



User Manual (cabinet)

RC04808S-Li

Solutions behind the power

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Publish statement

Thank you for purchasing this series UPS.

This series UPS is an intelligent, single phase in single phase out, high frequency online UPS designed by our R&D team who is with years of designing experiences on UPS. With excellent electrical performance, perfect intelligent monitoring and network functions, smart appearance, complying with EMC and safety standards, The UPS meets the world' s advanced level.

Read this manual carefully before installation

This manual provides technical support to the operator of the equipment.

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1. Important Safety Information

Please strictly observe all warnings and operating instructions in the manual and on the machine, and keep this manual properly. Before installing and operating the lithium battery product, please read this manual carefully.

The lithium battery product has high temperature and high voltage in side. During the installation, operation and maintenance of the equipment, it is necessary to abide by the local safety regulations and related operating procedures, or else it may cause personal injury or equipment damage. The safety precautions mentioned in the manual are only supplements to the local safety regulations. The company does not assume any responsibility for violation of general safety operation requirements or violation of safety standards for design, production and use of equipment.




 **Warning**

In a living environment, this product may cause radio interference. In this case, it may be necessary to take practical measures against interference.

1-1 Description of Symbols

The safety symbols used in this manual are shown in the following table. These symbols are used to remind readers of the safety matters that should be observed when installing, operating and maintaining the equipment.

Table 1 Description of safety symbols

Safety symbol	Meaning
	Safety tip
	ESD tip
	Beware of electric shock

Safety tips are classified into three levels: Danger, warning, attention, and caution. The “text reminder” of the safety level is located to the right of the symbol, and the detailed description of the safety content is located below the symbol, in the format shown below.

 **Danger**

Danger means that there is a dangerous situation, which will result in death or serious injury if it isn't avoided.

 **Warning**

Warning means that there is a dangerous situation, which may result in death or serious injury if it isn't avoided.

 **Caution**

Caution means that there is a dangerous situation, which may result in minor or moderate injury if it isn't avoided.

Attention

Attention is used to emphasize operations that are not related to physical injury.

1-2 Handling Instructions

- Before moving the lithium battery, be sure to use the original packaging materials to prevent or slow down the collision.



1-3 Preparation

- When the lithium battery product is directly moved from a low temperature environment to a warm environment such as indoors, condensation may occur inside. After moving to the installation site, let it stand for at least 2 hours and wait for it to dry completely before installing.
- Do not install it near water or damp environment.
- Avoid long-term use in places subject to vibration and impact.
- Do not install it in an environment with dust, volatile gas, excessive salt, or corrosive substances.
- Do not install it in a place with direct sunlight or heating equipment nearby.
- Do not block or cover the ventilation holes on the shell of the lithium battery.
- Do not place flammable and explosive materials around.

1-4 Installation Notes

- Do not connect devices that may overload the lithium battery product.
- Do not place the lithium battery product in places where it may be stepped on or tripped on the power cord.
- Only use power cords that comply with VDE test standards and CE certified.
- This product should be installed in an area with an altitude of less than 1000m. In places over 1000m, derate it according to IEC62040-3. The following table is for reference only. This is an example of power derating according to altitude:

Table 2 Power derating factors used above 1000m above sea level

Altitude		Derating factors	
m	feet	Natural convection	Forced air cooling
1000	3300	1.000	1.000
1200	4000	0.994	0.990
1500	5000	0.985	0.975
2000	6600	0.970	0.950
2500	8300	0.955	0.925
3000	10000	0.940	0.900
3500	11600	0.925	0.875
3600	12000	0.922	0.870
4000	13200	0.910	0.850
4200	14000	0.904	0.840
4500	15000	0.895	0.825
5000	16000	0.880	0.800

Note: ① This table is derived from IEC62040-3;
② Altitudes not listed allow interpolation.

1-5 Operation Notes

- The lithium battery product contains a battery inside. Even if it is not plugged in or started, there is still electricity in the output socket or output terminal of the lithium battery product.
- To completely turn off the power, please disconnect the maintenance switch (if any) and then turn off the BMS power switch (if any).
- Prevent liquid or other foreign objects from entering the lithium battery product.

1-6 Precautions for Maintenance, Repair and Troubleshooting

- There is high voltage inside the lithium battery product. Any maintenance must be carried out by qualified personnel.
- Even if the lithium battery product has been disconnected from the device, it is still live and dangerous as the internal components are still connected to the battery product.
- Before any repair or maintenance, you should not only disconnect the maintenance switch, but also confirm that there is no current inside and turn it off. In particular, ensure that the high-voltage capacitors such as the DC power bus capacitors have no voltage.
- Only qualified service personnel are allowed to replace the battery where safety measures are taken.
- The internal battery is not disconnected from the output circuit, and dangerous voltage may still be generated between the battery terminal and the ground. Therefore, make sure that there is no voltage before touching the circuit.
- The short circuit of the battery is quite dangerous. Please take the following precautions when repairing the battery:
 - Take off your watch, ring and any other metal objects
 - Only use tools with insulated handle
- When replacing the battery, the entire set must be replaced. The old and new battery cells in a single set mustn't be mixed.
- Use the specified charger and follow the charging requirements.
- It is forbidden to use lithium battery product under severe damage or deformation.
- Reverse charging, short circuit and reverse connection are prohibited. Do not use on non-designated devices.
- It is forbidden to charge in the environment below 0°C or above 60°C.
- When the battery product is used for the first time, it is forbidden to use if it has corrosion, unpleasant gas or any abnormality.
- Do not throw the battery into the fire, or else it may cause an explosion.
- It is forbidden to put the battery into water, sea water or rain.
- Only qualified personnel are allowed to replace the fuses of the same model and amperage.
- Do not open or damage the battery product. The spilled electrolyte is highly toxic and harmful to humans.
- Do not open the cover of the main body of the lithium battery product. There is a risk of electric shock.

2. Product Introduction

Lithium battery products are widely used in UPS, energy storage, electric vehicles, digital products and other fields. Among them, lithium iron phosphate batteries have obvious advantages in terms of safety, energy density, applicable temperature range, service life, and environmental protection. Our full range of lithium battery products use lithium iron phosphate cells, combined with the independently developed battery management system (BMS), featuring high safety, long cycle life, high energy density and high power density.

2-1 Explanation of Terms

- BP: Refers to battery pack.
- 4850: Refers to 48V50Ah lithium BP or 51.2V50Ah lithium BP.
- 48100: Refers to 48V100Ah lithium BP or 51.2V100Ah lithium BP.
- BMS: Battery management system.
- Lithium BP: An energy storage unit composed of lithium batteries, BMS, wires, structural parts, chassis, etc.
- Stand-alone mode: One lithium BP used alone.
- Parallel mode: Several lithium BPes used in parallel.
- Lithium battery system: Refers to a system consisting of one or several lithium BPes connected in series or parallel.

2-2 Function Introduction

Table 3 Function introduction

No.	Function	Description
1	System reset	Press and hold the F1 button for 10 seconds to reset and restart the system
2	Communication	Realize monitoring and communication through RS485, RS232, TTL and other interfaces
3	SOC estimation and display	Perform SOC dynamic calculation of the BP and indicate the remaining power by 4 green LED lights; refer to <i>7-5 LED Indicator Description</i>
4	SOH estimation	The ratio of the battery's maximum remaining capacity to the initial capacity is used to represent the battery's state of health (SOH). The higher the SOH, the greater the battery's maximum remaining capacity and the better the health.

