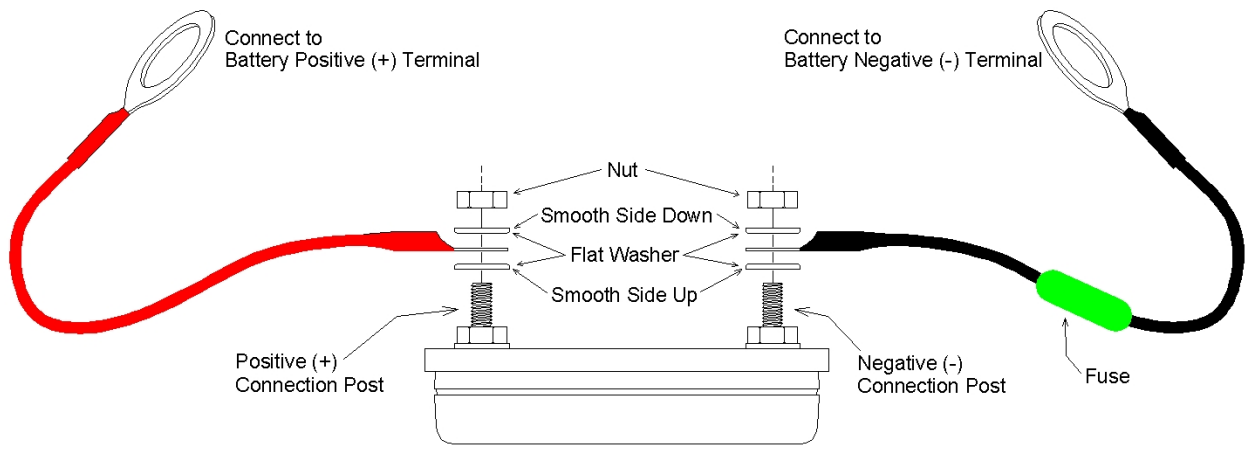


Figure 1



Figure 2

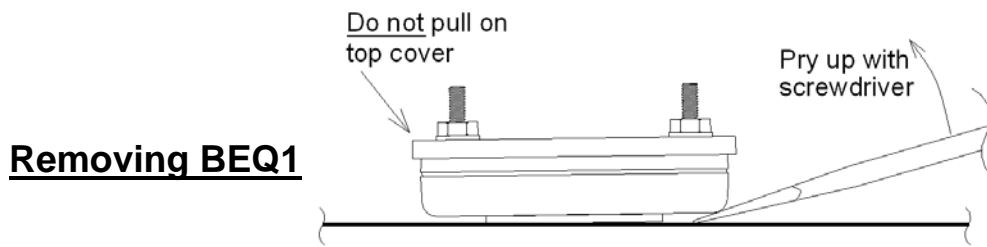


Figure 4

Specifications:

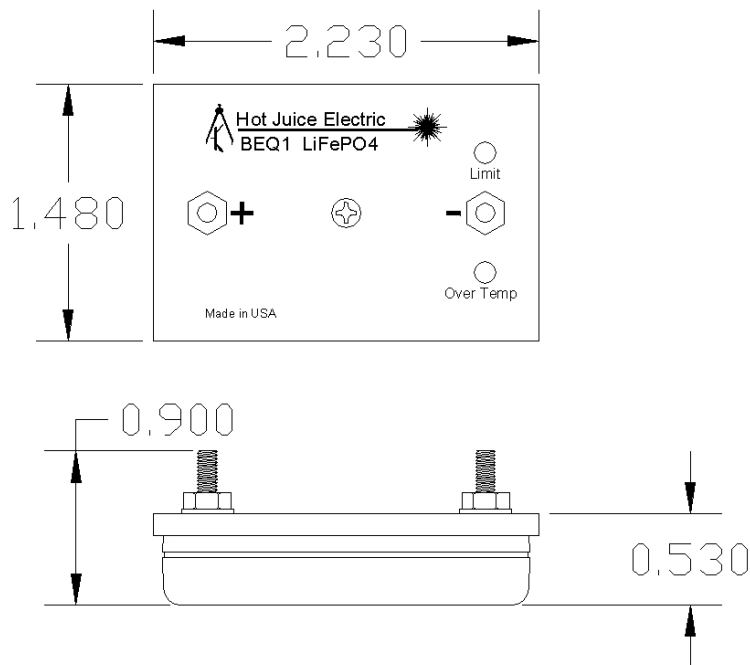
Absolute Maximum Ratings:

Max Terminal Voltage +5 Volts
Max Reverse Terminal Voltage -0.45 Volts
Max Operating Temperature +125° C
Max Dissipation 9.5 Watts continuous
Max Dissipation 23.5 Watts for 2 minutes
Max Current during Over Temp 600mA
Minimum Operating Temperature -40° C

Electrical Characteristics:

Turn ON voltage 3.656 Volts
Turn OFF Voltage 3.648 Volts
Hysteresis 8 mV
Shunt Current 3.5 Amps
Switching Speed 230 μ S
Quiescent Current 300 μ A
Over Temp Limit Trip Temperature +100° C

Dimensions:



Limited Warranty:

Hot Juice Electric, Ilc warrants that this product is free from defects in materials or workmanship for a period of two years from the date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced without charge. This warranty shall not apply if the product is modified, tampered with, misused, or subjected to abnormal working conditions.

The circuits contained in **Hot Juice Electric, Ilc** products are proprietary. Purchase of these products does not transfer any rights or grant any license to the circuits used in these products. Disassembling is explicitly prohibited. There are no user-serviceable parts inside. Removing the cover, tampering with, modifying, or repairing will automatically void the warranty. **Hot Juice Electric, Ilc** is not responsible for any consequential damages.

To obtain warranty, please contact

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