

PBMS9000
Battery Monitoring System
Installation & Operation Manual
V1.6



Safety and Notice



Danger and Warning

- ◆ This device can only be installed by professionals.
- ◆ The manufacturer shall not be held any responsible for any accident caused by the failure to comply with in instructions in this manual.



Risks of electric shocks, burning, or explosion

- ◆ This device can only be installed and maintained by qualified people.
- ◆ Before operation the device, isolate the voltage input and power supply and short-circuit the secondary windings of all current transformers.
- ◆ Using appropriated voltage tester to make sure the voltage has been cut-off.
- ◆ Put all mechanical parts, doors, or covers in their original positions before energizing the device.
- ◆ Always supply the device with the correct working voltage during its operation.

Failure to make these preventive measures could cause damage to equipment or injuries to people.

Revised Records

Date	Reviser	Version	Description
22-02-18	E.W, C.W	1.0	Official Version
23-02-08	C.W	1.1	Supplementary GPRS parameter introduction and 61850 description. Modify the dimension and the contents of the system alarm chapter.
23-05-11	C.W	1.2	Add function that String alarm link to DO. String Name could be customized. Each cell could set the internal resistance correction values and temperature correction values individually. Add hydrogen sensor.
23-05-22	C.W	1.3	Add data backup.
23-07-25	C.W	1.4	Supplementary description of Hall value mode and UPS with neutral wire.
23-12-27	C.W	1.5	Update project details and battery information pages; Monomer alarm add thermal runaway; Update email settings operation .
24-02-27	C.W	1.6	Delete detailed introduction about cells and add references.

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Chapter 1 Product Description

PBMS9000 Battery Monitoring System can be used to online monitoring of various battery banks, comprehensively measure and determine battery bank and battery cell performance, and display and alarm failed batteries to realize the automation of battery detection and failure anticipation detection. The system can self-diagnose the battery bank and automatically perform corresponding maintenance through real-time monitoring of the operating status and various operating parameters of battery cell, and can use the network to realize remote signaling, remote measurement, and remote control. The system can accurately grasp the actual operating status and health status of the battery bank in real time, and discover the problems existing in the battery bank in time, and realize the automatic maintenance function. The balance function makes the battery bank maintain a voltage balance during floating charge, keeps each battery cell in the best condition, and improve the battery backup time and operating life, detect backward batteries in time and generate alarms, which greatly reduces maintenance cost like manpower and material resources, improve the safety of battery use and reduce the accident rate, effectively save energy and reduce emissions, then create good economic and social benefits for the user.

Features:

- (1) Realize the measurement of battery cell voltage, charge & discharge current, resistance, temperature, SOC (State of Charge), SOH (State of Health).
- (2) Advanced measurement algorithm, without high current discharge, to achieve non-destructive measurement.
- (3) Split string voltage and string current measurement modules can be flexibly

configured according to site conditions, suitable for multi-pole battery, and string current module supports ripple current measurement, string voltage module supports ripple voltage measurement.

(4) Hibernate function with cell measurement module is able to achieve low energy consumption

(5) Advanced SN auto-searching function help to reduce the engineering workload and configuration errors effectively.

(6) Easy to locate the alarm or faulty battery cell by observing the breathing light on the cell sensors.

(7) Balance function enables the battery bank maintain a voltage balance during floating charge, and make each battery cell maintains the best active state, and improves the battery bank's backup time and operating life.

(8) Various alarm setting, achieve comprehensive warning.

(9) Flexible configuration, applicable to monitor 1-6 battery strings, up to 420pcs battery cells.

(10) Supports circle communication, any node is broken, it will not affect the communication of other cell module.

(11) Supported data storage, up to 5 years data could be stored .

(12) Charge and discharge record could be shown and stored by second, to observe the abnormal detail by every second.

(13) 6 DI and 6 DO ports are supported.

(14) MODBUS RTU, MODBUS Tcp, SNMP and IEC61850 protocol are supported.

(15) Dual Ethernet Port and 4G are supported.

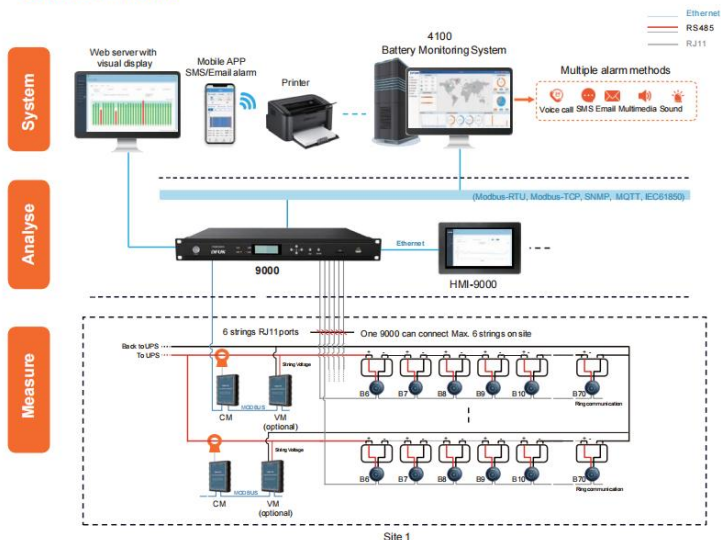
(16) Support hot standby dual power supply.

(17) Detailed historical data recorded. Complete alarm event management, data

support for battery maintenance, failure analysis, and report generation.

1.1 System Structure

System Structure



PBMS9000 Solution will include: PBMS9000 Main Control, Cell Sensor, Hall CT, Voltage Module, Current Module, and Temperature and humidity Sensor, each module is listed as below:

Module	Detail
PBMS9000 Main Control	Collecting, controlling, uploading data from cell sensor, and showing alarm to end user. One PBMS9000 is able to monitor at most 6 string of battery, 420 batteries in total.
VM	Voltage measurement module, it is for measuring group

	voltage (Optional)
CM	Current measurement module, it is for measuring group current
61/51	Cell sensor, for battery cell voltage, temperature, resistance, as well as alarm indicator
HMI	10 inches local display screen, it is for inquiry (Optional)
Temperature and Humidity Sensor	Measuring temperature and humidity (Optional)
Leak Current Module	Leak Current Measure Module (Optional)
Insulation Module	Insulation Resistance Measurement Module (Optional)
Hydrogen Sensor	Measuring hydrogen concentration (Optional)

1.2 Scope of application

Battery Monitoring System:

- (1) Measuring battery with 2V, 6V, and 12V;
- (2) Measuring 1-6 string of batteries;
- (3) Measuring 1-420 pcs of batteries;
- (4) Measuring battery pack voltage from 20V to 1000V;
- (5) Measuring current from -2000A to 2000A;

1.3 Technical Specification

Hardware Specification	
CPU	ARM cortex-A7 528MHz
Memory	512MB DDR3

ROM	EMMC 4G + micro-SD (8G as Standard, up to 32G)
Ethernet Port	2x10/100M
RS485	1 RS485, Baud Rate 9600, 19200, 38400bps (Optional), Half Duplex
DI	6 DI, Passive Switch input
DO	6 DO, 250VAC/5A or 30VDC/5A
Group Voltage	1~6 String, Range: DC 20~1000V, Accuracy: $\pm 0.5\%$, Resolution: 0.01V
Group Current	1~6 String, Range: DC-2000A~2000A, Accuracy: $\pm 2\%$ (15°C~35°C), Resolution: 0.01A
Ripple Current	1~6 String, Range: DC 0~0.4*I (I, rated current of hall sensor), Resolution: 0.01A, Accuracy $\pm 2\%$
Ripple Voltage	1~6 String, Range: 2V - 100V (Peak value), Resolution: 0.01V, Accuracy $\pm 2\%$
Temperature and Humidity	Up to 6 String, Temperature: Range: -20 °C - +60 °C, Resolution: 0.1 °C, Accuracy: ± 0.5 °C; Humidity: Range: 0~100%RH, Resolution: 0.1%RH, Accuracy: $\pm 3\%$ RH
Leak Current Measurement	1~6 Strings, Range : -200mA ~ +200mA , Resolution: 10uA, Accuracy: $\pm 1\%$ FS
Insulation Resistant Measurement	1~6 Strings, Range: 1K Ω ~ 30M Ω , Resolution: 10K Ω ~500K Ω Error Range <10%
Hydrogen Measurement	Range: 0 ~ 1000ppm, Resolution: 1ppm, Accuracy: $\pm 5\%$ FS
4G Module	• LTE-TDD B34/B38/B39/B40/B41 • LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28/B66 • UMTS/HSPA+ B1/B2/B4/B5/B6/B8/B19

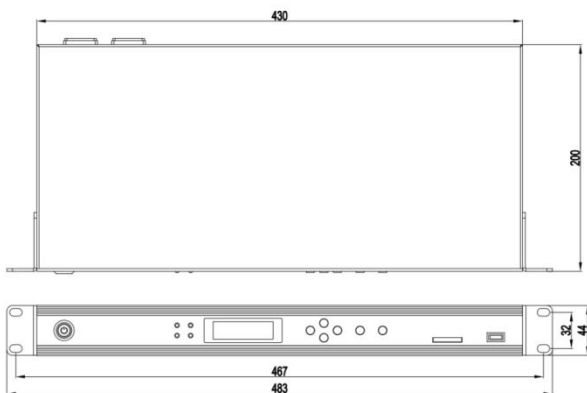
	• GSM/GPRS/EDGE 850/900/1800/1900 MHz • Standard SIM card (15mm×25mm)	
Performance Specification		
Cell quantity to connect single COM port	≤70 Cell sensor 51/61, Period < 100ms /pcs	
Average non-trouble time MTBF	>=100,000 hrs.	
Immunity Specification		
Electrostatic discharge immunity	GB/T17626.2-2006 (IEC61000-4-2:2008)	III
RF electromagnetic field radiation immunity	GB/T17626.3-2006 (IEC61000-4-3:2006+A1:2007+A2:2010)	Class A
Electrical fast transient pulse group immunity	GB/T17626.4-2008 (IEC61000-4-4:2012)	III
Surge immunity	GB/T17626.5-2008 (IEC61000-4-5:2014+A1:2017)	III
RF conducted immunity	GB/T17626.6-2008 (IEC61000-4-6:2013)	Class A
Industrial frequency magnetic field immunity	GB/T17626.8-2008 (IEC61000-4-8:2009)	V
Working Environment		
Power Supply	2 x AC 220V, Range: AC85 ~ 264V/DC120-370V	
Consumption	≤15W	
Working Temp.	-15℃ ~ +60℃	
Storage Temp.	-40℃ ~ +70℃	
Humidity	10-95%RH, No condensation	
Dimension		

L*W*H	483mm × 206mm × 44.5mm, Standard 1U device (19 inches)
Hold Size	440mm×46mm

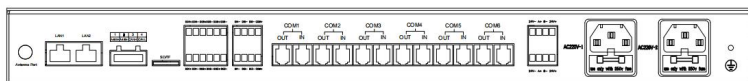
Chapter 2 Dimension and Appearance

2.1 Dimension

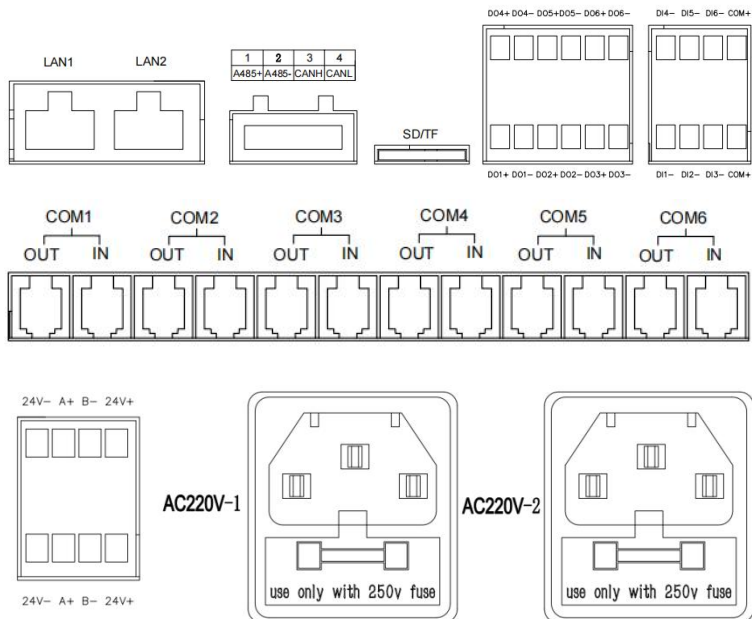
(1) Dimension (Unit: mm)



