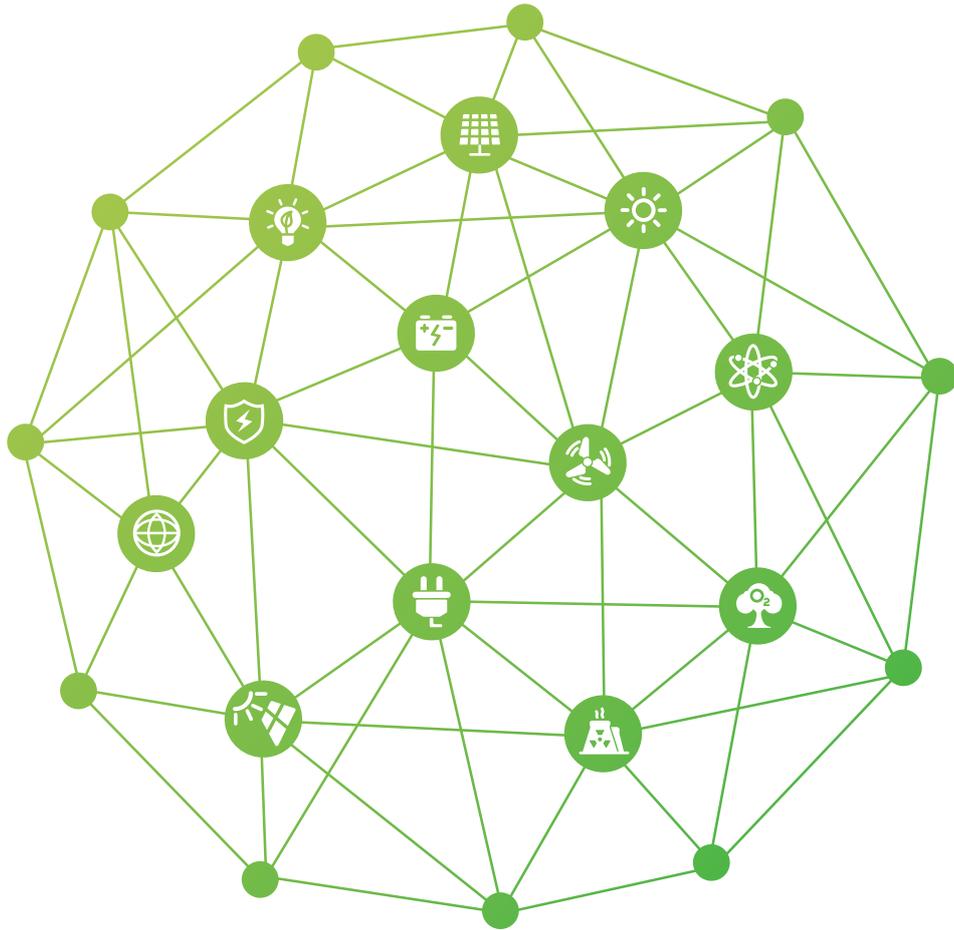




科曜能源  
KOYOE



# Stacked Energy Storage System

## User 's manual

Jiangsu Koyoe Energy Technology Co.,Ltd

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# Foreword

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## Overview

This document mainly introduces the stacked energy storage battery system, KY-51V105AH-S storage product introduction, application scenarios, installation instructions, system maintenance and related technical data of the battery module.

## Suitable

This document is primarily intended for the following people:

- Sales Engineer
- System Engineer
- Installation and after-sales engineer

## Symbol Description

The following symbols may appear in this article, and their meanings are as follows.

Symbol	Explanation
 Danger	Indicates a hazard with a high risk of death or serious injury if not avoided.
 Warning	Indicates a hazard with a medium risk that, if not avoided, could result in death or serious injury.
 Caution	Indicates a hazard with a low level of risk that, if not avoided, could result in minor or moderate injury.
 Notice	Used to transmit equipment or environmental safety warning information. Failure to avoid it may result in equipment damage, data loss, reduced equipment performance, or other unpredictable results.  "Notice" does not involve personal injury.
 Explanation	Supplementary explanation of key information in the main text.  "Instructions" are not safety warning information, and do not involve personal, equipment and environmental damage information.

## Modify records

The modification log accumulates the description of each document update. The latest version of the documentation contains updates from all previous documentation versions.

### **Document version: V1 (2022-01-18)**

The first official release.

### **Document version: V1.1 (2023-01-06)**

Delete inverter related information.

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# 1 Safety Precautions

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## 1.1 General security

### Statement

When installing, operating and maintaining the equipment, you must read this manual first, and follow the signs on the equipment and all safety precautions in the manual. When a new product is unpacked for the first time, please check the product and packing list first, if the product is damaged or missing parts, please contact your local distributor.

The "Notice", "Caution", "Warning" and "Danger" in the manual do not represent all the safety precautions that should be observed, but only serve as a supplement to all the safety precautions. Koyoe Energy disclaims any responsibility for violations of general safe operating requirements or violations of safety standards for the design, manufacture and use of equipment.

This equipment should be used in an environment that meets the design specifications, otherwise it may cause equipment failure, resulting in abnormal equipment function or component damage, personal safety accidents, property damage, etc., which are not within the scope of equipment quality assurance.

The installation, operation, and maintenance of the equipment shall comply with local laws, regulations and codes. All safety precautions stated in this manual are only in addition to local laws, regulations and codes.

In the event of any of the following situations, Koyoe Energy shall not be held responsible.

- Do not operate under the conditions of use described in this manual.
- The installation and use environment exceed the regulations in relevant international or national standards.

- Unauthorized disassembly, modification of the product or modification of the software code.
- Fail to follow the operating instructions and safety warnings in the product and documentation.
- Equipment damage caused by abnormal natural environment (force majeure, such as earthquake, fire, storm, etc.).
- Transportation damage caused by the customer's own transportation.
- Damage caused by storage conditions that do not meet product requirements.
- Do not use in the area and environment required by the product contract.
- Beyond product life.

## General requirements



Danger

During the installation process, live operation is strictly prohibited, and the battery must be turned off when the battery module is not assembled.

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- It is strictly forbidden to install, use and operate outdoor equipment and cables (including but not limited to handling equipment, operating equipment and cables, plugging and unplugging signal interfaces connected to the outdoors, high-altitude) under severe weather such as lightning, rain, snow, and strong winds. work, outdoor installation, etc.).
- After the equipment is installed, the empty packing materials in the equipment area, such as carton, foam, plastic, cable ties, etc., should be removed.
- In the event of fire, evacuate the building or equipment area and press the fire alarm bell, or call the fire alarm number. Under any circumstances, it is strictly forbidden to re-enter the burning building.
- It is strictly forbidden to alter, damage or cover the signs and nameplates on the equipment.

- When installing the equipment, use professional tools to tighten all the screws.
- Fully familiar with the composition and working principle of the entire photovoltaic grid-connected power generation system, as well as the relevant standards of the country/region where the project is located.
- Paint scratches that occur during equipment transportation and installation must be repaired in time. It is strictly forbidden to expose the scratched parts to the outdoor environment for a long time.
- Under any circumstances, do not change the structure, installation sequence, etc. of the equipment without the permission of the manufacturer.
- It is recommended to use the original packing carton for transportation, and it is not allowed to hoist and transport through the battery docking terminal.
- Do not reverse engineer, decompile, disassemble, disassemble, adapt, implant or other derivative operations on the device software, do not research the internal implementation of the device in any way, obtain the source code of the device software, steal intellectual property, etc., and must not disclose The results of any device software performance test.
- For Australian market, an overcurrent protection and isolation device that operates both positive and negative conductors simultaneously is required between inverter and battery and between parallel batteries. Please refer to AS/NZS 5139 for the requirements of the overcurrent protection and isolation device” .

