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Energy Storage System

ESI215-100K-M

User Manual

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Foreword

Summaries

Thank you for choosing the energy storage system product!

This document gives a description of the energy storage system ESI215-100K-M, including the features, performance, appearance, structure, working principles, installation, operation and maintenance. etc.

Please save the manual after reading, in order to consult in the future.

NOTE
The figures in this manual are just for illustration, details please take the actual product as standard.

Target Group

- User
- Technical support engineer
- Installation engineer
- Debugging engineer
- Maintenance engineer

Suitable Model

- ESI215-100K-M

Symbol Conventions

The manual quotes the safety symbols, these symbols used to prompt users to comply with safety matters during installation, operation and maintenance. Safety symbol meaning as follows.

Symbol	Description
	Alerts you to a high risk hazard that will, if not avoided, result in serious injury or death.
	Alerts you to a medium low risk hazard that could, if not avoided, result in moderate or minor injury.
	Alerts you to a low risk hazard that could, if not avoided, result in minor injury.
	Anti-static prompting.
	Be care electric shock prompting.
TIP	Provides a tip that may help you solve a problem or save time.
NOTE	Provides additional information to emphasize or supplement important points in the main text.

Change History

Record the content of each document update. The latest version contains the updates of all previous document versions.

Issue 01 (2024-01-19)

First issue.

Contents

1 Safety Description

This chapter mainly introduces the safety announcements. Prior to performing any work on the device, please read the user manual carefully, follow the operation and installation instructions and observe all danger, warning and safety information.

1.1 Safety Announcements

CAUTION

Before operation, please read the announcements and operation instructions in this section carefully to avoid accident.

The promptings in the user manual, such as "Danger", "Warning", "Caution", etc. don't include all safety announcements. They are just only the supplement of safety announcements when operation.

NOTE

Any device damage caused by violating the general safety operation requirements or safety standards of design, production, and usage will be out of Kehua's guarantee range.

1.1.1 Use Announcements

DANGER

Damaged device or device fault may cause electric shock or fire!

- Before operation, please check if the device is damaged or has other danger.
- Check if the external device or circuit connection is safe.

DANGER

Don't touch terminals or conductors that connected with grid to avoid lethal risk!

WARNING

Please do not put finger or tool into the rotating fans to avoid human injury or device damage.

CAUTION

The product is grade A device. If the product is used in residential area, it may cause wireless interference. User should take actions to avoid the interference.

1.1.2 Symbol Illustration

WARNING

The warning labels on the energy storage system and in the cabinet include the important information related to the device safe operation. DO NOT tear them up.

The illustration for the labels of energy storage system is as shown in Table1-1.

Table1-1 Symbol illustration

Symbol	Illustration
	Observe the user manual.
	There is dangerous voltage which may endanger human safety, be care of electric shock.
	After powering down, please wait for 10min to make the device discharge completely.
	Do not dispose the device together with the household waste but in accordance with the disposal regulations for electronic waste applicable at the installation

Symbol	Illustration
	site.
	Pay attention to safety
	External grounding mark. It needs to be connected with grounding to keep the operator safe.
	Beware of hot surface. While operating, the temperature of air outlet may be high, do not touch the air outlet louver to avoid scald.
	Take precautions against noise. Please wear the hearing protection equipment.

1.1.3 Battery Use Announcements

Lethal high voltage exists in the negative and positive of energy storage batteries, touching by accident will cause electric shock even endanger human safety.

DANGER

When maintaining the device, make sure that the connection between the PCS and energy storage battery has been disconnected completely. And set warning mark in the disconnected position to avoid reconnecting by accident.

DANGER

There is lethal high voltage between the positive and negative poles of batteries, DO NOT short circuit the positive and negative poles, once short circuit, the battery will generate large current and release a large number of energy, even cause battery thermal runaway, firing or explosion. To avoid battery circuit, DO NOT maintenance the battery with electricity.

DANGER

DO NOT place the battery under the environment where with high temperature or heating device, such as resistance furnace, boiler etc. Battery over-temperature is easy to cause leakage, smoking, releasing flammable gas, thermal runaway, firing or explosion.

DANGER

DO NOT dismantle, transform or damage the battery (such as impale the battery with sharp object, crush with dead weight or water logged, falling off, collision, etc.) to avoid causing electrolyte leakage, smoking, release flammable gas, thermal runaway, firing or explosion.

DANGER

DO NOT use the battery modules with different type together.

DANGER

The battery electrolyte is toxic and with volatility. When the electrolyte is spilled or with abnormal gas, please avoid touching the spilled electrolyte or gas. DO NOT approach unless professionals. Please contact the professionals immediately to deal with it.

DANGER

The gas generated from burning battery is harmful to eyes, skin and throat, please attention to the protection.

WARNING

Before installing the energy storage system, please configure the fire-fighting device according to the construction standards, such as fire-fighting sands, carbon dioxide extinguisher, etc. Before commissioning, ensure that the fire-fighting device has satisfied the requirements of local laws and regulations.

WARNING

Fasten the screws of copper bars and cables by specified moment of force, and check the screws' condition regularly. The false connection of the screws will cause the connection voltage drop to be too large, and even a large amount of heat will burn the battery when the current is large.

NOTE

When first startup, if the battery temperature is too low, SOC saltation may occur at the end of charge and discharge. The phenomenon is normal and not affect the normal operation. We suggest that keep the battery's temperature return to above 15℃ as far as possible and then start to discharge.

1.1.4 Grounding Requirements

WARNING

High leakage risk! Device must be grounded before performing electrical connection. The grounding terminal must be connected to ground.

- When installing, the device must be grounded first. When dismantling, the grounding wire must be removed at last.
- Don't damage the grounding conductor;
- The device should be connected to the protection earth permanently. Before operation, it should check the electrical connection to ensure the device is grounded reliably.

DANGER

In the event of grounding fault in the energy storage system, some part that should not be charged may have lethal voltage, and touch by accident will cause serious damage. Before installation and operation, ensure that there is no system grounding fault and take appropriate protective measure.

1.1.5 Electrical Connection

The electrical connection must be performed strictly according to the description and wiring principle diagram in the user manual and labels on the energy storage system.

WARNING

The configuration and technical specifications (such as voltage, current, etc.) of energy storage batteries, must meet the technical requirements of the energy storage system.

Grid-tied operation should be allowed by the local power supply department and the related operation should be performed by professionals.

All electrical connection must meet the electrical standards of the country or local region where the project located.

1.1.6 Measurement Under Operation

CAUTION

There exists high voltage in the device. If touching device accidently, it may cause electric shock. So, when perform measurement under operation, operator must be accompanied by someone and take protection measure (such as wear insulated gloves, etc.).

The measuring device must meet the following requirements:

- The range and operation requirements of measuring device meets the site requirements;
- The connections for measuring device should be correct and standard to avoid arcing.

1.1.7 ESD Protection

⚠ CAUTION

The static produced by human body may cause the sensitive components on the PCB damage.

- Avoid unnecessary touch for PCB.
- Wear an anti-static wrist strap before touching sensitive components, and the other end should be well grounded.

1.1.8 APP Parameter Setting

Parameter setting is closely related to the operation of energy storage system, so the setting should be performed after estimating.

- Improper parameter setting may affect the function of energy storage system.
- Only qualified professional can perform the parameter setting.

1.1.9 Moisture-proof and Sand-proof Protection

⚠ CAUTION

Moisture or sand incursion may cause the energy storage system damage!

Observe the following items to ensure the energy storage system works normally.

- When the air humidity is more than 95% or under the circumstance of sand storm, strong wind, hailstone, etc., don't open the door of the energy storage system.
- In the wet or damp weather, don't open the door of energy storage system to maintain or repair.

1.1.10 Safety Warning Mark Setting

In order to avoid accident for unwanted person getting close to inverter system or makes improper operation, it should observe the following requirements when perform installation, daily maintenance or repair.

- Set warning marks at the battery connection and grid connection of energy storage system to avoid switching on the breakers improperly.

- Set warning signs or safety warning belt in the operation area, which is to avoid unwanted person entering and cause human injury or device damage.
- After maintenance, ensure that pull out the key of energy storage system and save it properly.

1.2 Operator Requirements

⚠ CAUTION

The operation and wiring for energy storage system should be performed by qualified person, and ensure the electrical connection meets the related standards.

Before installing, operating and maintenance, the operator must understand the safety announcements, know correct operations and be trained strictly. The operator should meet the following requirements.

- With a certain knowledge of electrical connection, mechanical installation, and familiar with the electrical and mechanical principle.
- Be fully familiar with the constitution and operating principle of whole energy storage system.
- Be familiar with the structure and operating principle of connected device of energy storage system.
- Trained by professional electrical operation, installation and debugging.
- Can handle with the emergency conditions while installing, debugging.
- Be familiar with the related country and district standard.
- Be familiar with the illustrations in the user manual.

1.3 Others

- For the energy storage system are also installed far away from downtown, please prepare the emergency rescue facilities in advance.
- Take all possible auxiliary measures to ensure the safety of personnel and device.

2 Overview

This chapter mainly introduces the device features, appearance, operating mode, etc.

2.1 Product Intro

The product is the energy storage system with system power of 100kW/215kWh. The product matches with battery and management system to form a integrated system, the output end connects with 400Vac low-voltage AC grid to charge and discharge the battery, which realize the energy storage and backup. It can be used in the scene of small and medium-sized businesses (store, supermarket, porterhouse, hospital, etc.) small and medium-sized factories and charging stations, etc.

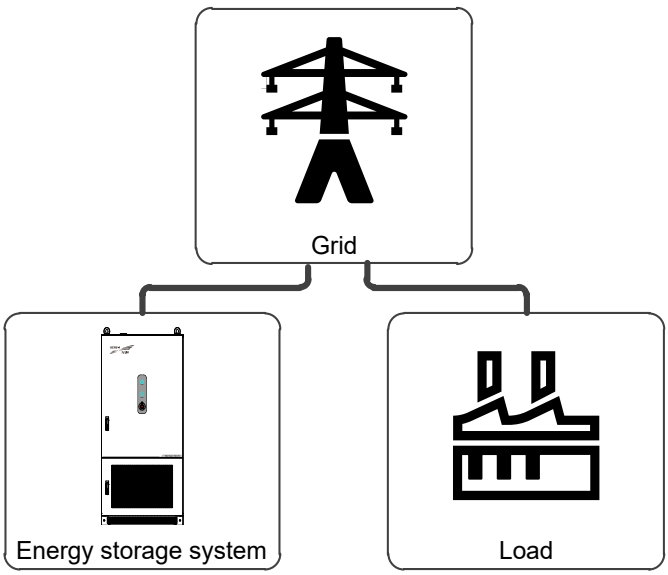


Figure2-1 Energy storage system constitution

CAUTION

Grid-tied operation of energy storage system needs to obtain the permission of local power supply department and performed by professionals.

The AC side of energy storage system should be connected with IT distribution system (as shown in Figure2-2).

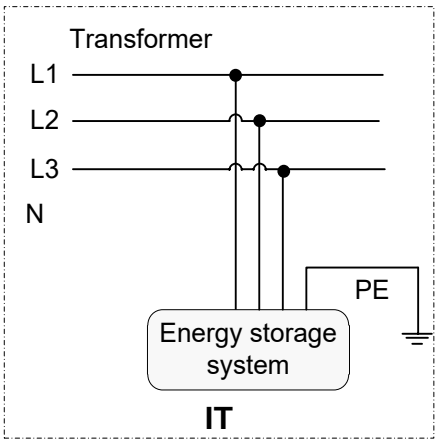


Figure2-2 Supported grid form of energy storage system

2.1.1 Model Meaning

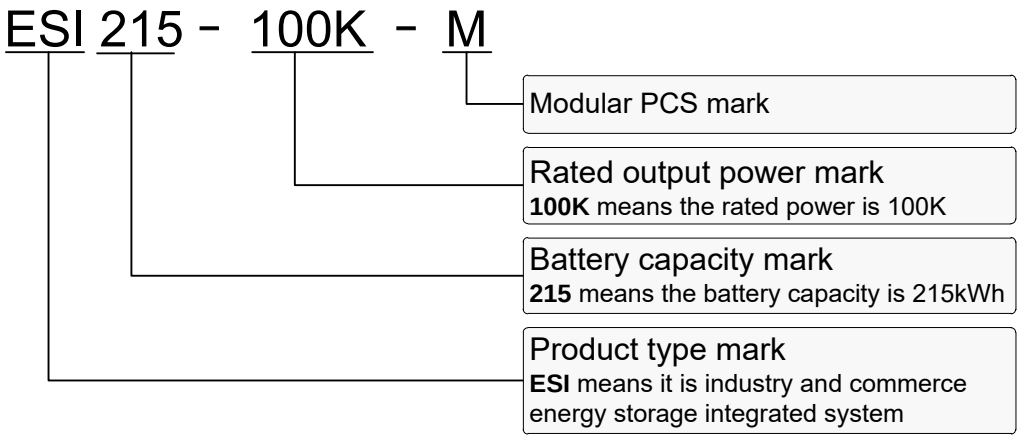


Figure2-3 Model meaning

Model Identification

By the nameplate inside the front door (position as shown in Figure2-4), user can view the device model, key technical specification, and scan the QR code to get the related product information.

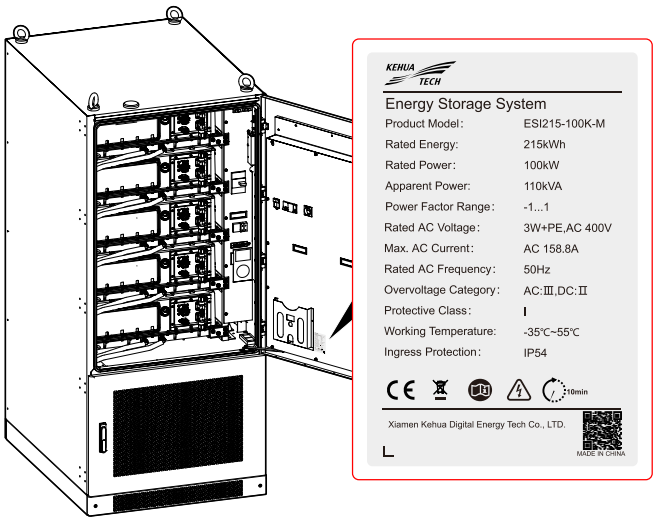


Figure2-4 Nameplate position diagram

NOTE

The parameters in the above nameplate are just for reference, detailed technical specifications please see the actual product.

2.1.2 Features

Innovative Structure Design

- With small volume, high power density, the footprint is small.
- The modules adopt front pull-out maintenance, easy to replace.
- Front air inlet, rear air outlet, adopt independent heat dissipation air flue.

Safe and Reliable

- Double fire-fighting of Pack and system.
- Three-level explosion-proof of cell, pack and energy storage system.
- Double insulation detection: BMS insulation + PCS insulation detection.
- Two-level BMS safe redundancy management, ensure the battery operating safely.

Smart Management

- Smart liquid-cooling, perfect heat dissipation, effectively decrease the temperature different and enhance the battery use ratio.
- System adopts multi-level linkage design to achieve smart control and protection.

Stable System Character

- With good adaptability to grid, the output power quality is excellent.
- Reactive power is adjustable, the power factor range is -1 (lagging) ～+1 (leading).
- The cabinet with IP54 outdoor design, reliable and durable, can be suitable for complex climate condition.

2.1.3 Application Scene

The output of energy storage system can connect with grid and load, it supports the function of grid-tied and off-grid, corresponding application scene is as shown in Figure2-5, Figure2-6.

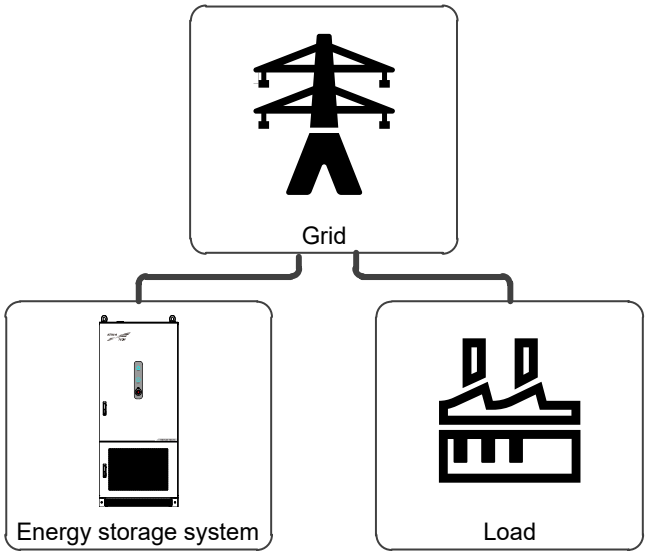


Figure2-5 Grid-tied application diagram

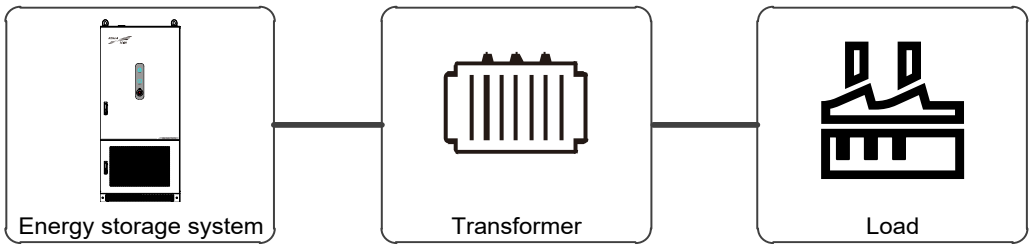


Figure2-6 Off-grid application diagram

NOTE

If the energy storage system is used in off-grid mode, it needs to match the isolation transformer or Kehua's switch cabinet to use.

2.2 Appearance and Structure

2.2.1 Appearance

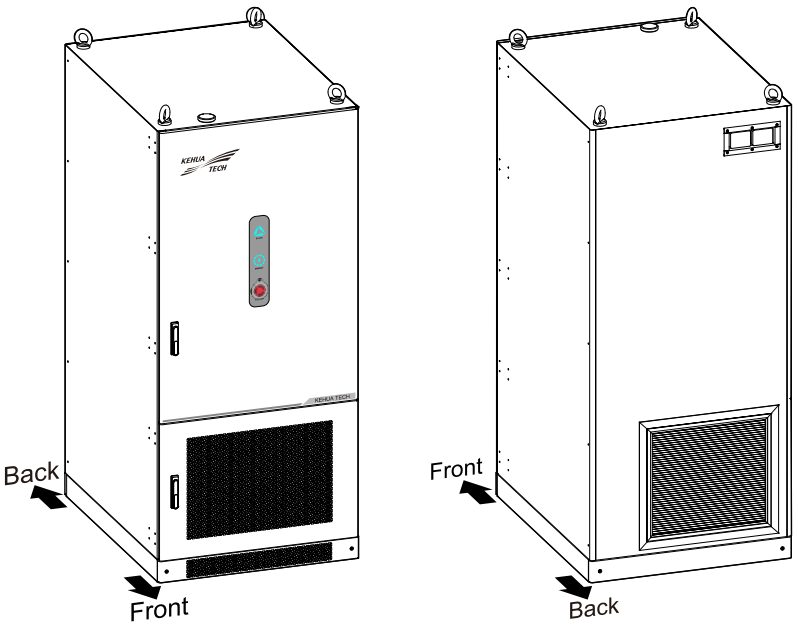


Figure2-7 Appearance

The operation panel of energy storage system is as shown in Figure2-8, corresponding illustration please see Table2-1.

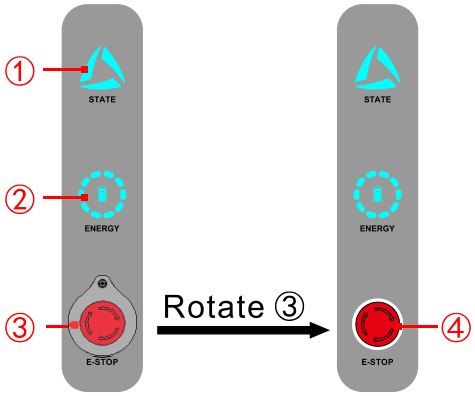


Figure2-8 Operation panel

Table2-1 Illustration for operation panel

No.	Silk screen	Name
①	STATE	Running status indicator
②	ENERGY	Charge & discharge status and battery capacity indicator

No.	Silk screen	Name
③	--	Anti-misoperation cover
④	E-STOP	E-STOP emergency stop button

NOTE

In order to avoid misoperation, E-STOP designs an anti-misoperation cover. When is needs to be operated, please rotate the cover to left (or right) and then press the E-STOP button.

WARNING

- E-STOP button is just for the use of energy storage system in fault or in emergency. When normal operation, please perform the OFF operation via APP (details see **5.3.5 ON**/OFF Setting).
- Improper use of E-STOP button may cause damage to the energy storage system. If the E-STOP button is used under load, it will bring high pressure to the related components of energy storage system. Frequent use may damage he button.
- When only the E-STOP button is pressed down, the internal AC and DC side terminals still live and there is still fatal high voltage inside the energy storage system.

CAUTION

After using the E-STOP button, if the energy storage system needs to recover normal operation, please upspring the E-STOP button in clockwise and power on the energy storage system according to 6.5 Recover Operation of Emergency Stop.

The indicator status illustration of energy storage system is as shown in Table2-2.

Table2-2 Indicator status illustration

Indicator	Status	Illustration
	Blue indicator on	Energy storage system is running.
		Energy storage system standby or OFF.

Indicator	Status	Illustration
	Flickers in blue (frequency: 1s)	
	Red indicator on	Energy storage system abnormal and with import alarm.
	Off	AC and DC power has been disconnected.
	Blue flow indicator	• Charging. • Shows the battery capacity.
	Blue breathing indicator	• Discharging. • Shows the battery capacity.

NOTE

There are 10 grids around the ENERGY indicator, with 10% battery capacity as one grid. The grid of existing electricity is always on.

- During charging, the existing battery capacity light on, and the remaining position to be charged is displayed in a cyclic manner with flow indicator.
- During discharging, the grid corresponding to the highest remaining power is dynamically displayed in the form of a breathing indicator (frequency: 1s), and the grid indicator without power goes out.

2.2.2 Structure Layout

The energy storage system adopts compartment design, the upper is battery cabin, the bottom is electric cabin. The fire extinguishing of cabinet adopts aerosol, and equips with smog sensor and leak detection controller. The structure layout is as shown in Figure2-9, corresponding component illustration is shown in Table2-3.

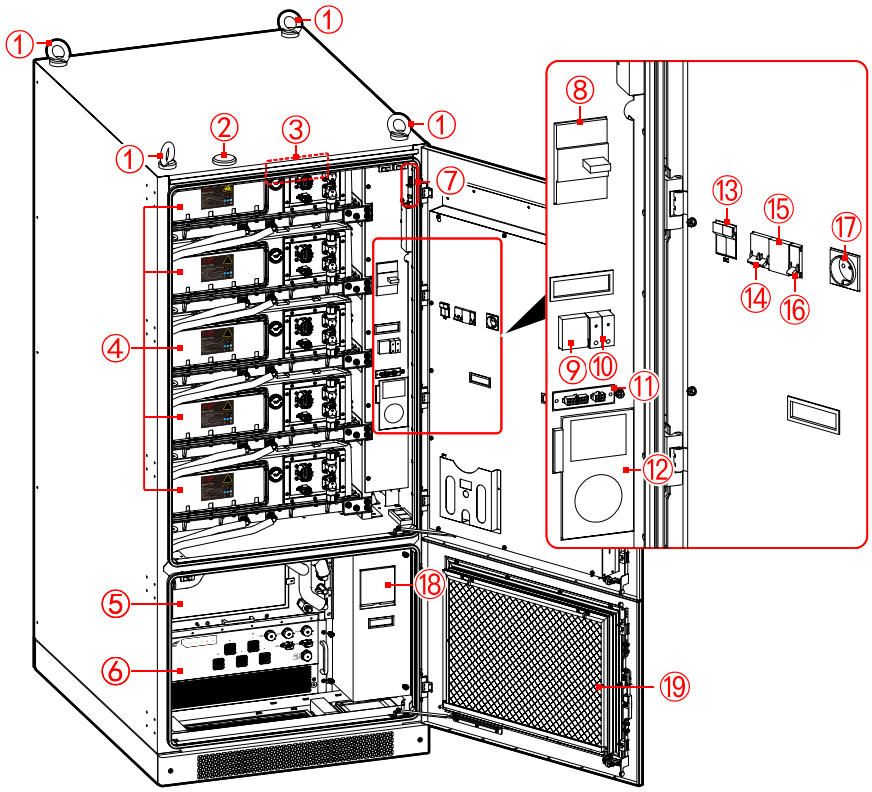


Figure2-9 Structure layout (open front door)

Table2-3 Structure layout illustration

No.	Name	Illustration
①	Lifting ring	Used for lifting transportation.
②	Antenna	Used for enhance the signal.
③	Illuminating lamp	Used to light up the battery cabin.
④	Battery pack	It is liquid cooling battery pack.
⑤	Liquid cooling unit	It is the battery system thermal management.
⑥	PCS host	Bidirection converter.
⑦	Aerosol fire extinguishing device	Used to put out a fire of battery cabin.
⑧	DC breaker	Used to control the on/off of the circuit between battery pack and PCS.