No.	Function	Description
5	Estimated time remaining	Refers to the discharge time when the battery is discharged to 0% under the current discharge current. It is calculated by BMS and can be provide to external devices for display. (Requires support of external device)
6	Operating status indication	A green LED light is used to display the operating status of the system. Different flashing frequencies represent different states of the BP. Refer to <i>7-5 LED Indicator Description</i>
7	Fault alarm indication	A red LED light is used to display the system failure. Different flashing frequencies represent different states of the BP. Refer to <i>7-5 LED Indicator Description</i>
8	Data storage	Record the battery voltage, temperature, alarm status, etc. Refer to <i>Appendix V</i>
9	Equalization management	In the charging process, the voltage between different cells is equalized by equalizing the charging current between different cells to improve the consistency of the cells in the BP and increase the life of the battery; the maximum effective equalization current during charging is about 200mA
10	Voltage detection and protection function	The battery voltage is detected by the BMS board voltage collection function, which can detect the voltage of each string of batteries and the total battery voltage. When the cell or total voltage is too high or too low, the BMS will make a protective action to stop charging or discharging to protect the battery system
11	Current detection and protection function	The current of the main loop is collected through the current sampling function of BMS. When the current is too high, the BMS will take protective action to stop charging or discharging to protect the battery system
12	Temperature detection and protection function	The temperature of the battery and PCB board is detected by the temperature collection function of the BMS board. When the temperature of the battery or PCB board is too high or too low, the BMS will make a protective action to stop charging or discharging to protect the battery
13	Charge and discharge control	Control the battery charging and discharging process, with protection functions against overcharge, overdischarge, overtemperature, overcurrent, short circuit, etc.
14	Short circuit protection	BMS will provide protection when the BP is short-circuited

No.	Function	Description
15	BP parallel management	By setting the BP ID, multiple sets of BPes of the same specification are connected in parallel; parallel connection up to 16 sets is supported
16	Parallel charging current limiting function	When the charging current allocated to each BP by the parallel battery system exceeds the charging current set by a single pack, the system will limit the size of the charging current
17	Anti-theft function (optional)	Gyroscope anti-theft: When the anti-theft function is enabled, the system will be locked if the device is moved without permission (the default setting is off)
		Software anti-theft: When the anti-theft function is enabled, the system will be locked if the battery is disconnected from the device for more than the specified time (the default setting is off)

2-3 Overall View

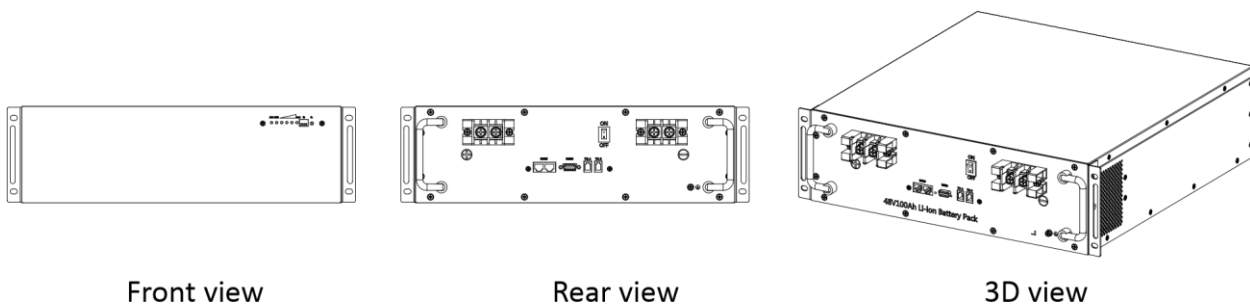


Fig. 1 BP outline drawing

2-4 Working Principle

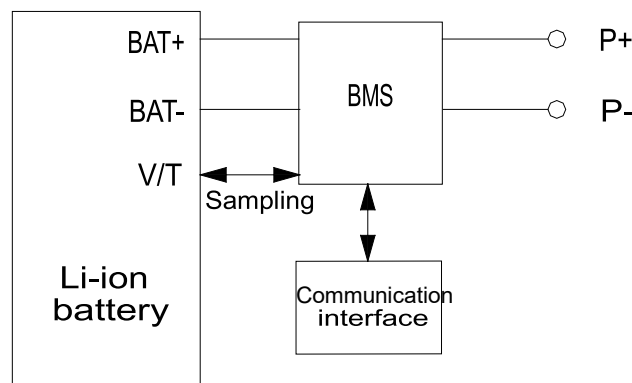


Fig. 2 Block diagram of working principle

Collect a series of data of the BP through BMS and make a safe and reliable protection mechanism for these data. BMS is responsible for collecting the voltage of each cell in the BP, charging and discharging current detection, temperature collection of the BP, controlling the cell balance, MOS tube opening/closing, etc. It ensures the safe use of the BP and provides a reliable DC power supply for electrical equipment.

2-5 Model List

Table 4 Model list

Product model	Voltage (V)	Capacity (Ah)	Maximum discharge current (A)	Size (mm, W*D*H)	Weight (kg)	Remarks
RC04825S-LI	48	25	75	440*500*86.5	17.5	Support parallel connection
RC04850S-LI	48	50	75	440*460*131	28	Support parallel connection
RC048100S-LI	48	100	75	440*650*131	43	Support parallel connection
RC051.225S-Li	51.2	50	75	440*500*86.5	18.5	Support parallel connection
RC051.250S-LI	48	100	75	440*460*131	28.5	Support parallel connection
RC051.2100S-LI	51.2	100	75	440*650*131	45	Support parallel connection

Note: The BP supports parallel use. It is recommended to derate the total power of the parallel system to 80%; for example, if a single 48100 BP is used alone with a maximum discharge power of 3kW, the total maximum power of two sets in parallel is $(3 \times 2) \times 0.8 = 4.8\text{kW}$.

3. Installation and Settings

Before installing the lithium battery product, please check whether the machine is the model you buy, and then unpack the lithium battery to check whether the machine is damaged during transportation. If any damage or missing parts are found, inform the carrier and dealer and do not switch on the machine.

Please keep the original packaging materials and this manual properly for future use.

3-1 Description of Panel Display

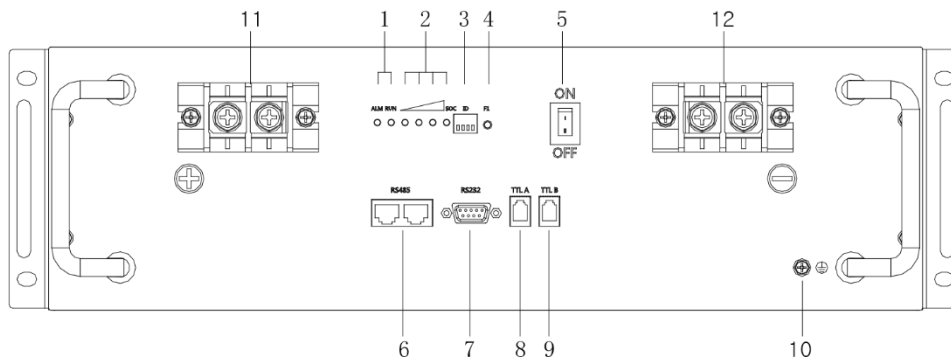


Fig. 3 Schematic diagram of operation display panel

Description of indicators and interfaces:

- | | | |
|------------------------------|----------------------------------|-----------------------------------|
| 1. Alm, Run status indicator | 5. BMS power switch | 9. TTL B communication interface |
| 2. SOC status indicator | 6. RS485 communication interface | 10. Ground screw |
| 3. ID DIP switch | 7. RS232 communication interface | 11. Positive connector of battery |
| 4. F1 function button | 8. TTL A communication interface | 12. Negative connector of battery |

Table 5 Description of panel indicators and interfaces of the BP

No.	Item	Description
1	ALM red light	Red light on or flashing indicates that the system has an alarm, protection, etc. Refer to <i>7-5 LED Indicator Description</i>
	RUN green light	Green light on or flashing indicate that the system is operating normally. Refer to <i>7-5 LED Indicator Description</i>
2	SOC	Display the remaining power of the system, which are 25%, 50%, 75% and 100% from left to right. Refer to <i>7-5 LED Indicator Description</i>
3	ID	DIP switch, to set BP ID
4	F1 function button	F1 function button (reserved)
5	BMS power switch	Turn on or off the lithium battery power supply

No.	Item	Description
6	RS485	For external communication; it can be connected to equipment or dynamic ring monitoring; refer to <i>Appendix I</i> for the definition of communication interface; the communication protocol is <i>Kstar BMS MODBUS Protocol</i>
7	RS232	For external communication, used to connect external equipment. Refer to <i>Appendix II</i> for the definition of interface; the communication protocol is <i>Kstar BMS MODBUS Protocol</i> ; this interface can't be used simultaneously with TTL interface
8	TTL A	For external communication; the two interfaces are used to connect different devices respectively. Refer to <i>Appendix III</i> for the definition of interface; the communication protocol is <i>Kstar BMS MODBUS Protocol</i> ; this interface can't be used simultaneously with RS232 interface
9	TTL B	Refer to TTL A; this interface can't be used simultaneously with RS232
10	Ground screw	For grounding of lithium BP
11	Positive connector of battery	Connected to 48Vdc positive interface of the battery or equipment
12	Negative connector of battery	Connected to 48Vdc negative interface of the battery or equipment

3-2 BP Installaton, Input/Output and Communication cable connection

Special attention before installation:

- Make sure that the positive and negative interfaces of the BP are in an insulated state!
- Make sure that the BMS power switch (POWER) of the BP is set to OFF!
- Be sure to install guide rail or battery shelf in the cabinet, place the BP on the rail or battery shelf, and then fix the BP to the cabinet column!
- Each BP must be supported by a separate rail, and can't be directly stacked. After installation, a clearance at least one floating nut should be reserved between the boxes!
- The ID of DIP switch must be set for all BPEs in the order from top to bottom (1#, 2#, ..., 15#, 16#, if necessary). The ID of the BP mustn't be repeated in a system!
- All wires must be connected reliably with appropriate terminals!
- Do not short-circuit the positive and negative poles, and do not connect the BPEs in series!

