

Battery Monitoring System

(Battery monitoring system for larger UPS systems)

TUTORIALS

V3.0

Table of content

1	System description	3
1.1	System Features	4
1.2	System wiring diagram	5
1.3	Modules description	6
2	Logging in / out	10
3	BTMS Monitoring Functionality	11
3.1	Monitoring Features	11
3.2	Data Center view	12
3.3	UPS View	18
3.4	String view	21
3.5	Examples	25
4	HMI User Interface	28
4.1	Main Screen	28
4.2	UPS Screen	29
5	Troubleshooting	33
5.1	Alarms	33
5.2	System malfunctions	33
5.3	Support	33
6	Appendix: BTMS Alarm List	34

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 Features

Highlights

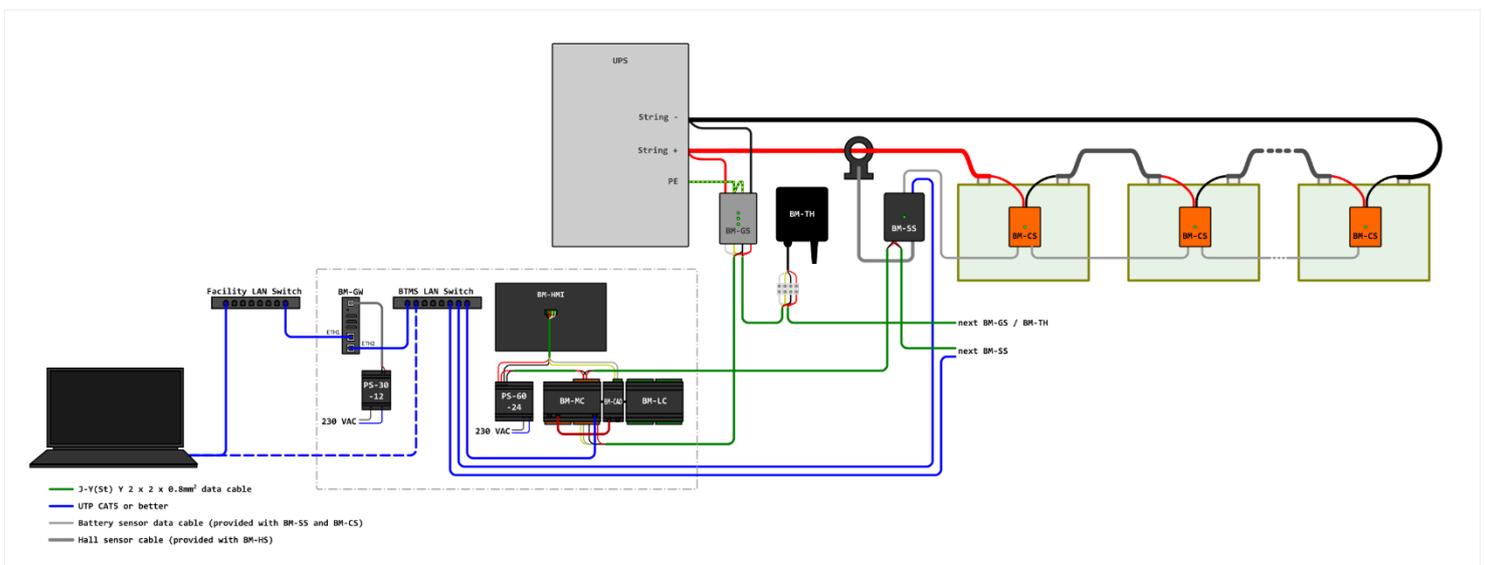
- **monitoring** of all important **battery** parameters of larger **UPS** systems in order to ensure operational reliability
- **simple and fast installation** on existing or new UPS systems
- **very reliable operation**
- simple and intuitive **WEB user interface**
- automatic **logging** of data and 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 hmidity	✓				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			

1.2 System wiring diagram



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: AC3750 V
 - Supports up to 120 batteries (BM-CS)

BTMS Hall Sensor

Highlights & Features

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



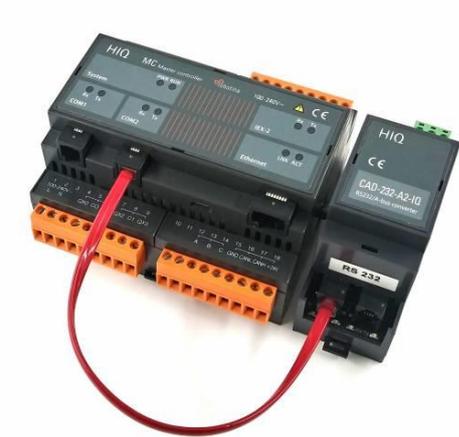
BTMS Cell Sensor

Highlights & Features

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



BTMS 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

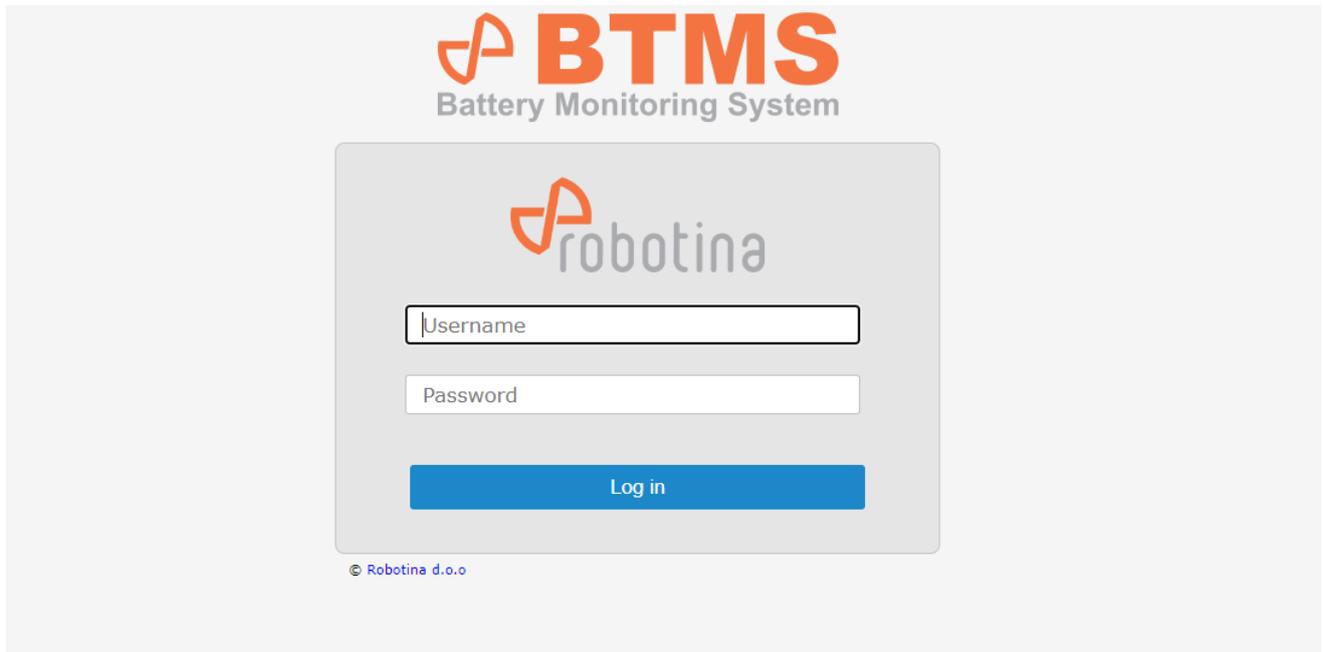
BTMS 7" HMI Touch Display



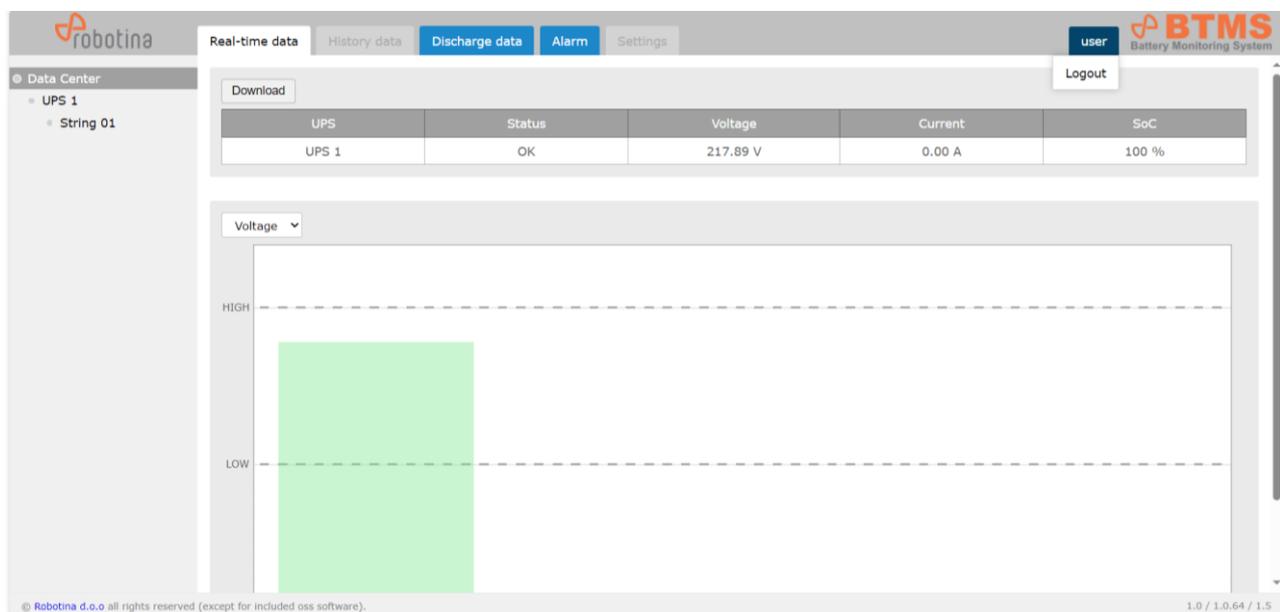
Highlights & Features

- 7" capacitive touch screen
- Supports up to:
 - 32 strings (arbitrary arranged in UPS)
 - 3840 batteries (8 BM-SS x 120 BM-CS)

2 Logging in / out



Insert your Username and Password and press Log in button

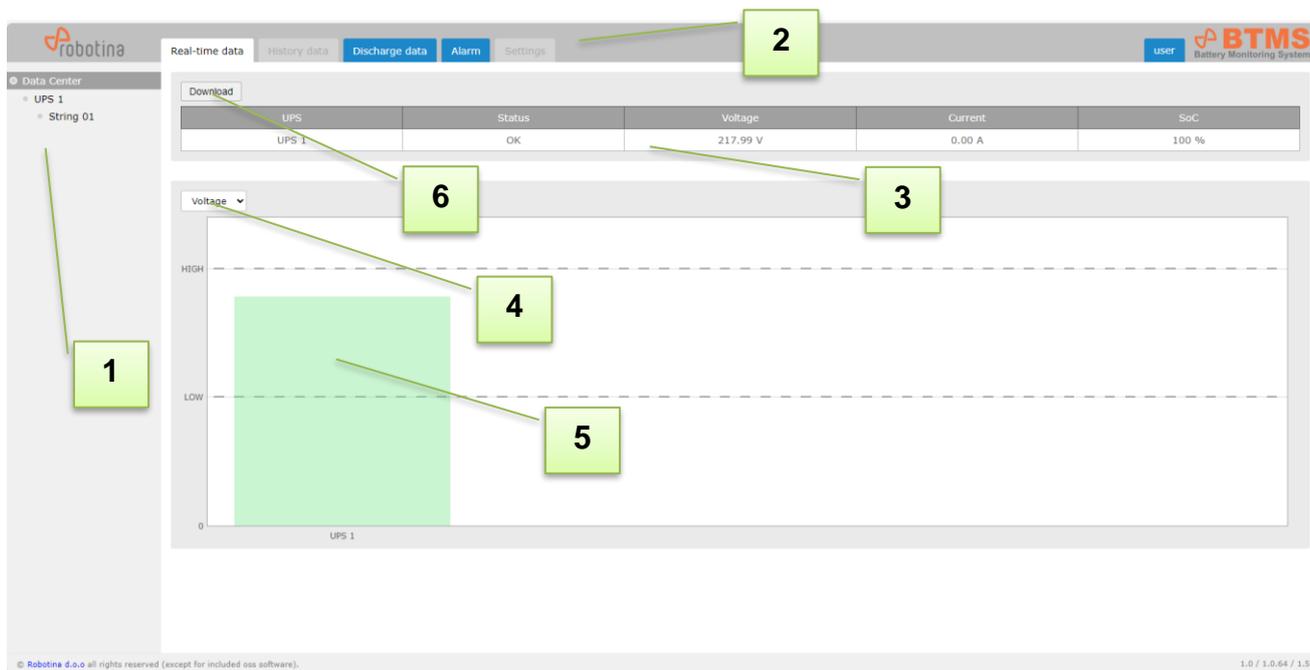


For Log out place your Cursor on User field and press Logout.

