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USER MANUAL

RBMS, RBMS MAX, SBMS, RHP51100A
Energy Storage System

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This manual is used to introduce the lithium iron phosphate battery system for high-voltage household energy storage. Please read this manual before installation and follow the instructions during the installation process. If you have any questions, please contact the supplier.

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1. Safety Operation Guide

Warning

This product is a high-voltage DC system and should only be operated by authorized personnel.

Warning: The set parameters of this product must not be changed arbitrarily, otherwise it will seriously affect the performance of this product!

Before connection

- 1) After opening the box, first check the product and packing list.
If any damage or missing parts are found, please contact the supplier;
- 2) Before installation, be sure to cut off the external power supply of the battery to ensure that it is in a shutdown state;
- 3) Connect the wires correctly, do not mistake the positive and negative cables, and ensure that there is no short circuit with external devices;
- 4) Prohibit direct connection between batteries and AC power sources;
- 5) The battery system must be well grounded, and the grounding resistance must be less than 100m Ω ;
- 6) Ensure that the electrical parameters of the battery system are compatible with related equipment;
- 7) Keep the battery away from water and fire.

Before connection

- 1) If you want to move or repair the battery, you must cut off the power and completely shut down the battery;
- 2) Do not connect batteries with different types of batteries;
- 3) Do not work batteries with faulty or incompatible inverters;
- 4) Do not disassemble the battery;
- 5) When encountering a fire, please use a lithium battery fire extinguishing device that meets national requirements;
- 6) Unauthorized personnel are not allowed to open, repair, or disassemble batteries without authorization. The supplier shall not be held responsible for any consequences resulting from violations of safety operation requirements or safety standards for the design, production, and use of equipment.

Reminder

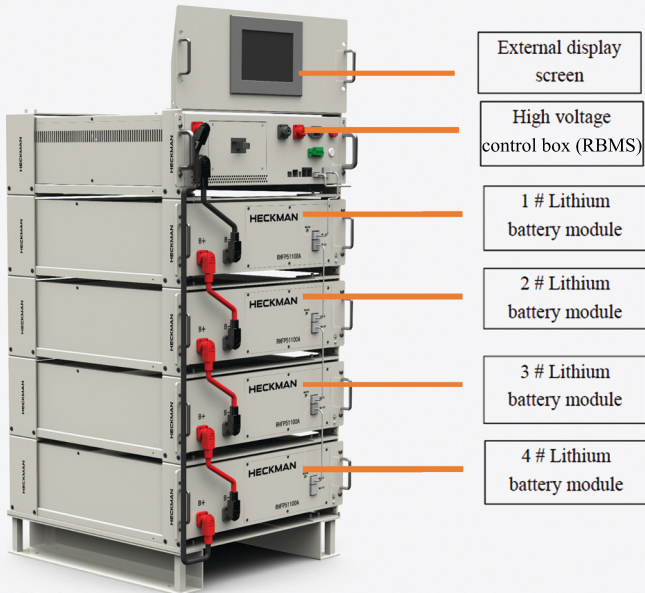
- 1) Please read the user manual carefully before installation and use;
- 2) This product is only suitable for use with household energy storage systems and should not be used in other situations;
- 3) Do not turn on the system switch of this product that has not been put into use to avoid consuming the power of the lithium battery pack;
- 4) If the battery is stored for a long time, it must be charged every 6 months, and the SOC of each charge should not be less than 90%;
- 5) The battery must be charged within 2 hours after triggering low voltage protection;
- 6) The output DC voltage of the battery is very high, and personal safety must be taken into account when using it;
- 7) Before maintenance, all battery outputs, switches, etc. must be disconnected;
- 8) If there are any abnormalities, please contact the supplier in a timely manner;
- 9) Due to the above reasons directly or indirectly causing battery damage, the battery will lose its warranty.

2. Product Introduction

This product consists of 1 RBMS, 1 external display screen (HMI), and N series connected lithium battery modules. Taking N=4 as an example, as shown in the following figure.