No.	Name	Illustration
⑨	Leak detection controller	Water leakage/ponding detection (external reasons) inside the cabinet.
⑩	Signal SPD	It is the SPD of external communication.
⑪	Wiring terminals	They are the communication connection of water immersion, illuminating lamp and power supply connection. Inner wiring, they have been connected before leave factory.
⑫	Dehumidifier	Used to adjust the humidity of battery cabin.
⑬	Fuse	Used to protect the DC power supply.
⑭	External power supply breaker	Used to control the on/off of external power supply.
⑮	External power supply SPD	It is the SPD of external power supply.
⑯	Breaker of socket	Used to control the on/off of the socket.
⑰	Socket	Used to supply power for external device.
⑱	AC breaker	Used to control the on/off of energy storage system between AC output and external wiring end
⑲	Front air inlet filter cotton	Used to prevent fine particle entering the energy storage system.

Battery Pack

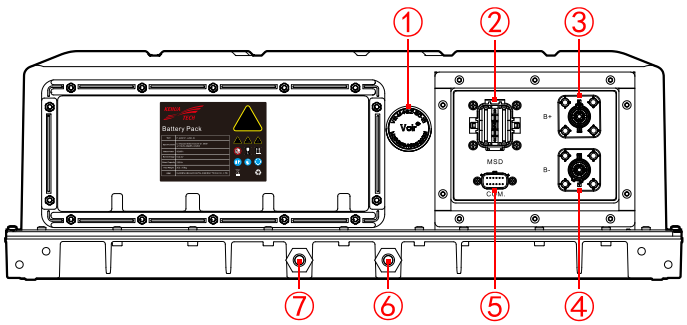


Figure2-10 Structure layout

Table2-4 Structure layout illustration

No.	Name	Illustration
①	Anti-explosion valve	Used to balance the pressure difference of inner and external battery pack
②	MSD (maintenance switch)	While installing, transporting and maintenance, it should be disconnected to ensure safety.
③	Battery pack's positive (B+)	Positive wiring terminal of battery pack, it has been connected before leaving factory.
④	Battery pack's negative (B-)	Negative wiring terminal of battery pack, it has been connected before leaving factory.
⑤	Communication port	It is the communication port of battery pack and BMS, it has been connected before leaving factory.
⑥	Inlet of cooling liquid	It is the cooling liquid's inlet, it has been connected before leaving factory.
⑦	Outlet of cooling liquid	It is the cooling liquid's outlet, it has been connected before leaving factory.

PCS

NOTE
The PCS host has been installed completely and there is no wire needs to be connected on site.

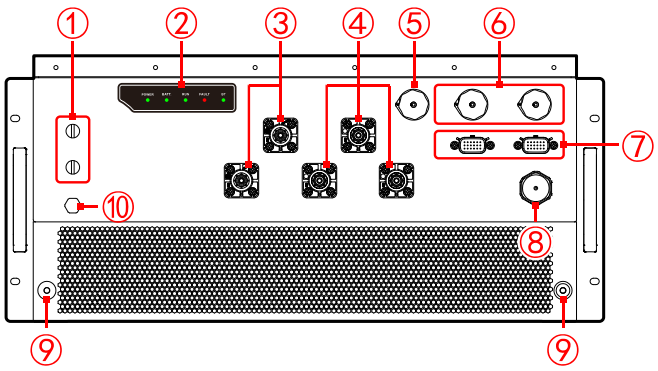


Figure2-11 PCS structure layout diagram

Table2-5 PCS structure layout illustration

No.	Mark	Name	Illustration
①	BAT.+/BAT.-	Water-proof plug	Reserved battery voltage sampling port.
②	-	Strip indicator panel	Indicate the work status of PCS.
③	B+/B-	DC terminals	Wiring terminals of DC side.
④	AC L1/L2/L3	AC terminals	Wiring terminals of AC side.
⑤	DRM	DRM port	Reserved port for DRM function.
⑥	ETH1/ETH2	Ethernet port	Used to connect with upper-computer. Ethernet is manly used for LAN monitor, and realize remote monitor.
⑦	COM1/COM2	Communication port	COM2: Used for BMS communication. COM1: Reserved port for communication.
⑧	WIFI/4G	Wireless communication port	Used for wireless communication.
⑨	⏚	Grounding terminal of wiring side	Used to connect the PCS with ground.
⑩	-	Breather valve	Used to balance the pressure difference between inside and outside of the PCS.

NOTE
WIFI has been configured in the system, and the WIFI of PCS is no need to connect.

- Strip indicator panel

The strip indicator panel has five indicator lights (as shown in Figure2-12), which can indicate the current operating status of the PCS. The description of these five indicator lights is shown in Table2-6.

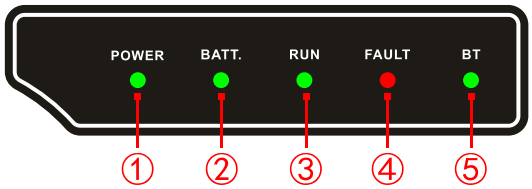


Figure2-12 Strip indicator panel

Table2-6 Indicator status illustration

No.	Mark	Color	Name	Status illustration
①	POWER	Green	Operation power indicator	On: the inner power of the PCS has been established.
				Off: the inner power of the PCS has not been established.
②	BATT.	Green	Battery connection indicator	On: the battery has been connected and meets the work condition.
				Off: the battery voltage does not meet the work condition.
③	RUN	Green	Running status indicator	On: in grid-tied operating status.
				Flicker: standby or OFF
				Off: AC and DC terminals not connected.
④	FAULT	Red	Fault alarm indicator	On: there is fault on PCS
				Flicker: there is alarm on PCS
				Off: there is no fault or alarm
⑤	BT	Green	Bluetooth indicator	On: the Bluetooth is normally connected
				Flicker: the Bluetooth is ready to connect
				Off: the power of Bluetooth is not established

NOTE

Before leaving the factory, the PCS has been connected with the system, there is no needs to install or wiring on site.

Dehumidifier

The energy storage system has dehumidification function. The dehumidifier (as shown in Figure2-13) can adjust the humidity inside the energy storage system to avoid the inner device aging, steel structure parts rusting. Default humidity is 75%RH (0-100% adjustable, we suggest keeping default setting).

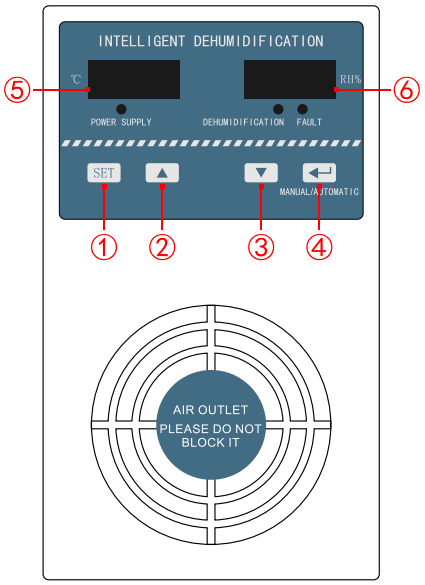


Figure2-13 Dehumidifier diagram

Table2-7 Button illustration

No.	Mark	Illustration	No.	Mark	Illustration
①	SET	Setting mode	④	↵	Switch between Manual and auto mode
②	▲	Increase value	⑤	℃	Shows the temperature
③	▼	Decrease value	⑥	RH%	Shows the humidity

The humidity setting procedure is as shown in Figure2-14. When the environment humidity is larger than the setting value, the dehumidifier will start to work automatically.

Figure2-14 Setting procedure

Leak Detection Controller

The energy storage system has leakage detecting function. The leak detection controller (as shown in Figure2-15) can select different response sensitivity by the dial switch on the panel to adapt the requirement of different detecting environment and level. The detection sensitivity from gear 1 to gear 4 increases sequentially. The factory default setting is gear 2 (we suggest keeping default setting), user can adjust the sensitivity according to needs. The sensitivity of each gear is as shown in Table2-8.

Figure2-15 Leak detection controller

Table2-8 Sensitivity illustration (under tap water)

Gear	Sensibility	Remark
Gear 1 (L)	Soaking alarm length > 20cm	Reference resistance: 60kΩ
Gear 2	Soaking alarm length > 6cm	Reference resistance: 100kΩ
Gear 3	Soaking alarm length > 2cm	Reference resistance: 160kΩ
Gear 4 (H)	Soaking alarm length > 1cm	Reference resistance: 300kΩ

2.2.3 Grounging Design

There are 2 external grounding terminals at the front and back of energy storage system, as shown in Figure2-16.

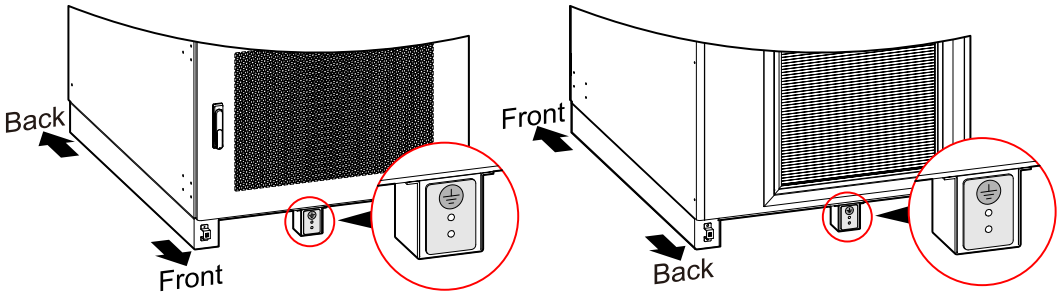


Figure2-16 Cabinet grounding terminals diagram

2.2.4 Wiring Holes Design

The wiring connection of energy storage system and external device is from the bottom wiring holes (as shown in Figure2-17).

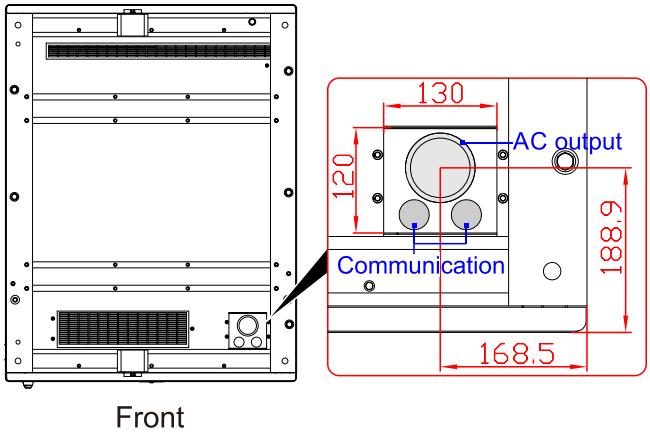


Figure2-17 Bottom wiring holes diagram (unit: mm)

2.3 Heat Dissipation Design

To make the energy storage system work in good status, please keep the installation space with good ventilation. The battery cabin adopts liquid cooling, the electric cabin adopts the heat dissipation method of front air inlet, rear air outlet to eliminate the inner heat, as shown in Figure2-18.

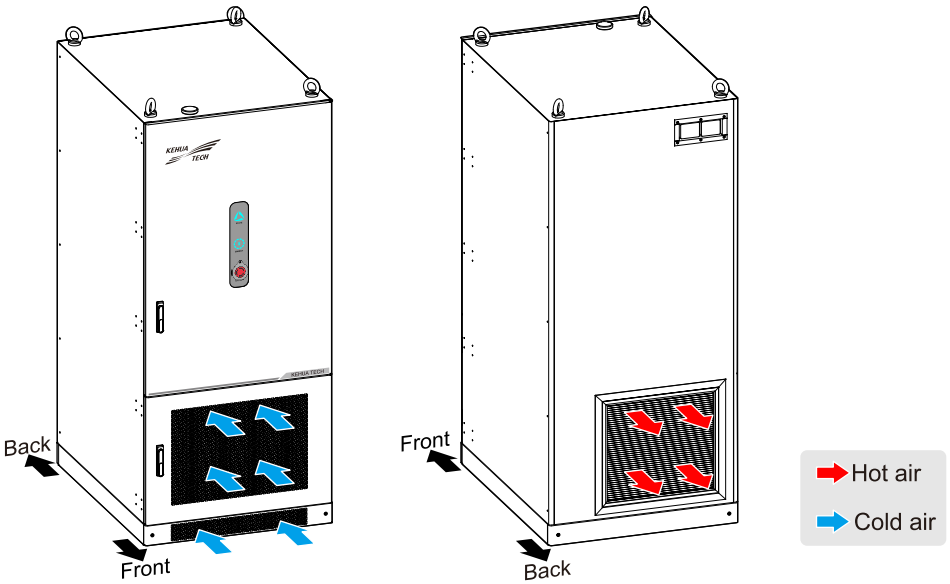


Figure2-18 Heat dissipation diagram

NOTE
Inlet air volume requirement: 2100m^3/h.

2.4 Communication

The energy storage system has one 9 pins' external communication port (position as shown in Figure2-19) to realize the communication of logger and BMS. And it also provides 2 network signal SPD LAN ports (position as shown in Figure2-20) to communicate with upper-computer. User can obtain the running data of energy storage system via communication port.

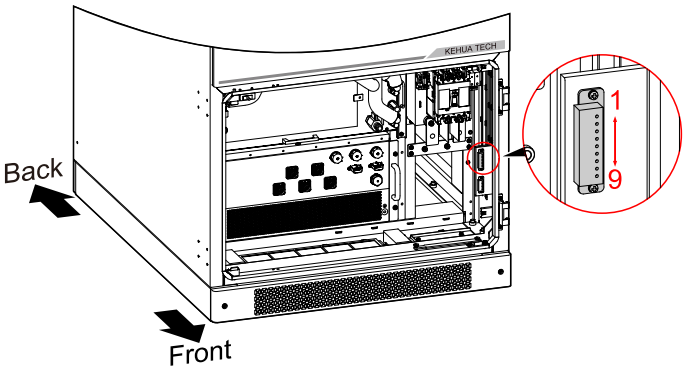


Figure2-19 External communication port diagram

Table2-9 Pin definition of external communication port

No.	Name	Illustration
①	BMS：CAN2-H	BMS external communication port (reserved for debugging)
②	BMS：CAN2-L	BMS external communication port (reserved for debugging)
③	GND	Grounding terminal (reserved for debugging)
④	KC541：COM3-A	Reserved RS485 communication port of Kehua's meter (optional)
⑤	KC541：COM3-B	Reserved RS485 communication port of Kehua's meter (optional)
⑥	GND	Reserved grounding terminal
⑦	PCS_CAN_H	Reserved inner parallel port
⑧	PCS_CAN_L	Reserved inner parallel port
⑨	GND	Reserved grounding terminal

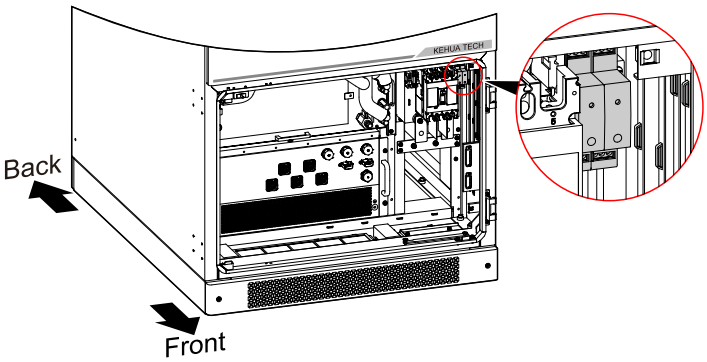


Figure2-20 Network signal SPD LAN ports diagram

Table2-10 Illustration of network signal SPD LAN ports

No.	Name	Illustration
1	Network signal SPD LAN port	Reserved port for connecting logger KC541
2	Network signal SPD LAN port	Reserved port for connecting logger KC541

2.5 Working Principle

The energy storage system is made up of 215kWh energy storage unit and one modular PCS, its capacity is 0.5C. The energy storage unit is made up of five liquid cooling battery pack, each battery pack has 48 pieces of cell, the cell capacity is 280Ah, every energy storage unit is 1P240S, the nominal capacity is 215 kWh. While discharging, the output DC power of battery cluster is connected to the PCS through DC breaker, and then converted into AC power and output to the grid or load through AC breaker. While charging, the grid output AC power to PCS, the PCS converter the AC power to DC power and then charge the battery.

The primary principle diagram of energy storage system is as follows.

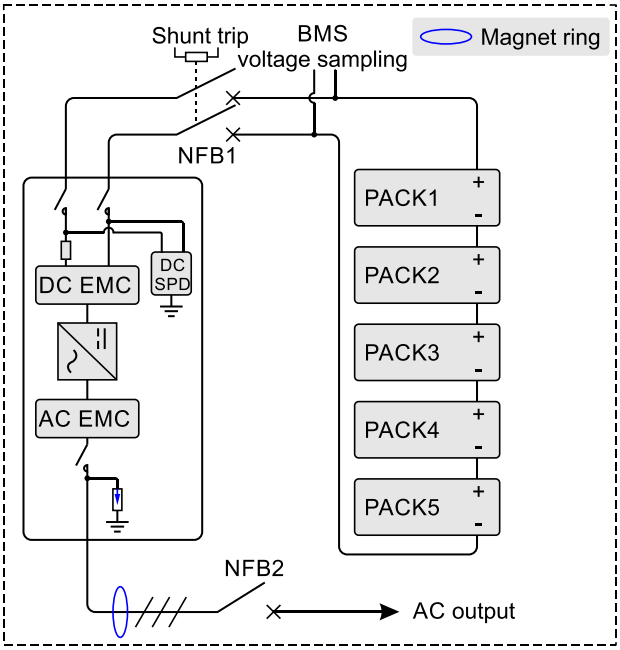


Figure2-21 Primary principle diagram of energy storage system

The auxiliary power supply of energy storage system preferentially use the external power supply and when the external power supply is disconnected temporarily, the power supply for system control can be carried out through battery side to ensure that the system control part is still in normal working status. The distribution principle of energy storage system is as shown in Figure2-22.

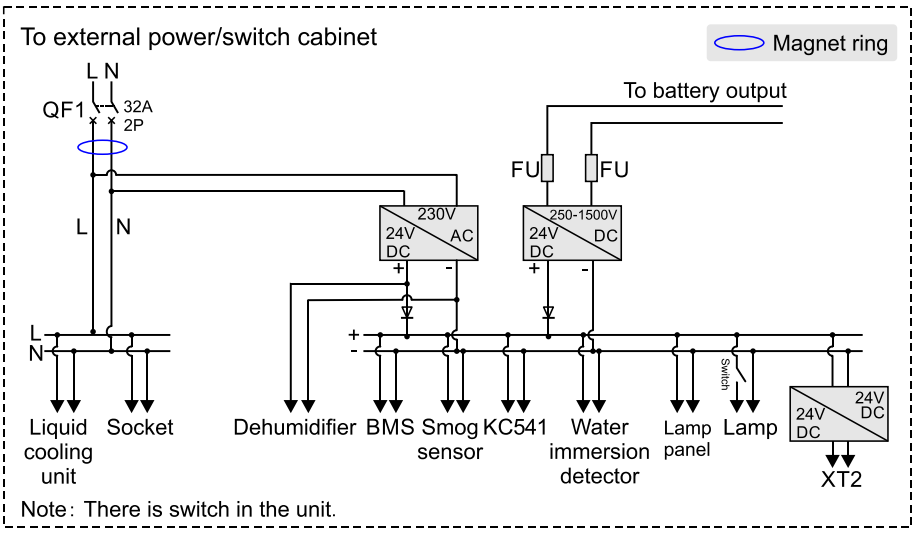


Figure2-22 Distribution principle diagram

2.6 Working Status

The working status of energy storage system includes startup, running, normal halt and fault. The conversion process of each working status is as shown in Figure2-23.

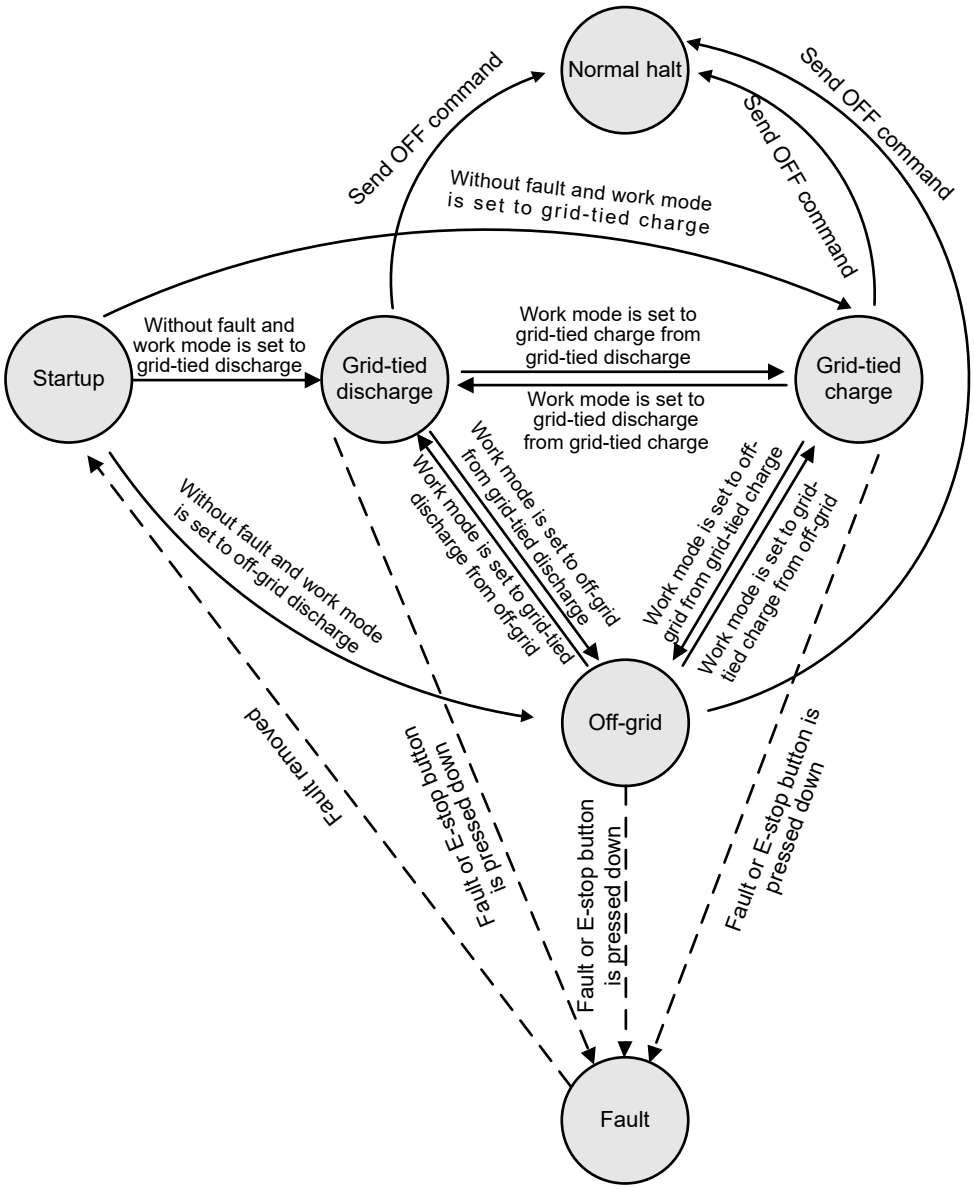


Figure2-23 Conversion diagram of working status

Startup

Startup is the preparation stage from halt status to running stage. At this mode, the energy storage system receives the start command and running according the setting mode.

Running

Running status includes grid-tied discharge, grid-tied charge and off-grid discharge. At this mode, the energy storage system can adjust the electric energy quality, adjust the reactive power and supply power for load.

