



## **BMS user manual**

**BMS ZE6000i-PCBT.xxxx / ver. 2**

*Programmable battery management system for Lithium Ion battery cells, for up to 32 round or prismatic cells, 10 to 400Ah*

### **NOTE:**

*This user guide applies to the micro lithium ion battery management system, part number ZE6000i-PCBT.xxxx, and associated modules.*

*For further information explaining terms used, acronyms & a glossary, refer the lithium ion battery management system application note.*



## Summary

Much of the function of the BMS is automatic; user involvement is limited to the following:

1. Powering the consumers on & off
2. Reading status information
3. Setting various user adjustable features
4. Responding to system messages
5. Dealing with system faults & error messages

Operation of these features is dealt with in the individual sections below:

## System on/off & battery isolation

The BMS system is always active when connected to the battery & continually monitors & manages the battery condition. User on/off control is limited to controlling power to the connected loads.

User control is set up as part of the system configuration, so you may need to consult the system installer if you are not sure of what has been implemented. The method for control of power to the loads can be one of the following:

- fully automatic
- user controlled via the user control & display panel
- user controlled with an installer fitted on/off switch or remote control

Fully automatic control will disconnect the loads whenever conditions require, such as overheat or overcurrent, but reconnect occurs automatically. This type of control would be typically used for unattended operation.

Control via the user control & display panel allows the user to connect or disconnect the loads using a touch sensitive pad on the display. Tap the pad to step through the control options. When the required control option is shown by the display, hold the pad for about a second until the “option accepted” message is displayed. Release the pad as soon as this message appears.

If your system is controlled by an installer fitted on/off switch or remote control, consult the installer for details.



### Load isolation

In addition to the user load control, all systems will automatically disconnect & re-connect the loads as set down in the table below.

System load management actions & reactions		
Condition	BMS response	Recovery
Battery voltage low	Disconnects if any one of the battery pack cell voltages falls below the minimum set level.	Automatic once the battery is put on charge, & all cell voltages have recovered by at least 0.5 volts
Battery temperature low	Disconnects if any sensed temperature falls below the minimum set level.	Automatic once the battery temperature has risen by a few degrees - the hysteresis is a configuration setting.
Battery temperature high	Disconnects if any sensed temperature rises above the minimum set level.	Automatic once the battery temperature has fallen by a few degrees - the hysteresis is a configuration setting.
Mean load current too high	Disconnects if the average load current exceeds the set level.	Automatic retry after a few seconds.
Peak load current too high	Disconnects if the peak load current exceeds the set level.	Automatic retry after a few seconds.

If the user display is fitted, & if a fault occurs, a plain English error message describes the offending condition.

### Reading status information

#### via user display panel

If the user display panel is installed, system status information is shown in plain English.



Under some circumstances, the display is powered down to conserve power. Tap the touch sensitive pad to restore the display. Control options are then offered & actioned by tapping or holding the touch sensitive pad. To read the system status just wait until the options offered message times out.

If the display is already powered up, then information is already available.

If all is OK, then the OK message is displayed, along with the battery voltage, battery current, battery state-of-charge values together with a "charging" message if charging is taking place.

The meanings of fault messages are self-evident and some action may be necessary to respond appropriately - refer to the fault response section below for details.

#### via serial port

By logging in to the BMS system configuration webpage as "Guest", and connecting the BMS to a PC USB port, the system status & system settings may be viewed. The displayed information will be similar to that shown below. For instructions on how to connect in this way, refer to the BMS configuration guide.



### via Bluetooth

The optional Bluetooth module can be used to provide a wireless link in place of a wired serial to USB connection. The Bluetooth module plugs into the “Bluetooth & expander uplink” port on the BMS:

**BMS connections**

The diagram shows a BMS unit with several ports. Lines connect these ports to labels: "contactor drive" (top right), "serial interface" (middle right), "display & user interface" (bottom right), "bluetooth & expander uplink" (bottom left), and "expander downlink" (bottom left).

**Serial interface:**  
This is an optional connection for system monitoring and system configuration. Configuration may only be carried out by qualified persons, but system monitoring is not restricted. To connect to a PC, use of a standard USB to serial connection lead, manufactured by FTDI, is recommended.