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Special reminder: There are two types of RBMS's, and the operating voltage range of RBMS MAX is 260-750VDC, supporting up to 13 lithium battery modules in series; The operating voltage range of the RBMS is 120-350VDC, and it supports up to 6 lithium battery modules connected in series.

The appearance of the RBMS's is consistent, please carefully observe the label on the RBMS panel to distinguish them.

High Voltage RBMS

Rated Voltage:	512V DC
Rated Current:	125A
Operating Ambient Temperature:	-20°C~60°C
Max Short Current and Duration:	20KA,20ms
Operation Voltage Range:	260~750V DC
Protection Class:	IP20
MODEL:	RBMS-S27H-125A-750
SN NO.	

Type RBMS MAX panel label

High Voltage RBMS

Rated Voltage:	256V DC
Rated Current:	125A
Operating Ambient Temperature:	-20°C~60°C
Max Short Current and Duration:	20KA,20ms
Operation Voltage Range:	120~350V DC
Protection Class:	IP20
MODEL:	RBMS-S27H-125A-350
SN NO.	

Type RBMS panel label

2.1 Product Features

- New type of lithium iron phosphate battery, safe and reliable, with long cycle life and replacement cycle
- Green and environmentally friendly raw materials, production, and usage processes
- High energy density and stable discharge platform
- Cabinet embedded installation size, compliant with EIA and ETSI specifications
- Small size and light weight
- Modular design

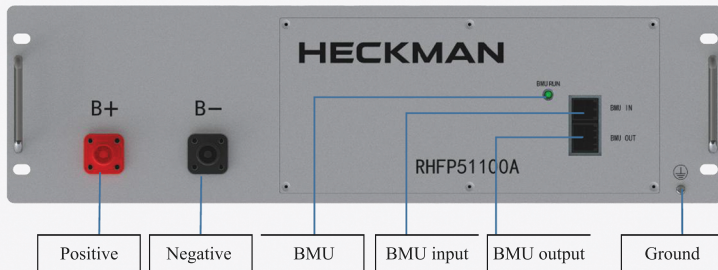
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- Plug in connectors for easier installation and maintenance
- Support high rate charging and discharging, high work efficiency
- Strong adaptability to the environment and wide working temperature range
- Comprehensive alarm protection function (overcharge, overdischarge, short circuit, overload, overcurrent, high temperature, low temperature, balance)
- Has good electromagnetic compatibility

2.3 Product Panel Description


2.3.1 Description of lithium battery module panel



2.3.2 Description of High Voltage Control Box Panel



No.	Name	Description	Note
1	B+ B-	Power port connected to battery side total positive and total negative	Recommended connecting bolt M6*10,torque 6-8N·m
2	P+ P-	Power port connected to charging equipment (Inverter) or DC bus	Recommended connecting bolt M6*10,torque 6-8N·m
3	AC220V	The mains signal input port must be taken from the Inverter output side	When the mains signal exists, the BMS draws power from the battery to keep it powered on; when the mains signal disappears, the BMS will shutdown;when the mains signal recovers, the BMS will synchronize and automatically turn on.
4	ON OFF	ON: The circuit breaker is closed; OFF:The circuit breaker is open	When the circuit breaker handle is in the tripped state in the middle position,it must be turned OFF before it can be closed again.
5	D1 D1 D2 D2	Two dry contact outputs are reserved	Prohibit charging and discharging dry contact output
6	DC Start	DC start button:start RBMS system by taking power from the battery side.	The system is connected to the battery.After the circuit breaker is closed,press and wait for the light to light up,indicating that the system is powered on.
7	System	System status indicator	System normal: the Green light is always ON; System Alarm: the Yellow light is always ON; Self Test Failure and Protection Status: the Red light is always ON; Charging: the Green light flashes; Discharge: Red light flashing; Self Checking: Red and Green light flashing alternately; Pre-charging: Yellow light flashing