3 BTMS Monitoring Functionality

3.1 Monitoring Features

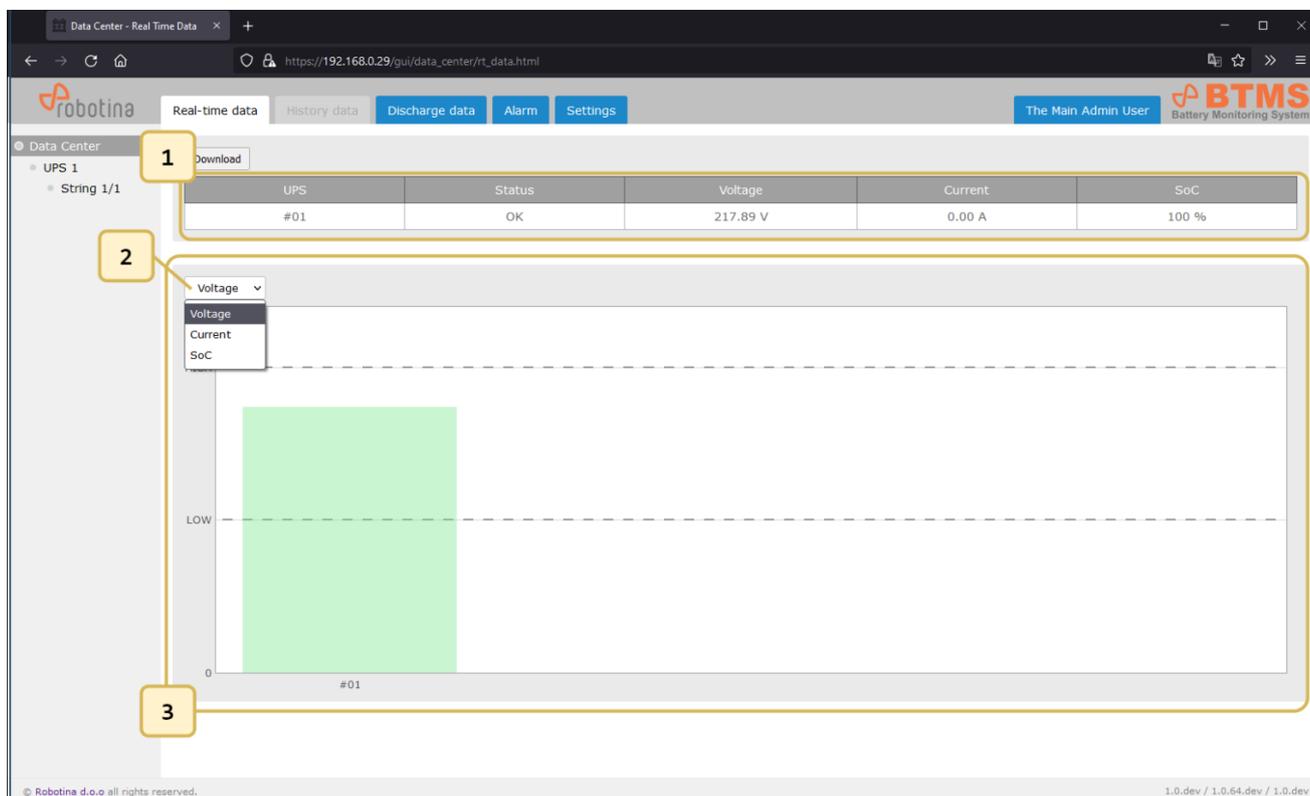
After successful log in following (main) screen appears:



1	Data Center tree structure
2	Tabs, Real time data, History data, Discharge data, Alarms, Settings (admin only)
3	Display of data
4	Data selection
5	Graphical display
6	Download button (download selected data int CSF file for your further use)

3.2 Data Center view

Real-time data



1	Tabular display of data for the Data Center
2	Select a parameter for the graphic display
3	Graphic bar-graph data display for the data center

Discharge data

1

#	UPS	String	Start	End	Action
2	#01	#01	05/25/2022 16:45:36	05/26/2022 09:11:26	String time-plot Cell time-plot
1	#01	#01	05/25/2022 12:07:23	05/25/2022 12:25:33	String time-plot Cell time-plot

Showing 1 to 2 of 2 entries

2 3

© Robotina d.o.o all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

1	Discharge events table
2	String time-plot for discharge event
3	Cell time-plot for discharge event

String time-plot for discharge event

String time-plot

Voltage Start: 2022/05/25 16:45 End: 2022/05/26 09:11 Download

Voltage
Current
SoC
Balance

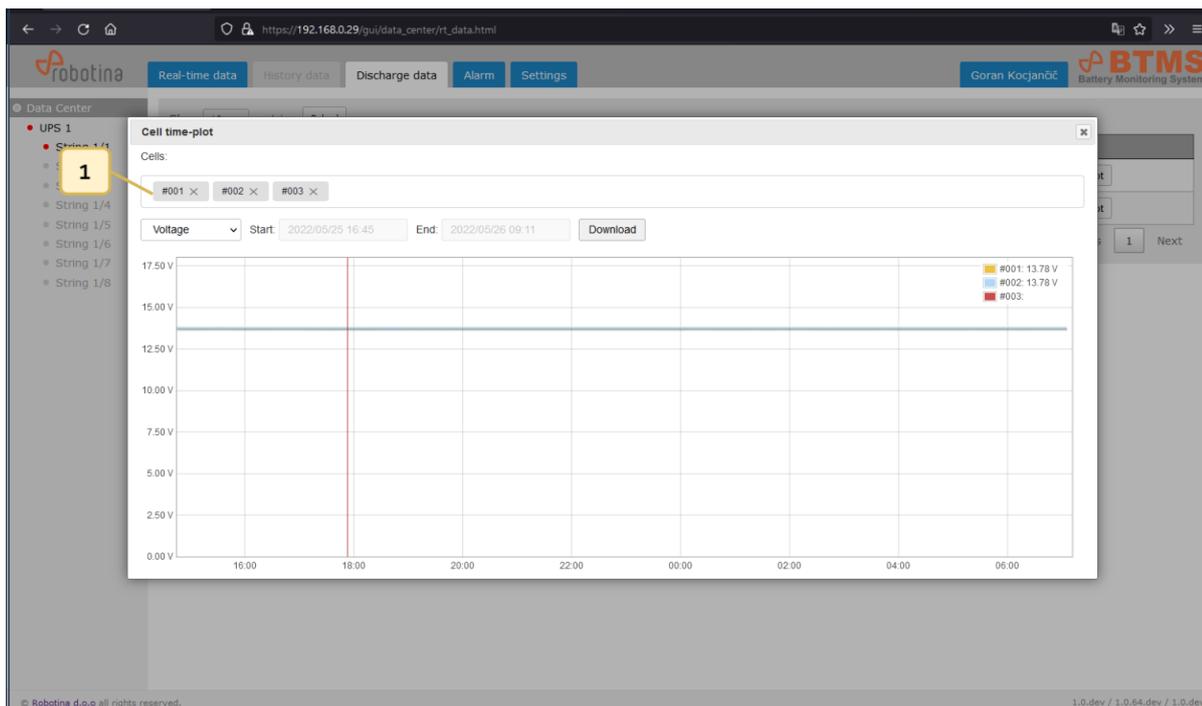
25.00 V
20.00 V
15.00 V
10.00 V
5.00 V
0.00 V

16:00 18:00 20:00 22:00 00:00 02:00 04:00 06:00

1

© Robotina d.o.o all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

Cell time-plot discharge event



1 Cell selection

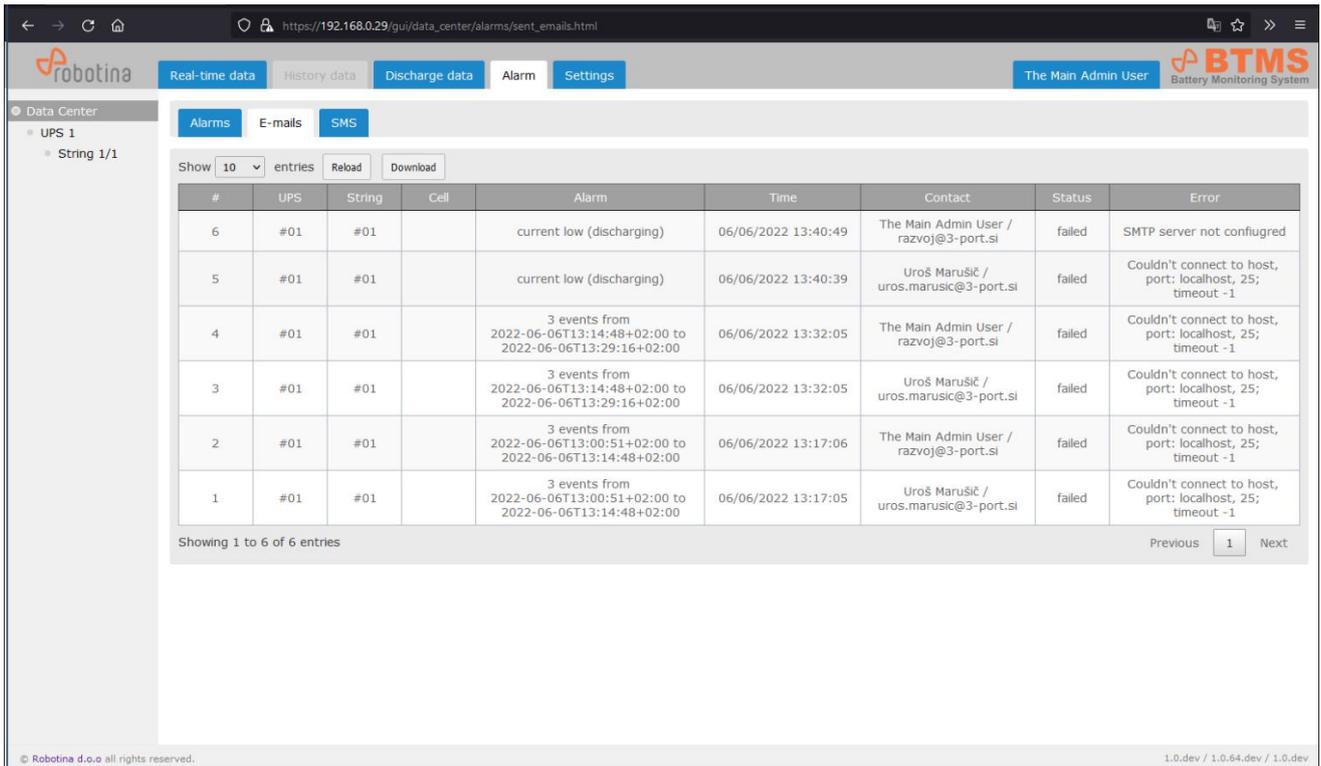
Alarm

#	UPS	String	Cell	From	To	Alarm	Status
14	#01	#01	#001	06/07/2022 14:22:20		Temperature high	active
13	#01	#01		06/06/2022 13:35:56	06/06/2022 13:38:24	Current low (discharging)	gone
12	#01	#01		06/06/2022 13:29:16	06/06/2022 13:38:24	Current high (charging)	gone
11	#01	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Voltage low	gone
10	#01	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Voltage high	gone
9	#01	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Current low (discharging)	gone
8	#01	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Current high (charging)	gone
7	#01	#01		06/06/2022 13:00:19	06/06/2022 13:00:51	Voltage low	gone
6	#01	#01		06/06/2022 12:43:25	06/06/2022 13:00:51	Voltage high	gone
5	#01	#01		06/06/2022 12:43:25	06/06/2022 13:00:51	Current low (discharging)	gone