(2) Back Terminals



2.2 Terminals Definition



Code	Definition
LAN1	Ethernet 1 (10M/100M)
LAN2	Ethernet 2 (10M/100M)
RS485+	RS485+ Port
RS485-	RS485- Port
CANH	CAN High (Reserved)
CANL	CAN Low (Reserved)

TF (Flipped)	TF Card (Standard)
DO4+	The fourth DO contact
DO4-	The fourth DO contact
DO5+	The fifth DO contact
DO5-	The fifth DO contact
DO6+	The sixth DO contact
DO6-	The sixth DO contact
DO1+	The first DO contact
DO1-	The first DO contact
DO2+	The second DO contact
DO2-	The second DO contact
DO3+	The third DO contact
DO3-	The third DO contact
DI4	The fourth digital input
DI5	The fifth digital input
DI6	The sixth digital input
COM	Public port for DI (Digital Input)
DI1	The first digital input
DI2	The second digital input
DI3	The third digital input
COM	Public port for DI (Digital Input)
COM1_OUT	The first RJ11 com port out
COM1_IN	The first RJ11 com port in
COM2_OUT	The second RJ11 com port out
COM2_IN	The second RJ11 com port in
COM3_OUT	The third RJ11 com port out
COM3_IN	The third RJ11 com port in

COM4_OUT	The fourth RJ11 com port out
COM4_IN	The fourth RJ11 com port in
COM5_OUT	The fifth RJ11 com port out
COM5_IN	The fifth RJ11 com port in
COM6_OUT	The sixth RJ11 com port out
COM6_IN	The sixth RJ11 com port in
U&I_G	Ground connection terminal
U&I_A	U&I (Group module) RS485+
U&I_B	U&I (Group module) RS485 负
U&I_V	24V DC Power Supply
T&H_G	Ground connection terminal
T&H_A	T&H (Temp&Hum., Leak Current, Insulation Resistant, Hydrogen Concentration) RS485+
T&H_B	T&H (Temp&Hum., Leak Current, Insulation Resistant, Hydrogen Concentration) RS485-
T&H_V	24V DC Power Supply
PowerInput1	Main Power Input
PowerInput2	Backup Power Input

Note: The “+” and “-” on the RS485 com port is not allowed to be exchanged.

2.3 External Module

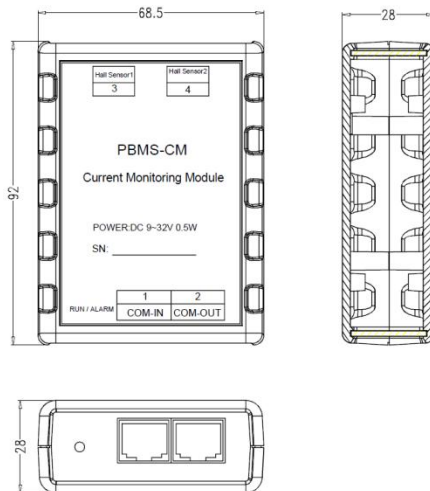
2.3.1 Cell Sensor Module

For detailed external dimensions and terminal definitions of 51 cell sensor, please refer to "PBAT51 Battery Cell Sensor User Manual-Vx.x-20xxxxxx.pdf";

For detailed external dimensions and terminal definitions of 61 cell sensor, please refer to "PBAT61 Battery Cell Sensor User Manual-Vx.x-20xxxxxx.pdf";

2.3.2 Current Module

(1) Dimension (Unit: mm)



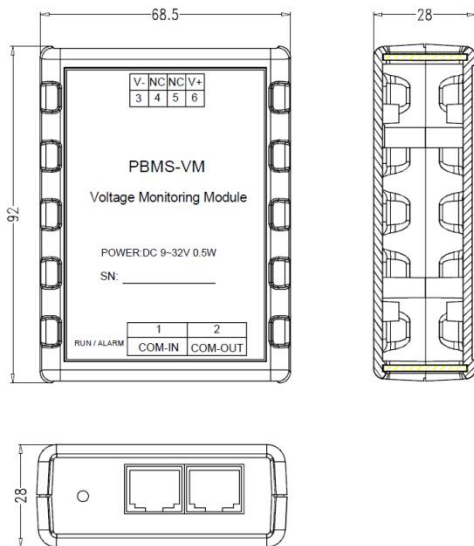
(2) Terminals Definition

No.	Code	Definition
1	COM_IN	Comm Port 1
2	COM_OUT	Comm Port 2
3	Hall Sensor1	Hall sensor interface 1
4	Hall Sensor2	Hall sensor interface 2

Note: COM_IN has the same function with COM_OUT, they could be exchanged to use randomly. Another sensor or module is able to communicate with this module using to COM_IN or COM_OUT. Voltage module is working with the same logic.

2.3.3 Voltage Module

(1) Dimension (Unit: mm)

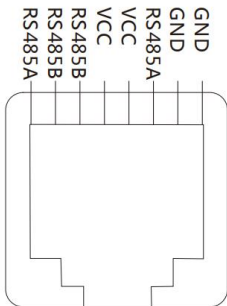


(2) Terminal Definition

No.	Code	Definition
1	COM_IN	Comm Port 1, connect to main module or last voltage module
2	COM_OUT	Comm Port 2, connect to next voltage module
3	V-	Voltage Measurement (-)
4	NC	Null
5	NC	Null
6	V+	Voltage Measurement (+)

2.3.4 Temperature and Humidity Sensor

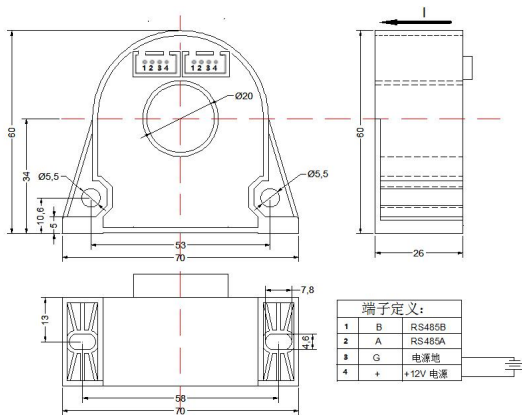
(1) Interface and Outlook



(2) Terminal Definition

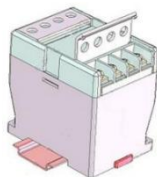
No.	Code	Definition
1	RJ45	Comm Port 1, connect to main module or last module
2	RJ45	Comm Port 2, connect to main module or last module

2.3.5 Leak Current Sensor



2.3.6 Insulation Resistant Monitoring Module

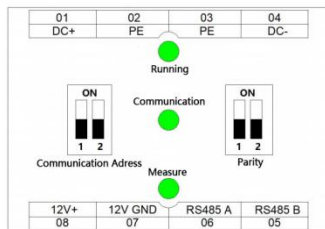
(1) Dimension



Length: 75mm, Width: 55mm, Height: 72mm

Installation Style: Standard DIN Rail Installed

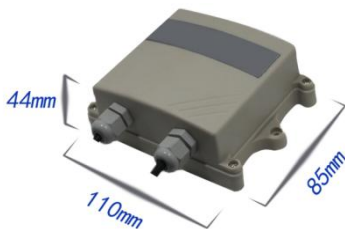
(2) Terminals



No.	Code	Definition
1	DC+	AC high voltage +
2	PE	Ground connected, only one port to connect
3	PE	
4	DC-	AC High voltage -
5	RS485 B	RS485 Communication (Default 9600, N81, Baud Rate Highest: 38400)
6	RS485 A	
7	12V GND	Power Supply - (DC9~28V, Recommended 12V or 24V)
8	12V +	Power Supply + (DC9~28V, Recommended 12V or 24V)

2.3.7 Hydrogen Sensor

(1) Dimension



Length: 110mm, Width: 85mm, Height: 44mm

(2) Terminals

No.	Wiring Color	Definition
1	Brown	Power Supply + (DC10~30V)
2	Black	Power Supply - (DC10~30V)
3	Yellow	RS485 A (Default, Baud 9600, Address 240)
4	Blue	RS485 B (Default, Baud 9600, Address 240)

2.4 HMI Dimension And Parameters

The HMI uses the Android 10 operating system. Application on the HMI can easily view data, alarms, and configuration parameters. Please refer to Chapter 4 for details of UI.

2.4.1 Dimension and display parameters

Parameters	Description
Screen Size	10.1 Inches (Screen Proportion is 16:9)
Resolution	1024*600Pixel
Display Dimension	222.72mm*125.44mm
Appearance Dimension	257.8mm*148.0mm*28mm
Back light brightness	250nit
Back light life(h)	30000Hrs

2.4.2 Electrical Parameters

Parameters	Description
CPU Processor	R818, 4 Cores(A53 1.6GHz)
Operating System	Android V10.0

Running Memory	1GB (2*512MB, DDR4)
EMMC	8GB (EMMC5.1)
Multi Touch	5 point
TP Surface Hardness	7 (Moh's hardness)
TP Transmittance	>85
Working Voltage	12V (Minimum 8V, Maximum 18V)
Working Current	12V 700mA
Power Supply	DC005; Or PH2.0-8P Terminal

2.4.3 Reliability parameters

Parameters	Description
Environmental Parameters	Storage Temperature: -30~80°C Working Temperature: -20~70°C Relative Humidity: 10~90%RH
Reliability parameters	EMC: Class B, EN55032 ESD: Level 3

Chapter 3 Display Interface

3.1 Description

PBMS9000 main control works with 128*32 resolution dot matrix black and white screen and 6 buttons to switch manual list. There are 4 LED light on the panel to show the current situation (Running, Communicating, Malfunctioning, Alarming) about the device.

The backlight on the screen would turn of automatically without operation in 60s, and turn on when operate again.

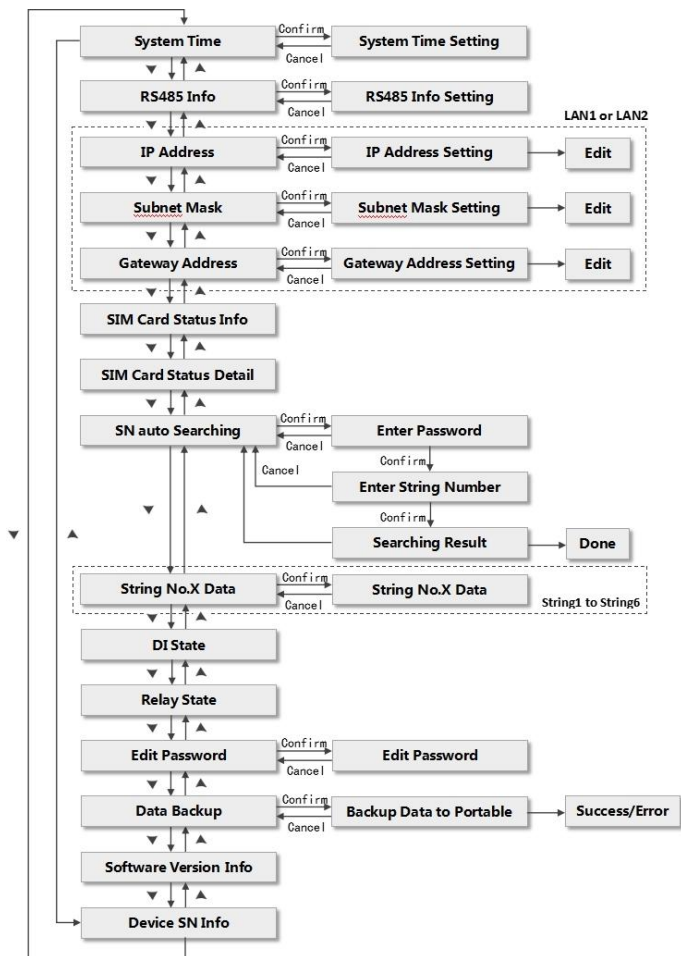
3.2 LED Indicator Light Status

There are 4 status of LED light to identify different status on PBMS9000

LED Light	Light Status	Current Status
Running Light	Slow Flashing 0.5HZ	Normal
	Fast Flashing 2 HZ	Measuring Internal Resistant, SN auto searching
Communicating Light	Slow Flashing 0.5HZ	RS485 Communicating Normal
	Light Up	RS485 Communicating Abnormal
	Light Off	No Communicating
	Fast Flashing2 HZ	Measuring Internal Resistant, SN auto searching
Alarm Light	Light Off	No String Alarm
	Light Up	String Alarm Occurs
Malfunctioning Light	Light Off	Device Normal
	Light Up	Device Malfunction