8	ID	ID allocation: when multiple RBMS are used in parallel, the ID is allocated by setting the dial switch. You must start with 1 for parallel work SBMS is needed	The dial switch has 4 bits in total and supports up to 15 RBMS Parallel machine 1 ON: ID+1 2 ON: ID+2 3 ON: ID+4 4 ON: ID+8
9	LAN	RBMS PC monitor software can be connected to PC through network cable.	The network cable standard is CAT5 or above, and can be connected by cross line or straight line. The line sequence can be according to the standard TIA-586A or TIA-568B
10	T-CAN T-485	Setting description of terminal matching resistance during CAN and RS485 communication: (120R), ON is effective	For parallel application, only the last one needs to be set; Single&Standalone application, should be used flexibly according to the site conditions (interference, communication distance, etc.)
11	COM-IN COM-OUT	RBMS external communication port(1 RS485 Channel and 1 CAN Channel): In parallel application: communicate with SBMS In Single&Stand-alone application: communicate with Inverter external equipment	The randomly configured twisted pair shielded harness must be used. See the harness label for the definition of wire sequence
12	GND HMI-B HMI-A 24V	For connecting to external display. Power supply for SBMS	Please follow the silkscreen wiring sequence when connecting to the display.
13	BMU-OUT	Communication interface with BMU	Cascade and Communication with BMU
14		RBMS cabinet ground point	It must be reliably grounded and the grounding resistance is less than 1 Ω

2.4 Product Technical Parameters

Basic system parameters:

Battery type	Lithium iron phosphate battery
Nominal voltage	51.2V * N (N is the number of battery modules)
Nominal capacity	100Ah
Rated discharge power	5,12 kW

Battery cell specifications	3.2V/100Ah
Cell connection method	16S1P
Grouping method of battery modules	N units in series
Battery module size	Width 482 x Depth 440 x Height 133 (mm)
Weight of battery module	46 kg
Dimensions of RBMS, RBMS MAX	Width 482 x Depth 500 x Height 132 (mm)
Weight of high-voltage control box	10 kg
Charging temperature	0~60℃
Discharge temperature	-20~60℃
Relative humidity at work	≤90% (40℃±2℃)
Special note	<ul style="list-style-type: none"> ◆ There are two types of high-voltage boxes available; ◆ The operating voltage range of RBMS MAX is 260-750VDC, with $6 \leq N \leq 13$; ◆ The operating voltage range of the RBMS is 120-350VDC, with $4 \leq N \leq 6$; ◆ The appearance of the RBMS's is consistent. <p>Please carefully observe the label on the high-voltage box panel to distinguish them.</p>

Battery module parameters:

Rated value	Rated charging voltage	57.6V * N (N is the number of battery modules)
	Rated charging current	50A
	Rated discharge voltage	43.2V*N
	Rated discharge current	120A
Battery module overvoltage	give an alarm	57.6V*N-0.1V
	First level protection	57.6V*N
	Secondary protection	59.2V*N

Undervoltage of battery module	Protection lifted	54.4V*N
	give an alarm	44.8V*N
	First level protection	43.2V*N
	Secondary protection	41.6V*N
	Protection lifted	46.4V*N
Charging overcurrent	give an alarm	40A
	First level protection	55A
	Secondary protection	70A
	Protection lifted	35A
Discharge overcurrent	give an alarm	90A
	First level protection	110A
	Secondary protection	120A
	Protection lifted	85A

Cell parameters:

Cell overvoltage	give an alarm	3599mV
	First level protection	3600mV
	Secondary protection	3700mV
	Protection lifted	3400mV
Cell undervoltage	give an alarm	2800mV
	First level protection	2700mV
	Secondary protection	2600mV
	Protection lifted	2900mV
Cell balance	Turn on voltage	3400mV
	Open differential pressure	10mV
Module balance	Turn on voltage	53V
	Open differential pressure	300mV
	Close the pressure differential	100mV