1 Alarms sub-page selection

2 Alarms table

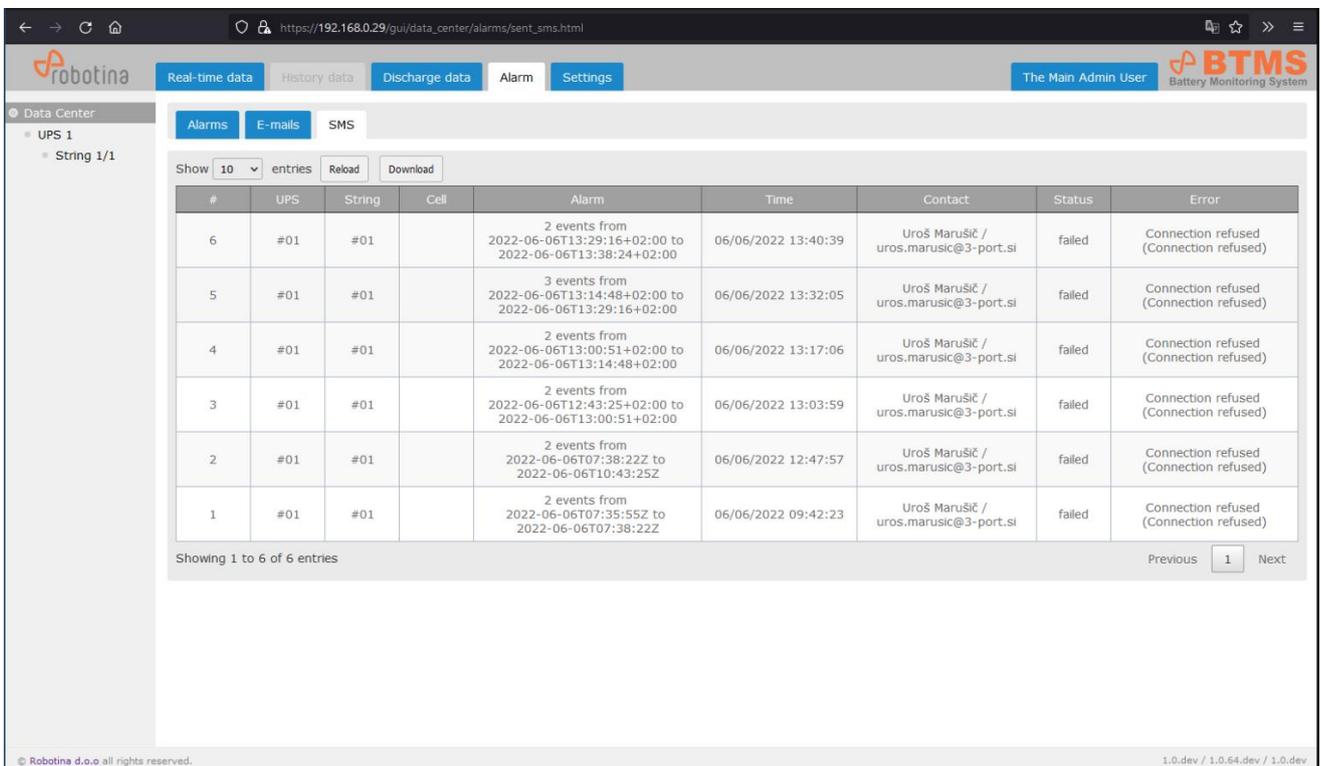
E-mails



© Robotina d.o.o all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

#	UPS	String	Cell	Alarm	Time	Contact	Status	Error
6	#01	#01		current low (discharging)	06/06/2022 13:40:49	The Main Admin User / razvoj@3-port.si	failed	SMTP server not configured
5	#01	#01		current low (discharging)	06/06/2022 13:40:39	Uroš Marušič / uros.marusic@3-port.si	failed	Couldn't connect to host, port: localhost, 25; timeout -1
4	#01	#01		3 events from 2022-06-06T13:14:48+02:00 to 2022-06-06T13:29:16+02:00	06/06/2022 13:32:05	The Main Admin User / razvoj@3-port.si	failed	Couldn't connect to host, port: localhost, 25; timeout -1
3	#01	#01		3 events from 2022-06-06T13:14:48+02:00 to 2022-06-06T13:29:16+02:00	06/06/2022 13:32:05	Uroš Marušič / uros.marusic@3-port.si	failed	Couldn't connect to host, port: localhost, 25; timeout -1
2	#01	#01		3 events from 2022-06-06T13:00:51+02:00 to 2022-06-06T13:14:48+02:00	06/06/2022 13:17:06	The Main Admin User / razvoj@3-port.si	failed	Couldn't connect to host, port: localhost, 25; timeout -1
1	#01	#01		3 events from 2022-06-06T13:00:51+02:00 to 2022-06-06T13:14:48+02:00	06/06/2022 13:17:05	Uroš Marušič / uros.marusic@3-port.si	failed	Couldn't connect to host, port: localhost, 25; timeout -1

SMS

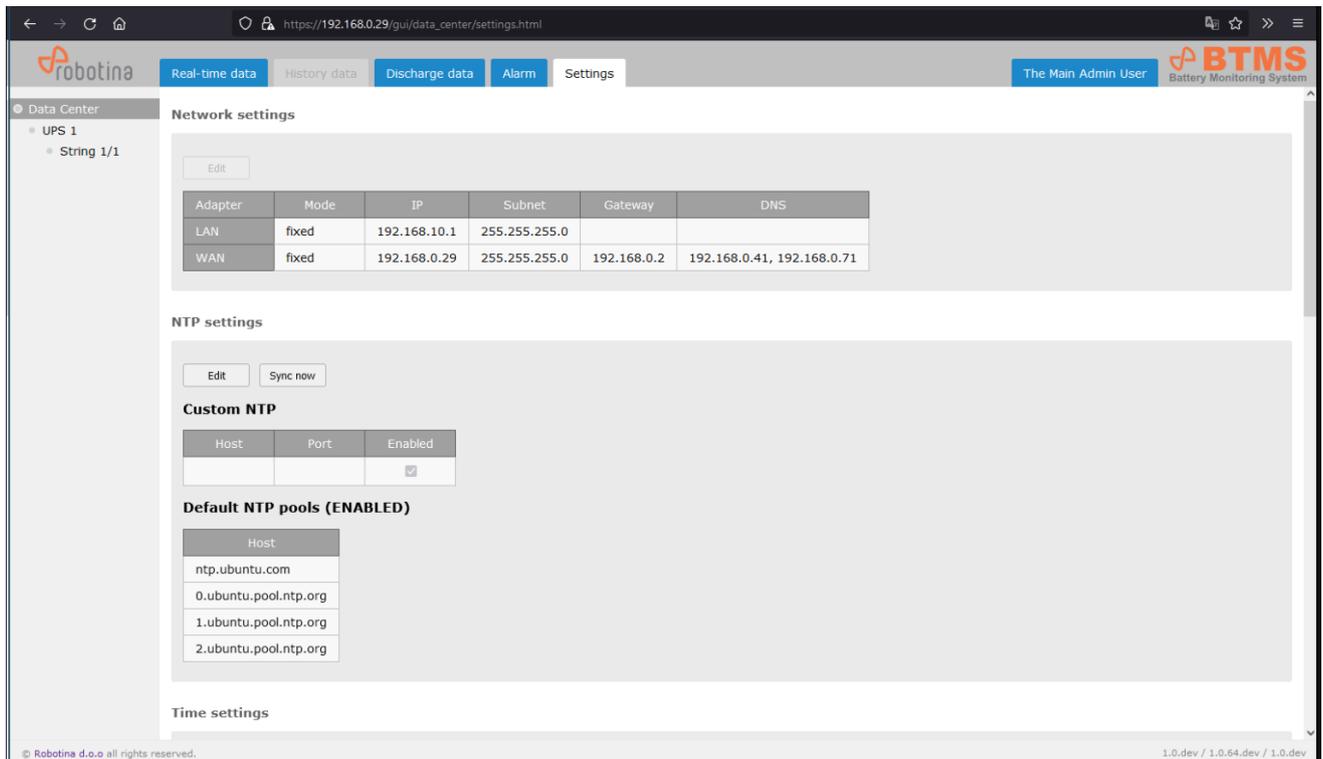


© Robotina d.o.o all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

#	UPS	String	Cell	Alarm	Time	Contact	Status	Error
6	#01	#01		2 events from 2022-06-06T13:29:16+02:00 to 2022-06-06T13:38:24+02:00	06/06/2022 13:40:39	Uroš Marušič / uros.marusic@3-port.si	failed	Connection refused (Connection refused)
5	#01	#01		3 events from 2022-06-06T13:14:48+02:00 to 2022-06-06T13:29:16+02:00	06/06/2022 13:32:05	Uroš Marušič / uros.marusic@3-port.si	failed	Connection refused (Connection refused)
4	#01	#01		2 events from 2022-06-06T13:00:51+02:00 to 2022-06-06T13:14:48+02:00	06/06/2022 13:17:06	Uroš Marušič / uros.marusic@3-port.si	failed	Connection refused (Connection refused)
3	#01	#01		2 events from 2022-06-06T12:43:25+02:00 to 2022-06-06T13:00:51+02:00	06/06/2022 13:03:59	Uroš Marušič / uros.marusic@3-port.si	failed	Connection refused (Connection refused)
2	#01	#01		2 events from 2022-06-06T07:38:22Z to 2022-06-06T10:43:25Z	06/06/2022 12:47:57	Uroš Marušič / uros.marusic@3-port.si	failed	Connection refused (Connection refused)
1	#01	#01		2 events from 2022-06-06T07:35:52Z to 2022-06-06T07:38:22Z	06/06/2022 09:42:23	Uroš Marušič / uros.marusic@3-port.si	failed	Connection refused (Connection refused)

Settings

Network settings, NTP settings



The screenshot shows the 'Settings' page in the Robotina GUI. The left sidebar shows 'Data Center' > 'UPS 1' > 'String 1/1'. The main content area is divided into three sections:

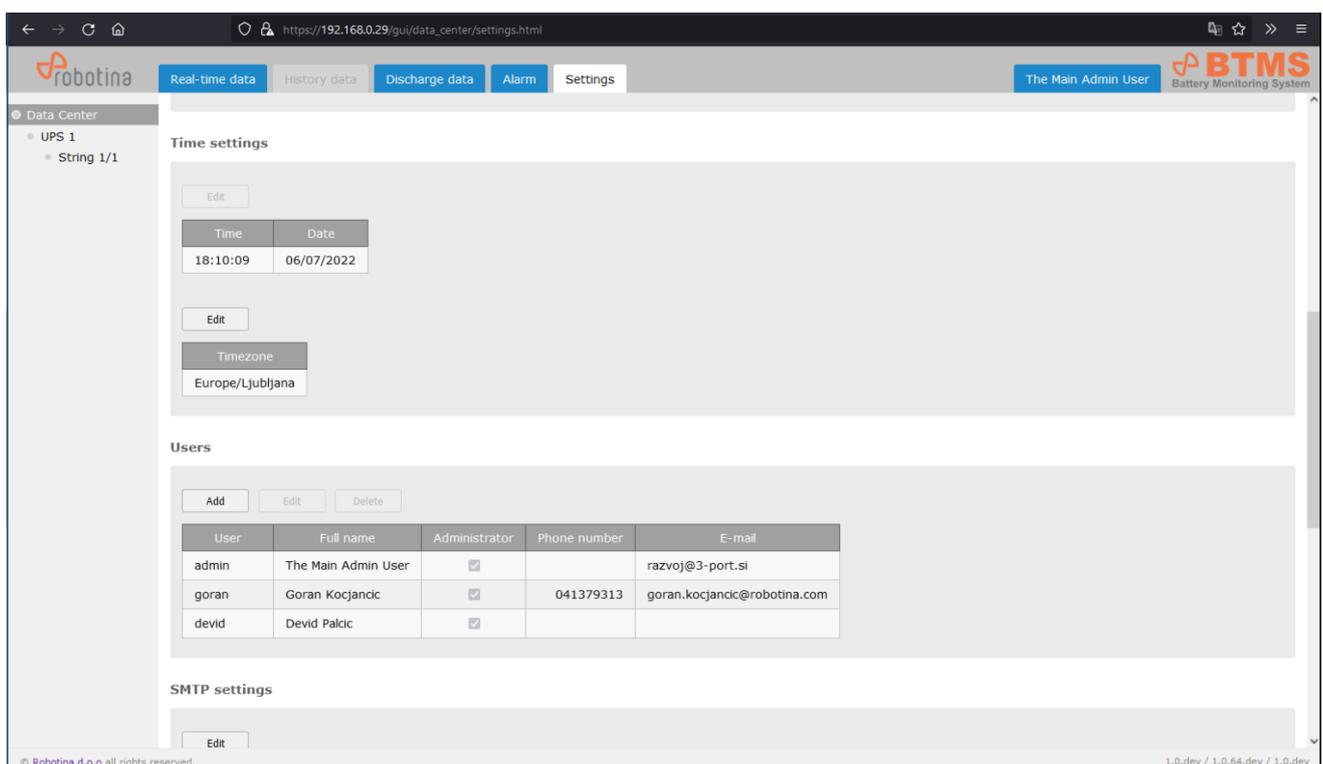
- Network settings:** Includes an 'Edit' button and a table with columns: Adapter, Mode, IP, Subnet, Gateway, and DNS.