Normal Halt

Normal halt is the status that the energy storage system received the OFF command while running and perform the OFF operation and normal halt.

Fault

When the energy storage system detects fault, if the system is running, it will stop running immediately and off the connection with grid and load. At this status, the alarm indicator light on, the current fault will show on the APP. User can dispose the fault on the basis of showed current fault and troubleshooting list.

2.7 Work Mode

The energy storage system includes 2 work modes: grid-tied mode and off-grid mode.

Grid-tied Mode

On grid-tied mode, the energy storage system can realize charge and discharge function.

- Charge includes constant current charging, constant power charging, constant voltage charging.
- Discharge includes constant power discharging.

Besides, on grid-tied mode, user can set the charge and discharge time through APP.

During grid-tied, the energy storage system can track the grid frequency automatically, and realize the function of smooth power output, peak shaving, system frequency modulation, load balancing, transient active output emergency response, transient voltage emergency support, improving power quality, etc.

Off-grid Mode

NOTE
In off-grid mode, the insulation transformer or Kehua's switch cabinet should be matched with energy storage system to use.

On off-grid mode, the energy storage system can output stabilized voltage and frequency. When the grid power down, it can supply power for load continuously to ensure the normal production and living electricity consumption.

CAUTION

In off-grid mode, electromoter cannot be connected with the energy storage system. If the electromoter must be connected, it is necessary to add slow-start device to electromoter to start it.

2.8 Protection Function

The energy storage system integrates perfect protection function (as shown inTable2-11) to ensure the reliability of system.

Table2-11 Protection function illustration

No.	Protection function	Illustration
1	Over/under voltage protection	The energy storage system can detect the abnormal voltage and do corresponding response. When the voltage of system exceeds the allowed range, the energy storage system will stop running and send alarm signal, and show the fault type on the APP.
2	Overcurrent protection	The energy storage system can detect the abnormal current and do corresponding response. When the DC current of system exceed the allowed range, the energy storage system will stop running and send alarm signal, and show the fault type on the APP.
3	Over/under temperature protection	The energy storage system can detect the abnormal temperature and do corresponding response. When the temperature of system exceeds the allowed range, the energy storage system will stop running and send alarm signal, and show the fault type on the APP.
4	Communication protection	● When the communication of PCS and BMS abnormal, the energy storage system will halt for protection. ● When the communication of PCS and logger is interrupted, the energy storage system will halt for protection.

No.	Protection function	Illustration
5	Insulation protection	The energy storage system can detect the abnormal insulation resistance value and do corresponding response. When the insulation resistance value lower than the allowed range, the energy storage system will stop running and send alarm signal and show the fault type on the APP.
6	Other protection	The energy storage system also has the fault protection function of water immersion, fire-fighting, emergency stop.

3 Installation

This chapter mainly introduces the installation of energy storage system, including installation process, installation preparation, transportation, unpacking and checking, installation procedures, etc.

3.1 Installation Process

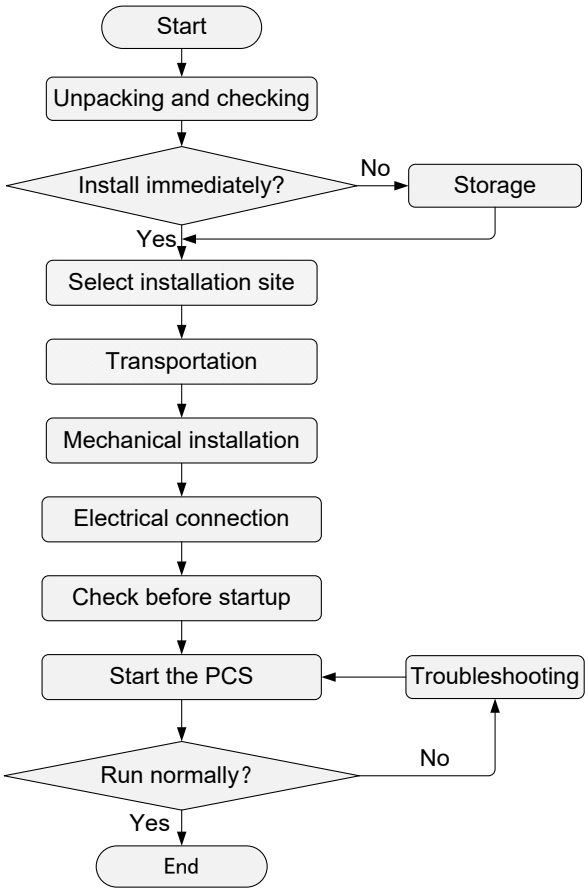


Figure3-1 Installation process

3.2 Unpacking and Checking

NOTE
Determine the unpacking site in advance. Generally, the unpacking site should be as close to the installation position as possible.

Check the External Package

The energy storage system has been completely tested and strictly inspected before leaving the factory, but damage may still occur during transporting, so a detailed inspection is required after arrival.

- Check the model, etc. of energy storage system (the delivering information can be find on the label at the side of the package, position as shown in Figure3-2), ensure that the model is in accordance with the ordered model.

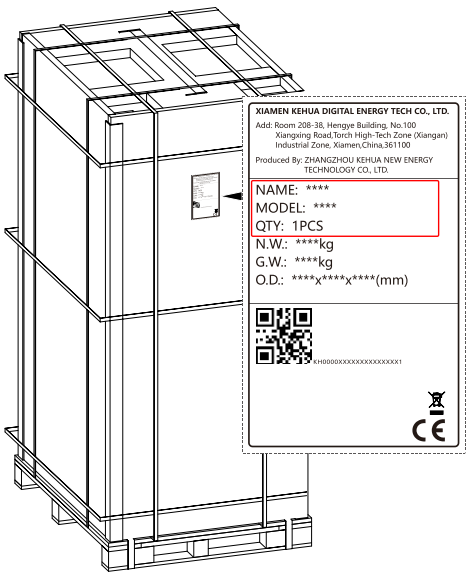


Figure3-2 Label position on package

- Inspect the package appearance for shipping damage, such as holes, cracks or other signs that could cause internal damage.
- Rainy days may be encountered during transporting, please check whether the energy storage is flooded with rainwater.

NOTE
if any shipping damage is found, do not open the package and contact the manufacturer immediately.

Check the Deliverables

Unpack the package, check if the types of the accessories are complete and correct. If there is any discrepancy, take notes and contact the distributor immediately.

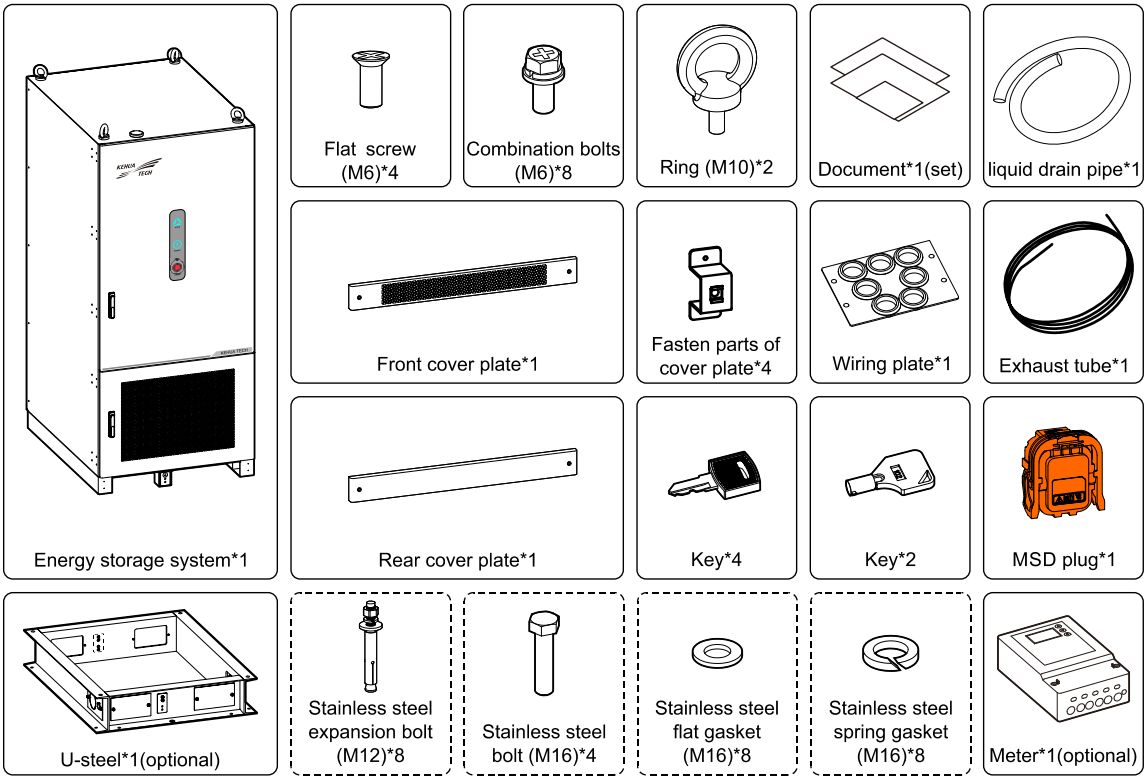


Figure3-3 Packing list

NOTE

The name and quantity of deliverables, please see the packing list.

The deliverables in the dotted frame are the accessory of U-steel (optional).

After unpacking, if the energy storage system will not be used immediately, please store it according to following requirements.

CAUTION

Please store the energy storage system on the basis of storage requirements. If the damage caused by mismatch storage requirement, it will be out of warranty.

- Package the energy storage system by original package, keep the desiccator in the package plastic bag, seal the inner plastic bag.

- The energy storage system should be placed in the place where is clean and dry and avoid direct sunshine, rain or ponding, strong mechanical vibration, impact or strong electric field. No corrosive or inflammable or explosive gas or object in the storage environment.

Figure3-4 Storage environment requirements

- Storage temperature: -20~45℃ (for long term storage, the temperature should be within the range of 0~35℃, if the energy storage system is stored out of temperature range for long time, it will affect the performance and service life of battery.

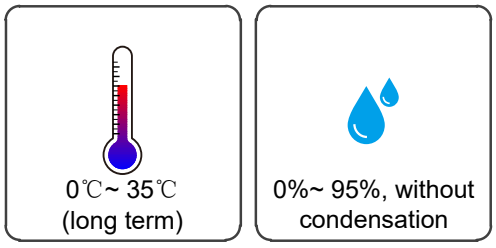


Figure3-5 Storage temperature and humidity

- The placed direction of energy storage system should be accord with the marked direction on the package. The package should be padded 20cm from the floor and keep at least 50cm away from the wall, heat source, cold source, window or air inlet.
- When multi energy storage systems are stored, DO NOT stack them together.
- DO NOT tilt or invert the packed energy storage system.
- During storage, please check the energy storage regularly (we suggest checking it once every 3 months). If the package is damaged by insects or rats, please replace the package in time.
- Under the storage condition above, the storage period is 6 months. If the energy storage system is stored over 6 months, the energy storage system should be checked and tested by professionals, and then, it can be put into use.

CAUTION

From the date of delivery, every 6 months of storage, please recharge the energy storage system according to the specified requirements (see section 7.2.8).

When the energy storage system has entered or passed through a humid environment, it is recommended to keep it in a dry and ventilated environment for more than 24 hours.

Before operation, perform an insulation impedance test. After the insulation impedance test is passed, perform a voltage withstand test. Only after all the tests have been passed can the energy storage system be operated.

If the insulation impedance test and voltage withstand test fail, continue to dry and ventilate the energy storage system.

Generally, the energy storage system can operate normally after drying and ventilating twice.

- If the product needs to be transported again, please strictly pack it before loading it for transporting.

3.3 Selection of Installation Site

When choosing an installation site, observe the following principles at least.

- The site where the energy storage system is placed should be solid and flat, well-drained, free of obstacles or protrusions, and avoid sites with existing underground utilities.
- The site should be open or solid enough above the site, with no risk of water or foreign objects falling on it.
- The surrounding environment of installation should be dry and well ventilated, and there should be no flammable, explosive or corrosive substances. Keep away from areas where dust, fumes, corrosive gases and noxious gases are generated.
- Do not install the energy storage system outdoors in salt damage areas.

NOTE

Salt damage areas mainly refer to coastal areas within 500m from the coast. The precipitation amount of salt spray varies greatly depending on the characteristics of seawater in the neighboring sea, sea breeze, precipitation, air humidity, terrain and forest cover.

- Do not install the energy storage system in locations accessible to children.
- The installation location needs to meet the necessary traffic conditions and have a reliable fire protection system.

- The energy storage system should be installed at a distance of no less than 12m from residential buildings and greater than 30.5m from crowded places such as schools and hospitals.
- The distance between the energy storage system and the production building must meet local fire codes or standards.
  - The safety distance between the energy storage system and the Class A production building should not be less than 12m.
  - The safety distance between the energy storage system and the Class B production building shall not be less than 10m.
  - The safety distance between the energy storage system and the production buildings of class C, D and E that meet the fire resistance rating of not less than grade II shall not be less than 10m.
  - If the outer walls of two adjacent buildings are non-burning and there are no door or window openings or exposed burning eaves, the fire separation distance can be reduced by 25% according to the safety distance corresponding to each type of production building.
  - If the safety distance of production buildings does not meet the requirements, a protective wall with a fire resistance of at least 3 hours must be equipped for protection. The protection spacing is not limited, and the length and height of the firewall should exceed the outer perimeter of the energy storage system by at least 1m. At the same time, it is necessary to take into account the space requirements required for various operations of the energy storage system.
- Installation space expansion conditions must be considered during the life cycle.

3.3.1 Installation Environment Requirements

According to the EMC and noise level, the energy storage system is used in an industrial environment, and the installation site should be selected from an outdoor site away from the living area. The installation environment requirements are as follows.

- Environment temperature: -35℃～+55℃.
- Relative humidity: 0%RH～95%RH, non-condensing.
- Altitude: 0m~3000m.
- Ensure that the installation site is well ventilated and free from excessive dust, acid, alkali, corrosive and explosive particles and gases.

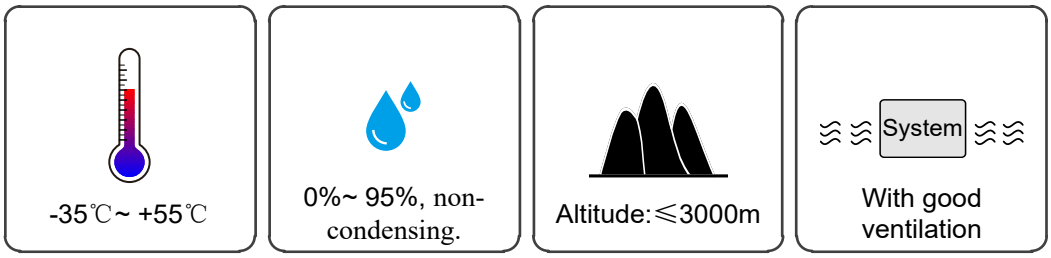


Figure3-6 Installation Environment Requirements

NOTE

When the energy storage system is exposed to sunlight, the internal temperature rise will increase, which may affect the charging and discharging performance, so it is recommended to install the energy storage system with a sunshade or other sheltering facilities.

3.3.2 Installation Space

Reserve enough space around the energy storage system (as shown in Figure3-7) for installation, operation, and maintenance, and normal ventilation. If allowed, it is recommended to leave more space between the energy storage system and other devices or walls for heat dissipation and maintenance, to ensure the stable and efficient operation of the energy storage system.

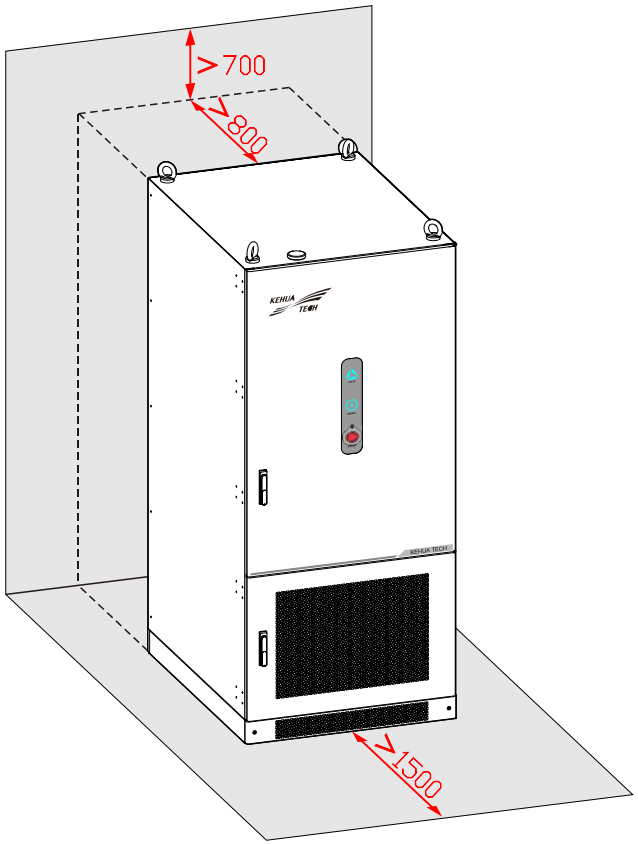


Figure3-7 Installation space (unit: mm)

NOTE

The size of energy storage system is 1000mm × 1300mm × 2340mm (W × D × H), and the minimum air inlet volume requirement is 2000m^3/h.

CAUTION

If multiple energy storage systems are deployed, refer to the standard GB51048 or local national regulations.

3.3.3 External Fire-fighting Suggestion

- A fire-fighting water supply system should be provided at the installation site of the energy storage system.
- Municipal water supply is preferred as the water source of fire-fighting, and fire-fighting water or natural water supply may also be used. When natural water sources are used, reliable water intake settings should be set.
- The designed flow of fire-fighting water supply shall be determined according to the sum of the maximum designed flow of water extinguishing systems that need to act simultaneously. The water consumption for fire-fighting shall be calculated according to the number of fires at the same time and the maximum water consumption required for extinguishing a fire.
- External fire hydrant system design shall meet the following requirements:
  - Fire hydrants should be evenly arranged along the roadside of the site. The distance between the fire hydrants and the energy storage system should be not greater than 20m.
  - Each energy storage system is recommended to have at least one fire hydrant, and the water consumption of the fire hydrant should not be less than 20L/s.
  - Anti-freezing measures should be taken against outdoor fire hydrants in cold areas.
  - Outdoor fire hydrants should be provided with permanent fixed markings.
  - Spray guns should be provided near the power distribution unit area.
  - The station area should be set up with a dedicated fir room (box) equipped with a fire hose, water gun and fire-fighting wrench.

3.4 Transportation

Please select suitable transportation device according to the weigh (<2.5t) and size (1000mm×1300mm×2250mm (W×D×H), without rings) of energy storage system.

When transporting on the installation site, the forklift or crane can be used to transport the energy storage system.

WARNING

In the process of loading, uploading and transporting, the operation safety regulations of the country/region where the project is located must be observed.

CAUTION

Improper transporting operations may result in the device damage or personnel injury.

- The energy storage system must be carried by trained professionals and should be directed by a professional on site at all times.
- Pay attention to the center of gravity of the energy storage system and move it carefully to avoid impact or fall.
- Do not tilt or lay the energy storage system down during handling. Otherwise, the internal components will bear great stress, which may cause damage to the components and adversely affect the performance. If the energy storage system is damaged due to improper operation, it is not covered by the warranty.

3.4.1 Forklift Transportation

This device can be carried by forklift. When you move the energy storage system by forklift, the forklift arm must be inserted from the front of the device and completely pass through the bottom of the device, as shown in Figure3-8.

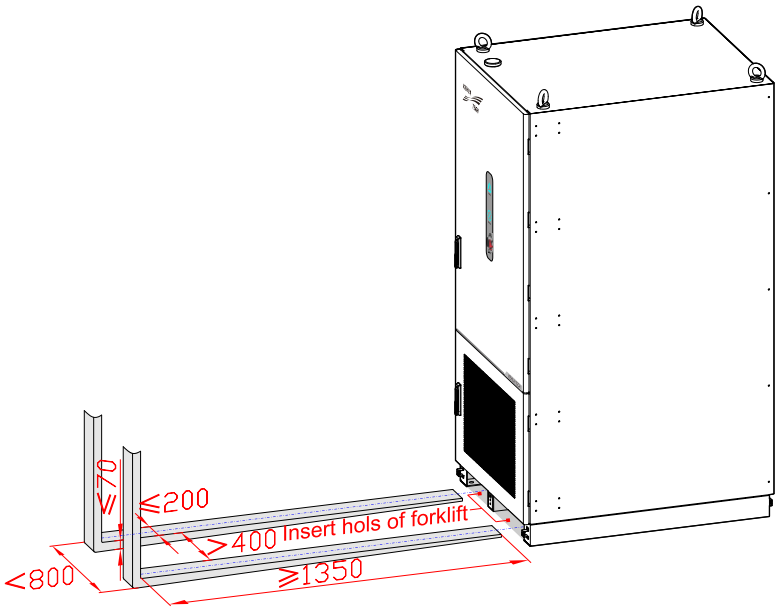


Figure3-8 Forklift transportation diagram (unit: mm)

CAUTION

- Forklift should have a safety factor of at least 2 times weight of the energy storage system.
- When lifting the energy storage system, keep the centre of gravity of the energy storage system at the center of the two forks and keep the handling process slow and smooth.
- Pay attention to the width and inserted depth between the fork arms to prevent instability or tipping.
- Pay attention to the distance between the forklift and the device to avoid damage to the appearance, door locks and louvers.
- During moving, the tilt angle of the energy storage system should not exceed 10°, do not put it down or lift it up suddenly, and pay attention to the turning, up ramps and down ramps to avoid collision of the device.

3.4.2 Lifting Transportation

The energy storage system can also be lifted with the top ring.

Transporting Condition

- Transporting should be carried out under good weather conditions as far as possible.

- Be sure to set up warning signs or warning tapes to avoid non-staff entering the lifting area to avoid accidents.
- Remove all obstructions, such as trees and cables, that exist or may exist during the move.
- Ensure that the ground on which the device is placed is solid, flat, well-drained, and free of obstacles or protrusions.
- Take necessary auxiliary measures to ensure safe and smooth lifting of the energy storage system.

⚠ CAUTION

The selected lifting crane must have sufficient load carrying capacity as well as enough arm length and rotation radius.

Lifting Tools Preparation

- Hook, flat taps, buckles

⚠ CAUTION

Lifting tools are provided by user, and with a safety factor of 4 times, that is, the maximum lifting weight > 10 tons.

Lifting Announcements

⚠ CAUTION

In the whole process of lifting the energy storage system, it is necessary to strictly follow the safety operation regulations of the crane.

Within 5m~10m of the operation area, it is strictly prohibited to stand, especially under the lifting arm and the lifting or moving machine, to avoid casualties.

In case of bad weather conditions, such as strong wind, heavy rain, fog, etc., the lifting work should be stopped.

The following requirements should be met during lifting:

- The door of the energy storage system cabinet is locked.
- Ensure that the joint of the flat tapes used is safe and reliable, and ensure that each flat tapes connected to the ring are equal in length, to avoid uneven lifting, which could result in the device toppling over.
- Do not install the front and rear plates and corresponding mounting parts during hoisting. Install them after lifting.

Lifting Operation

During lifting of the energy storage system, each operation should be carried out according to the following requirements.

- After the device has been lifted 20-30mm off the ground, it should be suspended and the connection between the rings and the lifting device should be rechecked to make sure that the connection is secure before lifting.
- The energy storage system shall be lifted vertically without dragging on the ground or any other surface.
- The whole lifting process should be carried out slowly, pay attention to the balance of the energy storage system, and do not tilt or move too fast to ensure it is lifted stably.
- After the energy storage system is in place, put it down gently to ensure stable landing of the device.

WARNING

Do not put the energy storage system outside the vertical landing area through shaking the hooks.