Temperature parameters:

Charging at high temperature	give an alarm	50°C
	First level protection	55°C
	Secondary protection	60°C
	Protection lifted	45°C
High	give an alarm	65°C

temperature discharge	First level protection	70°C
	Secondary protection	75°C
	Protection lifted	60°C
Charging at low temperature	give an alarm	3°C
	First level protection	0°C
	Secondary protection	-2°C
	Protection lifted	5°C
Low temperature discharge	give an alarm	0°C
	First level protection	-10°C
	Secondary protection	-20°C
	Protection lifted	3°C
Temperature imbalance	give an alarm	5°C
	First level protection	10°C
	Secondary protection	15°C
	Protection lifted	3°C

Other parameters:

temperature discharge	First level protection	70°C
	Secondary protection	75°C
	Protection lifted	60°C
Charging at low temperature	give an alarm	3°C
	First level protection	0°C
	Secondary protection	-2°C
	Protection lifted	5°C
Low temperature discharge	give an alarm	0°C
	First level protection	-10°C
	Secondary protection	-20°C
	Protection lifted	3°C
Temperature imbalance	give an alarm	5°C
	First level protection	10°C
	Secondary protection	15°C
	Protection lifted	3°C

3. Product installation and use

3.1 Product installation steps

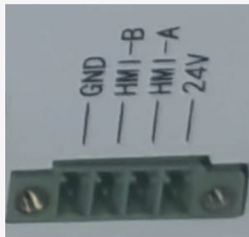
3.1.1 Open rack installation: Start from the bottom and sequentially advance. battery modules and RBMS, and fix them with bolts.

3.1.2 Battery Box Series Power Line Connection: One end of the series power line plug is black and the other end is red. The black plug is connected to the negative pole of the batterybox, and the red plug is connected to the positive pole of the battery box, as shown in the following figure, to prevent accidental insertion.

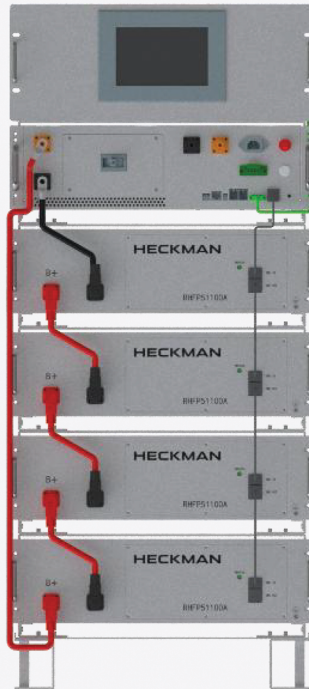
3.1.3 Communication line connection: Connect the communication line with an 8-pin plug on one end and a 12 pin plug on the other end. The 8-pin plug is connected to the BMU-IN communication interface, and the 12 pin plug is connected to the BMU-OUT communication interface, as shown in the following figure.

3.1.4 RBMS power line connection: There are a total of 2 high voltage box power lines, one with red ends and the other with black ends. The red plug is connected to the B+interface of the high voltage box and the positive pole of the N # lithium battery module, while the black plug is connected to the B - interface of the high voltage box and the negative pole of the N # lithium battery module, as shown in the following figure.

3.1.5 Display (HMI) communication cable connection: One end of the external display communication cable is connected to the communication port of the high-voltage box display screen, and the other end is connected to the external display screen.



Communication port for RBMS display screen (HMI)



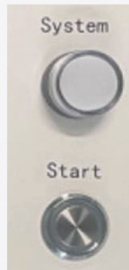
The red and black lines in the picture represent power lines, the green and grey line represents communication lines, and the green line represents display screen communication lines

3.2 Product usage steps

- 1) First, load the inverter. (Connect the P+ and P - of the RBMS to the input interface of the inverter battery, and connect the COM port to the corresponding communication interface of the inverter)
- 2) After loading the inverter, turn on the circuit breaker (ON/OFF) on the high-voltage control box panel. When the circuit breaker handle is in the middle position and in the tripped state, it needs to be turned off before closing.



