ZERO EMISSION VEHICLES AUSTRALIA

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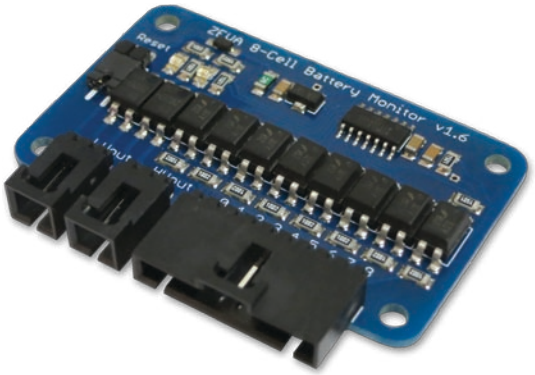


8-cell Battery Monitor Module

Simple, reliable and economical protection for your LiFePO4 battery pack.

Please read these instructions carefully for proper installation and use of this product.

SPECIFICATIONS

- Monitor 2–8 cells per module
- Automatic cell count detection
- Over-voltage threshold: 3.8V
- Under-voltage threshold: 2.5V
- Sampling rate: 10Hz
- Dimensions: 60x37x5mm
- Dual Solid State Relay (SSR) outputs, 500mA max.
- Status LEDs for visual feedback
- Power consumption:
  8.5mA when SSRs on, 3.5mA when SSRs off

PROTECTING YOUR LITHIUM BATTERIES

Lithium batteries have been a revolution in energy storage and a major enabling factor in the resurgence of electric vehicles. However lithium batteries can be damaged if their voltage goes out of safe operating range – either too high (overcharging) or too low (over-discharging).

Battery packs are commonly built from a large number of individual cells in series to achieve higher voltages. Due to manufacturing tolerances, cells always have some variation in capacity, so there will always be some cells in a pack which get full or go flat before others.

In battery packs made up of many cells in series, the overall voltage gives little indication of the voltage of individual cells in the chain. As such it is important to have a system which monitors the voltages of each cell and take action if any individual cell goes out of range.

ZEVA's 8-Cell Battery Monitoring Modules (BMMs) offer a simple and economical way to monitor the voltage of your Lithium Iron Phosphate (LiFePO4) cells, and signal external systems to protect the battery pack if a cell goes out of range. A single module can monitor 2–8 cells, or multiple modules can be cascaded for larger packs.

The BMM is microcontroller based and uses two Solid State Relays (SSRs) output to separately signal over-voltage or under-voltage conditions. There are also red and blue LEDs which provides visual feedback on module status.

Battery management or monitoring systems are the last line of defence for your battery pack. In normal circumstances it should not interfere with the vehicle operation, only intervening when something goes wrong and protection is required.

MODULE VARIANTS

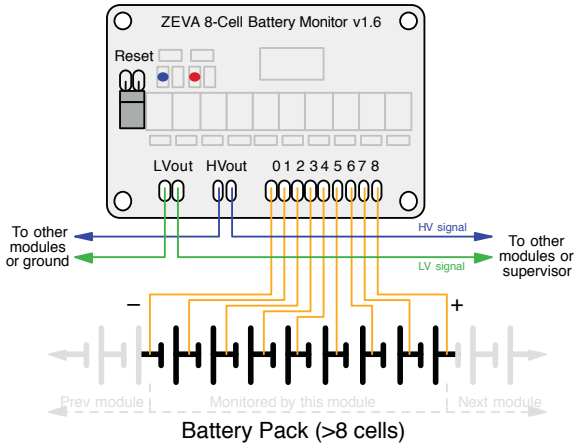
The modules are available in three different variants, for different applications as follows:

- **Momentary outputs:** In packs with more than 8 cells, multiple BMMs will be needed to monitor all the cells, and a supervisor module is used to monitor outputs from BMMs and take actions. Output relays are closed only while all cells monitored by the BMM are in range.
- **Momentary w/Hysteresis:** *(Blue **H** sticker on board.)* Commonly used for managing stationary power supply batteries, allowing automatic reset of chargers and loads with hysteresis on voltage thresholds to avoid rapid cycling/oscillation. Charge enable output (**HVout**) will turn off if any cell exceeds 3.8V and back on once it drops below 3.4V. Discharge enable output (**LVout**) will turn off if any cell drops below 2.5V, and back on once it recovers above 3.0V.
- **Latching outputs:** *(Green **L** sticker on board.)* For packs with 4-8 cells, one BMM can monitor the whole pack. Output relays are closed when all cells are within range, but will open and remain open if a cell goes out of range. This can be used to shut down your charger (using the overvoltage output) or drive system (using the undervoltage output) to protect the cells. Resetting the module is achieved by momentary power cycling (via onboard pin jumper, or adding a remote switch).

