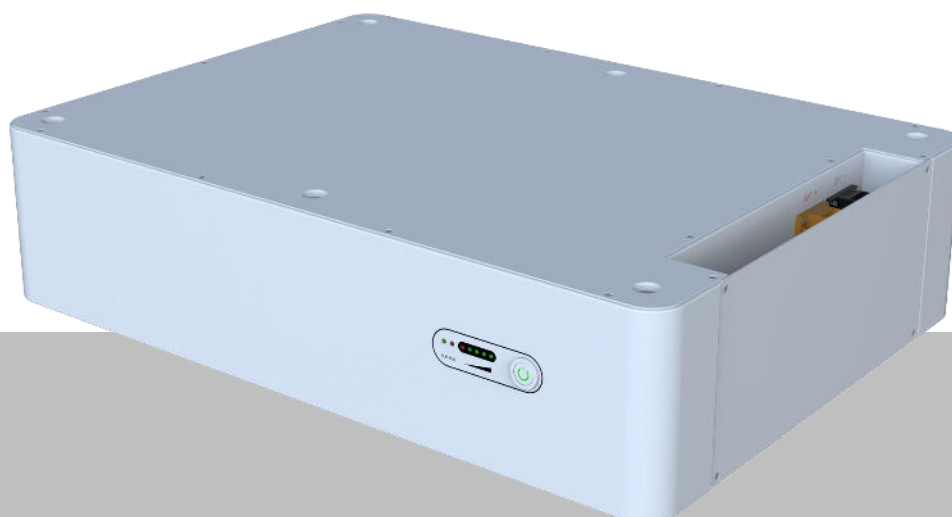




# **Future-H Series Energy Storage System User Manual(For Battery)**



044.SK0013000 V1.0

## • **About this Document**

This document describes the installation, electrical connection, operation, commission, maintenance and troubleshooting of Future-H Series System for battery (hereafter referred to as ABM 5.5L-A1-H). Before installing and operating ABM 5.5L-A1-H, ensure that you are familiar with product features, functions, and safety precautions provided in this document.

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# 1 Product Overview

## 1.1 Product Description

Each ABM 5.5L-A1-H consists of 106Ah cells which form 51.2V voltage battery module and 16 serial connection (1P16S). A Single cluster can connect up to 6 batteries in parallel to reach 30KWh. In order to meet the needs of customers' household power supply, it is combined with the SIM 6000 ES Plus-H Inverter into a household photovoltaic energy storage system, with protection functions such as overcharge, overdischarge, overcurrent, overtemperature and short circuit. At the same time, in order to better serve customers, the company has big data background for easy after-sales maintenance, but also equipped with APP display function, USB plug U disk upgrade function and remote upgrade functio.

## 1.2 Appearance

ABM 5.5L-A1-H consists of battery module (including cell and mechanical parts), battery management system (BMS) as well as power and communication terminals. Product appearance is shown as below.