3) Press the DC start button (Start), and the system status indicator light (System) will light up. The standby light will be green, the alarm light will be yellow, the self-test failure and protection status will be red, the charging light will be green, the discharging light will be red, the self checking light will alternate between red and green, and the pre charging light will be yellow.



4) By operating the LCD display screen (HMI), real-time data such as charging current, total voltage, individual voltage, temperature, and operating status can be queried.

5) When the mains power is cut off, the product enters the discharge working state without delay, providing backup power support for household equipment; If the mains power is restored midway, the battery pack will switch to charging mode; Otherwise, the battery pack will discharge until it reaches the over discharge protection, and the output will be automatically cut off. By operating the LCD display screen, real-time data such as discharge current, total voltage, individual voltage, temperature, and operating status can be queried.

3.3. Product Charging

⚠ This series of products can meet the requirements of balanced charging.

a. This charging method charges with a fixed current and time, and the charging speed is fast. BMS provides balanced charging function during charging, which is used to correct the voltage dispersion caused by the differences in the batteries themselves in the series battery pack, avoiding the occurrence of individual batteries deteriorating or even damaging the performance of the battery pack due to overcharging or undercharging, so that all battery voltages are within a certain reasonable range.

b. The product adopts an intermittent balancing method, which controls the number of balanced cells to be turned on and off, and the balanced cells are turned on and off in a certain proportion of time in the balancing circuit.

- The accuracy of voltage acquisition will be affected when the number of cells that are evenly turned on and discharged in a charging state is also balanced.

The intermittent balancing method can be used to adjust the time ratio, achieving sampling during the intervals when the balance is turned off, ensuring the accuracy of voltage acquisition.

- The use of intermittent balancing can effectively control temperature rise and ensure balance reliability by controlling the number and duration of balancing openings.

- Adopting intermittent mode helps maintain the consistency of the battery.

- Balance principle: When the detection chip detects that cell $n+1$ meets the balance on condition, the balance control pin outputs a high level relative to cell n , causing the balance MOS to conduct, releasing the power of cell $n+1$ through the balance resistor, slowing down the charging speed of cell $n+1$, and balancing the voltage of each section.

Due to the passive power consumption balancing method adopted by the system, from the perspective of system reliability, the number of balancing cells is limited and intermittent balancing is activated. The balanced resistance value is 25.5 ohms, and the balanced current varies with the cell voltage, $I=U/R$. When the cell voltage changes between 3-3.8V, the balanced current varies between 70-80mA.

c. When all of the following conditions are met, the cell balancing function that meets the conditions is activated:

- The battery pack is in a charging state;

- The maximum voltage of the power-saving core is higher than the balanced turn-on voltage (conventional 3.50V, can be set);

- The maximum voltage difference between battery cells exceeds the equilibrium opening voltage difference (20 mV, adjustable);

d. When all of the following conditions are met, the cell balancing function that meets the conditions is turned off:

- The battery pack is not in a charging state;

- The maximum voltage of the power-saving core is lower than the balanced turn-on voltage;

- The maximum pressure difference between battery cells is lower than the equilibrium opening pressure difference;

3.4 Security Protection and Alarm Function

The security protection function is divided into two forms: active protection (software protection) and passive protection (hardware protection), and the security protection and recovery parameters can be set by the upper computer, which has a certain degree of redundancy.

1) High total charging voltage protection and recovery function

The battery pack has protection and recovery functions for high total voltage during charging. When the total voltage reaches the set value for high total voltage alarm during charging and the duration exceeds the overvoltage alarm detection delay time, the BMS considers the charging overvoltage alarm state to have occurred and alarms, but it does not affect the normal charging function; When the total voltage rises to the set value of the total voltage protection and the duration exceeds the overvoltage protection detection delay time, the BMS considers that a charging overvoltage state has occurred, cuts off the charging circuit, and alarms to ensure the safety performance of the battery pack, but does not affect the normal discharge function. When the total voltage drops to the reset value, the battery pack returns to normal charging operation.