## Personal safety

- Appropriate personal protective equipment should be worn during equipment operation. If a malfunction that may cause personal injury or equipment damage is found, the operation should be terminated immediately, reported to the person in charge, and effective protective measures should be taken.
- Before using the tool, please master the correct use of the tool to avoid injury and damage to the equipment.
- When the device is running, the temperature of some internal casings is high, there is a danger of burns, please do not touch.

- To ensure personal safety and normal use, it should be grounded reliably before use.
- When the battery module fails, the temperature may exceed the burn threshold of the touchable surface, and contact should be avoided.
- Do not open or damage the battery module, the released electrolyte is harmful to skin and eyes and should be avoided.
- Do not place extraneous items on top of the device or insert it anywhere.
- Do not place flammable objects around the device.
- The battery is strictly prohibited to be placed in fire to avoid explosion and endanger personal safety.
- Do not put the battery module in water or other liquids.
- Do not short-circuit the docking terminals of the battery module. Short-circuiting the battery may cause fire.
- The battery may cause the danger of electric shock and large short-circuit current. When using batteries, the following precautions should be observed:
  - 1) Remove watches, rings or other metal objects.
  - 2) Tools with insulated handles.
  - 3) Wear rubber gloves and boots.
  - 4) Do not place small tools or metal parts on top of the battery module.
  - 5) Disconnect the charging power source before connecting or disconnecting the battery terminals.
  - 6) Determine if the battery is accidentally grounded. In case of accidental grounding, remove the power supply from the ground. Touching any part of a grounded battery can result in electric shock. If these grounds are removed during installation and maintenance, the possibility of this shock can be reduced.
- Do not clean the electrical parts inside and outside the cabinet with water or detergent.
- Do not stand or lean on or sit on the device.

- Do not damage each module of the device.
- When installing the battery module, if the battery module is dropped or subjected to strong impact, the device will be damaged, and it is strictly forbidden to continue to use it, otherwise there will be safety risks (potential battery leakage, electric shock injury, etc.).
- When installing the battery module, put the module on the tray and push it into the cabinet as soon as possible. If it is suspended in the air for a long time, it may fall.

## Battery leakage treatment measures

In the event of electrolyte leakage, the following emergency measures can be taken according to the seriousness of the leakage.

- Ensure adequate ventilation. Remove all ignition sources.
- Evacuate personnel quickly to a safe area, away from the leakage area and in the upwind direction.
- Use personal protective equipment. Avoid breathing vapours, fumes, gases or dust.
- Take steps to prevent further leakage or spillage when it is safe to do so.
- When there is a small amount of leakage, dry sand or inert adsorbent material can be used to absorb the leakage, and when there is a large amount of leakage, embankment should be built to control it.
- Attached or collected materials should be stored in suitable airtight containers and disposed of in accordance with relevant local laws and regulations.
- Remove all ignition sources and use spark-proof tools and riot-proof equipment.

In the event of a leak, avoid contact with the leaking liquid or gas. Electrolyte is corrosive and contact may cause skin irritation and chemical burns. If you come into contact with battery electrolyte, the following measures need to be taken.

- Inhalation: Evacuate the contaminated area, immediately move to fresh air, and keep breathing; if breathing is difficult, give oxygen; if the patient ingests or inhales this substance, do not perform mouth-

to-mouth artificial respiration; if breathing stops. Perform CPR immediately; get medical help right away.

- Eye Contact: Immediately flush eyes with plenty of water for at least 15 minutes without rubbing, and seek medical help immediately.
- Skin Contact: Immediately remove contaminated clothing, wash skin contact area with plenty of water and soap, and seek medical help immediately.
- Ingestion: Do not induce vomiting, do not feed anything from the mouth to an unconscious person, seek medical help immediately.
- Protection of first responders: Ensure that medical staff understand the hazard characteristics of the product and take self-protection measures to protect themselves and prevent the spread of contamination.

### Fire handling measures

- In the event of a fire, the system should be powered off when it is safe to do so.
- Use carbon dioxide, FM-200 or ABC dry powder fire extinguisher to put out the fire. Avoid putting out too much water vapor, as it may spread the flame.
- Firefighters need to avoid contact with high-voltage components during firefighting, otherwise there may be a risk of electric shock.
- When extinguishing fire, wear a breathing mask ((MSHA/NIOSH compliant or equivalent)) and full-body protective clothing.
- Put out the fire at a safe distance and with adequate protection.
- Prevent fire water from polluting surface and groundwater systems.



When the battery temperature is too high, the battery will be deformed, damaged, and the electrolyte will overflow, leaking toxic gas. Do not approach it to avoid skin irritation and chemical burns.

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### Flood Emergency Measures

- To ensure personal safety, power off the system.

- If any part of the battery is submerged in water, do not touch the battery to avoid electric shock.
- Do not use flooded batteries, contact a battery recycling company for disposal.

### Battery recycling

- Please dispose of used batteries according to local laws and regulations, do not dispose of batteries as household waste.
- If the battery leaks or bulges, please contact technical support or a battery recycling company for disposal.
- When the battery cannot be used beyond its service life, please contact a battery recycling company for disposal.
- Avoid exposing the battery to high temperature or direct sunlight.
- Avoid exposing batteries to high humidity or corrosive environments.

## 1.2 Personnel requirements

- Personnel responsible for installing and maintaining Koyoe products and equipment must first undergo strict training, understand various safety precautions, and master the correct operation methods.
- Only qualified professionals or trained personnel are allowed to install, operate and maintain the equipment.
- Only qualified professionals are allowed to dismantle safety features and overhaul equipment.
- Personnel operating the equipment, including operators, trained personnel, and professionals, should have special operation qualifications required by the local country, such as high-pressure operation, climbing, and special equipment operation qualifications.
- Replacement of equipment or parts (including software) must be done by professionals or authorized personnel.

 Explanation

## 1.3 Electrical Safety

- Professionals: Those who have experience in training or operating equipment, and can understand the potential sources of various dangers and levels of danger in the process of equipment installation, operation and maintenance.

- Trained personnel: Personnel who have received appropriate technical training and have the necessary experience, are aware of the dangers that may be brought to him when carrying out a certain operation, and can take measures to minimize the danger to himself or other personnel limit.
- Operators: operators other than trained personnel and professionals who may come into contact with the equipment.

## Grounding Requirements

- When installing the equipment that needs to be grounded, the protective ground wire must be installed first; when the equipment is removed, the protective ground wire must be removed last.
- It is forbidden to damage the grounding conductor.
- It is forbidden to operate the equipment without the grounding conductor installed.
- The equipment should be permanently connected to the protective ground. Before operating the equipment, check the electrical connections of the equipment to ensure that the equipment is properly grounded.

## General requirements



Before making electrical connections, make sure that the equipment is not damaged, otherwise it may cause electric shock or fire.

- 
- All electrical connections must meet the electrical standards of the country/region.
  - You must obtain the permission of the power department of the country/region in which it is located before it can be connected to the grid.
  - User-provided cables should comply with local laws and regulations.
  - Please use special insulating tools when working with high voltage.

## DC operation



It is forbidden to install or remove the power cord with power on. The moment the power cord contacts the conductor, an arc or spark will be generated, which may result in fire or personal injury.