### 1.2.1 Dimension (unit: mm)

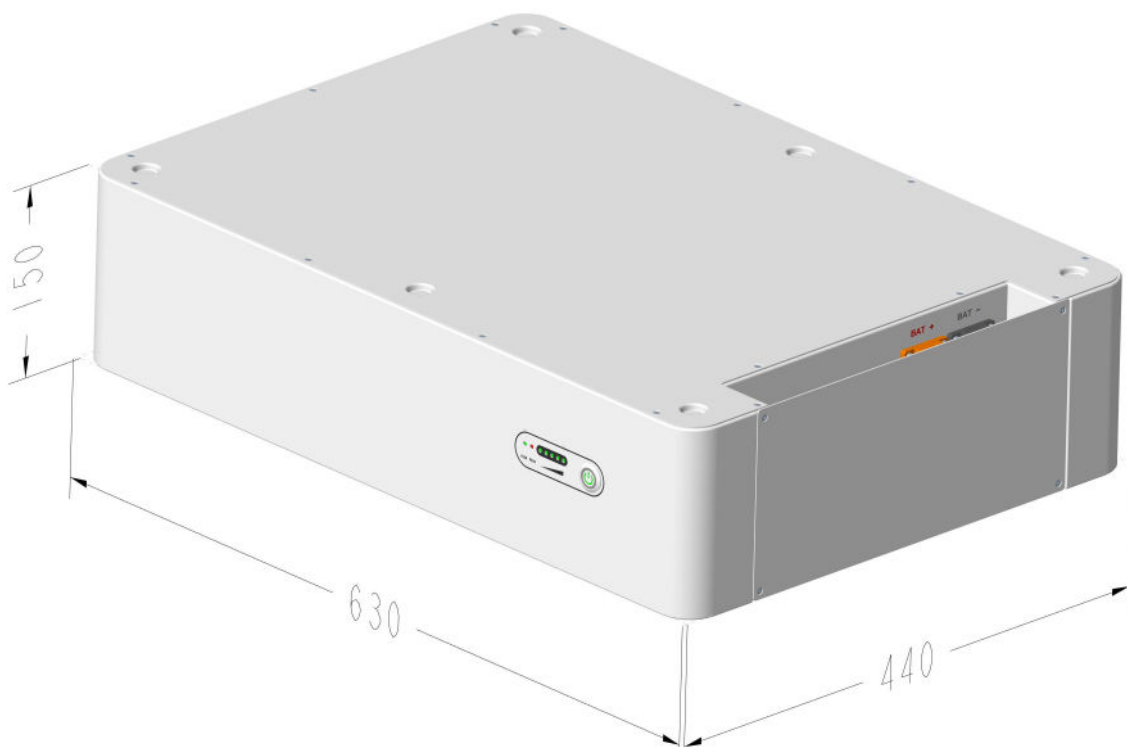


Figure 1: Battery size diagram

## 1.2.2 Introduction to the battery operation panel

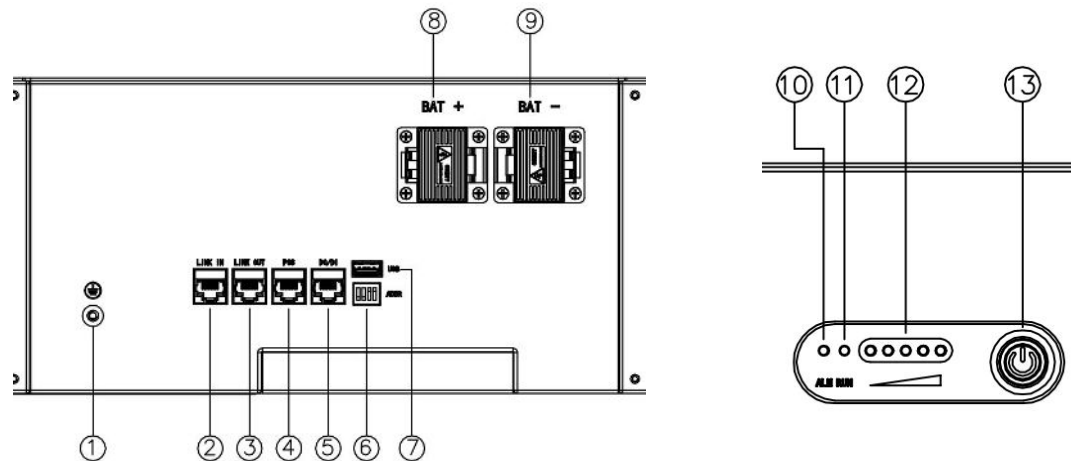


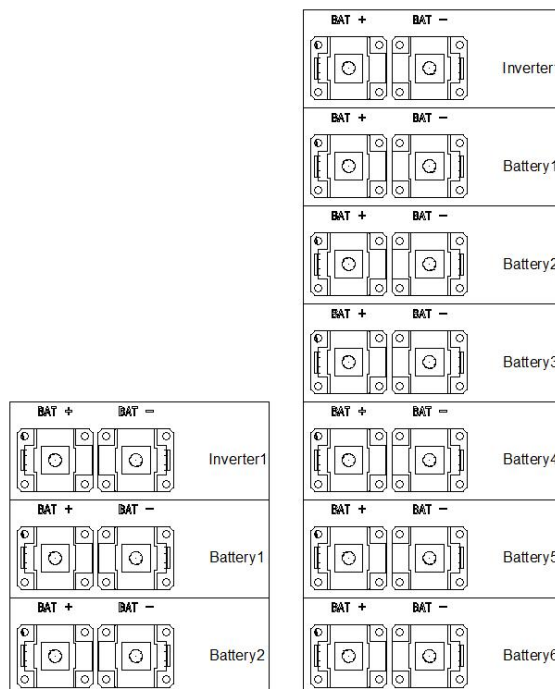
Figure 2: Introduction to the battery operation panel

| Location | Port     | Function  |
|----------|----------|---|
| 1        | GND      | Terminal connect to ground  |
| 2        | LINK-In  | Link-in for multi-cluster in parallel communication   |
| 3        | LINK-Out | Link-out for multi-cluster in parallel communication  |
| 4        | PCS      | inverter CAN communication  |
| 5        | DO/DI    | Relay output/input<br>(Output is for emergency alarm information, Input is for clustering and distinguishing) |
| 6        | ADDR     | Assign addresses for each model (see Table 1-2.1 - Table 1-2.6)   |
| 7        | USB      | USB interface for system upgrade<br>USB interface for system upgrade  |
| 8-9      | BAT +/-  | Positive and negative power terminals   |
| 10       | ALM      | Display alarm status  |
| 11       | RUN      | Displays the running state  |
| 12       | SOC      | Battery capacity display  |
| 13       | ON/OFF   | Power on / off button   |