2) Low discharge total voltage protection and recovery function

The battery pack has a low discharge total voltage protection and recovery function. When the total voltage reaches the low total voltage alarm set value during discharge and the duration exceeds the undervoltage alarm detection delay time, the BMS considers the low discharge alarm state to have occurred and alarms, but it does not affect the normal discharge function; When the total voltage drops to the set value of the total voltage protection and the duration exceeds the delay time of the undervoltage protection detection, the BMS considers that the discharge total voltage is too low, cuts off the discharge circuit and alarms to ensure the safety performance of the battery pack, but does not affect the normal charging function;

3) High voltage protection and recovery function for individual batteries

The battery pack has the function of protecting and recovering from high voltage of individual cells. When the voltage of a single cell reaches the set value for high voltage alarm during charging and the duration exceeds the delay time for voltage alarm detection, the BMS considers the high voltage alarm state to have occurred and alarms, but it does not affect the normal charging function;

When the single cell voltage rises to the set value of the single cell voltage high protection and the duration exceeds the overvoltage protection detection delay time, the BMS considers that the single cell charging voltage is too high, cuts off the charging circuit and alarms to ensure the safety performance of the battery pack, but does not affect the normal discharge function; When the single cell voltage drops to the reset value, the BMS considers that the protection state for high charging of the single cell voltage has been released, and the battery pack returns to normal working condition.

4) Low voltage protection and recovery function for individual batteries

The battery pack has the function of protecting and restoring the low voltage of individual cells. When the voltage of a single cell reaches the low voltage alarm set value during discharge and the duration exceeds the undervoltage alarm detection delay time, the BMS considers the low voltage alarm state to have occurred and alarms, but it does not affect the normal discharge function; When the single cell voltage drops to the low cell voltage protection setting value and the duration exceeds the undervoltage protection detection delay time, the BMS considers that the single cell discharge voltage is too low, cuts off the discharge circuit and alarms to ensure the safety performance of the battery pack, but does not affect the normal charging function; BMS enters sleep mode. When the switch power supply resumes charging and the cell voltage rises to the reset value, BMS considers that the low discharge protection state of the cell voltage has been released, and the battery pack returns to normal working state.

5) Short circuit protection

The battery pack has a short-circuit protection function. After a short circuit occurs at the output terminal of the battery pack, that is, when the discharge current exceeds the short-circuit protection current, the fuse will be disconnected to ensure the safety performance of the battery pack;

Charging and discharging actions are prohibited in this state;

After contact with a short circuit, the fuse needs to be replaced.

6) Discharge overcurrent (load) protection and recovery function

The battery pack has discharge overcurrent (load) protection and recovery functions. When the discharge current exceeds the overcurrent (load) alarm set value and the duration exceeds the discharge overcurrent alarm detection delay time, the BMS considers the discharge overcurrent alarm state to have occurred and alarms, but it does not affect the normal discharge function. When the discharge current exceeds the overcurrent (load) protection setting value and the duration exceeds the discharge overcurrent detection delay time, the BMS considers the discharge overcurrent protection state to have occurred, cuts off the discharge circuit, and alarms to ensure the safety performance of the battery pack; After overload cancellation or discharge current drops to the set value, the battery pack returns to normal discharge working state.

7) Charging overcurrent protection

The battery pack has a charging overcurrent protection function. When the charging current reaches the charging current overcurrent alarm set value and the duration exceeds the charging overcurrent alarm detection delay time, the BMS considers the charging overcurrent alarm state to have occurred and alarms, but it does not affect the normal charging function. When the charging current reaches the charging overcurrent protection setting value and the duration exceeds the charging overcurrent detection delay time, the BMS considers the charging overcurrent protection state to have occurred, cuts off the charging circuit, and alarms to ensure the safety performance of the battery pack; When the charging current drops to the charging overcurrent protection recovery value, the BMS considers that the charging overcurrent protection state has been released, and the battery pack returns to normal charging operation.