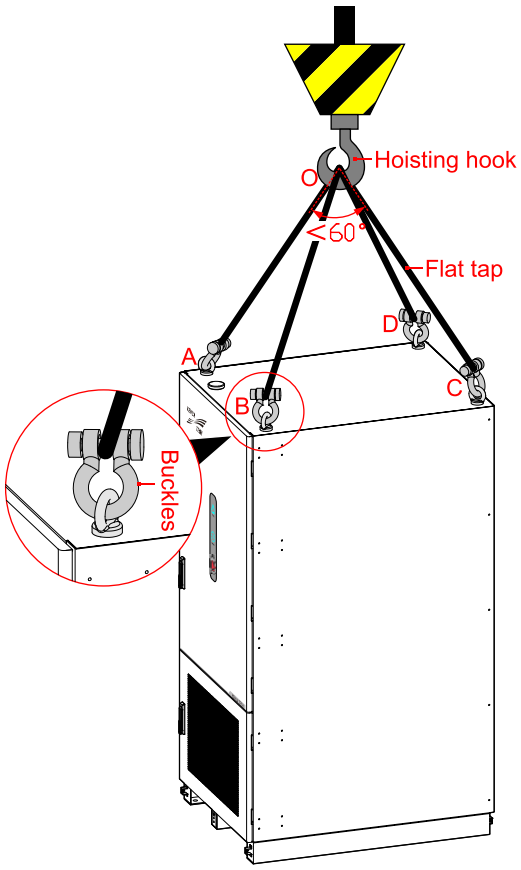


Figure3-9 Lifting diagram

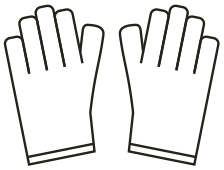
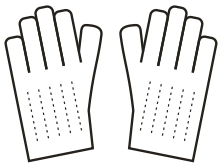
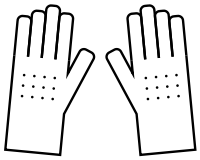
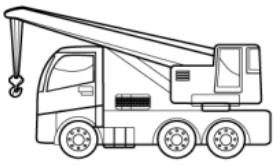
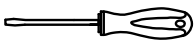
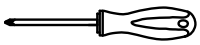
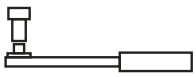
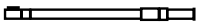
CAUTION

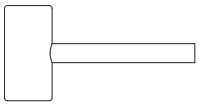
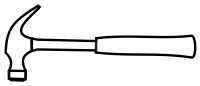
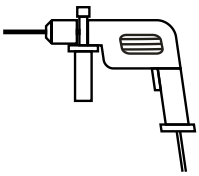
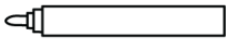
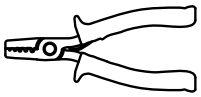
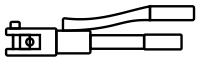
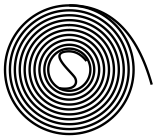
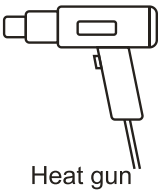
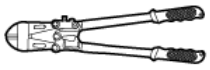
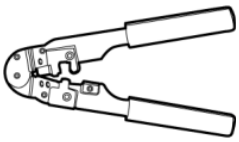
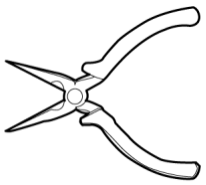
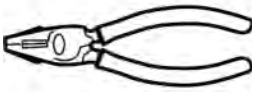
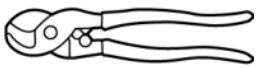
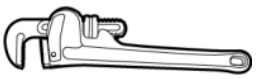
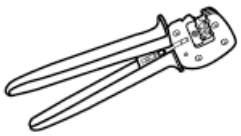
The vertical height from the hook to the top of the energy storage system should be more than 5 meters.

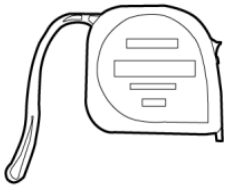
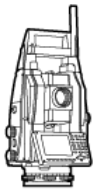
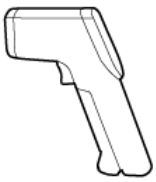
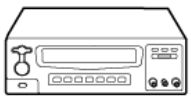
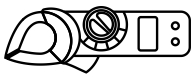
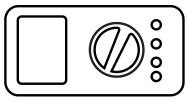
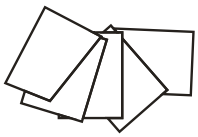
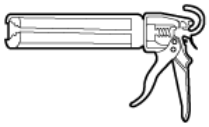
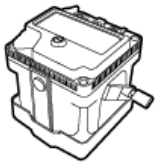
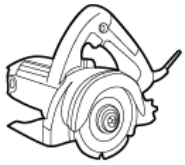
3.5 Installation Preparation

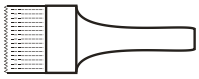
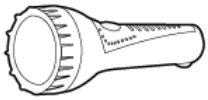
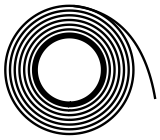
3.5.1 Tools

Personal protection			
			
Safety helmet	Protective glasses	Insulated shoes	Reflective jacket

 Dust mask	 Protective gloves	 ESD gloves	 Insulated gloves
 Safety belt			
Transportation tools			
 Hoisting wirerope	 Crane (>10000kg)	 Forklift	 Lift truck
 Manual forklift			
Installation tools			
 Flat-headscrewdriver	 Phillips screwdriver	 Socket wrench	 Adjustable wrench
 Torque wrench	 Wrench	 Electric screwdriver	 Ladder

 Rubber hammer	 Claw hammer	 Hammer drill	 Mark pen
Wiring tools			
 Diagonal pliers	 Wire stripper	 COAX crimping tool	 Hydraulic pliers
 Electrician's knife	 Heat shrink tubing	 Heat gun	 Label paper
 Cable tie	 Cutting plier	 Network cable crimping plier	 Needle-nose plier
 Plier	 Wire cutter	 Tube plier	 Crimping plier
 Open-ended wrench	 Crimping plier		

Measurement tool			
 Levelling instrument	 Steel ruler	 Rectangular ruler	 Long tap measure
 Tap measure	 Long coiled steel ruler	 Altimeter	 Laser locator
 Thermometer	 Level	 Phase sequence meter	 Pressure tester
 Clamp meter	 Multi-meter	 Network cable tester	 Ammeter
1. Cleaning tools			
 Vacuum cleaner	 Cotton cloth		
Others			
 Cable coil reel	 Sealant, sealant gun	 Insulation resistance meter	 Small cutter

 Brush	 Flashlight	 Sand paper	 Insulation tape

CAUTION

The installation tools need to be insulated to avoid electric shock.

3.5.2 Size

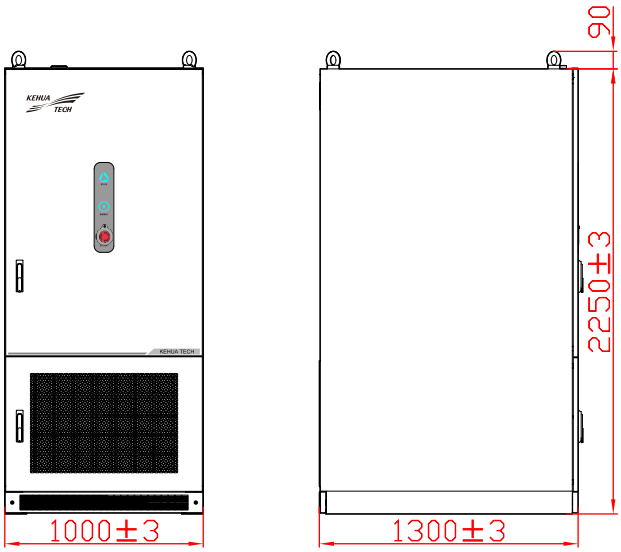


Figure3-10 Size (unit: mm)

3.5.3 Bottom Installation Holes Size

The bottom installation holes size of energy storage system is as shown in Figure3-11.

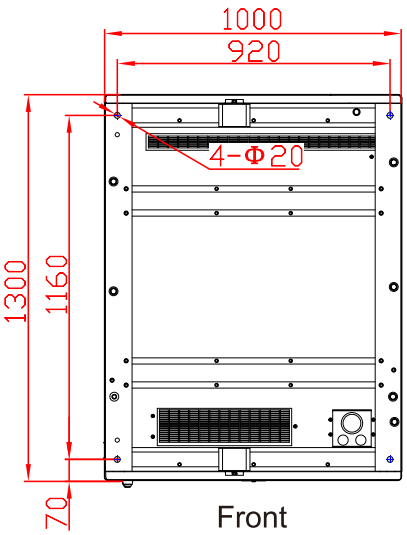


Figure3-11 Size of bottom installation holes (unit: mm)

3.6 Mechanical Installation

The energy storage system can be installed on the U-steel or on the foundation according to the actual condition on site.

WARNING

The energy storage system can only be installed without damage or fault.

CAUTION

- Only trained professionals are allowed to install the energy storage system. Improper installation may result in injury.
- Wear suitable protective equipment for personal protection in case of accidents during operating.

3.6.1 Foundation Installation

If the foundation installation is used, the foundation must be built according to the requirements for bottom installation holes and wiring holes of the energy storage system.

WARNING

The energy storage system is heavy (<2.5t). Before building the foundation, the installation site conditions (mainly geological conditions and environmental climate conditions, etc.) should be investigated in detail. And then the design and construction of the foundation can be performed.

Foundation Requirements

Unreasonable foundation construction will bring great difficulties or troubles to the placement, opening and closing of the energy storage system and later operation, therefore, the foundation of the energy storage system must be designed and constructed in accordance with certain standards in advance to meet the requirements of mechanical support, cable routing, and later maintenance.

The foundation should be constructed according to the following requirements at least:

- The foundation must ensure the stability and safety of the installation of the energy storage system.
  - The foundation must have sufficient bearing capacity to effectively support the energy storage system.
  - The soil at the installation site needs to be compact. If the soil is loose, take measures to ensure that the foundation is stable.
  - The bottom foundation pit must be tamped and filled up.
  - The upper surface of the foundation must be at the same level (no more than 5 mm).
- The foundation should be higher than the natural floor to avoid erosion of the bottom and interior of the energy storage system after rain or snowmelt water.
- Construct corresponding drainage measures according to local geological conditions.
- Build a cement foundation with sufficient cross-sectional area and height. The height of the foundation is to be determined by the construction party according to the geology on site.

NOTE

The dregs excavated during the construction of the foundation should be cleared immediately so as not to affect the subsequent lifting of the energy storage system.

When designing the direction of the air outlet, the wind direction of the installation site should be considered.

Cable Trench Requirements

Cable routing should be taken into account when building the foundation. Based on the cable inlet holes of the energy storage system, in order to facilitate the subsequent electrical connection, it is recommended to build cable trenches at the bottom of the energy storage system. That is to say, cable trenches should be preset in the foundation and pre-buried with cable conduits.

CAUTION

Take protective measures for the connecting cables of the energy storage system and external devices, such as laying protection tubes, to prevent rodents from damaging cables.

The requirements for pre-buried cable conduits as follows:

- The inner diameter of the cable conduit must be at least 1.5 times of the outer diameter of the cable, and the bending radius of the cable must be at least 10 times of the outer diameter of the cable.
- The signal cable should be separately from the power cable to avoid electromagnetic interference.
- Block the both ends of the pre-buried cable conduit temporarily to avoid other objects entering and affecting cable laying.

Grounding System Requirements

When constructing the foundation, the grounding flat steel should be reserved, and the grounding with the energy storage system needs to be bolted firmly.

CAUTION

The grounding system should be constructed by the user according to the geological conditions of the installation place and relevant regulations. No matter what kind of grounding method, the grounding resistance should be no more than 0.1Ω.

Operation Preparation

For foundation installation, prepare the following materials after foundation construction.

Table3-1 Material preparation

Name	Specification	Quantity	Use	Source
Stainless steel expansion bolt	M16	4	Fasten the energy storage system to the ground.	Provided by user
Antirust paint	/	0.3kg	Paint on the bolts to avoid corrosion.	Provided by user

Operation Procedure

Step 1 Construct the foundation according to the bottom installation holes of the energy storage system.

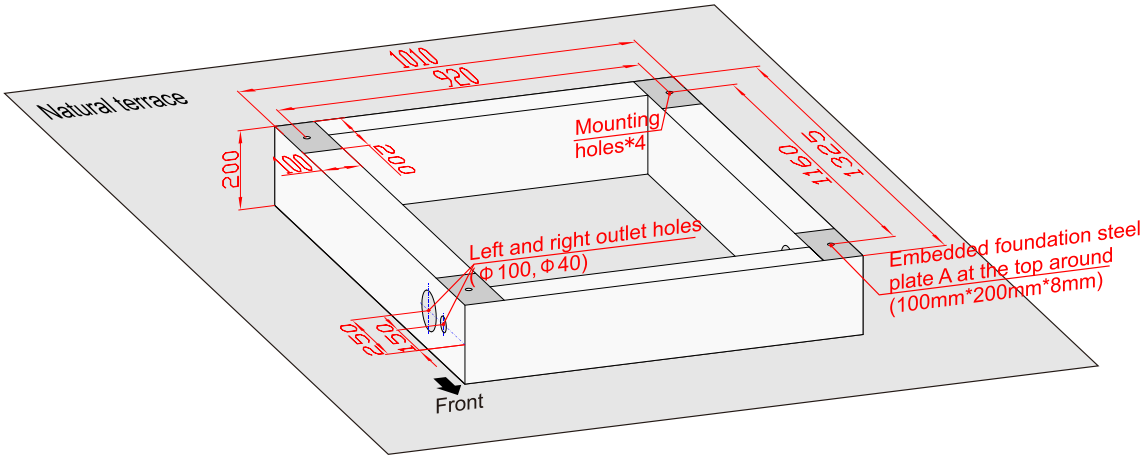


Figure3-12 Foundation diagram (unit: mm)

NOTE

The foundation can be constructed according to the recommended foundation diagram above, or the foundation can be designed by yourself, but it should meet the installation and maintenance requirements.

Step 2 Drill holes and install stainless steel expansion bolts (M16).

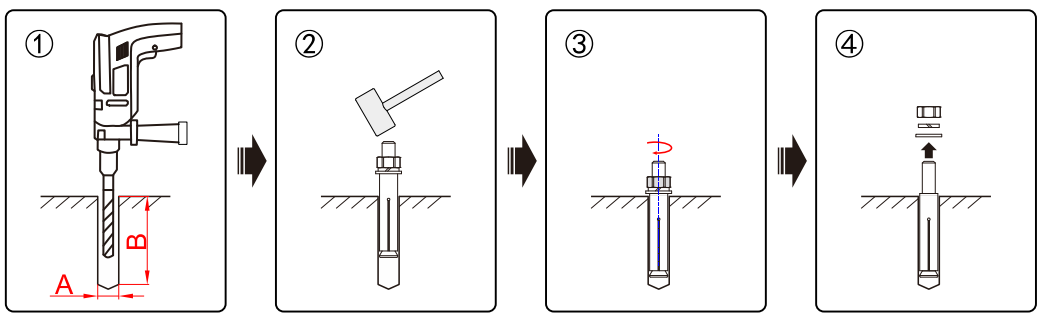


Figure3-13 Install expansion bolts

NOTE

The drilling hole size of expansion bolt M16 is: A=20mm, B=the length of expansion tube + 5mm.

Step 3 Remove the fastened bolts between the energy storage system and the wooden bracket, move the energy storage system to the foundation, make sure the bottom mounting holes are aligned with the expansion bolts, and slowly place it on the foundation.

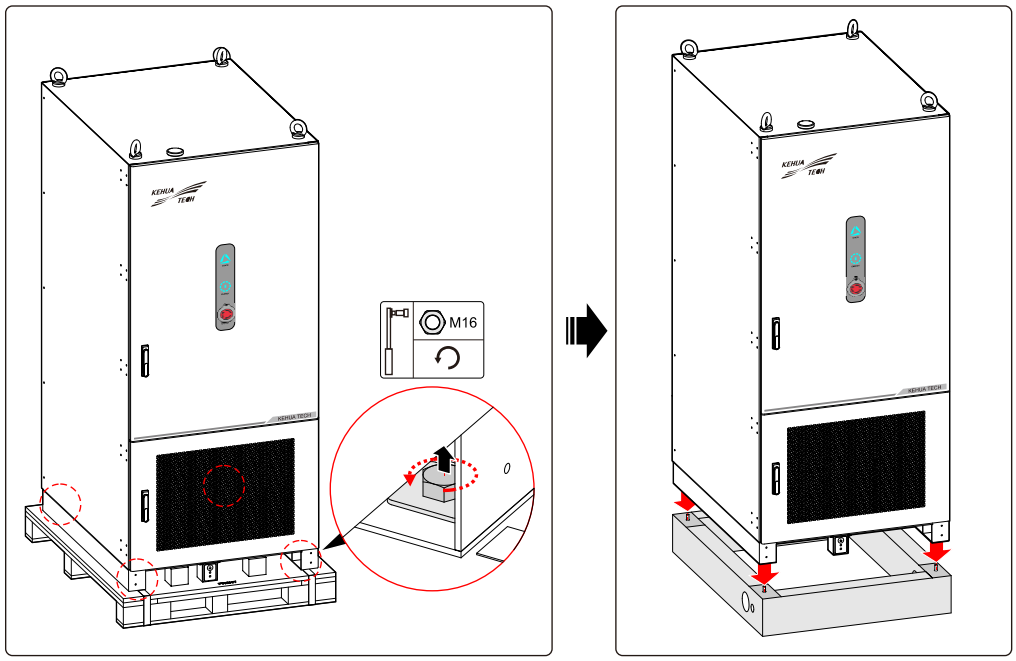


Figure3-14 Device placed diagram

Step 4 Fasten the energy storage system and do anti-corrosion treatment.

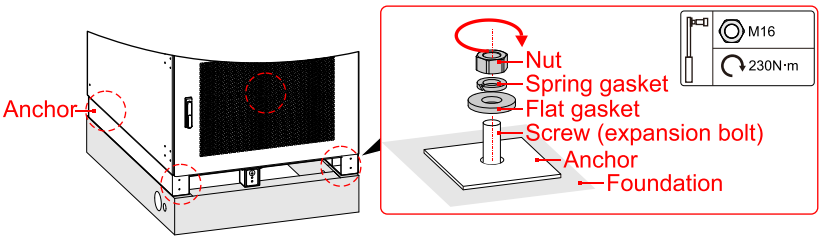


Figure3-15 Fixed position diagram

----End

3.6.2 U-steel Installation

NOTE

Customers can purchase the U- steel by themselves or choose from Kehua Company.

Floor Requirement

The U-steel installation floor must ensure the stability and safety of the installation position of the energy storage system.

- The foundation should have sufficient bearing capacity to effectively support the energy storage system.
- The soil at the installation site needs to be compact. If the soil is loose, take measures to ensure that the foundation is stable.
- The upper surface of the floor must be at the same level (no more than 5 mm).

Operation Preparation

When installing with Kehua's U-steel, the following materials should be prepared before installation.

Table3-2 Material preparation

Name	Specification	Quantity	Use	Source
Stainless steel expansion bolt	M12	8	Fasten the U-steel to the ground	Delivered with the U-steel
Stainless steel bolt	M16	4	Fasten the energy storage system with U-steel	Delivered with the U-steel
Stainless steel flat gasket	M16	8	Match with stainless steel bolt M16 to use	Delivered with the U-steel
Stainless steel spring gasket	M16	8	Match with stainless steel bolt M16 to use	Delivered with the U-steel
Anti-corrosion paint	/	0.3kg	Paint on the bolts to avoid corrosion.	Provided by user

Operation Procedure

Step 1 Mark the bottom installation holes of U-steel.

CAUTION

Before installation, measure the flatness of the installation surface of U-steel by level. Ensure that the flatness of the installation surface is less than 5mm.

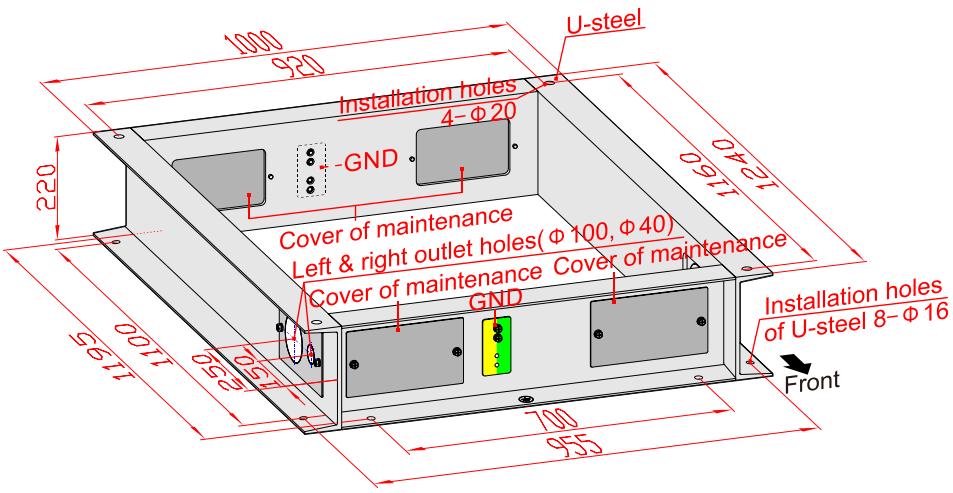


Figure3-16 U-steel diagram (Unit: mm)

NOTE

When designing or purchasing U-steel, the following requirements must be met:

- Material: Q235
- Specification: 22#b, height * width * waist thickness=220 mm *79 mm *9 mm.
- The surface of U-steel should be painted to prevent rusting, and the painting should meet the outdoor use conditions of the energy storage system.
- The flatness of installation surface on the U-steel should be less than 5mm.

Step 2 Drill holes and install expansion bolts (M12).

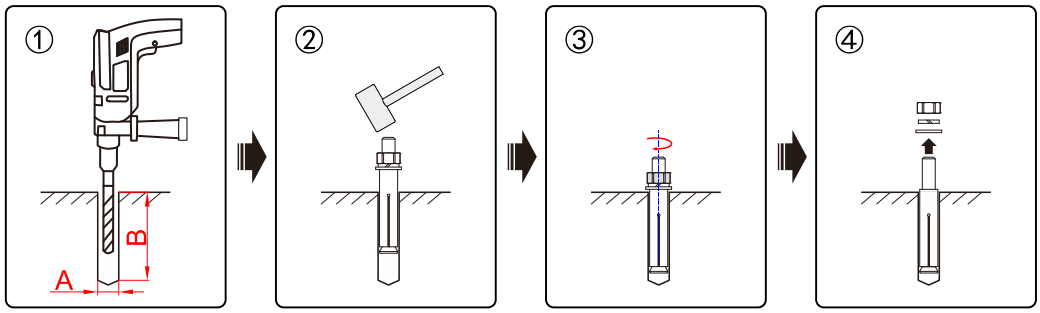


Figure3-17 Install expansion bolts

NOTE

The drilling hole size of expansion bolt M12 is: A=15mm, B= the length of expansion tube + 5mm.

Step 3 Fasten the U-steel.

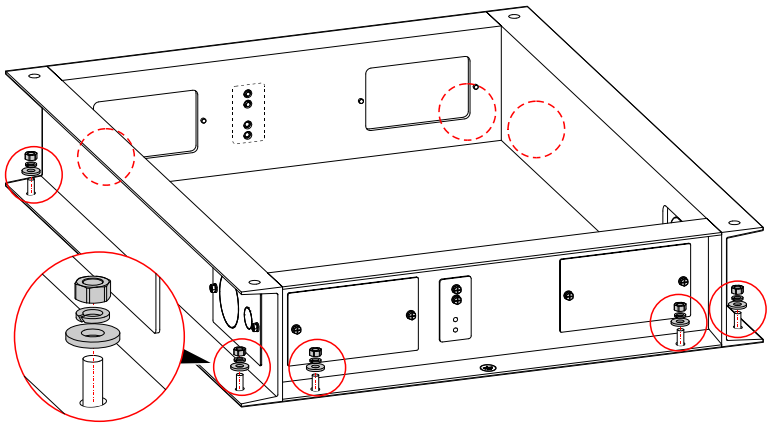


Figure3-18 Fasten U-steel

Step 4 Remove the fastened bolts between the energy storage system and the wooden bracket, move the energy storage system to the U-steel, make sure the bottom mounting holes of the energy storage system are aligned with the installation holes on the U-steel, and slowly place it on the U-steel.

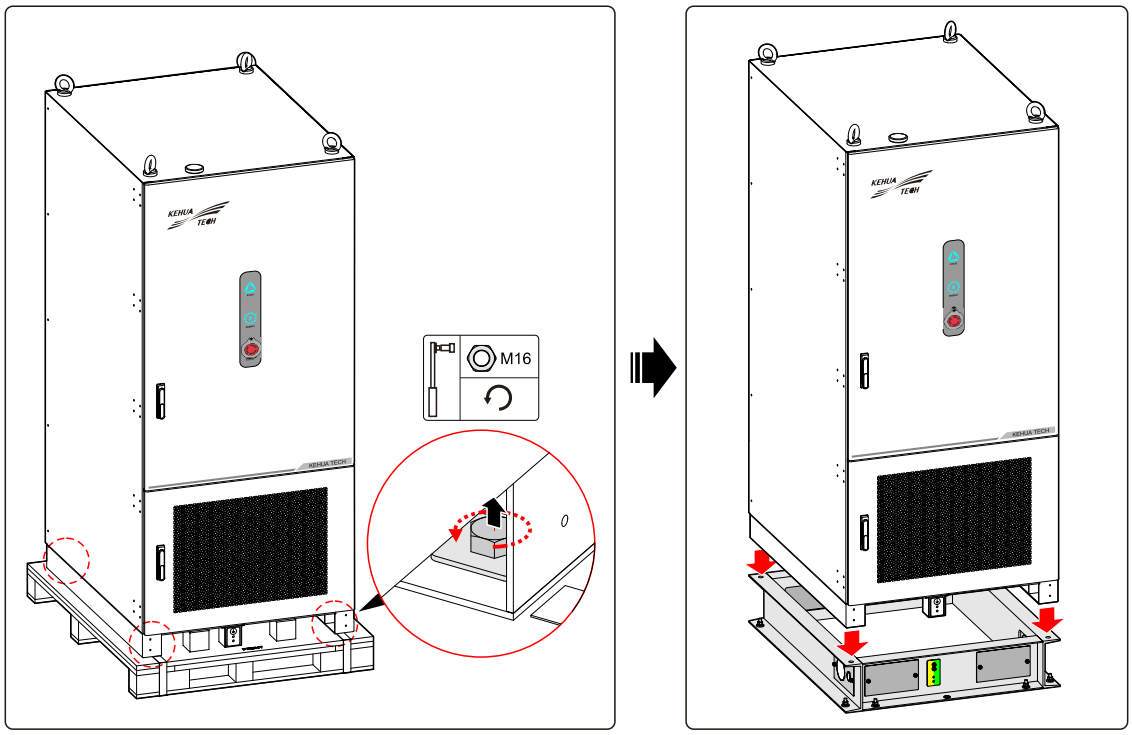


Figure3-19 Device placed diagram

Step 5 Fasten the energy storage system and do anti-corrosion treatment.

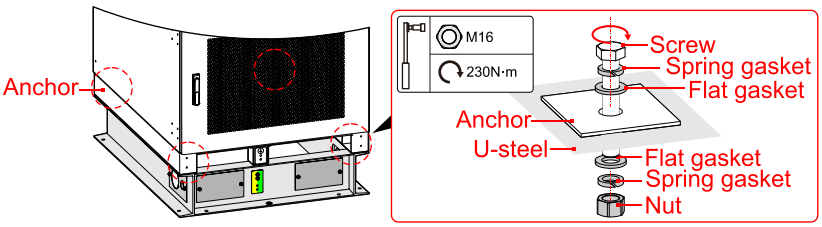


Figure3-20 Fasten the energy storage system

----End

4 Electrical Connection

CAUTION

- All the electrical connections must comply with the standards of the country where the project is located.
- Before connecting, ensure that breakers in all parts of the energy storage system are disconnected and the AC and DC sides are without electricity.

4.1 Cables Preparation

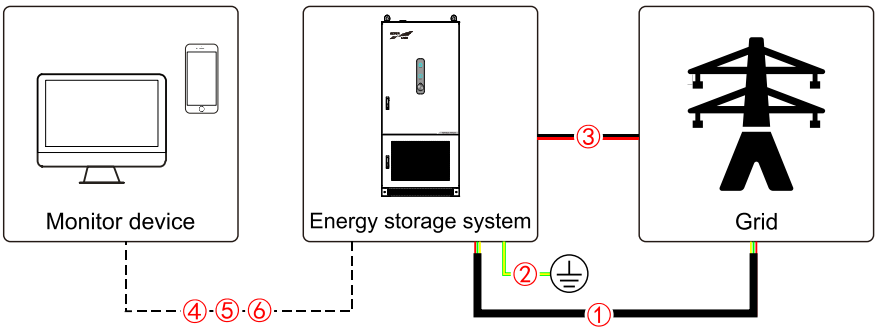


Figure4-1 Wiring diagram

Table4-1 Recommended cable and terminal specifications

No.	Cable name		Cable type	Cable Specifications (mm^2)	Terminal	Source
①	AC output	L1/L2/ L3	Outdoor multi-core cable	Copper core cable: 3 × 70+1 ×35 Aluminum core	Copper core cable: DT-70 Aluminum core cable: DTL-120	Provided by user

No.	Cable name		Cable type	Cable Specifications (mm^2)	Terminal	Source
②	Grounding	PE		cable: 3×120+1×70	Copper core cable: DT-35 Aluminum core cable: DTL-70	Provided by user
③	230V auxiliary power supply	L/N	Outdoor two-core cable	2×4	CE040010	Provided by user
④	Communication	LAN	Standard network cable	/	RJ45 plug	Provided by user
⑤		RS485	Twisted-pair shielded cable	0.5	E0508	Provided by user

NOTE

- The cable specification in above table are based on standard UL1015/UL10269/UL11627, please refer to the standards for reasonable replacement if other cables are used.
- The selection of cable specification should be in accordance with local cable standards.
- If single-core cables are used for AC output and grounding, the wire specification of each cable is the same as the recommended specification of the single wire diameter in the multi-core cable.
- The factors that affect the selection of a cable include: rated current, cable type, laying method, ambient temperature, and maximum expected line loss.
- Cable ①②③ are required, cable ④⑤ are connected according to needs.
- Copper-aluminum conversion terminals are required when aluminum cables are used.
- It is not recommended to use hard cables such as armored cables to avoid poor contact with the terminals due to bending stress.
- Please select flame retardant cables.
- If the recommended terminal is not used, please confirm with our company.

4.1.1 Wiring Requirements

The cables of the energy storage system include power cables and communication cables. Power cables and communication cables should be routed separately. In order to reduce electromagnetic interference, avoid long-distance parallel wiring of power cables and communication cables.

When the communication cables and the power cables cross, ensure that the two cables are perpendicular to each other as far as possible.

WARNING

It is forbidden to lead other cables into the energy storage system.

The distance requirement between shielding communication cables and power cables in parallel is 0.3m.

4.1.2 Cable Protection

Protection is required for the wiring of communication and power cables.

- Protection for communications cables
  - Communication cables are thin and easily damaged. Therefore, when wiring, route the power cables first, then route the communication cables.
  - Communication cables should be laid in the cable trench and tied with cable ties.
  - Do not route cables with heat sources or strong electromagnetic fields.
- Protection for power cables
  - The power cable has a strong electromagnetic field. Ensure their insulation layer is not scratched or damaged.
  - Properly fix power cables.

4.1.3 External Grounding Connection

Step 1 Connect the grounding terminal at the bottom of the energy storage system (locations shown in Figure4-2) to the grounding point on the U-steel or pre-buried in the foundation, and make anticorrosion treatment.

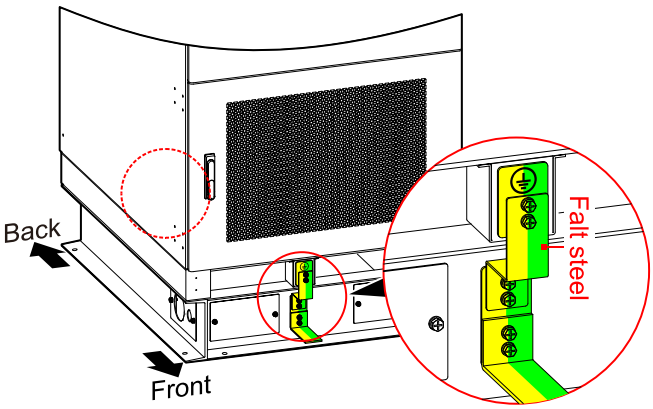


Figure4-2 External grounding terminal connection diagram (U-steel installation)

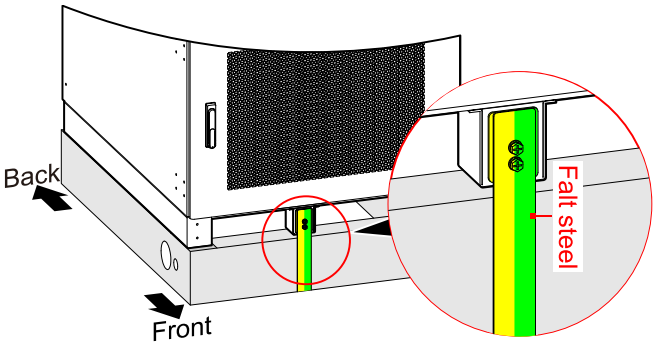


Figure4-3 External grounding terminal connection diagram (foundation installation)

NOTE

The grounding flat steel should be provided by user. The recommended size of the grounding flat steel or cable should be 35mm^2 and above.

There are two external grounding locations reserved at the bottom of the energy storage system, you can connect either of them.

CAUTION

When installing the energy storage system, it must be grounded first; when dismantling the energy storage system, the grounding cables must be removed last.

The grounding of the energy storage system must not be the same as the grounding of the lightning rod of the building where it is installed, they must be separated (as shown in Figure4-4). The grounding of the energy storage system should be directly connected to the grounding system, and the impedance should be less than 0.1Ω.

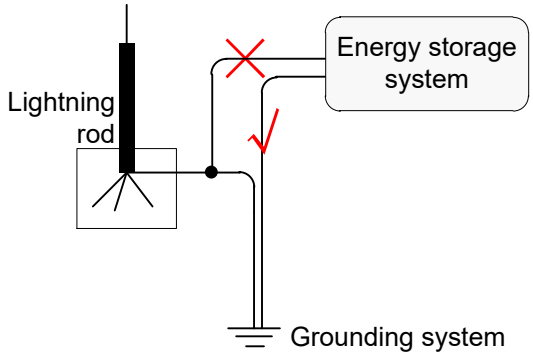


Figure4-4 Grounding connection announcement

Step 2 Install the fasten parts of cover plate, as shown in Figure4-5.

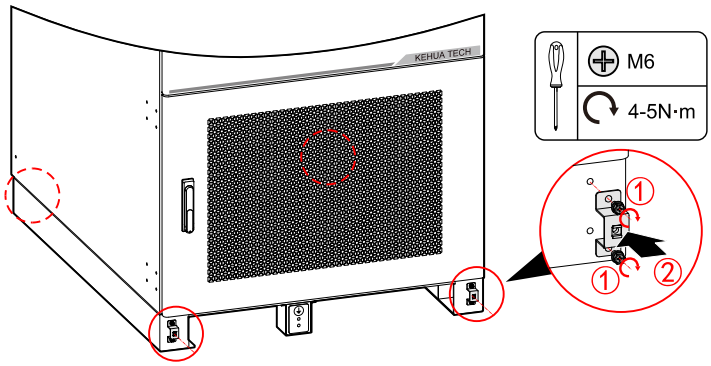


Figure4-5 Install the fasten parts of cover plate

Step 3 Install the cover plates, as shown in Figure4-6.

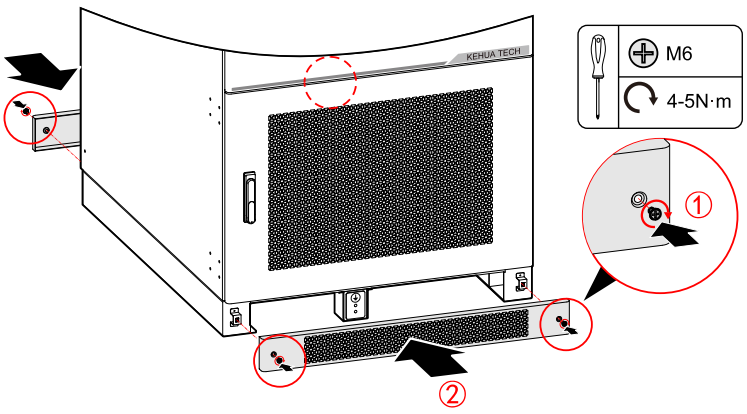


Figure4-6 Install the cover plates

----End

4.1.4 AC Output Connection

The AC output side connection form of the energy storage system are as shown in Figure4-7, Figure4-8.

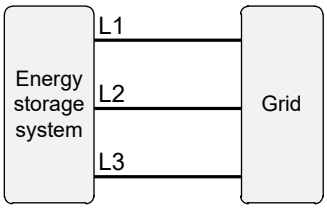


Figure4-7 AC output connection (grid-tied mode)

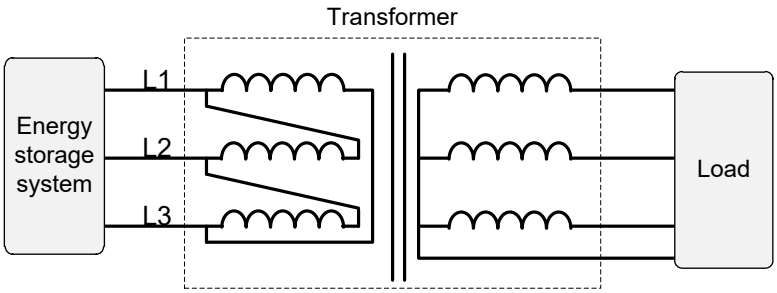


Figure4-8 AC output connection (off-grid mode)

WARNING

Only allowed by local power supply department, the energy storage system can be connected to the grid.

Before connecting to the grid, make sure that the grid voltage and frequency meet the requirements of the energy storage system, details please see **A Technical Specifications.** Otherwise, please contact the power supply department to solve the problem first.

Terminal Requirements

The size of provided AC terminals (in Figure4-9) should meet the following requirements: 12.5mm＜A＜14.5mm, 26mm＜B＜34mm, 13mm＜C＜17mm.

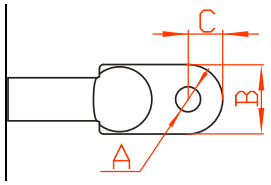


Figure4-9 Terminal size

Terminal Connection Requirements

When connecting terminals and cables of different specifications, make sure (as shown in Figure4-10):

- When adopt copper core cables or copper-clad aluminum cables, please use copper terminals.
- When adopt aluminum alloy cables, please use copper-aluminum transition terminals.

CAUTION

- DO NOT connect aluminum terminals directly to the AC copper bar. Otherwise, electrochemical corrosion may occur and the connection reliability may be affected.
- Copper-aluminum transition gaskets are not allowed to use.
- When copper-aluminum transition terminals are used, they must comply with the requirements of IEC61238-1.

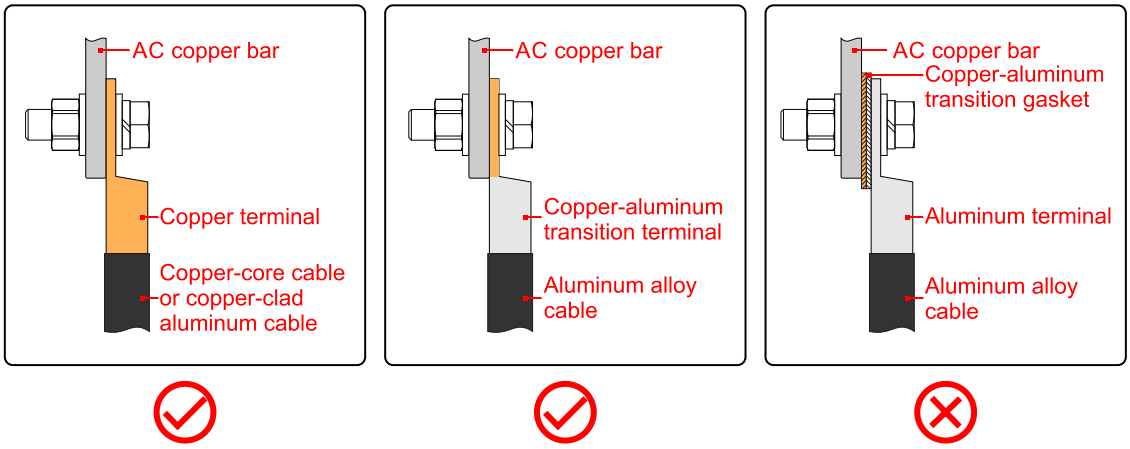


Figure4-10 Terminal connection requirements

Wiring Requirements

CAUTION

- Reserve a certain allowance for the length of the protective grounding cable to ensure that it can withstand the stress when the AC output cable bears the tension due to force majeure.
- Make sure that the cable sheath is located inside the energy storage system.

- Make sure that the AC output cables are connected tightly. Otherwise, the device may not operate, or the terminals may be damaged by generated heat after operation due to unreliable connection.

Wiring Procedure

CAUTION

The grid has high voltage, before wiring, ensure that the AC distribution breaker and all breakers of the energy storage system are disconnected. Ensure that the copper bars and wiring terminals of user side without electricity.

Step 1 Open the front door of the energy storage system, as shown in Figure4-11.

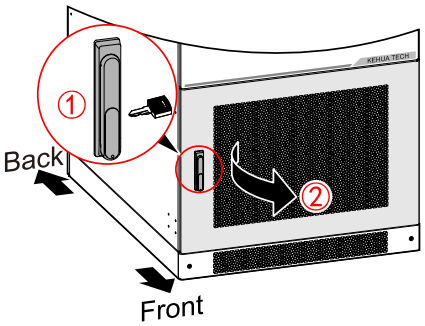


Figure4-11 Open the front door

NOTE

The doors of the energy storage system are equipped with a limiting device. When the door is opened, the limiting device will be locked automatically to prevent the door from shaking due to strong winds or external forces.

When the door needs to be closed, uplift the limiting device, then the door can be closed, as shown in Figure4-12.

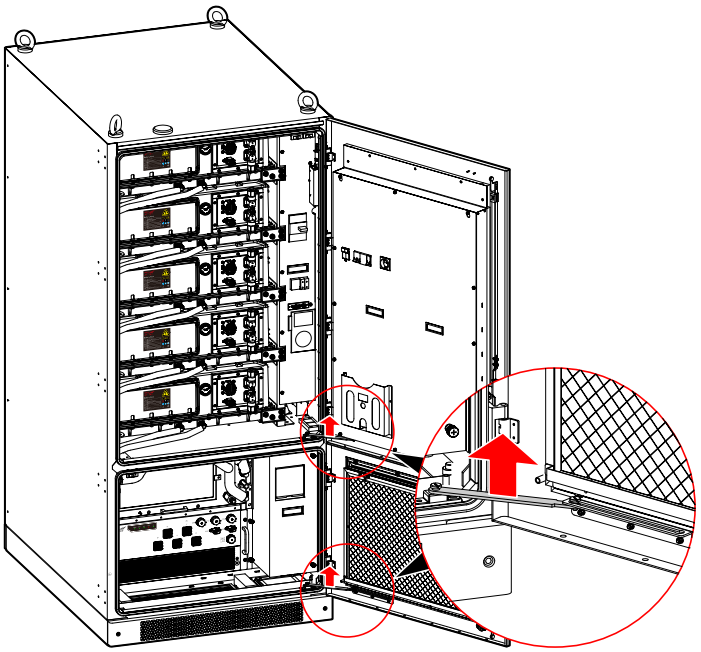


Figure4-12 Doors' limiting device diagram

Step 2 Unscrew the loose screws of AC wiring plate by screwdriver, and dismantle the wiring plate, as shown in Figure4-13.

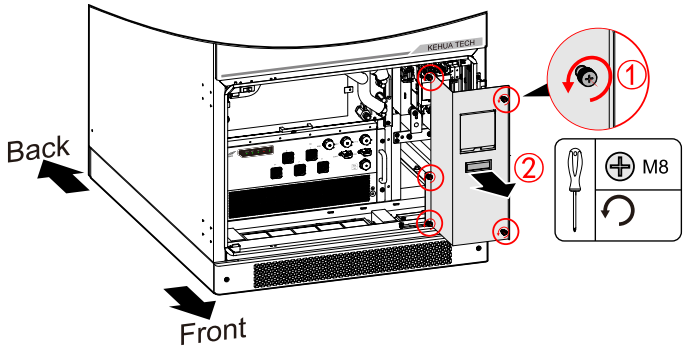


Figure4-13 Dismantle AC wiring plate

Step 3 Lead the AC output cables go through the bottom wiring hole (as shown in Figure4-14).

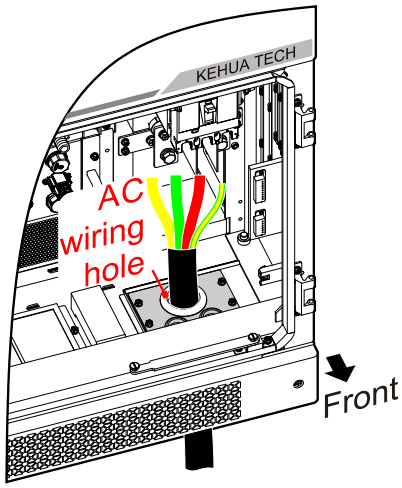


Figure4-14 AC wiring hole diagram

NOTE

The wiring plate is configured for multi-core cables as standard. If single-core cables are used, dismantle the standard multi-core wiring plate and replace it with delivered single-core cables wiring plate before routing the cables.

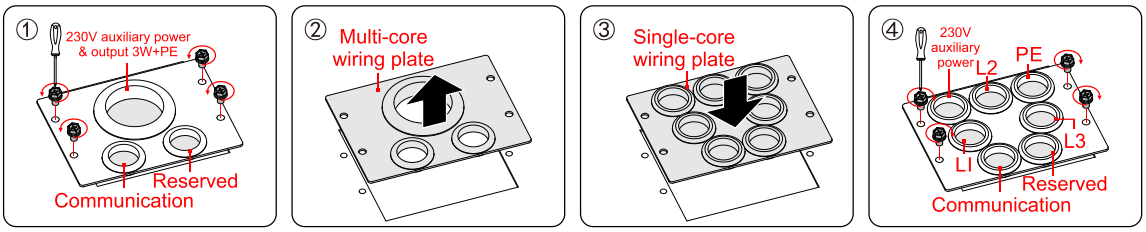


Figure4-15 Replace the wiring plate

Step 4 Crimp the AC output cables, as shown in Figure4-17.

CAUTION

When stripping the cable, please pull the cables out of the cabinet to avoid the cable skin, metal core, etc. left inside the cabinet and affecting the normal operation of the device, as shown in Figure4-16.

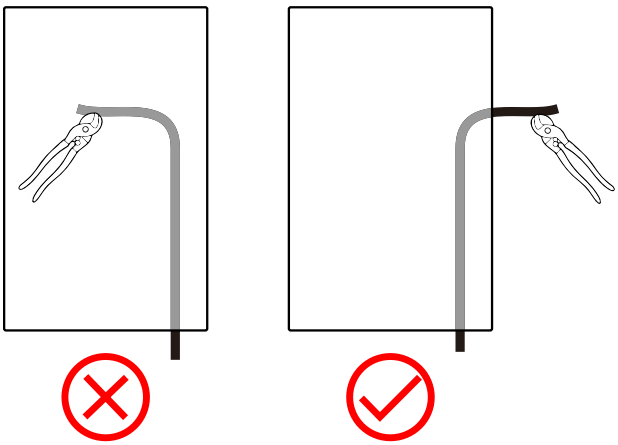


Figure4-16 Cable stripping operation requirements

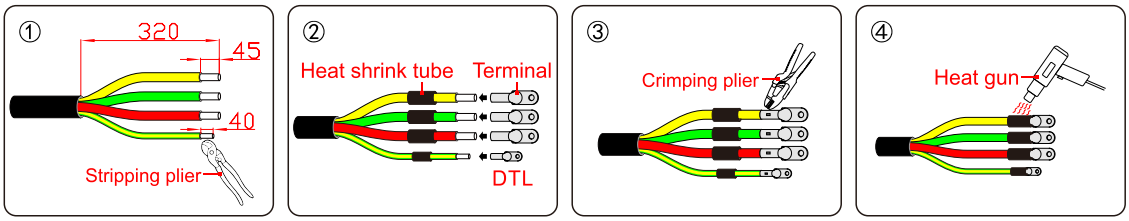


Figure4-17 Crimp the AC cables

NOTE

The stripping length in above figure is recommended based on the AC output L1/L2/L3/PE using multi-core aluminum wires, terminal DTL120 for L1/L2/L3 and DTL70 for PE. If other terminals are used, the corresponding stripping length = the actual internal length of the terminal + (1~2) mm.

Step 5 Connect the crimped AC cables to the corresponding copper bars (as shown in Figure4-18) in the order of PE, L2, L1 and L3.

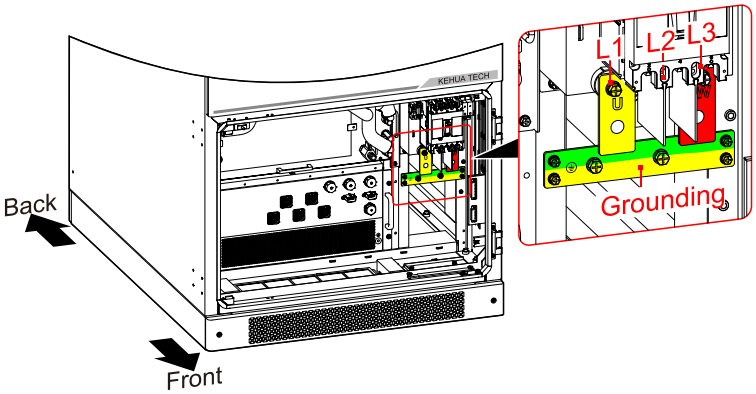


Figure4-18 AC copper bars diagram

⚠ CAUTION

- During wiring, the wiring holes of copper bars should be corresponding to the holes on the bottom wiring plate and ensure the cables vertical after wiring, and there is no overlap joint, no stress among the wires and plates.
- Ensure that the electrical connection between the grid and the AC output copper bars is in correct phase sequence and tightened firmly, otherwise, the device may fail to run or the terminals may be damaged by generated heat due to unreliable connection.
- The AC cable should be naturally sagging not less than 50mm, the axial tension on the AC copper bars should not exceed 80N. Radial stress or torque on the connection point is prohibited.

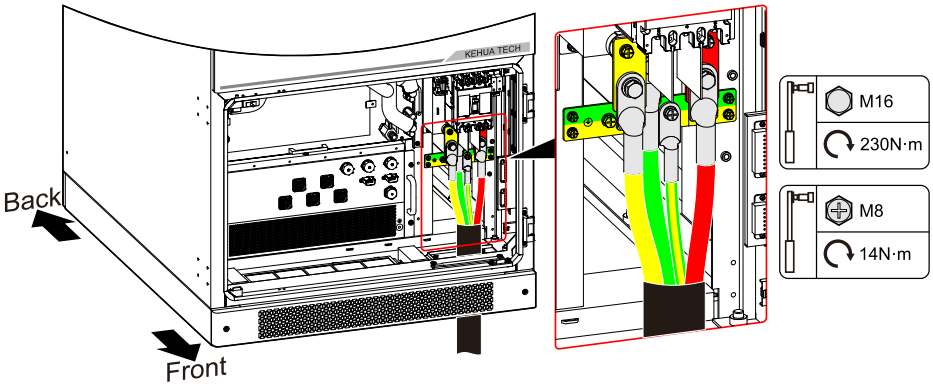


Figure4-19 AC wiring diagram

Step 6 Seal the gaps between the cables and the energy storage system by fireproof mud.

----End

4.1.5 230V Auxiliary Power Connection

Step 1 Lead the 230V auxiliary power supply cable go through the bottom wiring hole, as shown in Figure4-20.

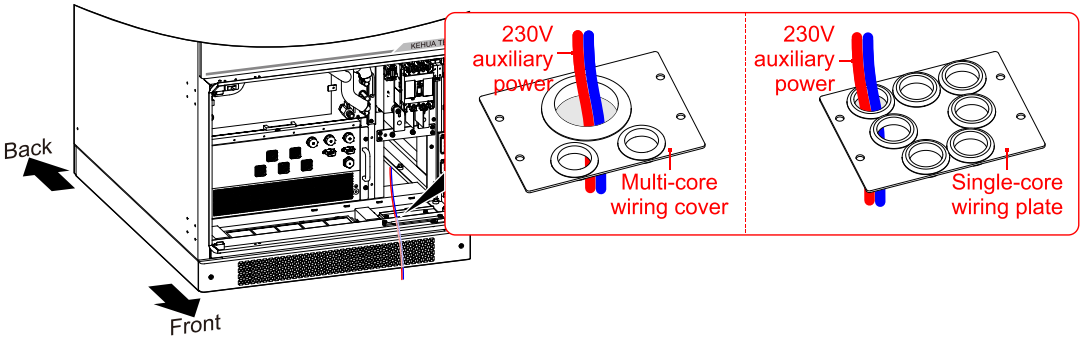


Figure4-20 Wiring hole diagram

Step 2 Crimp the 230V auxiliary power supply cables, as shown in Figure4-21.

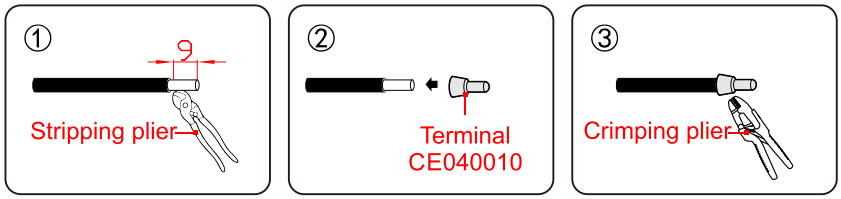


Figure4-21 Crimp the 230V auxiliary power supply cables

Step 3 Connect the crimped 230V auxiliary power cables to corresponding terminals of the energy storage system.

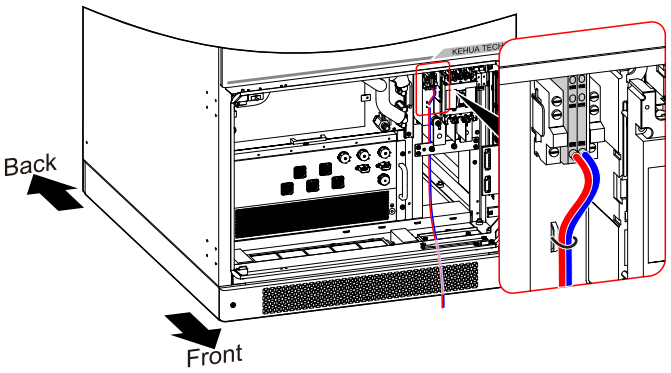


Figure4-22 Connection diagram of 230V auxiliary power cables

NOTE

The cable colors in above figure are only for clear display, the actual cable colors should be decided according to the conditions on site.

----End

4.1.6 24V Output Connection

NOTE

When the energy storage system is used with a switch cabinet or station control box, the 24V output cable also needs to be connected. If the energy storage system is used alone, this section is not required.

Step 1 Lead the 24V output cables go through the bottom wiring hole, as shown in Figure4-23.

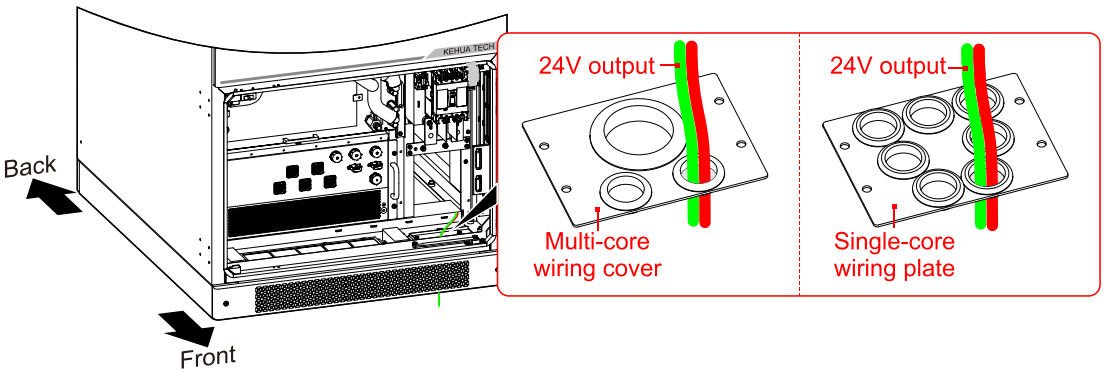


Figure4-23 Wiring hole diagram

Step 2 Crimp the 24V output cables, as shown in Figure4-24.

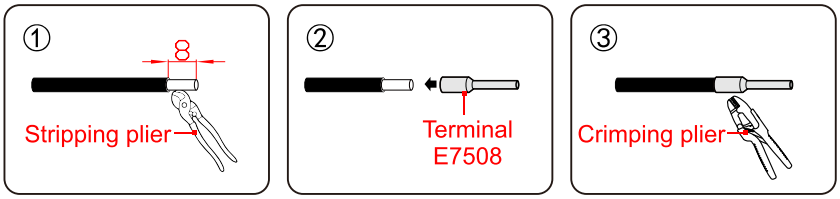


Figure4-24 Crimp the 24V output cables

Step 3 Connect the crimped 24V output cables to corresponding terminals of the energy storage system, as shown in Figure4-25.

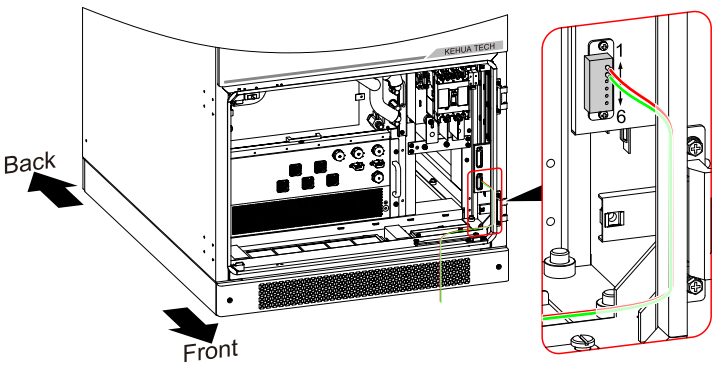


Figure4-25 Connection diagram of 24V output cables

NOTE

The cable colors in above figure are only for clear display, the actual cable colors should be decided according to the conditions on site.

Pin definition: pin1: 24Vdc (+); pin2: 24Vdc (-).

----End

4.1.7 External Communication Connection

Step 1 According to the actual needs, lead the external communication cables go through the bottom wiring hole, as shown in Figure4-26

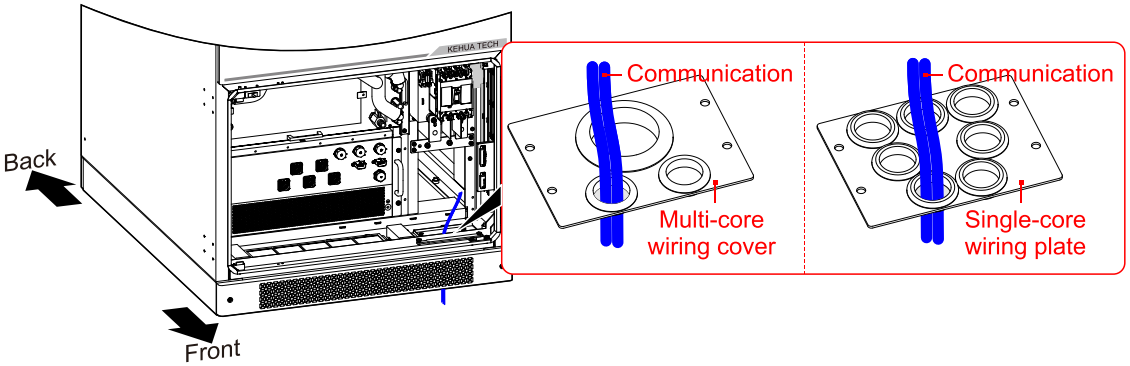


Figure4-26 Wiring hole diagram

Step 2 Crimp the external communication cables, as shown in Figure4-27.

NOTE

Refer to **Table2-9 Pin** definition of external communication port for the relevant wire sequence.

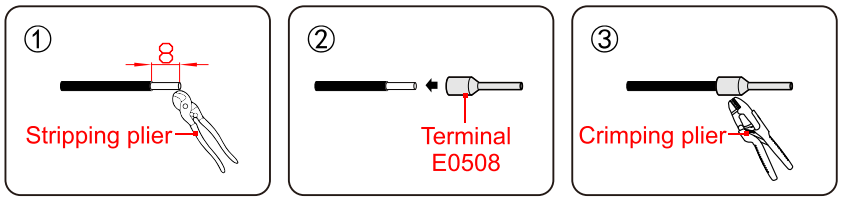


Figure4-27 Crimp the external communication cables

Step 3 Connect the crimped external communication cables to corresponding terminals of the energy storage system, as shown in Figure4-28.

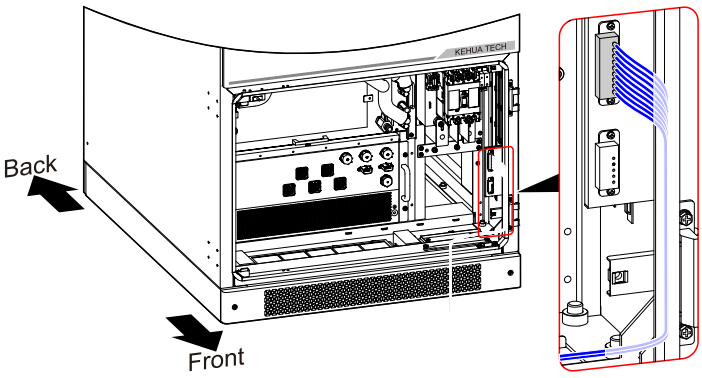


Figure4-28 Connection diagram of external communication cables

NOTE

The cable colors and number in above figure are only for reference, the actual cable colors and number should be decided according to the conditions on site.

If Kehua's meter is selected, the corresponding wiring diagram is shown in Figure4-29. if other manufacturers' meter is used, it will not be able to communicate.

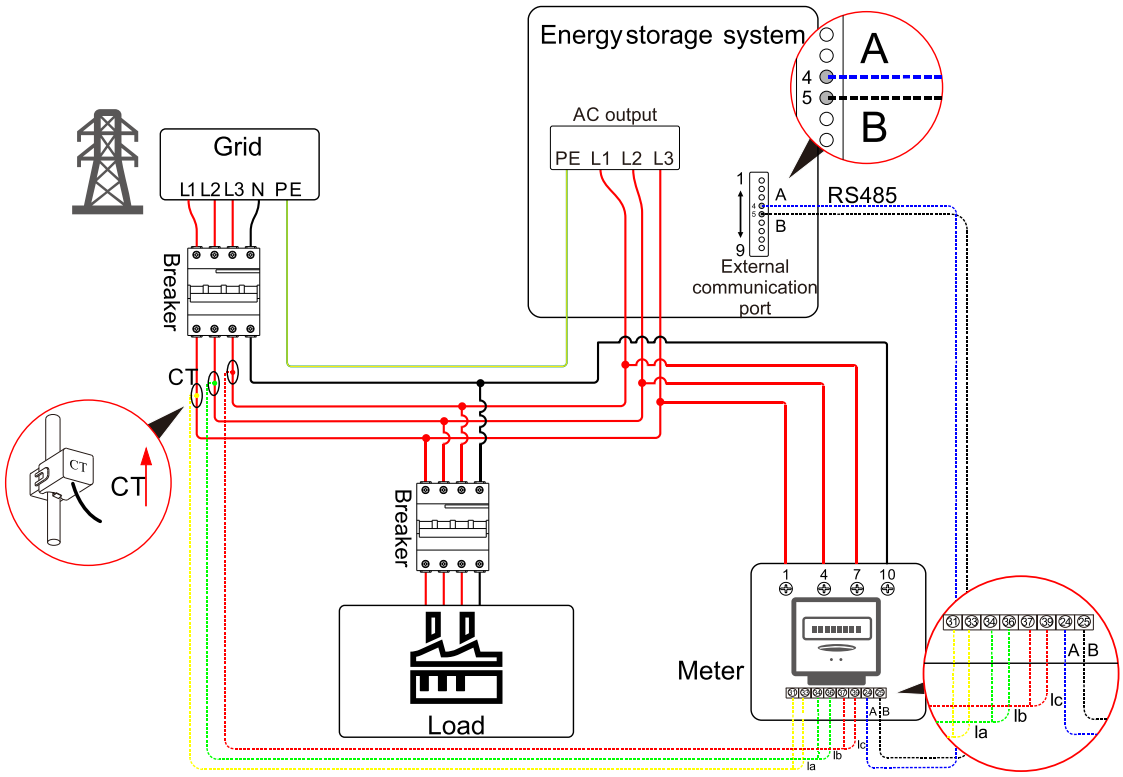


Figure4-29 Meter connection diagram

CAUTION

The grid voltage connected to the meter must be less than 500V. If a higher level of grid voltage needs to be connected, you need to add a voltage transformer. For details, please consult the manufacturer.

----End

4.1.8 Network Signal SPD LAN Connection

Step 1 Lead the Network signal SPD LAN cables go through the bottom wiring hole, as shown in Figure4-30.

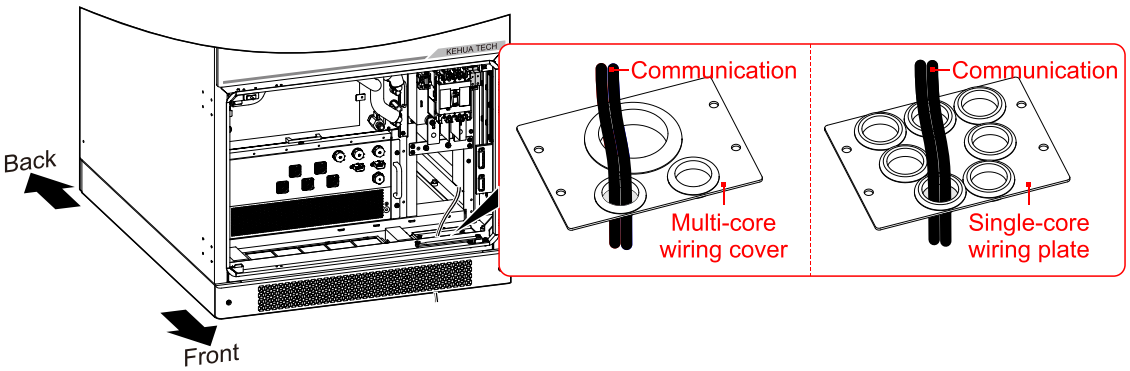


Figure4-30 Wiring hole diagram

Step 2 Crimp the Network signal SPD LAN cables, as shown in Figure4-31.

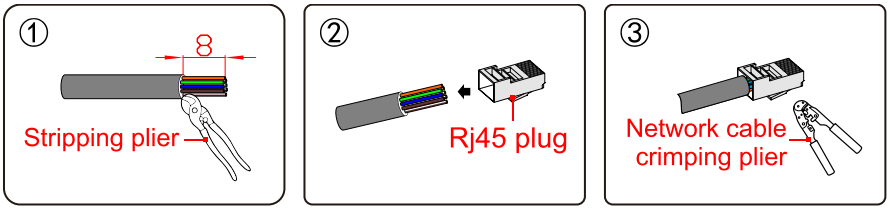


Figure4-31 Crimp the Network signal SPD LAN cables

Step 3 Connect the crimped Network signal SPD LAN cables to the corresponding communication port of the energy storage system, as shown in Figure4-32, Figure4-33.

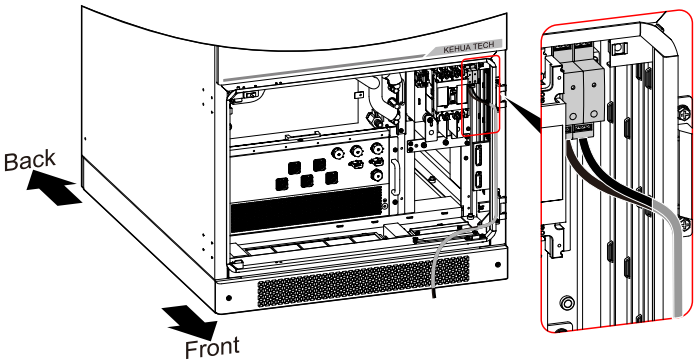


Figure4-32 Connection diagram of Network signal SPD LAN cables

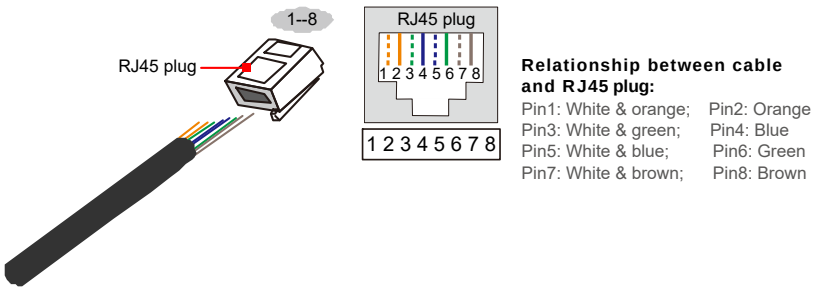


Figure4-33 Relationship between the cable and RJ45 plug

Step 4 Seal the gaps between the cables and the energy storage system by fireproof mud.

Step 5 Reinstall the wiring plate and close the door.

CAUTION

Before installing the wiring plate, please check the correctness and firmness of all the connection, and clean up any construction debris in the wiring compartment.

----End

4.2 Check the Installation

To ensure normal operation, after finishing the installation and wiring, please check the following items.

- Check that the energy storage system is firmly fastened to the installation floor.
- Check that the cables are connected correctly:
  - The positive and negative of the DC side are connected correctly.
  - The phase sequence of L1, L2 and L3 on the AC side is correctly connected.
- Check that the connection points of each cable are stable.
- Check whether each cable is bent with stress.
- Check whether the cables are neat, and whether the cable is tied in accordance with the process specification.
- Check whether the gaps of bottom wiring holes are sealed with fireproof mud.
- Check that no other objects, such as tools, wire skins, etc., are left inside the cabinet.

5 APP Operation Illustration

NOTE

The parameter values and other details in the figures of this chapter are for illustration only, please refer to the actual display on the APP as standard.

5.1 APP Introduction

WiseSolar+ APP can establish a communication connection with the energy storage system through the WIFI module to realize the near-end maintenance of the energy storage system. Users can use WiseSolar+ APP to view information, query alarm and event and set parameters of the energy storage system.

5.2 APP Connection Operation

5.2.1 Connection Requirements

The following conditions need to be met for connecting the APP:

- The AC and DC breakers of the energy storage system are powered on.
- The WLAN function of the mobile phone is turned on.
- The visual distance between the mobile phone and the energy storage system is within 5 metres.
- APP has been downloaded and installed.

NOTE

WiseSolar+ APP can be downloaded and installed in the following ways.

Mode 1: Search for WiseSolar+ via the following application market and download and install the WiseSolar+ APP.

- APP market(Android mainland users, HarmonyOS users), Google (Overseas users).
- APP store (iOS).

Mode 2: Scan the following QR code and follow the instructions to download and install WiseSolar+ APP.

Figure5-1 APP QR code

5.2.2 APP Connection Procedure

Step 1 Connect your mobile phone WIFI to the WIFI of the energy storage system corresponding to, as shown in Figure5-2.

Figure5-2 Connect WIFI

NOTE

The energy storage system's naming rule of WIFI is KC + S/N of logger.

Default password of the energy storage system's WIFI is Logger123.

Step 2 Connect the energy storage system to WiseSolar+ APP.

1. Open the WiseSolar+ APP and tap the icon in the lower right corner (as "1" shown in Figure5-3).
2. Select **To device** (as "2" shown in Figure5-3).
3. Select **WIFI** (as "3" shown in Figure5-3) to enter the local login page.
4. Select **Local Login** (as "4" shown in Figure5-3), select **I am the owner** (as "5" shown in Figure5-3), the scanning page will pop up, tap **Manual Input** (as "6" shown in Figure5-3), fill in the S/N of connected logger (refer to NOTE in "Step 1"), and then tap **Confirm**. At this time, the energy storage system has established a communication connection with the mobile phone.

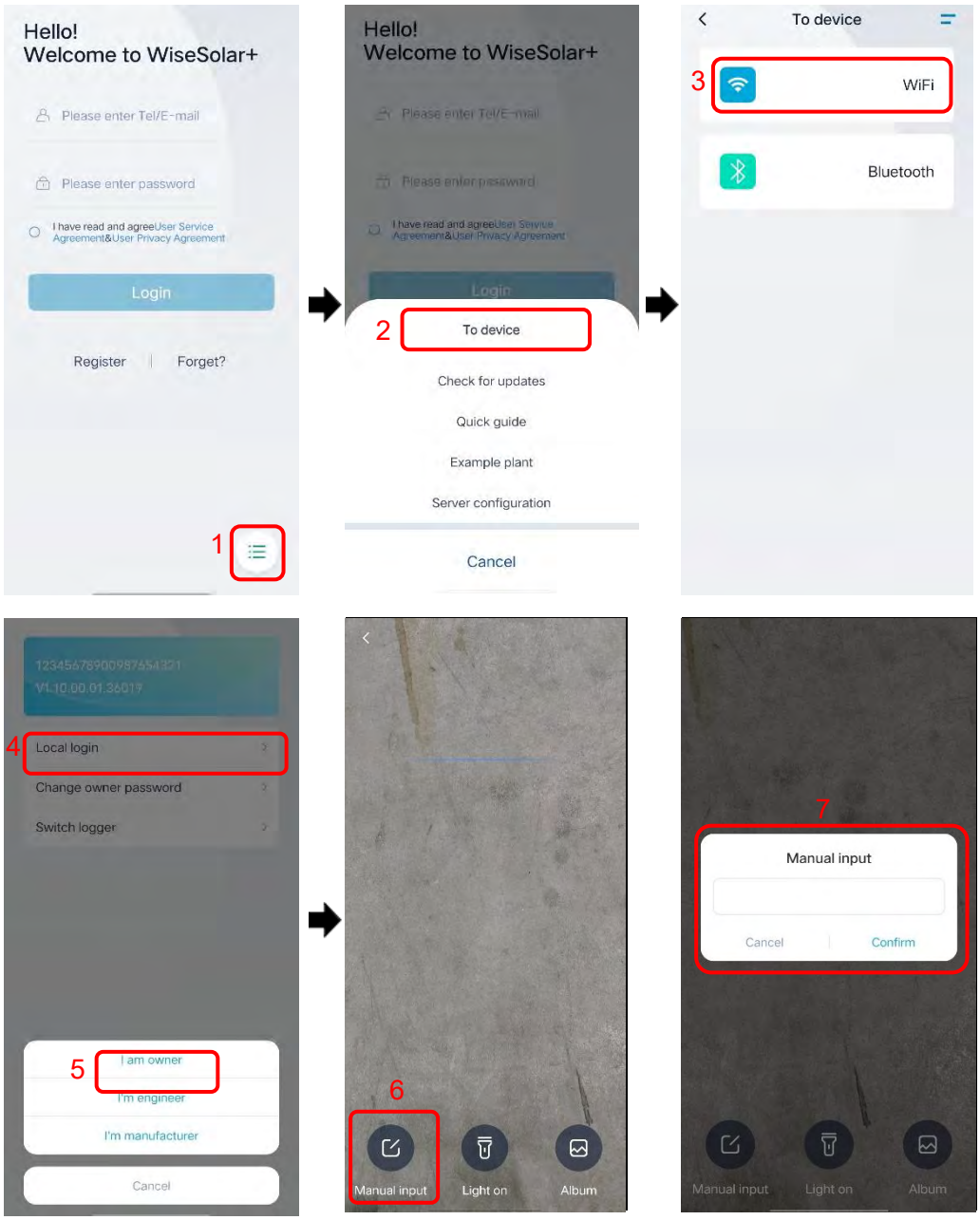


Figure5-3 Operation for connecting with the energy storage system

NOTE

Since the WIFI module of the energy storage system does not have an automatic connection function, you need to make sure that your mobile phone is connected to the WIFI of the energy storage system before daily use of the APP (if the WIFI of energy storage system has been connected once, you only need to tap the corresponding WIFI to connect in the future).

----End

5.3 APP Function Introduction

5.3.1 APP Icon Illustration

Detailed APP icon illustration is shown in Table5-1.

Table5-1 APP icon illustration

Icon	Illustration	Icon	Illustration
	Monitoring page		Setting interface
	Application page		Alarm info interface
	Device list page		History record page

NOTE

When an icon is selected, the icon will be displayed in inverse colour, such as , , , , , .

5.3.2 Monitoring Page

Step 1 In the home page, tap **System details**, as "1" shown in Figure5-12, it will enter system monitoring page.

Step 2 Tab the bottom icon (as "1" shown in Figure5-12), it will enter device list page.

NOTE

Device list includes dehumidifiers, BMS, energy storage converter, and liquid cooling units.

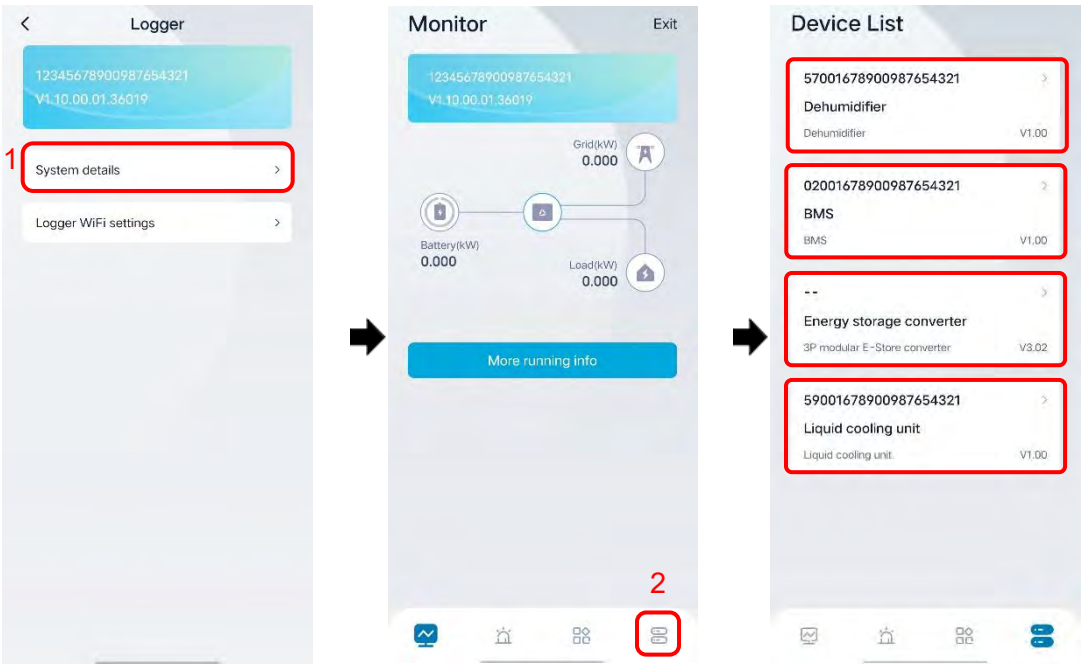


Figure5-4 Monitoring page operation

Step 3 Select the device to be monitored to enter the corresponding monitoring info page of the device.

----End

In the monitoring info page, you can monitor the running information, alarm information, settings and history records of each device, as described below.

Energy Storage Converter

Tap **Energy Storage Converter** in the Device List page to enter corresponding monitor page, as shown in Figure5-5.

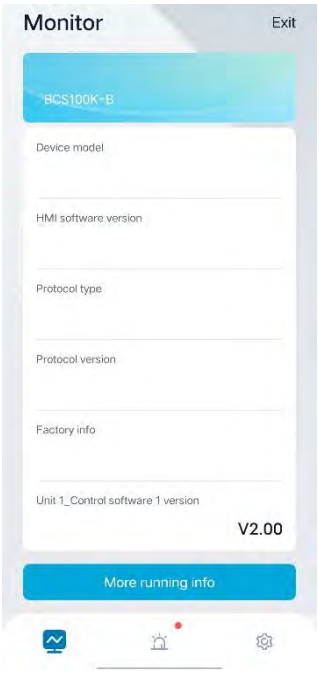


Figure5-5 Monitoring page of energy storage converter

- Tap "More Running info" button at the bottom, the following items can be viewed (as shown in Figure5-6).
  - Battery information: BMS system status, total battery current, total battery voltage, battery SOC, battery SOH.
  - System information: running status, system three-phase output current, related power and power factor.
  - Unit 1 information: unit three-phase voltage, unit three-phase output phase current, and so on.

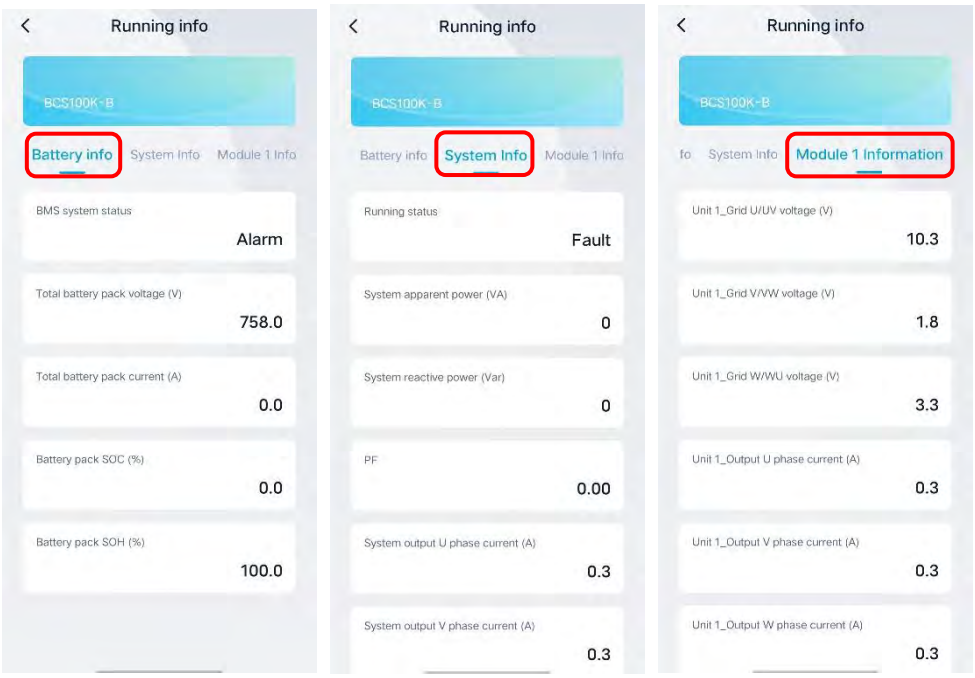


Figure5-6 More running info page

- Tap the bottom icon , you can view the current alarm info.

Figure5-7 Alarm info page

- Tap the bottom icon , you can view and change the related setting of energy storage converter (as shown in Figure5-8), such as: ON/OFF, system running mode, active power and reactive power, etc.

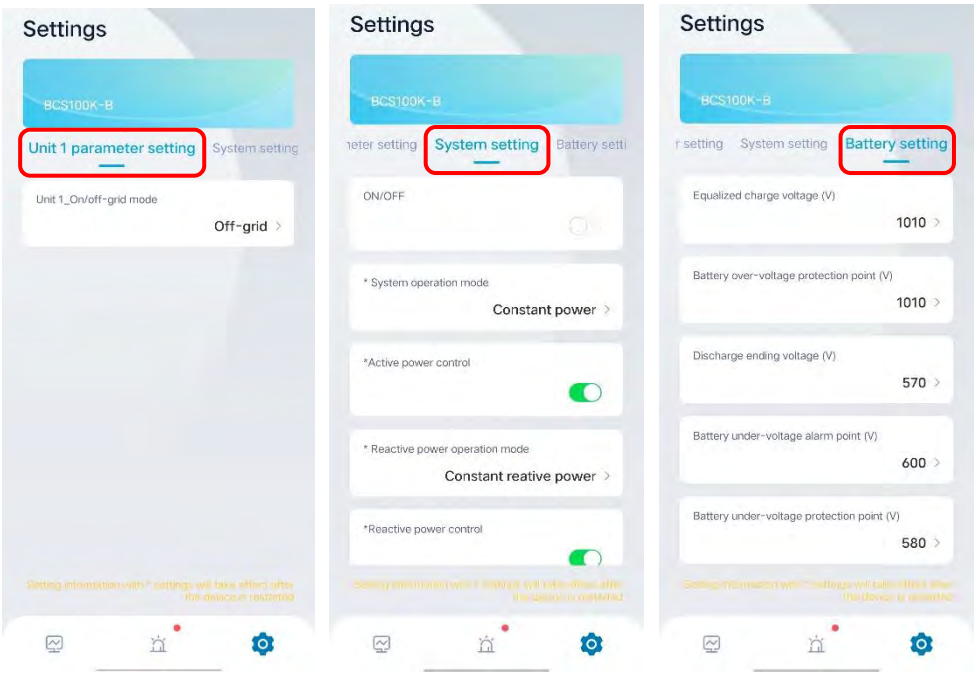


Figure5-8 Setting info

NOTE

User can view the battery settings by default. If the parameters need to be changed, please contact the manufacturer to confirm.

Dehumidifier

Tap **Dehumidifier** in the Device List page to enter corresponding monitor page, as shown in Figure5-9.

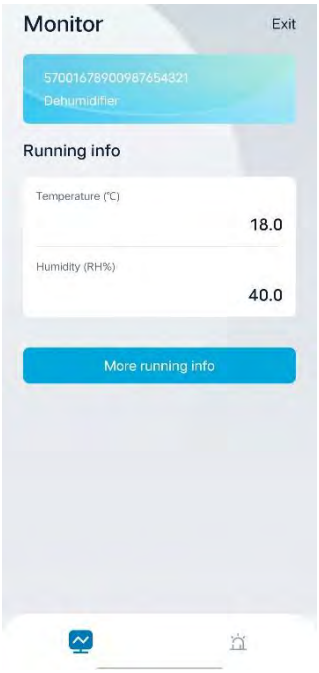


Figure5-9 Dehumidifier page

- Tap "More running info " button, the work mode can be viewed, as shown in Figure5-10.

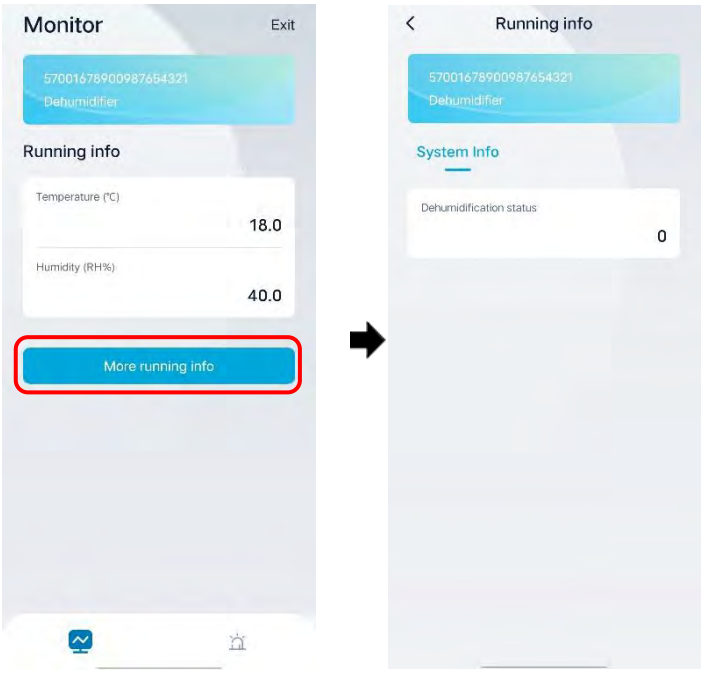


Figure5-10 More running info page

- Tap the bottom icon , you can view the current alarm info of dehumidifier, as shown in Figure5-11.

Figure5-11 Alarm info page

BMS

Tap **BMS** in the Device List page to enter corresponding monitor page, as shown in Figure5-12.

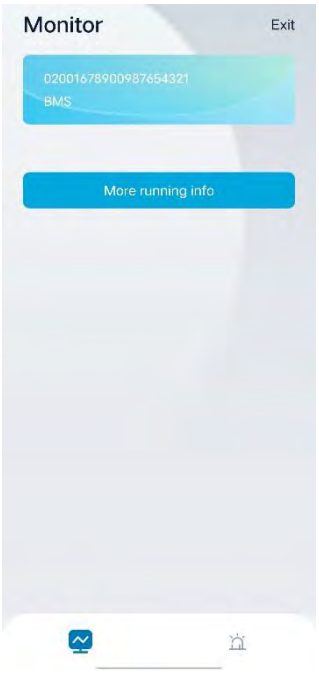


Figure5-12 BMS monitoring page

- Tap "More running info " button, the related info of battery system can be viewed, such as cluster voltage, min. cell voltage, cluster status, total cluster SOC, etc., as shown in Figure5-13.

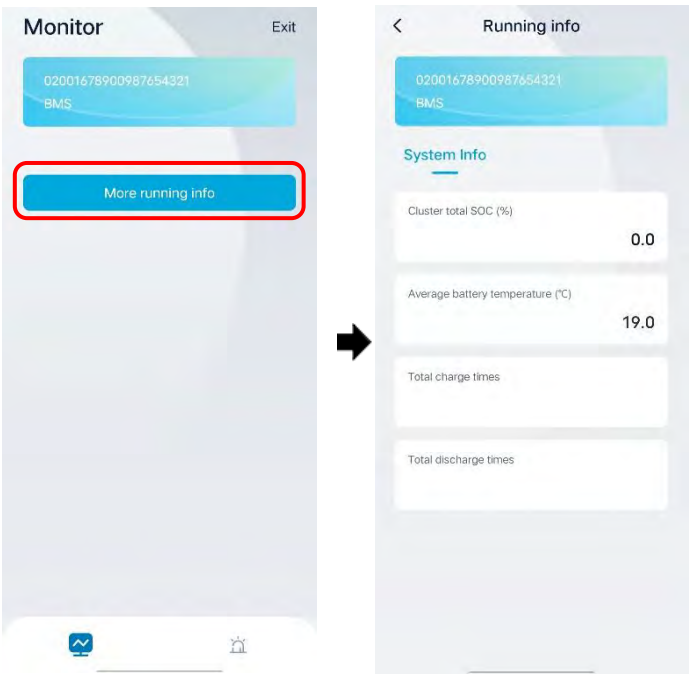


Figure5-13 More running info page

- Tap the bottom icon , you can view the current alarm info of BMS, as shown in Figure5-14.

Figure5-14 Alarm info page

Liquid Cooling Unit

Tap **Liquid cooling unit** in the Device List page to enter corresponding monitor page, as shown in Figure5-15.

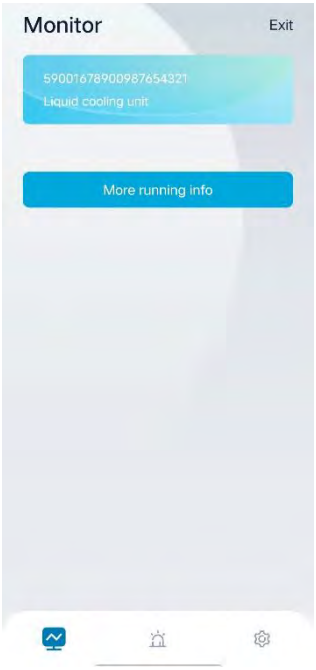


Figure5-15 Liquid cooling unit page

- Tap "More running info " button, the system info of liquid cooling unit can be viewed, such as the current status of the liquid cooling unit, the return water pressure, the discharge water pressure, etc., as shown in Figure5-16.

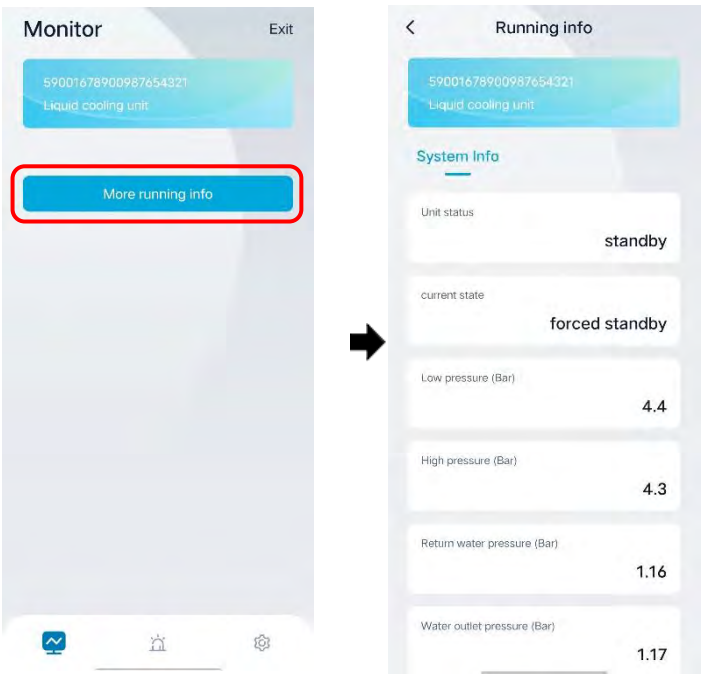


Figure5-16 More running info page

- Tap the bottom icon , you can view the current alarm info of the liquid cooling unit, as shown in Figure5-17.

Figure5-17 Alarm info page

- Tap the bottom icon , you can view the current setting status of the liquid cooling unit, such as ON/OFF, cooling return water, cooling out water and other parameters, as shown in Figure5-18.

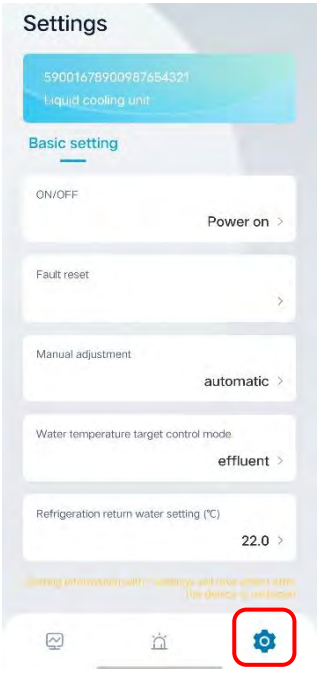


Figure5-18 Setting info page

NOTE

Keep the parameters of the liquid cooling unit by default. If the parameters need to be changed, please contact the manufacturer to confirm.

5.3.3 Plan Curve

NOTE

1. Users can schedule the energy storage system periodically according to the actual needs.
2. the illustration for the period of plan curve: users can set the working condition of the energy storage system on a workday or vacation according to local policies, for example, to realize the function of time of use. The maximum active power cannot exceed 110, and the maximum reactive power setting value cannot exceed 100.

CAUTION

The plan curve function can be enabled only in constant power mode, and in constant current mode, it is prohibited to enable the function.

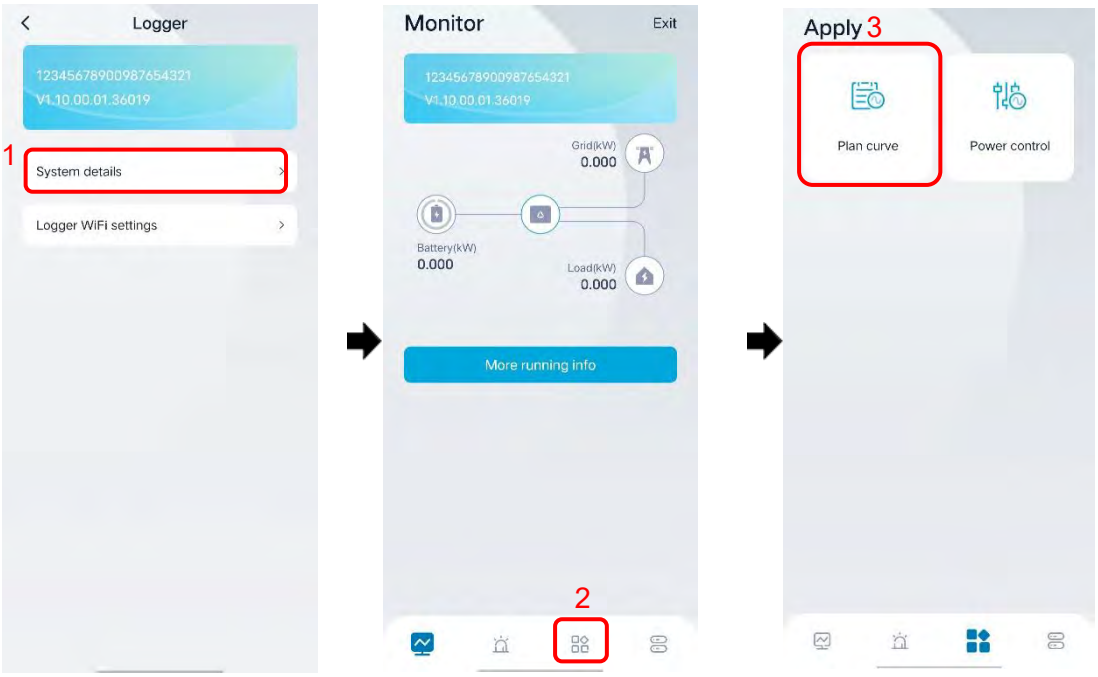
Step 1 Tap the **System Details** in home page (as "1" shown in Figure5-19) to enter the system monitoring page.