Table 1 Battery address setting method, as described in the table:

| Address |     | Dip switch position |     |     |           | Dfinition |
|---------|-----|---------------------|-----|-----|-----------|-----------|
|         |     |                     |     |     |           |           |
| address | #1  | #2                  | #3  | #4  |           |           |
| 1       | ON  | OFF                 | OFF | OFF | Battery1  |           |
| 2       | OFF | ON                  | OFF | OFF | Battery2  |           |
| 3       | ON  | ON                  | OFF | OFF | Battery3  |           |
| 4       | OFF | OFF                 | ON  | OFF | Battery4  |           |
| 5       | ON  | OFF                 | ON  | OFF | Battery5  |           |
| 6       | OFF | ON                  | ON  | OFF | Battery6  |           |
| 7       | ON  | ON                  | ON  | OFF | Battery7  |           |
| 8       | OFF | OFF                 | OFF | ON  | Battery8  |           |
| 9       | ON  | OFF                 | OFF | ON  | Battery9  |           |
| 10      | OFF | ON                  | OFF | ON  | Battery10 |           |
| 11      | ON  | ON                  | OFF | ON  | Battery11 |           |
| 12      | OFF | OFF                 | ON  | ON  | Battery12 |           |

Note:If use Future-H Series system,the Battery1 is the top one, as the picture below.



### 1.3 Function Introduction

| Function                     | Description  |
|------------------------------|--|
| APP Display and Upgrade      | Display BMS Information and Upgrade  |
| CAN Communication            | 2 Circuits, with Isolation, one for Battery Parallel Communication, one for the Inverter Communication   |
| Battery Parallel             | Support max 12pcs of batteries in parallel, but max 6pcs of batteries for Future-H Series solar system.  |
| SOC Count                    | Dynamic SOC Estimation for Battery Packs   |
| SOP Count                    | Evaluation of Maximum Battery Output or Maximum Input Capacity at the Next Moment Based on Different Temperatures, Voltages and SOC .  |
| Running Alarm Status Display | Indication by 2 LEDs, Green: System Operation Status, Red: Fault Status;   |
| Power off                    | 1、Button Shutdown, 2、No Communication Shutdown, 3、Battery Low Voltage Shutdown 4、When Used in Parallel, it Can Be "One Key Shutdown"   |
| Power on                     | 1、Key On, 2、Charge On, 3、Activate Signal on, 4、When Used in Parallel Can be "One Key turn-On"  |
| Balanced Management          | Improve the Consistency of the Voltage of Each Single Cell, and Protect the Battery.   |
| Voltage Detection            | Detection of Single Cell Voltage (14-16 strings) or Total Voltage (2-Circuits)   |
| Current Detection            | Battery Charging Current, Discharging Current Detection  |
| Temperature Detection        | 8 Circuits, 6 Circuits for Battery Temperature Detection, 2 Circuits for MOS Tube Temperature Detection  |
| Protective Function          | With battery over-charge protection, over-discharge protection, battery over-voltage protection, high temperature over-high protection, low temperature protection, short-circuit protection and hardware failure protection function, etc.. And every fault alarm, protection and action is recorded, which is convenient for after-sales to view and analyze the problem |
| Pre-charge Control           | Low-current Charging of Low-voltage Batteries  |
| Preamp Control               | Pre-charge the Inverter Capacitor  |
| Interface Mode               | Same port  |

### 1.4 Battery software upgrade

#### 1.4.1 Upgrade via USB

- Copy the upgrade file into the U disk;
- Battery off, access U disk;
- Start the battery and successfully enter the upgrade state, the ALM and RUM two leds will blink for 3 seconds at the same time;
- The battery LED light flashes in the mode of running horse light, indicating that the upgrade is completed.

**Note:** Choose the USB upgrade mode, there must be no other files in the U disk, otherwise the upgrade will not be possible or the upgrade error.

### 1.4.2 Through inverter remote upgrade

- Through our inverter, connect to WiFi for remote upgrade;
- The LED light that displays the SOC continuously flashes at 500ms during the upgrade process;
- The host will upgrade the slave machine in turn after the upgrade is completed;
- The device in the slave upgrade displays the SOC LED light flashing continuously at 500ms;
- The LED displays normally after the upgrade.

**Note:** Inverter remote upgrade mode can only upgrade the battery host.

## 2 Safety

Safety information contains in this section must be observed at all times when working on or with batteries. For safety, installers have responsibility to familiarize themselves with this manual and all warnings before installation.

### 2.1 Application

Please read the product manual and the warning signs on the surface of the battery box carefully before using the battery. Improper use of the battery may cause damage to the battery by overheating, and we will not be responsible for any accidents caused by not operating according to the specifications.