3.3 Data Query

PBMS9000 menu display structure shows as below:



3.3.1 System Time Interface

Display: System Time: Display current time on the device, show as Figure 1; Press "Enter" to edit as Figure 2;	--System Time-- 2021-12-31 10:00:00 Figure 1 Edit System Time 2021-12-31 10:00:00 Figure 2
---	--

3.3.2 RS485 Interface

Serial Port: RS485 Port Info; bps, Baud Rate; add, Modbus Address, Show as Figure 1; Press "Enter" to edit as Figure 2;	--Serial Port-- Bps:9600 add:001 Figure 1 Edit Serial Port Bps:9600 add:001 Figure 2
---	--

3.3.3 Ethernet Port Setting Interface

IP Address, Subnet Mask, Gateway Address display as Figure 1 Press "Enter" to configure settings: Press "▲▼" to switch between Subnet	--IP1-- 192.168.23.120 Figure1
--	---

Mask and Gateway Address, press "Enter" to edit (Show as Figure 2) and "Enter" again to confirm. Press "Enter" again at the last step, display "Set Network Ok" means all correct, "Format Error" means some format entered wrong.

Ethernet Port 2 has the same settings as ethernet port 1.

Edit IP1 □□□
192.168.023.120

Figure 2

3.3.4 SIM Status

SIM Status: NG-No SIM, 4G-SIM Card Installed, and signal status;

--SIM Status--
 NG  00dBm

3.3.5 SIM Detail

SIM Details: For troubleshooting when SIM is failed

--SIM Details--
SIM Network OK

3.3.6 SN Auto Searching Interface

Auto Search Addr: SN Auto Searching;
SN Auto Searching function is designed to make sure the communication signal is with the good quality and all SN

--Auto Search Addr--
Press Enter

Figure 1

are correct. Press "Enter" then enter "1101" as Figure 2. Press "Enter" again to Figure 3 to configure string number, press "Enter" to process the searching.

Waiting for searching result and it would show as Figure 4, the number still changing means, it is still searching, otherwise, it is done. If the number is different with the cell sensor quantity, there might have some cell sensors are damaged or weird damage. Press "Enter" again When searching complete to save configuration and back to Figure 1.

```
--Auto Search Addr--
1 1 0 1
```

Figure 2

```
--Set Num Of Groups --
Number:1
```

Figure 3

```
COM:01 02 03 04 05 06
NUM:00 00 00 00 00 00
```

Figure 4

Search Complete!

Figure 5

3.3.7 String and Battery Info Interface

Display:

String X Info (X: 1-6): Battery string measurement result, including string voltage, string current and the status of battery string.

```
--String 1 Info--
U(V):0.00 I(A):0.00
Status:Floating
```

Figure 1

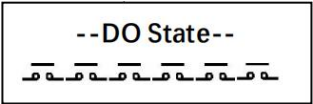
```
#1----- --Cell Info--
U:0.000 R:0.000
T:0.0 SOC:0.00%
```

Figure 1: U (V) as string voltage, I (A) as string current, Status as current status of string. Press "Enter" to show battery detail in the string as Figure 2. Press "▲▼" to check different detail for different battery. Press "ESC" to back to string detail.	Figure 2
---	-----------------

3.3.6 DI State Interface

DI State: DI output status, display 3 DI current status.	 --DI State-- The display shows three status indicators, each consisting of a horizontal bar with a small circle at the end, representing the state of three different DI outputs.
---	---

3.3.7 DO State Interface

DO State: DO status, display 4 DO current status.	 --DO State-- The display shows four status indicators, each consisting of a horizontal bar with a small circle at the end, representing the state of four different DO outputs.
--	---

3.3.8 Change Password Interface

Modify confirmation password: Press "Enter" and enter password to change password. Once the old password and new password have been entered, press "Enter"	 --Modify Password-- Press Enter
---	---

to confirm.	
-------------	--

3.3.9 Data Backup

Plug-in portable drive, press “Enter” to start, Processing is showing. The screen will show “Data Backup ok!” or show error when processing done. Backup data will be stored under “dataBackup” folder in the portable drive. Note: FAT32 format is needed for portable drive.

--Data BackUp--

Press Enter

Processing...

Data BackUp OK!

3.3.10 Software Display Interface

Display:

Software Version: Current Software

Version

--Software Version--

1.0.0-2022/01/01

3.3.11 SN Display Interface

Display:

SN: Current Serial Number

--SN--

BMS202201010001

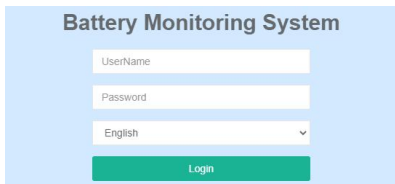
Chapter 4 UI Description

4.1 Description

PBMS9000 is designed with web interface for data inquiry about battery management and debug. The web based system could be able to access by PC and HMI. Running parameters configuration, real-time data and historical data for battery, engineering device mapping, firmware update is able to set on the web system. HIM must be connected with LAN2 to access (LAN 2 port IP default is 192.168.1.99).

4.2 Login

Connect device to PC or HMI with network cable, it could be accessed by tablet via wireless signal, launch browser (Firefox or Chrome, IE is not supported), key in IP address to access system, Chinese, Traditional Chinese and English is supported.

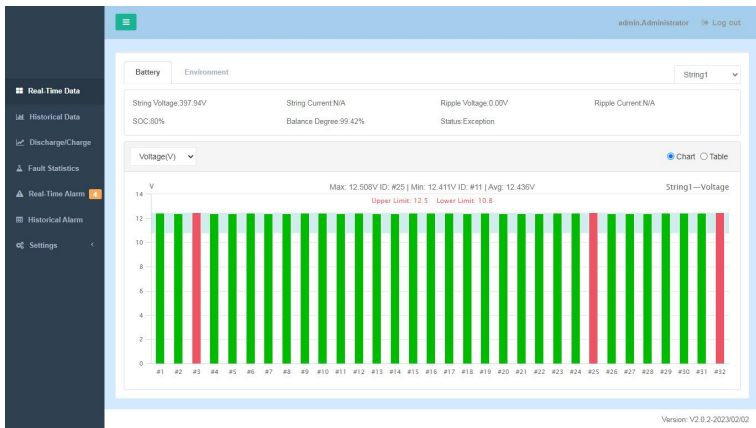
The image shows a login form for the 'Battery Monitoring System'. The form is set against a light blue background. It contains three input fields: 'UserName', 'Password', and a language dropdown menu currently showing 'English'. Below these fields is a green 'Login' button.

Factory Default Username: admin Password: admin

Note: Change default language: “Settings - Project Settings - Project Details” after login

4.3 Real Time Data

Click on “Real-Time Data” from the left after login, battery data detail will be shown on the right.

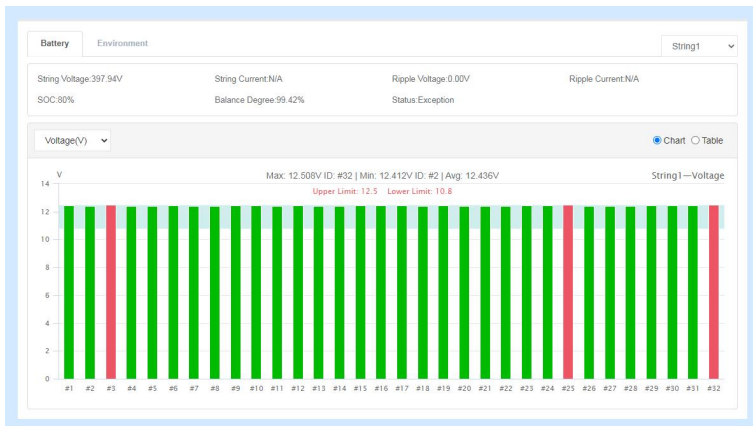


This page is showing voltage, current, temperature, internal resistant of batteries and connection status of each cell sensor. The top left corner is showing project logo and user info, top right corner is showing current version of the system.

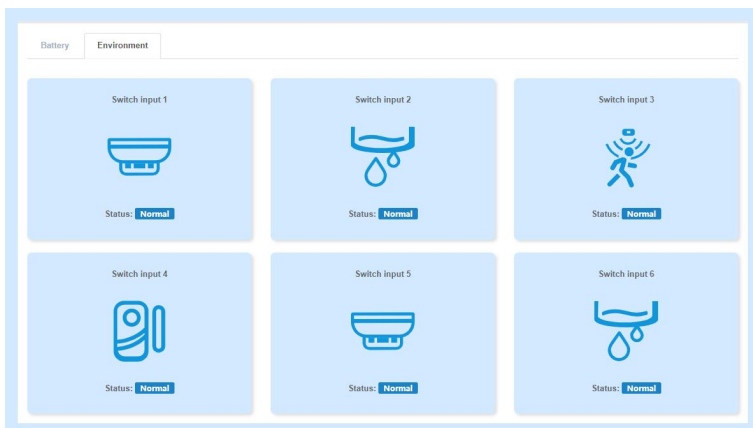
String and environment can be shown by switching on different tap (Show as below)

Note: String tab and battery tab is showing different color for different status: green –normal, red – alarm, red and flashing - thermal runaway, yellow – balancing, grey – disconnected.

String Info:

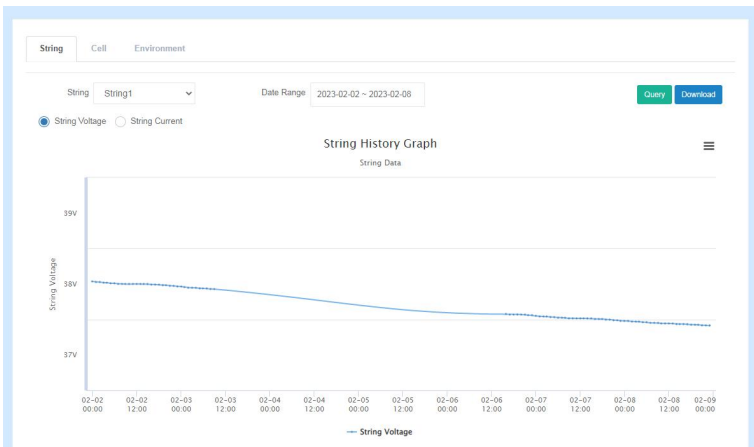


Environment Info:

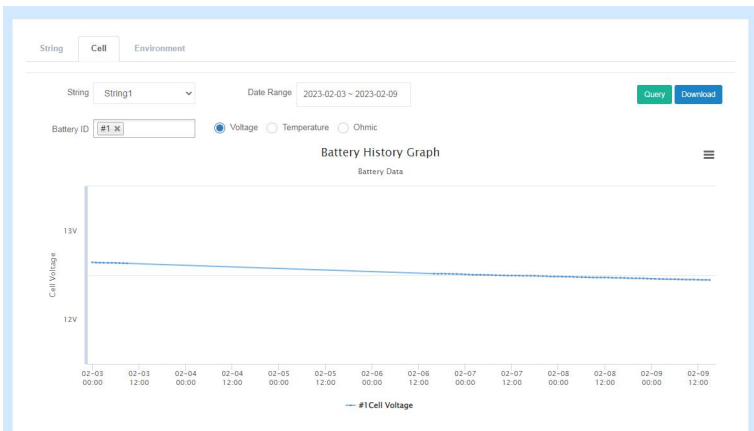


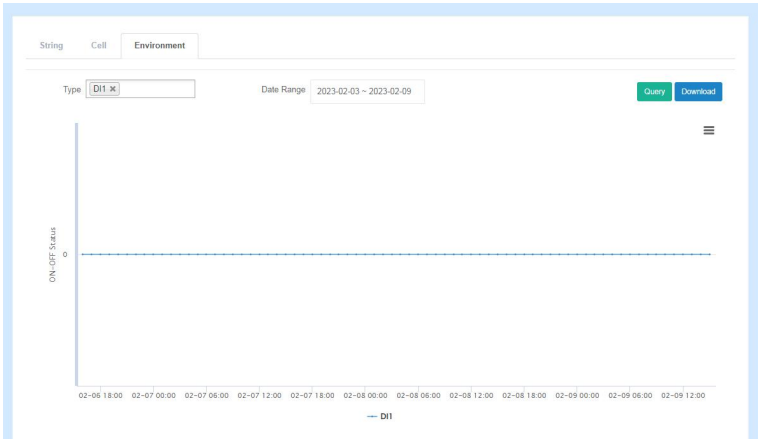
4.4 Historical Data

Click on “Historical Data” on the left to show battery historical data



String, cell, environment detail can be shown by switching on different tap (Show as below)





- 1) Based on time period and parameters to check historical data for battery strings and environment.
- 2) Based on time period and parameters to check historical data for batteries (Up to 70 pcs batteries)

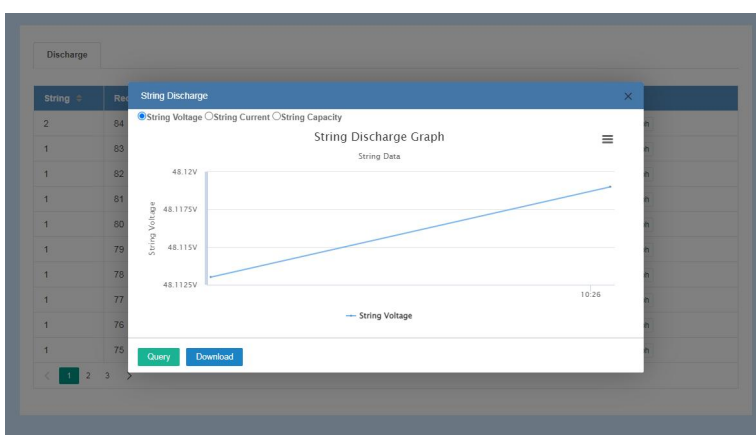
Note:

- 1) The maximum storage historical alarm record of device is 1 year. The oldest 1-month data will be deleted when the record exceed.
- 2) The historical data is recorded according to the voltage, current, temperature, and internal resistant measurement by the maximum load (420 pcs cell sensors)

4.5 Discharge Data

Click on “Discharge Data” on the to show discharge data

Data					
String	Record ID	Type	Start Time	End Time	Operation
3	84	Discharge	2022-06-01 11:53:47	2022-06-01 11:54:47	String Graph Cell Graph
1	83	Discharge	2022-05-16 19:21:58	2022-05-16 19:21:58	String Graph Cell Graph
1	82	Charge	2022-05-16 18:51:03	2022-05-16 18:51:04	String Graph Cell Graph
1	81	Capacity ...	2022-05-16 17:42:01	2022-05-16 17:47:01	String Graph Cell Graph Download Report
1	80	Charge	2022-05-16 16:52:59	2022-05-16 16:53:59	String Graph Cell Graph
1	79	Capacity ...	2022-05-16 16:46:59	2022-05-16 16:51:59	String Graph Cell Graph Download Report
1	78	Capacity ...	2022-05-16 16:44:45	2022-05-16 16:45:45	String Graph Cell Graph Download Report
1	77	Capacity ...	2022-05-16 16:42:10	2022-05-16 16:43:10	String Graph Cell Graph Download Report
1	76	Charge	2022-05-16 10:27:03	2022-05-16 10:28:03	String Graph Cell Graph
1	75	Discharge	2022-05-16 10:25:03	2022-05-16 10:26:03	String Graph Cell Graph



- 1) Showing discharge record as list in different time period
- 2) Showing historical data with group measuring device in certain discharging time period (including string voltage and string current), click "Download" to export data as excel file.

3) Showing historical data with cell sensor in certain discharging time period (including voltage, temperature and internal resistant) up to 70 pcs, click “Download” to export data as excel file.

4.6 Fault Statistics

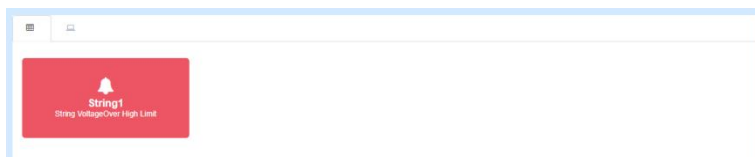
Click on “Fault Statistics” to show fault statistics



- 1) Select “Yearly” as data type, system would show the data of the selected year in month; Select “Monthly” as data type, system would show the data of the selected month in day.
- 2) Only 12 months would be allowed to choose if the type is “Monthly” ; Only year could be chosen when the type is “Yearly” .
- 3) Click on “Query” button to show result with current condition, click on “Download” to export data to excel file.

4.7 Real-Time Alarm

Click the “Real-Time Alarm” on the left to display alarm detail



The next tab is showing the recently alarmed battery info

Time	Type	Details
2023-01-12 09:17:47	String Voltage	Trigger: 39.019, Threshold: 38, Event: String1 Upper Limit Trigger.

Reboot or reconfigured, the real-time alarm display will be reset.

4.8 Historical Alarm

Click on “Historical Alarm” on the left to display historical alarm record

Alarm Message

SMS Records

Type: String1

String+Cell

Date Range: 2023-01-06 ~ 2023-01-12

Query

Download

Time	String/Ba...	Type	Details	Value
2023-01-12 09:17:47	String1	String Voltage	Trigger: 39.019, Threshold: 38, Event: String1 Upper Limit Trigger.	39.019
2023-01-12 09:17:47	String1	String Voltage	Trigger: 39.019, Threshold: 36, Event: String1 Lower Limit Recover.	39.019
2023-01-09 09:01:18	String1	String Voltage	Trigger: 0, Threshold: 36, Event: String1 Lower Limit Trigger.	0
2023-01-06 15:08:16	String1	String Voltage	Trigger: 39.017, Threshold: 38, Event: String1 Upper Limit Trigger.	39.017

<

1

>

1) Select string number on “Type” dropdown list to check “String + Cell” or string only or cell only data. Select “Device” to check relevant DI alarm info.

- 2) End time must be greater than start time in the range, one year data record is supported to be checking.
- 3) Click on “Query” to display result with current condition, click on “Download” to export data to excel file.
- 4) Click on the page number at the bottom to check the relevant detail on the screen.

The screenshot shows a web interface for "SMS Records". At the top, there are two tabs: "Alarm Message" and "SMS Records", with "SMS Records" being the active tab. Below the tabs is a "Date Range" filter set to "2022-07-01 ~ 2022-07-31". To the right of the date range are two buttons: "Query" (highlighted in green) and "Download". Below this is a table with the following columns: "Create Time", "Target Tel", "Contacts", "Contents", "Send Time", and "Result". The table contains one data row: "2022-07-08 09:59:42", "12345678", "someone", "String1String Voltage2022-07-08 09:59:42Over High Limit", "2022-07-08 09:59:42", and "Success". At the bottom of the table, there is a pagination bar showing "< 1 >".

Create Time	Target Tel	Contacts	Contents	Send Time	Result
2022-07-08 09:59:42	12345678	someone	String1String Voltage2022-07-08 09:59:42Over High Limit	2022-07-08 09:59:42	Success

SMS operation is the same as historical alarm, information for receiver, content, time and result will be shown.

4.9 Settings

Click on “Settings” on the left to expend the settings menu.

4.9.1 Network Settings

Click on “Settings – Parameters Settings - Network Settings” on the left to display network settings.

Local network configuration shown as below:

Local Settings

LAN1	LAN2
IP Address: 192.168.23.76	IP Address: 192.168.1.99
Subnet Mask: 255.255.255.0	Subnet Mask: 255.255.255.0
Gateway: 192.168.23.1	Gateway: 192.168.1.1
DNS: 8.8.8.8	DNS: 8.8.8.8

GPRS

APN Enable: ☒ OFF ☐ ON	APN Account:
APN Access: internet	Password:

Two ethernet ports are able to configure with 2 different IP address, subnet mask, default gateway and DNS. GPRS parameters are not used by default. If the SIM card needs to use a dedicated network server for network communication, configure APN activation and modify relevant parameters.

Note: Same network segment is not allowed to configure with dual ethernet settings!

MQTT configuration could be set as IoT communication parameters, including enable, server or user settings as basic parameters, data collection and MQTT encrypted certification file.

IoT communication parameters

MQTT settings

MQTT enable: ☒ OFF ☐ ON

UserName:

Server IP:

Password:

Server port:

Read Save

Data acquisition parameters

Data acquisition interval(Floating Charge) (s):

Ambient temperature change threshold(°C):

Data acquisition interval(Charge/Discharge) (s):

Ambient humidity change threshold(%RH):

Proactively report change data: ☒ OFF ☐ ON

Cell voltage change threshold(V):

String voltage change threshold(V):

Cell internal resistance change threshold(mΩ):

String current change threshold(A):

Cell temperature change threshold(°C):

Read Save

MQTT certification

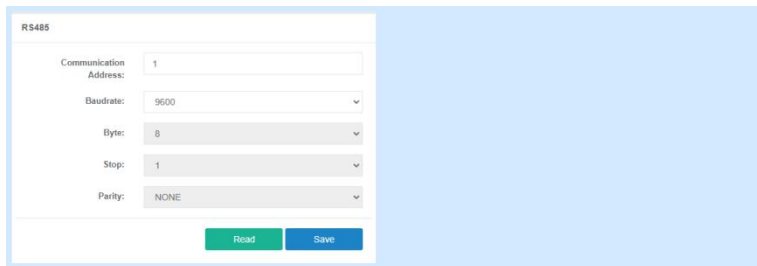
SSL certificate /

SSL key /

- 1) Enable MQTT function and connect device to internet.
- 2) Different battery status would have different collecting period
- 3) System would automatically report data or alarm when the value has exceeded the limit as set.
- 4) Encrypted certification file will need to be uploaded when SSL is turned on. Certificate and encrypted file are generated by server.
- 5) MQTT default port number is 1883, SSL is 8883

4.9.2 Serial Port Settings

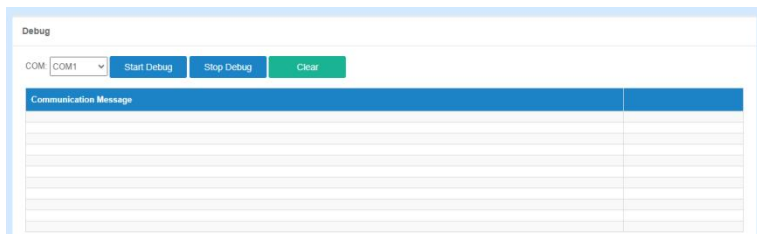
Click on “Settings – Parameters Settings – Serial Port Settings” on the left to show serial port settings info



The screenshot shows a web interface for RS485 settings. It includes a title 'RS485' and a form with the following fields: 'Communication Address' (text input with value '1'), 'Baudrate' (dropdown menu with value '9600'), 'Byte' (dropdown menu with value '8'), 'Stop' (dropdown menu with value '1'), and 'Parity' (dropdown menu with value 'NONE'). At the bottom of the form are two buttons: 'Read' (green) and 'Save' (blue).

Display upper MODBUS tunnel serial port parameters, including communication address, baud rate, byte, stop, and parity. Default value: communication address = 1, baud rate = 9600, byte = 8, stop = 1, parity = NONE.

