MADHURA
SINCE 1994

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)

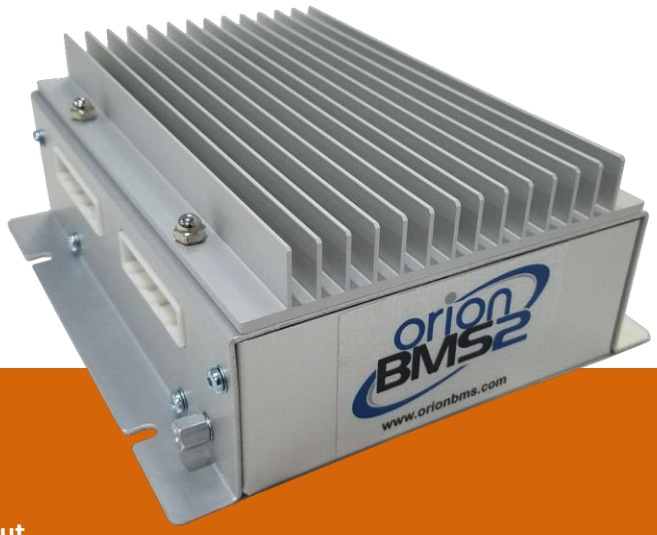
Specification Item	Min	Typ.	Max	Units
Supply Voltage	10		60	Vdc
Supply Current—Active (Rev. C)		1.1		W
Operating Temperature	-40		80	C
Digital Output Voltage (Open Drain) (Rev. B & C)			60	V
Digital Output Sink Current (60v max—Rev. B & C)			175	mA
Analog Outputs Voltage	0		5	V
Cell Voltage Measurement 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

Madhura Power Technologies Pvt. Ltd.
A 202 Trade Towers, International Convention Centre SB Road, Pune 411016 INDIA
Tel.: +91-20-25632783, 25638494
Email: sales@madhura.net Website : www.madhura.net

MADHURA
SINCE 1994

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)

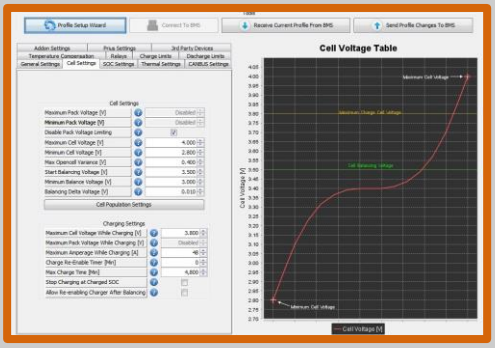
Power Supply

- 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

Madhura Power Technologies Pvt. Ltd.
A 202 Trade Towers, International Convention Centre SB Road, Pune 411016 INDIA
Tel.: +91-20-25632783, 25638494
Email: sales@madhura.net Website : www.madhura.net