Equipment damage or personnel injury:

- This equipment is very heavy. Be sure to use safe and feasible lifting methods according to the weight.
- Be sure to use the recommended number of screws to fix the lug to the BP.
- Be sure to use the recommended number of screws and floating nuts to fix the BP to the cabinet.
- Be sure to install the BP at the bottom of the cabinet or close to it.

3-3 Rail Installation

According to the following installation steps, install and fix the BP in a 19-inch cabinet.

- 1) Fix the front of the rail with 6 (M5x12) screws.

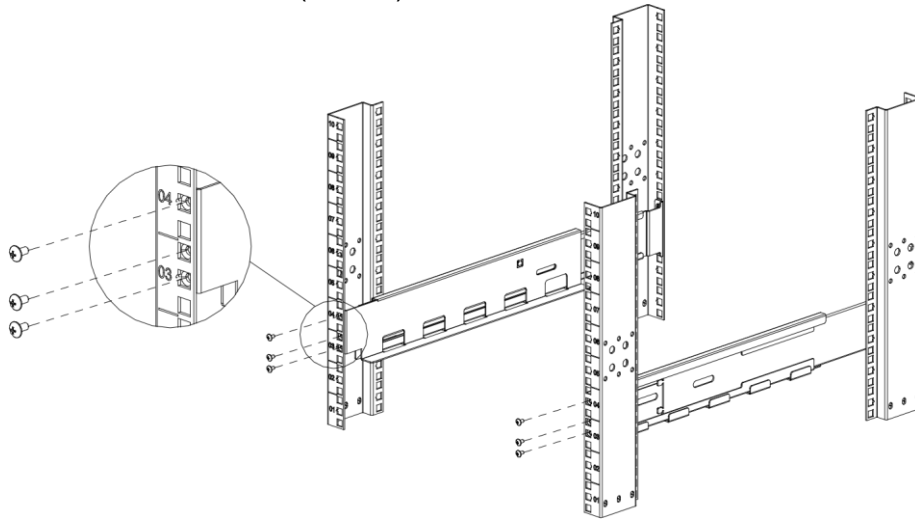


Fig. 4 Fixing the front of the rail

- 2) Fix the rear of the rail with 6 (M5x12) screws.

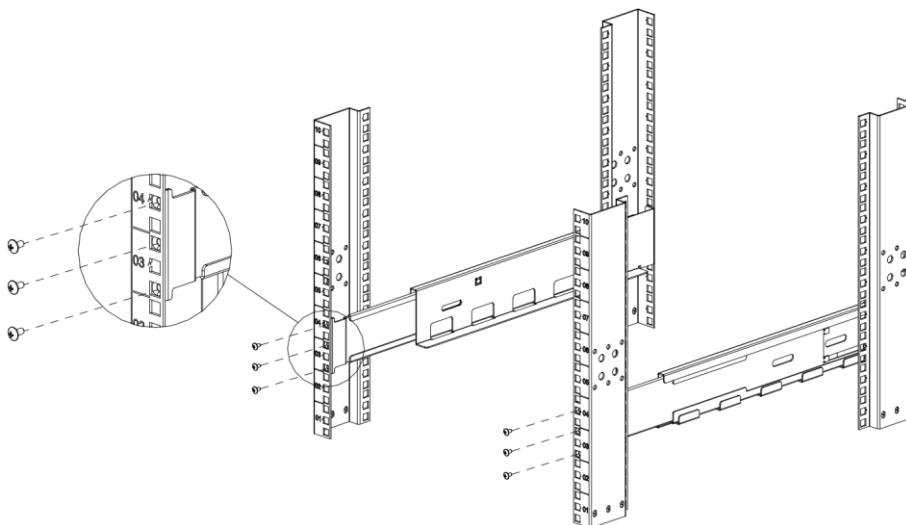


Fig. 5 Fixing the rear of the rail

3) Put the BP on the guide rail and push it gently.

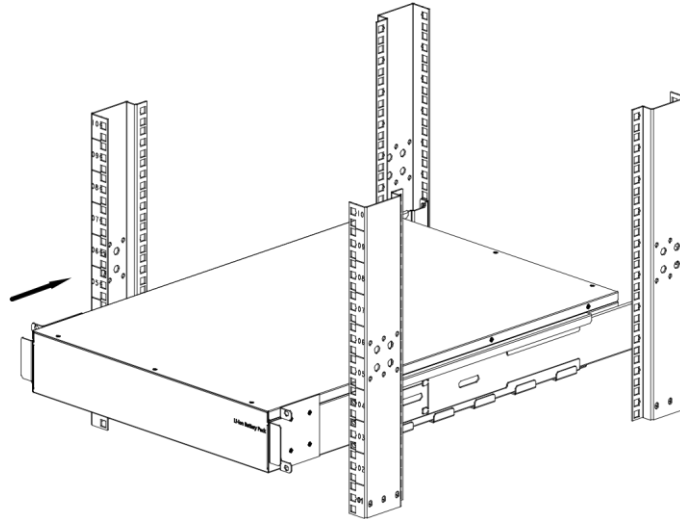


Fig. 6 BP placement

4) Lock the BP and the column together with 4 screws and floating nuts.

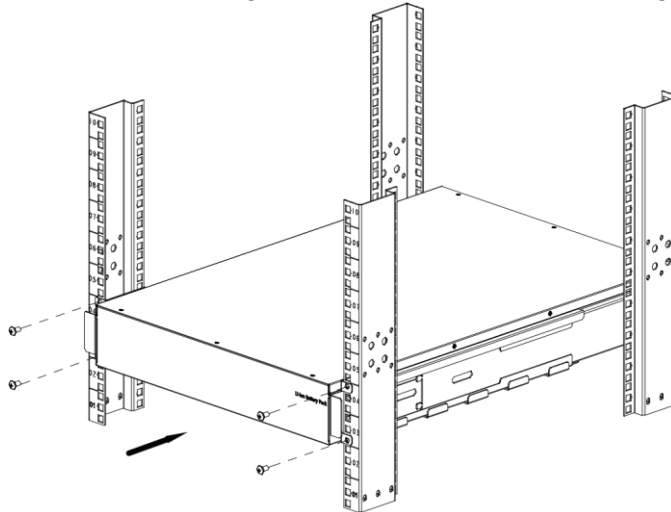


Fig. 7 Fixing

5) Grounding

Connect the ground screw on the chassis panel to the ground with a yellow-green copper wire of 10AWG (5mm²) to ensure appropriate grounding.

3-4 Setting BP ID

Adjust the DIP switch to set the BP ID according to *Table 6 Comparison of dip switch positions*. It is 1#, 2#, ..., 15#, 16# from top to bottom. The default option is 16# , ID shouldn't repeat in the same system.

Table 6 Comparison of dip switch positions

1#	2#	3#	4#	5#	6#	7#	8#
9#	10#	11#	12#	13#	14#	15#	16#

Note: ☒ Indicates the handle position of DIP switch

3-5 Electrical Connection and Installation in Stand-alone Mode

In stand-alone mode, the BP does not need separate ID setting. It uses the default DIP setting 16#.

1) Connecting a single lithium battery communication cable

Refer to *Fig. 8 Schematic diagram of connecting a single BP to equipment*, and connect the communication interface of the lithium BP to the communication interface of the equipment with the communication cable in the accessories (single external communication supports RS485, RS232 and TTL).

2) Connecting a single lithium battery power cable

Refer to *Fig. 8 Schematic diagram of connecting a single BP to equipment*, and connect the positive and negative terminals of the BP to the positive and negative terminals of the equipment with the red and black battery power wires in the accessories. connect single BP to the equipment with copper wire at least 16mm² (or 5AWG); 25mm² (or 4AWG) copper wire is recommended.