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- Before the electrical connection of the equipment, if any live parts may be touched, the disconnecting device corresponding to the front stage of the equipment must be disconnected.
- Before connecting the power cord, make sure that the label of the power cord is correct.
- If the device has multiple inputs, all inputs of the device should be disconnected, and the device can be operated only after the device is completely powered off.

### **Wiring Requirements**

- The use of cables in a high temperature environment may cause the insulation layer to deteriorate and be damaged. The distance between the cable and the heating device or the periphery of the heat source area should be at least 30mm.
- Cables of the same type should be bundled together, and cables of different types should be laid at least 30mm apart. Do not twist or cross each other.

## **1.4 Installation Environment Requirements**

- It should be installed in a dry and well-ventilated environment to ensure good heat dissipation.
- It is recommended to choose a sheltered installation site or build a sunshade.
- Avoid direct sunlight or rain, the surrounding environment is clean, there is no large amount of infrared radiation, organic solvents and corrosive gases.
- The installation location is far away from the fire source.
- The installation location is not accessible to children.
- The installation location is far away from water sources such as faucets, sewer pipes, sprinklers, etc.
- The product should be fixed on the wall or a fixed object with a similar load to avoid tipping.

- It is recommended to install it under the eaves, garages, etc., to avoid the rain.
- The equipment needs to be on a firm, flat support surface.
- Do not place flammable and explosive materials around the device.
- When the device is running, do not cover the ventilation openings or the cooling system to prevent high temperature fire.
- Do not place the device in an environment with flammable, explosive gas or fumes, and do not perform any operations.

## 1.5 Shipping Requirements

- The operation and service life of the energy storage are related to the working temperature. Please install the energy storage at the same ambient temperature or better than the ambient temperature.
- The working environment temperature of this system is 0~50°C, and the system may run with reduced load in the environment exceeding 40°C.
- If the battery module is stored in a cold environment (eg 0°C) before installation, the battery module requires additional heating means before it can be charged. It is recommended to place the battery module in a relatively constant temperature and warm location before installation to help efficient debugging.
- When the ambient temperature where the product is located exceeds 45°C or is lower than 0°C, the battery charge and discharge power may be derated.

Certified by UN38.3 (UN38.3: Section 38.3 of the sixth Revised Edition of the Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria) (this product belongs to the ninth category of dangerous goods).

The products meet the transportation requirements of vehicles and ships. The transport box must be firm, and the outside of the box should meet the requirements of the national standard and should have signs such as "handle with care" and "moisture-proof". Affected by the external environment (such as temperature, transportation, storage, etc.), the specifications of the product are subject to the specific date of manufacture.

During transportation, avoid:

- Rain, snow directly hit or fall into the water
- Drop or mechanical shock



Caution

When the battery leaks or bulges, it is forbidden to transport, please contact a battery recycling company for disposal.

## 1.6 Installation and debugging

- When carrying heavy objects, be prepared to bear the weight to avoid being crushed or sprained by heavy objects.



- Wear protective gloves when handling equipment by hand to avoid injury.

When the device is powered on for the first time, the parameters must be correctly set by professionals. Incorrect settings may cause the device to be inconsistent with the country's certification and affect the device's normal operation.

## 1.7 Maintenance and replacement



Danger

During the operation of the equipment, there is high voltage, which may cause electric shock, resulting in death, serious personal injury or serious property damage. Therefore, before any maintenance work, the device must be powered off, and the operation must be carried out in strict accordance with the safety precautions listed in this manual and other related documents.

- Please maintain the equipment under the condition that you are familiar with and understand the contents of this manual and have suitable tools and test equipment.
- Before performing maintenance work, please power off the

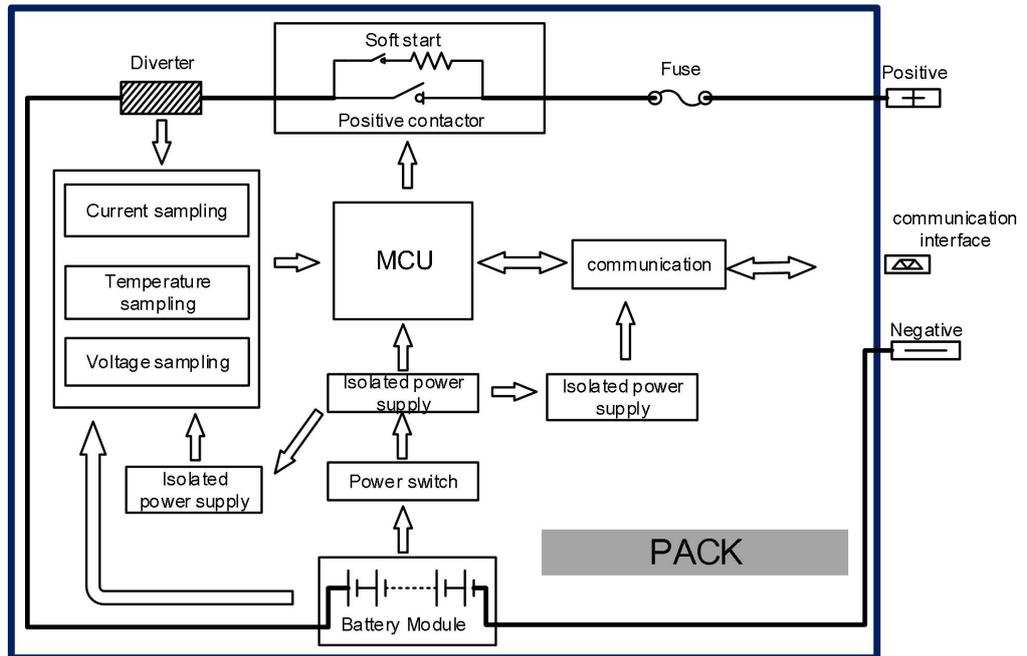
equipment, and then follow the instructions of the delayed discharge label, wait for the corresponding time, and ensure that the equipment is powered off before operating the equipment.

- In the maintenance process, please try to avoid irrelevant personnel from entering the maintenance site, and must erect temporary warning signs or fences for isolation.
- If the equipment fails, please contact your dealer in time to deal with it
- The equipment can be powered on again only after the fault has been dealt with, otherwise it may cause the fault to expand or the equipment to be damaged.
- Do not open the cover without authorization, otherwise there will be a risk of electric shock, and the resulting failure is not covered by the warranty.
- Operation and maintenance personnel and professional technicians should be fully trained in safe use and equipment maintenance, and should operate with adequate precautions and personal protective equipment.
- When it is necessary to move or rewire, the power input must be cut off. After waiting for 5 minutes, the internal energy of the machine has been discharged, and the maintenance can be started after confirming that there is no dangerous voltage on the DC bus and the parts to be repaired inside the machine with a multimeter.
- Repairs to batteries should be performed or supervised by personnel familiar with batteries and the precautions they require.
- When replacing the battery, please replace the battery module of the same type.
- Immediately after maintenance operations are completed, check to ensure that no tools or other parts are left in the equipment.
- If the device is not used for a long time, it is necessary to store batteries and supplementary power according to this manual.

## System block diagram

The following figure shows the system block diagram of a single battery pack. When multiple battery packs are installed in series, there are

contactors and fuses between the batteries for isolation. When a single battery is abnormal, it can be separately protected and disconnected without affecting other battery packs.



# 2 Product description

## 2.1 Product Introduction

### Model name

KY stacked battery module model is:KY-51V105AH-S.

Figure 2-4 Model Identification

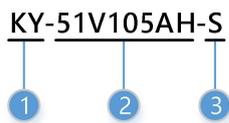


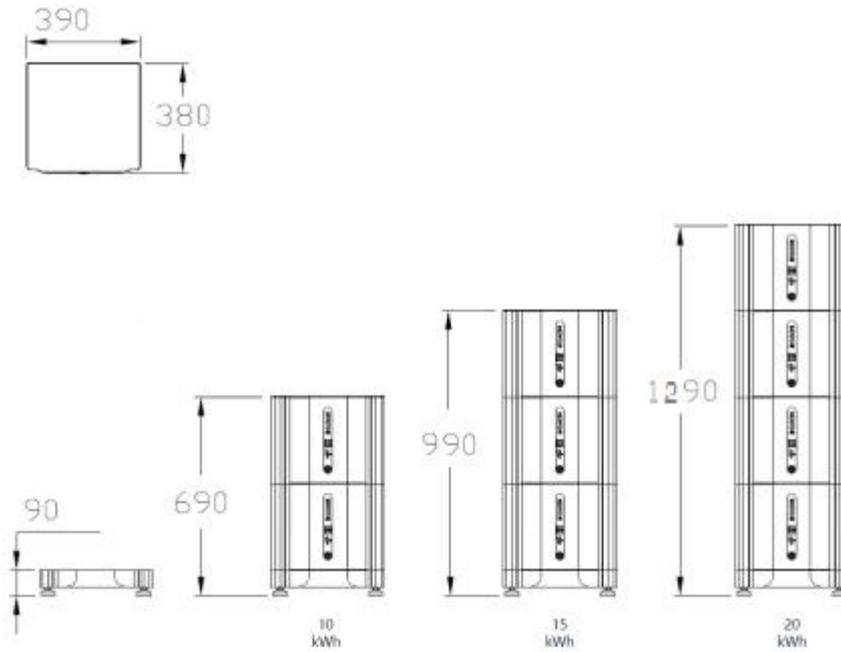
Table 2-4 Model description

Mark	Implication	Value
1	company abbreviation	KY : KOYOE
2	Cell parameters	51V105AH : The rated voltage of the module is 51V, and the battery capacity is 105AH
3	Cell category	S: Vertical stacked battery pack

### Description of energy storage capacity

For battery capacity expansion, need to increase the number of battery packs in series.

Figure 2-5 Schematic of stacking size

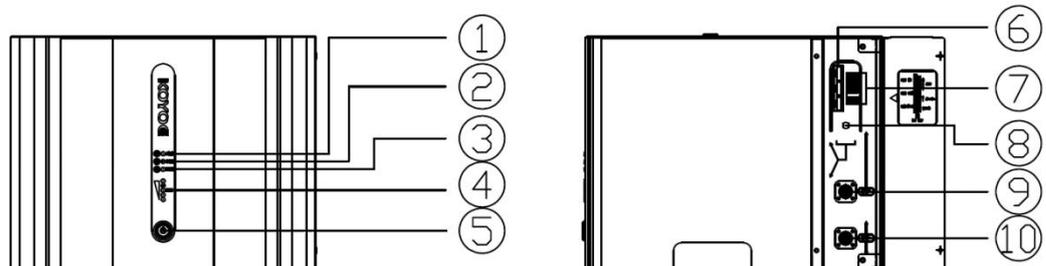


## 2.2 Appearance description

### Battery module

The standard capacity of the battery module is 5.3kWh.

**Figure 2-11** Battery module interface



( 1 ) Alarm indicator	( 2 ) Com indicator	( 3 ) Running indicator
( 4 ) SOC	( 5 ) Power button	( 6 ) CAN interface
( 7 ) DIP	( 8 ) +12VDC interface	( 9 ) BAT+
( 10 ) BAT-		

#### Explanation

The CAN interface is divided into CAN1 and CAN2, among which CAN1 is the communication interface between the battery modules, CAN2 is the communication interface between the battery modules.

## 2.3 Label Description

## Carton identification

Table 2-6 Carton identification description

Icon	Name	Meaning
	Anti-scalding warning signs	When the system is working, the shell temperature is high, there is a danger of burns, and it is strictly forbidden to touch it.
	Delay discharge identification	There is a high voltage after the energy storage is powered on, and there is still residual voltage after the energy storage is powered off. It takes 10 minutes to discharge to a safe voltage.
	High voltage identification	There is a high voltage after the energy storage is powered on. It must be carried out by a qualified professional electrical technician.
	Operation warning signs	The product must be powered off during operation.
	Save flag	Keep dry.
	Product description logo	Some components are recyclable.
	View instruction manual identification	Remind the operator to pay attention to the instruction manual of the energy storage Carton.
	Grounding sign	Protective ground connection location.

 Explanation

The icons are for reference only, please refer to the actual product.

## Nameplate

### Battery module nameplate

Figure 2-12 PACK nameplate

	
<b>Name (名称):</b>	Rechargeable Li-ion Battery
<b>Model (型号):</b>	KY-51V105AH-S
Serial Number (序列号)	
<b>Battery Cell (电芯)</b>	
Cell Technology (电芯技术)	Li-ion (LFP) (磷酸铁锂)
Capacity (容量) (Ah)	105
Cell Quantity (电芯串数) (pcs)	16
<b>Battery Parameters (电池参数)</b>	
Nominal Voltage (额定电压) (Vdc)	51.2
Rated Capacity (额定容量) (Ah)	105
Rated Energy (额定能量) (Wh)	5376
Max Voltage (最大电压) (Vdc)	58.4
Max Charge Voltage (最大充电电压) (Vdc)	56.8
Discharge Cut-off Voltage (放电截止电压) (Vdc)	46.4
Standard Charge Current (额定充电电流) (A)	50
Max Charge Current (最大充电电流) (A)	55
Standard Discharge Current (额定放电电流) (A)	50
Max Discharge Current (最大放电电流) (A)	55
<b>Others (其它参数)</b>	
Designation (认证命名)	IFpP/38/131/201/[16S]E/0+45/90
Dimension (尺寸) (mm)	390*380*300
Communication (通讯方式)	RS485/CAN
Protective Class (保护等级)	Class I
Ingress protection (防护等级)	IP54
Operation Temperature (工作温度) (°C)	0~50
Storage Temperature (储存温度) (°C)	-20~45
Humidity (湿度)	0~95%
Altitude (海拔) (m)	<2000
	
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# 3 System installation

## 3.1 Check before installation

### Check the outer packaging

Before unpacking the components of the energy storage system, check the outer packaging for visible damage, such as holes, cracks, or other signs of possible internal damage, and check the model number. If there is any abnormal packaging or model mismatch, do not open it and contact your dealer as soon as possible.

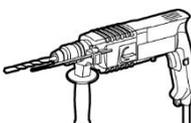
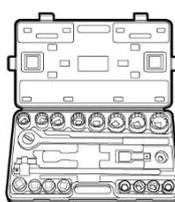
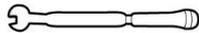
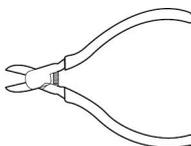
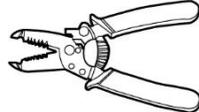
### Check delivery

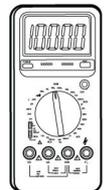
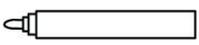
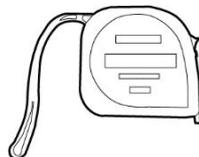
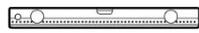
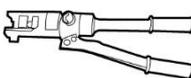
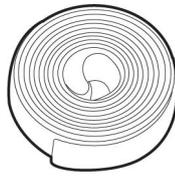
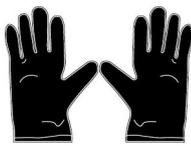
After unpacking the energy storage unit, check that the delivery is complete and free of any visible external damage. If anything is missing or damaged, please contact your dealer.

 Explanation

For the number of deliverables that come with the Carton, see the Packing List inside the Carton.

## 3.2 Preparation of tools and instruments

Tools and instruments		
 <p>Impact drill ( <math>\Phi</math>8mm )</p>	 <p>Torque socket wrench</p>	 <p>Torque wrench</p>
		  

Diagonal pliers	Wire stripper	Torque screwdriver
 <p>Rubber hammer</p>	 <p>Utility knife</p>	 <p>Wire cutters</p>
 <p>Crimping Tool</p>	 <p>Crimping Tool</p>	 <p>PV- MS-HZ Wrench</p>
 <p>Cable tie</p>	 <p>Vacuum cleaner</p>	 <p>Multimeter</p>
 <p>Marker pen</p>	 <p>Steel tape</p>	 <p>Level</p>
 <p>Hydraulic pliers</p>	 <p>Thermal casing</p>	 <p>Hot air blower</p>
 <p>Safety gloves</p>	 <p>Safety goggles</p>	 <p>Dust mask</p>

 Safety shoes	-	-
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### 3.3 Choose the installation location

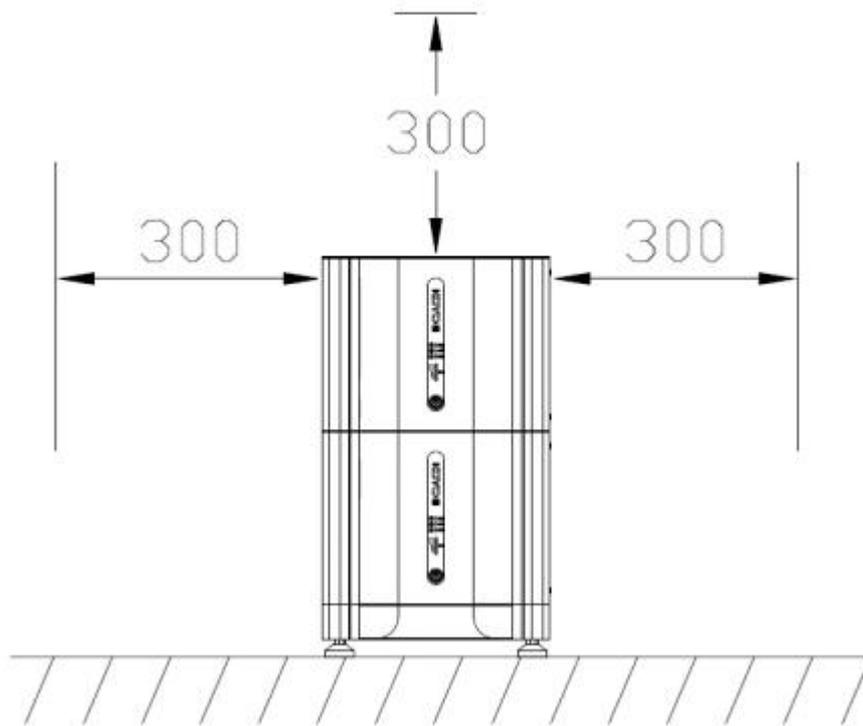
#### Basic requirements

- During the operation of the energy storage, the temperature of the chassis and heat sink will be relatively high, please do not install it in a place where it is easy to touch.
- Do not install in an area where flammable and explosive materials are stored.
- The energy storage will be corroded when installed in salt-damaged areas, which may cause fire. Do not install it outdoors in salt-damaged areas. The salt damage area refers to the area within 500m from the coast or affected by the sea breeze. The area affected by the sea breeze varies according to meteorological conditions (eg typhoons, monsoons) or topography (with dikes, hills).
- Do not install where children can touch.
- The cabinet must be placed horizontally and fixed on a solid ground such as cement. The integrated cabinet cannot be installed forward, horizontally, upside down, backward or sideways.

#### Installation space requirements

Ventilation and heat dissipation are very important to the battery system. In any case, a distance of at least 300mm from the left and right of the cabinet and at least 300mm from the top of the cabinet is required to ensure sufficient space for installation and heat dissipation.

**Figure 4-1** Installation space



 Explanation

The above space requirements are the minimum requirements, and the actual space requirements can be increased according to the actual environmental conditions.

## 3.4 Equipment installation

### Installation Instructions

 Explanation

Each module of the cabinet is shipped separately and sealed in a carton. Please ensure that the floor where the cabinet is placed meets the load-bearing requirements (1 battery module weighs 50kg). Users need to calculate the load-bearing capacity according to the purchased products.

#### Notice

- In order to prevent the dust from entering the human respiratory tract or falling into the eyes during drilling, the operator should wear protective glasses and dust masks.
- Use a vacuum cleaner to remove the dust inside and outside of all

holes, and then measure the hole distance. For holes with large errors, they need to be repositioned and drilled.

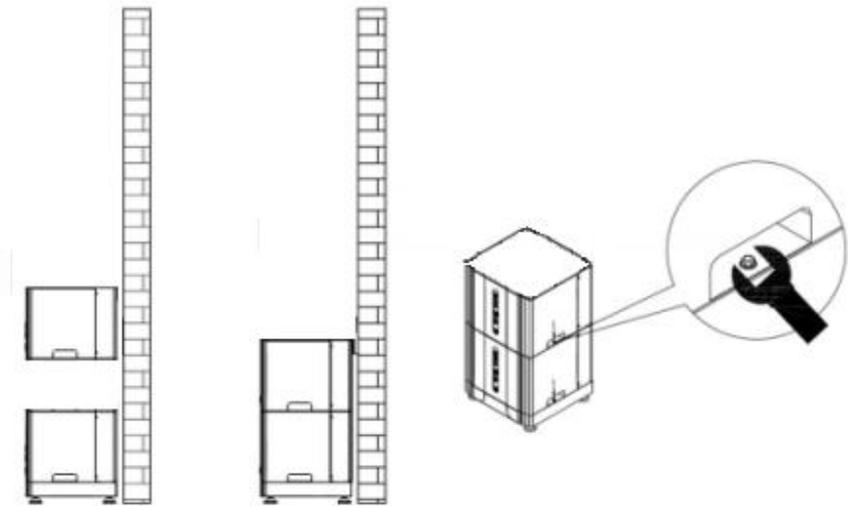
- The ground on which the stacker is installed must be flat and not protruding, otherwise it will be placed unevenly and cause the danger of tipping.

---

## Module installation

The installation sequence is from bottom to top.

**Figure 4-6** Installation diagram



Recommended placement against wall. The wall must have sufficient strength. Then choose a suitable position for the base, and then place the first battery module on the base with the limit hole. Make sure that the limit pin is aligned. , lock the fasteners on both sides, then install the battery packs from bottom to top, Finally, lock the screws on both sides.



**Warning**

After each module is placed, tighten the left and right fastening screws before installing the next module to prevent it from falling.

---

# 4 Electrical connections

## Precautions

### Danger

Before making electrical connections, please make sure the battery system is in the "OFF" state, and operation with power is strictly prohibited, otherwise the high voltage of the energy storage may cause electric shock.

### Warning

- Equipment damage caused by incorrect wiring is not covered by the equipment warranty.
- Operations related to electrical connection must be carried out by professional electrical technicians.
- When making electrical connections, operators must wear personal protective equipment.

### Explanation

The cable colors in all the electrical connection diagrams in this chapter are for reference only, and the selection of cables should comply with local cable standards (yellow-green bi-color wires can only be used for protective grounding).

## 4.1 Prepare the cable

Table 4-1 User-supplied cables

Number	Cable	Type	Recommended Specifications	Source
1	Ground wire	Single core outdoor copper core	<ul style="list-style-type: none"> <li>• 6mm<sup>2</sup> or equivalent</li> </ul>	User-provided

		cable		
--	--	-------	--	--

**Table 4-2** Cables shipped with battery module packaging carton

No.	Cable	Type		Source
1	Communication cable (between battery modules)	Outdoor shielded twisted pair		In wire harness packaging bag
2	Battery positive Cable	7awg Red		
3	Battery negative Cable	7awg Black		
4	Battery series Cable	7awg Red and Black		

 Explanation

- The selection of the minimum wire diameter of the cable should conform to the local cable standard.
- The factors that affect the selection of cables are: rated current, cable type, laying method, ambient temperature and maximum expected line loss.

## 4.2 External Electrical Connections

The connection between battery packs needs to be completed after all the stacking installations are completed, just connect the corresponding positions according to the wiring harness of the purchased product, and finally connect the output wires according to the actual required length and position.

The specific wiring is as follows:

**Table 4-4** Battery module connection table

Battery module interface	Docking interface	Explanation
BAT+	Connect BAT+ as a host As a slave, connect a module BAT-	Positive output of battery module

BAT-	As the host, connect to the next module BAT+ Connect BAT-	Negative output of battery module
CAN1	Connecting battery modules in series	Communication interface between battery packs
CAN2	Connect CAN interface	Communication interface between battery module and inverter

 Explanation

The wiring position in the picture in the actual product will have a definition mark for each wiring port, and you can connect according to the corresponding mark when wiring.

The interfaces shown in the figure are all functional interfaces of the system. The actual product may be deleted according to the function of the product. You can select the wiring according to the function of the product you purchased.

 Warning

All ports marked with "+" and "-" must be connected as required, otherwise it may cause danger.

## 4.2.1 Install the cable

### Precautions

 Danger

Please make sure that the protective ground wire is connected reliably. If it is not connected or loose, it may cause electric shock.

 Explanation

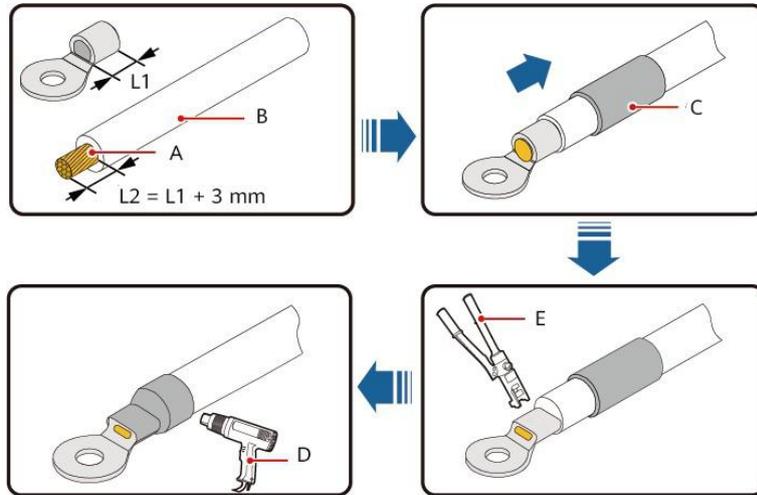
It is recommended to apply silica gel or paint on the outside of the ground terminal for protection after the ground wire is installed.

### Harness production

If you need to crimp the OT terminal, you can crimp as shown in the

figure below. The specification and model should be selected according to the wire used.

**Figure 4-1** Schematic diagram of crimping OT terminals



- ( A ) Core                      ( B ) Insulation                      ( C ) Thermal casing  
 ( D ) Hot air blower              ( E ) Hydraulic pliers

### Notice

- When stripping the wire, do not scratch the wire core.
- The cavity formed after the conductor crimping piece of the OT terminal is crimped should completely cover the wire core, and the wire core should be tightly combined with the OT terminal without loosening.
- The crimping place can be covered with heat shrinkable sleeve or insulating tape. Take heat shrink tubing as an example.
- The specifications of wires and heat-shrinkable tubes used are determined according to the type of wire harness actually produced.
- In the process of using the hot air blower, please pay attention to protection to prevent the equipment from being burnt.
- It is not recommended to use hard cables such as armored cables for DC input cables.
- Before assembling the DC connector, make sure that the polarity of the cable is correct, and label the positive and negative cables.
- After crimping the positive and negative metal terminals, pull back the DC input cable so that it does not fall off to ensure that the cable connection is tight.

After the wiring harness is made, it can be connected according to the wiring mark one by one. After all power wiring harnesses and communication lines are connected, check them according to the wiring diagram to prevent wrong connections.

### Ground wire installation

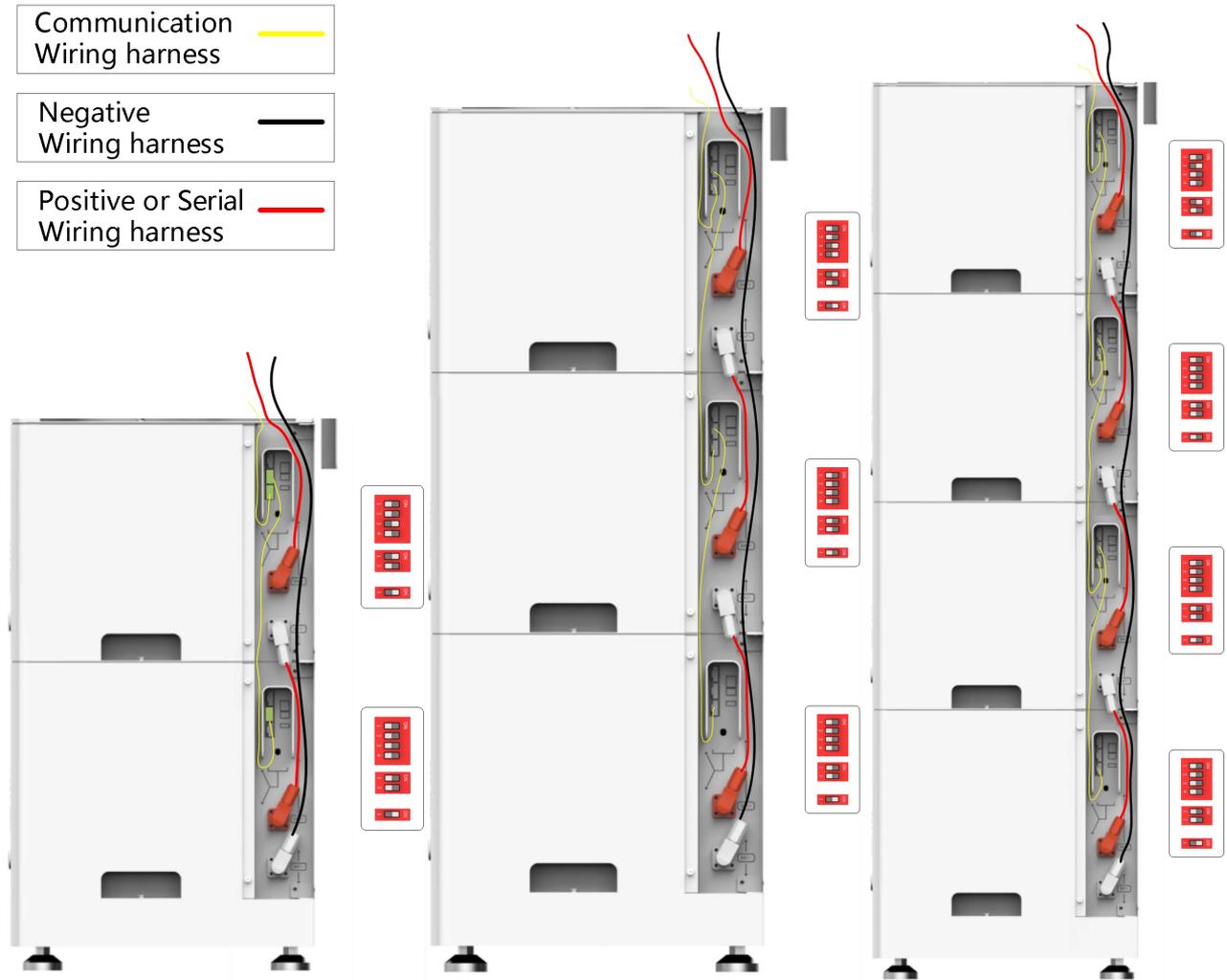
Connect the screw hole marked with the ground wire mark  on the base to the ground with a crimped ground wire, and ensure that the grounding is reliable. The grounding position is shown in the figure below.



#### Explanation

After the ground wire is installed, apply silicone or paint on the outside of the ground terminal for protection.

## 4.2.2 Wiring and DIP Switch Diagram



# 5 System debugging

## 5.1 Check before power-on

Table 5-1 Inspection items and acceptance criteria

Number	Check item	Acceptance Criteria
1	Module installed in place	The installation is correct and the docking is reliable.
2	Reasonable cable arrangement	The cable layout is reasonable to meet user requirements.
3	Beautiful cable ties	The cable ties should be uniform, and there should be no sharp corners at the cut.
4	Reliable grounding	The ground wire is connected correctly and firmly.
5	The installation environment meets the requirements	The installation space is reasonable, the environment is clean and tidy, and there is no construction residue.

## 5.2 System power on

### Notice

- After the battery module is unpacked, if it is not installed immediately, the Power button must be turned off.
- Press and hold the battery module Power button for 3S to start, the system power-on steps should start from the slave machine, and finally turn on the host computer.

### Battery Power button Instructions

The battery Power button is a self-reversing switch, and it needs to be

pressed for 3 seconds to start normally. The specific operation is: press and hold the Power button, the green indicator light on the button will light up, and after 3 seconds, the LED indicator RUN will light up, which means the battery pack starts normally. , you can release the button, and the same operation is performed when it is turned off. Press and hold the Power button until the RUN light turns off, indicating that the shutdown is successful. Release the Power button and the battery will be powered off.

When the system is running normally, the battery module cannot be turned off by long-pressing the slave Power button, and it can be turned off only by operating the master. When the communication is normal, all slaves in the master system are also turned off, and there is no need to repeatedly operate the slaves.

## 5.3 Battery DIP Instructions

**Table 5-2 Master and Slave DIP Code Description**

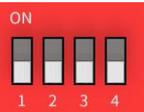
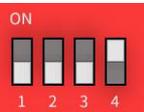
DIP icon	Master-slave
	Slave
	Master

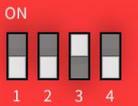
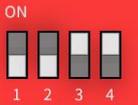
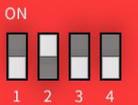
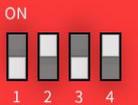
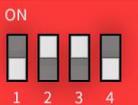
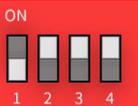
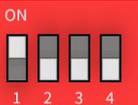
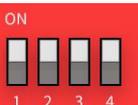
 Explanation

In addition to the above two dialing methods, the other dialing methods are used as error dialing, and the battery pack fails to work normally.

There can only be one master in a stacking system, and the number of slaves can be increased according to the actual configuration.

**Table 5-3 Address DIP Code Description**

DIP icon	Binary	Number of system battery packs
	0000	0 ( Fault )
	0001	1

	0010	2
	0011	3
	0100	4
	0101	5
	0110	6
	0111	7 ( Fault )
	1000	8 ( Fault )
	1001	9 ( Fault )
	1010	10 ( Fault )
	1011	11 ( Fault )
	1100	12 ( Fault )
	1101	13 ( Fault )
	1110	14 ( Fault )
	1111	15 ( Fault )

 Explanation

This dial only operates on the master, and the slave does not do any

action. On the master, it represents the number of battery packs in the current stacker system, and the minimum number of battery packs is 1, The maximum number of battery packs is 6.

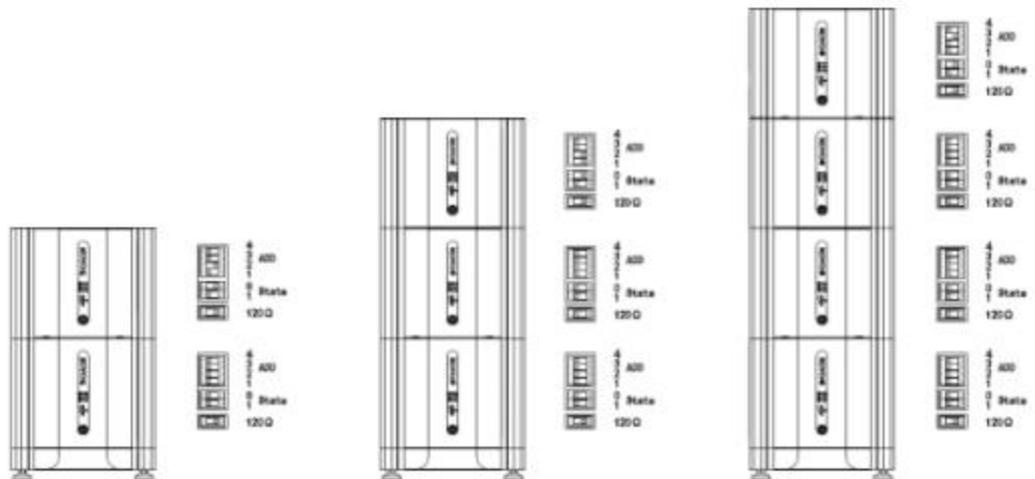
**Table 5-4** Description of matching resistance dial

DIP icon	Definition
	Resistor not enabled
	Resistor enabled

 Explanation

This dial is used to match the resistance of the communication. This dial must be enabled on the host and the slave at the bottom to ensure normal and reliable communication between the battery modules. The dial code is shown in the figure below.

**Figure 5-1** DIP diagram of battery module



## 5.4 LED Indicator Description

**Table 5-5** LED Indicator

Classification	State		Definition
Battery module master	RUN light flashes	COM light flashes	PACK allocation address
	NA	Steady red	Failure mode

	RUN light is always on	SOC display, COM light flashes	Normal mode SOC represents 20% per grid
Battery module slave	RUN light is always on	SOC display, COM light flashes	Normal mode SOC represents 20% per grid
	RUN light is always on	SOC light is off	PACK allocation address
	RUN light is always on	Steady red light	Failure mode

### Battery information monitoring

The battery pack is connected with the inverter through CAN communication. The voltage, current, temperature and other information of the battery can be monitored and displayed through the inverter.