- Keep the batteries away from heat sources, high voltage places and long periods of sunlight exposure;
- Batteries must not be thrown into water or fire;
- Do not reverse the positive and negative terminals of the battery;
- Do not use metal to short the positive and negative terminals of the battery
- Avoid excessive physical shocks and impacts to the battery, do not hit, drop or step on the battery;
- It is strictly forbidden to disassemble or assemble the battery privately without the permission and guidance of the manufacturer;
- Cannot mix with other batteries of different manufacturers, types and models;
- Do not use or store in high temperature environments, as this may cause the battery to heat up, catch fire or have a reduced service life;
- Charge the battery promptly (within 15 days) after it runs out of charge;
- Please use the matching or recommended professional lithium battery charger;
- Stop using the battery if it has abnormal conditions such as odor, discoloration, noise, liquid leakage, or serious deformation;
- If electrolyte leaks into the skin or eyes, flush with water and seek immediate medical attention;
- Please place the battery out of the reach of pets and children, and prohibit children from touching the battery;
- Below 0°C, due to the low temperature performance of the battery, please reduce the power to use, a battery pack with a load of 2.5KW or less.



## 2.2 Safety Precautions





### 2.2.1 Environment requirements








- Do not expose the battery to temperature above 55°C or heat sources.
- Do not install or use the battery in wet locations, moisture, corrosive gases or liquids, such as bathroom.
- Do not expose the battery to direct sunlight for extended periods of time.
- Place battery in safe place away from children and animals.
- Battery power terminals shall not touch conductive objects such as wires.
- Do not dispose the batteries in fire, which may cause an explosion.
- The PACK shall not come in contact with liquids.
- The PACK can only be installed indoors. Regarding indoor installation, please do not install it in the bedroom, living room, kitchen, etc.

### 2.2.2 Operation and Precautions

- Do not touch the PACK with wet hands.
- Do not disassemble the PACK without permission
- Do not crush, drop or puncture the PACK and battery.
- Dispose the batteries according to local safety regulations.
- Store and recharge battery in accordance with this manual.
- Ensure the connection of ground wire reliable. Ensure the connection of ground wire reliable.
- Remove all metal objects such as watches and rings that could cause a short-circuit before installation, replacement and maintenance.
- The Pack shall be repaired, replaced or maintained by skilled personal that has been recognized.
- When storing or handling batteries, do not stack batteries without package.
- Do not break the battery, the released electrolyte may be toxic and is harmful to skin and eyes.
- Packaged batteries should not be stacked more than specified number stipulated on the packing case.
- Do not use damaged, failed or deformed batteries, which may lead to high temperature or even dangerous accidents. Continued operation of damaged battery may result in electrical shock, fire or even worse.

### 2.3 Warning Labels

| Symbols   | Description                          |
|---|--------------------------------------|
|  | Do not dispose in trash              |
|  | Lithium ion battery can be recycled  |
|  | Certification in European union area |
|  | Electric shock hazard                |

|  |   |
|--|---|
|   | Explosive gas                                 |
|   | May leak corrosive electrolyte                |
|   | Heavy enough to cause severe injury           |
|   | Keep the Pack away from children              |
|   | Make sure the battery polarity well connected |
|   | Do not expose to fire                         |
|  | Operate as the Manual                         |







|   |               |
|---|---------------|
|  <br>Lithium Ion Battery  |               |
| Model   | ABM 5.5L-A1-H |
| Nominal Voltage   | 51.2V         |
| Rated Capacity  | 106Ah         |
| Rated Energy  | 5500Wh        |
| Max Charge Current  | 100A          |
| Max Discharge Current   | 100A          |
| Ingress Protection  | IP20          |
| Charge Temperature  | 0°C ~ 55°C    |
| Discharge Temperature   | -20°C ~ 55°C  |
|    <br>X <span style="float: right;">Made In China</span> |               |

Figure 4 : Nameplate

## 2.4 Emergency Responses

Manufacturer takes foreseeable risk scenarios into consideration and is designed to reduce hazards and dangers. However, if the following situation occurs, do as below:

| Situation Occurs | Description and Action   |
|------------------|--|
| Leakage          | <ol style="list-style-type: none"><li data-bbox="456 600 1394 667">1. Avoid touch of leaking liquid or gas. If you touch the leaking electrolyte, do as below immediately.</li><li data-bbox="456 701 1331 734">2. Inhalation: Evacuate the contaminated area, and seek medical Help.</li><li data-bbox="456 768 1394 835">3. Eye contact: Rinse eyes with flowing water for 15 minutes, and seek medical help.</li><li data-bbox="456 869 1394 936">4. Skin contact: Rinse contacted area thoroughly with soap and water, and seek medical help.</li><li data-bbox="456 969 1043 1003">5. Ingestion: Vomiting, and seek medical help.</li></ol> |
| Fire             | If the BATTERY is on fire, try to extinguish the fire with fire sand and evacuate people due to the situation  |
| Wet Packs        | If BATTERY is flooded or submerged, do not access it. Contact Growatt or distributor for technical assistance immediately.   |
| Damaged PACKS    | Damaged batteries are dangerous and must be handled with special attention. They are no longer suitable for use and may cause danger to people. If the BATTERY damaged, stop use it and contact the Growatt or distributor.  |

