Electronics4all BMS01 Battery Monitoring System Instruction Manual

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Contents

FCC COMPLIANCE AND ADVISORY STATEMENT

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Any changes or modifications not explicitly approved by Electronics4All Inc. could cause the device to cease to comply with FCC rules Part 15, and thus void the user's authority to operate the equipment.

INDUSTRY CANADA COMPLIANCE AND ADVISORY STATEMENT

Operation is subject to the following two conditions:

1. This device may not cause interference, and
2. this device must accept any interference, including interference that may cause undesired operation of the device.

SAFETY

1. Operate the device only with the specified antenna, AC/DC adapter, and internal battery.
2. The device is intended for use only in a clean and dry indoor environment.
3. Always wear personal protective equipment appropriate to the environment where the device is installed and operated.
4. The device contains a lithium-ion battery. The device should not be shipped with the battery installed. See the Internal Battery section for more information.
5. In the event of an emergency, disconnect the DC power plug and activate the external disconnect switch / circuit breaker. See the Battery Bank Wiring section for disconnect installation information.
6. The device contains no user serviceable parts. Do not attempt to repair the unit. See the Contact Information section for support or repair.

INSTALLATION

PROFESSIONAL INSTALLATION

The BMS-1001-TH wireless gateway is designed specifically to operate within an electric power generating facility. Incorrect installation or configuration of the BMS may result in unsatisfactory performance. As such, only authorized personnel should be permitted to install, configure, and access the BMS.

INTENDED USE

The BMS-1001-TH is intended to be installed and operated in an indoor industrial environment only.
The wireless system is Class A equipment and may cause radio interference in residential areas.
Only authorized, trained personnel are permitted to possess, install, and operate the BMS-1001-TH.

The device should be installed only in locations where the general public has restricted access.

The BMS-1001-TH is sold directly to electric utility companies by Electronics4All Inc. and is not made available on the retail market. Resale or otherwise making the device available to the general public is not permitted.

PRODUCT DISPOSAL

The BMS-1001-TH is recycled by Electronics4All Inc. See the Contact Information section to recycle the BMS-1001-TH.

MAINTENANCE AND CLEANING

Clean the enclosure and antenna using a clean dry cloth.

BMS-1001-TH BATTERY MONITORING SYSTEM

The BMS-1001-TH Battery Monitoring System (BMS) is designed to monitor the individual voltages of series-connected battery cells. The system is targeted towards lead-acid battery banks used for electric power plant generator start-up. Each BMS can monitor between 7 and 10 cells, and may be ganged to monitor up to 96 cells. Each BMS supports the connection of a hall effect current transducer to monitor battery string current. The individual battery voltages, battery string current, ambient humidity and ambient temperature are reported back to a central gateway via an encrypted Bluetooth data link.

In order to receive Bluetooth data broadcast by the BMS, an Electronics4All Inc. GTW-BL100 Wireless Gateway is required.

INTERFACES

FRONT MEMBRANE

The BMS contains 3 tactile push buttons, 2 rotary encoders, and 8 status LEDs on the front of the unit.

Button Label	**Function**
PWR	Turns BMS ON or OFF
PB1	Controls BLE pairing, see instructions for use
PB2	Controls BLE pairing, see instructions for use

LED Label	**Colour**	**Function**
PWR	Orange	Indicates the power status of the BMS
COM (LEFT)	Red	Used to indicate status of BLE pairing and transmission of data

COM (RIGHT)	Green	Used to indicate status of BLE pairing and transmission of data
Li-Ion	Green	Indicates that the BMS is being powered from the internal lithium-ion b attery
Lead Acid	Green	Indicates that the BMS is being powered from the external lead-acid battery bank
Debug	Orange	Flashes when the USB interface is con nected and data is being sent or receiv ed over the interface
Bat Low	**Red**	Indicates that the internal lithium-ion b attery charge is low. The AC/DC adapt er or USB should be connected to rech arge the battery. Current firmware (Re v. 3111) turns on the LED when less th an 500 mAh is remaining, and turns off the LED when the charge exceeds 100 0 mAh
Fault	**Red**	Turns on when a fault is detected. Curr ently limited to detecting a fault with th e internal lithium-ion battery

ROTARY ENCODERS

The rotary encoders set the broadcast interval of the BMS in 30 second increments, from 01 (30 seconds) to 99 (2970 seconds, or 49.5 minutes). Setting 00 disables broadcasts.

The broadcast interval may be set at any time. Any changes to the broadcast interval after pairing will be reflected immediately.

CONNECTIONS

The external lead-acid battery bank is connected to the screw terminals on the bottom of the BMS.

Each cell voltage input supports measurement range of 0-5 VDC. Up to 10 series connected cells may be monitored. The maximum input range of the entire string must not exceed 36 VDC.

When less than 10 battery cells are connected, the cells should always be wired from bottom to top, and the unconnected cells should be shorted to the highest potential in the battery bank.

The BMS supports connection of a CR Magnetics CR5210 series current transducer.

The current firmware version (3111) only supports reporting of the CR5210-50 (± 50 A) current transducer. Other current ranges will operate, but the reported current from the BMS will not be correct.

A USB type B connector and a 2.5 mm ID power jack are on the bottom of the BMS.

Both the USB connection and the DC input will automatically charge the internal lithium-ion battery.

The DC input accepts a voltage range of 7 VDC to 15 VDC, with a minimum current of 2 A.

BATTERY BANK WIRING

TERMINAL PLUG

The 6-pin battery cell input terminal receptacles are designed to mate with Phoenix Contact Terminal Block Plug 1827745.

WIRE CONNECTIONS

Ferrules required on all wire input connections to prevent loose wire strands from contacting adjacent terminals. The Phoenix Contact 1827745 terminal plug accepts the following:

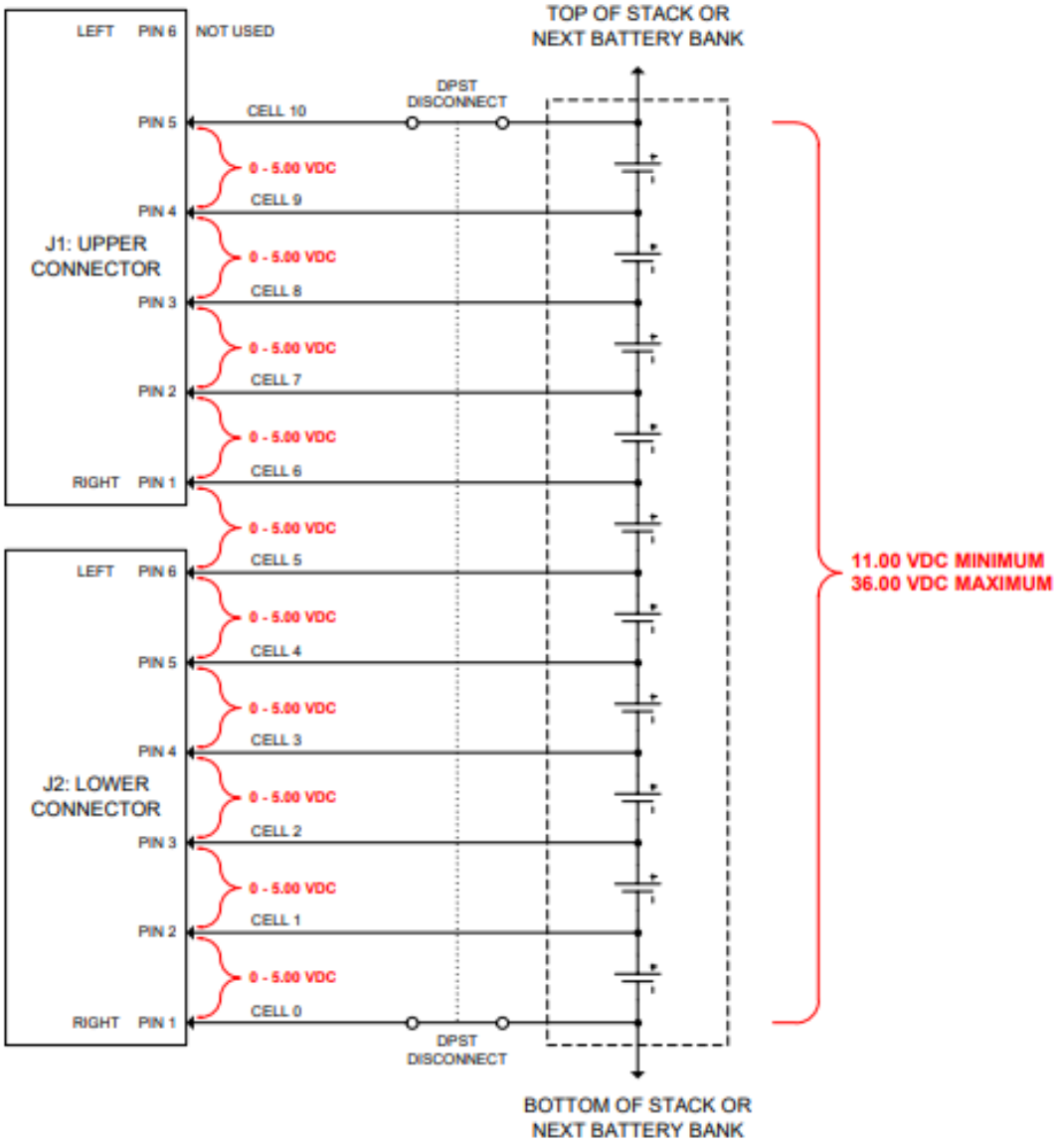
Connection Type	Ferrule Tip Cross Section
Conductor cross section flexible, with ferrule without plastic sleeve	0.25 mm^2 to 1.5 mm^2
Conductor cross section flexible, with ferrule with plastic sleeve	0.25 mm^2 to 0.5 mm^2
2 conductors with same cross section, stranded, with ferrule without plastic sleeve	0.25 mm^2 to 0.34 mm^2
2 conductors with same cross section, stranded, with TWIN ferrules with plastic sleeve	0.5 mm^2

Screw heads should be tightened between 0.22 Nm to 0.25 Nm.

INPUT RATINGS

1. Each individual cell voltage should not exceed 5.00 VDC
2. The sum of all individual cell voltages connected to a BMS should fall within the range of 11.00 VDC to 36.00 VDC

Caution: The maximum applied voltage between adjacent battery cell inputs should not exceed 5.00 VDC, and the maximum applied voltage between cell input 0 and cell input 10 should not exceed 36.00 VDC.



Battery Cell Input Ratings

SYSTEM CONNECTION ARRANGEMENT

A site analysis should be performed when deploying a BMS system to ensure that all cells within a battery bank are adequately monitored, and the input rating of each individual BMS is not exceed.

For example, the typical lead-acid battery bank used for generator start-up is comprised of 96 series connected cells with a nominal float voltage of 2.70 VDC and an absolute minimum (discharged) voltage of 1.80 VDC. To monitor the entire battery system, 10 BMS' are required:

1. 8 × BMS' are each connected to 10 cells (80 cells total). Each analog input will vary between 1.80 VDC and 2.70 VDC, and the total voltage applied to the BMS is between 18.00 VDC and 27.00 VDC.
2. 2 × BMS' are each connected to 8 cells (16 cells total). Each analog input will vary between 1.80 VDC and 2.70 VDC, and the total voltage applied to the BMS is between 14.40 VDC and 21.60 VDC.

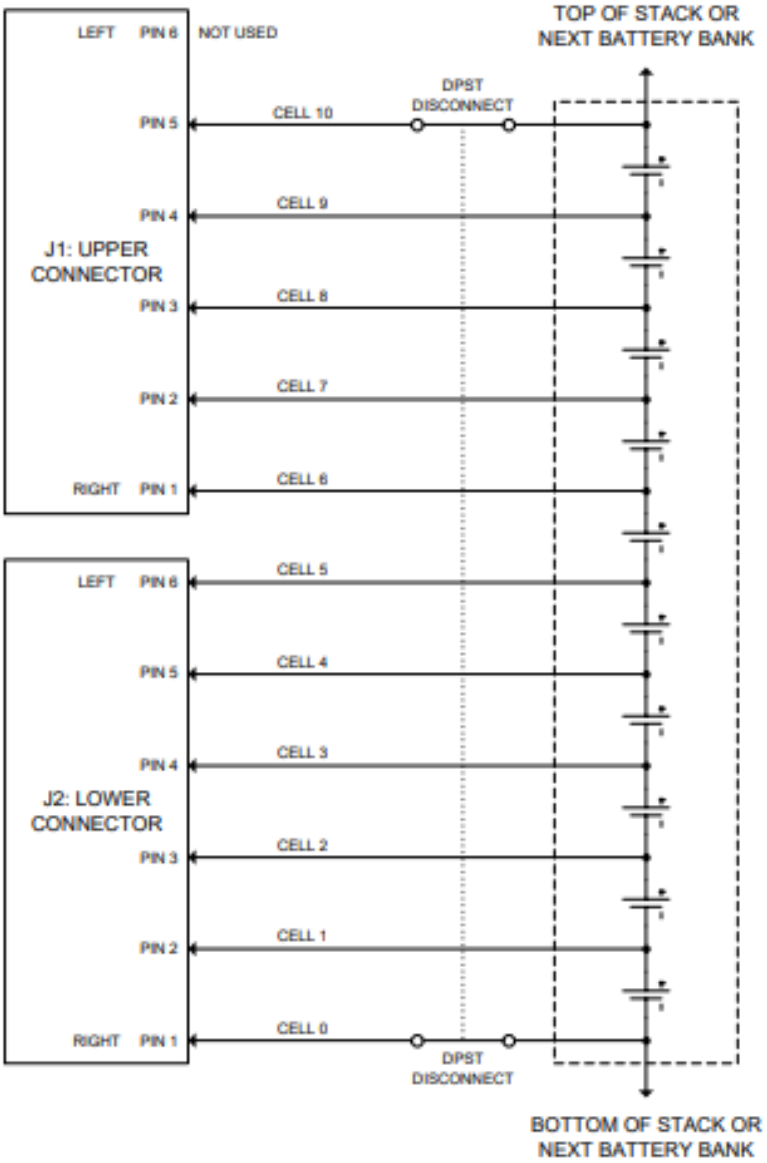
Other wiring arrangements are possible. For assistance in determining the connection scheme for a particular installation, please contact Electronics4All.

In addition to serving as an analog input, battery cell connections 0 and 10 are the main input power connections to the BMS. When less than 10 battery cells are connected to an individual BMS, the cells should always be wired from bottom (lowest potential) to top (highest potential), and the unconnected cells inputs should be shorted to the

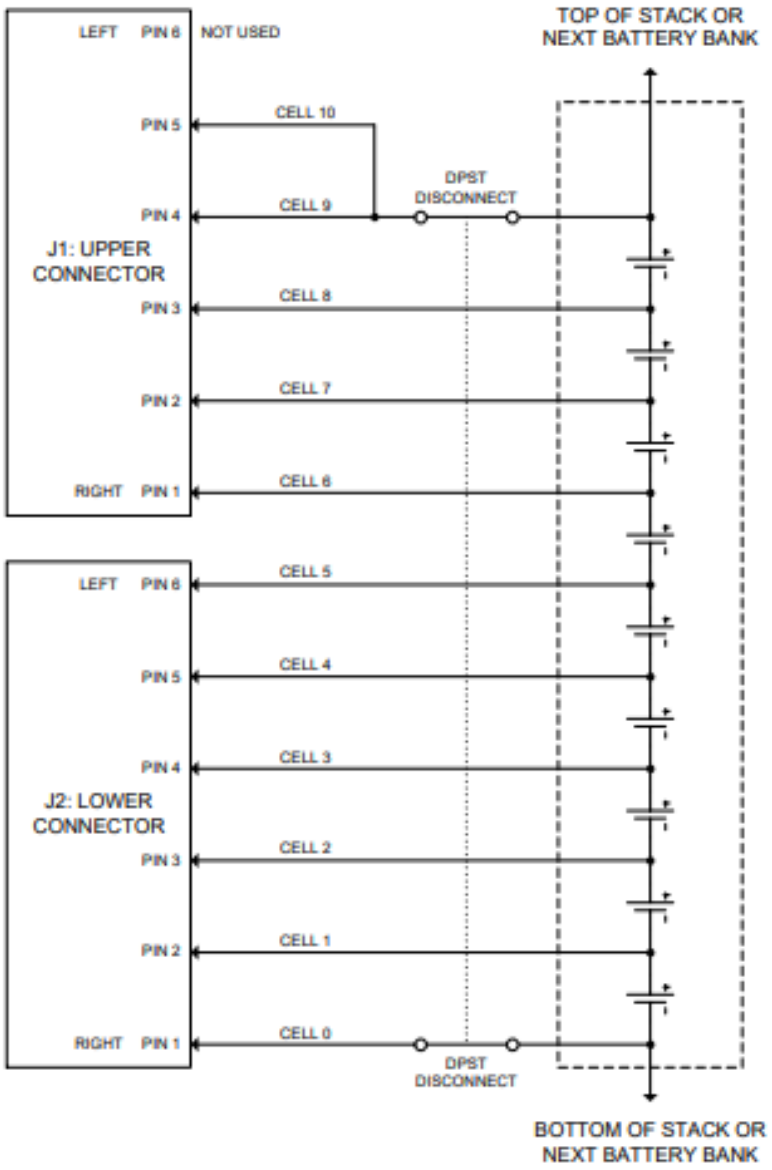
highest potential in the battery bank being monitored.

⚠Connections that serve as power inputs to the BMS should be protected by an external circuit breaker or emergency disconnect switch. The circuit breaker or disconnect must interrupt both conductors simultaneously, be suitably located and easily reached, and be marked as the disconnecting means for the BMS.

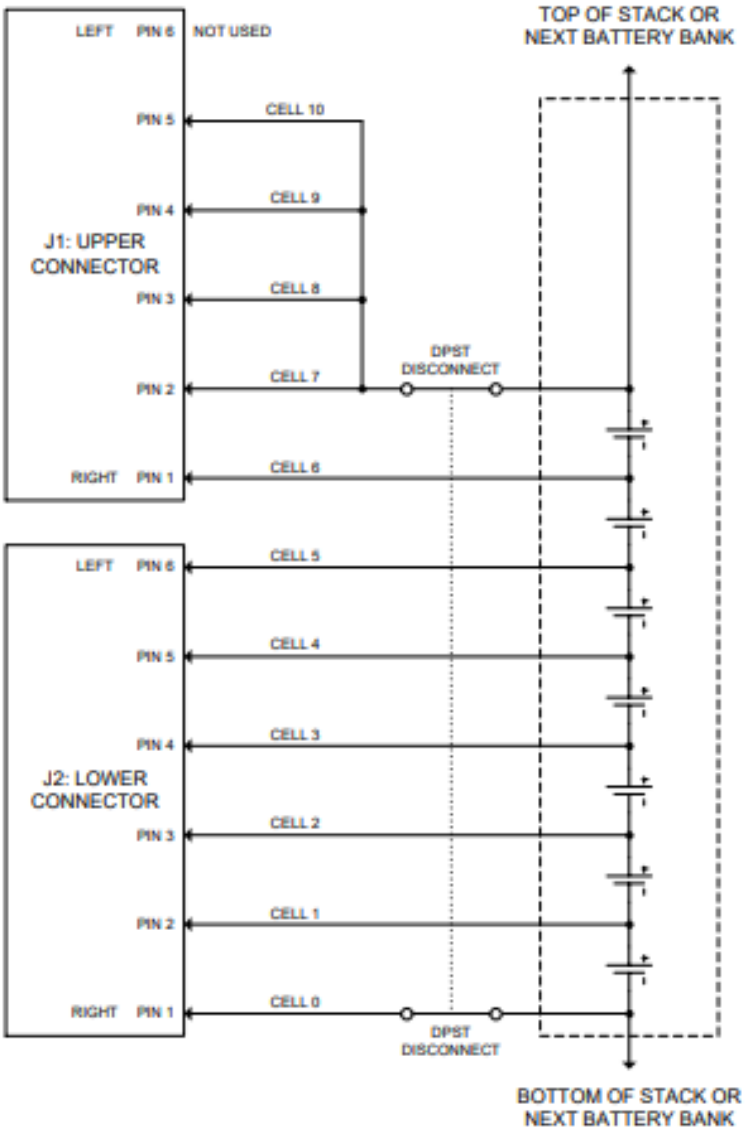
Example 10 Cell Wiring to BMS



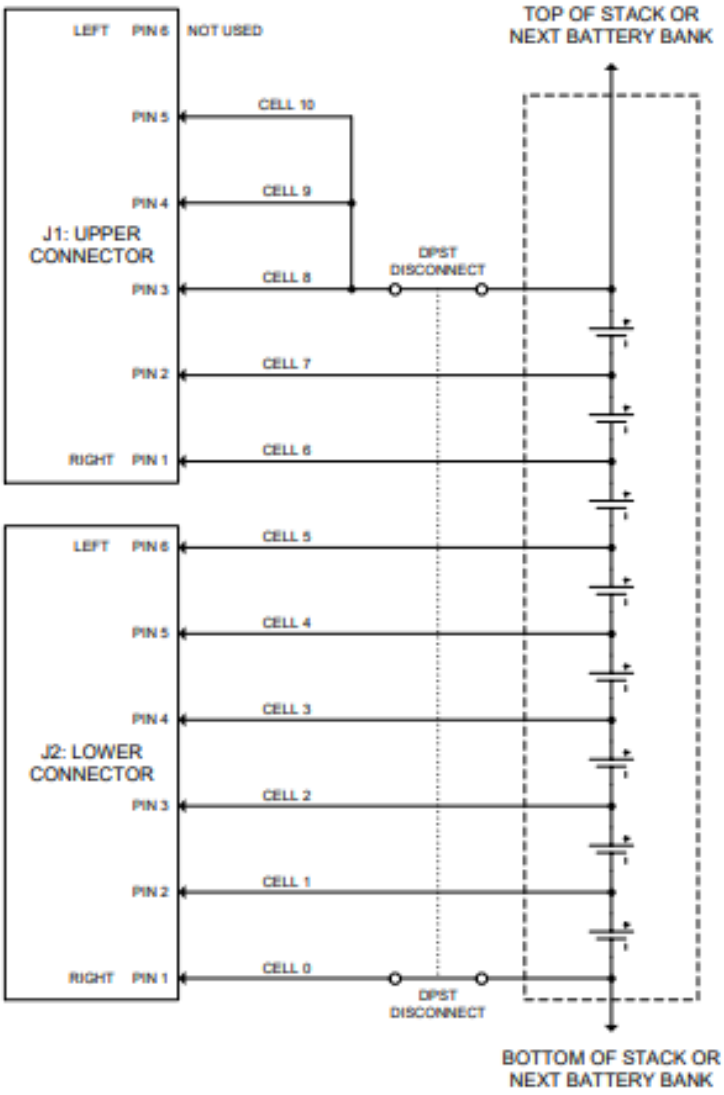
Example 9 Cell Wiring to BMS



Example 8 Cell Wiring to BMS



Example 7 Cell Wiring to BMS



MOUNTING BRACKET

A mounting bracket is provided on the rear of the BMS that connects to a standard 35 mm DIN rail.

ANTENNA

The BMS-1001-TH is designed to operate with the following antenna:

Manufacturer: PulseLarsen Antennas
Part Number: W1010
Frequency: 2.4 – 2.5 GHz
Gain: 2.0 dBi
Nominal Impedance: 50 Ω
VSWR: ≤ 2.0
Polarization: Vertical
Electrical Length: ¼ Dipole
Radiation: Omni

PAIRING

PAIRING STATUS

To determine if the BMS has been paired with a Gateway, press and release the PB1 pushbutton. If the green COM LED turns on for 1 second, the BMS is paired with a Gateway. If the red COM LED turns on for 1 second, the BMS is not paired with a Gateway.

PAIRING A BMS TO A GATEWAY

1. Place the target Gateway in Pairing Mode by pressing and releasing the PB1 pushbutton on the Gateway. The green COM LED will turn on.

2. Press and hold the PB1 button on the BMS. The red COM LED on the BMS will turn on for 1 second. Release the PB1 button on the BMS.
3. If pairing was successful, the green COM LED on the BMS will then turn on for 1 second, and the green COM LED on the Gateway will turn off.
4. If pairing was not successful, the green COM LED on the BMS will not turn on and the green COM LED on the Gateway will remain on. If this occurs, simply reattempt this step.

UNPAIRING A BMS FROM A GATEWAY

To unpair a BMS from a Gateway, press and hold the PB1 button. After 5 seconds, the red COM LED will start to flash rapidly. The PB1 button may then be released. The BMS is now no longer paired from the Gateway.

INTERNAL BATTERY

A 3300 mAh lithium-ion battery is installed in the BMS to provide reserve power should a fault occur with external

lead-acid battery bank. The internal battery provides power to the external interfaces, the Bluetooth link, and the current transducer circuitry.

When the BMS is drawing power from the internal battery, the green ‘Li-Ion’ LED on the front membrane will be on. The BMS will operate for approximately 11 days from a fully-charged internal battery and a 30 second broadcast rate.

The battery is accessed by removing the battery cover on the right side of the BMS enclosure.

The red ‘Bat Low’ LED will turn on when the BMS detects that less than 500 mAh is remaining in the internal battery. The internal battery may be recharged in the BMS by connecting either the included AC/DC power adapter (CUI Inc. SWI24-12-N-P6), or via a USB connection to a PC or dedicated USB charging device. The approximate charging times for each method are provided in the table below:

Charging Method	**Maximum Charging Current**	**Charge Time (80% / 100%)**
AC/DC Adapter	1.5 A	2.2 hours / 3.2 hours
USB	500 mA	6.6 hours / 7.6 hours

The ‘Bat Low’ LED will automatically turn off once more than 1000 mAh of capacity has been returned to the internal battery during a recharge.

The BMS contains protection circuitry that automatically disables battery charge operation when the battery temperature is below 10 °C or above 45 °C. The battery will continue to provide power if charge operation is inhibited. Charge operation will resume once the temperature returns to within the permissible range.

The BMS will disable all operation once battery temperature exceeds 60 °C. Discharge operation will resume once the temperature drops below 55 °C.

NOTE: The BMS should not be shipped with the internal battery installed. When transporting a BMS, the lithium-ion battery should be removed and shipped separately using an approved UN/DOT 38.3 shipping container.

RESET

The BMS may be reset at any time by pressing and holding both the PB1 and PB2 buttons for at least 4 seconds. The BMS will need to be re-paired after a reset.

CURRENT TRANSDUCER

The BMS is designed to support a CR Magnetics CR5210-50 current transducer. The BMS generates a 24 VDC 60 mA output to power the transducer, and accepts a ± 0.00 to 5.00 VDC analog input.

The transducer may be positioned anywhere within the lead-acid battery string to monitor battery charge and discharge current.

TERMINAL PLUG

The 4-pin current transducer terminal receptacle is designed to mate with Phoenix Contact Terminal Block Plug 1827729.

WIRE CONNECTIONS

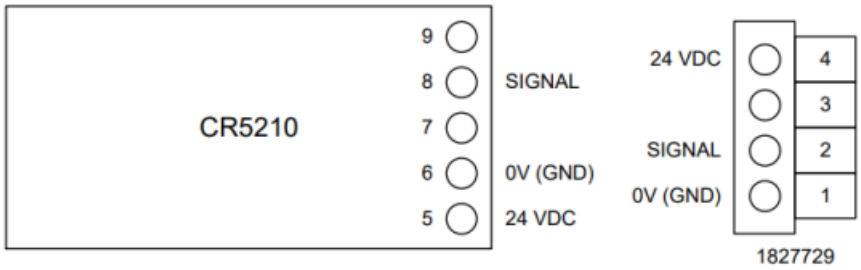
Ferrules are required on all wire input connections to prevent loose wire strands from contacting adjacent terminals. The Phoenix Contact 1827729 terminal plug accepts the following:

Connection Type	**Ferrule Tip Cross Section**
Conductor cross section flexible, with ferrule without plastic sleeve	0.25 mm^2 to 1.5 mm^2
Conductor cross section flexible, with ferrule with plastic sleeve	0.25 mm^2 to 0.5 mm^2
2 conductors with same cross section, stranded, with ferrule without plastic sleeve	0.25 mm^2 to 0.34 mm^2
2 conductors with same cross section, stranded, with TWIN ferrules with plastic sleeve	0.5 mm^2

Screw heads should be tightened between 0.22 Nm to 0.25 Nm.

TRANSDUCER CONNECTIONS

Transducer and BMS Mating Connector Pinouts



RATINGS

Parameter	**Value**
Voltage Output	24.00 VDC ± 5 %
Maximum Current Output	60 mA
Analog Input	± 5.00 VDC
Maximum Analog Input	± 5.50 VDC

Caution: Do not exceed the maximum voltage or current ratings of the transducer terminal.

SPECIFICATIONS

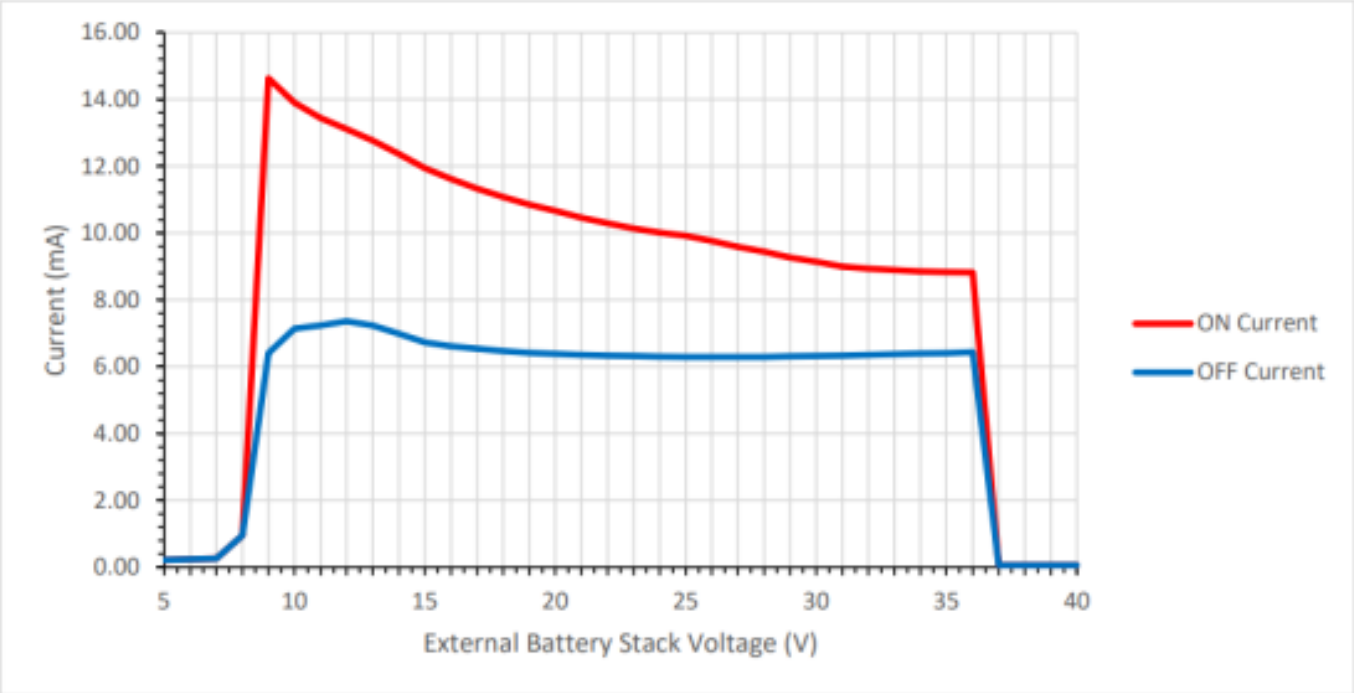
Radio	
Wireless Processor	• 48 MHz Arm Cortex M4F Processor • 2.4-GHz RF Transceiver Compatible with BLE 5.0 • Output Power up to +5 dBm with Temperature Compensation • Receiver Sensitivity: -105 dBm, 125 kbps
Security	• AES 128- and 256-bit Crypto Accelerator • ECC and RSA Public Key Hardware Accelerator • SHA2 Accelerator (Full Suite Up to SHA-512) • True Random Number Generator (TRNG)
Communication Range	300 m Line of Sight (Paired to GTW-BL100 Wireless Gateway)
Communication Interval	User Programmable in 30 second Increments
I/O	
Analog Front End (AFE)	• 11 VDC to 36 VDC Local Lead-Acid Battery String Input • Up to 10 Individual Series Connected Cells • 0 – 5.00 VDC Measurement Range per Cell • 16-bit Resolution

Current Measurement	• Single Channel Input for Hall Effect Current Transducer • 24 VDC 60 mA Power Output • -5.00 VDC to +5.00 VDC Analog Input • 12-bit Resolution
Temperature Measurement	-40 °C to 120 °C (± 0.5 °C, +15 to +40 °C)
Humidity Measurement	0 to 100 % Relative Humidity (± 3.5 % RH, 20 to 80 % RH)
Communication Port	USB 2.0 Debugging Interface
Interface	
Indicators	Front Fascia Membrane (Red, Green, Orange LEDs)
User interface	• Front Fascia Membrane (3 Push Buttons) • Dual Rotary Encoders (0-9 Selection via Dial)
Mechanical	
Dimensions (Enclosure)	120 mm (H) x 90 mm (W) x 50 mm (T)
Weight	300 g
Certifications	
FCC	2AXVKBMS01
Industry Canada	26661-BMS01

Safety	61010-1
Accessories	
Internal Battery	Panasonic NCR18650B 3400 mAh 3.6V
Antenna	PulseLarsen Antennas W1010
AC/DC Adapter	CUI Inc. SWI24-12-N-P6
Current Transducer	CR Magnetics CR5210-50
Mating Connectors	Battery Cells (6 Pin): Phoenix Contact 1827745 Current Transducer (4 Pin): Phoenix Contact 1827729

OPERATING CURRENT PROFILE

Battery Stack Load Current vs. Battery Stack Voltage



CONTACT INFORMATION

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Documents / Resources

	Electronics4all BMS01 Battery Monitoring System [pdf] Instruction Manual BMS01, 2AXVKBMS01, BMS01 Battery Monitoring System, Battery Monitoring System