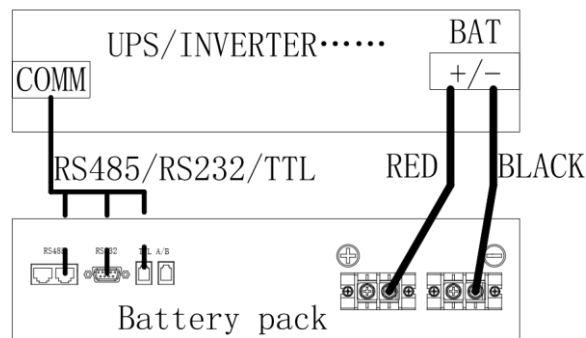


Fig. 8 Schematic diagram of connecting a single BP to equipment

3-6 Electrical Connection and Installation in Parallel Mode

In parallel mode, the BP ID needs to be set according to 3-2 and *Table 6 Comparison of dip switch positions*. The BPs in the same system are set with ID numbers in sequence, and ID shouldn't repeat in the same system.

1) Multiple lithium BPs connected in parallel with communication cables

Refer to *Fig. 9 Connection diagram of multiple BPs and the equipment*, and connect the RS485 interfaces of the BPs to the RS485 interfaces of the BPs in parallel and connect the communication interface of one of the lithium batteries to the communication interface of the equipment with the communication cable in the accessories (multiple external communication supports RS485).

2) Multiple lithium BPs connected in parallel with power cables (No exceeding 3kW power)

Refer to *Fig. 9 Connection diagram of multiple BPs and the equipment* and connect the positive and negative poles of the BP to the positive and negative interfaces of the equipment with the red and black power wires in the accessories; connect BPs and between BP and the equipment with copper wire at least 16mm² (or 5AWG); 25mm² (or 4AWG) copper wire is recommended.

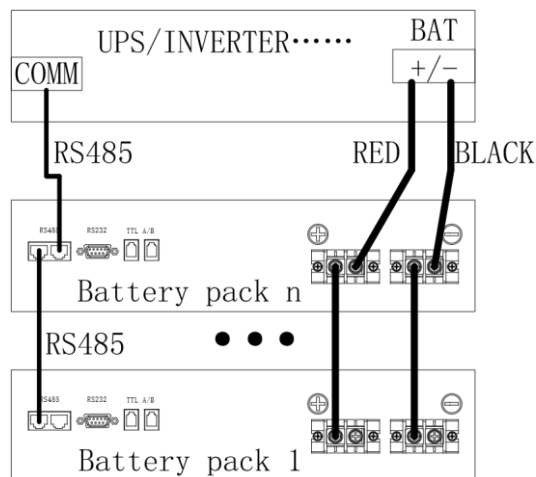


Fig. 9 Connection diagram of multiple BPs and the equipment

3-7 Connecting BMS Host Computer

You can use the (RS232, RS485) cables in the accessories to connect the communication interface and the computer as needed (for interface descriptions, see Appendixes I, and II).

Refer to *Appendix IV* for connection instructions.

4. Operation

4-1 Turning on/off Battery System

Special attention before starting:

- Make sure that the cables are connected correctly.
- Make sure that the ID of the BP is correct.
- Make sure that no unrelated devices are connected to the system.

4.1.1 Power-on operation

- In stand-alone mode

1) Turn on the BP manually in stand-alone mode

Ensure that the power cables and communication cables are connected correctly, set the BMS power switch on the operation panel of the BP from OFF to ON.

2) Turn on the BP automatically in stand-alone mode

Follow the manual power-on steps in stand-alone mode above to put both the BP and the load device switch in the ON position; connect the load device is to the mains and turn it on. After about 60 seconds, the RUN indicator on the BP lights up, indicating that the battery system has been started automatically.

Make sure that the BMS power switch of the battery is turned on, and turn on the load device according to the operation instructions. After this step is completed, the battery system and the load device are in working state.

- In parallel mode

1) Turn on the BPes manually in parallel mode

Make sure that the power cable and communication cable are connected correctly and the BP ID is correct, turn on the BPes in sequence, and set the BMS power switch on the battery operation panel from OFF to ON.

2) Turn on the BPes automatically in parallel mode

Follow the manual power-on steps in parallel mode above to put both the BP and the load device switch in the ON position; connect the load device is to the mains and turn it on. After about 60 seconds, the RUN indicator on the BP lights up, indicating that the battery system has been started automatically.

Make sure that the BMS power switch of the battery is turned on, and turn on the load device according to the operation instructions. After this step is completed, the battery system and the load device are in working state.

4.1.2 Power-off operation

1) Manual power-off in stand-alone mode

Turn off the load device first, then press the BMS power switch of the BP, and put the power switch in the OFF position.

2) Manual power-off in parallel mode

Turn off the load device first, then press the BMS power switch of each BP in turn, and put the power switch in the OFF position.

5. Troubleshooting

When your machine has any problem, please troubleshoot according to the following table. If the problem still exists, please contact your dealer.

Table 7 Troubleshooting

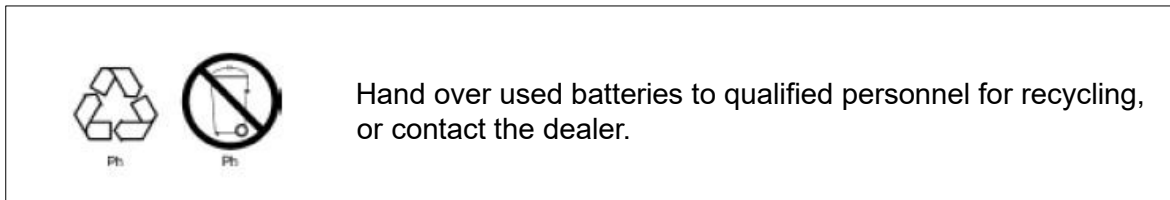
Failure	Reason	Solution
The ALM indicator of the battery flashes once	<ol style="list-style-type: none"> 1. Cell overvoltage protection 2. Overall overvoltage protection 	<ol style="list-style-type: none"> 1. Discharge the battery 2. Stop charging and let the battery stand still until the voltage drops
The ALM indicator of the battery flashes 2 times continuously	<ol style="list-style-type: none"> 1. Cell undervoltage protection 2. Overall undervoltage protection 	<ol style="list-style-type: none"> 1. Charge the battery
The ALM indicator of the battery flashes 3 times continuously	<ol style="list-style-type: none"> 1. Charging overcurrent protection 2. Discharging overcurrent protection 3. Short circuit protection Abnormal current zero point 	<ol style="list-style-type: none"> 1. Stop charging, or charge at a current not greater than the specified value 2. Remove high-power load, or discharge at a current not greater than the specified value 3. Check whether the positive and negative poles of the external terminals are shorted 4. Wait for automatic recovery 5. Remove the charging and load, power off and restart; if the problem persists, please contact the dealer
The ALM indicator of the battery flashes 4 times continuously	<ol style="list-style-type: none"> 1. Charging overtemperature protection 2. Charging undertemperature Protection 3. Discharging overtemperature protection 4. Discharging undertemperature protection 5. Battery NTC failure 6. PCB NTC failure 	<ol style="list-style-type: none"> 1. Stop charging and resume automatically when the battery temperature drops below 45°C 2. Stop charging and resume automatically when the battery temperature rises above 45°C 3. Stop discharging and resume automatically when the battery temperature drops below 55°C 4. Stop discharging and resume automatically when the battery temperature rises above -15°C 5. Wait for automatic recovery 6. Remove the charging and load, power off and restart; if the problem persists, please contact the dealer
The ALM indicator of the battery flashes 5 times continuously	<ol style="list-style-type: none"> 1. MOSdrive undervoltage 2. MOS drive overvoltage 3. Abnormal total voltage 4. Charging MOS adhesion 5. Discharging MOS adhesion 6. MCU initialization failure 	<ol style="list-style-type: none"> 1. Wait for automatic recovery 2. Remove the charging and load, power off and restart; if the problem persists, please contact the dealer

Failure	Reason	Solution
The ALM indicator of the battery flashes 6 times continuously	1. Analog front-end failure Analog front-end communication failure Analog front-end 2. initialization failure 3. Abnormal sampling (AFE communication failure)	1. Wait for automatic recovery 2. Remove the charging and load, power off and restart; if the problem persists, please contact the dealer
The ALM indicator of the battery flashes 7 times continuously	1. Gyroscope anti-theft 2. Software anti-theft	1. Cancel anti-theft 2. Contact your dealer
Battery discharge time becomes short	1. Insufficient battery 2. charge Overload 3. Battery aging, battery voltage drops quickly	1. Keep charging at the rated current for more than 2 hours and let the battery recharge 2. Check load usage and remove non-critical equipment 3. Contact the dealer to replace the battery
The BP can't be started after the BMS power switch is switched to the ON position	1. Low battery voltage 2. BMS power switch is not pressed in place 3. Internal battery failure	1. If the battery voltage is low, charge it first and then turn it on 2. Make sure the BMS power switch is in the ON position 3. Please contact your dealer

6. Storage, Maintenance and Transportation

Operation and use

The repair and replacement of all components of this lithium battery system must be done by qualified personnel. If the battery has exceeded its service life, be sure to contact the dealer to replace it.