# 3 Storage and Transportation

## 3.1 Storage Requirements

- Place the BATTERY follow the identification on the packing case during storage.
- Do not put the BATTERY upside down or sidelong.
- The defective PACK needs to be separated from other batteries.
- The storage environment requirements are as follows:
  - 1) Install the BATTERY in a dry and clean place with proper ventilation
  - 2) The storage temperature for a short week is between -20°C to 55°C
  - 3) If you store the PACK over a long period of six months, the storage temperature is between-10°C to 40°C, relative humidity: 10%~90%RH.
  - 4) Place the BATTERY away from corrosive and organic substances (including gas exposure).
  - 5) Free from direct exposure to sunlight and rain
  - 6) At least two meters away from heat sources (such as a radiator) , free from exposure to intensive infrared radiation.
- If the BATTERY has not been used for more than six months, it needs to be charged, The charging procedure is as follows:
  - 7) Identify the PACK that needs charging;
  - 8) Refer to quick installation guidance, complete the installation and wire connection. Ensure BATTERY in off status during all the steps.
  - 9) Activating the inverter, activating the battery and starting charging;
  - 10) When the RUN\_LED is always on and the SOC LED is flashing to indicate that it is in normal charging;
  - 11) When the 5 SOC LED lights are always on, it indicates a full charge.

## 3.2 Transportation Requirement

PACK has been certified in UN38.3 (Section 38.3 of the sixth Revised Edition of the Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria) and SN/T 0370.2-2009 (Part 2: Performance Test of the Rules for the Inspection of Packaging for Exporting Dangerous Goods). PACK is classified as category 9 dangerous goods.

- The BATTERY shall not be transported with other inflammable, explosive or toxic substances .Ensure the original Package and label complete and recognizable.
- Prohibit direct exposure to sunlight, rain, condensing water caused by temperature difference and mechanical damages
- There will be a drop in capacity during transportation and storage.
- Transportation temperature is between -10°C to 40°C, relative humidity: 10%~90%RH

## 4 Installation

- Ensure to read the Guidance before installation in order to understand product information and safety cautions;
- Operators should be well trained technicians and fully understand the whole photovoltaic system, grid network, working principle and national regional standards;
- Installers must use insulating tools and wear safety equipment;
- Device damages caused by failure to comply with storage, transportation, installation and use requirements specified in Guidance are not covered by Warranty.
- The BATTERY can only be installed indoors. Regarding indoor installation, please do not install it in the
  - bedroom, living room, kitchen, etc.
  - Different types of batteries are not recommended to be mixed and used in parallel
  - The battery system cannot be installed, dismantled, and maintained when it has been powered on.

### 4.1 Installation environment

The ambient temperature for the installation of the battery system shall be above 0°C, below 40°C, and the humidity shall between 10% and 95%.

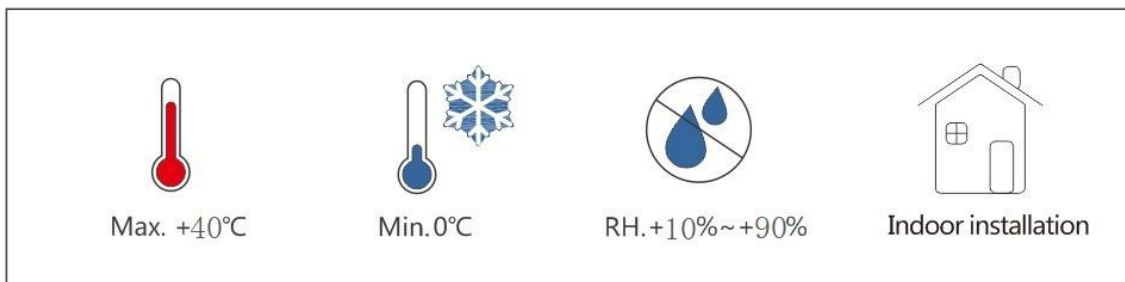
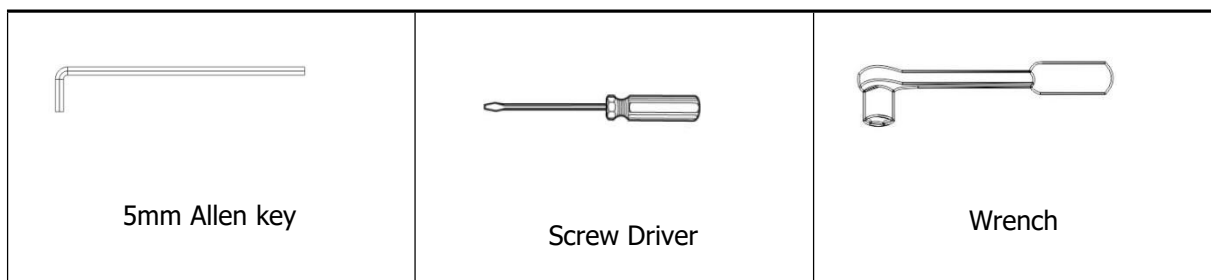
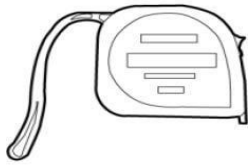



Fig 5: Installation environment requirements

### 4.2 Installation Required Tools

The following tools are required to install the BATTERY:



|  |  |  |
|--|--|--|
|  <p>Tap Measure</p> |  <p>Multi-meter</p> |  |
|--|--|--|

It is recommended to wear the following safety gear when dealing with the BATTERY.