EXAMPLE WIRING DIAGRAMS

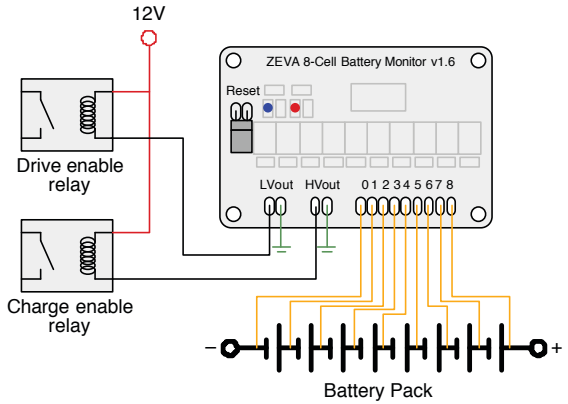
The following diagrams show example wiring for the two types of module available, latching or momentary.

Mometary variant (multiple modules + supervisor):



Battery Pack (>8 cells)

Latching or Hysteresis variants (single modules):



In installations with a single "battery enable" relay (combining charge and drive enable function), the **HVout** and **LVout** outputs may be wired in series such that an open circuit on either will open the power relay.

INSTALLATION

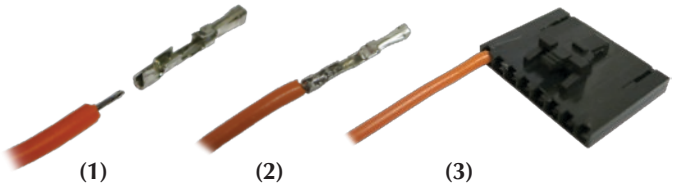
Before you commence installation, remove the jumper across the two pins labelled RESET. This will keep the module powered down and offer some protection from temporary wiring faults during installation.

The board has a 3mm hole in each corner which should be used to securely mount the module. If mounting to metal surfaces, use standoffs or an insulating layer between to ensure the circuit board does not contact the metal. Modules should be installed in a location protected from water and debris – typically inside your sealed battery enclosure is ideal.

Once mounted, connect wires from cells to the module plug. We recommend wiring the plug fully before connecting to the module. The BMM uses Molex C-Grid SL locking plugs for connections to cells and outputs. They provide secure, reliable connections, but can be a little fiddly to wire up until you get the hang of it.

The plugs are designed for fairly small gauge wire, around 24-30AWG. The wire's insulation needs to be small enough to fit into the plug housing, which limits outer diameter to about 2mm. The best way to connect wires to pins is crimping first then adding a little solder to the joint. A suitable crimping tool is available from vendors such as Altronics (part T1537).

If you don't have a suitable crimping tool, you can the solder wire directly to the plug, ensuring minimal gap between the insulation and the back of the pin. You may need to compress the wings on the pin insert a little for them to fit comfortably into the housing.



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When the pin is fully inserted, a barb on the pin should engage a slot in the housing to lock it in place, and a faint click should be heard. Either inspect visually or give a gentle tug on the wire after insertion to ensure it is secure. Pins can be removed if necessary by applying pressure on the pin's barb with a jeweler's screwdriver, then the pin can be pulled from the housing.

Ensure that all wiring is secured so it will not become damaged from vibration or abrasion.

Power is always taken from input #8. If using the module with fewer than 8 cells, simply add a wire jumper from your top-most cell to input #8. (For example, if monitoring 4 cells add a small wire between input #4 and #8.)

Please consult the manual for your supervisor module or BMS Master Unit for instructions on integrating modules with the rest of your battery protection system.

OPERATION AND USE

Modules will automatically detect the number of cells connected when first powered up, and (if using monentary output variants) will flash the LEDs and outputs according to the number of cells detected for visual confirmation. If the LEDs are blinking alternately, it means zero cells have been detected. Note: *Due to the likelihood of frequent in-system resets, latching variants do not flash outputs on startup. We recommend performing tests after installation to verify all cells are being monitored.*

The threshold for over-voltage is 3.8V, and under-voltage is 2.5V. The blue status LED will be lit whenever the **LVout** relay is closed, and the red LED will be lit whenever the **HVout** relay is closed, i.e both LEDs should be lit whenever all cells are within safe voltage range.

LiFePO4s are typically charged to 3.65V per cell, so if your pack is in a good state of balance the BMMs should not interfere with a normal charge cycle. Once a cell is full, voltage rises quickly and damage may occur above 4.2V, so it is important that your supervisor system can respond by disabling the charger within a few seconds.

When discharging, cells will not suffer damage unless they are driven negative – that is, if a cell goes completely flat (0V) but the voltage from other cells forces current to continue flowing. For the low voltage threshold, 2.5V was chosen because it allows for a significant amount of voltage sag under load (so the BMM will not give false positives during acceleration), but still allowing sufficient notice of a low cell before damage will occur.

POWER CONSUMPTION WARNING

An inherent problem with any BMS which powers itself from the cells it is monitoring is that the BMS itself slowly discharges the cells. In normal operation this effect is insignificant, but if the vehicle is to be left unused for extended periods of time (months or years), it is recommended that either the cells are left fully charged, or the BMMs are powered down (by removing the Reset plug) to ensure they can't flatten any cells.

TECHNICAL SUPPORT

If you have any queries not covered by this manual, feel free to contact us via our website: **www.zeva.com.au**

Products are covered against manufacturing faults for a period of 12 months from date of purchase. If you believe your module may be faulty, please contact us for RMA information.

ZEVA is a 100% carbon neutral business. All products proudly designed and manufactured in Australia.