**Display & user interface:**  
If the BMS has been configured to use the optional remote display unit, it plugs into this connection..

**Uplink, downlink & bluetooth:**  
The optional bluetooth module may be connected at the uplink connector. The bluetooth module broadcasts system settings & status data.

**BMS specification**

For instructions on how to connect in this way, refer to the BMS6156 configuration guide.

To operate this interface, first pair your Bluetooth device with the BMS, then use the BMS Bluetooth webpage to view the system data.

This webpage shows the same information as the wired serial link, but can only be used with PC's using Windows operating system along with the required ActiveX control. This is detailed in the BMS6156 configuration guide.

Alternatively, the system data may be viewed via Bluetooth using terminal software such as “Real Term” or for Android devices: “Blue term” or “SENA BTerm”.

The data stream includes control codes, which may be ignored if they appear on the received data view.



## Setting various user adjustable features

User settable features are limited to display related properties, so if there is no display fitted, there are no user settings available.

User options are presented in sequence by tapping the display touch sensitive pad. To activate a displayed option, hold the touch sensitive pad for about a second until the “option accepted” message is displayed. Release the pad as soon as this message appears.

The display has an automatic brightness feature, which dims the display in low light conditions. This may be overridden within the user options to be either permanently bright or permanently low or restored to automatic.

Other options may be present in your system. If so, they will appear in the sequence presented by successively tapping the touch sensitive pad.

Under some circumstances, the display is powered down to conserve power. Tap the touch sensitive pad to restore the display. A red led is permanently illuminated within the display as an aid to locating the panel in low light conditions.

## System messages, faults & error messages

Information presented via the serial port or Bluetooth connection does not include error messages. Faults and errors must be deduced by comparing the detailed battery status report with the settings report; checking that all parameters are within the system operating range.

The user display does not present all the technical parameters; just a statement of prevailing conditions. Only very basic technical knowledge is required to interpret & respond.

Typical message content includes:

### For information only:

- Battery is charging
- Battery is balancing
- System is on, system is off (refers to power to loads being enabled)
- Pack voltage, battery current & state-of-charge

### Conditions requiring corrective action:

- Overcurrent for both charging & discharging
- Temperature too high or too low for charging or for discharging
- Cell voltage too high, resulting in charger disconnection
- Cell voltage low, resulting in loads disconnection

In some cases, the corrective action is included in the message, for example “recharge” appears if the battery is depleted.

If there is no corrective action included in the error message, a recurring fault condition should be investigated unless the reason for it is obvious. For example, if the system disconnects with a “temperature too low” message and the temperature is low then the reason is clear. The table below summarises reported conditions & the appropriate response. If in any doubt, always seek expert advice, since any battery can present a hazard if fault conditions are not addressed.



<b>Reported messages, reasons &amp; responses</b>		
<b>Reported condition</b>	<b>Reason</b>	<b>Response</b>
Voltage too low	This is a normal response when the battery is depleted	Recharge to clear to message.
Voltage too high	Automatic; system should disconnect charger. This is a normal response at the end of the recharge cycle.	If the battery charging message remains present on the display after a few minutes, discontinue charging & investigate.
Battery temperature too low for charging	Cold - automatic response; system should disconnect the charger.	If the battery charging message remains present on the display after a few minutes, discontinue charging & investigate. Return to normal temperature will clear the condition.
Battery temperature too low for discharging	Cold - automatic response; system should disconnect the loads.	Return to normal temperature will clear the condition.
Battery temperature too high for charging	Automatic; system should disconnect the charger.	If the battery charging message remains present on the display after a few minutes, discontinue charging & investigate. If this occurs repeatedly in normal conditions, investigate the cause.
Battery temperature too high for discharging	Automatic; system should disconnect the loads.	If this occurs repeatedly in normal conditions, investigate the cause.
High current	If this occurs during recharge, check that the charger is not faulty.  If this occurs while loads are being powered, check for an overload fault.	This could occur if the overcurrent thresholds have been set too low during configuration, or if additional loads have been connected not originally included.
Comms error	The BMS has been unable to communicate with a peripheral device - system may disconnect the loads.	Check for loose connectors. If the condition does not clear, investigate the cause.