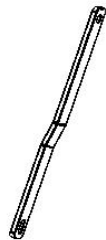


|  |  |   |
|--|--|---|
|  <p>Insulated Glove</p> |  <p>Safety Goggle</p> |  <p>Safety Shoes</p> |
|--|--|---|

### 4.3 Check

#### 4.3.1 Pre-installation Check

|                          |  |
|--------------------------|--|
| <p>Check the package</p> | <p>Check the BATTERY package before open it. If any abnormality is detected, do not open the Package and contact your distributor.</p>                 |
| <p>Check the power</p>   | <p>Check and confirm the BATTERY is powered off before installation.</p>   |
| <p>Check deliverable</p> | <p>Check the quantity of all parts inside according to the package list. If there is any part missing or damaged, please contact your distributor.</p> |

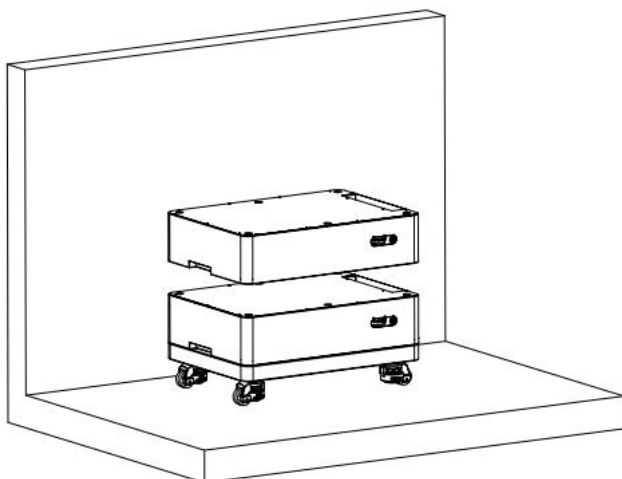
### 4.3.2 Check Packing List

| ABM 5.5L-A1-H Battery Pack |                            |          |   |
|----------------------------|----------------------------|----------|---|
| Item No                    | Product Name               | Quantity | schematic drawing   |
| 1                          | ABM 5.5L-A1-H Battery Pack | 1 pc     |    |
| 2                          | User Manuals               | 1 pc     |    |
| 3                          | copper connector           | 2 pcs    |   |
| 4                          | Communication cable        | 1 pc     |  |
| 5                          | Shorting Cap               | 1 pc     |  |

## 4.4 Installation

### 4.4.1 Battery Replacement

- 1) Please install indoors and ensure the level of the ground.
- 2) The batteries must be installed on ABM Battery Base , and up to 6 batteries can be stacked horizontally. Make sure the batteries are installed in the correct orientation. Please refer to the diagram below.



### 4.4.2 Electrical Connection (Please refer to the Future-H Series user manual)

#### 4.4.3 inverter Communication interface definition

| Item | Crystal head picture  | Serial no. | Definition |
|------|---|------------|------------|
| PCS  |  | 1          | RS485_B    |
|      |   | 2          | RS 485_A   |
|      |   | 3          | GND_COM    |
|      |   | 4          | CAN_H      |
|      |   | 5          | CAN_L      |
|      |   | 6          | GND_COM    |
|      |   | 7          |            |
|      |   | 8          |            |



## 5 Power on and off the Battery

- The installation and use of batteries involve much specialized knowledge. Therefore, technicians should be given appropriate technical training and obtain operational certificates in compliance with local laws and regulations. Please ensure technicians have obtained training certificate before operation.
- Please stand on dry insulating objects and do not wear conductive material such as watches and necklace during operation. Insulated tools should be used.
- Do not contact any positions with potential difference.
- Prohibition sign should be hung on the battery: " Non - professionals, do not touch".
- If any abnormalities occur during the startup phase, power off the BATTERY immediately. After problem confirmed, proceed again.
- Make sure the inverter is turned off before checking the BATTERY.

### 5.1 Power On

When multiple batteries are connected in parallel or multiple clusters of batteries are connected in parallel, press one of the battery power buttons and all the batteries connected in parallel can be turned on.

| Power on the PACK by pressing power button(t>1S) |   |   |
|--|---|---|
| Serial   | Procedures  | Acceptation criteria  |
| 1  | Connect the battery and inverter  | Make sure the wiring harnesses are well connected   |
| 2  | Press POWER button for one second. Observe the LED indication on panel. | 1.If both RUN/ALM and SOC lights turn on normally, PACK is powered on successfully.<br>2.If ALM light turns red, there is a failure and should solve it before power on again.  |
| Power on the BATTERY by inverter                 |   |   |
| 1  | Connect the battery and inverter  | Make sure the wiring harnesses are well connected   |
| 2  | Power on the inverter to charge the battery                             | 1. If both RUN/ALM and SOC lights turn on normally, BATTERY powers on successfully.<br>2. If ALM light turns red, there is a failure and should solve it before power on again. |

### 5.2 Power off

Press the power button for 3 seconds and then release, the battery enters the shutdown state and all LEDs turn off. If in the case of multiple batteries connected in parallel, press the power button of any one of the batteries for 3 seconds and then release it to turn off the all batteries.

## 6 Maintenance Guide

### System Failure Information List and Troubleshooting Suggestions

| Error Indication       | Error description                      | Error cause   | Suggested actions  |
|------------------------|--|---|--|
| * (ALM Light Flickers) | Discharge under voltage protection     | Single cell voltage below the threshold for under-voltage protection. | There is over discharge risk. User should stop discharging and arrange recharge  |
|                        | Charge over voltage protection         | Single cell voltage exceeding threshold for protection threshold      | 1. There is no safety threat;<br>2. User should stop charging. Idle battery and it will turn to normal status.   |
|                        | External CAN Communication failure     | Communication loss between inverter and battery                       | 1. There is no safety threat and user should stop using battery.<br>2. Check if inverter and battery communication terminal is well connected.<br>3. If inverter and PACK cannot communicate when the communication wire is confirmed well connected, user should contact installer to repair battery. |
|                        | Interior CAN Communication failure     | Communication loss between two parallel                               | Check CAN connection between two batteries, CAN connection between Link-in and Link-out;   |
|                        | Parallel connection failure protection | Communication failure between two parallel connected battery          | Check CAN connection between two batteries, CAN connection between Battery and Inverter;   |
| ● (ALM light on)       | Discharge short circuit                | External short circuit of battery                                     | There is safety risk and user should stop using battery, User should contact installer to repair inverter and battery  |
|                        | Pre-charge short circuit               |   |  |
|                        | Pre-charge overtime circuit            |   |  |
|                        | Parallel failure                       | The pack type is different  | There is safety risk and user should stop using battery, User should contact installer to use the same battery in Parallel.  |
|                        | Main circuit fault                     | BMS main power circuit failure  | There is safety risk and user should stop using battery. User should contact installer to repair battery   |
|                        | MOS control failure                    | Turn off MOS tube,there is still current                              | There is safety risk and user should stop using battery. User should contact installer to repair battery   |

## 7 Technical Specifications

Functional parameters of ABM 5.5L-A1-H Energy Storage System are as shown below:

| No. | Items                                 | Specification   |
|-----|---------------------------------------|---|
| 1   | Battery Module                        | ABM 5.5L-A1-H 106   |
| 2   | Nominal Voltage                       | 51.2V   |
| 3   | Rated Capacity/Energy                 | 106Ah/5.5kWh  |
| 4   | Operating Voltage                     | 40 – 58.4V  |
| 5   | Max. charging current(25°C)           | 100A  |
| 6   | Max. discharging current(25°C)        | 100A  |
| 7   | Peak discharge current                | 250A 150ms  |
| 8   | Battery Type                          | Cobalt Free Lithium Iron Phosphate (LFP)  |
| 9   | Charging operating temperature range  | 0°C~55°C  |
| 10  | Discharge operating temperature range | -20°C ~55°C   |
| 11  | Storage conditions                    | Temperature: -20°C ~ +50°C<br>-10°C~40°C<br>Humidity: 10%~90%RH<br>Within six months after initial charge |
| 12  | Cooling                               | Natural cooling   |
| 13  | Dimension (W/D/H)                     | 630*440*150mm   |
| 14  | Weight                                | 47±1kg  |
| 15  | Installation                          | Floor standing installation   |
| 16  | Ingress protection                    | IP 20   |
| 17  | BATTERY safety certification          | CE(EMC)/UN38.3/MSDS/ROHS  |
| 18  | Communication port                    | CAN/RS485   |
| 19  | Number of batteries in parallel       | Max.12 BATTERY  |
| 20  | Warranty                              | 5 Years   |

