

Battery Monitoring System

(Battery monitoring system for larger UPS systems)

INSTALLATION, COMMISSIONING and MAINTENANCE MANUAL

V3.1

Table of content

1	System description	4
1.1	System and wiring diagram	5
1.2	System Features	6
2	Modules description	8
2.1	BTMS Gateway.....	8
2.2	BM-SS BTMS String Master.....	10
2.3	BTMS Hall Sensor.....	12
2.4	BTMS Cell sensor	14
2.5	BTMS Power Supply.....	16
2.6	BTMS Battery master controller.....	18
2.7	BTMS IO expansion module.....	20
2.8	BTMS Temperature and humidity sensor.....	21
2.9	BTMS 7" HMI Touch display	23
2.10	BTMS IOT Agregator	24
3	BTMS Installation.....	26
3.1	Base System.....	27
3.1.1	Install BM-CS.....	27
3.1.2	Install BM-HS	27
3.1.3	Install BM-SS.....	27
3.1.4	Install BM-GW.....	28
3.1.5	Install BM-PS-60-24	28
3.1.6	Install BM-MC and BM-C-A1.....	29
3.1.7	Install BM-HMI-BM.....	29
3.1.8	Install BM-TH	30
3.2	Power ON.....	30
4	BTMS commissioning.....	31
4.1	General settings.....	32
4.1.1	Network settings	32
4.1.2	NTP settings.....	33
4.1.3	Time settings.....	33
4.1.4	Users Setting.....	34
4.1.5	SMTP settings	35
4.1.6	SMS notifications	35
4.1.7	Modbus server.....	35
4.1.8	Project settings	36
4.2	Adding string and battery sensors.....	36

4.2.1	Assign string sensor to string.....	37
4.2.2	Assign string to UPS.....	38
4.2.3	Adding BM-MC, BM-LC and BM-TH.....	39
4.2.4	Validate Configuration.....	41
4.2.5	Check Settings.....	41
4.3	String and Battery sensors settings.....	42
4.3.1	Alarm settings.....	42
4.3.2	Resistance settings.....	44
4.3.3	Balancing settings.....	44
4.3.4	Cell settings.....	45
4.3.5	Hall Setting.....	46
4.3.6	Voltage Measurement.....	47
4.3.7	Configuration file.....	48
4.4	BTMS Installation and Commissioning steps overview.....	50
5	Maintenance.....	52
5.1	Maintenance plan.....	52
5.2	Preventive Maintenance Checklist.....	52
6	Troubleshooting.....	56
6.1	Alarms.....	56
6.2	System malfunctions.....	56
6.3	Support.....	56
7	Appendix: BTMS Alarm List.....	57

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.

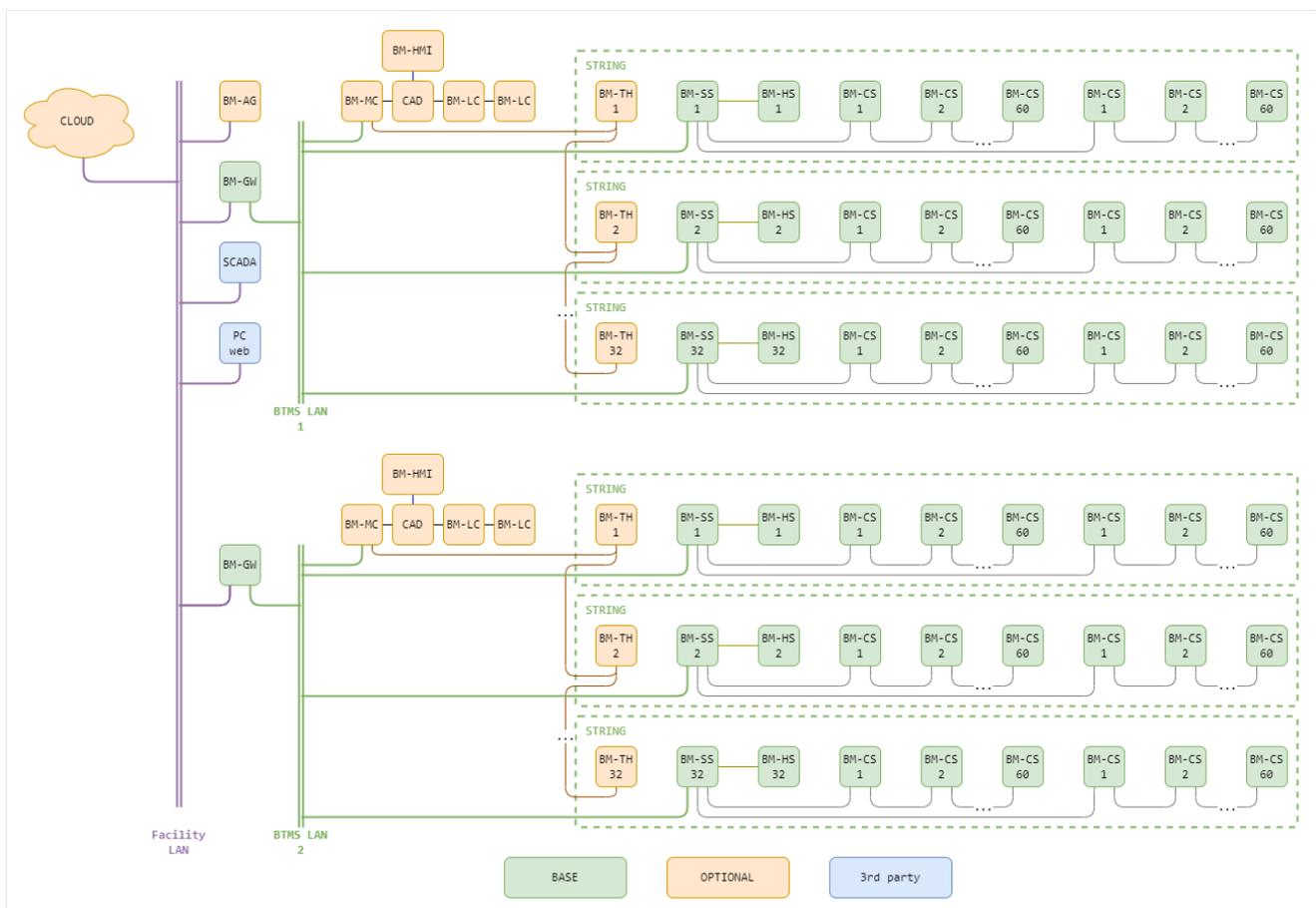
This not only effectively extends the backup time and operating life of the battery pack, but also greatly reduces the maintenance costs such as manpower and material resources. It also improves the safety of battery use, reduces the accident rate and effectively saves energy and reduces emissions, creating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

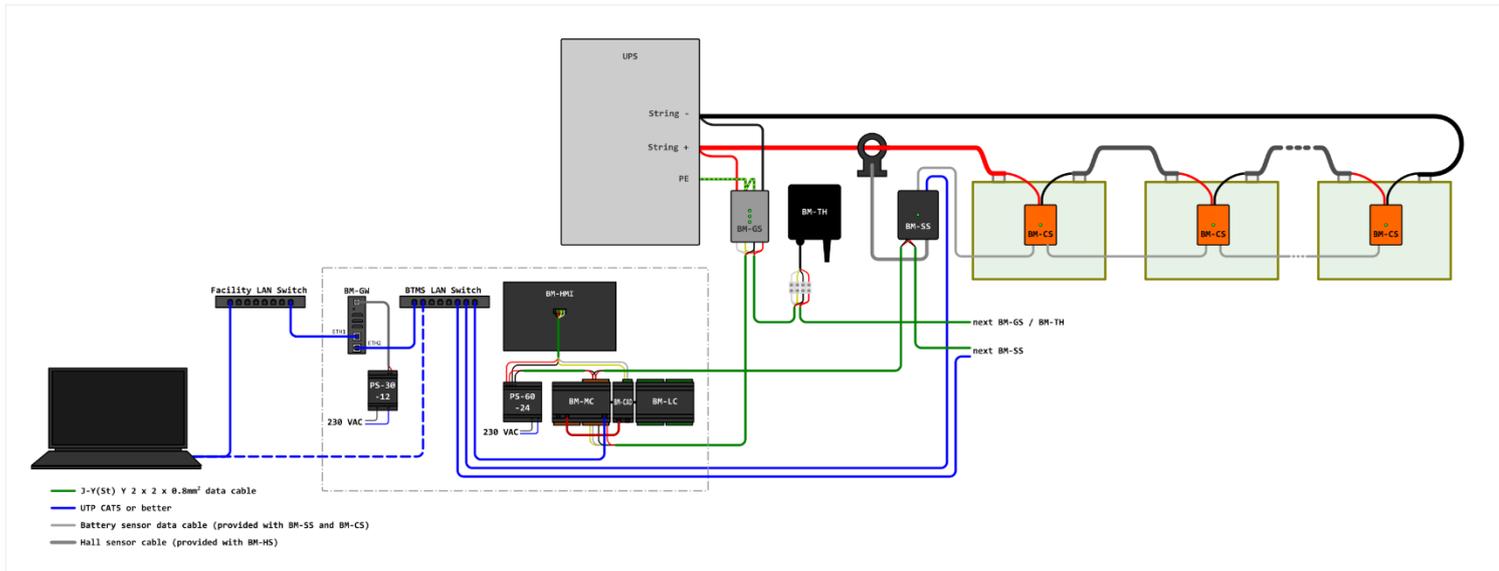
Dictionary of terms and abbreviations

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-AG	BTMS Aggregator	When several BM-GW's are needed at the Datacenter, aggregate all BM-GW and provide site functionality + Cloud connectivity and alarming.'
BM-GW	BTMS Gateway	Visualization (browser) of batteries and installed systems connected to the GW logically grouped into strings and UPS's in real time and their historical data. Alarming, Cloud connectivity
SCADA	3rd party SCADA	Any SCADA that accesses battery, stringig and/or UPS data via Modbus TCP/IP protocol.
PC web	PC with WEB Browser	Viewing the user interface from BM-AG or BM-GW via any web browser.
BM-MC	BTMS Master Controller	It allows the connection of BM-TH sensors and configurable digital inputs for monitoring additional alarm signals and outputs for alarming or switching off strings where an error occurs.
BM-HMI	BTMS Human-Machine Interface	Local display of the state of the batteries inside the UPS, string and by battery.
CAD	BTMS HMI interface	Communication interface for connecting BM-HMI to BM-CS
BM-LC	BTMS IO Module	Expansion for MC with additional digital inputs and outputs.

BM-TH	BTMS Temperature and Humidity sensor	Ambient temperature and relative humidity sensor.
BM-SS	BTMS String Master	It monitors the string (string current), aggregates battery data (total string voltage, average SOC, Balance) and enables monitoring of data from BM-CSs.
BM-HS	BTMS Hall Sensor	It measures the string current
BM-CS	BTMS Cell / Battery Sensor	Control of each individual battery / cell. It allows monitoring the status, voltage, internal resistance, temperature of the cell and calculates SOC and SOH.
SOC	State Of Charge	Calculated battery charge; it is calculated from the actual voltage on the battery and by integrating the charge and discharge current.
SOH	State Of Health	Informative battery state calculation that takes into account internal resistance, battery temperature, rise/fall of voltage during charge/discharge and other parameters that affect battery performance.
Balance	Voltage balance within string	Calculation of voltage inequality on the batteries within the string. Battery sensors can actively equalize the voltage between the batteries within the string during the floating charge phase.

1.1 System and wiring diagram





1.2 System Features

Highlights

- monitoring of all important **battery** parameters of larger **UPS** systems in order to ensure operational reliability
- **simple and fast installation** on existing or new UPS systems
- **very reliable operation**
- simple and intuitive **WEB user interface**
- automatic **logging** of data and storage for a period of one year
- easy **download of all displayed data** for further processing in **standard format (csv)**
- easy connectivity to 3rd party SCADA, BMS, ... systems via standard **Modbus TCP/IP protocol**

System functionality

Data	Real-time data	History data	Alarming		Range	Accuracy	Resolution	
			Low	High				
Per Battery (cell)	Voltage	✓	✓	✓	✓	2V battery..... 1.6 .. 2.6 V 12V battery.... 7.5 .. 15.6 V	±0.2 %	0.001 V
	Resistance	✓	✓		✓	0.1 .. 50 mΩ	±(1.5 % + 25 μΩ)	0.001 mΩ
	Temperature	✓	✓		✓	-20 .. +85 °C	±0.5 %	0.1 °C
	SOC	✓	✓	✓		0 .. 100 %		1 %
	SOH	✓	✓	✓		0 .. 100 %		1 %

Per string	Voltage	✓	✓	✓	✓	20 .. 800 V	± 0.5 %	0.01 V
	Current	✓	✓	✓	✓	-1000 .. 1000 A	± 2 %	0.01 ADC
	State	✓				floating charge, equalizing charge, discharge, idle		
	SOC	✓	✓	✓		0 .. 100 %		1 %
	Balance	✓	✓			0 .. 100 %		0.01 %
	Ambient temperature	✓				-40 .. +80 °C	± 0.5 °C	0.1 °C
	Ambient humidity	✓				0 .. 100 % RH	±3 %RH	0.1 %RH
	Hall sensor state				✓			
Per UPS	Voltage	✓				Average of string voltages		
	Current	✓				Sum of string currents		
	SOC	✓				Average of string SOC		

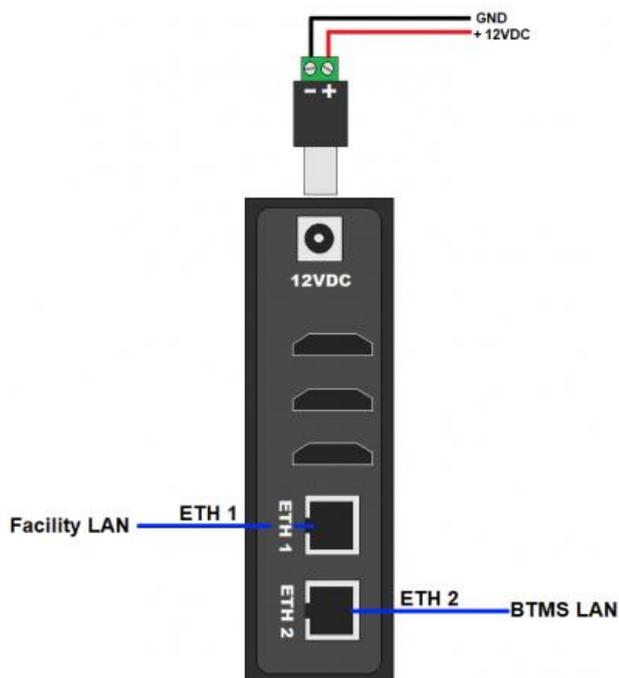
System limitations

Device		Functionality	Limitations
BM-GW	BTMS IOT Agregator	Combines several BM-GW into one system	Virtually unlimited number of BM-GW
BM-GW	BTMS IOT Gateway	Combines several BM-SS into UPS WEB interface Data collection and logging	Up to 32 battery strings Strings arranged arbitrarily in up to 32 UPS-es
BM-SS	BTMS String master	Combines several BM-CS into string	Up to 120 batteries / string
BM-HS	BTMS Hall sensor	Measures string current	One per string
BM-CS	BTMS Cell sensor	Measures battery	One per battery
BM-MC	BTMS Master controller	Enables the connection of BM-LC, BM-TH and BM-HMI	One per BM-GW
BM-LC	BTMS IO expansion module	Connection of auxiliary sensors (leakage, fire, ..) Connection of auxiliary alarm devices (string disconnection, warning light, siren)	Up to 32 IOs (Up to 4 per BM-MC)
BM-TH	BTMS Temperature and humidity sensor	Ambient temperature and humidity measurement	One per string
BM-HMI	BTMS Human-Machine Interfaces	Local inspection of data from UPS, strings and batteries	One per BM-MC

HW Technical specification

Power supply:	12 VDC 2A max (Barrel Connector 5.5mm x 2.1mm)
Construction:	Extruded aluminum IP30
CPU:	Rockchip RK3588 Quad-core ARM Cortex-A76(up to 2.4GHz) and quad-core Cortex-A55 CPU (up to 1.8GHz)
System Memory:	4 GB LPDDR4X at 2133MHz
Storage:	eMMC Flash 32GB, 256 GB SSD
Ethernet:	2 x RJ-45 10/100/1000/2500 Mbps
LTE:	Cat 4
Working temp.:	0°C to +70°C
Humidity:	0% to 95%
Vibration Endurance:	2 Gms with storage (5 to 500Hz, X/Y/Z direction; random, operating)

Wiring



Mounting

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

2.2 BM-SS BTMS String Master



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)