Debug



The screenshot shows a web interface for the debug function. It has a title 'Debug' and a section with a 'COM' dropdown menu set to 'COM1', and three buttons: 'Start Debug' (blue), 'Stop Debug' (blue), and 'Clear' (green). Below this is a table with a blue header row labeled 'Communication Message'. The table has two columns and several empty rows for displaying data.

- 1) All tunnel input and output message are be able to show on in the debug function
- 2) Start Debug, Stop Debug and Clear messages are supported.

4.9.3 Alarm Settings

Click on “Settings – Parameters Settings – Alarm Settings” on the left to show alarm settings.

Alarm Parameter

Alarm Masking

Apply Alarm Template

Read Config

Confirm Config

Alarm Linkage: ☐ String link with DO

No	Alarm Type	Trigger Type	Threshold	Recovery	Trigger Action	Enable	Operation
1	String Current	Over High Limit	10	10	Write Record-WEB	No	🔗 Modify
2	String Current	Under Low Limit	-10	-10	Write Record-WEB	No	🔗 Modify
3	String Voltage	Over High Limit	40	39	Write Record-WEB	Yes	🔗 Modify
4	String Voltage	Under Low Limit	36	36	Write Record-WEB	Yes	🔗 Modify
5	String SOC	Under Low Limit	10	10	Write Record-WEB	No	🔗 Modify
6	Cell Voltage	Over High Limit	12.5	12.5	Write Record-WEB	Yes	🔗 Modify
7	Cell Voltage	Under Low Limit	10.8	10.8	Write Record-WEB	Yes	🔗 Modify
8	Cell Ohmic	Over High Limit	2	2	Write Record-WEB	No	🔗 Modify
9	Cell SOC	Under Low Limit	10	10	Write Record-WEB	No	🔗 Modify
10	Cell SOH	Under Low Limit	10	10	Write Record-WEB	No	🔗 Modify
11	Cell Temperature	Over High Limit	50	50	Write Record-WEB	No	🔗 Modify
12	Cell Temperature	Under Low Limit	10	10	Write Record-WEB	No	🔗 Modify

1) Set and modify alarm settings info. Notice, the String X alarm will link to the relay DO X action when String link with DO is set to active.

2) Import default template is allowed.

Switch to different tab to set alarm masking. It is able to filter the alarm that already known and not show on the screen.

Check the checkbox to enable the alarm masking for string or cell, click on confirm button on the top right corner.

Note: The cell sensor on this page would be changed based on the device mapping, please refer to chapter 4.9.13 for the settings.

The screenshot shows a web-based configuration interface for 'Alarm Masking'. At the top, there are two tabs: 'Alarm Param' and 'Alarm Masking', with the latter being the active tab. To the right of the tabs are two buttons: 'Read Config' (green) and 'Confirm Config' (blue). Below the tabs, there is a checkbox labeled 'Alarm Masking Enable'. A horizontal separator line follows. Below the line, the label '#1' is displayed. Underneath, there are three checkboxes labeled '#1', '#2', and '#3', all of which are currently unchecked.

4.9.4 Group Module Settings

Click on “Settings – Parameter Settings – Group Settings” to show group module settings

- 1) Switch tab for CM/VM module settings, Temperature and humidity settings, leak current module settings, insulation resistant module settings, hydrogen sensor settings
- 2) Choose sensor quantity on the dropdown list to enable the module
- 3) CM/VM must enter the string and SN, SN is labelled on the CM VM cover
- 4) The T/H device only needs to enter the communication address based on the DIP switch in the binary module
- 5) The default communication address of the leakage current module starts from 241
- 6) The communication address of the insulation module starts from 16 by default
- 7) Hydrogen sensor communication address is 240 by default

CMVM
Temperature And Humidity
Leakage current module
Insulation module
Hydrogen sensor

Quantity Of Used: 1

Module#1

Belonging To The Group: 1

Address(SN): 2301010201

Module#2

Belonging To The Group:

Address(SN):

Module#3

Belonging To The Group:

Address(SN):

Module#4

Belonging To The Group:

Address(SN):

Module#5

Belonging To The Group:

Address(SN):

Module#6

Belonging To The Group:

Address(SN):

Module#7

Belonging To The Group:

Address(SN):

Module#8

Belonging To The Group:

Address(SN):

Module#9

Belonging To The Group:

Address(SN):

Module#10

Belonging To The Group:

Address(SN):

Module#11

Belonging To The Group:

Address(SN):

Module#12

Belonging To The Group:

Address(SN):

Read
Save

CMVM
Temperature And Humidity
Leakage current module
Insulation module
Hydrogen sensor

Quantity Of Used: 6

Physical Address#1: 1

Physical Address#2: 3

Physical Address#3: 7

Physical Address#4: 15

Physical Address#5: 31

Physical Address#6: 63

Read
Save

CMVM
Temperature And Humidity
Leakage current module
Insulation module
Hydrogen sensor

Quantity Of Used: 6

Physical Address#1: 241

Physical Address#2: 242

Physical Address#3: 243

Physical Address#4: 244

Physical Address#5: 245

Physical Address#6: 246

Read
Save

CMVM
Temperature And Humidity
Leakage current module
Insulation module
Hydrogen sensor

Quantity Of Used: 6

Physical Address#1: 16
Physical Address#2: 17
Physical Address#3: 18
Physical Address#4: 19
Physical Address#5: 20
Physical Address#6: 21

Read Save

CMVM
Temperature And Humidity
Leakage current module
Insulation module
Hydrogen sensor

Enable: OFF ON

Physical Address: 240

Read Save

Hall Sensor

Hall Sensor

Hall Sensor 100
Adjust String1

Read Save
Hall Calibration

- 1) Set Hall specification zero and calibration.
- 2) "Read" button is to read the current specification of Hall, data is able to edit and save as new specification.
- 3) Hall calibration is used to adjust hall specification to zero point. Hall must be taken out from the group of battery and left it as no current situation before calibration. Please ask for specification from professional before adjust and settings.

4.9.5 Function Settings

Click on “Settings - Parameters Settings – Function Settings” to display parameters setting page.

The screenshot displays the 'Function Settings' interface, which is organized into three main sections: 'Res Measurement', 'Balance', and 'Other parameters'.

- Res Measurement Section:** This section is divided into two panels. The left panel, titled 'Res Measurement Parameters', contains input fields for 'Measurement interval days' (set to 15) and 'Res Measurement Time' (set to 01:00), with a circular clock icon next to the time field. Below these fields are 'Read' and 'Save' buttons. The right panel, also titled 'Res Measurement', features dropdown menus for 'String' (set to 'String1') and 'Battery ID' (set to '#1'). Below these are 'Manual Measuring Cell' and 'Manual Measuring All' buttons.
- Balance Section:** This panel includes a 'Balance Enable' toggle switch (currently set to 'ON'), a 'Balance Degree(%)' input field (set to 98.5), and a 'Balance Interval(s)' dropdown menu (set to 120). 'Read' and 'Save' buttons are located at the bottom.
- Other parameters Section:** This panel contains a 'Hall value mode' dropdown menu (set to 'Positive and negative(no neutral wire)'). 'Read' and 'Save' buttons are positioned at the bottom.

Internal Resistance Measurement:

Set the interval days and the time for automatic timing measurement, click the button to manually measure.

- 1) Measuring (All): Measure all internal resistant for all batteries, it would take some times per round.
- 2) Measuring (Cell): Choose one string or one cell to measuring internal resistant.

Balance Parameter:

- 1) Balance function would be activated if the balance degree is lower than setting value (Example: 90% is the setting value, if the balance degree is lower than 90%, balance function would be activated).
- 2) In order to prevent the damage for battery, balance interval time must be set in

between of 2 times of balancing.

3) Maximum balance degree is 99.5%.

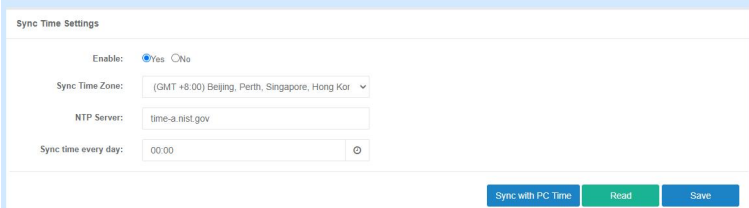
Other parameters:

1) Hall value mode, choose different mode based on whether the battery string uses UPS with a neutral wire, and the default is "Positive and negative(no neutral wire)". Set to the "Positive and negative (with neutral wire)" mode to monitor the voltage and current at the positive and negative terminals. Please refer to Chapter 5.3.1 for details.

Note: When the mode is set to "positive and negative (with neutral line)", the string voltage can only be calculated by using the accumulation method. The positive terminal voltage is the accumulation of the cell voltage of the front half string, and the negative terminal voltage is the accumulation of the cell voltage of the rear half string.

4.9.6 Time Settings

Click on "Settings – Parameters Settings – Time Settings" on the left the show time settings



The screenshot shows a web interface titled "Sync Time Settings". It contains the following fields and controls:

- Enable:** Radio buttons for "Yes" (selected) and "No".
- Sync Time Zone:** A dropdown menu showing "(GMT +8:00) Beijing, Perth, Singapore, Hong Kong".
- NTP Server:** A text input field containing "time-a.nist.gov".
- Sync time every day:** A text input field containing "00:00" with a clock icon to its right.

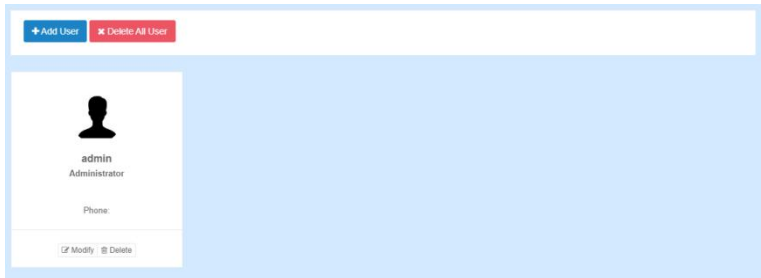
At the bottom right, there are three buttons: "Sync with PC Time" (blue), "Read" (green), and "Save" (blue).

1) Time zone is able to set and default time zone is GMT +8:00

- 2) NTP server could be set as IP address or NTP server: time-a.nist.gov
- 3) System is connected to NTP server to synchronize time automatically
- 4) Click on “Sync” button to sync time with PC

4.9.7 User Settings

Click on “Settings – Parameter Settings – User Settings” to show user settings page.

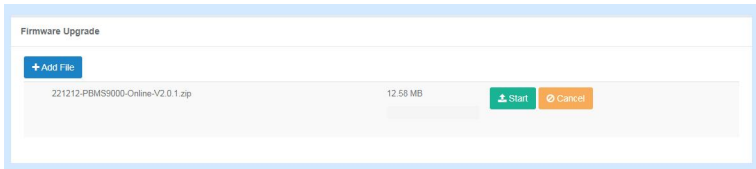


- 1) Click on “Add User” to add user with username, password, identity, contact info
- 2) Click on “Delete All User” to delete all user account info, alert message would be shown before deleting (User with caution)
- 3) Click on “Modify” button below of the user account to modify current user info.
- 4) Click on “Delete” button below of the user account to delete the current user account, alert message would be shown before deleting.

4.9.8 Firmware Upgrade

Firmware Upgrade:

Click on “Settings – Parameter Settings – Firmware Upgrade” to show firmware upgrade page



- 1) Please make sure only one website is launched before upgrade
- 2) Select the upgrade file from local
- 3) Click on “Start” to upgrade and it would automatically reboot
- 4) Please DO NOT configure any settings during upgrading, it would take about 5 minutes to upgrade and it would reboot once done. Login again once device rebooted.
- 5) Please clear browser cache (browsing history, cookie, etc.) to update webpage date before access the system

Important Notes:

(1) Please DO NOT change the name for the upgrade file. If there is same file name under the same path, please change the previous file name to others then do the upgrade.

Please upgrade firmware within this webpage and contact to technician before upgrading. Illegal upgrade operations are prohibited.