Adapter	Mode	IP	Subnet	Gateway	DNS
LAN	fixed	192.168.10.1	255.255.255.0		
WAN	fixed	192.168.0.29	255.255.255.0	192.168.0.2	192.168.0.41, 192.168.0.71
- NTP settings:** Includes 'Edit' and 'Sync now' buttons. It has a 'Custom NTP' section with a table:

Host	Port	Enabled
		<input checked="" type="checkbox"/>

 Below it is a 'Default NTP pools (ENABLED)' section with a list of hosts:
 - ntp.ubuntu.com
 - 0.ubuntu.pool.ntp.org
 - 1.ubuntu.pool.ntp.org
 - 2.ubuntu.pool.ntp.org
- Time settings:** This section is partially visible at the bottom of the screenshot.

Time settings, Users



The screenshot shows the 'Settings' page in the Robotina GUI, specifically the 'Time settings' and 'Users' sections.

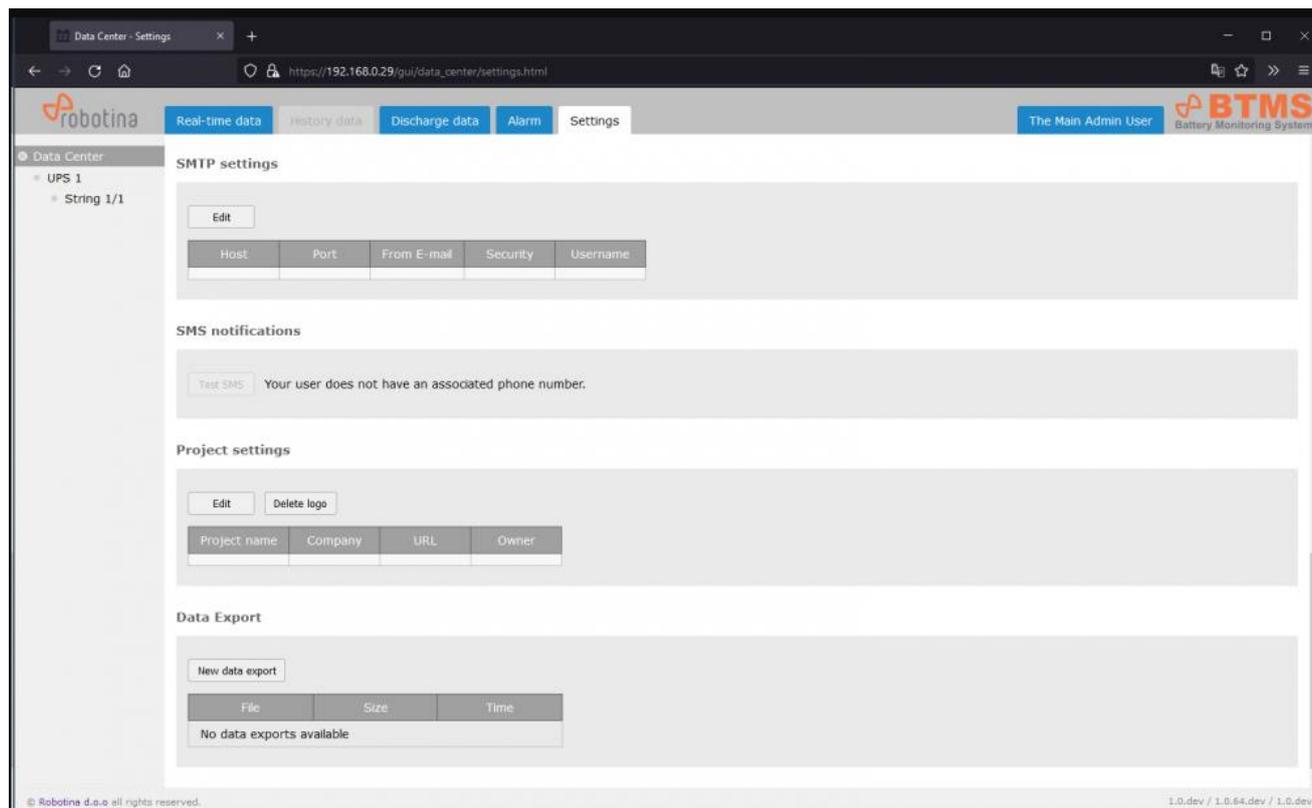
- Time settings:** Includes an 'Edit' button and a table:

Time	Date
18:10:09	06/07/2022

 Below the table is another 'Edit' button and a 'Timezone' dropdown menu set to 'Europe/Ljubljana'.
- Users:** Includes 'Add', 'Edit', and 'Delete' buttons. It features a table with columns: User, Full name, Administrator, Phone number, and E-mail.

User	Full name	Administrator	Phone number	E-mail
admin	The Main Admin User	<input checked="" type="checkbox"/>		razvoj@3-port.si
goran	Goran Kocjancic	<input checked="" type="checkbox"/>	041379313	goran.kocjancic@robotina.com
devid	Devid Palcic	<input checked="" type="checkbox"/>		
- SMTP settings:** This section is partially visible at the bottom of the screenshot.

SMTP settings, SMS notifications, Project settings, Data export



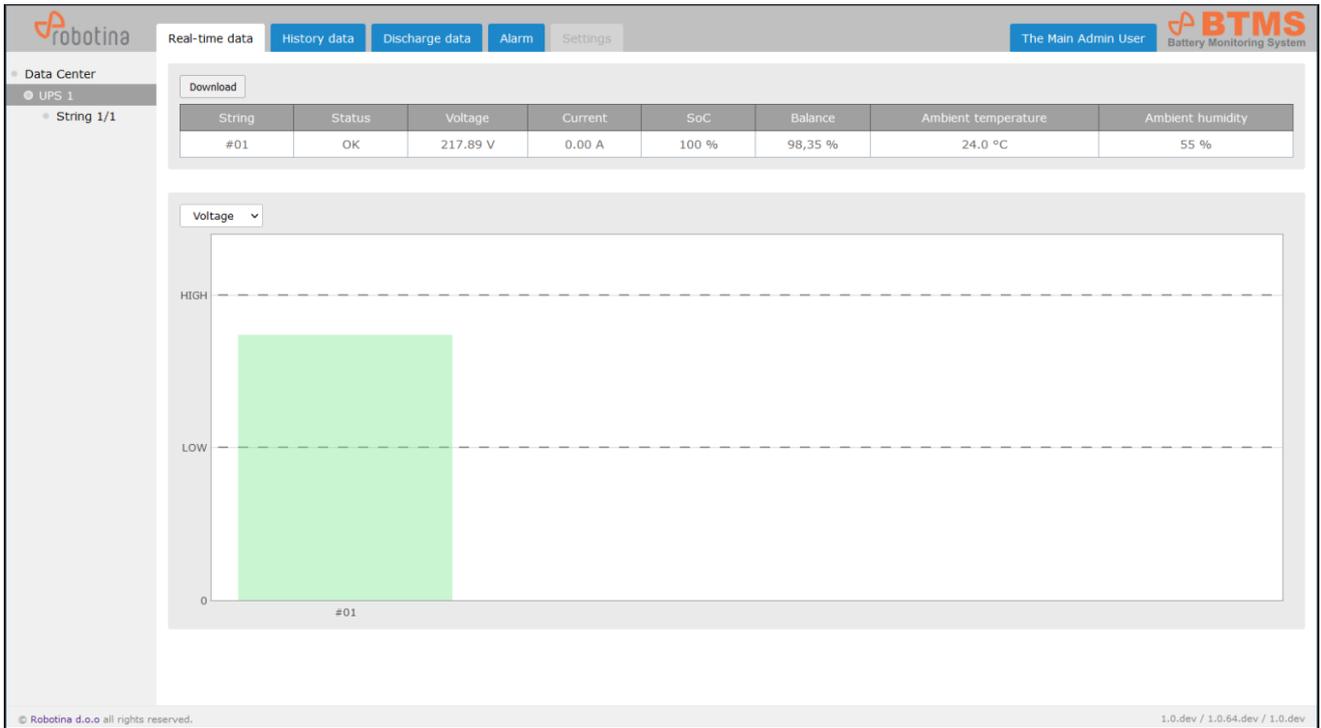
The screenshot shows the 'Data Center - Settings' page in a web browser. The page is divided into several sections:

- Navigation:** Includes tabs for 'Real-time data', 'History data', 'Discharge data', 'Alarm', and 'Settings'. The 'Settings' tab is active. The user is identified as 'The Main Admin User'.
- Left Sidebar:** Shows a tree view with 'Data Center' expanded, containing 'UPS 1' and 'String 1/1'.
- SMTP settings:** Features an 'Edit' button and a table with columns: Host, Port, From E-mail, Security, Username.
- SMS notifications:** Includes a 'Test SMS' button and a message: 'Your user does not have an associated phone number.'
- Project settings:** Includes 'Edit' and 'Delete logo' buttons, and a table with columns: Project name, Company, URL, Owner.
- Data Export:** Includes a 'New data export' button and a table with columns: File, Size, Time. Below the table, it states 'No data exports available'.

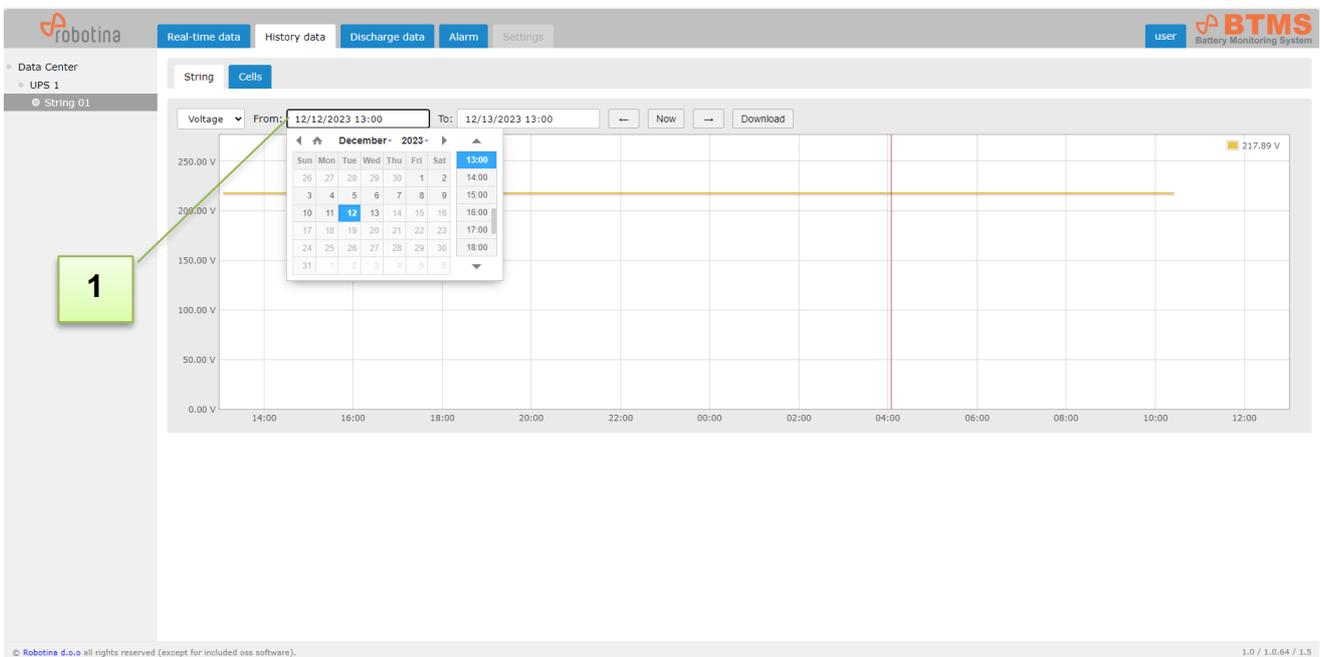
At the bottom of the page, there is a copyright notice: '© Robotina d.o.o. all rights reserved.' and version information: '1.0.dev / 1.0.64.dev / 1.0.dev'.

3.3 UPS View

Real time data



History data



1 Select timespan

Discharge data

The screenshot shows the Robotina BTMS interface with the 'Discharge data' tab selected. The left sidebar shows a tree view under 'Data Center' with 'UPS 1' expanded to show strings 1/1 through 1/8. The main content area displays a table of discharge events for two strings.

#	UPS	String	Start	End	Action
2	#01	#01	05/25/2022 16:45:36	05/26/2022 09:11:26	String time-plot Cell time-plot
1	#01	#01	05/25/2022 12:07:23	05/25/2022 12:25:33	String time-plot Cell time-plot

Showing 1 to 2 of 2 entries

Navigation: Previous 1 Next

Footer: https://bmgwtest.smpcloud.com/gui/data_center/discharge.html 1.0.dev / 1.0.64.dev / 1.0.dev

String time.plot

The screenshot shows the 'String time-plot' window overlaid on the main interface. The window title is 'String time-plot' and it has a close button (X). The plot shows 'Voltage' on the y-axis (0.00 V to 30.00 V) and time on the x-axis (16:00 to 06:00). A horizontal yellow line is plotted at approximately 28.00 V. The start and end times are set to 2022/05/25 16:45 and 2022/05/26 09:11. A 'Download' button is visible in the top right of the plot area.

String time-plot

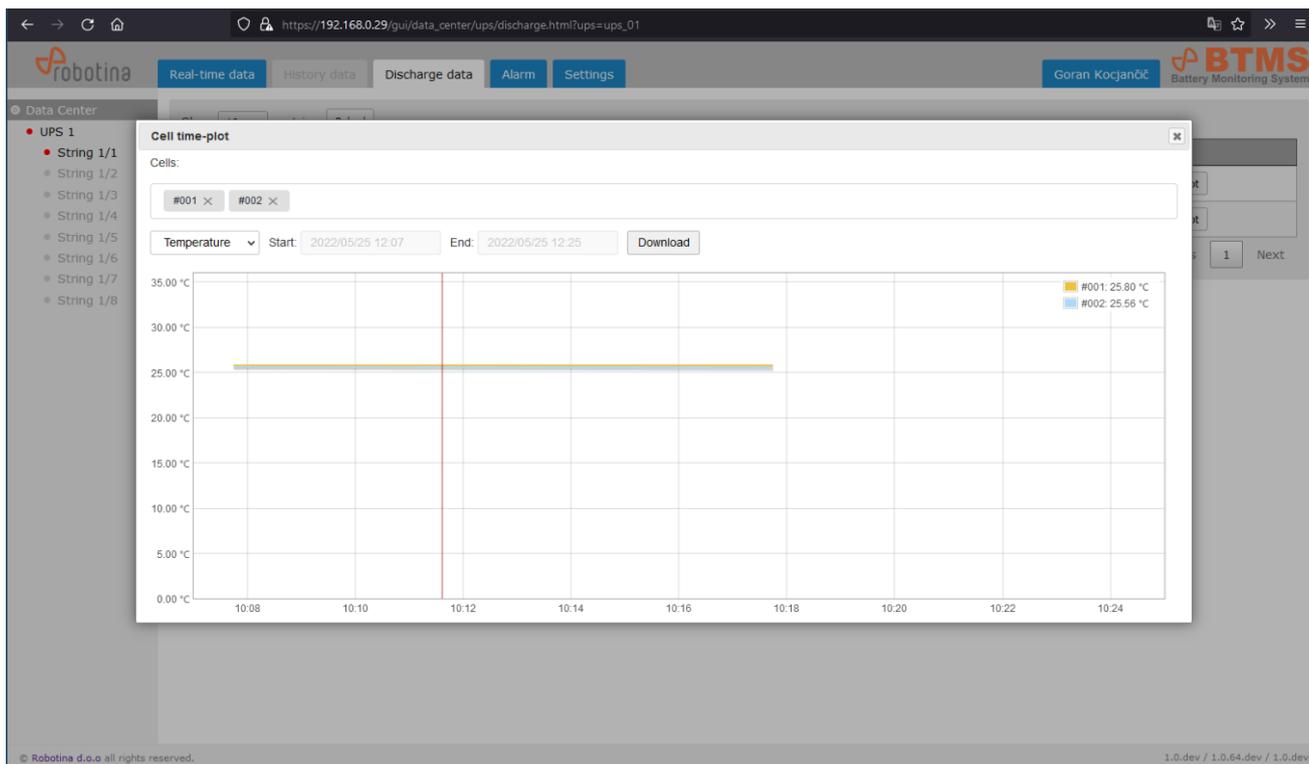
Voltage Start: 2022/05/25 16:45 End: 2022/05/26 09:11 Download

Y-axis: 0.00 V, 5.00 V, 10.00 V, 15.00 V, 20.00 V, 25.00 V, 30.00 V

X-axis: 16:00, 18:00, 20:00, 22:00, 00:00, 02:00, 04:00, 06:00

Footer: © Robotina d.o.o all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

Cell time-plot



Alarm

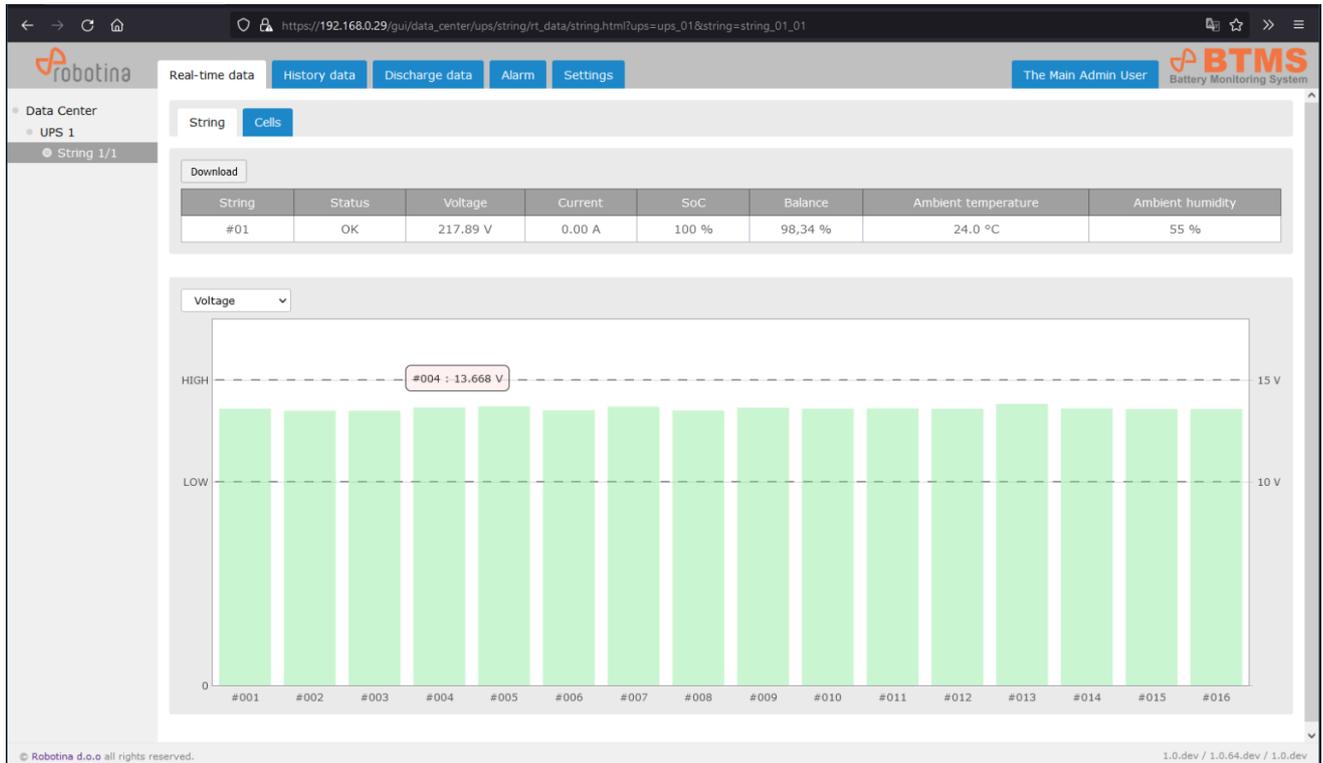
The screenshot shows the 'Alarm' interface with a table of 14 entries. The table columns are '#', 'String', 'Cell', 'From', 'To', 'Alarm', and 'Status'. The entries are as follows:

#	String	Cell	From	To	Alarm	Status
14	#01	#001	06/07/2022 14:22:20		Temperature high	active
13	#01		06/06/2022 13:35:56	06/06/2022 13:38:24	Current low (discharging)	gone
12	#01		06/06/2022 13:29:16	06/06/2022 13:38:24	Current high (charging)	gone
11	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Voltage low	gone
10	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Voltage high	gone
9	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Current low (discharging)	gone
8	#01		06/06/2022 13:14:48	06/06/2022 13:28:41	Current high (charging)	gone
7	#01		06/06/2022 13:00:19	06/06/2022 13:00:51	Voltage low	gone
6	#01		06/06/2022 12:43:25	06/06/2022 13:00:51	Voltage high	gone
5	#01		06/06/2022 12:43:25	06/06/2022 13:00:51	Current low (discharging)	gone

The interface includes a sidebar with 'UPS 1' and 'String 1/1' selected, and a top navigation bar with 'Real-time data', 'History data', 'Discharge data', 'Alarm', and 'Settings' tabs. The user 'The Main Admin User' is logged in. The table shows 14 entries, with the first entry being active and the others gone.

3.4 String view

Real-time data



Cells

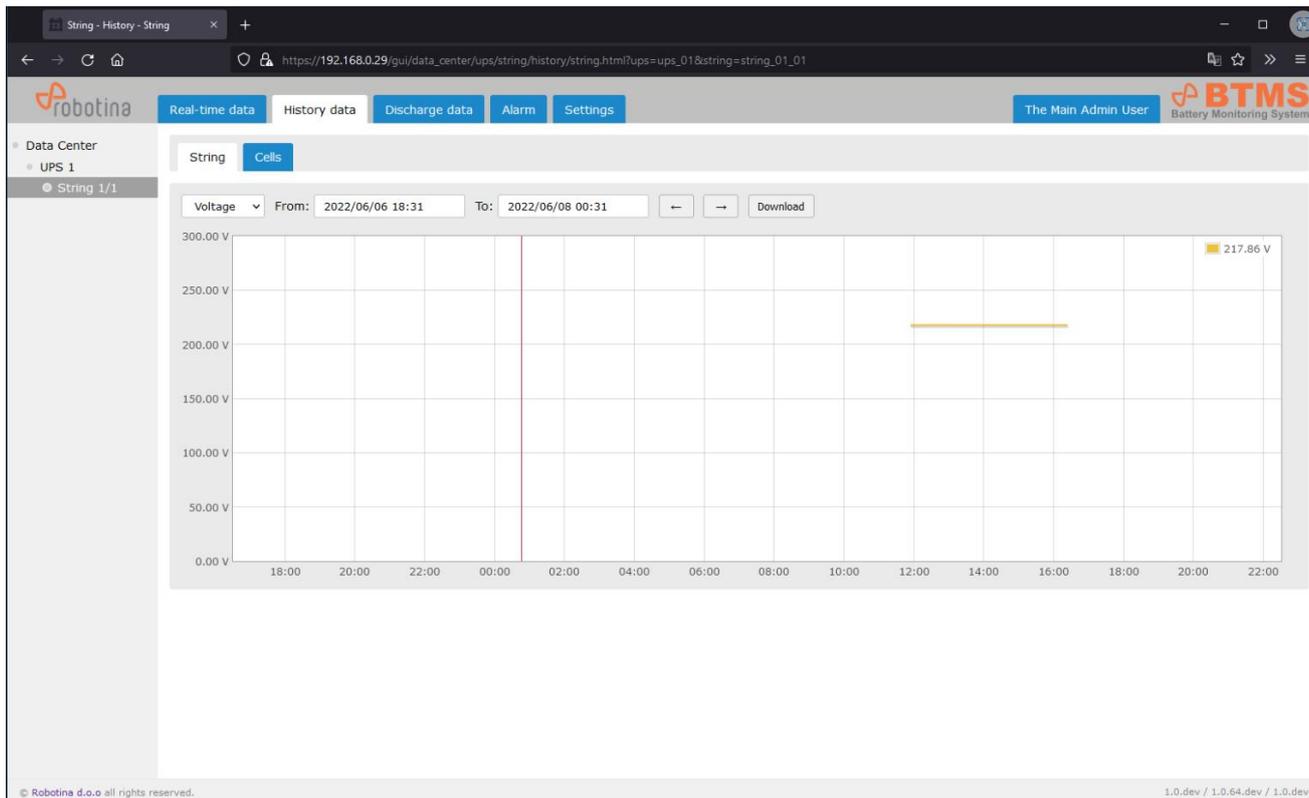
Cells View Summary:

Cell	Status	Voltage	Resistance	Temperature	SoC	SoH
#001	OK	13.611 V	18.036 mΩ	300.0 °C	100 %	76 %
#002	OK	13.502 V	16.718 mΩ	300.0 °C	100 %	79 %
#003	OK	13.506 V	16.674 mΩ	300.0 °C	100 %	79 %
#004	OK	13.666 V	15.875 mΩ	300.0 °C	100 %	81 %
#005	OK	13.725 V	15.655 mΩ	300.0 °C	100 %	82 %
#006	OK	13.529 V	15.439 mΩ	300.0 °C	100 %	82 %
#007	OK	13.703 V	15.058 mΩ	300.0 °C	100 %	83 %
#008	OK	13.512 V	18.096 mΩ	300.0 °C	100 %	76 %
#009	OK	13.655 V	15.747 mΩ	300.0 °C	100 %	82 %
#010	OK	13.611 V	15.647 mΩ	300.0 °C	100 %	82 %

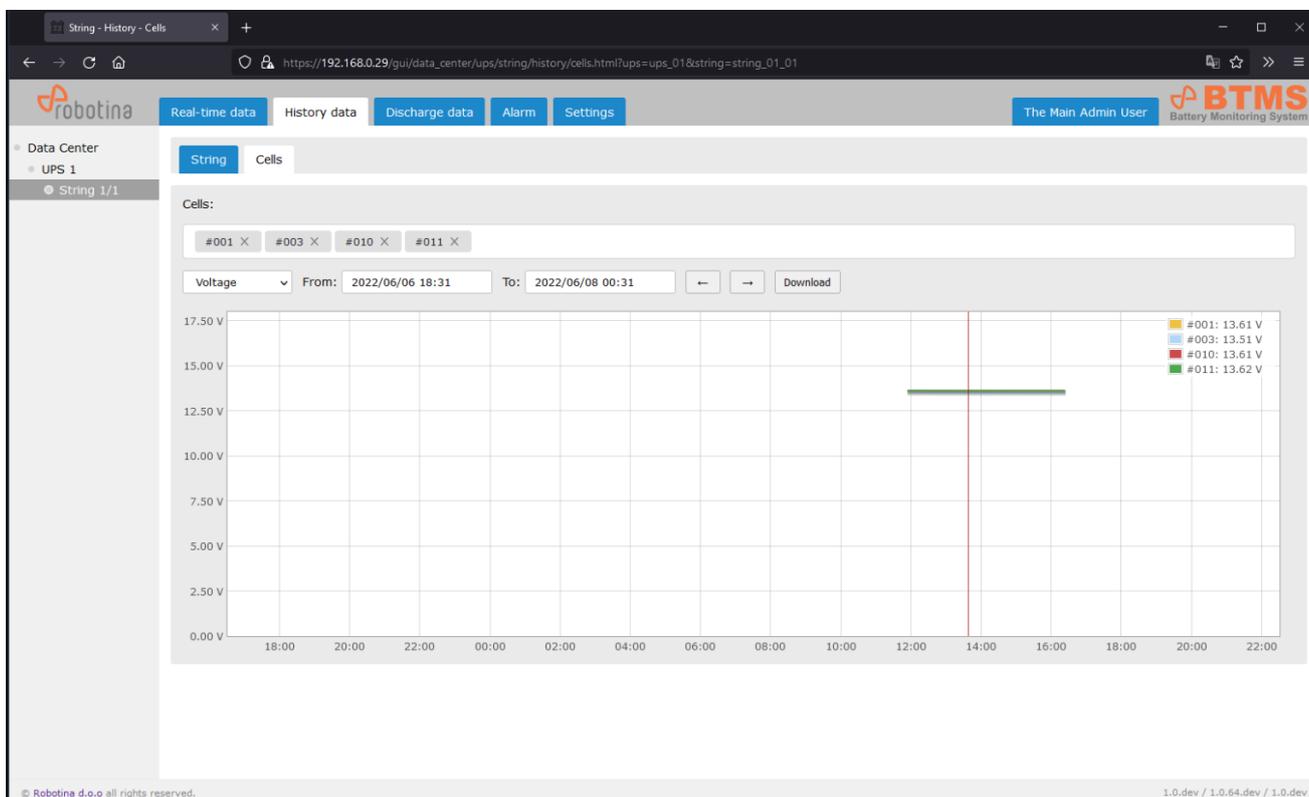
Showing 1 to 10 of 16 entries

History data

String



Cells



Discharge data

String - Discharge

https://192.168.0.29/gui/data_center/ups/string/discharge.html?ups=ups_01&string=string_01_01

robotina BTMS Battery Monitoring System

Goran Kocjančič

Real-time data History data Discharge data Alarm Settings

Data Center

- UPS 1
 - String 1/1
 - String 1/2
 - String 1/3
 - String 1/4
 - String 1/5
 - String 1/6
 - String 1/7
 - String 1/8

Show 10 entries

#	Start	End	Action
2	05/25/2022 16:45:36	05/26/2022 09:11:26	String time-plot Cell time-plot
1	05/25/2022 12:07:23	05/25/2022 12:25:33	String time-plot Cell time-plot

Showing 1 to 2 of 2 entries

Previous 1 Next

© Robotina d.o.o. all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

String time-plot

String - Discharge

https://192.168.0.29/gui/data_center/ups/string/discharge.html?ups=ups_01&string=string_01_01

robotina BTMS Battery Monitoring System

Goran Kocjančič

Real-time data History data Discharge data Alarm Settings

Data Center

- UPS 1
 - String 1/1
 - String 1/2
 - String 1/3
 - String 1/4
 - String 1/5
 - String 1/6
 - String 1/7
 - String 1/8

Show 10 entries

#	Start	End	Action
2	05/25/2022 16:45:36	05/26/2022 09:11:26	String time-plot Cell time-plot

String time-plot

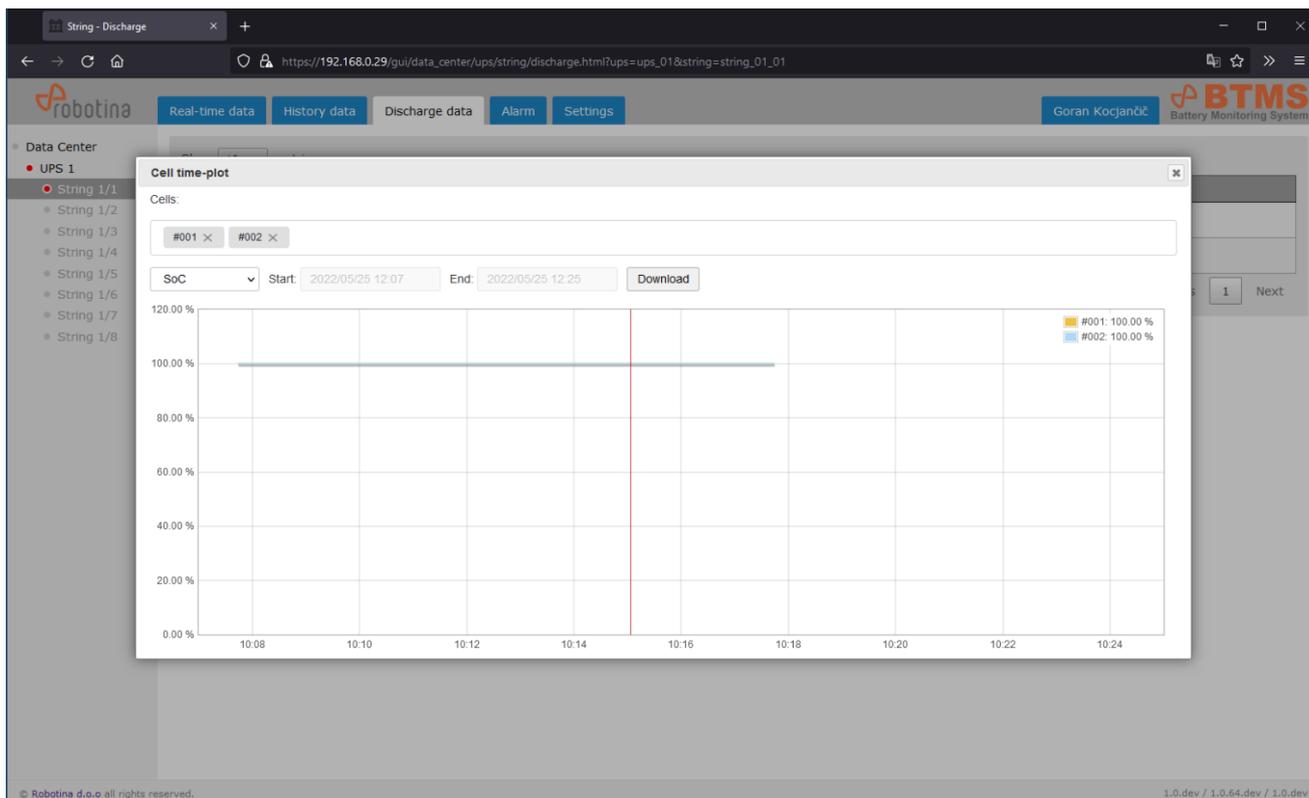
SoC Start: 2022/05/25 16:45 End: 2022/05/26 09:11 Download

120.00 %
100.00 %
80.00 %
60.00 %
40.00 %
20.00 %
0.00 %

16:00 18:00 20:00 22:00 00:00 02:00 04:00 06:00

© Robotina d.o.o. all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

Cell time-plot



Alarm

#	Cell	From	To	Alarm	Status
14	#001	06/07/2022 14:22:20		Temperature high	active
13		06/06/2022 13:35:56	06/06/2022 13:38:24	Current low (discharging)	gone
12		06/06/2022 13:29:16	06/06/2022 13:38:24	Current high (charging)	gone
11		06/06/2022 13:14:48	06/06/2022 13:28:41	Voltage low	gone
10		06/06/2022 13:14:48	06/06/2022 13:28:41	Voltage high	gone
9		06/06/2022 13:14:48	06/06/2022 13:28:41	Current low (discharging)	gone
8		06/06/2022 13:14:48	06/06/2022 13:28:41	Current high (charging)	gone
7		06/06/2022 13:00:19	06/06/2022 13:00:51	Voltage low	gone
6		06/06/2022 12:43:25	06/06/2022 13:00:51	Voltage high	gone
5		06/06/2022 12:43:25	06/06/2022 13:00:51	Current low (discharging)	gone

Showing 1 to 10 of 14 entries

Settings

The screenshot shows the 'Alarm settings' configuration page in the Robotina BTMS interface. The page is titled 'String - Settings' and is accessed via the URL `https://192.168.0.29/gui/data_center/ups/string/settings.html?ups=ups_01&string=string_01_01`. The user is logged in as 'The Main Admin User'.

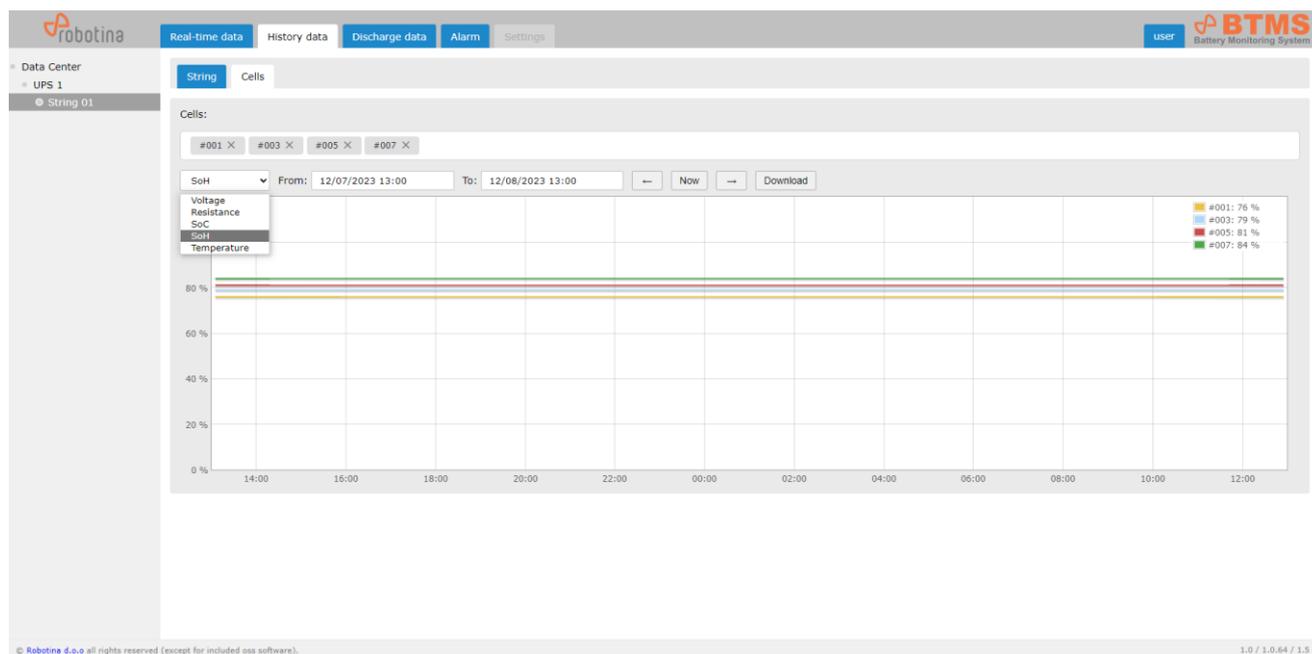
The 'Alarm settings' section is divided into two columns: 'SMS' and 'e-mail'. The settings are as follows:

Setting	SMS	e-mail
String current charge limit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
String current discharge limit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
String voltage high limit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
String voltage low limit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
String SoC low limit	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Hall alarm enable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cell voltage high limit	<input type="checkbox"/>	<input type="checkbox"/>
Cell voltage low limit	<input type="checkbox"/>	<input type="checkbox"/>
Cell resistance high limit	<input type="checkbox"/>	<input type="checkbox"/>
Cell SoC low limit	<input type="checkbox"/>	<input type="checkbox"/>
Cell SoH low limit	<input type="checkbox"/>	<input type="checkbox"/>
Cell temperature high limit	<input type="checkbox"/>	<input type="checkbox"/>

© Robotina d.o.o. all rights reserved. 1.0.dev / 1.0.64.dev / 1.0.dev

3.5 Examples

Example History data SOH



Cell data overview:

Real-time data
History data
Discharge data
Alarm
Settings

user

String
Cells

Show 10 entries
Download

Cell	Status	Voltage	Resistance	Temperature	SoC	SoH
#001	OK	13.690 V	17.718 mΩ	22.4 °C	100 %	77 %
#002	OK	13.508 V	14.854 mΩ	22.4 °C	100 %	84 %
#003	OK	13.612 V	16.142 mΩ	22.6 °C	100 %	81 %
#004	OK	13.564 V	15.109 mΩ	22.5 °C	100 %	83 %
#005	OK	13.689 V	15.747 mΩ	22.3 °C	100 %	82 %
#006	OK	13.550 V	14.548 mΩ	22.4 °C	100 %	85 %
#007	OK	13.585 V	14.737 mΩ	22.9 °C	100 %	84 %
#008	OK	13.633 V	15.637 mΩ	22.4 °C	100 %	82 %
#009	OK	13.922 V	15.471 mΩ	22.6 °C	100 %	82 %
#010	OK	13.564 V	15.031 mΩ	22.8 °C	100 %	83 %

Showing 1 to 10 of 16 entries
Previous 1 2 Next

© Robotina d.o.o all rights reserved (except for included oss software). 1.0 / 1.0.64 / 1.5

String Real time data resistance:

Real-time data
History data
Discharge data
Alarm
Settings

user

String
Cells

Download

String	Status	Voltage	Current	State	SoC	Balance	Ambient temperature	Ambient humidity
String 01	OK	218.00 V	0.00 A	Floating charge	100 %	97,83 %	21.5 °C	48.9 %

Resistance

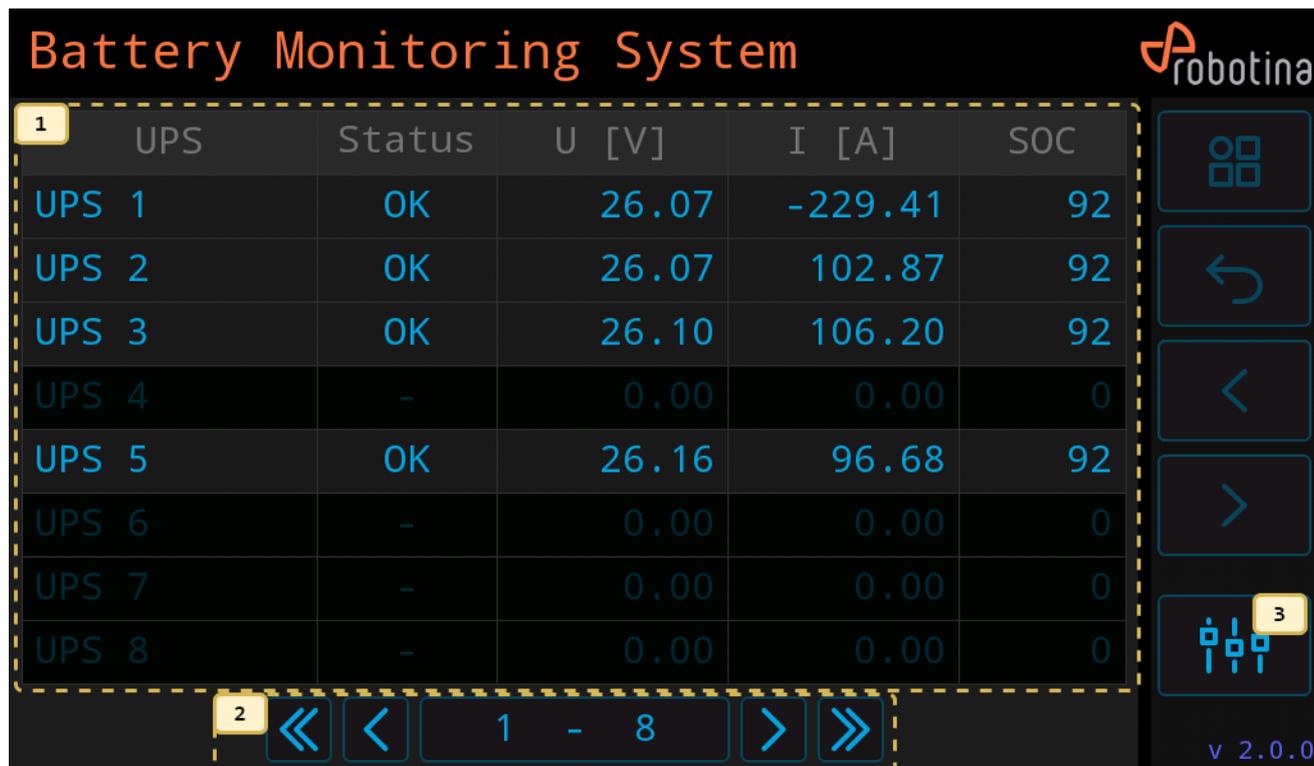
© Robotina d.o.o all rights reserved (except for included oss software). 1.0 / 1.0.64 / 1.5

Downloaded data into CSF file:

```
String,Timestamp,Voltage [V]
string_01_01,2023-12-12T12:05:03.433Z,217.89
string_01_01,2023-12-12T12:15:03.433Z,217.88
string_01_01,2023-12-12T12:25:03.433Z,217.88
string_01_01,2023-12-12T12:35:03.433Z,217.88
string_01_01,2023-12-12T12:45:03.433Z,217.88
string_01_01,2023-12-12T12:55:03.433Z,217.89
string_01_01,2023-12-12T13:05:03.433Z,217.89
string_01_01,2023-12-12T13:15:03.433Z,217.89
string_01_01,2023-12-12T13:25:03.434Z,217.89
string_01_01,2023-12-12T13:35:03.434Z,217.89
string_01_01,2023-12-12T13:45:03.435Z,217.89
string_01_01,2023-12-12T13:55:03.433Z,217.89
string_01_01,2023-12-12T14:05:03.433Z,217.89
string_01_01,2023-12-12T14:15:03.433Z,217.89
string_01_01,2023-12-12T14:25:03.434Z,217.88
string_01_01,2023-12-12T14:35:03.433Z,217.89
string_01_01,2023-12-12T14:45:03.433Z,217.89
string_01_01,2023-12-12T14:55:03.433Z,217.89
string_01_01,2023-12-12T15:05:03.433Z,217.89
string_01_01,2023-12-12T15:15:03.434Z,217.90
string_01_01,2023-12-12T15:25:03.433Z,217.90
string_01_01,2023-12-12T15:35:03.433Z,217.90
string_01_01,2023-12-12T15:45:03.434Z,217.90
string_01_01,2023-12-12T15:55:03.433Z,217.89
string_01_01,2023-12-12T16:05:03.433Z,217.90
string_01_01,2023-12-12T16:15:03.433Z,217.89
string_01_01,2023-12-12T16:25:03.434Z,217.90
string_01_01,2023-12-12T16:35:03.433Z,217.90
string_01_01,2023-12-12T16:45:03.434Z,217.90
string_01_01,2023-12-12T16:55:03.434Z,217.90
string_01_01,2023-12-12T17:05:03.433Z,217.90
string_01_01,2023-12-12T17:15:03.433Z,217.91
string_01_01,2023-12-12T17:25:03.433Z,217.90
string_01_01,2023-12-12T17:35:03.433Z,217.91
string_01_01,2023-12-12T17:45:03.433Z,217.91
string_01_01,2023-12-12T17:55:03.433Z,217.91
string_01_01,2023-12-12T18:05:03.433Z,217.90
string_01_01,2023-12-12T18:15:03.433Z,217.91
string_01_01,2023-12-12T18:25:03.433Z,217.91
string_01_01,2023-12-12T18:35:03.433Z,217.91
string_01_01,2023-12-12T18:45:03.433Z,217.91
string_01_01,2023-12-12T18:55:03.433Z,217.91
string_01_01,2023-12-12T19:05:03.433Z,217.92
string_01_01,2023-12-12T19:15:03.433Z,217.91
string_01_01,2023-12-12T19:25:03.433Z,217.91
string_01_01,2023-12-12T19:35:03.433Z,217.92
string_01_01,2023-12-12T19:45:03.434Z,217.91
string_01_01,2023-12-12T19:55:03.433Z,217.91
string_01_01,2023-12-12T20:05:03.433Z,217.91
string_01_01,2023-12-12T20:15:03.433Z,217.92
string_01_01,2023-12-12T20:25:03.433Z,217.92
string_01_01,2023-12-12T20:35:03.433Z,217.90
```