# 6 System maintenance

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## 6.1 Power off the system

### Precautions



- After the system is powered off, there is still residual power and residual heat in the internal chassis, which may cause electric shock or burns. Therefore, 10 minutes after the system is powered off, wear protective gloves before operating the energy storage. Make sure that all indicator lights of the energy storage system are off before performing maintenance on the energy storage system.
- 

### Steps

- To start the system, firstly close all the external isolation switches between inverter and battery modules if possible, and secondly long press the power button on the front panel of each battery module. Please turn on all the battery modules from bottom to top if there are more than 3 modules.
- To turn off system, firstly trip or open all the external isolation switches between inverter and battery modules if possible, and secondly long press the power button on the front panel of battery module until the RUN indicator is off. Please turn off all the battery modules from top to bottom if there are more than 3 modules.

## 6.2 Routine maintenance

To ensure the long-term good operation of the energy storage system, it is recommended to perform routine maintenance on the system as described in this chapter.



Caution

When performing maintenance on system cleaning, electrical connection, and grounding reliability, the system must be powered off first.

**Table 6-1** Maintenance List

Check the content	Inspection Method	Maintenance cycle
System cleaning	Check whether the heat sink at the bottom of the PACK is blocked and dusty.	Once every six months to one year.
System operating status	<ul style="list-style-type: none"> <li>Observe whether the appearance of the energy storage is damaged or deformed.</li> <li>Listen to see if there is any abnormal sound during the operation of the energy storage device.</li> <li>When the energy storage is running, check whether the parameters of the energy storage are set correctly.</li> </ul>	Once every six months.
Electrical connections	<ul style="list-style-type: none"> <li>Check whether the cable connection is disconnected or loose.</li> <li>Check whether the cable is damaged, and focus on checking whether the skin of the cable in contact with the metal surface has any traces of cuts.</li> <li>Check whether the unused DC input terminals and COM ports are locked.</li> </ul>	Half a year after the first commissioning, and once every six months to a year thereafter.
Ground reliability	Check whether the grounding cable is reliably grounded.	Half a year after the first operation, and once every six months to a year thereafter.

## 6.3 Battery storage and recharge

### Battery Module Storage Requirements

- When the battery module is stored, it should be placed correctly according to the label of the packing carton, and should not be placed upside down or sideways.
- When the battery module packaging carton is stacked, they should meet the stacking requirements on the outer packaging.
- When handling the battery module, it is required to handle it with care, and it is strictly forbidden to damage the battery module.
- Storage environment requirements:
  - Ambient temperature:  $-10\text{ }^{\circ}\text{C} \sim 55\text{ }^{\circ}\text{C}$  , recommended storage temperature:  $20\text{ }^{\circ}\text{C} \sim 30\text{ }^{\circ}\text{C}$ .
  - Relative humidity:  $5\%RH \sim 80\%RH$ .
  - Dry, ventilated, clean.
  - Avoid contact with corrosive organic solvents, gases and other substances.
  - Avoid direct sunlight.
  - The distance from the heat source should not be less than two meters.
- When the battery module is stored, it must be disconnected from the outside, and the Power button on the panel must be turned off.
- The AC mains input voltage of the supplementary power grid: single-phase grid  $220\text{V}/230\text{V}/240\text{V}$ ,  $\pm 10\%$ , three-phase voltage:  $380\text{V}/400\text{V}$ ,  $\pm 10\%$ .
- The storage of battery modules should be counted monthly. For batteries whose storage time is close to 12 months ( $-10\text{ }^{\circ}\text{C}$  to  $25\text{ }^{\circ}\text{C}$ ), 9 months ( $25\text{ }^{\circ}\text{C}$  to  $35\text{ }^{\circ}\text{C}$ ) or 6 months ( $35\text{ }^{\circ}\text{C}$  to  $55\text{ }^{\circ}\text{C}$ ) module, and arrange for supplementary power in time.
- When using the stored battery modules, the principle of first-in, first-out should be followed.
- The battery module needs to be replenished to at least 50% SOC before long-term storage.

### Expired Storage Judgment Conditions

In principle, it is not recommended to store battery modules for a long time,

and they should be used in time. Stored battery modules should be handled as follows.

**Table 6-2** Lithium battery replenishment cycle

Storage temperature requirements	Actual storage temperature	Recharge cycle	Remark
-10°C < T < 55 °C	$T \leq -10^{\circ}\text{C}$	Not allowed	During the replenishment cycle: no treatment, use as soon as possible Reaching the time of replenishment: Replenishment processing The total storage time cannot exceed the warranty time
	$-10^{\circ}\text{C} < T \leq 25^{\circ}\text{C}$	12 months	
	$25^{\circ}\text{C} < T \leq 35^{\circ}\text{C}$	9 months	
	$35^{\circ}\text{C} < T \leq 55^{\circ}\text{C}$	6 months	
	$55^{\circ}\text{C} < T$	Not allowed	

- If the battery module is deformed, damaged or leaked, it will be scrapped directly, regardless of the storage time.
- The storage time is calculated based on the latest charging time marked on the recharge label on the outer package of the battery module. After the battery module is recharged, refresh the last charging time and the next charging time on the supplementary label (the next charging time = the most recent charging time). One charge time + replenishment cycle).
- The maximum allowable period and number of times to store and replenish power is 3 years or 3 times, such as: replenishment once every 8 months, the maximum allowable 3 times; replenishment once every 12 months, the maximum allowable 3 times; The allowable period and number of times suggest that the battery module should be scrapped.
- Long-term storage of lithium batteries will cause capacity loss. After lithium batteries are stored at the recommended storage temperature for 12 months, the general irreversible capacity loss is 3% to 10%. If the customer conducts the discharge test and acceptance according to the specification, there is a risk of failing the test for battery modules with a capacity less than 100% of the rated capacity after storage.

## Battery module pre-charging inspection

- The appearance inspection of the battery module is required before the battery module is replenished, and the battery module that passes the inspection can be recharged for the next step, and the unqualified battery module is discarded.
- If the battery module does not have any of the conditions listed below, it will be judged as passing the appearance inspection.

Deformation of the battery module

Damaged battery module casing

Battery module leaks

## Battery module charging instructions

The KY energy storage inverter can supplement the battery module, and select the forced charging mode when supplementing the power.

If you use other charging equipment to supplement the power, you need to choose professional energy storage battery charging and discharging equipment, and have a professional to operate, if the battery damage caused by the use of non-Kyoyao charging equipment is not covered by the warranty.

# 7 FAQs

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## 7.1 SOC Change Description

1、When the battery is nearly full, the SOC rises more and more slowly?

When the SOC is greater than 90%, it will enter the current-limiting state, and the charging current will gradually decrease, so the SOC rise speed will slow down, and finally the SOC will reach 100%.

2、The battery has been turned off for a period of time, and the SOC is different from before when it is turned on again?

When the battery is standing for a period of time, the battery management system will correct the SOC according to the current temperature and voltage. Occasional SOC changes are normal. This can improve the SOC accuracy.

3、During the charging and discharging process of the battery, the SOC will suddenly change to 0 or 99%?

During the charging process, the SOC will be forcibly corrected according to the single-cell voltage. If the SOC suddenly changes to 99%, it means that the current highest cell voltage reaches 3.55V, which means that the battery is fully charged and the SOC is forced to be corrected. Perform SOC low correction.

# A Abbreviation

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<b>A</b>	
<b>APP</b>	application
<b>B</b>	
<b>BCU</b>	battery control unit
<b>BAT</b>	battery
<b>C</b>	
<b>COM</b>	communication
<b>D</b>	
<b>DC</b>	direct current
<b>E</b>	
<b>EMI</b>	Electromagnetic Interference
<b>P</b>	
<b>PACK</b>	Battery pack
<b>S</b>	
<b>SOC</b>	State of Charge