Order code:	BM-SS-A1
Mounting:	DIN rail, 85 mm
Dimensions:	85×120×39 mm

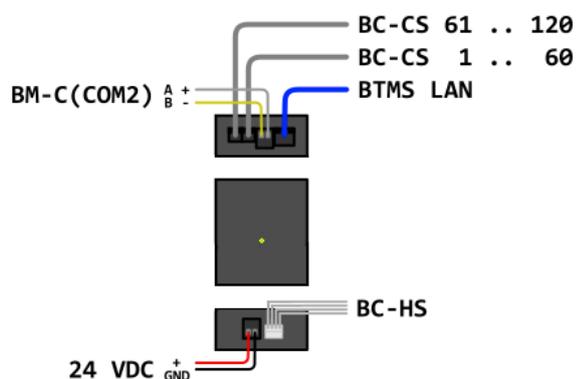
Technical specification

Power supply	Nominal	24 VDC
	Range	12 .. 36 VDC
Power loss	≤ 2W	
Operating temperature	Standard	0 .. 45 °C
	Limit	-10 .. 55 °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

2.3 BTMS Hall Sensor

Highlights & Features

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

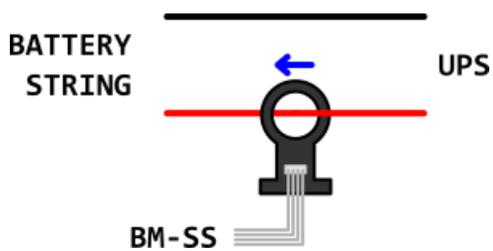


Order code:	BM-HS-50	50 A
	BM-HS-100	100 A
	BM-HS-200	200 A
	BM-HS-300	300 A
	BM-HS-400	400 A
	BM-HS-500	500 A
Mounting:	On the + string cable and screwed to the surface	
Dimensions:	95 × 80 × 25 mm	
Core inner diameter:	40 mm	

Technical specification

Dimensions:	width	95 mm	
	height	80 mm	
	depth	25 mm	
	core inner diameter	40 mm	
Current measurements	type	rated	range
	BM-HS-100	50 A	0 .. ± 100 ADC
	BM-HS-200	100 A	0 .. ± 200 ADC
	BM-HS-400	200 A	0 .. ± 400 ADC
	BM-HS-800	400 A	0 .. ± 800 ADC
	BM-HS-1000	500 A	0 .. ± 1000 ADC
	Resolution	0.01 ADC	

Wiring



Mounting

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

2.4 BTMS Cell sensor

Highlights & Features



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

Order code:	BM-CS-12	for 12 V battery
	BM-CS-02	for 2 V battery
Mounting:	On battery, 3M double sided adhesive tape	
Dimensions:	60 × 95 × 25 mm	

Technical specification

Power supply	BM-SS-02	2 VDC (1.6 .. 2.6 VDC)
	BM-SS-12	12 VDC (7.5 .. 15.6 VDC)
Power loss	BM-SS-02	110 mW
	BM-SS-12	90 mW
Operating temperature	standard	0 .. 45 °C
	max	-10 .. 55 °C
Storage temperature	-40 .. 70°C	
Operating humidity	5 .. 95 % RH, Non condensing	
Dimensions:	width	60 mm
	height	80 mm
	height max	95 mm
	depth	25 mm
Voltage measurements	BM-SS-02	1.6 .. 2.6 VDC
	BM-SS-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

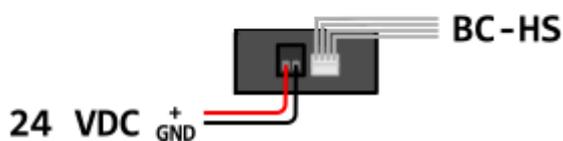
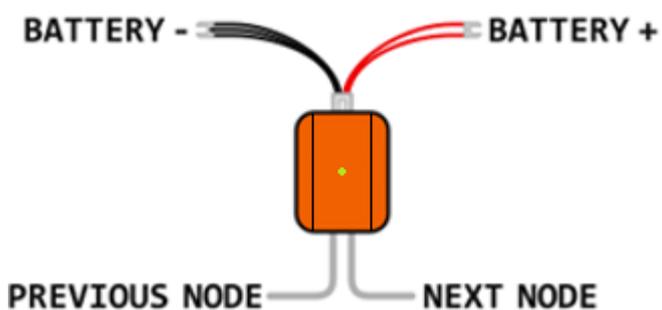
Normal operation	Green LED breathing mode
Alarm / Error	Red LED flashing

Battery SOC is calculated using the default battery characteristic parameters:

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



2.5 BTMS Power Supply

Highlights & Features



- Suitable for parallel operation without extra components
- Protection Class II, Double Isolation (No Earth connection is required)
- Universal AC input voltage and full power up to 55°C
- Power will not de-rate for the entire input voltage range
- Efficiency > 88.0% @ 115Vac & 230Vac
- NEC Class 2 / Limited Power Source (LPS) certified
- Over-voltage / Overcurrent / Over Temperature Protections

Model number:	BM-PS
Mounting:	DIN rail, 4M, 71mm
Dimensions:	91 x 71 x 55.6 mm

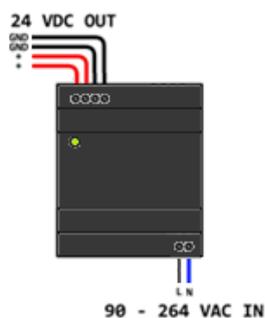
Safety standards

CB Certified for worldwide use TUV to EN 60950-1, UL/cUL recognized to UL 60950-1 and CSA C22.2 No. 60950-1, CB scheme to IEC 60950-1, Limited Power Source (LPS)

Technical specification

Input voltage range	85 - 264 VAC
Output voltage	24 VDC
Output current	2.5 A
Input current	< 1.50A @ 115Vac, < 1.00A @ 230Vac
Max Inrush Current (Cold Start)	< 30A @ 115Vac, < 60A @ 230Vac
Operating temperature	-25°C to +71°C
Storage temperature	-25°C to +85°C

Wiring



Mounting

- On DIN rail (35 mm) in cabinet

Dimensioning the power supply

When the total consumption of all modules powered by one power supply is greater than the capacity of the power supply, you need several power supplies that can be connected in parallel or you can arrange the power supplies in segments.

Module	Max consumption
BM-AG	720 mA
BM-GW	720 mA
BM-MC	280 mA
BM-LC	120 mA
BM-SS	85 mA
BM-HS	-
BM-CS	-
BM-TH	20 mA

Module	Max supply
BM-PS	3.80 A

2.6 BTMS Battery master controller



Highlights & Features

- Communication with temperature and humidity sensors
- Additional digital inputs for connecting various sensors (leakage, gas,...)
- Additional digital outputs for disconnecting strings with an error or for alarming
- Supports up to:
 - 32 strings (BM-SS)
 - 4 Digital IO modules (BM-LC) with 8 DI and 8 DO each

Order code:	BM-MC-A1
Mounting:	DIN rail, 6M, 106 mm
Dimensions:	148x108x58 mm

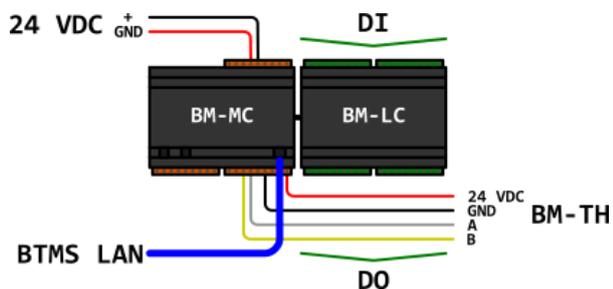
Technical specification

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

2.7 BTMS IO expansion module



Highlights & Features

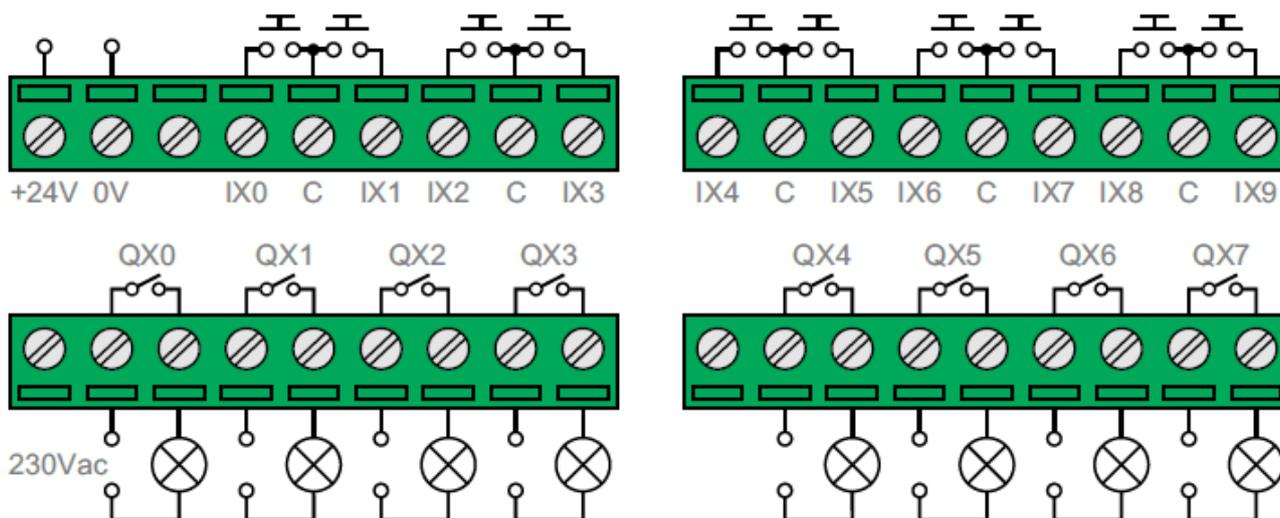
- Expansion for MC with additional digital inputs and outputs
- Additional sensors (leak, gas) can be connected to inputs
- Relay outputs can disconnect faulty string or turn on additional signaling in the event of an error on the string

Order code:	BM-LC
Mounting:	DIN rail, 6M, 106 mm
Dimensions:	106×108×58 mm

Technical specification

Output power per relay	
- incandescent / halogen 230V	1000 W
- halogen 12V with transformer	500 W
- LED with transformer or compact	500 W
Total power for all outputs together:	4000 W
Maximum switching voltage	250Vac
Dielectric strength output to output	400Vac
Maximum input cable length:	50 m
Power supply:	24 V / max. 120 mA
Ingress protection:	IP20
Operating temperature:	0..45 °C
Storage temperature:	-20..75 °C
Relative humidity:	0..95 % n/c
Weight:	280g

Terminals



2.8 BTMS Temperature and humidity sensor

Highlights & Features

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



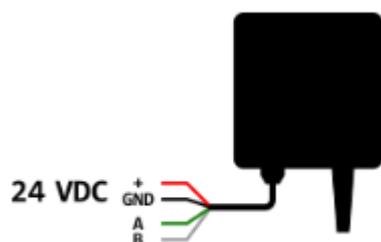
Order code:	BM-TH
Mounting:	On wall
Dimensions:	135 x 150 x 45 mm

Technical specification

Supply voltage	10 .. 30 VDC	
Power consumption:	0.4 W max	
Temperature measuring	Range	-40 .. +80 °C
	Precision	± 0.5 °C (25 °C)
	Resolution	0.1 °C

	Long term stability	$\leq 0.1 \text{ }^\circ\text{C} / \text{year}$
	Response time	$\leq 18/\text{s}$ (1 m/s wind speed)
Humidity measuring	Range	0 .. 100 % RH
	Precision	$\pm 3 \text{ \%RH}$ (5 .. 95 %RH, 25 °C)
	Resolution	0.1 %RH
	Long term stability	$\leq 0.1 \text{ \%RH} / \text{year}$
	Response time	$\leq 6 \text{ seconds}$ (1 m/s wind speed)
Dimensions:	housing width	110 mm
	max width	135 mm
	housing height	100 mm
	max height	150 mm
	depth	45 mm

Wiring



Red	Vcc
Black	GND
Green	RS 485 A
White	RS 485 B

Mounting

- On wall next to string

2.9 BTMS 7” HMI Touch display

Highlights & Features



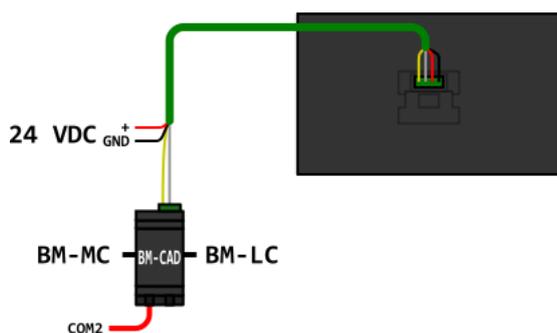
- 7” capacitive touch screen
- Supports up to:
 - 32 strings (arbitrarily arranged in UPS)
 - 3840 batteries (8 BM-SS × 120 BM-CS)

Order code: **BM-HMI**

Technical specification

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

Wiring



Mounting

- On the wall
- On the cabinet

2.10 BTMS IOT Agregator

Highlights & Features

- It logically combines several BM-GWs into one system
- Overview of the entire Data Center via a single web interface
-



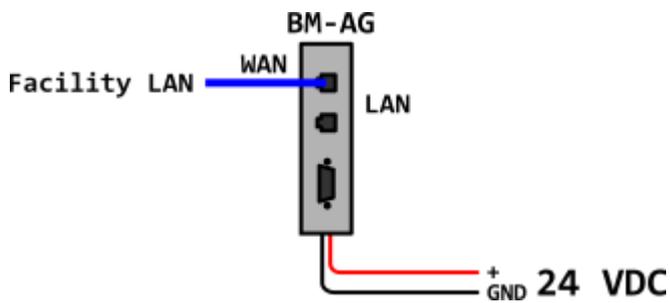
Order code:	BM-AG
Mounting:	DIN rail, 31 mm
Dimensions:	31 x 125 x 100 mm

Technical specification

Power supply:	12 to 24 VDC, 1.39-0.72A
Construction:	Extruded aluminum and heavy-duty steel, IP30
CPU:	Intel® Celeron® N3350 2C @1.1 GHz, TDP: 6W
System Memory:	1 x DDR3L-1866 SO-DIMM 4 GB
Storage:	128 GB SSD
System I/O Outlet:	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.:	-20°C to +70°C (-4°F to +158°F)	
Humidity:	0% to 95%	
Vibration Endurance:	2 Gms with storage (5 to 500Hz, X/Y/Z direction; random, operating)	
Mounting:	DIN rail, wall	
Weight (net/gross):	0.3 kg (0.67 lb)/0.45 kg (0.99 lb)	
Dimensions:	height	125 mm
	width	31 mm
	depth	100 mm

Wiring

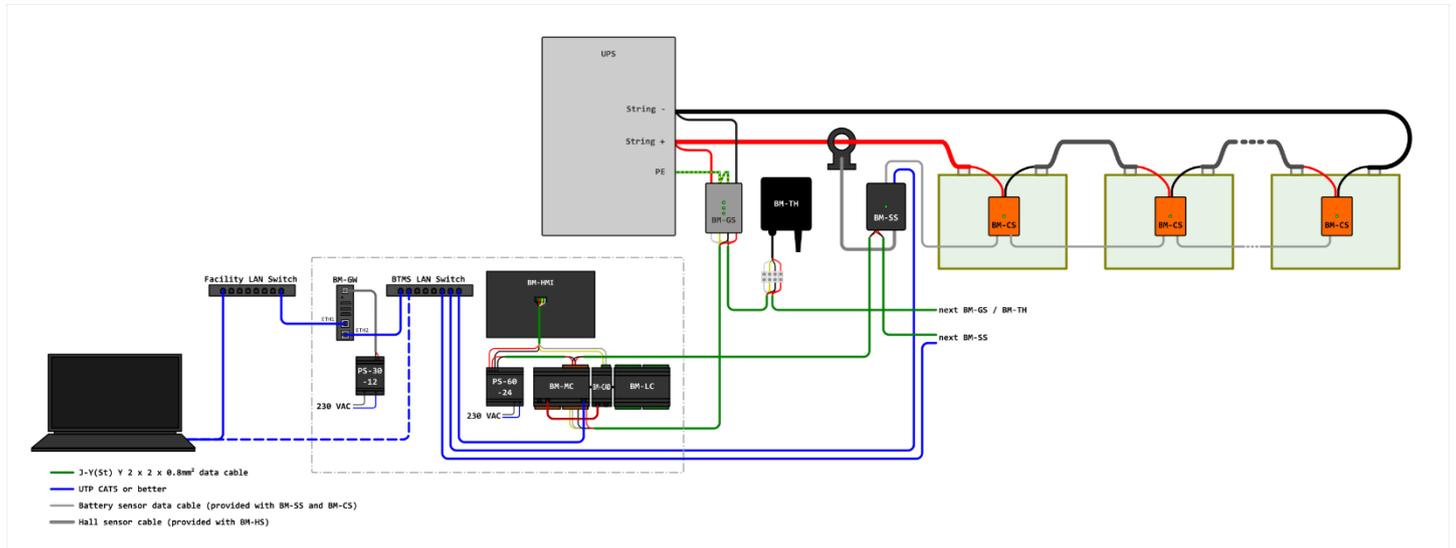


Mounting

- DIN rail, 31 mm
- On the cabinet

3 BTMS Installation

System wiring diagram



Following steps to be done before start installation:

- Disconnect the UPS from batteries by switch off battery breaker
- Break string to small segments where total voltage doesn't reach 50 V
- Provide a place to install BTMS panel which includes below
- BM-PS in (Power supply)
- BM-GW (Gateway)
- BTMS LAN switch (Network switch)
- BM-MC (Master controller)
- BM-HMI (and communication adapter CAD-232-A2-IQ)

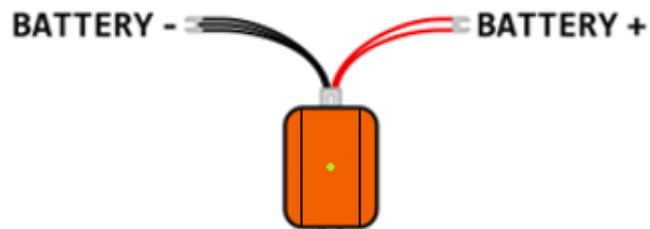
Provide space to install below component on the battery cabinet

- BM-SS (String sensor)
- BM-CS (Cell sensor)
- BM-HS (Hall sensor)

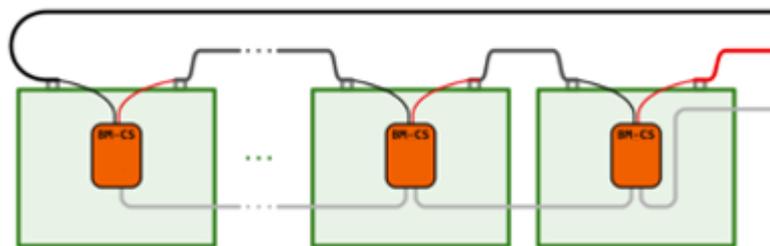
3.1 Base System

3.1.1 Install BM-CS

- Connect red / black wires to battery terminals (Use original cables as they are)



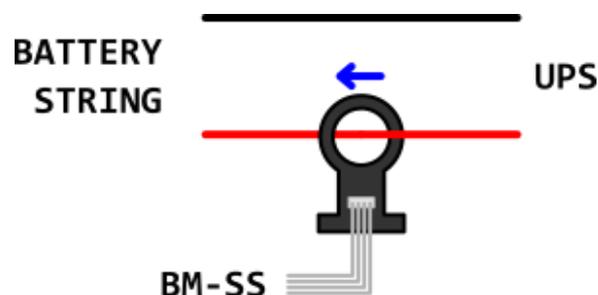
- Mount on battery with supplied 3M double sided stickers
- Plug in red / black battery cable connector in
- Connect the sensors with included white RJ9-RJ9 cables
- 1st OUT port (right) to 2nd IN port (left),
- 2nd OUT port (right) to 3rd IN port (left),



- Max 60 BM-CS in one line

3.1.2 Install BM-HS

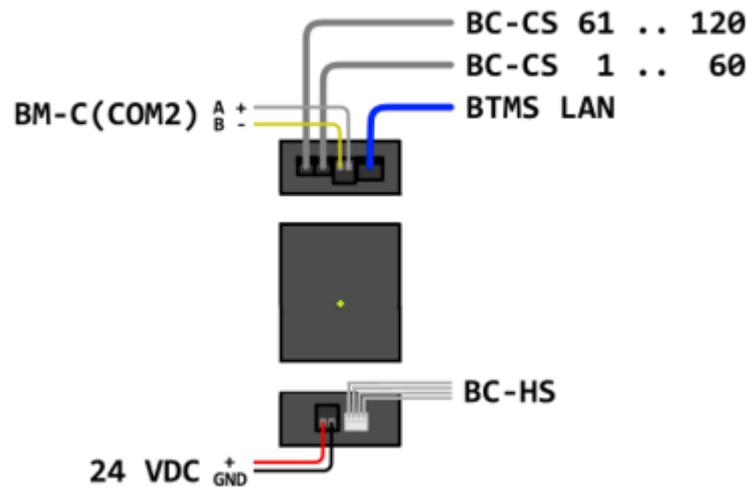
- Unscrew split core and put around + wire from UPS to string
- Arrow is pointing from UPS to 1st battery



3.1.3 Install BM-SS

- Mount on DIN rail near the 1st string battery
- Connect BM-HS with included 4-pin flat cable
- Connect 1st battery BM-CS with included white RJ9-RJ9 cable

- Connect 1st battery BM-CS of second line (if needed)
- Power supply (+24 Vdc) from battery monitoring panel

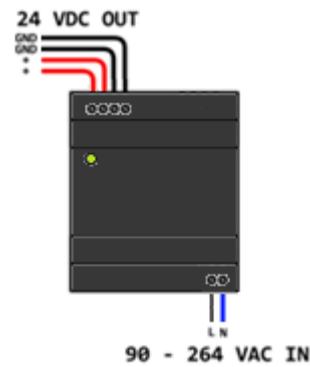


3.1.4 Install BM-GW

- Mount in distribution cabinet on DIN rail with the included bracket
- Install BTMS LAN switch
- Mount in distribution cabinet or LAN cabinet
- Plug the power supply into the appropriate socket
- Connect LAN cables to BM-GW
- Pull the LAN cables to the BM-SS but do not connect them to the LAN switch (Properly mark which cable goes to which BM-SS)

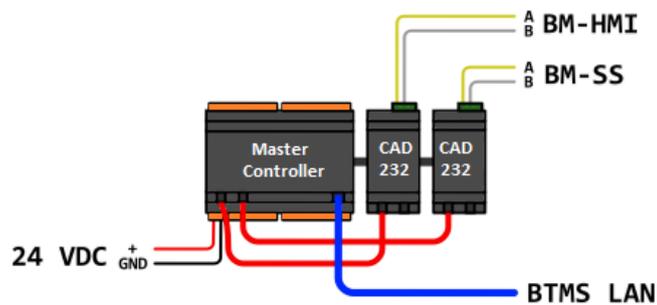
3.1.5 Install BM-PS-60-24

- Check that the BM-PS capacity (3.8 A) is sufficient for all devices powered by the PS power supply
- If the consumption exceeds the capacity of the power supply divide the consumers into groups and uses several power supplies
- Make sure that circuit breaker is switched OFF
- Mount BM-PC on DIN rail in distribution cabinet
- Connect AC L & N terminals
- Connect DC + & - terminals to
 - All BM-SS
 - BM-GW



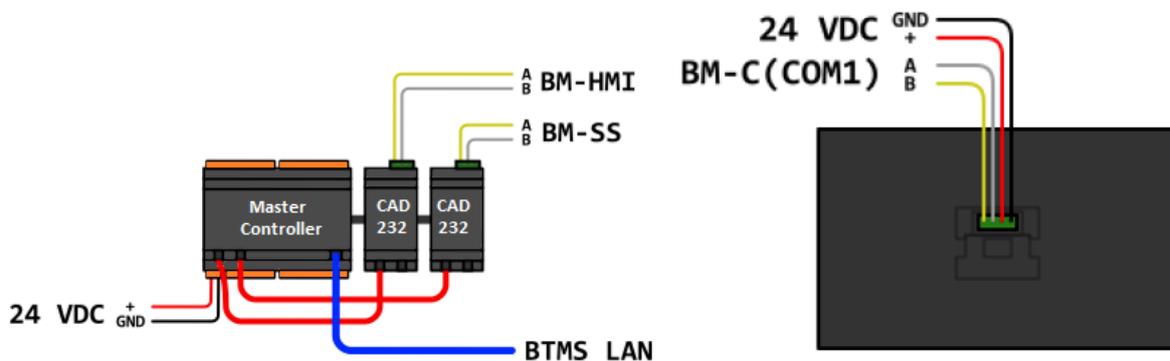
3.1.6 Install BM-MC and BM-C-A1

- Mount in distribution cabinet on DIN rail
- Connect DC power supply +24 V & GND terminals to + & - of power supply terminals
- Connect LAN cable to BTMS LAN switch



3.1.7 Install BM-HMI-BM

- Mount CAD-232-A2-IQ adapter on DIN rail next to BM-MC
- Ensure that the connecting cable (short RJ9 to RJ9) to the BM-MC is correctly inserted
- Connect BM-MC COM 2 port with CAD-232-A2-IQ adapter bottom port (it doesn't matter which one)
- Connect BM-HMI A & B terminals to CAD-232-A2-IQ A & B terminals
- Connect BM-HMI +24 V & GND terminals to + & - BM-PS terminals



3.1.8 Install BM-TH

- Mount BM-TH on wall next to string
- Pull communication bus and power supply to BM-MC - do not connect to BM-TH
- Communication bus must follow rules for RS-485 wiring
 - Bus line (no branching)
 - Use twisted pair shielded cable
 - Shield connected ONLY to one end of line
 - Terminate line with 120-ohm resistor on both side
 - Max length 1200 m



3.2 Power ON

- Visually inspect wiring
- Power on BM-PS circuit breaker
- Check that all devices that are powered by the power adapter are turned on and are working stably (the LED indicators are lit continuously)

4 BTMS commissioning

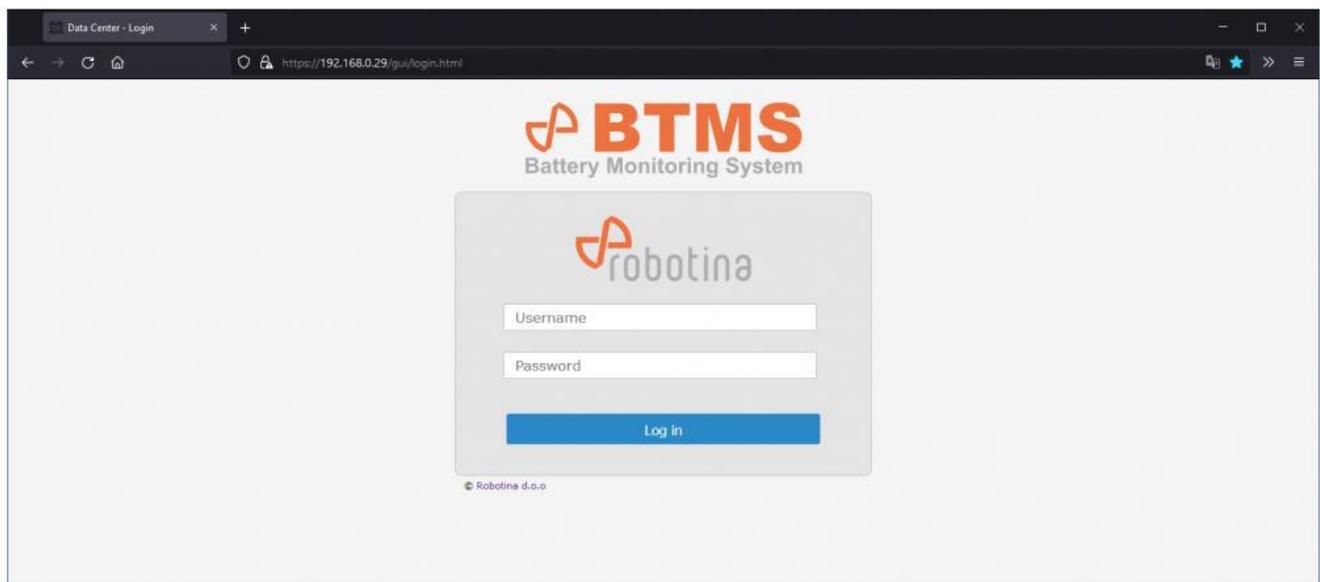
The initial settings of the BTMS system can only be made by a specially trained authorized person or by Robotina. To properly set up the system, it is necessary to provide the following information:

- 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 $m\Omega$
 - Cut-off voltage in V
 - Recovery voltage in V
 - Float voltage in V
 - Float current in A
 - Internal resistance correction in $m\Omega$
- 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 $m\Omega$
 - SOC lower limit in %
 - SOH lower limit in %
 - Temperature upper limit in $^{\circ}C$
- 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.xls" has been prepared to help with data entry.

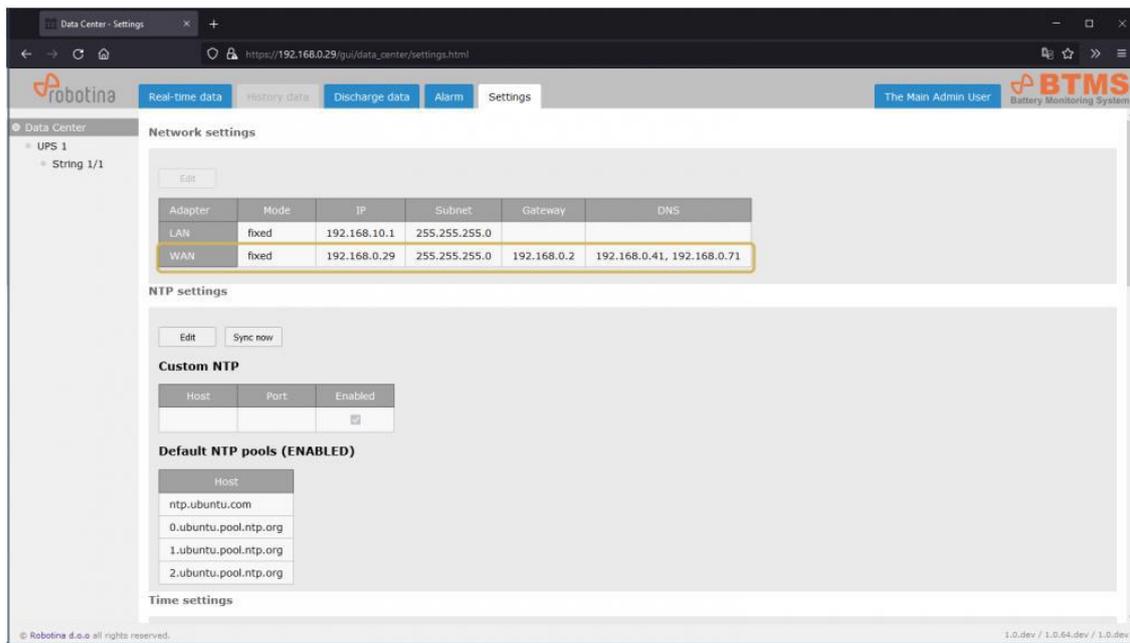
- Connect the laptop to the BTMS LAN switch
- Set the IP on the laptop to 192.168.10.20
- Open the address 192.168.10.1 in the Internet browser
- Login with default username (admin) and default password (bmgw!admin)



4.1 General settings

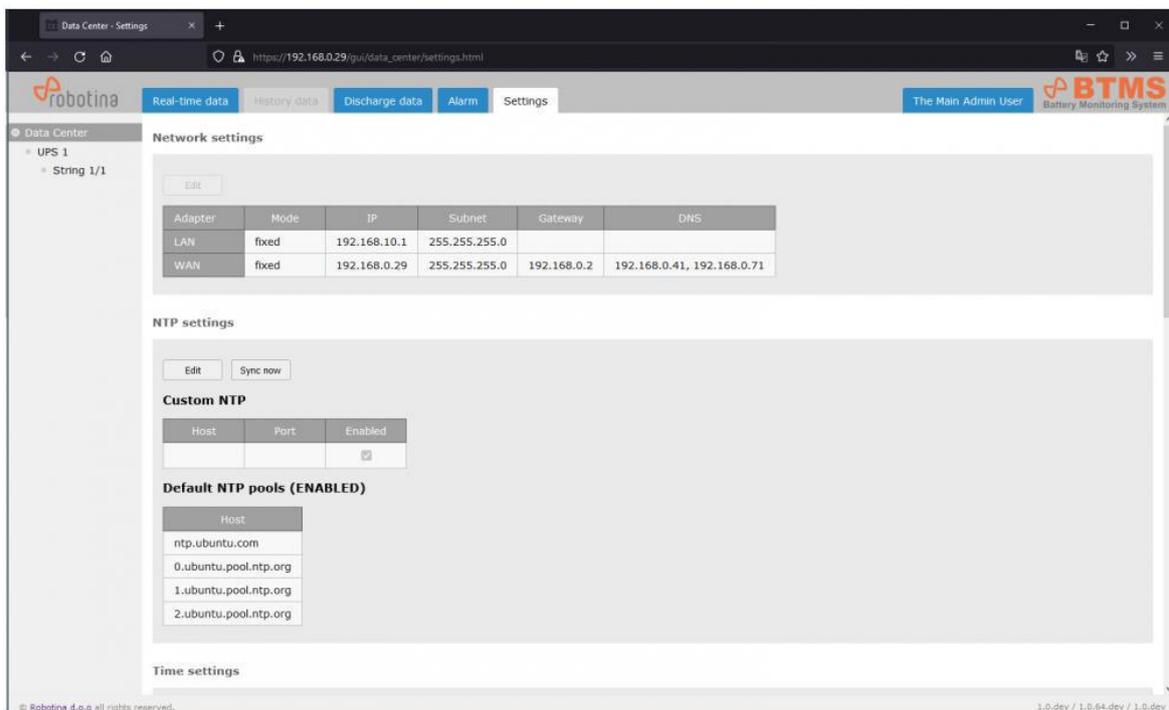
4.1.1 Network settings

- Select Settings - General tab
- Set the parameters for the WAN interface



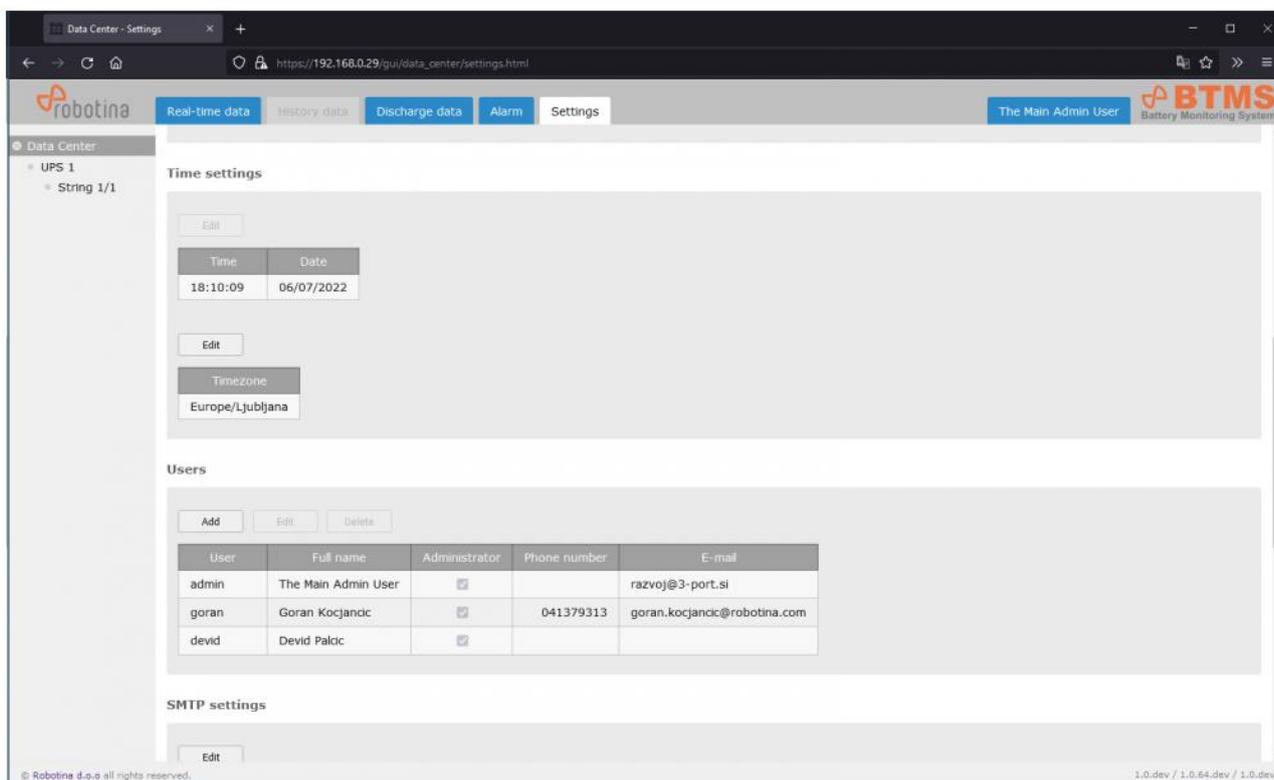
4.1.2 NTP settings

- if necessary / requested set the parameters for an additional NTP (Network Time Protocol) server



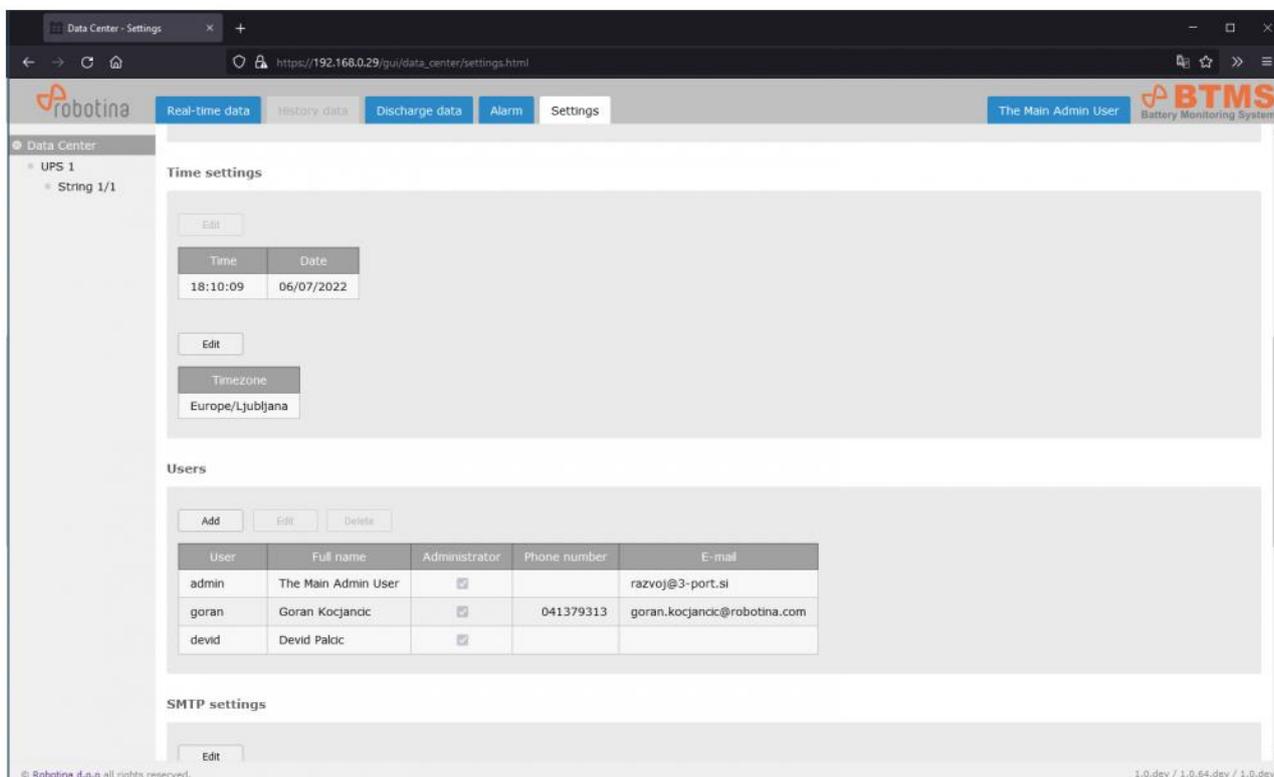
4.1.3 Time settings

- Set the desired time zone



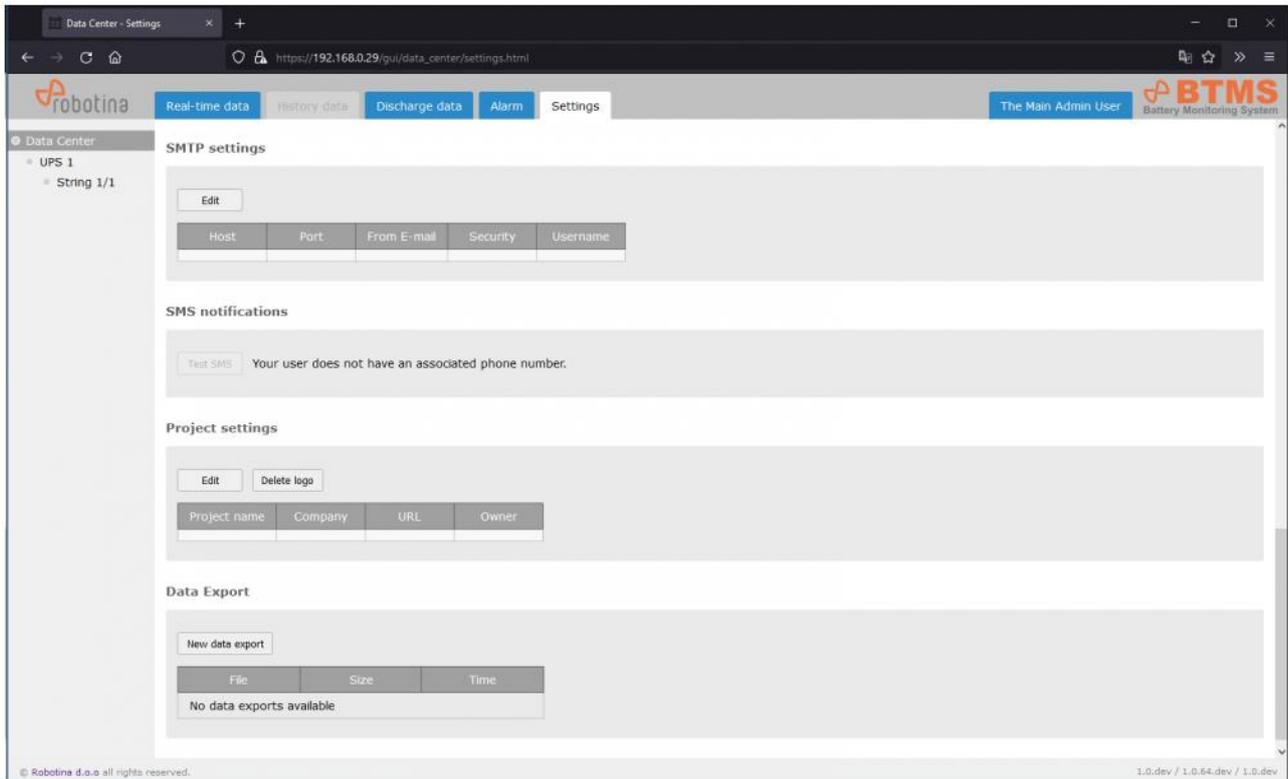
4.1.4 Users Setting

- Change (and remember!) the admin password
- Add users



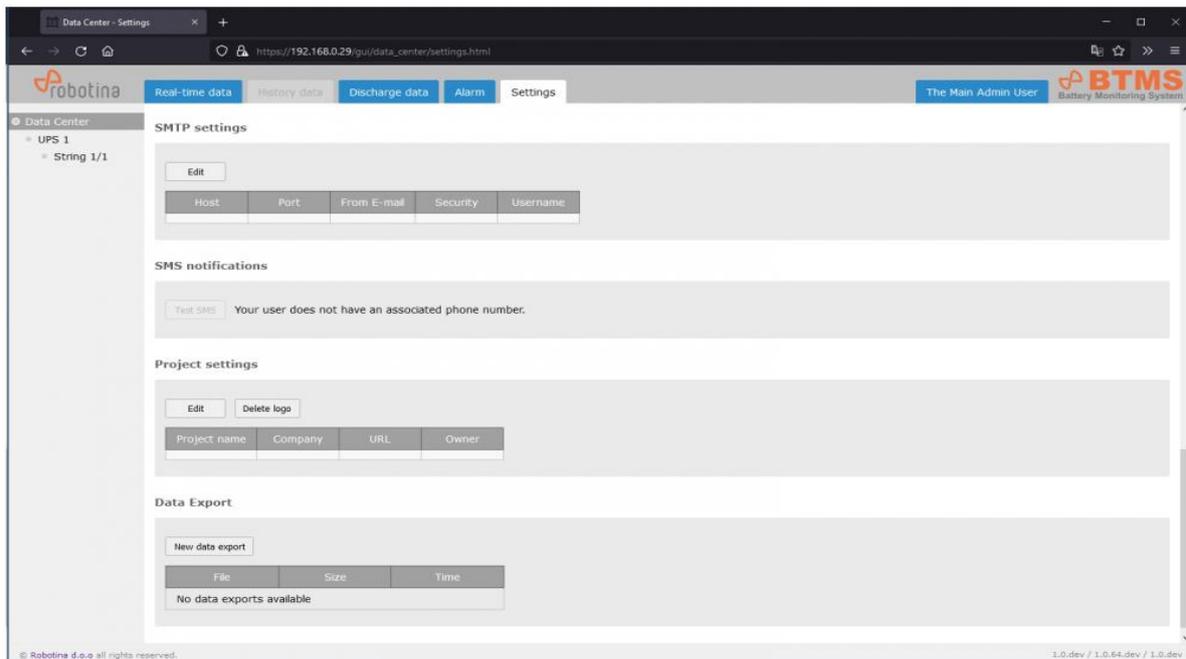
4.1.5 SMTP settings

- Set the parameters for the SMTP (e-mail) server



4.1.6 SMS notifications

- Test SMS messaging

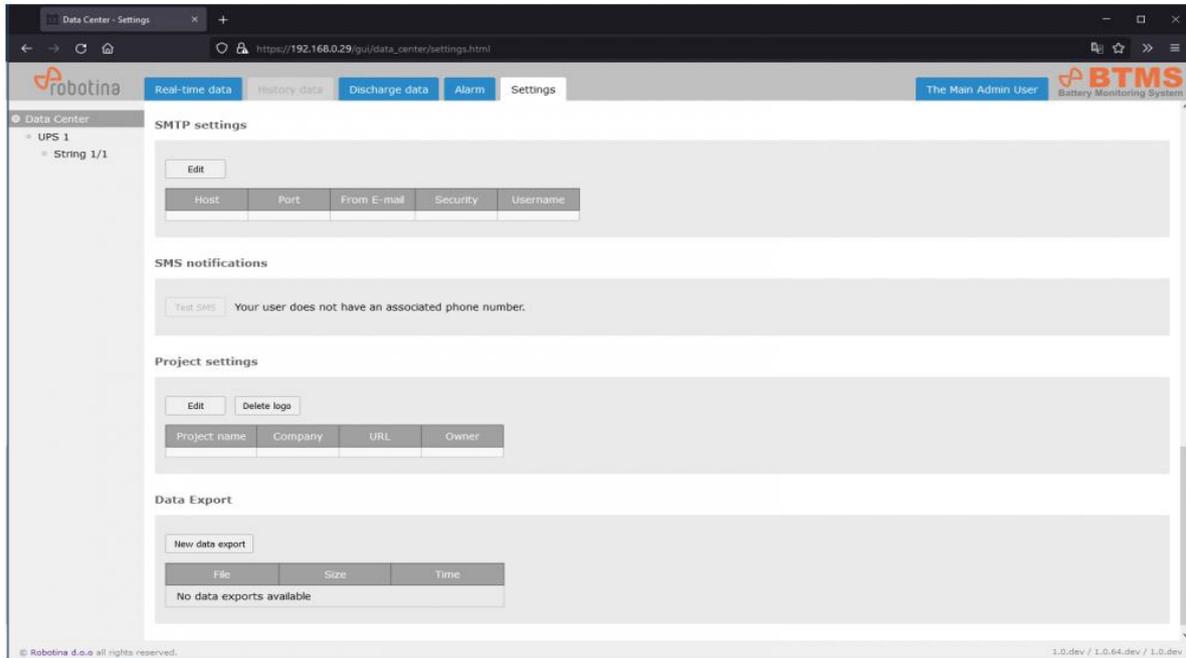


4.1.7 Modbus server

- Edit Modbus settings

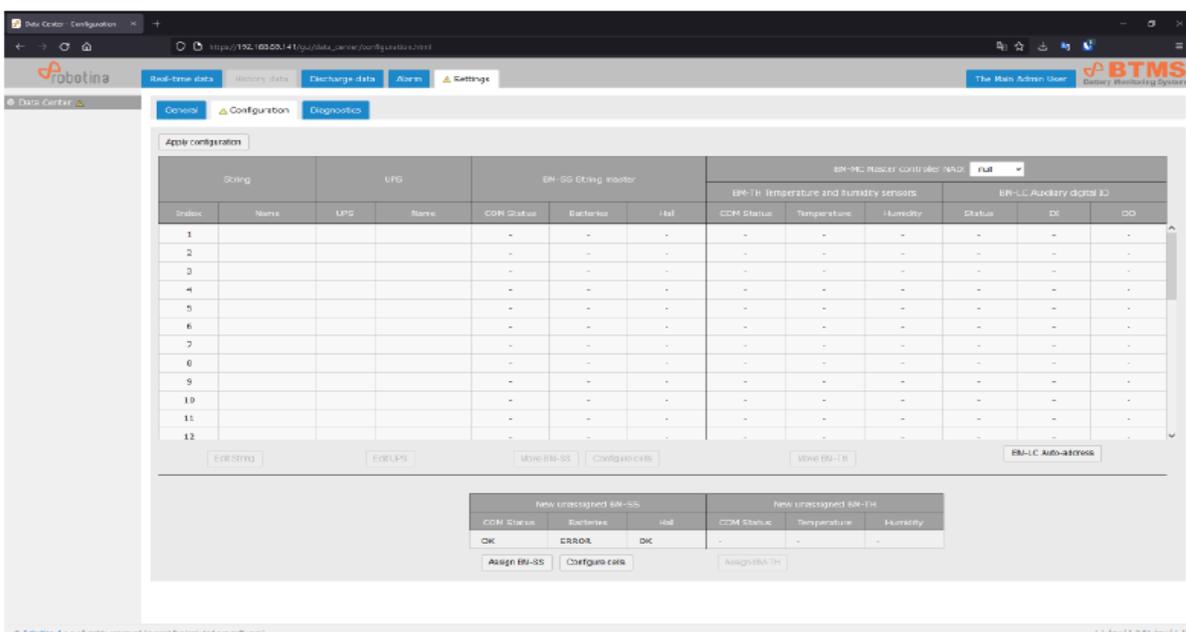
4.1.8 Project settings

- Set project information
- The project name is displayed as root in the tree menu
- You can also change the logo that appears above the tree menu

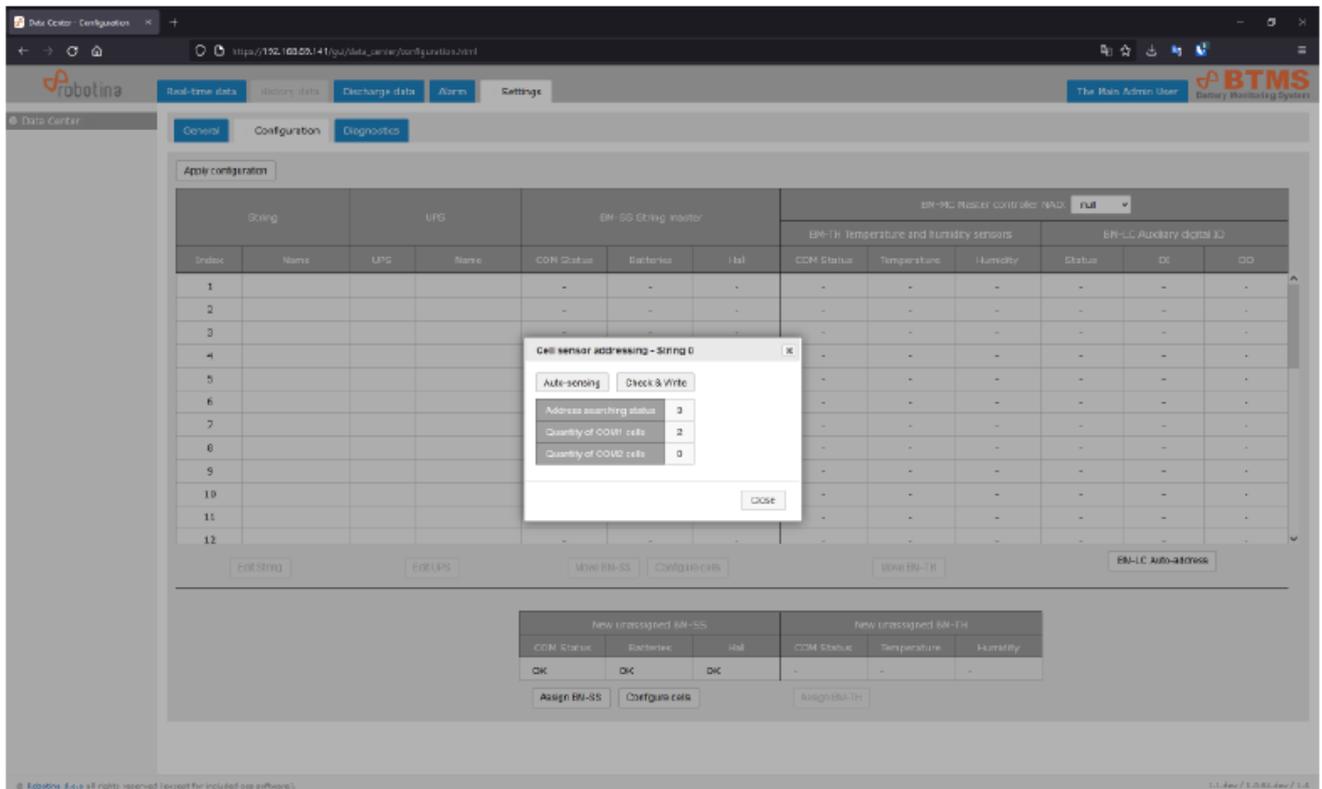


4.2 Adding string and battery sensors

- Select Settings - Configuration tab
- Connect a string sensor (always only one new-one at a time)
- In the New unassigned BM-SS table (below main table) OK should appear for COM Status and HALL

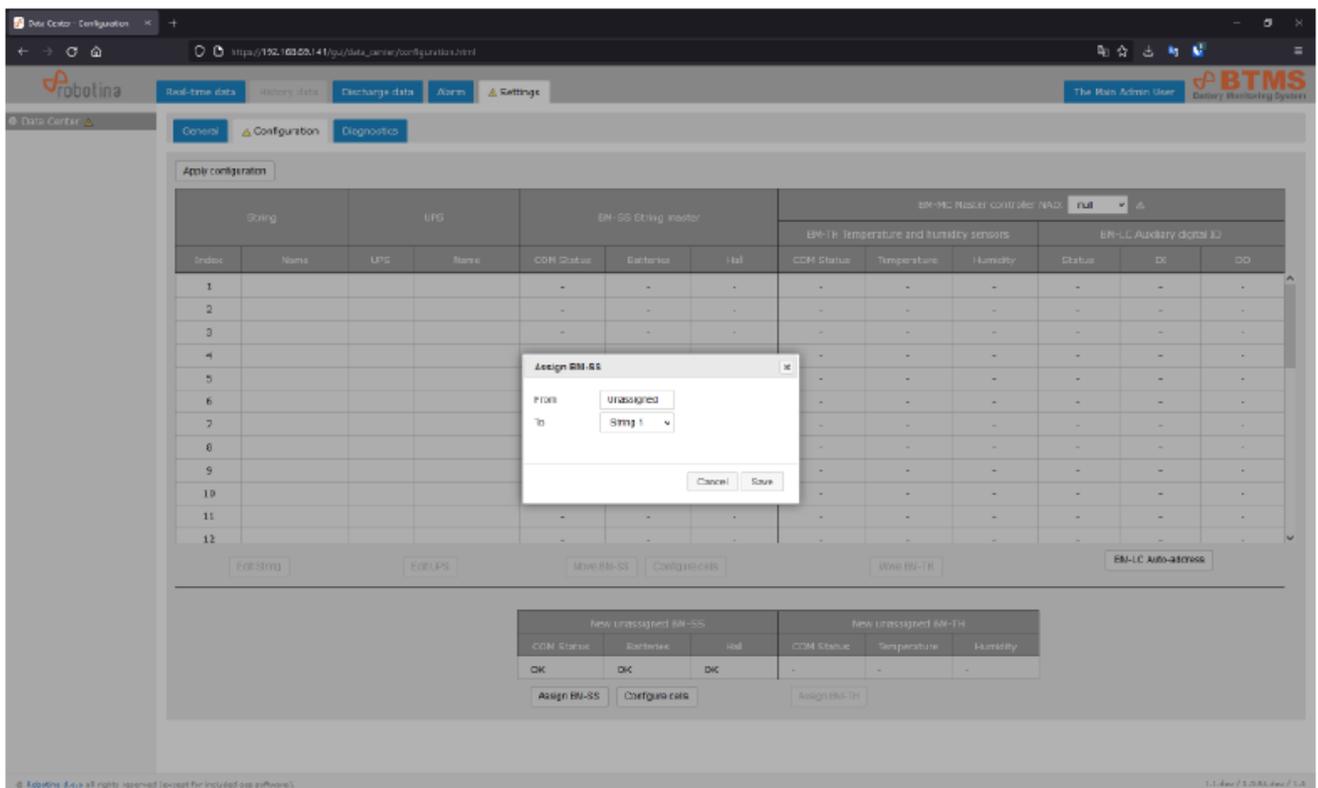


- To set the battery sensors press the Configure cells button
- In Cell sensor addressing dialog box
- Press Auto-sensing
- Wait that Address searching status change to 3
- Check whether all battery sensors have been found
- If all sensors found then confirm with the Check & Write button
- If the number of sensors found does not match the expected check sensor
- Cabling and repeat Auto-sensing



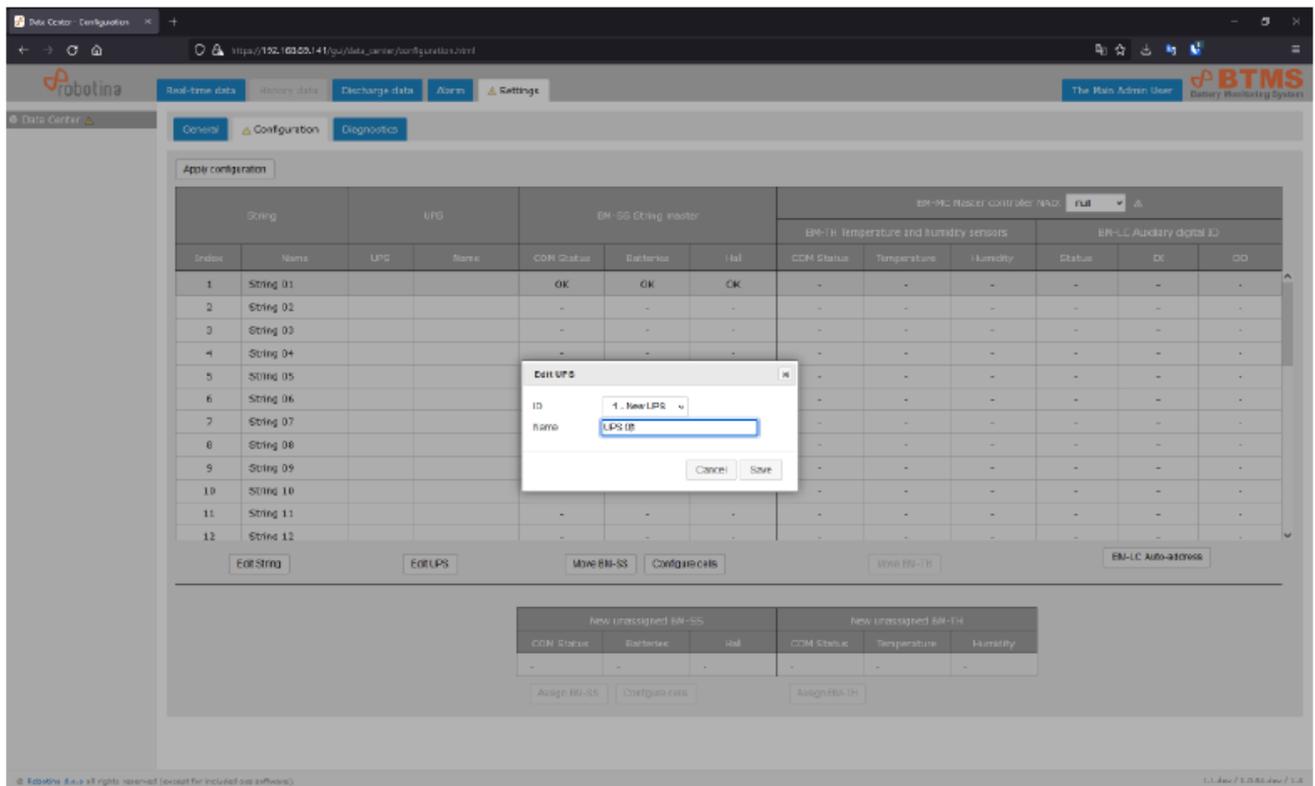
4.2.1 Assign string sensor to string

- Press Assign BM-SS
- In Assign BM-SS dialog box select to which string BM-SS should be assigned



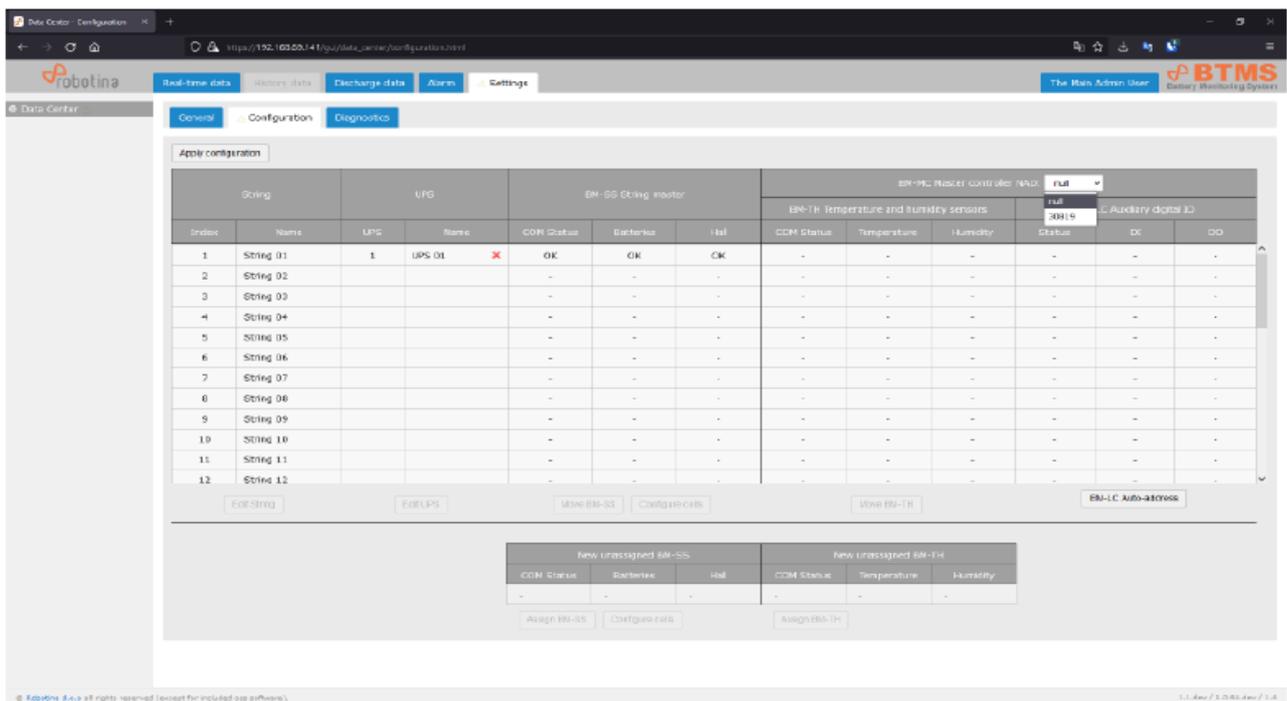
4.2.2 Assign string to UPS

- In main table select row
- Press Edit UPS
- In Edit UPS dialog
 - Select UPS ID
 - Set name for UPS
- Subsequent movement or reassignment of BM-SS sensors to another string and automatic reconfiguration of battery sensors is also possible
- Repeat the process for all string sensors



4.2.3 Adding BM-MC, BM-LC and BM-TH

- Select Settings - Configuration tab
- Select BM-MC controller in main table 1st row right side
- Press BM-LC Auto-address to discover connected BM-LC IO modules
- If the modules are connected correctly, the statuses in the right 3 columns should change



- Connect BM-TH temperature and humidity sensor (only one new sensor at a time)

- The data of the connected sensor should appear in the New unassigned BM-TH table below the main table

The screenshot shows the 'Apply configuration' section of the Robotina Data Center Configuration page. It features a main table for BM-SS strings and a summary table for new unassigned BM-TH sensors.

String		UPS		BM-SS String monitor			BM-MC Master controller NAD: 30029					
Index	Name	UPS	Name	COM Status	Battery	Hal	BM-TH Temperature and humidity sensors			BM-LC Auxiliary digital ID		
1	String 01	1	UPS 01	OK	OK	OK	COM Status	Temperature	Humidity	Status	OK	DO
2	String 02			-	-	-	-	-	-	-	-	-
3	String 03			-	-	-	-	-	-	-	-	-
4	String 04			-	-	-	-	-	-	-	-	-
5	String 05			-	-	-	-	-	-	-	-	-
6	String 06			-	-	-	-	-	-	-	-	-
7	String 07			-	-	-	-	-	-	-	-	-
8	String 08			-	-	-	-	-	-	-	-	-
9	String 09			-	-	-	-	-	-	-	-	-
10	String 10			-	-	-	-	-	-	-	-	-
11	String 11			-	-	-	-	-	-	-	-	-
12	String 12			-	-	-	-	-	-	-	-	-

New unassigned BM-SS			New unassigned BM-TH		
COM Status	Battery	Hal	COM Status	Temperature	Humidity
-	-	-	OK	23.1 °C	44.2 %

- Use the Assign BM-TH button to determine which string the sensor belongs to
- Repeat for all BM-TH sensors

The screenshot shows the 'Apply configuration' section of the Robotina Data Center Configuration page after the sensor has been assigned to String 01. The main table now shows data for String 01, and the summary table for new unassigned BM-TH sensors is empty.

String		UPS		BM-SS String monitor			BM-MC Master controller NAD: 30029					
Index	Name	UPS	Name	COM Status	Battery	Hal	BM-TH Temperature and humidity sensors			BM-LC Auxiliary digital ID		
1	String 01	1	UPS 01	OK	OK	OK	OK	23.2 °C	41.5 %	-	-	-
2	String 02			-	-	-	-	-	-	-	-	-
3	String 03			-	-	-	-	-	-	-	-	-
4	String 04			-	-	-	-	-	-	-	-	-
5	String 05			-	-	-	-	-	-	-	-	-
6	String 06			-	-	-	-	-	-	-	-	-
7	String 07			-	-	-	-	-	-	-	-	-
8	String 08			-	-	-	-	-	-	-	-	-
9	String 09			-	-	-	-	-	-	-	-	-
10	String 10			-	-	-	-	-	-	-	-	-
11	String 11			-	-	-	-	-	-	-	-	-
12	String 12			-	-	-	-	-	-	-	-	-

New unassigned BM-SS			New unassigned BM-TH		
COM Status	Battery	Hal	COM Status	Temperature	Humidity
-	-	-	OK	23.2 °C	41.5 %

4.2.4 Validate Configuration

- Check whether the data in the main table reflect the actual desired state
- Confirm the configuration with the Apply configuration button above the table

The screenshot shows the 'Configuration' tab in the BTMS interface. A table lists 12 strings, each associated with a UPS unit. The table includes columns for Index, Name, UPS, Name, COM Status, Batteries, Hall, and sensor data (COM Status, Temperature, Humidity, Status, DI, DO). A 'BM-MC Master controller NAD' dropdown is set to 20915. Below the table are buttons for 'Exit String', 'Exit UPS', 'Move BM-SS', 'Configure cells', 'Move BM-TH', and 'BM-LC Auto-address'. At the bottom, there are sections for 'New unassigned BM-SS' and 'New unassigned BM-TH' with their respective columns and 'Assign' buttons.

Index	String	UPS	Name	BM-SS String master			BM-MC Master controller NAD: 20915					
				COM Status	Batteries	Hall	BM-TH Temperature and humidity sensors			BM-LC Auxiliary digital IO		
				COM Status	Temperature	Humidity	Status	DI	DO			
1	String 01	1	UPS 13	✗	OK	OK	OK	22.7 °C	57.5 %	OK	ON	OFF
2	String 02	1	UPS 13	✗	OK	OK	OK	22.6 °C	58.4 %	OK	ON	OFF
3	String 03	1	UPS 13	✗	OK	OK	OK	22.6 °C	57.2 %	OK	ON	OFF
4	String 01	2	UPS 14	✗	OK	OK	OK	22.8 °C	57.6 %	OK	OFF	ON
5	String 02	2	UPS 14	✗	OK	OK	OK	22.6 °C	58.4 %	OK	OFF	ON
6	String 03	2	UPS 14	✗	OK	OK	OK	22.8 °C	57.4 %	OK	OFF	ON
7	String 01	3	UPS 15	✗	OK	OK	OK	23.0 °C	56.4 %	OK	OFF	ON
8	String 02	3	UPS 15	✗	OK	OK	OK	23.0 °C	57.1 %	OK	OFF	ON
9	String 09			-	-	-	-	-	-	-	-	-
10	String 10			-	-	-	-	-	-	-	-	-
11	String 11			-	-	-	-	-	-	-	-	-
12	String 12			-	-	-	-	-	-	-	-	-

- The tree menu on the left side should refresh and reflect the actual status of the UPS and strings connected to the BM-GW

The screenshot shows the 'Real-time data' tab in the BTMS interface. A table displays the status of three UPS units: UPS 13, UPS 14, and UPS 15. Below the table is a bar chart showing the voltage levels for these UPS units. The chart has a 'Voltage' dropdown and shows three green bars representing the voltage for each UPS unit. The y-axis ranges from 0 to HIGH, with a dashed line indicating a LOW threshold.

UPS	Status	Voltage	Current	SoC
UPS 13	OK	626.74 V	0.00 A	100 %
UPS 14	OK	626.48 V	4.72 A	100 %
UPS 15	OK	572.67 V	0.00 A	100 %

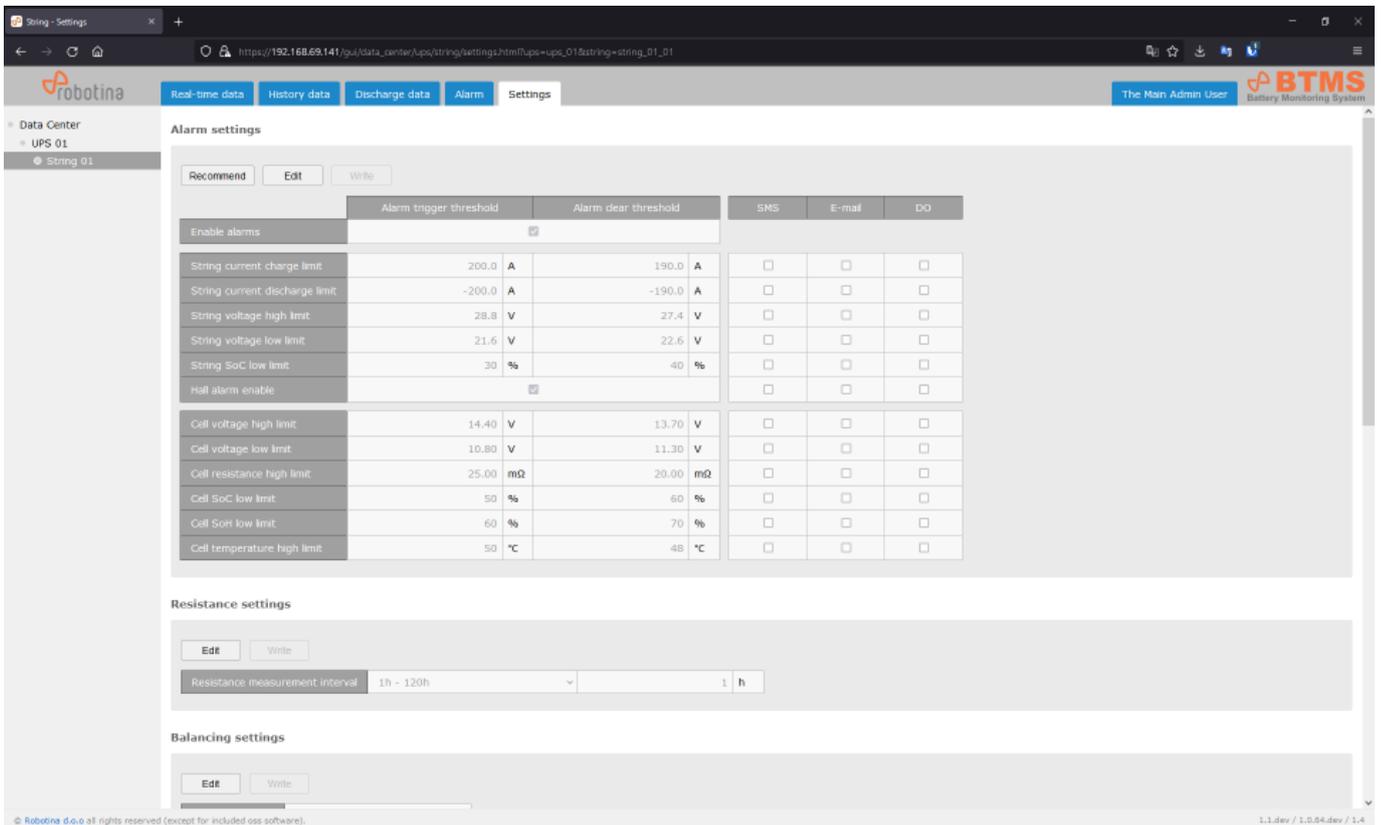
4.2.5 Check Settings

- Switch the laptop to the facility network
- Set the IP on the laptop according to the requirements for the facility LAN

- Use the Internet browser to go to the address you set for the WAN connection

4.3 String and Battery sensors settings

- To set up an individual BTMS string sensor, just select it in the tree structure on the left and select the Settings view.



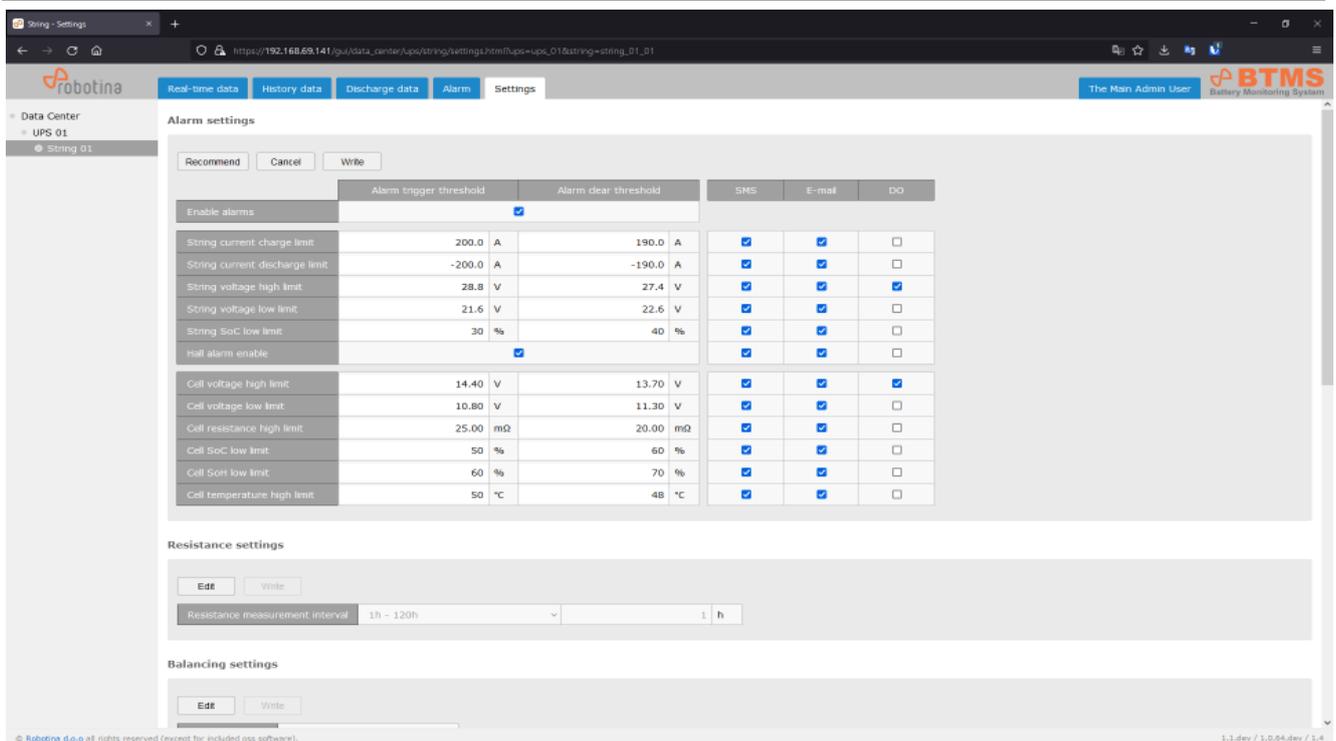
The screenshot shows the 'String Settings' page in the BTMS web interface. The page has a navigation bar with tabs for 'Real-time data', 'History data', 'Discharge data', 'Alarm', and 'Settings'. The 'Settings' tab is active. On the left, there is a tree structure showing 'Data Center' > 'UPS 01' > 'String 01'. The main content area is titled 'Alarm settings' and includes buttons for 'Recommend', 'Edit', and 'Write'. Below these buttons is a table with the following data:

	Alarm trigger threshold	Alarm dear threshold	SMS	E-mail	DO
Enable alarms	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
String current charge limit	200.0 A	190.0 A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
String current discharge limit	-200.0 A	-190.0 A	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
String voltage high limit	28.8 V	27.4 V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
String voltage low limit	21.6 V	22.6 V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
String SoC low limit	30 %	40 %	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hall alarm enable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cell voltage high limit	14.40 V	13.70 V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cell voltage low limit	10.80 V	11.30 V	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cell resistance high limit	25.00 mΩ	20.00 mΩ	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cell SoC low limit	50 %	60 %	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cell SoH low limit	60 %	70 %	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cell temperature high limit	50 °C	48 °C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

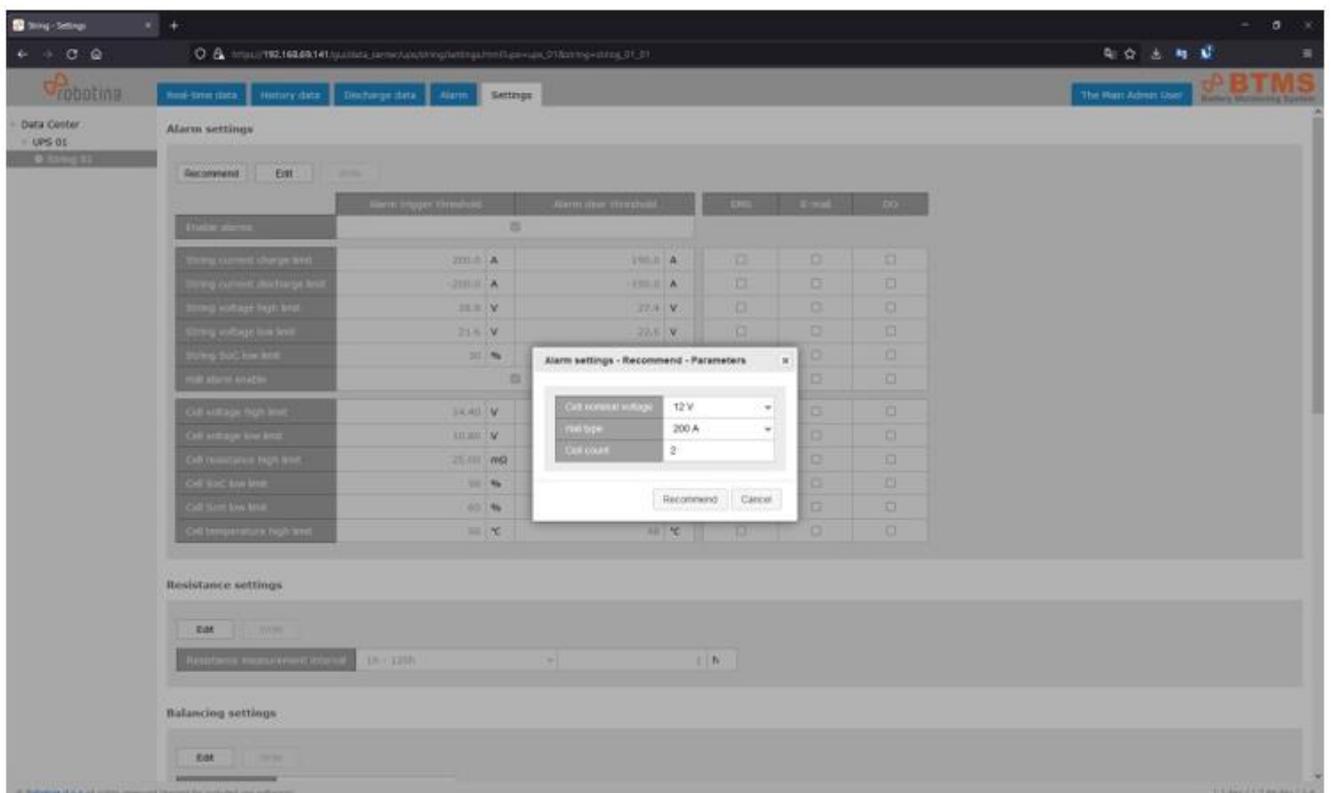
Below the table are sections for 'Resistance settings' and 'Balancing settings', each with 'Edit' and 'Write' buttons. The 'Resistance settings' section shows a 'Resistance measurement interval' dropdown set to '1h - 120h' and a unit selector set to 'h'. The footer of the page contains the text: '© Robotina d.o.o. all rights reserved (except for included oss software). 1.1.dev / 1.0.54.dev / 1.4'.

4.3.1 Alarm settings

- The conditions for triggering and automatic alarm reset are set for the string and for all batteries within the string.
- Editing of the settings is enabled with the Edit button above the table.



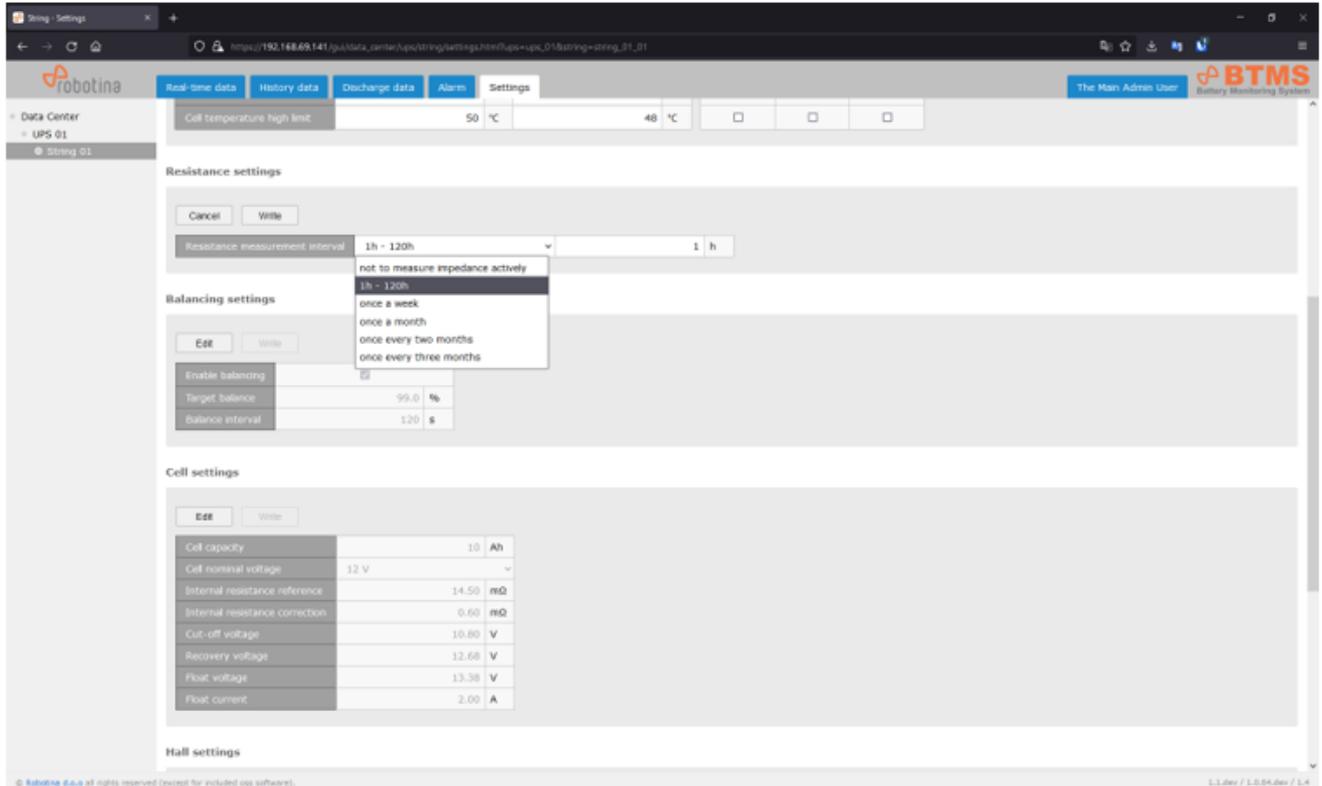
- Limit values are set in the left part of the table, and the action that the alarm triggers is set in the right part. The action can be sending an SMS or/and e-mail message or/and triggering a digital output.
- Use the Write button to use the entered changes. The “Cancel” button cancels all changes.
- The Recommend button presets some alarm parameters depending on the connected batteries and the used Hall sensor.



- The proposed values can then be further adapted to the requirements and entered.

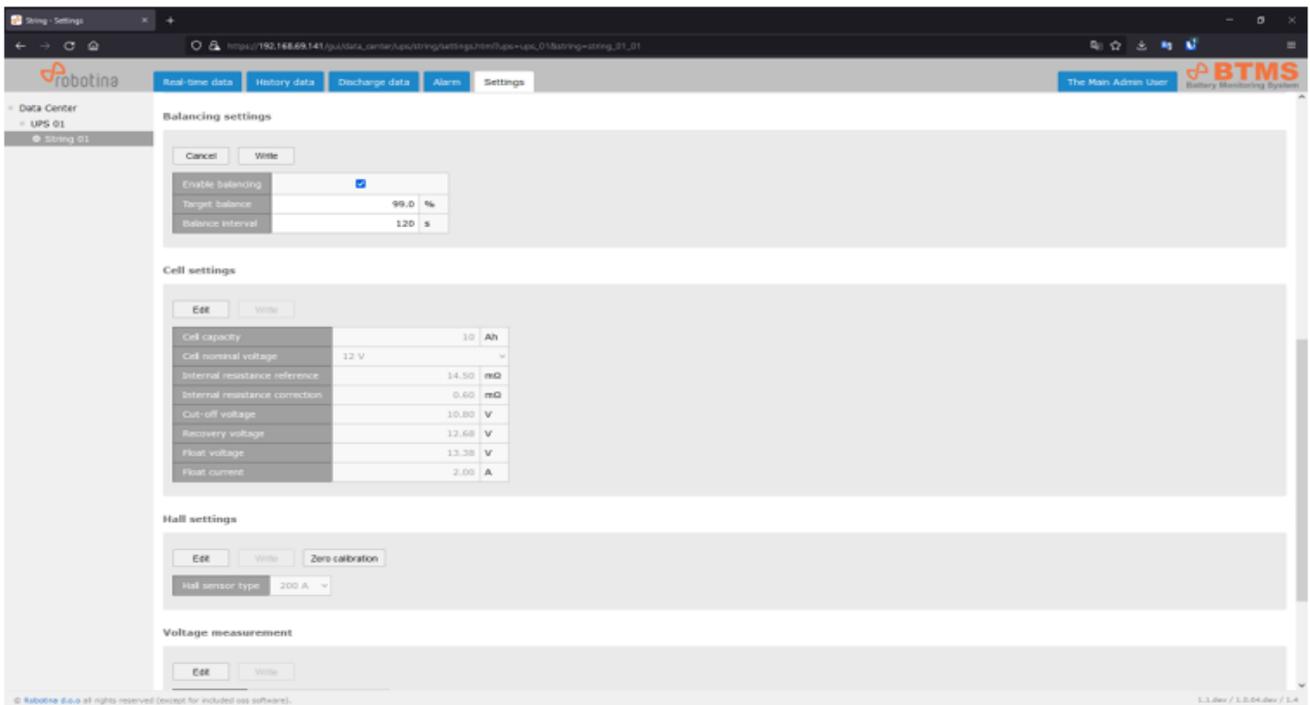
4.3.2 Resistance settings

- Here we set the battery resistance measurement frequency.



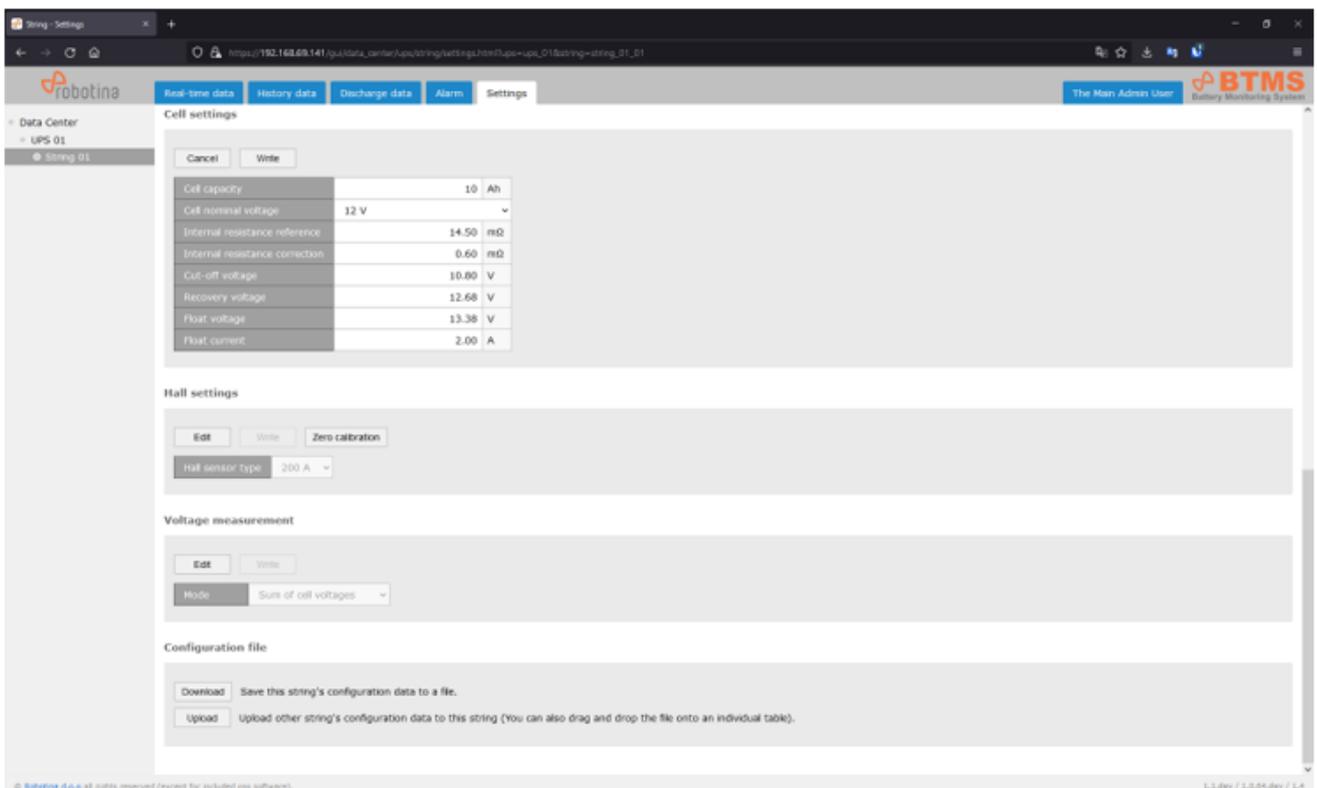
4.3.3 Balancing settings

- Battery balancing can be enabled or disabled. If balancing is enabled, set the threshold value at which balancing is triggered and the balancing execution interval.



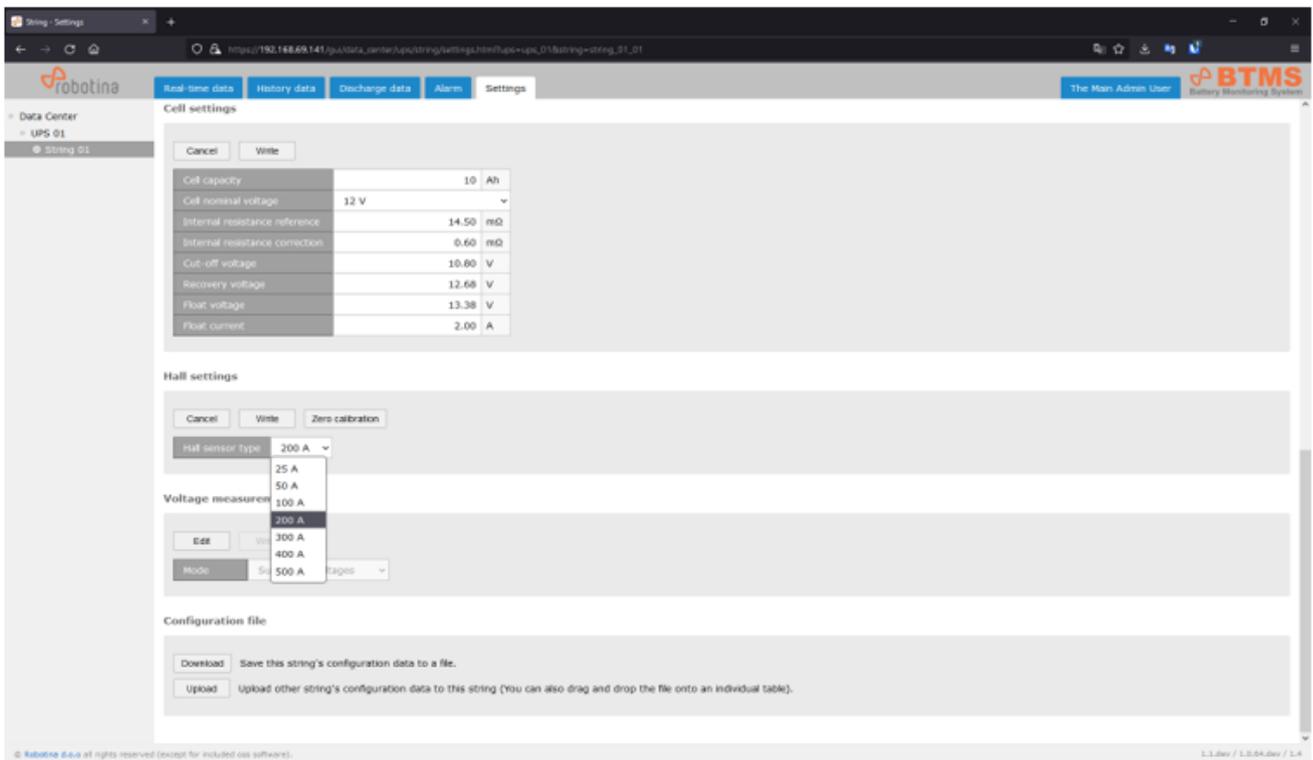
4.3.4 Cell settings

- For the proper functioning of battery status monitoring, it is necessary to specify what batteries are used in the string.



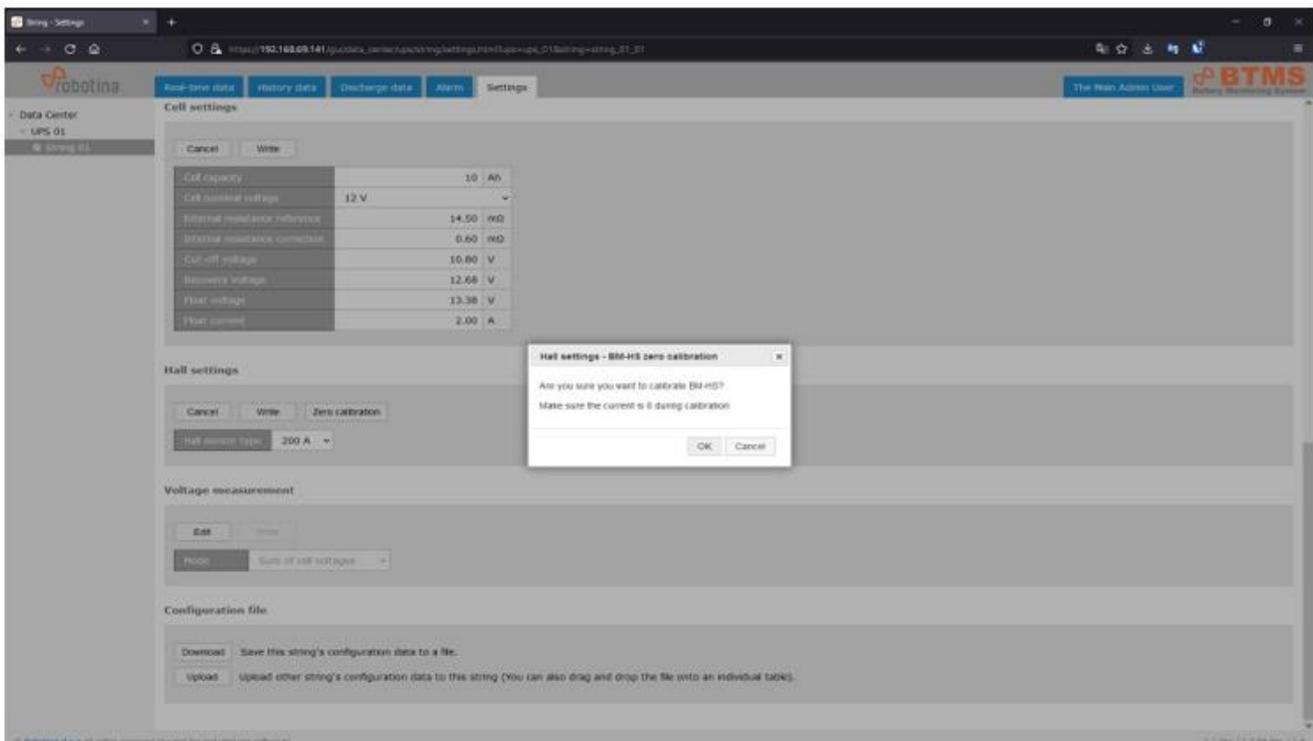
4.3.5 Hall Setting

- Select the sensor used from the values offered.



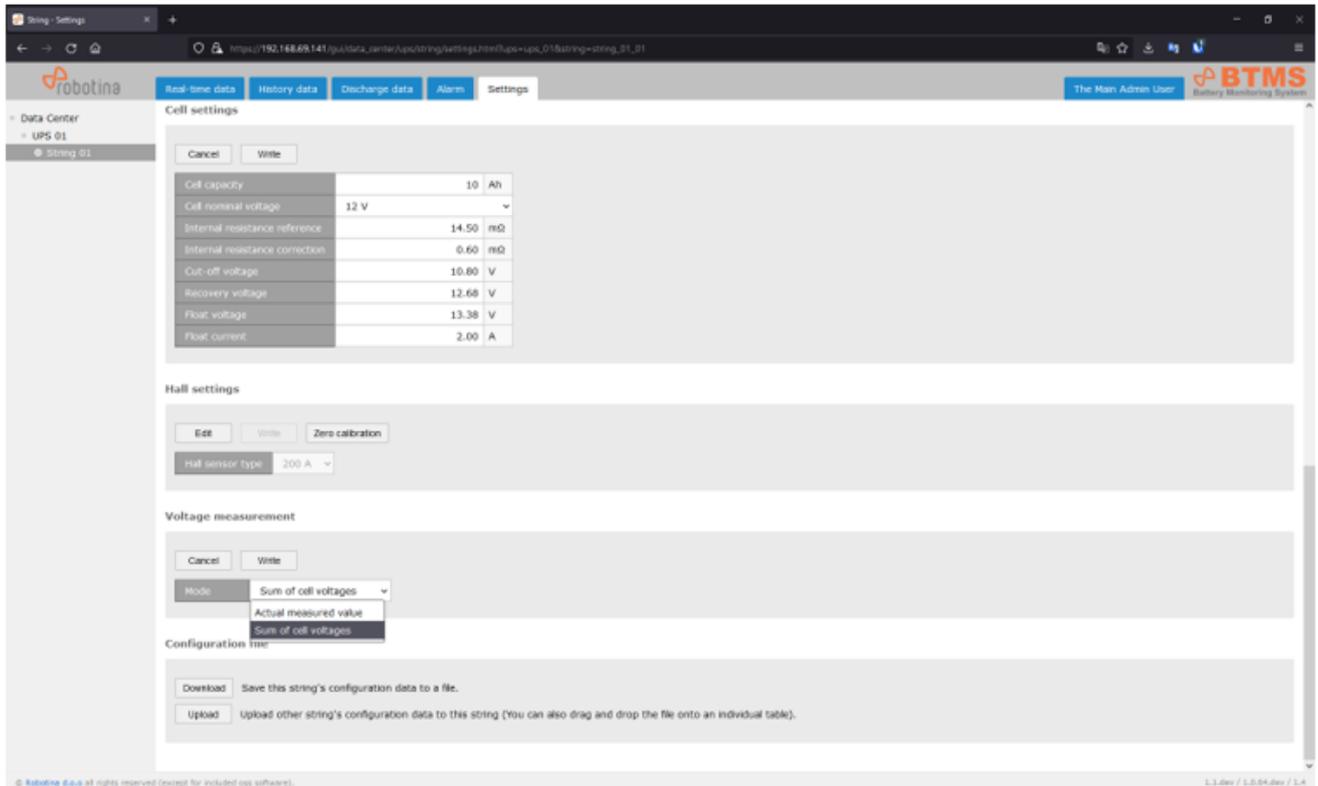
The Zero calibration button is used to calibrate the Hall sensors.

It is important to ensure that during calibration the string current is 0 A



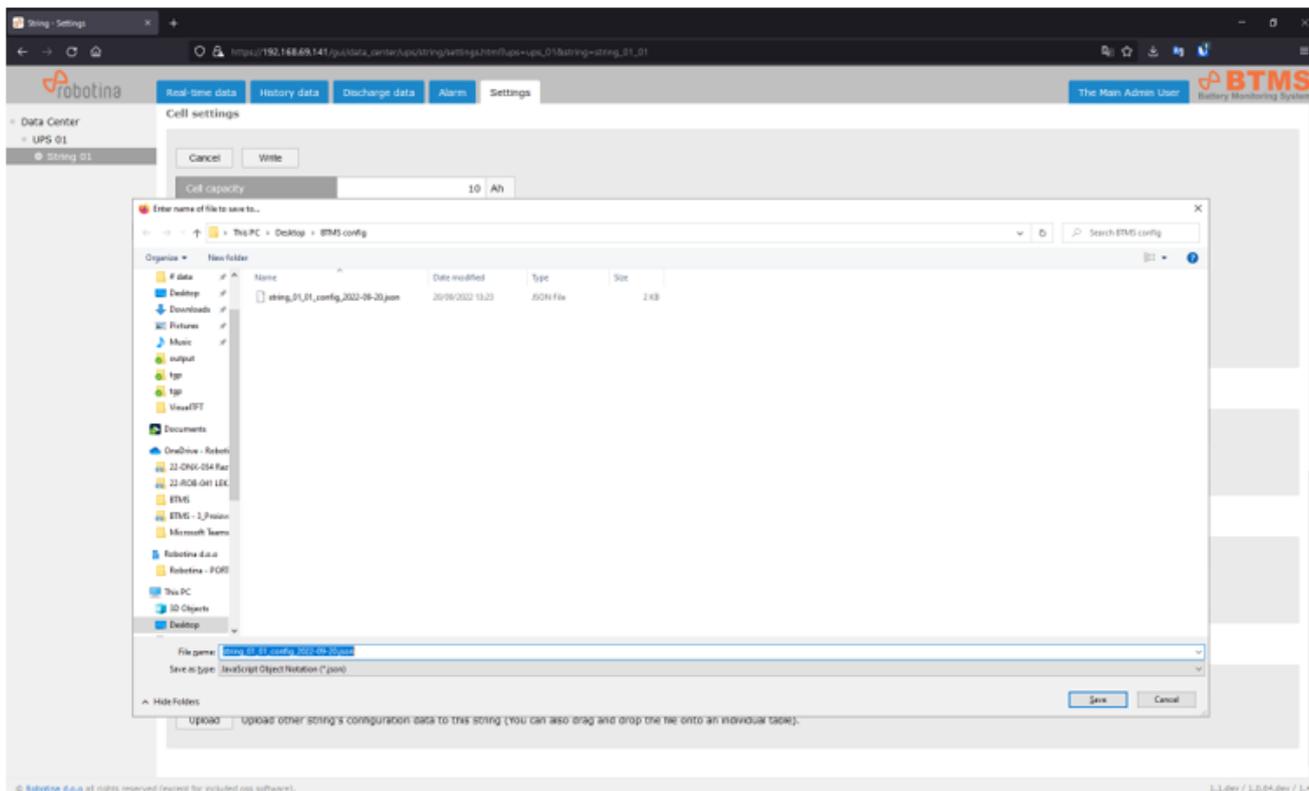
4.3.6 Voltage Measurement

- The string sensor allows 2 ways of measuring the string voltage: as the sum of the voltage of the batteries in the string or directly. Since we have to work with dangerously high voltage when measuring the voltage directly, it is recommended to use the summation of the voltage of individual batteries where possible.

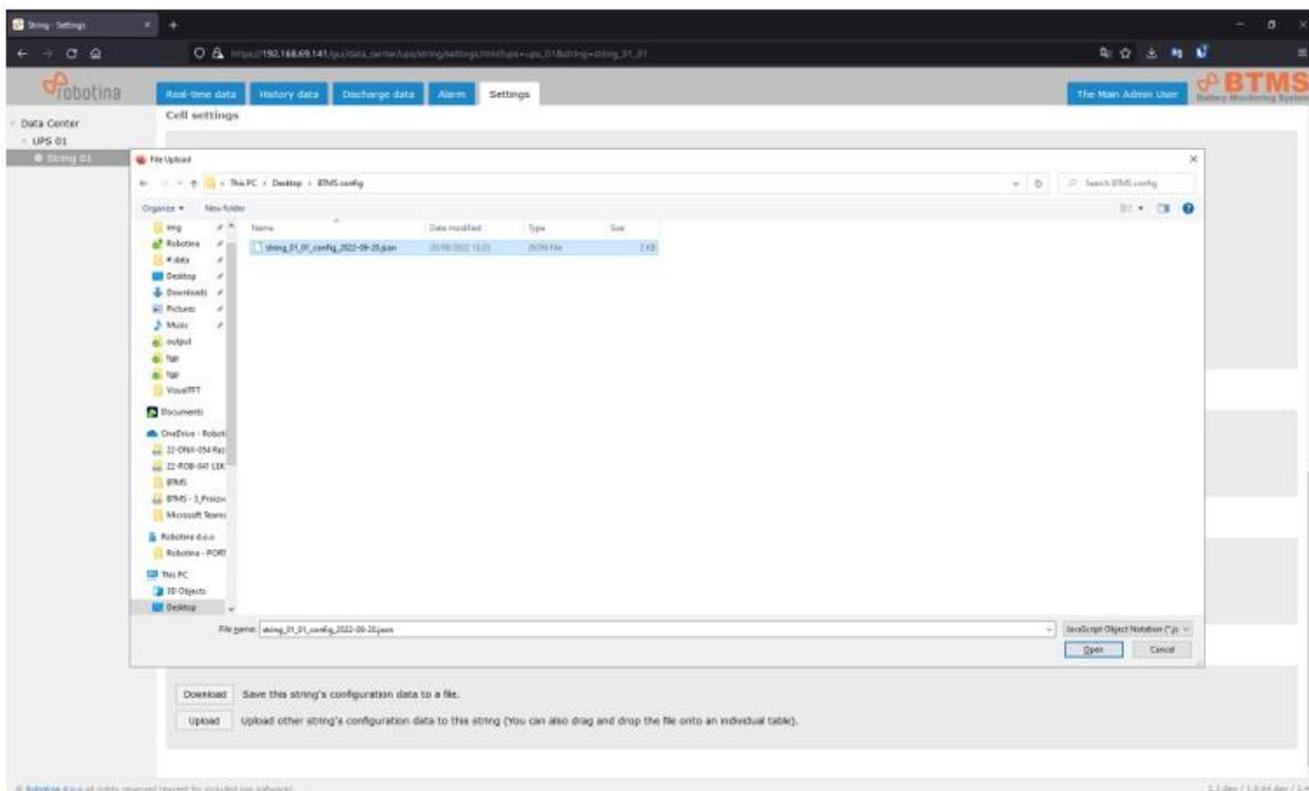


4.3.7 Configuration file

- It is possible to easily save the string sensor settings to a file.



- And reading all the instructions from this one.



- If we drag and drop the saved file onto the settings table, only the parameters that are in the table will be entered from the file.

4.4 BTMS Installation and Commissioning steps overview

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: "BTMS Commissioning Table v2.0.xls"	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	General settings	Follow the steps in 4.1 General settings	Authorized system integrator
5	Add string, battery and other sensors	Follow the steps in "4.2 Adding string and battery sensors".	Authorized system integrator
6	String and Battery sensors setup	Follow steps in "4.3 String and Battery sensors settings"	Authorized system integrator
7	BM-GW setup	Set WAN, NTP, Time setting. Add Users for WEB UI app.	Authorized system integrator

8	Function test	<p>On all user interfaces (touch panel, WEB UI on BM-GW), check whether all displayed data are consistent with the expected values.</p> <p>Check Modbus TCP/IP communication with the BM.-MC controller.</p>	Authorized system integrator
9	Archive relevant data	Archive Configuration file and commissioning table	Authorized system integrator

5 Maintenance

Regular maintenance of electrical installations has a decisive effect on reliability and safe use. Therefore, electrical installations must be periodically inspected and tested. It is mandatory that the maintenance personnel are familiarized with project documentation and electrical installation plan. All electrical installations must be safe for both people and equipment throughout their lifetime. We expect normal operation of the installations with as few interventions and repairs as possible.

5.1 Maintenance plan

Basically, all electrical equipment that is installed in Battery Monitoring System does not require any special maintenance. Nevertheless, periodic preventive maintenance activities performed by authorized personnel are strongly recommended.

5.2 Preventive Maintenance Checklist

We strongly recommend quarterly preventive maintenance checkup. We provide a checklist with recommended maintenance activities that should be performed by authorized personnel.

BTMS Battery Monitoring System Preventive Maintenance Checklist						
CUSTOMER DATA						
1 PLANT/BUILDING		2 LOCATION		3 CONTRACT		
4 EQUIPMENT		5 CUSTOMER		6 DATE		
7 TESTED BY						
BTMS EQUIPMENT DATA						
# of UPS	# of Strings	# of Batteries per String	Total Batteries	# of Battery Sensors	# of String Sensors	# of Hall Sensors
VISUAL AND ELECTRICAL/MECHANICAL INSPECTION						
CHECK POINT	COND*	NOTES				
1 EXTERIOR OF EQUIPMENT (visually inspect all equipment on dirt and corrosion, damage, note any changes and recommendations)						
2 COMPLETENESS OF ASSEMBLY (visually inspect all equipment completeness, note any changes and recommendations)						
3 INDICATING LIGHTS (check if all indicating lights are operational, note any changes and recommendations)						
4 WIRING VISUAL VERIFICATION (inspect all wirings on dirt, damage and corrosion, note any changes and recommendations)						
5 TIGHTNESS OF BOLT CONNECTIONS (check all connections for proper tightness and torque note any changes and recommendations)						
6 DISCONNECT STRINGS. DOES SYSTEM OPERATE CORRECTLY (disconnect Ethernet cable on string sensor one string by one, note if proper alarms appear)						
7 VERIFICATION OF CELL SENSORS (BM-CS) (check if all Cell sensors are functioning and provide measurements, note any changes and recommendations)						

8 VERIFICATION OF ALL STRING SENSORS (BM-SS) (check if all String sensors are functioning and provide measurements, note any changes and recommendations)		
9 VERIFICATION OF ALL HALL SENSORS (BM-HS) (check if all Hall sensors are functioning and provide measurements, note any changes and recommendations)		
10 VERIFICATION OF ALL MASTER CONTROLLERS (BM-C) (check if all Master Controllers are functioning and provide measurements, note any changes and recommendations)		
11 VERIFICATION OF ALL TOUCH PANELS (BM-HMI) (check if all Touch Panels are functioning and note any changes and recommendations)		
12 VERIFICATION OF ALL GATEWAYS (BM-GW) (check if all Gateways are functioning and note any changes and recommendations)		
LOG VERIFICATION		
CHECK POINT	COND*	NOTES
13 CHECK LOG FILES FOR COMPLETENESS		
SOFTWARE/HARDWARE MAINTANANCE		
CHECK POINT	COND*	NOTES
14 BACKUP ALL CONTROLLERS		
15 BACKUP ALL DATABASES		
16 INSTALL ALL FIRMWARE UPDATES/PATCHES		

DOCUMENT ALL EQUIPEMENT		
CHECK POINT	COND*	NOTES
17 PROVIDE ALL DATA LISTED IN "btms commissioning table v2.0.xlsx"		
PHOTO DOCUMENTATION		
CHECK POINT	COND*	NOTES
18 PHOTO DOCUMENT ALL REGULAR AS WELL AS UNUSUAL SITUATION AND EQUIPEMENT		
NOTES		
<p>*CONDITION: A=ACCEPTABLE; r=NEEDS REPAIR, REPLACEMENT OR ADJUSTMENT; C=CORRECTED; NA=NOT APPLICABLE ** YEARLY WITHIN MAJOR SEERVICE</p>		

6 Troubleshooting

6.1 Alarms

If you notice any alarm check the BTMS Alarm list for further action. Alarm list is attached at the end of the document.

6.2 System malfunctions

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.

- Check the power supply and the power supply of all components are connected correctly
- Check 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)

6.3 Support

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 above, our technical support will also be more effective in identifying errors and will help you more effectively.

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>



7 Appendix: BTMS Alarm List

Alarm	Alarm trigger	Alarm clear	Action
String current charge limit	String charging current over alarm trigger threshold	Automatically String charging current below alarm clear threshold	Turn off the UPS Check the UPS settings Verify string current
String current discharge limit	String discharging current over alarm trigger threshold	Automatically String discharging current below alarm clear threshold	Turn off UPS Check wiring Verify UPS settings Verify string current
String voltage high limit	String voltage over alarm trigger threshold	Automatically String voltage below alarm clear threshold	Turn off the UPS Check the UPS settings Verify string voltage
String voltage low limit	String voltage below alarm trigger threshold	Automatically String voltage over alarm clear threshold	Turn off the UPS Check the UPS settings Check the condition of the batteries in the string Verify string voltage
String SoC low limit	String SOC below alarm trigger threshold	Automatically String SOC above alarm clear threshold	Check the operation of the UPS Check the string breaker Check the condition of the batteries in the string
Hall alarm enable	Hall sensor faulty or disconnected	Automatically Hall sensor is working correctly	Check the Hall sensor connection
Cell voltage high limit	Battery voltage over alarm trigger threshold	Automatically Battery voltage below alarm clear threshold	Check the UPS settings
Cell voltage low limit	Battery voltage below alarm trigger threshold	Automatically Battery voltage over alarm clear threshold	Check the condition of the other batteries in the string, if they are all at the limit, the problem is in the UPS settings; if the other batteries are within the expected values, the cause is most likely in the battery.

Alarm	Alarm trigger	Alarm clear	Action
Cell resistance high limit	Battery internal resistance over alarm trigger threshold	Automatically Battery internal resistance below alarm clear threshold	Check the wiring of the battery and the battery sensor. Manually checks the battery's internal resistance. Replace the battery.
Cell SoC low limit	Battery SOC below alarm trigger threshold	Automatically Battery SOC over alarm clear threshold	Check the condition of the other batteries in the string, if they are all at the limit, the problem is in the UPS settings or operation; if the other batteries are within the expected values, the cause is most likely in the battery.
Cell SoH low limit	Battery SOH below alarm trigger threshold	Automatically Battery SOH over alarm clear threshold	Check the wiring of the battery and the battery sensor. Replace the battery.
Cell temperature high limit	Battery temperature over alarm trigger threshold	Automatically Battery temperature below alarm clear threshold	Turn off the UPS and wait for the temperature to drop to normal. Check the battery wiring (power part). If the problem persists, replace the battery.,
Cell disabled	At least 1 battery (cell) sensor is disabled.	Automatically Battery (cell) sensor enabled again	Check battery sensor wiring. Check battery voltage. Check ethernet cable. If the problem persists, replace the battery or battery sensor.

NOTES: