Battery Monitoring System

(Battery monitoring system for larger UPS systems)

INSTALLATION MANUAL

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Table of content

1. System description

This system comprehensively measures the battery performance, and displays the real-time parameters and real-time alarm for the failed battery to realize the automation of battery detection and failure expected detection. Through real-time monitoring of the battery power parameters and operating status obtained by the Controller, the actual operating status and health status of the battery pack can be accurately grasped, and problems existing in the use of the battery pack can be found in time.

The HMI touch display displays the power data, health status and alarm reminder of each battery in real time. The cell sensors detect the condition of each battery in real time, and gives a timely alarm to the bad battery, so as to accurately grasp the actual running state and health of the battery pack in real time, and to timely find problems in the use of the battery pack.

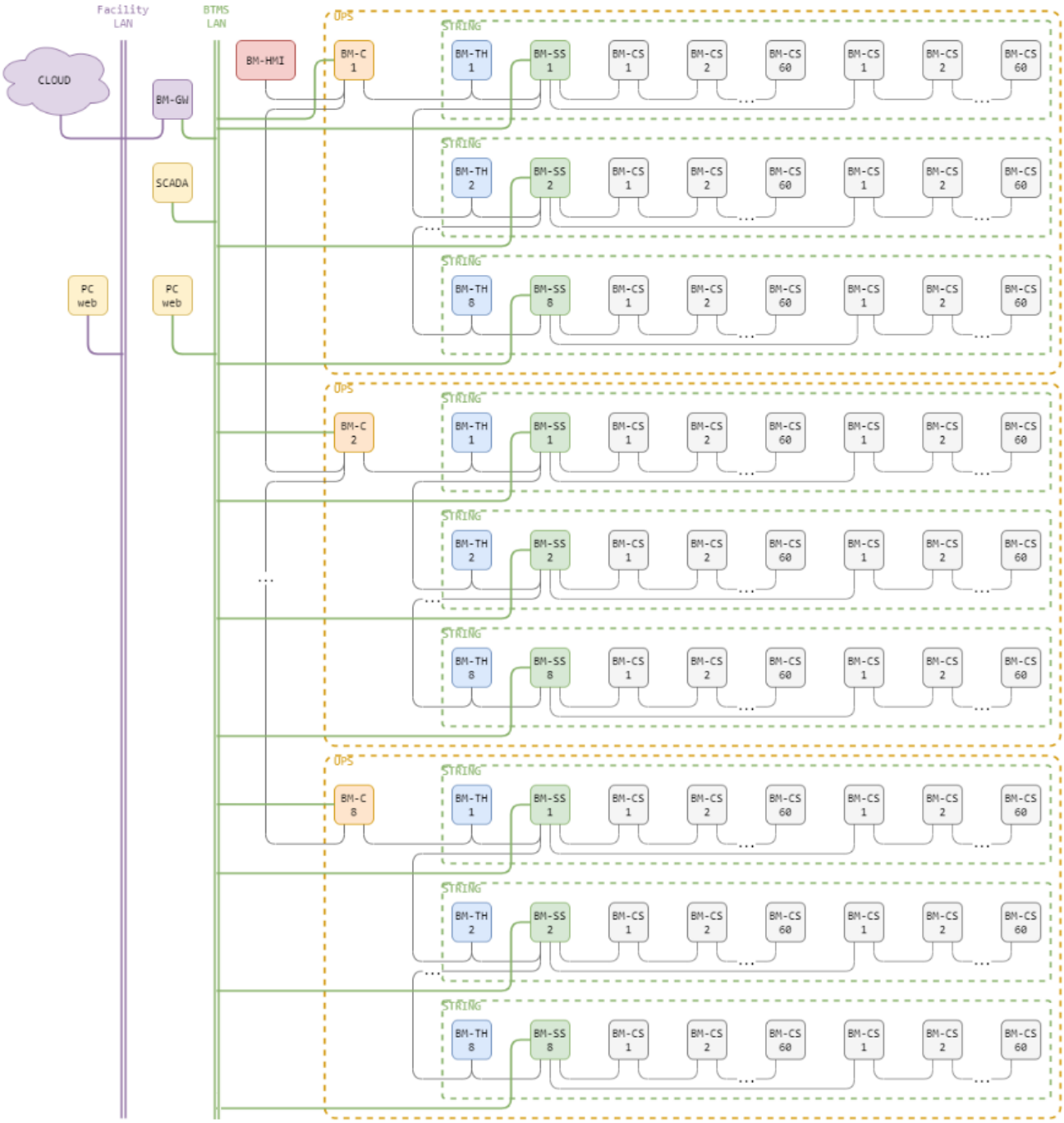
This not only effectively extends the backup time and operating life of the battery pack, but also greatly reduces the maintenance costs such as manpower and material resources. It also improves the safety of battery use, reduces the accident rate and effectively saves energy and reduces emissions, creating for the user and create good economic and social benefits for the users.

Dictionary of terms and abbreviations

BTMS	Battery Monitoring System	Battery monitoring system for larger UPS systems.
Battery	-	Lead-acid rechargeable battery stores electricity to operate the UPS during a power outage.
Cell	-	Basic battery building. A battery usually consists of several cells connected in series.
String	-	Multiple batteries connected in series.
UPS	Uninterruptible Power Supply	A device that provides battery backup when the electrical power fails or drops to an unacceptable voltage level.
BM-CS	Battery Cell Sensor	Sensor that monitors the status of an individual cell or battery.
BM-SS	Battery String Master	A sensor that connects the BCS and monitors the state of the string.
BM-HS	Hall Sensor	Direct current sensor that operates on the basis of the Hall effect.
BM-TH	Temperature and Humidity Sensor	Measurement of ambient temperature and relative humidity.
BM-C	Master Controller	A controller that allows monitoring the status of several BSMs, displaying the status of batteries and strings on the TD and serving data to the control system.
BM-HMI	Touch Display	Graphic display with touch screen.

BM-GW	Gateway	It provides a complete overview of the current status and history via a web browser in the local network and a secure connection of the system to the cloud service.

System diagram



2. Modules description

BTMS Gateway

Order code: BM-GW

Highlights & Features

- Local WEB UI
- real-time data display
- data logging
- history data display (tables, time-plots)
- history and real-time data download
- e-mail, SMS alarming
- Robust and safe connection of BTMS system to BTMS cloud platform.
- Secure access and communication (TLS encryption)
- Local data buffer, no data loss
- User data safety according to GDPR
- Secure remote access to BM-C controllers

System specifications

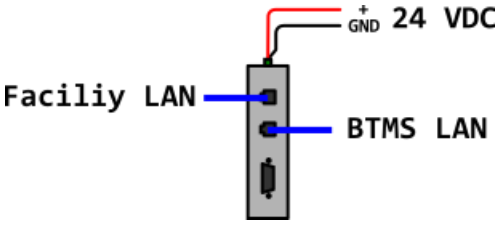
- Up to **32 strings arbitrarily distributed on several UPSs**
- **Up to 120 batteries / string** (3840 batteries / system)
- **Temperature and humidity** sensor for each string
- Logging data for one year by automatically deleting old data
- Send e-mail and SMS alarms directly from the device

HW Technical specification

Power supply in	12 ... 24 VDC, 1.39 ... 0.72 A
Construction in	Extruded aluminum and heavy-duty steel, IP30
CPU in	Intel® Celeron® N3350 2C @1.1 GHz, TDP: 6 W
System Memory in	1 x DDR3L-1866 SO-DIMM 4 GB

Storage in	128 GB SSD	
System I/O Outlet in	Serial 1 x DB9 RS-232/422/485	
	Display 1 x VGA	
	Ethernet 2 x RJ-45 isolated* 10/100/1000 Mbps	
	DIO 1 x DB9 8-bit programmable DIO	
	LTE Cat 4 Quectel EG25-G Mini PCIe	
Working temp. in	-20 °C ... +70 °C (-4 °F ... +158 °F)	
Humidity in	0% to 95%	
Vibration Endurance in	2 Gms with storage (5 to 500 Hz, X/Y/Z direction; random, operating)	
Mounting in	DIN rail, wall	
Weight (net/gross) in	0.3 kg (0.67 lb.)/0.45 kg (0.99 lb.)	
Dimensions in	height	125 mm
	width	31 mm
	depth	100 mm

Wiring



Mounting

- On DIN Rail (35 mm) in control system cabinet

BTMS Battery master controller

Order code: BM-C

Highlights & Features

- Full control for an UPS system
- Supports up to in
- 8 strings (8 BM-SS)
- 960 batteries (8 BM-SS × 120 BM-SC)
- Standard Modbus/TCP connectivity to SCADA systems

Technical specification

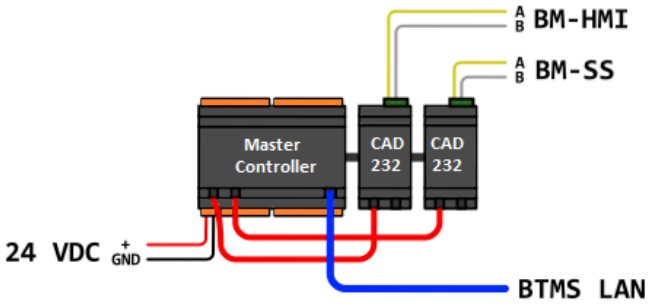
Power supply	Normal	24 VDC
	Range	18...28 VDC
Power consumption	Typical	150 mA
	Max	250 mA
Digital outputs	Relay 8 A / 250 VAC or 8 A / 30 VDC resistive	
Operating conditions	0 ... 50 °C / 0 ... 85 RH non-condensing	
Mounting	DIN Rail	
Dimensions	Width	185 (110 + 2 × 37,5) mm
	Height	103 mm
	Depth	51 mm

LED Indicators

PWR		Power supply OK
RUN		Run
		Stop
		Pause
		Program error

		No kernel
		Hardware error
IEX2	IEX-2 modules communication status	
COM1	BM-TP communication status	
COM2	BM-SS communication status	
Ethernet	LAN communication status	

Wiring



Mounting

- On DIN Rail (35 mm) in control system cabinet

BM-SS BTMS String Master

Order code: BM-SS

Highlights & Features

- Real-time monitoring of string voltage, charge-discharge current, charge-discharge state and string SOC.
- Monitor the voltage, impedance, temperature, SOC and SOH of each battery with BM-CS cell sensors and the specially designed isolated power bus.
- Advanced one-step auto-sensing for individual address. No more manual intervention and setup needed, reducing workload and setup errors.
- Advanced measurement algorithm, no need to discharge large current and measurement can be lossless.
- Balancing function: Keep voltage balanced during the floating charge process of battery pack, keeping the individual battery in the best state, extending backup time and life span of battery pack.
- Communication is based on power-isolated RS 485. Secure and stable.
- Quickly locate the alarmed or faulty battery pack in machine room.
- External open Hall Sensor, measuring charge-discharge current in different ranges.
- Isolated voltage in communication interface: AC 3750 V
- Supports up to 120 batteries (BM-CS)

Technical specification

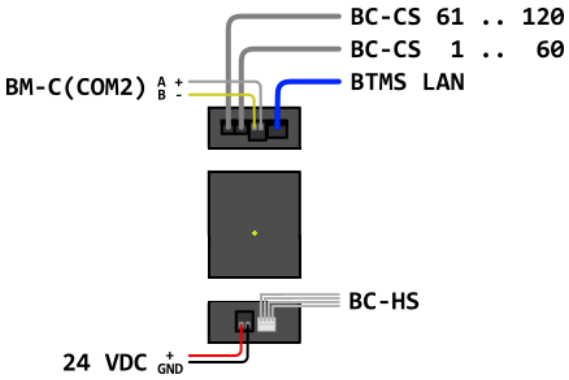
Power supply	Normal	24 VDC
	Range	12 ... 36 VDC
Power loss	< 2 W	
Operating temperature	0 ... 45 °C	
Storage temperature	-40 ... 70 °C	
Working humidity	5 ... 95 % RH non-condensing	

Dimensions	Width	85 mm
	Height	105 mm
	Height max	120 mm
	Depth	39 mm
Voltage measurements	Range	20...800 VDC
	Accuracy	±0.5%
	Resolution	0.01 VDC
Current measurements	Range	-1000...1000 A
	Accuracy	±2%
	Resolution	0.01 ADC

LED Indicators

Normal operation	Green LED breathing mode
Alarm / Error	Red LED

Wiring



Mounting

- On DIN Rail (35 mm) in control system cabinet or next to first BM-CS and next to BM-HS

BTMS Cell sensor

Order code: BM-CS-xx

Highlights & Features

- Real-time cell voltage measurement
- Internal resistance measurement on line
- Negative pole temperature measurement
- Balancing function

Technical specification

Power supply	BM-CS-02	2 VDC (1.6 ... 2.6 VDC)
	BM-CS-12	12 VDC (7.5 ... 15.6 VDC)
Power loss	BM-CS-02	110 mW
	BM-CS-12	90 mW
Operating temperature	0..45 °C	
Storage temperature	-40..70 °C	
Working humidity	5..95% RH non-condensing	
Dimensions	Width	60 mm
	Height	80 mm
	Height max	95 mm
	Depth	25 mm
Voltage measurements	BM-CS-02	1.6 ... 2.6 VDC
	BM-CS-12	7.5 ... 15.6 VDC
	Accuracy	± 0.2%
	Resolution	0.001 V
Resistance measurements	Range	0.1 ... 50 mΩ

	Consistency	± (1.5 % + 25 µΩ)
	Repeatability	± (1.0 % + 25 µΩ)
	Resolution	0.001 mΩ
Balancing	Current	0.2 A
	Time	1 min

LED Indicators

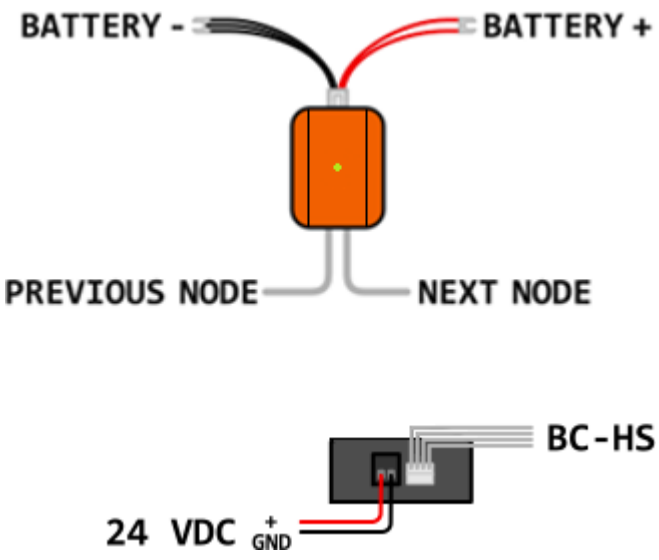
Normal operation	Green LED breathing mode
Alarm / Error	Red LED flashing

Battery SOC is calculated using the default battery characteristic parameters in

Battery voltage level	2 V	12 V
Float range	-0.02 C* ... +0.02 C*	
Float voltage	2.23 V	13.38 V
Cut-off voltage	1.75 V	10.8 V
Recovery voltage	2.12 V	12.68 V

* C is the battery capacity

Wiring



Mounting

- Directly on the battery / cell with the included double-sided sticker
- Use supplied cable with U spade terminals directly for battery / cell wiring

BTMS Hall Sensor

Order code: BM-HS-xxx

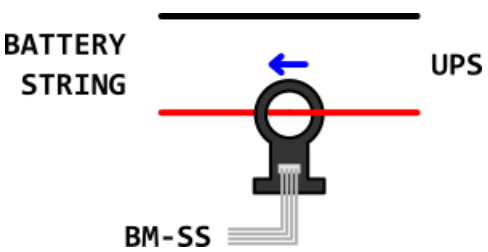
Highlights & Features

- easy installation (split core)
- wide current range of application

Technical specification

Dimensions	Width	95 mm	
	Height	80 mm	
	Depth	25 mm	
	Core inner diameter	40 mm	
Current measurements	BM-HS-100	Measure Range 0 ... 100 A	Rated Input: 50 A
	BM-HS-200	Measure Range 0 ... 200 A	Rated Input: 100 A
	BM-HS-400	Measure Range 0 ... 400 A	Rated Input: 200 A
	BM-HS-800	Measure Range 0 ... 800 A	Rated Input: 400 A
	BM-HS-1000	Measure Range 0 ... 1000 A	Rated Input: 500 A
	Resolution	0.01 ADC	

Wiring



Mounting

- On positive wire between first battery / cell and UPS
- Pay attention to the direction indicated by the arrow

BTMS 7” HMI Touch display

Order code: BM-HMI

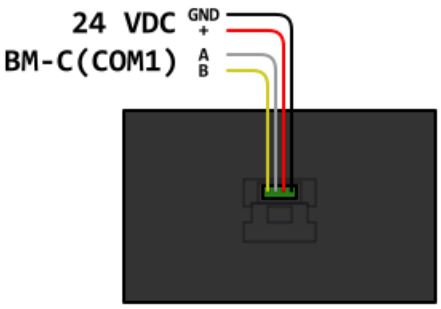
Highlights & Features

- 7” capacitive touch screen
- Supports up to in
- 8 UPSs (8 BM-C)
- 64 strings (8 BM-C × 8 BM-SS)
- 7.680 batteries (8 BM-C × 8 BM-SS × 120 BM-CS)

Technical specification

Power supply	24 VDC, 5 W max	
Size	7“	
Resolution	1024 × 600	
Colors	65 k, 16-bit RGB	
Communication	RS 485	
	1200 - 115200 bps	
Dimensions	Width	184 mm
	Height	118 mm
	Depth	15 mm
	Max depth	23 mm

Wiring



Mounting

- On the wall
- On the cabinet

BTMS Power Supply

Order code: BM-PS

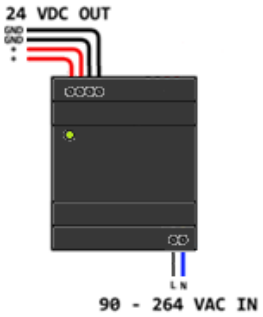
Highlights & Features

- Universal AC input voltage and full power up to 50°C
- Efficiency > 88.0% @ 230Vac and 115Vac

Technical specification

Input voltage range	90 - 264 VAC	
Output voltage	24 VDC	
Output current	3.80 A	
Input current	< 1.5A @ 115Vac, < 1.0A @ 230Vac	
Operating temperature	-25°C to +71°C;	
Storage temperature	-25°C to +85°C	
Mounting	DIN rail, 4M 71mm	
Dimensions	Height	71 mm
	Depth	91 mm
	Width	57 mm

Wiring



Mounting

- On DIN rail (35 mm) in cabinet

BTMS Temperature and humidity sensor

Order code: BM-TH

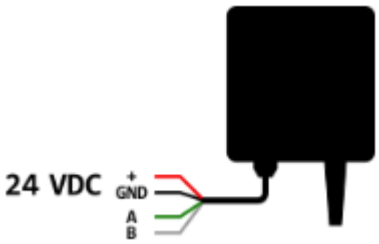
Highlights & Features

- High measurement accuracy
- Integrated use of temperature and humidity
- Superior performance, good long-term stability

Technical specification

Supply voltage	10...30 VDC	
Power consumption	0..4W max	
Temperature measuring	Range	-40... +80 °C
	Precision	+- 0.5°C (25°C)
	Resolution	0.1°C
	Long term stability	< 0.1°C/year
	Response time	< 18/s (1m/s wind)
Humidity measuring	Range	0..100% RH
	Precision	+- 3% RH
	Resolution	0.1 % RH
	Long term stability	< 0.1 % RH /year
	Response time	< 6s (1m/s wind)
Dimensions	Width	135 mm
	Height	150 mm
	Depth	45 mm

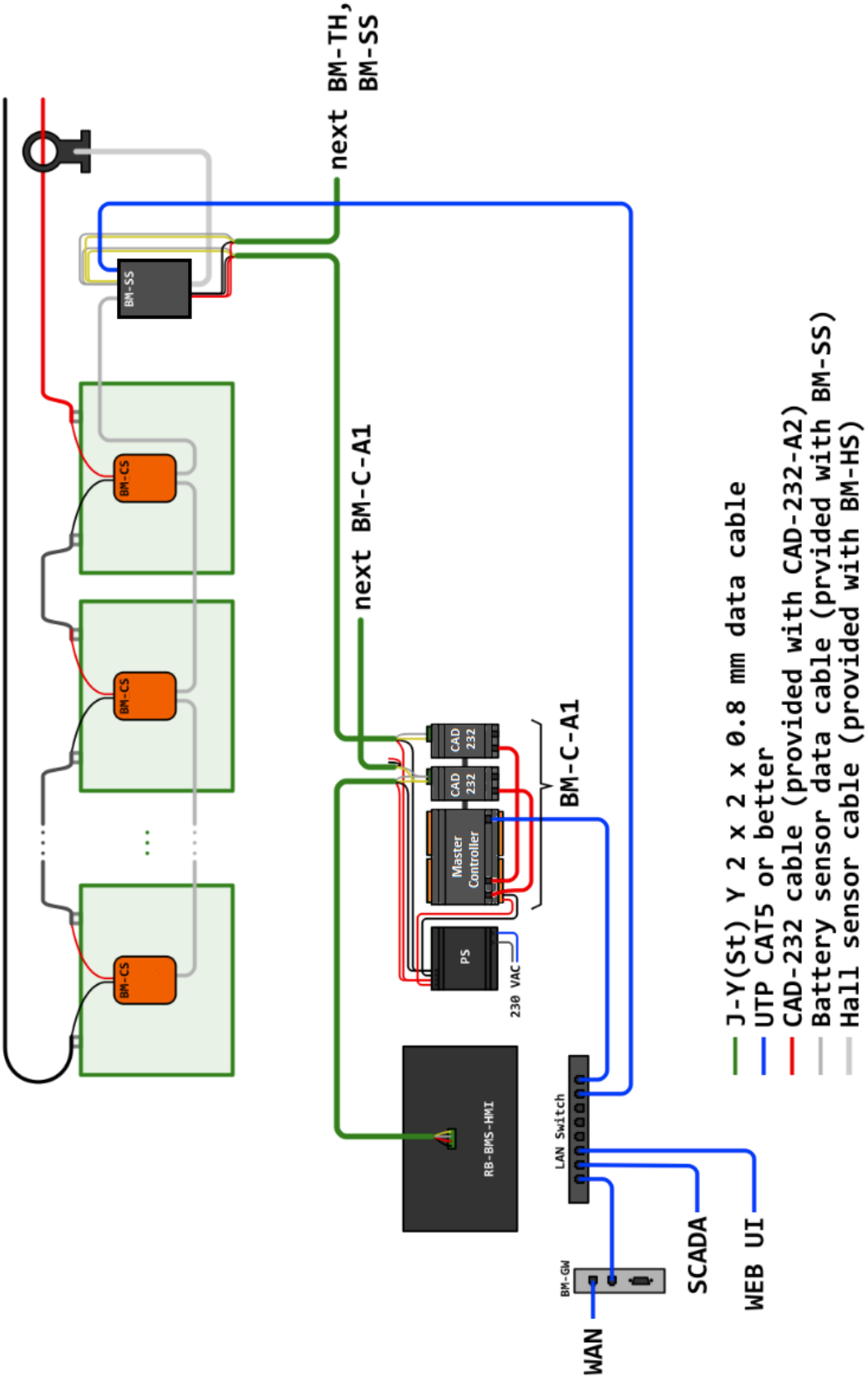
Wiring



Mounting

- On wall next to string

3. System wiring diagram



4. Commissioning

The initial settings of the BTMS system can only be made by a specially trained authorized person or by Robotina. To properly set up the system, it is necessary to provide the following information:

- Gateway IP address within facility LAN:
  - DHCP or fixed (IP, Subnet mask, Gateway IP)
- Gateway IP address within BTMS LAN:
  - IP, Subnet mask, Gateway IP
- Battery / Cell info (provided by the client prior to commissioning):
  - Capacity in Ah
  - Nominal voltage in V
  - Reference internal resistance in mΩ
  - Cut-off voltage in V
  - Recovery voltage in V
  - Float voltage in V
  - Float current in A
  - Internal resistance correction in mΩ
- Battery / Cell alarm and recovery info (provided by the client prior to commissioning):
  - Voltage upper limit in V
  - Voltage lower limit in V
  - Resistance upper limit in mΩ
  - SOC lower limit in %
  - SOH lower limit in %
  - Temperature upper limit in °C
- String info (provided by the client prior to commissioning):
  - Resistance measuring interval in hours
- String alarm and recovery info (provided by the client prior to commissioning):
  - Charging current limit in A
  - Discharging current limit in A
  - Voltage upper limit in V
  - Voltage lower limit in V
  - SOC lower limit in %
- Hall (current) sensor info (provided by the client prior to commissioning):
  - Type
  - Nominal current in A
- Balancing settings (provided by the client prior to commissioning):
  - Balancing enabled (yes/no)

    - Target balance in %
    - Interval time in s
- Communication settings (determined by the commissioning engineer at commissioning):
    - RS485 address (10 ... 17)
    - RS485 baud rate (38400 bps)
    - LAN IP address (192.168.10.100 ... 192.168.10.131)
    - LAN Subnet mask (255.255.255.0)
    - LAN Gateway (192.168.10.1)

An excel table "BTMS Commissioning Table v2.0.xml" has been prepared to help with data entry.

Commissioning steps

Step	Activity	Description	Done by
1	Mounting & wiring	Mount all modules and wire them according wiring diagrams. It is necessary to be very careful when wiring, as there can be very high and life-threatening voltage in the string due to serial batteries / cells connections.	Installer
2	Test wiring	Check the entire wiring carefully. Connect the power supply to all modules and check if the modules are working correctly (the LED indicators behave according to the instructions).	Installer
3	Fill in the table	For each string and for each gateway, all necessary data must be entered in the table. The information from the table, which must be filled in by the customer, is necessary so that the authorized system integrator can set up the BTMS system correctly.	Customer
4	BM-SS setup	For each BM-SS, it sets the necessary parameters for used batteries / cells and for alarming. Set addresses and communication parameters for serial and Ethernet communication.	Authorized system integrator
5	BM-TH setup	Set addresses communication parameters for serial communication.	Authorized system integrator

6	BM-C setup	Set data on the used BM-SS and BM-TH sensors connected to the BM-C controller. Set the communication parameters for Modbus TCP/IP communication with the display system.	Authorized system integrator
7	BM-GW setup	Set WAN, NTP, Time setting. Add Users for WEB UI app.	Authorized system integrator
8	Function test	On all user interfaces (touch panel, WEB UI on BM-GW), check whether all displayed data are consistent with the expected values. Check Modbus TCP/IP communication with the BM.-C controller.	Authorized system integrator

5. Troubleshooting

If you are having problems with the system, try the appropriate solutions below. This may fix a system error that is the result of one of the most common system failures or installation mistakes. In any case, our technical support will be able to help you, it is at in http://support.robotina.com.

By trying the solutions listed below, our technical support will also be more effective in identifying errors and will help you more effectively.

The power supply and the power supply of all components are connected correctly

Communication cables are properly connected (it is best to check each one step by step)

Check that the hall sensor is facing correctly (there is an arrow on it showing the direction of the electric current)

Check LED on Cell sensor and String master (is green breathing mode or constant red)

One of the possible causes of malfunction may also be incorrect initial system configuration.

The initial configuration of the system can only be done by an authorized person! Contact an authorized person for any problems.

Robotina Help Desk in http://support.robotina.com

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