Storage

The product should be stored in a dry warehouse, without exposure to sunlight and rain. No harmful gases, flammable, explosive products and corrosive chemicals are allowed in the warehouse. Avoid mechanical impact, heavy pressure and strong magnetic field, and avoid direct sunlight. Keep at least 2m from heat sources. The packing box should be padded at least 20cm from the ground and at least 50cm away from walls, windows or air inlets. Products stored more than 3 months under such condition must be charged. Products stored more than 6 months must be checked for capacity. Products stored more than 1 year must be retested before use.

Before storing this product, please charge it to 50%~75% SOC (2~3 SOC indicators turn on), and turn off the BMS power switch and maintenance switch (if any). The product should be placed face up in normal packaging in dry place. During storage, please charge and maintain according to the following table:

Table 8 Storage conditions

Storage temperature	Charging interval	Charging time
-25°C - 40°C	Every 3 months	1-2 hours
40°C - 45°C	Every 2 months	1-2 hours

Note: Environmental factors can affect battery life. High ambient temperature, high humidity, low-quality power supply, and frequent, short-term discharge will shorten battery life.

Battery maintenance

- If the BP isn't used for a long time, or works in an area with long-term continuous power, charge and discharge the battery every three months.
- In high-temperature areas, the battery should be manually charged and discharged every two months. The operation process is the same as above.
- The long-term storage battery (more than 3 months) must be placed in a dry and cool place. The storage environment requires a temperature of $25\pm 2^{\circ}\text{C}$ and a humidity of $(65\pm 20)\% \text{ RH}$.
- If the battery is found to be in poor condition under normal use, e.g. the backup time of the battery is significantly shortened, the terminal voltage of each battery is seriously unbalanced, it must be replaced early. When replacing the battery, it must be performed by qualified personnel.
- The batteries should be replaced as a whole.

Battery transportation requirements

- The battery should be packed and transported in a state charged no more than 60%. During transportation, it should be prevented from severe vibration, impact, squeezing, sunlight and rain. It is suitable for transportation in truck, train, ship, and aircraft.

7. System Protections

7-1 Cell voltage protection function

1) Charging overvoltage protection

During the charging process of the BP, when the voltage of any battery cell is greater than/equal to the cell overvoltage protection threshold or the total voltage is greater than/equal to the total overvoltage protection threshold, the system starts the charging overvoltage protection mechanism, and the BP stops charging. If the voltage of all batteries is less than the recovery value of cell overvoltage protection or the total voltage is less than the recovery value of total overvoltage protection after the charging is stopped, the charging overvoltage protection state will be released. For protection parameters, see Items 15 and 17 of *Table 9 Protection functions and parameters*.

2) Discharging undervoltage protection

During the discharging process of the BP, when the voltage of any battery cell is less than/equal to the cell overvoltage protection threshold or the total voltage is less than/equal to the total overvoltage protection threshold, the system starts the discharging undervoltage protection mechanism, and the BP stops discharging. If the voltage of all batteries is greater than the recovery value of cell undervoltage protection or the total voltage is greater than the recovery value of total undervoltage protection after the discharging is stopped, the discharging undervoltage protection state will be released. For protection parameters, see Items 16 and 18 of

Table 9 Protection functions and parameters.

7-2 Current protection function

1) Charging overcurrent protection

When the BP is charging and the charging current is greater than the charging overcurrent protection threshold, the system starts the charging overcurrent protection mechanism and the BP stops charging. If the charging current is less than the recovery value of the charging overcurrent protection, the charging overcurrent protection state will be released. For protection parameters, see Item 23 of *Table 9 Protection functions and parameters*.

2) Discharging overcurrent protection

When the BP is discharging and the discharging current is greater than the discharging overcurrent protection threshold, the system starts the discharging overcurrent protection mechanism and the BP stops discharging. If the discharging current is less than the recovery value of the discharging overcurrent protection, the discharging overcurrent protection state will be released. For protection parameters, see Item 24 of *Table 9 Protection functions and parameters*.

7-3 Temperature protection function

1) Battery charging overtemperature protection

When the BP is charging and the battery temperature is greater than/equal to the charging overtemperature protection threshold, the system starts the charging overtemperature protection mechanism and the BP stops charging. If the battery temperature is lower than the

recovery value of the charging overtemperature protection, the charging overtemperature protection state will be released. For protection parameters, see Item 19 of *Table 9 Protection functions and parameters*.

2) Battery charging undertemperature protection

When the BP is charging and the battery temperature is less than/equal to the charging undertemperature protection threshold, the system starts the charging undertemperature protection mechanism and the BP stops charging. If the battery temperature is greater than the recovery value of the charging undertemperature protection, the charging undertemperature protection state will be released. For protection parameters, see Item 21 of *Table 9 Protection functions and parameters*.

3) Battery discharging overtemperature protection

When the BP is discharging and the battery temperature is greater than/equal to the discharging overtemperature protection threshold, the system starts the discharging overtemperature protection mechanism and the BP stops discharging. If the battery temperature is lower than the recovery value of the discharging overtemperature protection, the discharging overtemperature protection state will be released. For protection parameters, see Item 20 of *Table 9 Protection functions and parameters*.

4) Battery discharging undertemperature protection

When the BP is discharging and the battery temperature is less than/equal to the discharging undertemperature protection threshold, the system starts the discharging undertemperature protection mechanism and the BP stops discharging. If the battery temperature is greater than the recovery value of the discharging undertemperature protection, the discharging undertemperature protection state will be released. For protection parameters, see Item 22 of *Table 9 Protection functions and parameters*.

Table 9 Protection functions and parameters

No.	Protection items	Threshold	Recovery value	Unit	System working status
1	Slight cell overvoltage	3500	3450	mV	Normal; charging and discharging not affected
2	Slight cell undervoltage	3100	3200	mV	Normal; charging and discharging not affected
3	Slightly high total voltage	3.5*N	3.45*N	V	Normal; charging and discharging not affected
4	Slightly low total voltage	3.1*N	3.2*N	V	Normal; charging and discharging not affected
5	General cell overvoltage	3600	3500	mV	Normal; charging and discharging not affected
6	General cell undervoltage	2800	3000	mV	Normal; charging and discharging not affected
7	General high total voltage	3.6*N	3.6*N	V	Normal; charging and discharging not affected
8	General low total voltage	2.8*N	3*N	V	Normal; charging and discharging not affected
9	General charging overtemperature	50	45	°C	Normal; charging and discharging not affected

No.	Protection items	Threshold	Recovery value	Unit	System working status
10	General discharging overtemperature	60	55	°C	Normal; charging and discharging not affected
11	General charging undertemperature	5	10	°C	Normal; charging and discharging not affected
12	General discharging undertemperature	-10	-5	°C	Normal; charging and discharging not affected
13	General charging overcurrent	30 (25Ah) /55 (50Ah) /55 (100Ah)	3	A	Normal; charging and discharging not affected(Switch to charge current limiting mode)
14	General discharging overcurrent	60	50	A	Normal; charging and discharging not affected
15	Severe cell overvoltage	3800	3550	mV	Cell overvoltage protection
16	Severe cell undervoltage	2500	2900	mV	Cell undervoltage protection
17	Severe high total voltage	3.8*N	3.55*N	V	Total voltage overvoltage protection
18	Severe low total voltage	2.5*N	2.9*N	V	Total voltage undervoltage protection
19	Severe charging overtemperature	55	45	°C	Charging over-temperature protection
20	Severe discharging overtemperature	65	55	°C	Discharging over-temperature protection
21	Severe charging undertemperature	-2	5	°C	Charging under-temperature protection
22	Severe discharging undertemperature	-20	-15	°C	Discharging under-temperature protection
23	Severe charging overcurrent	35 (25Ah) /60 (50Ah) /60 (100Ah)	Delay 90s	A	Charging overcurrent protection
24	Severe discharging overcurrent	80	Delay 90s	A	Discharging overcurrent protection
25	PCB severe overtemperature	120	70	°C	PCB over-temperature protection

Explain of number of cells in series: $N = \text{Battery voltage} / 3.2$

Table 10 The relationship between the number of cells in series and the voltage

Battery voltage V	Number of cell in series N	Remarks
48	15	
51.2	16	
±96	60	Same as 192V
±128	80	Same as 256V
±256	160	Same as 512V
.....		

