



www.orionbms.com

# Orion BMS 2 Purchasing Guide

## Rev. 1.1

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Ewert Energy Systems is a research & development company focusing on developing solutions for plug-in hybrid and electric vehicles and other energy storage applications. Ewert Energy provides custom solutions as well as off the shelf components.

# Main Components

## Orion 2 BMS Main Unit



In order to reduce costs, the Orion BMS 2 is offered with various numbers of cell group locations populated. Please carefully read “Wiring the BMS” in the “Wiring and Installation Guide” before determining how many cell BMS is required. Ideally, the BMS can be ordered sized to the actual number of cells in the application, however, depending on the placement of fuses, safety disconnects or and any high resistance busbars / wires, the BMS may need to be ordered sized for substantially more cells than the pack actually has. For example, a battery that has 48 cells may require 60 or 72 cell version of the Orion BMS 2 depending on where high impedance busbars or fuses are located. The Orion BMS 2 is available in increments of 12 cells from 24 cells to 180 cells. Multiple units can be connected together in series to support more than 180 cells.

To allow safety disconnects and fuses in the middle of the pack and take advantage of the 2.5kV isolation barriers, some smaller sizes are also available with “-S” configurations that offer cell groups on different connectors. Custom population configurations can be made for larger volume orders.

The following table shows the standard available cell number ordering options. Additional custom configurations can be requested.

### **24-72 Cell Size Enclosure Size**

<u>BMS Size</u>	<u>Cell Groups Populated</u>		<u>BMS Size</u>	<u>Cell Groups Populated</u>
24	1, 2		48-S*	1, 2 and 4, 5
36	1, 2, 3		60	1, 2, 3, 4, 5
48	1, 2, 3, 4		72	1, 2, 3, 4, 5, 6

\* -S ordering options are split differently to provide 2.5kV isolation between cell groups

**84-108 Cell Size Enclosure Size**

<u>BMS Size</u>	<u>Cell Groups Populated</u>
84	1, 2, 3, 4, 5, 6, 7
96	1, 2, 3, 4, 5, 6, 7, 8
108	1, 2, 3, 4, 5, 6, 7, 8, 9

**120-180 Cell Size Enclosure Size**

<u>BMS Size</u>	<u>Cell Groups Populated</u>
96-S*	1, 2, 4, 5, 7, 8, 10, 11
120	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
132	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
144	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
156	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
168	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
180	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

\* -S ordering options are split differently to provide 2.5kV isolation between cell groups

Standard order Orion BMS 2 units with less than 72 cells are packaged in the 72 cell size enclosure, BMS units with either 84, 96 or 108 cells are packaged in the 108 cell size enclosure and the standard sizes 120 - 180 cell are packaged in the 180 cell size enclosure. The enclosure drawings are available on the support page of the Orion BMS website ([www.orionbms.com/downloads](http://www.orionbms.com/downloads)).

The Orion BMS is configured by default to have an internal termination resistor on the CAN1 interface and no termination resistor on the CAN2 interface. The Orion BMS can be special ordered with any configuration of termination resistors. Please request a quote for special configurations.

The Orion BMS is designed to manage one battery string and is not setup to manage multiple strings with one unit. If multiple strings are to be paralleled together, special care must be taken and more than one Orion BMS unit would be necessary. Please see our “Parallel String” and “Wiring and Installation Manual” for more information. Please note that this does not apply to a single string where multiple cells have been paralleled together.

Orion BMS 2 units can be connected to remote cell tap modules to allow for more than 180 cells, but not to exceed a maximum pack voltage of 800 volts DC.

## Remote Cell Tap Module

The Orion BMS 2 supports up to 2 remote cell tap modules which allow for a semi-distributed style design implementation. Remote modules range in size from 24 to 180 cells just like the main BMS units do. These modules are designed to be used in situations where battery packs are split up in multiple physical locations or in situations where more than 180 cell taps are needed (Note: 800V absolute maximum battery pack voltage limitations apply, which may limit the number of cells in series). More cell taps may be needed in the event that some cell tap positions need to be skipped or when the BMS is used with lower voltage cells such as lithium titanate. Unlike the first generation of the Orion BMS, these remote modules **do not** require an additional current sensor and do not use either of the CANBUS interfaces on the main BMS unit (they use a dedicated high speed digital communication interface).

If more than one remote module is used, the module with the largest number of cells connected to it should be put in as remote #1 as this will improve the cell polling time of the overall system. Each remote module supports up to 8 additional thermistors (optional). The thermistors are wired the same way as on the main unit.

The Remote Cell Tap Module units have the exact same physical appearance as the main Orion 2 BMS modules as the enclosure, heatsink and connectors are all shared between them to reduce cost. For this reason, the Remote Cell Tap Modules can be purchased in all the same physical configuration sizes that the main Orion 2 BMS unit can be purchased in as described above.

**IMPORTANT NOTE:** The main Orion 2 BMS unit will need to be purchased specially with Remote Cell Tap Module support enabled in order to support Remote Cell Tap Modules (by default the remote module support circuitry is not loaded to reduce cost).

## Current Sensor



The current sensor should be sized to meet the highest amperage expected in an application. While no longer as important with these higher accuracy current sensors, they should be sized as small as possible to improve accuracy. For example, if an application has an expected maximum amperage of 275 amps, a 500A current sensor should be used. Some headroom should be left between the maximum expected amperage and the size of the current sensor to allow for brief current transients that may exceed the rating of the current sensor. For example, if the application is expected to draw 190 amps maximum, a 500A current sensor should be selected even though a 200A sensor is technically large enough. While accuracy is somewhat improved by using the smallest current sensor for the application, it is best to error on the side of getting a sensor that is larger than necessary since the accuracy is not greatly improved.

The current sensors offered with the Orion BMS are dual range sensors and contain 2 sensors in each package. One sensor is smaller than the other and this is used to provide both redundancy and to improve accuracy measuring smaller currents while maintaining the ability to measure large currents as well.

The following sizes are stocked: **+/- 200A, 500A, 800A and 1000A**

When using the Orion BMS 2 with applications with AC to DC inverters, the 200A and 800A sensors are recommended.

The Orion BMS supports current sensors > 1000A, however those applications typically require more care to select. Please contact Ewert Energy if higher currents are necessary.

The current sensor is technically optional, however it is strongly recommended because the majority of the Orion BMS systems' features depend on having an accurate current sensor. Without a current sensor, the Orion BMS is unable to provide any of the following calculations:

- Internal resistance calculations
- Battery health monitoring
- Over-current protection (still provides over and under voltage protection)
- Current measurements
- Open cell voltage calculation
- Weak cell faults
- State of charge calculation or state of charge drift
- Calculation of Charge or Discharge current limits

## Thermistors



The Orion BMS 2 main unit and each of the remote cell tap modules support up to 8 thermistors each. While the B value of the thermistors is programmable with the Orion BMS 2, the thermistors must be 10K thermistors and must all have the same B value. The thermistors available for purchase with the unit are 10K thermistors with a B25/50 value of 3380K and come standard with 2 meter of wire which can be cut down to size or extended if necessary.

Although thermistors are technically optional, we strongly recommend using them as they improve the accuracy of certain calculations by the BMS and provide thermal protections for the battery pack. Thermistors can be ordered pre-wired into the thermistors / current sensor harness or included loose with the order. If more thermistors are required for the specific application, a thermistor expansion module can be used. A thermistor expansion module supports up to 80 additional thermistors per module and up to 10 thermistor expansion modules can be used with each BMS.

## CANdapter



The CANdapter is necessary to connect the Orion BMS unit to a computer via a USB port to upload settings to the BMS, updating firmware and logging data to a PC. One CANdapter can be used between multiple Orion BMS units and is only needed when settings need to be changed, firmware needs updating or if diagnostic data needs to be retrieved from the BMS unit.

### Product Specifications:

- Used to **program and diagnose** the Orion BMS
- Up to 1Mbps baudrate
- Creates virtual serial port for easy access
- Supports extended identifiers
- Activity and error status LEDs

More info on the CANdapter can be found at <http://www.candapter.com>

# Wiring Harnesses

For convenience, pre-assembled wiring harnesses are available for all Orion BMS 2 connectors. The Orion BMS uses professional automotive grade locking connectors which require special crimping tools or machine dies to assemble. These crimping tools run several hundred dollars each or are rented from the manufacture on a monthly basis. While it is usually economical for larger production orders to assemble custom wiring harnesses, many of our customers benefit from purchasing pre-assembled harnesses.

The Orion BMS has 3 main harnesses:

- 1.) Cell voltage tap harnesses
- 2.) Main I/O harness
- 3.) Current sensor & thermistor harness

Purchasing pre-assembled wiring harnesses is optional. Crimps and connectors can also be purchased at the time the unit is purchased or directly from component distributors. The part numbers for the connectors used can be found in the wiring manual.



*Cell voltage tap harness - 36 cell*



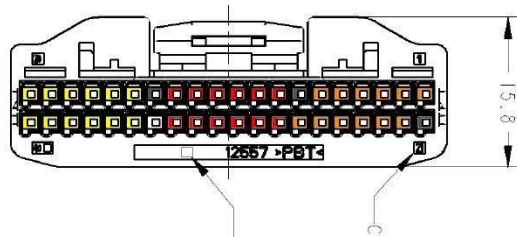
*Cell voltage tap harness - 12 cell*



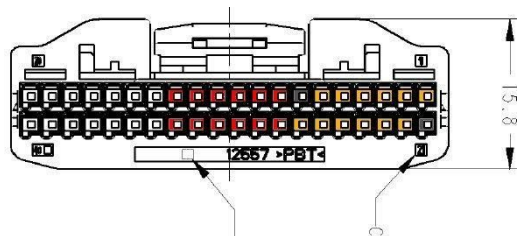
## Cell Voltage Tap Wiring Harnesses

The Orion BMS is populated in increments of 12 cell groups and the wiring harness options are available to match those increments to minimize cost and reduce waste. The wiring harnesses are available with 12 cell, 24 cell and 36 cell configuration per connector. If an 84 cell BMS is ordered, cell groups 1, 2, 3, 4, 5, 6 and 7 are populated and therefore the cell voltage tap wiring harness connectors included would be 2 of the 36 cell harnesses and one 12 cell harnesses for a total of 84 cells.

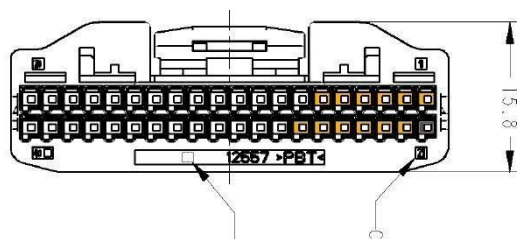
Unlike the previous generation of the Orion BMS, **the Orion BMS 2 now uses cell tap connectors with gold plated contacts**. These gold plated contacts have a longer lifespan at elevated temperatures and in high vibration environments. **Gold plated connectors, while nearly identical in appearance, cannot be used with tinned connectors**. Using gold plated contacts with tinned connectors will result in long term reliability issues from the dissimilar metals and must be avoided. The Orion BMS 2 can be special ordered with tinned connectors for backwards compatibility with older tinned wiring harnesses, though it may be subject to longer lead times or higher cost.



*Standard 36 Cell Harness Configuration (3 group)*



*Standard 24 Cell Harness Configuration (2 group)*

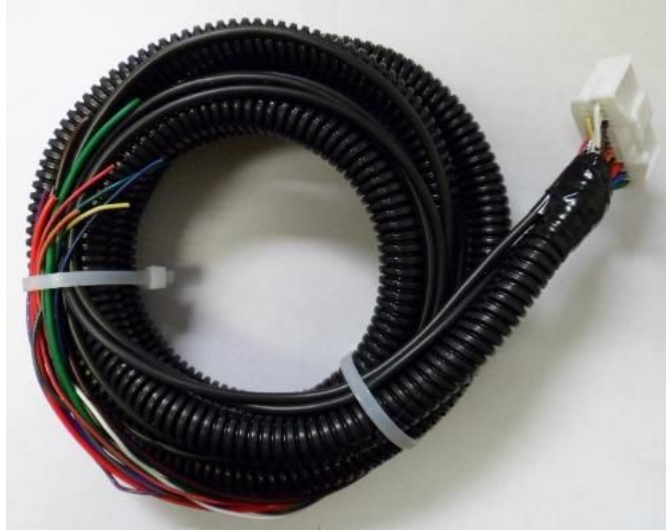


*Standard 12 Cell Harness Configuration (1 group)*

Cell voltage tap wiring harnesses are available in 6 foot (1.8 meter) lengths and 12 foot (3.6 meter) lengths. The wires are inserted into the connector on one end and are blunt cut wire without any terminals on the other end. This allows the harnesses to be cut to length and appropriate crimps to be applied on the battery end. The wires are 22 AWG stranded.

Cell voltage tap wiring harnesses are in 5 feet of  $\frac{5}{8}$ " ,  $\frac{1}{2}$ " or  $\frac{3}{8}$ " convoluted tubing. The convoluted tubing may be cut or discarded depending on the application requirements.

## Main I/O Harness



*Main I/O Harness - Part Number CWHMIO3*

The Main I/O harness is also terminated in cut wire. All usable pins are populated including the 2 CAN interfaces. All wires are 6 feet (1.8 meters) in length except for the CAN wires. CAN1 wires are 12 feet in length (designed to reach the front of a vehicle) and CAN2 wires are 4 feet in length since CAN2 does not include a termination resistor by default and the maximum recommended physical distance from the main bus is just under 4 feet). Both CAN wires are single shielded twisted pairs.

Older CWHMIO2 harnesses (used with the previous generation of the Orion BMS) are compatible with the Orion 2 BMS, however the CWHMIO2 harnesses lack the wire for pin 26 - Multi-Purpose Enable that is now used on the Orion BMS 2.