4.9.9 Email Settings

Click on “Settings – Parameters Settings – Email Settings” to show email settings page

Send Email Settings

SMTP Server: smtp.gmail.com

Port: 25

Sending Mailbox: example@gmail.com

Password:

Confirm Password:

Restart Email Service

Read

Save

Receiving Mailbox List

+ Add Mailbox

✖ Delete All Mailbox

	Name	Mailbox	Operation

Email alert message cycle would be 1 minute, message would be generated per minute and once the message sends out successfully, same message would not generate again. **Please note that network settings must be done first as the email alert message would need internet access to be sent out!**

DTL: Send email settings must setup with send box email address settings, such as smtp server, port number and password. Gmail settings as example shows as below.

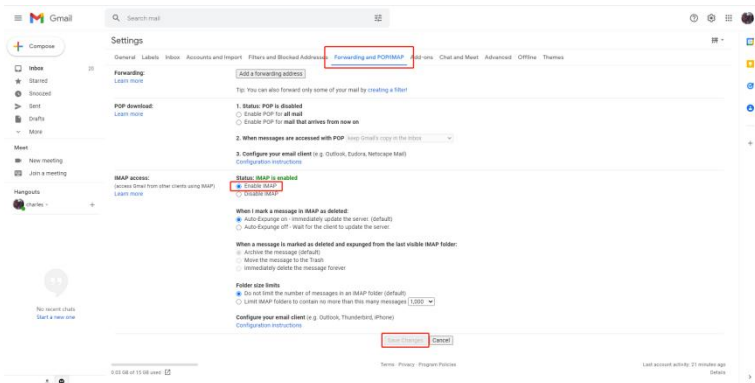
Smtp Server: smtp.gmail.com Port: 465/587.

Check if IMAP is enabled:

Open browser and login to Gmail(<https://mail.google.com>), click setting button in the upper right corner.

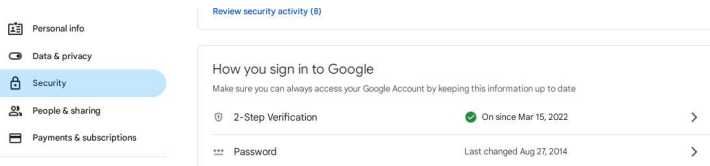


Click “Forwarding and POP/IMAP” , select enable IMAP, and click save changes.



Generate app password:

1. Enable the function of 2-Step Verification to create an App password individually. Select [2-Step Verification], after passing the verification, select to enable the 2-step verification function.



Scroll to the bottom of the page and select [Application specific password].

← 2-Step Verification

Application specific password

We don't recommend using app passwords, and in most cases they're not necessary to sign in. To keep your account secure, use the "Sign in with Google Account" feature to connect the app to your Google Account.

Application specific password

2 Password



Enter the application name (custom), click [Create].

← Application specific password

latest security standards. Before creating an app-specific password, you should determine whether the app you are using requires such a password to log in.
[Learn more](#)

Your application-specific password

Dfun	Creation time: March 15, 2022; Last use time: April 1, 2022	
------	---	--

To create a new app-specific password, type a name for it below...

Create

After adding App password successfully, a 16-number password will appear, be sure to save the password, otherwise, it will not appear if the page is closed. After that, only email account and App password are needed to send email via the app. Using port 587 to send email by default.

Generated app password

Your app password for you device

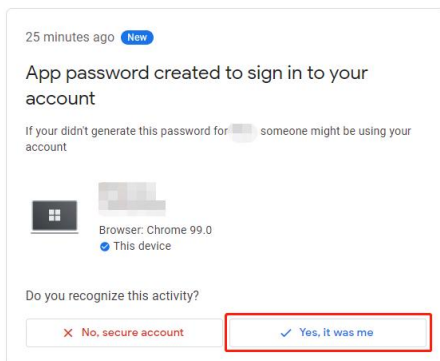
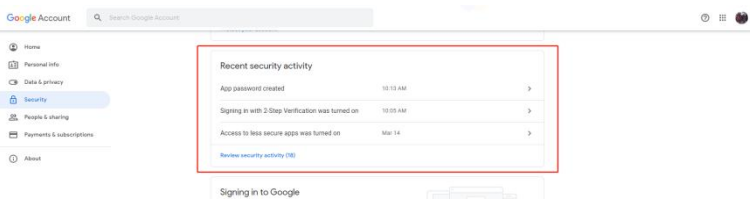
abcd efgh ijkl mnop

How to use it
Go to the settings for your Google Account in the application or device you are trying to set up. Replace your password with the 16-character password shown above.
Just like your normal password, this app password grants complete access to your Google Account. You won't need to remember it, so don't write it down or share it with anyone.

Done

Other notices:

1. When operations related to security settings are performed, Google will send a series of relevant confirmation prompts. Click on each activity message to confirm that it was done by yourself.



4.9.10 Project Details

Click on "Settings – Project Settings – Project Details" to show project detail page.

Project Information

Information Setting

Project Name

Project

Room Name

Room

Device Name

9000

Owner Name

User

Company Name

Example Technology CO., LTD.

Company Website

http://www.example.com.cn

Language Type

☒ 简体中文 ☐ 繁體中文 ☐ English

Alarm Sound

☒ OFF ☐ ON

Device SN

2201010001

Device Type

standard

Restart Device

Save

Data Recording Settings

History Record Switch:

Turn On

History Time Interval:

1h

Save

Charge/Discharge Recording Settings

Charge/Discharge Record Switch:

Turn On

Backup Time(min):

600

Save

Delete Record Settings

Select Date Type:

Monthly

Start

-

End

Delete Alarm Record

Delete SMS Record

Delete History Record

Delete Charge/Discharge Record

Storage Capacity

Total Capacity:

3.0G

Used Capacity:

496K

Logo Settings

Please clear the browser cache and refresh the web after uploading.

Login Logo

Logo.png

Choose File

Upload

User Logo

Head.png

Choose File

Upload

- 1) Project detail and company info could be customized.
- 2) Change default language.
- 3) Alarm sound can be activated, and when the system generates an alarm, the

webpage will play the alarm sound.

- 4) History Time Interval is used to uniformly set the recording time interval of historical data. The charging records are based on the rate of change of the group voltage, with a default interval of 1% variation for each recording. For discharging records, the recording interval is determined based on the Backup Time. Within 30 minutes, the interval is 5 seconds. Between 0.5 to 1 hour, the interval is 15 seconds. For 1 to 3 hours, the interval is 30 seconds. Beyond 3 hours, the interval is 60 seconds.
- 5) Historical data can be deleted according to year, month and date.
- 6) Show storage capacity in total and usage.
- 7) Logo setting is able to be set the login page logo and the logo on the top left corner.

4.9.11 Battery Information

Click on “Settings – Project Settings – Battery Information” to view more detail.

Battery Setup

String Information

String 1 Name:

String 2 Name:

String 3 Name:

String 4 Name:

String 5 Name:

String 6 Name:

Battery Information

Manufacturer:

Equipment Model:

Capacity(AH):

Voltage Type(V):

Cut-off Voltage(V):

Recovery Voltage(V):

Float Current(A):

Float Voltage(V):

Ohmic Reference(mΩ):

Ohmic Correction(mΩ):

Voltage Calculation:

Read

Save

String information can customize the name of each String. If it is empty, the system will use String N by default. Battery information can set the parameters such as manufacturer, model, capacity, voltage, internal resistant reference, cut-off voltage, recover voltage, float current, float voltage, voltage calculation, internal resistant correction.

Note:

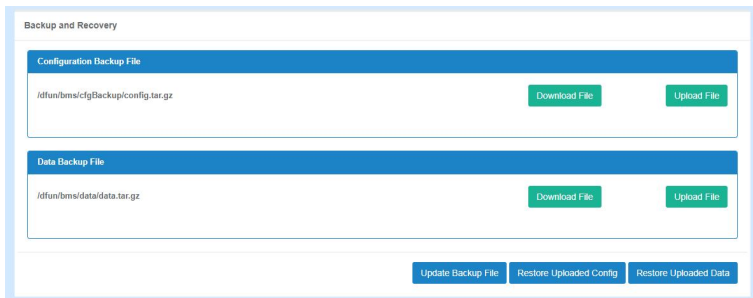
String Voltage Calculation:

Measurement Value: The actual voltage measured value

Calculated Value (Default): Sum up based on the cell battery voltage

4.9.12 Project Backup

Click on “Settings – Project Settings – Project Backup” to display backup page.



- 1) All configuration file for parameters settings, business settings, project settings could be able to backup and restore.
- 2) All data file for history data, history alarm, charge/discharge data could be able to backup and restore.
- 3) Update Backup File: Update system configuration backup files and system data backup files.
- 4) Restore Uploaded Config: Used to manually restore the configuration after transferring the backup files to other devices (this operation will overwrite the local configuration, please be cautious!).
- 5) Restore Uploaded Data: Used to manually restore the data after transferring the backup files to other devices (this operation will overwrite the local data, please be cautious!).

4.9.13 Device Mapping

Click on "Settings – Service Configuration – Device Mapping Configuration" to view the mapping detail page.

Address Map

Choose File

Upload

Download

Reload Config

Asleep Cells

Awake Cells

SN Auto Searching

Confirm Config

- BMS
 - Channel1
 - Channel2
 - Channel3
 - Channel4
 - Channel5
 - Channel6
- DI

Channel 1 Battery Number:
4

Channel 2 Battery Number:
0

Channel 3 Battery Number:
0

Channel 4 Battery Number:
0

Channel 5 Battery Number:
0

Channel 6 Battery Number:
0

Address Map

Choose File

Upload

Download

Add

Confirm Config

- BMS
 - Channel1
 - Channel2
 - Channel3
 - Channel4
 - Channel5
 - Channel6
- DI

No	Device Name	String Node	Device Node	Ohmic Correction(mV)	Temperature Correction(°C)	Operation
1	CELL	1	2108162122	0	0	Modify Delete
2	CELL	1	2108162118	0	0	Modify Delete
3	CELL	1	2108162119	0	0	Modify Delete
4	CELL	1	2108162120	0	0	Modify Delete

Address Map

Read

Save

- BMS
 - Channel1
 - Channel2
 - Channel3
 - Channel4
 - Channel5
 - Channel6
- DI

DI1 Setting

Enable ☒

Name

Anti-state ☐

☒ Smoke
 ☐ Leak
 ☐ Infrared
 ☐ Door

DI2 Setting

Enable ☒

Name

Anti-state ☐

☐ Smoke
 ☐ Leak
 ☒ Infrared
 ☐ Door

DI3 Setting

Enable ☒

Name

Anti-state ☐

☐ Smoke
 ☐ Leak
 ☐ Infrared
 ☒ Door

DI4 Setting

Enable ☒

Name

Anti-state ☐

☐ Smoke
 ☐ Leak
 ☐ Infrared
 ☒ Door

DI5 Setting

Enable ☒

Name

Anti-state ☐

☒ Smoke
 ☐ Leak
 ☐ Infrared
 ☐ Door

DI6 Setting

Enable ☒

Name

Anti-state ☐

☐ Smoke
 ☒ Leak
 ☐ Infrared
 ☐ Door

- 1) Add, modify or delete cell sensor address table under each COM port.
- 2) Auto SN searching function is able to search devices under all tunnel.
- 3) Click on confirm button to finish the mapping once the processing done (It is not necessary to confirm again once the auto SN searching is confirmed).
- 4) Support one clicks to hibernate/awake cell sensor, voltage and current measurement module (CM/VM) .
- 5) Support import/export address configuration list.

Steps for Auto SN Searching:

1. Enter total string number and click ok.
2. Check on the prompted message and confirm it to wait for the searching
3. Check on the result which has been done, confirm it to finish the configuration

Modify device address info:

1. Click on Add button to add cell sensor, string node and device node must be entered.
2. Click on Modify/Delete button to modify/delete the selected cell sensor.
3. Device node must be the same as SN labeled on the device if modified.

Chapter 5 Data acquisition and measurement parameters

5.1 Summary

PBMS9000 has 6 RJ11 channels connected to the battery monitoring module. The next RS485 is divided into two wiring ports, connected to voltage and current measurement module (CM/VM) , temperature and humidity sensor, leakage current

sensor and insulation module.

5.2 Battery monitoring module

The quantity of cell sensors is same as the quantity of batteries in each string.