7-4 Anti-theft Function (Optional)

1) Gyroscope anti-theft

When it is enabled, the anti-theft function will be triggered and the system will be locked if the device is moved without permission. In this state, the battery can't be charged or discharged, the buzzer keeps beeping, and the ALM indicator flashes in red. The gyroscope anti-theft function is divided into high, medium and low sensitivity. This function is turned off by default, and the sensitivity is medium by default when this function is turned on for the first time.

2) Software anti-theft

When it is enabled, the system will be locked if the battery is disconnected from the device for more than the specified time. In this state, the battery can't be charged or discharged, the buzzer keeps beeping, and the ALM indicator flashes in red. This function is turned off by default.

7-5 LED Indicator Description

● Basic indicators

1) Running indicator (RUN, green)

Running indicator flashes slowly: the system is working normally, but no external device is connected for communication; the flashing period is 3 seconds.

Running indicator flashes quickly: the system is working normally, and the communication with external devices is normal; the flashing period is 1 second.

2) Alarm indicator (ALM, red)

Refer to Table 7, Table 10, Table 13, and Table 14.

3) Battery power indicator (SOC, green)

The four power indicators are numbered from left to right as 1, 2, 3, 4; each indicator indicates 25% of the power.

Table 11 Description of power LED indicators (○ means off, ● means on, ✱ means flashing)

Battery power indicator 1	Battery power indicator 2	Battery power indicator 3	Battery power indicator 4	SOC range	Charging/ discharging state
○	○	○	○	NA	No started or online upgrade procedure
●	○	○	○	1%~25%	Discharging
●	●	○	○	25% (excluding) ~50%	Discharging
●	●	●	○	50% (excluding) ~75%	Discharging
●	●	●	●	75% (excluding) ~100%	Discharging
●	●	●	✱	75%~100% (excluding)	Charging
●	●	✱	○	50% (excluding) ~75% (excluding)	Charging
●	✱	○	○	25% (excluding) ~50% (excluding)	Charging
✱	○	○	○	1%~25% (excluding)	Charging

- Indicator combination

Use the running indicator and the alarm indicator in combination to indicate the online upgrade status of the BMS software, as shown in the following table:

Table 12 BMS software online upgrade indicator

Running indicator	Alarm indicator	Battery power indicator 1	Battery power indicator 2	Battery power indicator 3	Battery power indicator 4	Status
●	●	○	○	○	○	Ready to upgrade BMS software online
☀	☀	○	○	○	○	In the process of upgrading BMS software online

7-6 Charging/Discharging of the Battery System in Various States

Table 13 Charging/discharging of the battery system in various states

External charging/discharging state	Standby	Failure	Protection	Discharging	Charging	Sleep
Discharging externally	N	N	Y/N	Y	Y	Y
Charging	N	N	Y/N	Y	Y	Y

Note: If the protection can't be recovered automatically, it will switch to the failure mode; see

Table 13 for whether the protection mode allows external charging and discharging.

7-7 List of Automatically Recoverable Protections

Table 14 List of automatically recoverable protections

No.	Protection items	Protection conditions	Conditions for automatic recovery	Charging	Discharging	Alarm indicator
1	Cell overvoltage protection	Any cell voltage $\geq 3.8V$	Maximum cell voltage $< 3.55V$	N	Y	☀1 time
2	Total overvoltage protection	Separate test channel voltage $\geq 57V$ ($3.8V \times 15$)	Separate test channel voltage $< 53.25V$ ($3.55V \times 15$)	N	Y	☀1 time
3	Charging overtemperature protection	Maximum temperature of cell in charging state $\geq 55^\circ C$	Maximum temperature of cell in charging state $< 45^\circ C$	N	Y	☀4 times
4	Charging undertemperature protection	Minimum temperature of cell in charging state $\leq 1^\circ C$	Minimum temperature of cell in charging state $> 5^\circ C$	N	Y	☀4 times
5	Charging overcurrent protection	Charging current ≥ 35 (25Ah) /60(50Ah) /60(100Ah)	Delay 90s	N	Y	☀3 times

No.	Protection items	Protection conditions	Conditions for automatic recovery	Charging	Discharging	Alarm indicator
6	Cell undervoltage protection	Any cell voltage $\leq 2.5V$	All cell voltage $> 2.9V$	Y	N	*2 times
7	Total undervoltage protection	Separate test channel voltage $\leq 37.5 (2.5V*15)$	Separate test channel voltage $> 43.5V (2.9V*15)$	Y	N	*2 times
8	Discharging overtemperature protection	Maximum temperature of cell in discharging state $\geq 65^{\circ}C$	Maximum temperature of cell in discharging state $< 55^{\circ}C$	N	N	*4 times
9	Discharging undertemperature protection	Minimum temperature of cell in discharging state $\leq -20^{\circ}C$	Minimum temperature of cell in discharging state $> -15^{\circ}C$	N	N	*4 times
10	Discharging overcurrent protection 1	Discharging current $\geq 80A$ for 5s	Delay 90s	Y	N	*3 times
11	Discharging overcurrent protection 2	Discharging current $\geq 160A$ for 20ms	Delay 90s	Y	N	*3 times
12	MOS drive undervoltage	12V voltage $\leq 8V$	12V voltage $\geq 10V$	N	N	*5 times
13	MOS drive overvoltage	12V voltage $\geq 18V$	12V voltage $\leq 13V$	N	N	*5 times
14	Analog front-end failure	940 chip failure	Reset the chip and check again after 6s	N	N	*6 times
15	Analog front-end communication failure	940 communication failure	Reset the chip and check again after 6s	N	N	*6 times
16	Short circuit protection	Hardware protection	Delay 300s	N	N	*3 times
17	Battery failure NTC	Any NTC short circuit or open circuit	Continue testing until the normal state remains for 10s	N	N	*4 times

No.	Protection items	Protection conditions	Conditions for automatic recovery	Charging	Discharging	Alarm indicator
18	Sampling current has large deviation	Current gap between large and small loops >6A for 100ms	1. Current gap between large and small loops is < 3A, recovers automatically after 10s; 2. If the current gap between large and small loops is > 6A, maintain the protection state.	N	N	✳3 times
19	Abnormal total voltage detection	Difference between cumulative battery voltage and total battery voltage is greater than 1.5V for 1s	Continue testing, < 1.5V for 1s	N	N	✳5 times
20	Abnormal current zero point	Large loop zero drift > 50mV or small loop zero drift > 20mV	Continue testing, large loop zero drift < 50mV and small loop zero drift < 20mV for 1s	N	N	✳3 times
21	PCB NTC failure	NTC short circuit or open circuit	Continue testing until the normal state remains for 10s	N	N	✳4 times

7-8 List of Protections that can't be Recovered Automatically

Table 15 List of protections that can't be recovered automatically

No.	Protection items	Protection conditions	Charging	Discharging	Alarm indicator
1	Charging MOS adhesion	There is still current when the charging MOS is disconnected	N	N	✳5 times
2	Discharging MOS adhesion	There is still current when the discharging MOS is disconnected	N	N	✳5 times
3	Start gyroscope anti-theft	Illegal battery movement detected	N	N	✳7 times
4	Start software anti-theft	The battery is disconnected from the device for more than 30 minutes	N	N	✳7 times

Note: When this protection occurs, please turn off the power and restart; if the protection still does not recover, please contact the dealer.

8. Product Specifications

BP parameters			
Model	RC04825S-Li /RC051.225S-Li	RC04850S-Li /RC051.250S-Li	RC048100S-Li /RC51.2100S-Li
Cell material system	LFP	LFP	LFP
Nominal voltage (Vdc)	48/51.2	48/51.2	48/51.2
Nominal capacity (Ah)	25	50	100
Nominal power (kWh)	1.2/1.28	2.4/2.56	4.8/5.12
Maximum continuous discharging current (A)	75	75	75
Peak discharging current (A) (15mS)	160	160	160
Maximum continuous charging current (A)	25	50	50
Recommended charging current (A)	≤25	≤50	≤50
Maximum continuous output power (kW)	3.5/3.7	3.5/3.7	3.5/3.7
Equalized charging voltage (V)	54/57.6	54/57.6	54/57.6
Floating charging voltage (V)	51.7/55.2	51.7/55.2	51.7/55.2
Recommend charging voltage (Vdc)	51.7/55.2	51.7/55.2	51.7/55.2
Discharge cut-off voltage (Vdc)	40.5/43.2	40.5/43.2	40.5/43.2
Typical calendar life	≥10 years, depending on surrounding environment and usage		
Protective function	Cell over-/under-voltage protection, BP total over-/under-voltage protection, charging/discharging overcurrent protection, charging under-temperature protection, discharging over-temperature protection, short circuit protection, equalization, temperature acquisition, battery error report, etc.		
parallel connection	Yes	Yes	Yes
Communication method	TTL, RS232, RS485	TTL, RS232, RS485	TTL, RS232, RS485
Indicators	Alarm, operation, SOC	Alarm, operation, SOC	Alarm, operation, SOC
Thermal management	Natural heat dissipation		
Physical characteristics			
Dimensions, W*D*H (mm)	440*500*86.5	440*460*131	440*650*131
Net weight (kg)	17.5/18.5	28/29.5	43/45
Environment			
Operating temperature	Charging: 0°C ~ 55°C; discharging: -20°C ~ 55°C		
Operating humidity	Relative humidity ≤70%, no condensation		
Storage temperature	-20°C ~ 45°C (short-term), -10°C ~ 25°C (long-term), @50% power		
Storage humidity	Relative humidity ≤70%, no condensation		
Altitude requirements	≤2000m		

* The product specifications are subject to change without notice.