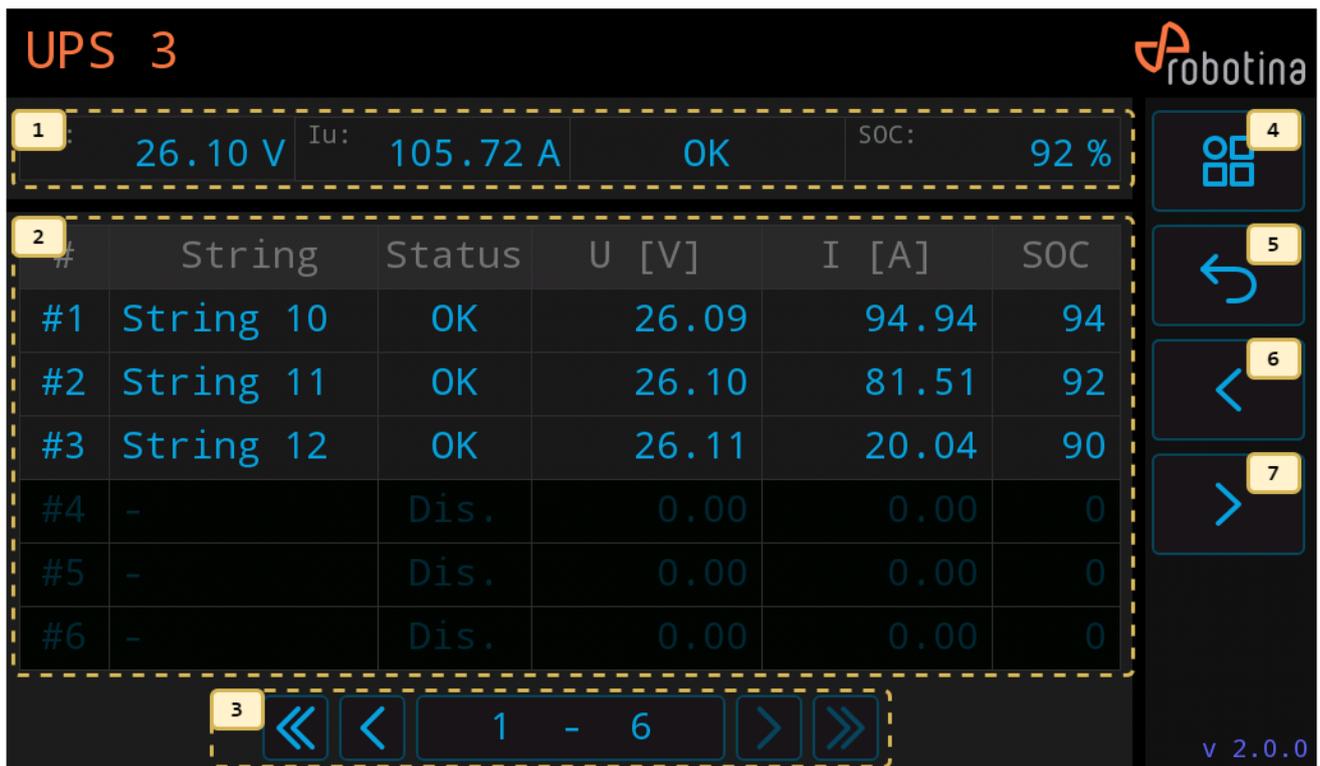
4 HMI User Interface

4.1 Main Screen



1	UPS data
	- tap to display UPS details
2	UPS navigation buttons
	- first ups
	- previous 8 UPS
	- next 8 UPS
	- last 8 UPS
3	Settings screen

4.2 UPS Screen



The screenshot displays the 'UPS 3' interface. At the top, it shows 'UPS 3' and the 'robotina' logo. Below this, a summary bar (1) displays '26.10 V', 'Iu: 105.72 A', 'OK', and 'SOC: 92 %'. A table (2) lists six strings with their respective status, voltage (U [V]), current (I [A]), and SOC. A navigation bar (3) at the bottom includes left and right arrow buttons, a central box with '1 - 6', and double arrow buttons. On the right side, there are four navigation buttons: a main screen button (4), a previous screen button (5), a previous UPS button (6), and a next UPS button (7). The version 'v 2.0.0' is shown in the bottom right corner.

#	String	Status	U [V]	I [A]	SOC
#1	String 10	OK	26.09	94.94	94
#2	String 11	OK	26.10	81.51	92
#3	String 12	OK	26.11	20.04	90
#4	-	Dis.	0.00	0.00	0
#5	-	Dis.	0.00	0.00	0
#6	-	Dis.	0.00	0.00	0

1	UPS data
2	String data - tap to display String details
3	String navigation
4	Main screen
5	Previous screen
6	Previous UPS
7	Next UPS

String screen

UPS 3 > String 10

26.09 V	Is:	52.16 A	OK
SOC: 94 %	Balance:	0.00 %	Idle
Temp.: 0.0 °C	RH:	0.0 %	DI=0 DO=0

2 11s

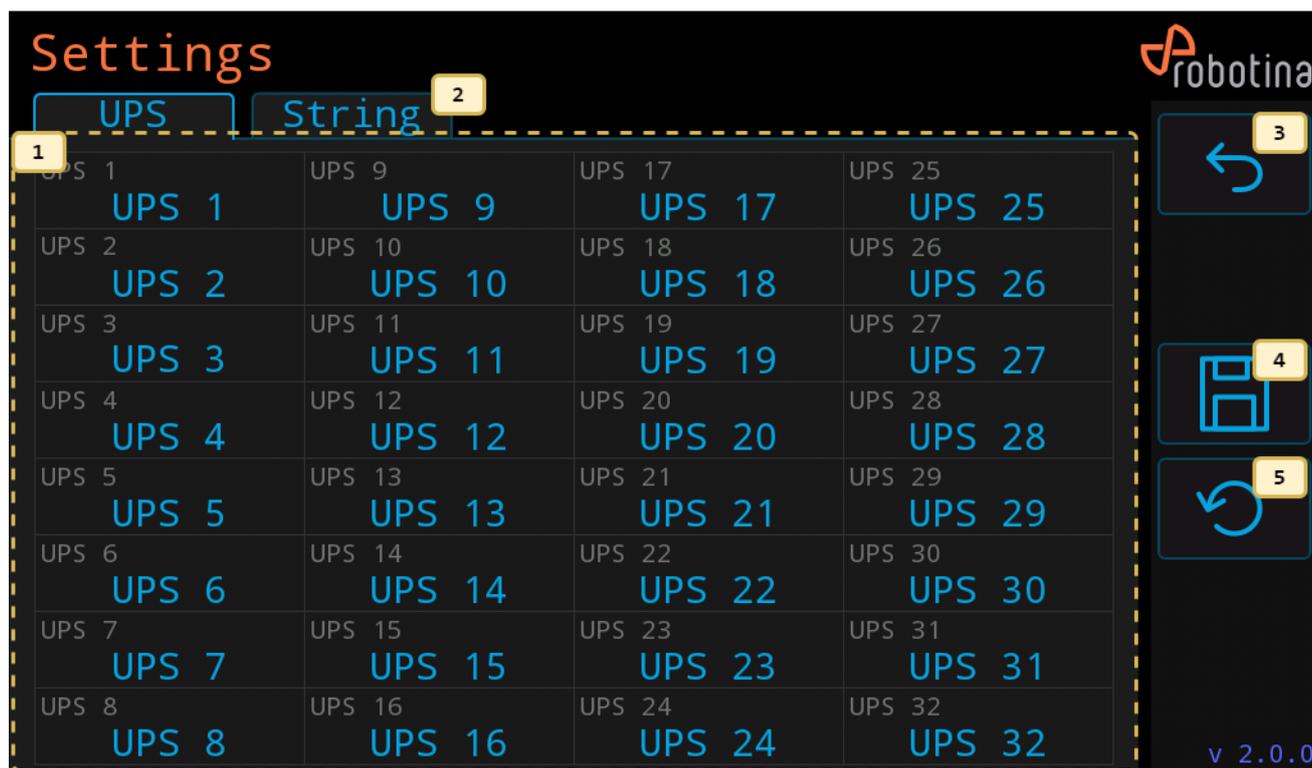
#	✓	1	✓	2	✓	3	✓	4	✓	5	✓	6	✓	7	✓	8	✓	9	✓	10
Uc V		11.29		13.03		12.01		12.08		12.31		14.39		13.79		11.42		12.94		12.00
Rc mΩ		0.022		0.058		0.047		0.015		0.074		0.094		0.022		0.062		0.031		0.025
T °C		25.5		25.2		25.8		25.7		25.8		25.9		25.3		25.6		25.0		25.0
SOC %		98		96		97		99		97		97		96		97		97		98
SOH %		100		100		100		100		100		100		100		100		100		100
Rem. h		100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0

1 - 10

v 2.0.0

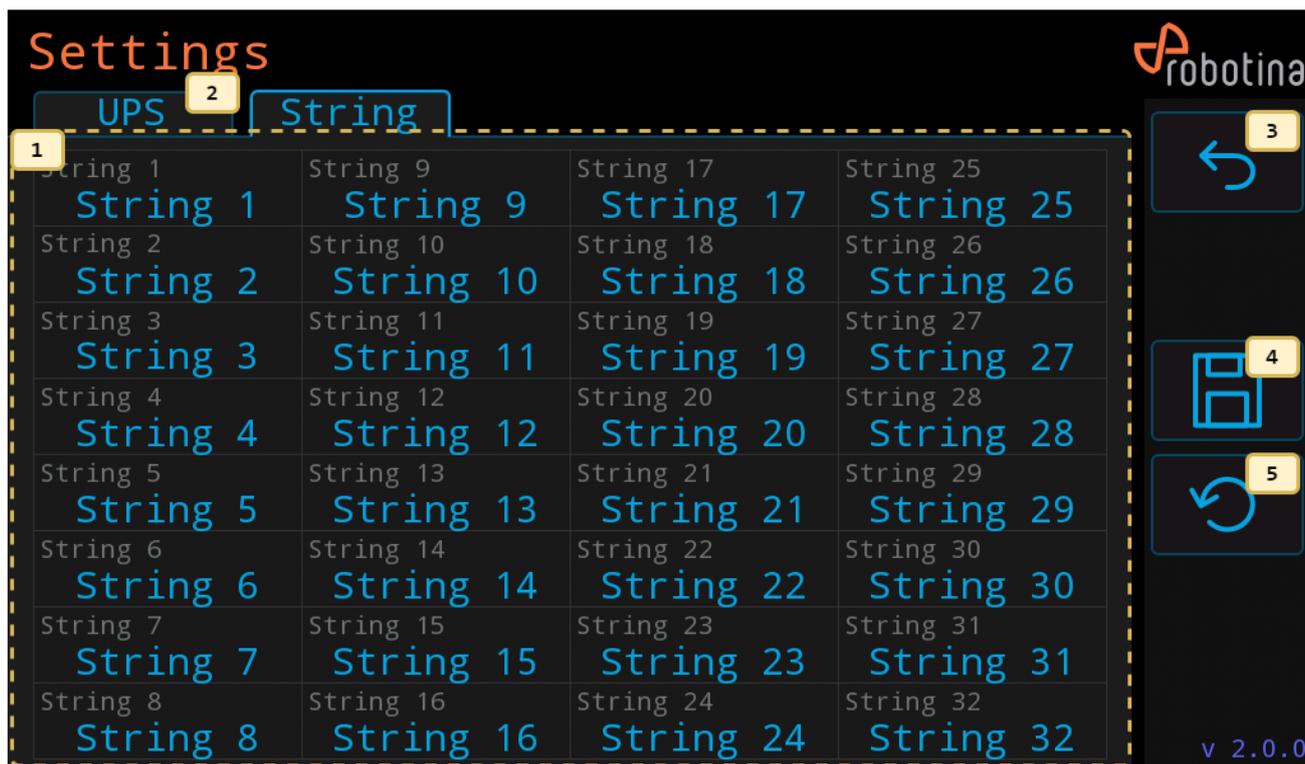
1	String detailed data
2	Cells data
3	Cell navigation
4	Main screen
5	Previous screen
6	Previous String
7	Next String

UPS names screen



1	UPS names
	- tap to edit name
2	go to String names screen
3	Previous page
4	Save names to Flash memory
5	Restore default names

String names screen



1	String names - tap to edit name
2	go to String names screen
3	Previous page
4	Save names to Flash memory
5	Restore default names

5 Troubleshooting

5.1 Alarms

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

5.2 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)

5.3 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>



6 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. If the problem persists, replace the battery or battery sensor.

NOTES: