

Lithium Ion Battery Management System for 12V-48V Applications



Designed Use

- Designed for Lithium Ion battery packs up to 48V nominal (60V max)
- Individual cell voltage rating: 0.2v to 5v per cell tap
- Supports from 1 to 16 cells in series
- -40C to 80C operating temperature range
- Integrated low loss passive cell balancing to within 10mV
- Cell voltage resolution of about 1.5mV

Applications

- Light mobile applications (scooters, golf carts, etc.)
- Solar & wind energy storage
- Uninterruptible power supply
- Battery backup

Basic Functions

- Over-voltage and under-voltage protection
- Over-current protection
- Temperature protection
- Intelligent cell balancing
- State of charge monitoring
- State of health monitoring

Additional Functions

- Data logging capabilities
- Stored diagnostic information
- Programmable interfaces
- Current limit calculations (intelligent current limiting)
- Stored battery usage statistics including histogram data

Display Options

- Interfaces with third party smartphone software (CAN version only)
- Optional basic state of charge display
- Optional data logging display

Interfaces

- 2 digital signal outputs for controlling charge and discharge limiting mechanisms
- 1 digital signal output for controlling a battery charger
- 1 CANBUS 2.0B interface [optional] (both standard and extended IDs supported)
- 1 digital RS-232 interface for programming and diagnostics
- 3 multi-purpose outputs with software assignable functions (2 on Rev. B)
- 1 multi-purpose input with software assignable functions
- 3 analog 0-5v outputs that represent the following signals: Charge Current Limit (CCL), Discharge Current Limit (DCL), State of Charge (SOC).
- 3 thermistor inputs (additional monitoring possible with thermistor expansion module) (2 on Rev. B)

Features

- Centralized design allows for faster polling of data resulting in increased accuracy and resistance to EMI
- No cell boards (all electronics are contained within the unit.)
- Supports OBD2 protocol for storage of diagnostic trouble codes, freeze frame snapshots and polling of live data
- PC software can be used to monitor battery performance, read and reset trouble codes, program battery profile information, and update settings
- Accurate amp-hour and pack state of charge tracking (with correction based on cell open voltage)
- Retains data when power is lost (no always-on power source needed)
- Charger integration to allow for tapering of current during charge (if supported by charger)
- Battery profile information and settings are field programmable via PC utility.
- Internal resistance is measured for all individual cells
- Pre-calculated charge and discharge current limits
- Stores a snapshot of active data when faults occur for easy problem diagnosis.

Dimensions

- 7.14 in (W) x 4.01 in (L) x 1.50 in (H)

| Specification Item | Min | Typ. | Max | Units |
|--|-----|------|-----|-------|
| Supply Voltage | 10 | | 60 | Vdc |
| Supply Current—Active (Rev. C) | | 1.1 | | W |
| Operating Temperature | -40 | | 80 | C |
| Digital Output Voltage (Open Drain) (Rev. B & C) | | | 60 | V |
| Digital Output Sink Current (60v max—Rev. B & C) | | | 175 | mA |
| Analog Outputs Voltage | 0 | | 5 | V |
| Cell Voltage Measurement Range | 0.5 | | 5 | V |
| Cell Voltage Measurement Error (over 1-5v range) | | 0.25 | | % |
| Cell Balancing Current | | | 150 | mA |
| Cell Voltage Resolution | | 1.5 | | mV |

| Optional Specifications | |
|---|--|
| Item | Value |
| CANBUS speed (on supported units) | 125, 250, 500, or 1000 Kbps |
| Current Sensor Values Supported (all 50mV shunts) | 20A, 50A, 100A, 150A, 200A, 333A, 400 A, 500A (600A and 1000A supported with reduced resolution) |

Lithium Ion Battery Management System



Orion BMS 2

Main Features

- Monitors every cell voltage in series
- Field programmable and upgradeable
- Intelligent cell balancing (efficient passive balancing)
- Enforces min. and max. cell voltages
- Enforces maximum current limits
- Enforces temperature limits
- Professional and robust design
- Monitors state-of-charge
- Retains lifetime data about battery history
- Integration with 3rd party smartphone apps (Torque, EngineLink) and external displays

Battery Compatibility

- Compatible with almost all lithium-ion cells
- One-click setup for common battery types
- Supports 4-180 cells in series per BMS unit (2x additional remote units can be used in series)

Battery Calculations

- State of Charge (SOC) & Pack Health
- Open-Circuit (sitting) cell voltages
- Charge & Discharge current limits
- Internal resistance (for all cells and total pack)

Centralized Design

- No cell tap boards or external circuitry
- Fast cell voltage polling (every 25 mS typical)
- High immunity to EMI and other noise
- High accuracy cell voltage measurement

2x Programmable CANBUS Interfaces

- CAN2.0B (11-bit and 29-bit IDs supported)
- Independently operate at different baud rates
- Fully customizable message formatting
- Field upgradable firmware and settings using either CAN interface
- One-click setup for many common chargers and inverters
- ISO-15765 OBD2 protocol compatible
- Compatible with CAN-Open and J1939

Charger Support

- Integrated support for J1772 charging stations
- Works with J1772 proximity & pilot signals
- Supports CHAdeMO DC fast charging protocol

Input / Output

- Easy interfacing with chargers and loads
- On/off outputs for controlling charge and discharge sources
- 0 – 5V analog outputs for gradual current reduction (improves usable range of battery)
- Thermal management controls for battery cooling / heating

Diagnostic Features

- Diagnostic trouble codes quickly identify and diagnose battery problems
- Freeze frame data records exact conditions and battery data when a fault occurred
- Supports OBD2 automotive protocol for storing diagnostic trouble codes and polling live data

Data Logging

- Unit tracks total number of battery cycles
- Records detailed lifetime battery usage and environment conditions internally.
- All BMS parameters can be logged using PC utility software
- Optional WiFi Connect module can record any parameters to a memory card or Internet
- Internal event logging for easy troubleshooting

Other Features

- Integrated isolation fault detection circuit
- Multiple remote modules may be used in series
- Automotive grade locking connectors
- Temperature compensation for improved monitoring in different temperatures
- Integrated status LED for indicating faults

Common Applications

- Electric Vehicles (cars, trucks, busses, boats, heavy equipment, racing, etc)
- Hybrid & Plug-In Hybrid Vehicles
- Solar and wind energy storage
- UPS and peak shaving applications
- Research & Laboratory Testing

Cell Voltage Monitoring Specs

- Cell voltage measurement resolution of 0.1mV.
- Maximum individual cell voltage rating: 0.5v to 5v per cell tap.
- Cell voltage measurement total error <0.25% across full product temperature range.
- Total pack voltages from 12vDC up to 800vDC (maximum).
- Supports from 4 to 340 cells per battery pack (requires remote modules for more than 180 cells, 800vDC maximum).

Reliability & EMI Immunity

- Operates through the highest class passenger vehicle load dump ISO 7637 Class IV (178V, 400mS, 0.5 ohm source.)
- Operates through ISO 7637 “cold crank” brownouts down to 5v on input supply rail and can operate > 100mS with no power (with initial voltage of at least 12v)
- Meets EN 50498: 2010 EMC Aftermarket Vehicle Directive
- Meets European UNECE Reg 10.05 (Replaced Road Vehicle Directive)

Product Dimensions & Weight (Typical, With Heatsink)

- 24-72 Cells: 7.15” (W) x 6.72” (L) x 2.37” (H) — 2.50 lbs
- 84-108 Cells: 9.50” (W) x 6.72” (L) x 2.37” (H) — 3.25 lbs
- 120-180 Cells: 15.52” (W) x 6.72” (L) x 2.37” (H) — 4.80 lbs

Isolation

- Cell taps isolated from input power supply, chassis and I/O
- 2.5kV isolation between each connector of cell taps
- Isolation allows for use of in-pack safety disconnects and fuses
- High voltage isolation fault detection circuit to monitor the breakdown of wire insulation

I/O Interfaces

- 2 Digital signal outputs for enabling charge and discharge.
- 1 Digital signal output to control a battery charger
- 5 Digital programmable multi-purpose outputs
- 2 Digital programmable CANBUS (CAN2.0B) interfaces.
- 3 Analog 0-5v outputs that represent the following signals: Charge / Discharge Current Limits and State of Charge (SOC)
- 1 PWM fan output and fan speed feedback monitor (external switch and relay required, uses MPO4)
- 8 Thermistor inputs (Can support up to 800 thermistors through external thermistor expansion modules (sold separately))
- 1 Dual range current sensor input (measures pack current)

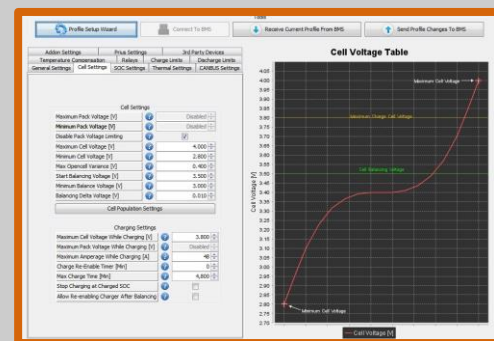
Power Supply

- 3 redundant 12V—24V DC power supplies for reliability
- BMS retains data and settings without power
- Low power sleep mode

| Specification Item | Min | Typ | Max | Units |
|---|---------------------------------------|-----|------|-------|
| Input Supply Voltage | 8 | | 30 | Vdc |
| Supply Current—Active (at 25 degrees Celsius) | | < 2 | | Watts |
| Supply Current—Sleep (at 25 degrees Celsius, 12vDC) | | 450 | | µA |
| Operating Temperature | -40 | | 80 | C |
| Sampling Rate for Current Sensor | | 8 | | mS |
| Sampling Rate for Cell Voltages | | 25 | 40 | mS |
| Isolation Between Cell Tap #1 and Chassis / Input Supply | 1.5 | | | kVrms |
| Isolation Between Cell Taps #2+ and Chassis / Input Supply | 2.5 | | | kVrms |
| Isolation Between Cell Tap Connectors | 2.5 | | | kVrms |
| Digital Output Switching Voltage (Open Drain) | | | 30 | V |
| Digital Output Sink Continuous Current (Some outputs can pulse up to 4A for contactors—see wiring manual for details) | | | 175 | mA |
| Cell Voltage Measurement Range | 0.5 | | 5 | V |
| Cell Voltage Measurement Error (over 1-5v range) | | | 0.25 | % |
| Cell Balancing Current | | | 200 | mA |
| Cell Current (Operating) | | 0.5 | | mA |
| Cell Current (Low Power Sleep) | | 50 | | µA |
| Thermistor Accuracy | | 1 | | C |
| Cell Voltage Reporting Resolution | | 0.1 | | mV |
| Optional Specifications | | | | |
| CAN bus speed | 125, 250, 500, or 1000 Kbps | | | |
| Current Sensor Values | +/- 200A, 500A, 800A, 1000A Available | | | |



Screenshot of Torque smartphone display



Screenshot of BMS utility