Appendix I Description of RS485 Communication Interface

RS485 communication interface is RJ45 terminal

Port definition:

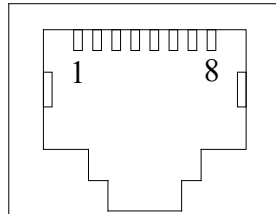


Fig. 10 RS485 communication interface

Table 16 RS485 interface description

RS485	
Pin No.	Definition
1	ISO_5V
2	ISO_5V
3	RS485_A
4	RS485_A
5	RS485_B
6	RS485_B
7	ISO_GND
8	ISO_GND

RS485 communication provides the following functions:

- Monitor the current operating status of the BP
- Monitor the current alarm information of the BP
- Monitor the current operating parameters of the BP
- Communicate with the host computer
- Upgrade system program

Appendix II Description of RS232 Communication Interface

RS232 communication interface is RJ45 terminal

Port definition:

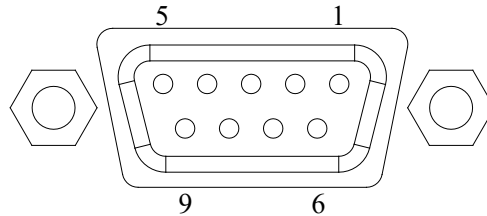


Fig. 11 RS232 communication interface

Table 17 RS232 interface description

RS232	
Pin No.	Definition
1	NC
2	TX
3	RX
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

RS-232 communication provides the following functions:

- Monitor the current operating status of the BP
- Monitor the current alarm information of the BP
- Monitor the current operating parameters of the BP
- Communicate with the host computer
- Upgrade system program

RS-232 communication data format:

- Baud rate ----- 9600bps
- Byte length ----- 8bit
- End bit ----- 1bit
- Parity ----- None

Appendix III Description of TTL Communication Interface

TTL communication interface is RJ11 terminal

Port definition:

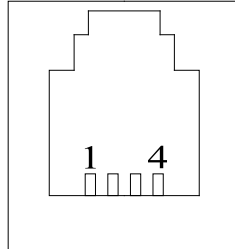


Fig. 12 TTL communication interface

Table 18 TTL interface description

TTL	
Pin No.	Definition
1	ISO_3.3V
2	TX
3	RX
4	ISO_GND

TTL communication provides the following functions:

- Monitor the current power supply status of the BP
- Monitor the current alarm information of the BP
- Monitor the current operating parameters of the BP
- Communicate with UPS to transmit information of the BP
- Upgrade system program

Baud rate ----- 9600bps

Appendix IV BMS Host Computer Connection Steps

- (1) Enter the host computer: Before connecting to the host computer, make sure that the hardware driver (232/485/CAN) has been installed, double-click the BMS host computer icon



, and enter the host computer interface as shown below:

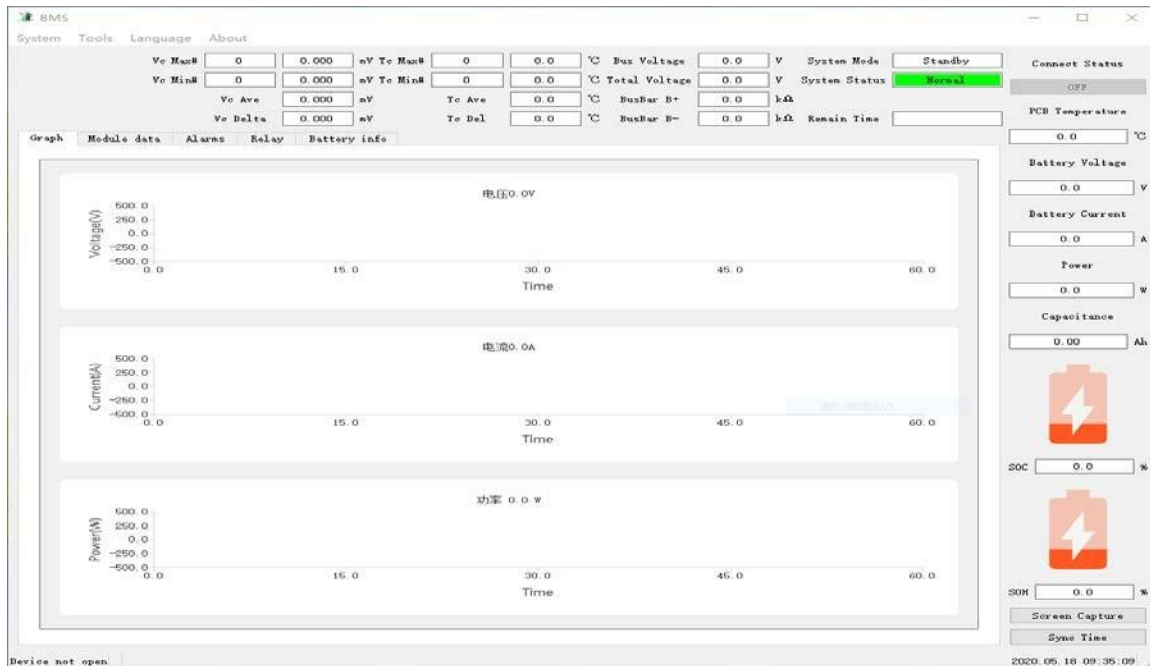


Fig. 13 Host computer interface

- (2) Configure the port settings: Click [System]--[Port Settings] in the upper left corner, as shown below:

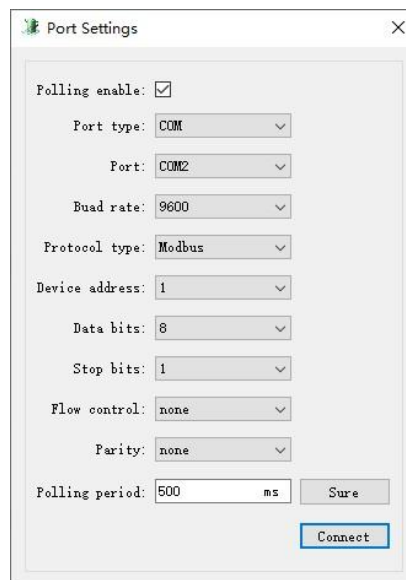


Fig. 14 Port setting interface

The port type in the second line has two options: COM and CAN. Select CAN port for CAN communication and COM port for other communications (232, 485, etc.).

- (3) Select the corresponding port:

① COM port: COM port has two identification methods:

- a) Identified by plugging and unplugging the communication cable: When the communication cable is not connected, the port does not have a COM port. When the communication cable is plugged in, an extra COM5 appears. After unplugging, COM5 disappears again, indicating that the communication cable corresponds to the COM5 port:

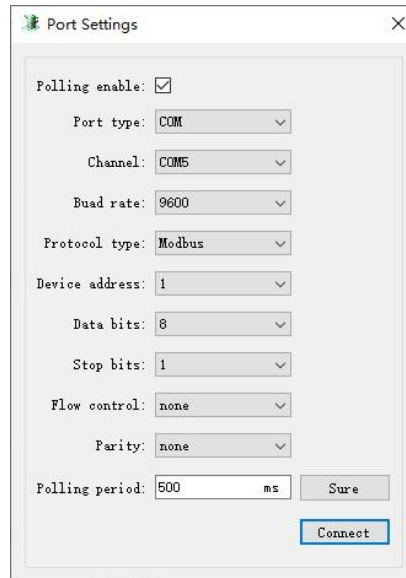


Fig. 15 Port selection interface

- b) The correct port number can be queried and selected by searching Device Manager\Port (COM & LPT), the baud rate is 9600, and [Device Address] should be set to the same value as the BP ID viewed; other items, including the protocol, device address and data bits, are default.

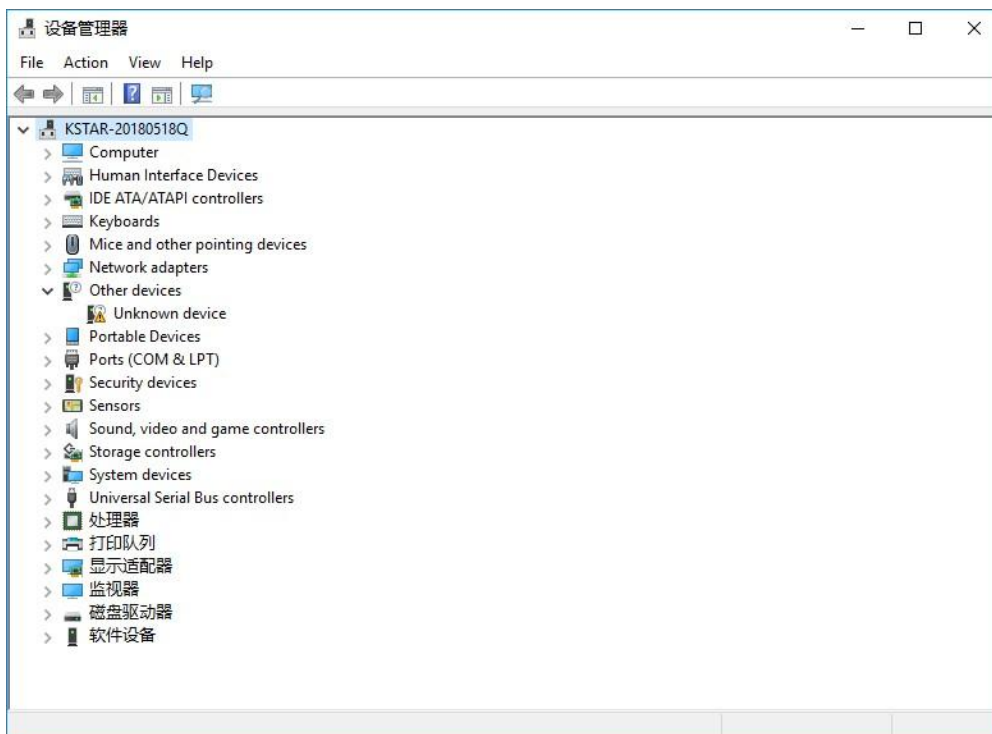


Fig. 16 Port setting interface

- ② CAN port: Default 0, baud rate 250K.



Fig. 17 CAN port settings

- (4) Click Connect: Successful connection to the host computer: The communication status in the upper right corner of the main interface becomes ON, and the upper part of the main interface will display that non-zero data is read. If no non-zero data is read, it means that the connection has failed. Please check whether the above steps are performed correctly.

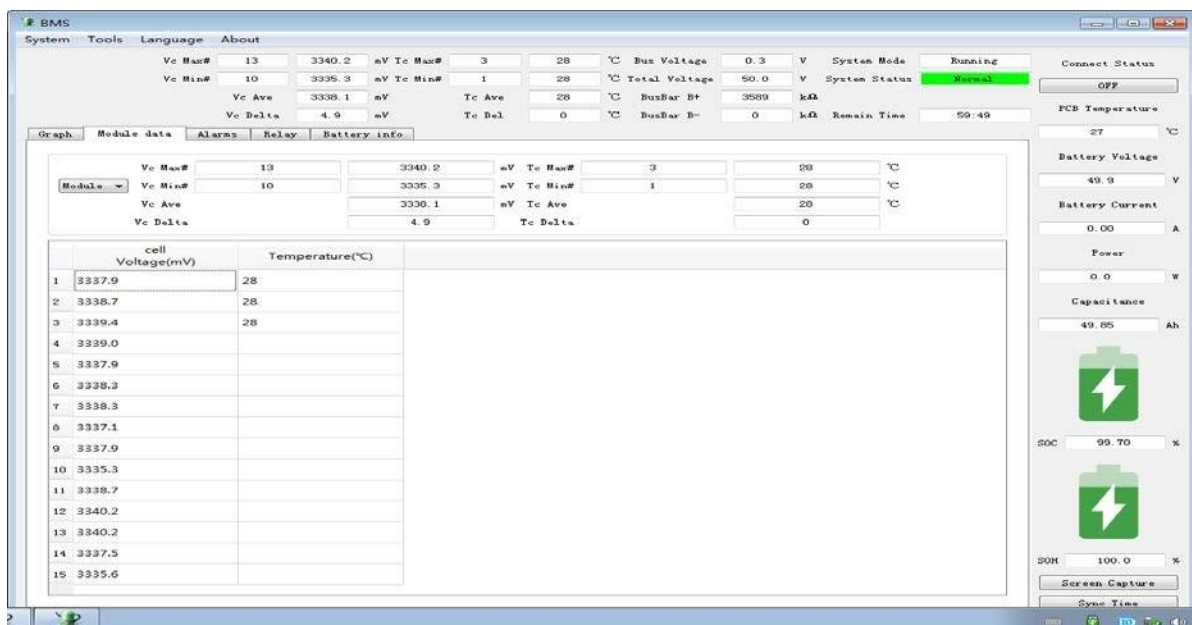


Fig. 18 Connecting to the host computer

Appendix V Diagram of Data Storage Function Interface

- (1) Click [Sync Time] in the lower right corner of the start interface of the BMS host computer to ensure that the data recording time is consistent with the actual time.
- (2) Click [Tools] - [History] in the upper left corner of the main interface of the BMS host computer in sequence. In the pop-up interface, click [Read Record] in the lower right corner to read the historical data. Click [Save Record] to save the data locally. Click [Clear Data] to clear the displayed historical data.

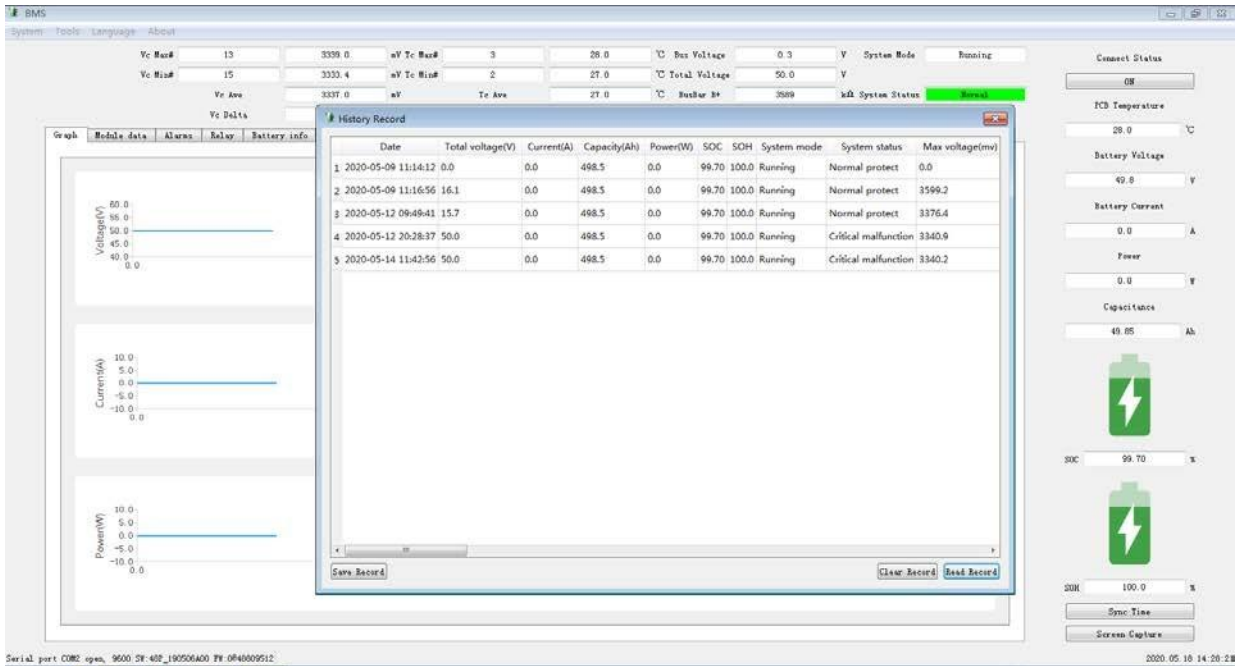


Fig. 19 Data storage