## Appendix 1

| LED indicator            |                             |                |                |                |                |                |
|--------------------------|-----------------------------|----------------|----------------|----------------|----------------|----------------|
| Status                   | Items                       | SOC indicator  |                |                |                |                |
|                          |                             | LED1           | LED2           | LED3           | LED4           | LED5           |
| Charge SOC               | 0%                          | ●<br>(t=500ms) | ●<br>(t=500ms) | ●<br>(t=500ms) | ●<br>(t=500ms) | ●<br>(t=500ms) |
|                          | 1%-19%                      | ●              | ●<br>(t=500ms) | ●<br>(t=500ms) | ●<br>(t=500ms) | ●<br>(t=500ms) |
|                          | 20%-39%                     | ●              | ●              | ●<br>(t=500ms) | ●<br>(t=500ms) | ●<br>(t=500ms) |
|                          | 40%-59%                     | ●              | ●              | ●              | ●<br>(t=500ms) | ●<br>(t=500ms) |
|                          | 60%-79%                     | ●              | ●              | ●              | ●              | ●<br>(t=500ms) |
|                          | 80%-100%                    | ●              | ●              | ●              | ●              | ●              |
| Discharge SOC            | 100%-80%                    | ●              | ●              | ●              | ●              | ●              |
|                          | 79%-60%                     | ●              | ●              | ●              | ●              |                |
|                          | 59%-40%                     | ●              | ●              | ●              |                |                |
|                          | 39%-20%                     | ●              | ●              |                |                |                |
|                          | 19%-1%                      | ●              |                |                |                |                |
|                          | 0%                          | ●<br>(t=500ms) |                |                |                |                |
| Idle                     | 100%-80%                    | ●              | ●              | ●              | ●              | ●              |
|                          | 79%-60%                     | ●              | ●              | ●              | ●              | ●              |
|                          | 59%-40%                     | ●              | ●              | ●              |                |                |
|                          | 39%-20%                     | ●              | ●              |                |                |                |
|                          | 19%-1%                      | ●              |                |                |                |                |
|                          | 0%                          | ●<br>(t=500ms) |                |                |                |                |
| Status                   | Items                       | RUN            |                |                | ALM            |                |
| Charge and discharge MOS | Open circuit                | ● (t=1s)       |                |                |                |                |
|                          | Closed circuit              | ●              |                |                |                |                |
| Alarm                    | Total voltage under voltage |                |                |                | ● (t=1s)       |                |

|            |  |  |          |
|------------|--|--|----------|
|            | Total voltage over voltage                             |  | ● (t=1s) |
|            | Cell under voltage alarm                               |  | ● (t=1s) |
|            | Cell over voltage alarm                                |  | ● (t=1s) |
|            | Alarm before power off                                 |  | ● (t=1s) |
|            | Charge over current                                    |  | ● (t=1s) |
|            | Discharge over current grade 1                         |  | ● (t=1s) |
|            | Interior CAN communication failure                     |  | ● (t=1s) |
|            | Large voltage difference between internal and external |  | ● (t=1s) |
|            | Low charging temperature                               |  | ● (t=1s) |
|            | Low discharge temperature                              |  | ● (t=1s) |
|            | High charging temperature                              |  | ● (t=1s) |
|            | High discharging temperature                           |  | ● (t=1s) |
|            | Charge over power                                      |  | ● (t=1s) |
|            | Discharge over power                                   |  | ● (t=1s) |
|            | Large charging circulation                             |  | ● (t=1s) |
|            | Large discharging circulation                          |  | ● (t=1s) |
|            | Mos high temperature                                   |  | ● (t=1s) |
|            | Large Cell voltage difference                          |  | ● (t=1s) |
|            | Large Cell temperature difference                      |  | ● (t=1s) |
| Protection | Total voltage under voltage                            |  | ●        |
|            | Total voltage over voltage                             |  | ●        |
|            | Cell under voltage alarm                               |  | ●        |
|            | Cell over voltage alarm                                |  | ●        |
|            | Short circuit  |  | ●        |
|            | Charge Over current                                    |  | ●        |
|            | Discharge Over current grade 1                         |  | ●        |
|            | Parallel versions are inconsistent                     |  | ●        |
|            | Parallel failure                                       |  | ●        |
|            | Large voltage difference between internal and external |  | ●        |
|            | MOS control failure                                    |  | ●        |
|            | low charging temperature                               |  | ●        |

|  |  |  |   |
|--|--|--|---|
|  | low discharging temperature                                  |  | ● |
|  | High charging temperature                                    |  | ● |
|  | High discharging temperature                                 |  | ● |
|  | Charging over power  |  | ● |
|  | Discharging over power                                       |  | ● |
|  | Same address failure   |  | ● |
|  | Precharge timeout  |  | ● |
|  | Precharge short circuit                                      |  | ● |
|  | AFE disconnected   |  | ● |
|  | Cell dropout   |  | ● |
|  | Temperature dropout  |  | ● |
|  | Abnormal battery voltage sampling                            |  | ● |
|  | Temperature short circuit                                    |  | ● |
|  | Abnormal load voltage sampling                               |  | ● |
|  | Failed to load parameters                                    |  | ● |
|  | AFE over voltage   |  | ● |
|  | AFE under voltage  |  | ● |
|  | AFE charging overcurrent                                     |  | ● |
|  | AFE discharging overcurrent                                  |  | ● |
|  | Excessive differential voltage between primary and secondary |  | ● |
|  | Charging current limit failure                               |  | ● |
|  | Discharge current limit failure                              |  | ● |
|  | Main circuit disconnection                                   |  | ● |
|  | Discharge overcurrent grade 2                                |  | ● |
|  | MOS high temperature alarm                                   |  | ● |
|  | Excessive differential voltage                               |  | ● |
|  | Excessive differential temperature                           |  | ● |

**note** : ● Indicates always on

● t=500ms indicates the flashing interval 500ms

● t=1s indicates the flashing interval 1s