## Thermistor / Current Sensor Harness



*Current Sensor Harness with thermistors installed - Part Number: CWHCRT8*



*Current sensor harness without thermistors installed - Part Number: CWHCUR8*

Current sensors and thermistors share the same connector on the Orion BMS 2 unit. The harness is available with and without thermistors installed.

The current sensor wires are 18 inches in length. While it may be possible to extend the current sensor wires, doing so is not recommended as it may reduce the accuracy of the current measurement.

If the CWHCRT8 harness is ordered, it comes with eight of the 10K thermistors with a B25/50 value of 3380K and are 2 meters in length each. While the 2 meter length is the only length stocked, it is possible to cut and manually extend the thermistors if necessary.

# Installation Tools

## Tap Validation Tool



The tap validation tool is used to determine if the battery tap connectors are properly wired before connecting to the Orion BMS. Improperly wired connectors can cause permanent damage to the Orion BMS unit that is not covered by warranty.

### **Product Specifications:**

- Checks critical battery wiring harnesses for correctness prior to plugging them in.
- Compatible with cell tap harnesses for the Orion Battery Management System.
- Runs on internal 9v battery and is handheld for field use.
- Tool is available for purchase OR weekly rental.
- **The tap tool is available with gold plated cell tap connector contacts.** While short term temporary mating of gold and tinned connectors should not damage the connectors, the tool should be ordered with gold contacts when used primarily with Orion 2 gold plated connectors.

The tap validation tool is available both for weekly rentals for single use applications as well as for purchase for OEMs that need the tool for use on an assembly line.

# Available Add-Ons

## Thermistor Expansion Module



The thermistor expansion module is used in applications where more than the 8 standard thermistors are needed for temperature monitoring. One thermal expansion module monitors up to 80 thermistors. The unit communicates with the main Orion BMS system via either two 5V analog signals (emulated thermistors) or via the CAN interface. Up to 10 thermistor expansion modules can be used with the Orion BMS 2 when used with the CANBUS interface method. The thermal expansion module is programmable and can be setup for the exact number of thermistors the application requires. A software utility allows for viewing the value of each individual thermistor so that thermistor errors can easily be located.

Please see the Thermistor Expansion Module Purchasing Guide for more information on ordering options.

## Basic Display Module



The Basic Display module provides visual feedback of the essential information on a battery pack. This information includes State of Charge, Power Limited (reduced output power), and the Malfunction Indicator Status (error indicator).

### Product Specifications:

- Operates with the Orion BMS, Orion BMS 2 and Orion JR BMS (BMS sold separately).
- Full automotive operating temperature range (-40C to 80C).
- Compact size and shape.
- Uses only the analog signals from the Orion BMS (no digital communication)
- Supports brightness dimming for automotive use.

## Data Logging Display Module



The CAN Data Logger and Display module for the Orion BMS provides visual feedback of the essential information on a battery pack as well as data logging capabilities for diagnostics. This display and logging combo connects to an Orion BMS unit via CAN (Controller Area Network) and logs user-selected data to a memory card while displaying State of Charge, Power Limited (reduced output power), and the Malfunction Indicator Status (error indicator)

### Product Specifications

- Logs BMS parameters to memory card at user selectable sampling rate
- Connects to the Orion BMS via CAN (no analog connections)
- Supports brightness dimming for automotive use (via CAN)
- External “event trigger” input which can flag events for future review
- Log graphing and analysis software
- Real time clock to store data and time of each charge / discharge cycle
- Supports CAN frequencies of 125, 250, 500Kbps, and 1 Mbps
- User customizable logging frequency from 100mS to 10 seconds
- Compatible with any size “micro SD” type memory card up to 32Gb in size (required for data logging; memory card not included with purchase)



## Orion Connect WiFi Module



The Orion BMS Connect is an internet based remote monitoring system that enables monitoring battery packs through a web browser, smartphone, or tablet. Instant data, charts of recent history, and diagnostic information including recent events, fault codes, and freeze frame data are available. The device can also optionally log data to a local memory card and generate emailed alerts when certain events occur. Onboard memory allows this device to be used in certain mobile applications where data can be synchronized periodically.

### **Product Specifications**

- Monitors parameters in real time: Pack amperage, pack voltage, highest and lowest cell voltages and temperatures, pack state of charge, DTC codes including freeze-frame data.
- Optional memory card data logging
- Supports multiple WiFi protocols (802.11 b/g/n)
- 12-48v DC power supply
- Compatible with Orion BMS, Orion BMS 2 and CANBUS-enabled Orion Jr. BMS units

## **OEM & Reseller Sales**

Prices listed on the Orion BMS website are our suggested retail prices for single quantity units. We offer a favorable pricing structure for OEMs, so please request a quote for pricing for quantities over 5 units. For larger orders, custom modifications are possible.