- (1) The cell sensor measures the voltage, temperature and internal resistance of each battery.
- (2) Each RJ11 is connected to 70 cell sensors and 70 batteries at most.
- (3) Single batteries of different RJ11 channels can belong to the same battery string.
- (4) The SN number of all single batteries in the same circuit must be unique.
- (5) RJ11 line under each COM port shall not exceed 50m.
- (6) Collecting period is 100ms/pcs.

5.2.1 Data communication acquisition

PBMS9000 is able to connect 6-way of cell sensor 51/61 with RJ11 plug.

- (1) Each channel can connect max 70 cell sensors.
- (2) The length of communication line of each acquisition channel shall not exceed 50m.

When installing settings , the SN address code of the cell sensor is correctly configured to PBMS9000. Two SN address code configuration modes are provided, manual entry and one click search address. One click search address is more convenient and faster. When only a few cell sensors address need to be modified , it can be entered manually. Refer to the midpoint table configuration in chapter 4.9.13 for specific steps.

PBMS9000 provides two mutually independent RJ45 Ethernet interfaces. Support IEEE-802.3 ethernet standard 10baset / 100BaseTX.

5.2.2 Battery string distribution

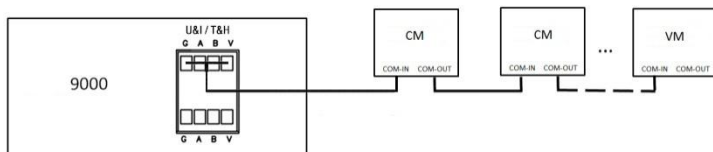
PBMS9000 is able to connect 6-way of cell sensor 71 with RJ11 plug. It can be allocated into different battery strings, and the cell sensors collected by each RJ45 port is mapped to different battery strings. The specific mapping relationship is shown in the table below.

Strings	RJ11 (com)	Note
1	1 2 3 4 5 6	All RJ11 port cell sensors are mapped to battery string 1.
2	1 2 3	No.1-No.3 RJ11 port cell sensors are mapped to battery string 1.
	4 5 6	No.4-No.6 RJ11 port cell sensors are mapped to battery string 2.
3	1 2	No.1-No.2 RJ11 port cell sensors are mapped to battery string 1.
	3 4	No.3-No.4 RJ11 port cell sensors are mapped to battery string 2.
	5 6	No.5-No.6 RJ11 port cell sensors are mapped to battery string 3.
4 5 6	1	If the number of battery strings is configured as 4, 5 and 6, each RJ11 port is one string, that is, RJ11 ports of 1-6 are strings 1-6 respectively. In addition, if the number of configuration battery strings is
	2	
	3	
	4	

	5	4, the RJ11 port of 5-6 is disabled. Similarly, if the number of configuration battery strings is 5, the RJ11 port of channel 6 is disabled.
	6	

5.3 Voltage and Current measurement module

Connect the battery string voltage measurement module and battery string current measurement module through RS485 port for data acquisition. Up to 12 measurement modules can be connected, and each measurement module is connected together by hand-in-hand serial connection for networking communication. The voltage measurement module and current measurement module are powered by PBMS9000 through cascaded communication lines without additional power supply. The connection between the measurement module and PBMS9000 is shown in the following figure:



Battery string voltage: battery string voltage provides two modes, direct measurement mode and single voltage superposition mode.

Direct measurement mode : A battery string needs to be equipped with a voltage measurement module (VM). The user needs to connect the measurement lines of the positive end of the first battery and the negative end of the last battery of the battery string to the voltage measurement module. Voltage range: DC20~1000V. Connecting the voltage beyond the measurement range will lead to inaccurate measurement

results and even module damage.

Single voltage superposition mode: Accumulate the voltages of all batteries collected by the unit. The accumulated value is the voltage value of the battery string, and there is no need to select a voltage module.

Note: PBMS9000 factory defaults to the mode of single voltage superposition mode. If the user needs to change, refer to 4.9.11 for configuration.

Battery string current: At least one current module shall be selected for each battery string (CM) to measure the current of the battery string. Each current measurement module provides two hall interfaces, but these two hall interfaces can only be used for current measurement of the same battery string. When the measuring object is a multi-pole battery and the current is shunted by multiple connecting lines, multiple current measurement modules can be selected to measure the current of the battery string with multiple halls. Finally, the current of the battery string displayed on the host terminal is the sum of the measured current values of multiple modules. The same battery string can be paired with up to 4 current measurement modules to measure the current of the battery string. The current module supports monitoring ripple current.

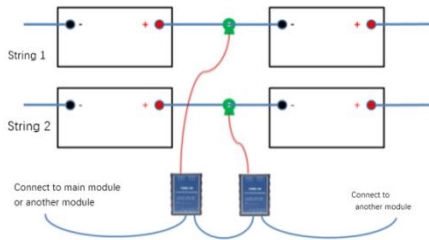
5.3.1 Introduction of current module

CM, the back of the current measurement module is provided with back glue, which can be pasted on the clean and flat battery rack, electric box or battery surface.

The measurement module and the host, the measurement module and the module are connected hand in hand through the network cable to realize the power supply and networking communication of the module. The usage mode of Hall sensor and current module needs to be determined based on the number of poles in the battery pack and whether the UPS has a neutral wire. The tested battery string is

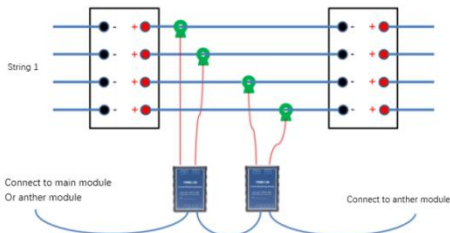
divided into unipolar battery and multipole battery.

1) The installation method of single pole battery string is shown in the figure below:



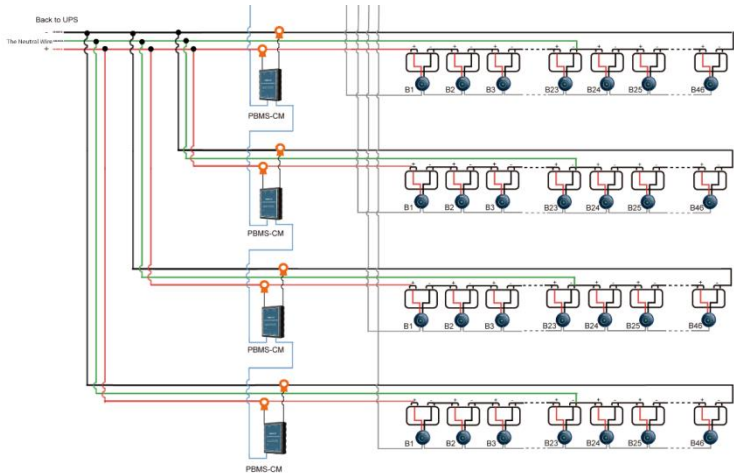
In this state, only one hall current sensor is connected to each CM to measure the charge discharge current and ripple current of the corresponding battery string.

2) The installation method of multi pole battery string is shown in the figure below:



In this state, each CM can be connected with two hall current sensors. Through the combination of the two CM, the measured current can be accumulated at the host end to measure the charge discharge current and ripple current of the four-pole battery.

3) The installation method when using UPS with neutral wire is shown in the figure below:



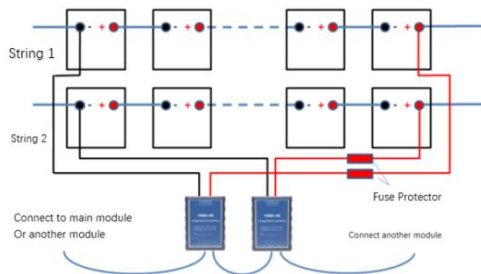
When using some high-capacity UPS, a neutral wire is required to divide the circuit into two parts. In this case, each CM module can be connected to two Hall current sensors, each connected to the positive and negative terminals of the circuit. Hall 1 monitors the positive terminal current and is connected to port 3 of CM. Hall 2 monitors the negative terminal current and is connected to port 4 of CM.

5.3.2 Introduction of voltage module

VM the back of the voltage measurement module is provided with back glue, which can be pasted on the clean and flat battery rack, electric box or battery surface.

The measurement module and the host, the measurement module and the module are connected hand in hand through the network cable to realize the power supply and networking communication of the module.

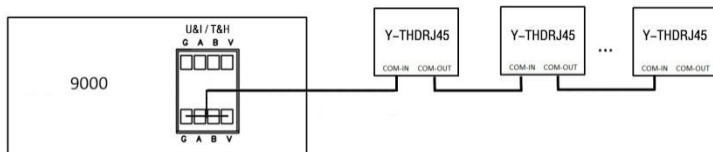
The installation method of VM is shown in the figure below:



VM monitors the string voltage of a string of batteries. Before the string voltage is connected to the voltage measurement module, the fuse protector shall be connected in series. The specification of the fuse protector is rated current 2A and rated voltage 1000V.

5.4 Temperature and humidity sensor

The temperature and humidity sensor are used to connect the equipment for data acquisition through RS485 interface, and up to 6 sensors can be connected. The measurement modules are connected together through hand-in-hand serial connection for network communication. The sensor is powered by PBMS9000 through class communication line without additional power supply. The connection between the sensor and the host is shown in the figure below:



The temperature and humidity sensors communicate through RJ45 port. A magnet is built in the bottom, which can be adsorbed on the surface of the metal shell to more directly measure the temperature and humidity data of the equipment. The 6-digit

dial switch sets the equipment address, which is convenient and fast to install.

5.5 Leakage Current Module

The leakage current module is connected via RS485 port to collect data, up to 6 modules to be connected at the same time, and the connection mode during each module is hand-in-hand connection. All those modules are connected as a string and the string is powered by PBMS9000 main control module and no extra power required.

RS485 is the connection type between each of modules, the wrong connection will be occurred damage for the module. The two terminals of the sensor are in parallel and can be cascaded through the terminals. This product is a weak current sensor with built-in precision magnetic material as a magnetic induction component, which is easy to be disturbed by vibration and external strong magnetic field. Therefore, it is recommended that users handle it gently and do not touch it. At the same time, the intensity of interference magnetic field in the use environment is assessed.

5.6 Insulation Module

The module measurement port (RS485 port) can be connected to an insulation module for data collection. A maximum of six insulation modules can be connected to each other in series, and each module can be connected hand in hand for networking communication. Modules are powered by the PBMS9000 main control through cascading communication cables. No additional power supply is required. Insulation modules are connected to each other over RS485 and installed with standard DIN rails. The bit dip switch sets the address. When all four dip bits are dialed down, the module is the base address 16. In other cases, the 4-bit dip bits

correspond to the binary value plus the base address 16.

5.7 Hydrogen Sensor

The module measurement port (RS485 port) can be connected to a hydrogen sensor for data collection. The sensor is powered by a PBMS9000 without the need for additional power configuration.

The first-class brand electrochemical hydrogen sensor is adopted, which has the characteristics of rapid response, sensitivity, and strong anti-interference ability. Through our unique compensation algorithm and multi-stage standard gas calibration, it also has the characteristics of long life, high accuracy, high repeatability, and high stability. Suitable for occasions where hydrogen leakage is prone and real-time monitoring of concentration is required. The wall mounted waterproof shell is easy to install and has a high degree of protection, which can be applied to harsh on-site environments.

Chapter 6 System alarm

6.1 Summary

Users can customize all electrical parameters and set linkage.

6.2 Alarm analysis

6.2.1 Alarm type judgment

There are two kinds of monitoring types of alarms: exceeding the upper limit and exceeding the lower limit.

6.2.2 Alarm object type

Alarm monitoring includes almost all electrical parameters during battery

operation:

Out of limit type	Parameter Type
Upper Limit	Battery string voltage
	Battery string current
	Monomer voltage
	Monomer temperature
	Monomer internal resistance
	Battery Thermal Runaway
Lower limit	Battery string voltage
	Battery string current
	Remaining capacity of battery string SOC
	Monomer voltage
	Monomer temperature
	Remaining capacity of battery SOC
	Battery health SOH

6.2.3 Alarm action conditions

After setting the parameters, it is necessary to determine the action conditions for triggering the fixed value.

For example: Set the string current to exceed the upper limit. Set the enable as yes, the trigger type is over the upper limit, the threshold is 10, and the recovery value is 10. After setting and saving, an event record will be generated when the battery string current is higher than 10A.

6.2.4 Alarm recovery value

When the alarm object meets the threshold conditions and generates an alarm,

the alarm can be eliminated only after the real-time value of the object is restored to the specified range of the recovery value. This value prevents the repeated alarm output caused by the frequent fluctuation of the real-time value of the object up and down the threshold value. The value range is based on the actual situation.

For example, set the upper limit of monomer voltage alarm to 2.5V and the recovery value to 2.3V. When the collector collects > 2.5V, the alarm will be generated. When it is 2.4V, the alarm will not be eliminated, and when it returns to 2.5V, the alarm will not be generated again. The alarm will not be extinguished until the voltage recovers to < 2.3V.

The value range of recovery value is set according to the characteristics of the measuring point and the field environment. Setting it to 0 means that once the real-time value is not within the limit range and alarm recovery time is set to 0, the alarm will be eliminated immediately.

6.2.5 Alarm trigger action

When the alarm object generates an alarm, the corresponding linkage action can be set to remind the maintenance personnel. The triggering action includes the following contents:

Trigger action	Description
WEB	Web page alarm information prompt
DO Output	The audible and visual alarm for alarm
SMS	SMS Alert receiving
EMAIL	Email receiving alarm

Chapter 7 Data forwarding

In addition to the function of viewing data on the web, PBMS9000 also supports the function of data forwarding. The data center software can read all real-time data of the collector through MODBUS, SNMP, MQTT, DL/T860(IEC61850) for unified monitoring.

7.1 Modbus forwarding

PBMS9000 provides one RS485 and two 10 / 100M Ethernet ports for data forwarding. Customers can read data through RS485 with Modbus RTU protocol or Modbus TCP protocol through Ethernet port according to the actual needs of the site.

(1) Ethernet supports multi host Modbus TCP connection and multi host TCP connection. In theory, the number of connections is not limited, but in practice, it is recommended to limit the number of connections to less than 10.

(2) Modbus - RTU only supports 8 data bits and 1 stop bit. No verification. Baud rate and MODBUS address can be modified through web page or LCD.

Note: the communication protocols of Modbus RTU and Modbus TCP are the same. Refer to <PBMS9000Series_Modbus_Address_Mapping_Vx.x_20xxxxx.xlsx> for detailed protocols.

7.2 SNMP forwarding

SNMP is a network management standard based on TCP / IP protocol family. It is a standard protocol for managing network nodes (such as servers, workstations, routers, switches, etc.) in IP network. SNMP can enable network administrators to

improve network management efficiency, find and solve network problems in time and plan network growth. Network administrators can also receive notification messages and alarm event reports from network nodes through SNMP to learn about network problems.

The communication string mainly contains two types of commands: GET command and SET command. The GET command reads data from the device. These data are usually operation parameters, such as connection status, interface name, etc.

The most common default communication strings are public (read-only) and private (read / write). In addition, there are many vendors private default communication strings. Some form of default communication string can be found on almost all network devices running SNMP.

In terms of security, this device only supports the use of GET command and public communication string.

Using SNMP MIB software, you can easily query the forwarding information of all SNMP nodes (import the provided. My file). Refer to

<PBMS9000Series_OID_Tables_Vx.x_20xxxxxx.xlsx> for detailed protocols.

Detailed SNMP software reference documents: <iReasoning MIB Browser instructions_20xxxxxx.docx>、<MG-SOFT MIB Browser instructions_20xxxxxx.docx>.

7.3 MQTT Forwarding

MQTT (Message Queuing Telemetry Transport), it is lightweight protocol based on publish/subscribe mode. This protocol is setup based on TCP/IP. The most he greatest advantage of MQTT is that it can provide real-time, reliable messaging services for connecting remote devices with very little code and limited bandwidth. As an instant messaging protocol with low overhead and low bandwidth usage, it is widely used in the Internet of Things, small devices, mobile applications and so on.

The implementation of MQTT protocol requires the completion of client and server communication. In the process of communication, MQTT has 3 identities: Publish, Broker (Server), Subscribe. The message publisher and subscriber are both clients, the message broker is the server, and the message publisher can be both subscribers. The PBMS9000 main control implements the client functionality of MQTT.

MQTT transmits message divided into: Topic and payload:

(1) Topic is a type of message. When a subscriber subscribes, the message content of the topic is received (payload);

(2) Payload is the payload of a message. It refers to the content that a subscriber uses.

Note: please refer to <MQTT_Data_Format_Specification_Vx.x_20xxxxxx.docx>

7.4 DL/T860(IEC61850)

DL/T860 (IEC61850) standard is a systematic and high starting point international communication standard for the power industry. Compared with the traditional communication protocol system, DL/T860 has greater advantages on the technical level: two service levels, ACSI (abstract communication service interface) and SCSM (special communication service mapping), are used comprehensively, and the service and communication network are independent; The SCL (Substation Description and Configuration Language) model for system and IED automation configuration is standardized, which can provide standard equipment interface and system interface for substation automation system.

PBMS9000 can forward data based on DL/T860 (IEC61850), which needs to be customized according to the actual situation of different projects. Please refer to 《PBMS9000Series_61850_Protocol_Vx.x_20xxxxxx.xlsx》

Chapter 8 Auxiliary functions

8.1 Battery status

PBMS9000 provides the function of judging the state of the battery string. The state of the battery string mainly includes five states: equalizing charge, discharge, floating charge, standing and abnormal. The judgment of PBMS9000 is mainly based on the battery string voltage, battery string current and battery characteristic parameters. The details are as follows:

State	Condition
Abnormal	Abnormal string module or abnormal hall connection in current module.
Equal charge	When the hall connection is normal, the absolute value of the string current is $>$ floating charge current, and the string current is positive. Or string voltage $>$ string average charging voltage (PS).
Discharge	When the hall connection is normal, the absolute value of the string current $>$ the floating charge current, and the string current is negative.
Floating charge	When the hall connection is normal, the absolute value of string current $\leq$ floating charge current and string voltage $\geq$ floating charge voltage.
Standing	The absolute value of hall connection normal string current $\leq$ floating charge current and string voltage $<$ floating charge

	voltage.
--	----------

PS: The string average charging voltage is based on the set floating charging voltage. As follows:

Average charging voltage of 2V battery string = number of batteries * (floating charging voltage + 0.13)

Average charging voltage of 12V battery string = number of batteries * (floating charging voltage + 0.78)

Average charging voltage of 6V battery string = number of batteries * (floating charging voltage + 0.39)

8.2 Voltage equalization

PBMS9000 provides voltage equalization function to keep the voltage equalization of the battery string during floating charge, keep each battery in the best active state, and improve the backup time and operation life of the battery string. The equalization function needs to meet certain conditions before voltage equalization (4 batteries with the largest voltage among the batteries that meet the equalization conditions each time):

- 1、 The battery string is in floating charge state;
- 2、 The equalization function is on (it is off by default and can be configured by software);
- 3、 The battery voltage is greater than the average voltage of the battery string battery;
- 4、 The equalization degree of battery voltage is less than the set target equalization degree (0 by default, which can be configured by software);
- 5、 Meet the requirements for the interval between two equalizations (2 minutes by default, which can be configured by software);

When the battery string is in the floating charge state, if the equalization function is enabled, when the equalization cycle arrives, PBMS9000 calculates the equalization degree of each battery voltage of the string. If the battery voltage is greater than the

average voltage of the battery string and the equalization degree of the battery voltage is less than the set target equalization degree, the corresponding battery meets the equalization conditions. PBMS9000 sends the equalization command to the four batteries with the largest voltage among the batteries that meet the equalization conditions. After the unit monitoring the battery receives the equalization command, the light on the unit will flash continuously for three times and then discharge the battery evenly. The equalization current is 0.2A and the equalization process lasts for 1 minute.

PS: Battery voltage equalization = $(1 - |V_i - V_{avg}| \div V_{avg}) \times 100\%$

V_i : Battery voltage.

V_{avg} : Average voltage of battery string

8.3 Internal resistance measurement

When the battery string is in the floating charge state (internal resistance measurement is not actively carried out in other states), PBMS9000 will issue the internal resistance measurement command to the monomer according to the set time, and measure the internal resistance of the battery when the monomer receives the internal resistance measurement command.

At the same time, PBMS9000 also supports passive measurement of battery internal resistance, that is, manually measuring battery internal resistance through debugging software.

8.4 SOC remaining capacity

PBMS9000 has the function of estimating the SOC (remaining battery capacity) of a single battery and battery string. The important basis of SOC estimation is the characteristic parameters of the battery, including the voltage level, recovery voltage and of the battery; For battery SOC calculation, the default battery characteristic parameters are used without modification:

Voltage level	2V	12V	6V
Cut-off voltage	1.75V	10.8V	5.4V
Recovery voltage	2.12V	12.68V	6.34V
Floating charge voltage	2.23V	13.38V	6.69V
Floating charge current range	-0.02C to +0.02C	-0.02C to +0.02C	-0.02C to +0.02C

PS: C is the battery capacity

The default [recovery voltage] value is the optimal value obtained from a large number of experiments. Do not change it without special circumstances (such as the reference value provided by the battery manufacturer).

PS: Refer to chapter 4.9.11 for the voltage level, floating charge range, cut-off voltage and recovery voltage of the battery.

8.5 SOH health state

PBMS9000 supports the estimation function of SOH (battery health state) of a single battery. One of the important bases for SOH estimation is the internal resistance reference value of the battery. Users need to set the internal resistance

reference value of the battery according to the actual information of the battery.

PS: Refer to chapter 4.9.11 for the setting of the internal resistance of the battery.

8.6 Switching value input

PBMS9000 provides 6 external passive node inputs, which are suitable for monitoring circuit breaker position signal, knife switch position signal and other status information.

Generally speaking, when the external node is closed, the corresponding switching value input of the LCD is displayed as closed, and the internal status information will also be set to 1; When the external node is disconnected, the corresponding switching value input of the LCD is displayed as disconnected, and the internal status information will also be set to 0.

8.7 Relay output

PBMS9000 is configured with 6 relay output ports. The relay specification is 250VAC / 5A, which can be used with the function of the alarm system to monitor whether the relevant parameters exceed the limit, and then output reasonable relay action (see Chapter 6 for the detailed introduction of the alarm system).

Relay alarm action needs to meet the following three conditions:

1. Relay mode is local alarm mode;
2. The alarm system generates an alarm;
3. The alarm event generated by the alarm is the action object set by the relay.

8.8 NTP

During the operation of the battery monitoring host, the accuracy of the built-in real-time clock needs to be ensured. Therefore, NTP server is built to enable NTP time service function, and the time of NTP time service is configured to synchronize the clock when the system runs to NTP synchronization time. Or manually synchronize in a web page. Please refer to section 4.10.6 for details.

Chapter 9 Maintenance and troubleshooting

Problems	Reasons	Solutions
After adding the control power supply, the equipment has no display.	The power supply is not connected properly.	1. Check whether the correct working voltage is added to the 24V + and 24V - terminals of the equipment; 2. Check whether the control power fuse is burned.
Abnormal internal resistance.	All internal resistance values are 0.	Click the manual internal resistance test operation on the web page.
	Individual internal resistance is too large.	Measuring line contact problem, reconnect the measuring line.
Incorrect current measurement.	Hall has no field calibration.	When the group current is zero, carry out hall zero calibration on the web page.
	Hall configuration specification	Check whether the specifications of hall are consistent with those

	configuration error.	displayed on the web page.
No monomer. detected by one click Address Search	The total length of RJ11 line exceeds 50m.	Replace the RJ11 long communication line and reduce the RJ11 long communication line.
	RJ11 line resistance is too large.	Replace all RJ11 wires.
	The single communication line does not comply with the "left in right out" principle.	Modify the wiring sequence of single RJ11 communication port.

Notice:

- The information stated in this manual can be modified without prior notice due to update need.
- DFUN (ZHUHAI) CO.,LTD. reserves the right to interpret the information stated.

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