8) Over temperature protection and recovery function

The battery pack has over temperature protection and recovery functions for charging and discharging. When the temperature reaches the over temperature alarm set value and the duration exceeds the over temperature alarm detection delay time, the BMS considers the over temperature alarm state to have occurred, but it does not affect the normal charging and discharging functions.

When the temperature reaches the set value of the over temperature protection and the duration exceeds the delay time of the over temperature protection detection, the BMS considers that the over temperature protection state has occurred, cuts off the circuit and alarms to ensure the safety performance of the battery pack;

When the temperature drops to the over temperature protection recovery value, BMS considers that the over temperature protection state has been released, and the battery pack returns to normal charging and discharging operation.

9) Low temperature protection and recovery function

The battery pack has low-temperature protection and recovery functions for charging and discharging. When the temperature reaches the low-temperature alarm set value and the duration exceeds the low-temperature alarm detection delay time, the BMS considers the low-temperature alarm state to have occurred, but it does not affect the normal charging and discharging functions. When the temperature reaches the low temperature protection set value and the duration exceeds the low temperature protection detection delay time, BMS considers the low temperature protection state to have occurred, cuts off the circuit and alarms to ensure the safety performance of the battery pack;


When the temperature reaches the low temperature protection recovery value, BMS considers that the low temperature protection state has been released, and the battery pack returns to normal charging and discharging operation.


4. Product maintenance

4.1 Handling and Placement

- 1) Operations must be carried out by qualified and authorized personnel.
- 2) Due to the heavy weight of the battery system, please handle with caution during transportation

4.2 Routine Maintenance

 **Danger: Battery maintenance must be carried out by qualified and authorized personnel**

 **Danger: The system must be shut down before maintenance begins.**

- 1) Voltage check: Check the voltage of the battery system through the monitoring system.

Check if there is any abnormal voltage in the system. For example, the voltage of a single battery is abnormally high or low.

- 2) SOC check: Check whether the SOC of the battery system is normal through the LCD display screen.

- 3) Cable inspection: visually inspect all cables of the battery system. Check if the cable is broken, aged, or loose.

- 4) Balance: If not charged for a long time, the battery string will become unbalanced. Solution: Perform balance maintenance (charging to full) every 3 months, which is automatically completed by communication between the system and external devices under normal circumstances.

- 5) Historical inspection: Analyze whether there are accidents (alarms and protections) in the historical records, and analyze their causes.

- 6) Shutdown and maintenance: Some issues with battery energy storage require a restart to be discovered. It is recommended to perform a system restart every 6 months.

4.3 Testing and Maintenance

Regularly test the discharge capacity of the battery pack using either an online discharge or a battery discharge capacity tester, and record the results.

5. Package Contents

5.1 RBMS/RBMS MAX

No.	Name	Quantity
1	4-PIN Connector	1 pc
2	RJ45 Coupler	1 pc
3	Cable Sleeve	4 pcs
4	Mounting Screws	4 pcs
5	RBMS–Inverter Communication Cable	1 pc
6	Parallel Communication Cable	1 pc
7	RBMS Control Unit	1 pc

5.2. External Display (HMI)

No.	Name	Quantity
1	External Display (HMI)	1 pc
2	RBMS–Inverter Communication Cable	1 pc
3	RBMS–HMI Communication Cable	1 pc

5.3. RHFP Battery Module

No.	Name	Quantity
1	RHFP Battery Module	1 pc
2	Power Wire Connectors	1 set
3	Mounting Parts for Rack Cabinet	1 pc
4	RHFP–RHFP Communication Cable	1 pc

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