Step 2 Tap the bottom icon (as "2" shown in Figure5-19) to enter the application page.

Step 3 Select plan curve (as "3" shown in Figure5-19) to enter the detail setting page.

Step 4 After enabling the plan curve, tap the setting (as "4" shown in Figure5-19) to arrange the working time of the energy storage system in a week.

Step 5 Tap the workday and vacation (as "5" shown in Figure5-19) to set the working time, active power and reactive power for the day.



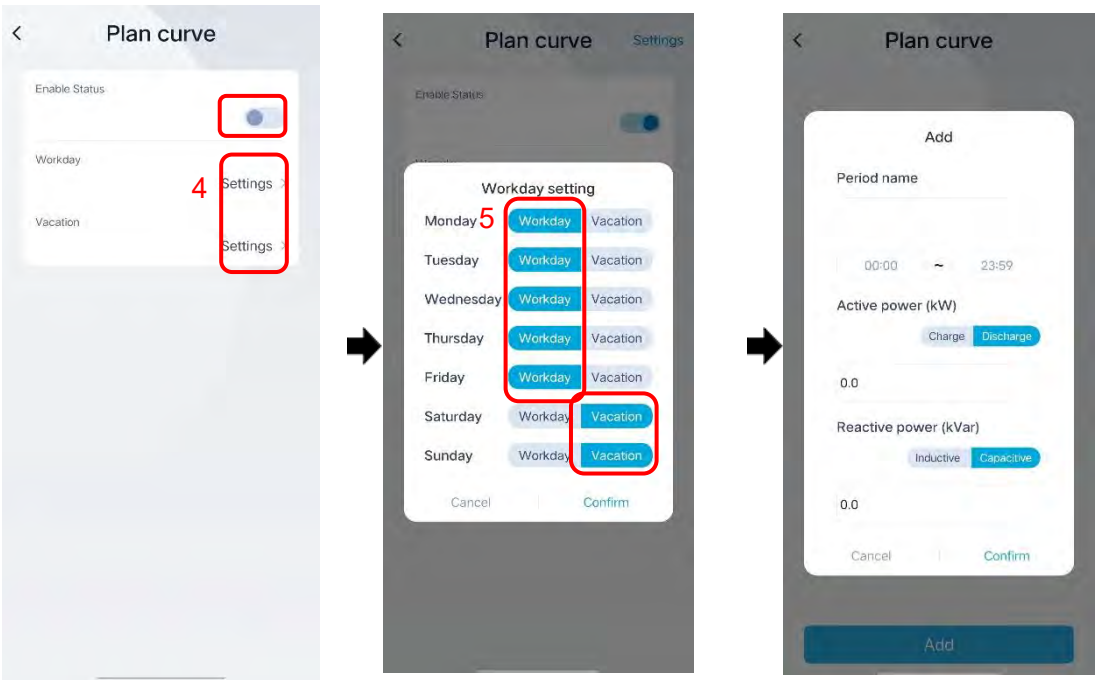


Figure5-19 Setting procedure of plan curve

NOTE

The workday and vacation can be defined by user. The power and period about charge and discharge on workday and vacation can be set according to the actual demand.

----End

5.3.4 Power Control

Step 1 Tap the **System Details** in home page (as "1" shown in Figure5-20) to enter the system monitoring page.

Step 2 Tap the bottom icon (as "2" shown in Figure5-20) to enter the application page.

Step 3 Select power control (as "3" shown in Figure5-19) to enter the detail setting page.

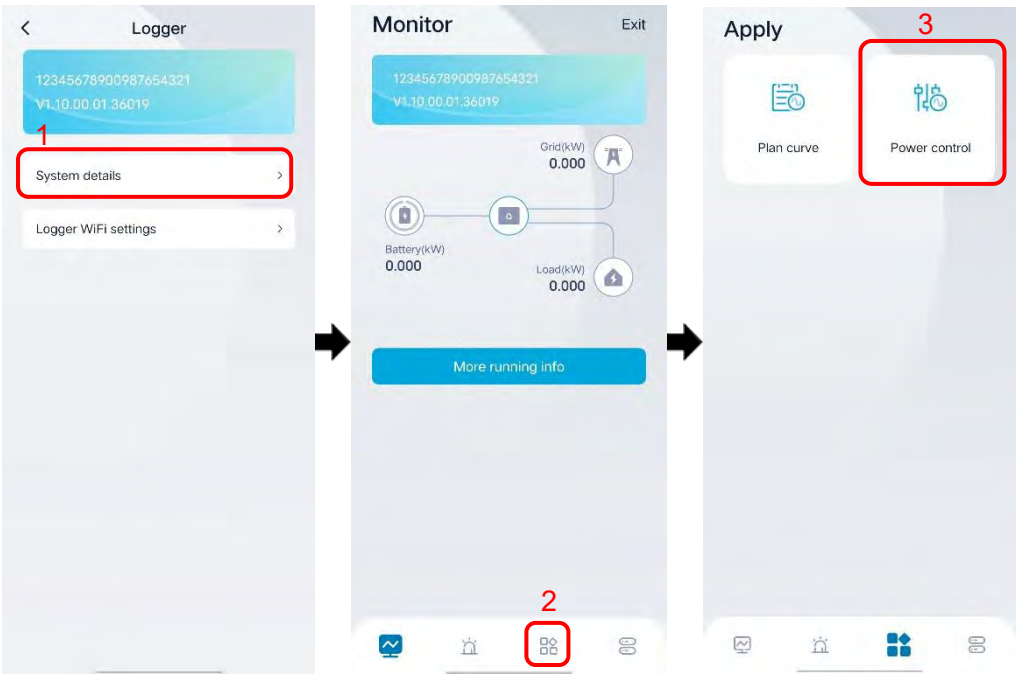


Figure5-20 Setting procedure of power control

In the power control page (as shown in Figure5-21), user can set the related parameters of configuration, anti-countercurrent, and anti-overdemand etc.

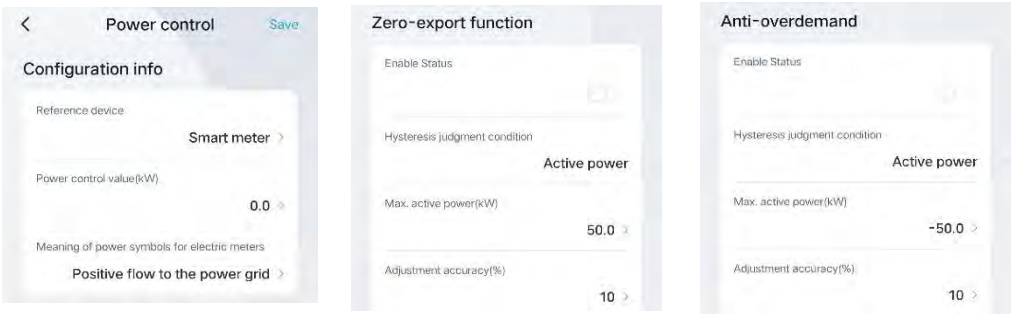


Figure5-21 Power control page

Table5-2 setting parameters illustration of power control

Setting item		Illustration	Remark
Configuration Info	Reference device	Currently, only Smart meter is supported.	-
	Power control value	After enabling the function of zero-export or anti-overdemand, the maximum active power allowed to run without triggering the function of	Setting range: -100~100

Setting item		Illustration	Remark
		zero-export or anti-overdemand.	
	Meaning of power symbols for meter	Can be set to flow to grid as positive and flow to the grid as negative. When it is set to flow to the grid as positive, the current direction is positive and it is the direction of reverse current.	The positive or negative of symbol is determined according to the current direction of CT in Figure4-29. Take the CT current flows to the grid as positive, otherwise, it is set to negative.
Zero-export	Enable status	Can be set to on or off.	-
	Hysteresis judgement condition	The active power is the judgement condition and cannot be changed.	-
	Max active power	Maximum active power of allowed backflow.	-
	Adjustment accuracy	When the zero-export function is enabled, the correction value of the power that triggers the zero-export (the adjustment precision is unidirectional correction). Example: set the power of zero-export is XkW, the adjustment precision is Y, the allowed power is (X-|X*Y|)kW.	Setting range: -100~100
Anti-overdemand	Enable status	Can be set to on or off.	-
	Hysteresis judgement	The active power is the judgement condition and cannot be changed.	-

Setting item		Illustration	Remark
	condition		
	Max active power	Maximum active power of allowed over-demand.	-
	Adjustment accuracy	When the anti-overdemand function is enabled, the correction value of the power that triggers the anti-overdemand (the adjustment precision is unidirectional correction). Example: set the power of anti-overdemand is XkW, the adjustment precision is Y, and the allowed power is (X+|X*Y|)kW.	Setting range: -100~100

NOTE

Zero-export function: when the power delivered to the grid is larger than the set maximum active power, the power control will be set to limit the power of the energy storage system and prevent the current of the energy storage system from flowing backward to the grid.

Anti-overdemand function: when the input power from the grid is larger than the set maximum active power, the power of the energy storage system will be adjusted through the set power to control and prevent the input power from the grid exceeding the limit.

CAUTION

- Zero-export and anti-overdemand functions can only be used in constant power mode (default setting), and they are prohibited in constant current mode.
- When the plan curve function is not enabled and the zero-export or anti-overdemand function is enabled, the active power of the energy storage system can only be dispatched according to the power setting value of "Power Control".
- If the plan curve is enabled and the zero-export or anti-overdemand function is enabled, the active power of the energy storage system can only be dispatched according to the active power setting of the plan curve.

----End

5.3.5 ON/OFF Setting

Step 1 Select "Energy storage converter" for monitoring in the device list page (see "**5.3.2 Monitoring Page**" for entering operation), as shown in "1" in Figure5-22.

Step 2 Select "Setting" button to enter the setting page of the energy storage converter, as shown in "2".

Step 3 Select "System Setting" and enter this page to set the power of the energy storage converter before power on, such as active power, reactive power, etc., as shown in "3".

Step 4 After setting the power, tap "ON/OFF" in the same interface to start the system, as shown in "4". When shutting down, you can tap the position shown in "4".

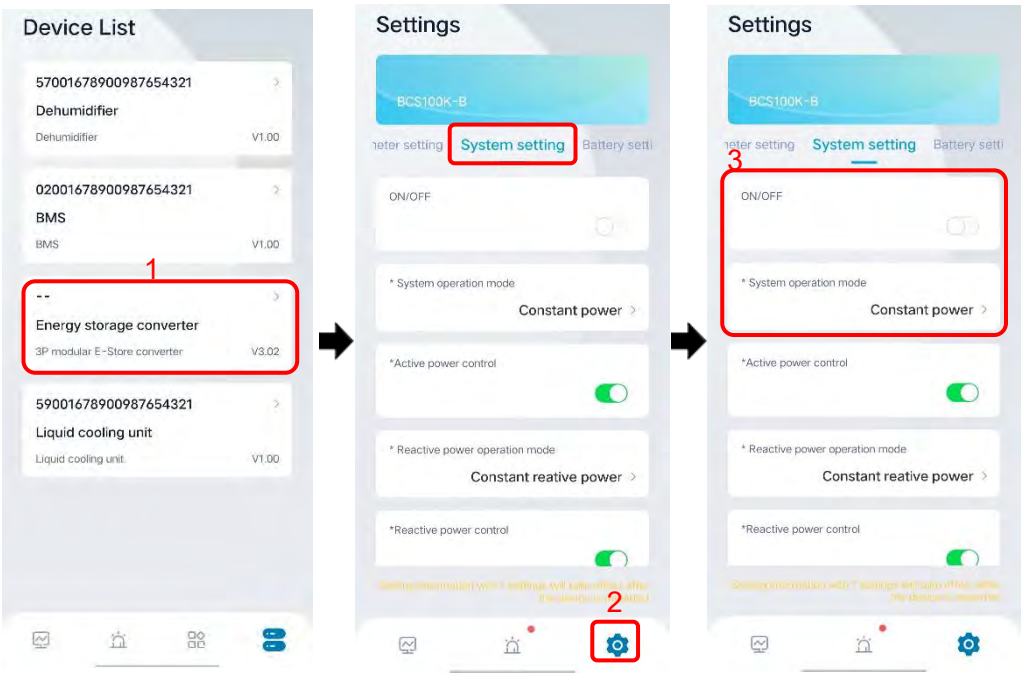


Figure5-22 ON/OFF procedure

NOTE

When setting the power, the setting range of active power is 0~110, and the setting range of reactive power is 0~100.

----End

6 Commissioning

This chapter mainly introduces the system operation of the energy storage system.

6.1 Check Before Running

DANGER

Before operating, check and make sure that there is no damage on the energy storage system or exist other potential hazards.

Table6-1 Checking list for commissioning

Check item		Check result
General checking	1. The appearance of the energy storage system should be in good condition, with no damage, no rust and no paint falling off. If there is any paint falling off, please repair the paint. 2. Each component in the energy storage system should be in good condition, with no damage. 3. The copper bars should be without deformation. 4. Labels should be clearly visible, damaged labels should be replaced in time.	☐Normal ☐Abnormal
	1. DC breaker is disconnected. 2. AC breaker is disconnected. 3. External power supply breaker is disconnected.	☐Normal ☐Abnormal

Check item		Check result
	The operating mechanism, switch and other movable components are flexible, reliable and accurate. For the device equipped with temperature display, temperature control, fan, condensation control devices, etc., they should also be checked according to the electrical performance requirements and instructions for the installation and use.	☐Normal ☐Abnormal
	Ensure that there is no sundries in the cabinet, such as tools, remainder materials for installation.	☐Normal ☐Abnormal
Installation checking	Make sure that the space around the energy storage system meets the requirements.	☐Normal ☐Abnormal
	The cabinet should be horizontal, every door can be opened normally.	☐Normal ☐Abnormal
	Ensure that the energy storage system has been reliably installed in place.	☐Normal ☐Abnormal
	The installation bolts of the energy storage system and electrical components are fastened firmly.	☐Normal ☐Abnormal
Electrical connection checking	1. The power cables and communication cables routing should be separated. 2. The joints of the cable buckle should be cut neatly, and no spines are exposed. 3. A certain allowance for the cables should be left at the turn as required. 4. The routing of cables should be straight and smooth and without crossover in the cabinet.	☐Normal ☐Abnormal
	1. The cable connection position should be the same as designed. 2. Terminal crimping should be in line with the specifications, and the connection is firm and reliable. 3. Each cable should be clearly labelled at both ends, and the labels are oriented in the same direction.	☐Normal ☐Abnormal

Check item		Check result
	The cable protection layer should be well wrapped and without obvious damage. The connection of AC output and communication cables should be connected correctly and firmly and reliably, and with no short-circuit. The installing bolts of each cable are fastened firmly.	☐Normal ☐Abnormal
	The impedance of the AC side live wire to ground should be greater than 1MΩ.	☐Normal ☐Abnormal
	The grounding point of cabinet should be firm and the resistance should be not more than≤0.1Ω. The grounding conductor is reliably connected to the cabinet grounding terminal or copper bar. The grounding of the energy storage system must not be directly connected to the lightning rod (strap) of the building.	☐Normal ☐Abnormal
	The gap between the cables and wiring plate is sealed up.	☐Normal ☐Abnormal
	The connected grid voltage should be the same as the AC grid-tied voltage required by the energy storage system.	☐Normal ☐Abnormal

NOTE

Check items are not limited to the items listed in Table6-1, user can add check items based on site conditions.

6.2 Startup

CAUTION

- Confirm that the AC voltage meets the allowed voltage range of the energy storage system.
- Grid-tied operation needs to be allowed by the local power supply department and operate by professional electrician.
- When first use, before startup, please remove the stickers on the front and rear air inlet and outlet holes (as shown in Figure6-1).

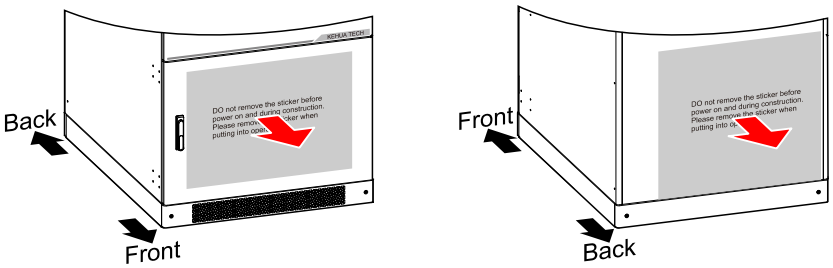


Figure6-1 Remove the stickers

After checking, start up the energy storage system according to the following steps.

Step 1 Open the upper door and install the MSD plug to the middle lithium module, as shown in Figure6-2

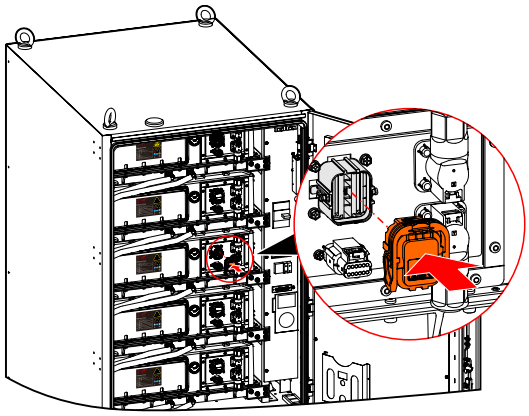


Figure6-2 Install MSD plug

NOTE

Only the MSD plug of middle lithium module is not installed, the other MSD plugs have been installed before delivering, and they don't need to be operated.

CAUTION

The MSD should not be assembled by force, please operate it according to Figure6-3.

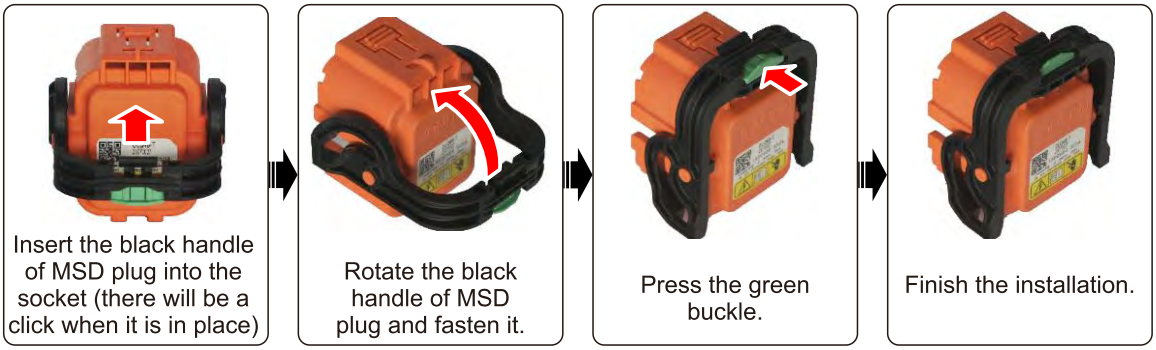


Figure6-3 Installation diagram for MSD plug

Step 2 Power on the external power supply, close the external power supply breaker QF1, as shown in Figure6-4.

Step 3 Close DC breaker NFB1 (as shown in Figure6-4), DC side is connected.

Step 4 Close the AC breaker NFB2 (as shown in Figure6-4), the AC side is connected.

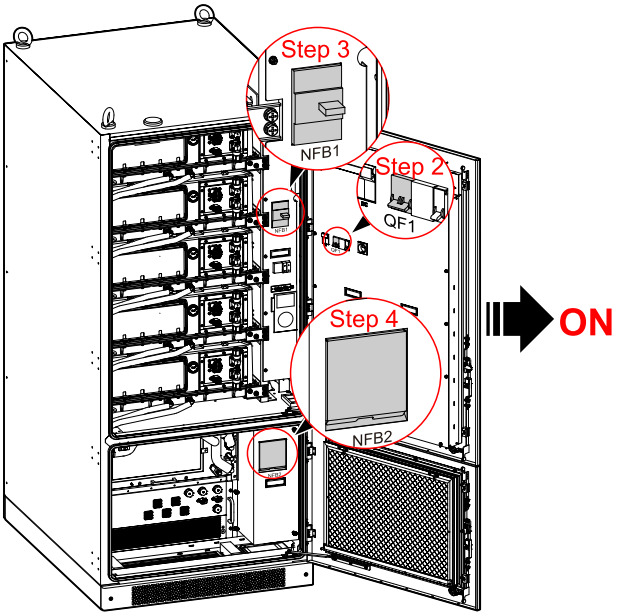


Figure6-4 Close the corresponding circuit breakers

Step 5 Power on the energy storage system on the APP (see **5.3.5 ON**/OFF Setting).

----End

Check After Startup

After starting the energy storage system, check the overall operating condition of the system.

Table6-2 Checking list after startup

Check item	Check result
No abnormal status in the system: abnormal noise, overheating, smoke or abnormal odor.	Normal Abnormal
Check the voltage of battery pack on APP within the range of 672~864V.	Normal Abnormal
No alarm showed on the APP.	Normal Abnormal
The running status of the device who is communicating with logger shows normal on the APP.	Normal Abnormal

CAUTION

The temperature of the air outlet is high when the machine is running at its limit, it is strictly prohibited to touch the metal plate of air outlet to prevent scalding.

6.3 Shutdown

CAUTION

When shutting down the energy storage system normally, it must be operated through APP first. It is strictly prohibited to directly disconnect the breaker with load, otherwise it may lead to malfunction of the energy storage system, and in serious cases, it may cause damage to the energy storage system, and the damage caused by it will not be covered by the warranty.

Step 1 Power off the energy storage system on the APP (see **5.3.5 ON**/OFF Setting).

Step 2 Observe the power and current through APP to make sure the power and current is 0.

Step 3 Disconnect the AC breaker (as ⑱ shown in Figure2-9).

Step 4 Disconnect the DC breaker (as ⑧ shown in Figure2-9).

Step 5 Disconnect the external power supply breaker (as ⑭ shown in Figure2-9).

----End

6.4 Procedure for Stopping the System in Case of a Major Fault

When a major fault occurs, stop the operating of the energy storage system as follows.

Step 1 Press down the E-STOP button (as ④ shown in Figure2-8).

Step 2 Disconnect the AC breaker (as ⑱ shown in Figure2-9).

Step 3 Disconnect the DC breaker (as ⑧ shown in Figure2-9).

Step 4 Disconnect the external power supply breaker (as ⑭ shown in Figure2-9).

----End

⚠ CAUTION

When the energy storage system is malfunctioning, it is strictly prohibited to restart the system through APP. It is necessary to disconnect the power and check that there is no problem, and then re-power on the energy storage system, otherwise it will cause damage to the device.

6.5 Recover Operation of Emergency Stop

When major faults are removed, follow the steps below to recover the operation of the energy storage system.

Step 1 Popup the E-STOP button (as ④ shown in Figure2-8) in clockwise, the energy storage system will restore the original running status before emergency stop.

----End

7 Routine Maintenance

This chapter mainly introduces the maintenance and safety precautions, cyclical maintenance and maintenance procedures for the energy storage system.

7.1 Maintenance Guide

Correct maintenance is the key to keep the energy storage system running in optimum condition and it will ensure a long service life for the energy storage system.

7.1.1 Safety Precautions

DANGER

Before checking or maintenance, if the DC and AC sides have just been disconnected, it is necessary to wait 10 minutes to ensure the device fully discharged. Measure with a voltmeter to ensure that the power supply is switched off and in a safe condition before maintenance.

At least 2 persons must be present at the same time during maintenance or troubleshooting.

NOTE

When the cover plate of DC breaker or AC breaker needs to be removed, you can measure the voltage at the lower end of the DC breaker or the voltage at the upper end of AC breaker to judge the discharge condition. If the measured voltage is close to 0V, that means the energy storage system is completely discharged.

In order to perform the maintenance of the energy storage system safely and successfully, it is important to observe the relevant safety precautions, to use the necessary tools and test equipment, and to operate by qualified maintenance personnel. Always observe the following safety procedures:

- Ensure that the energy storage system will not be reconnected accidentally.
- When operating, DO NOT wear any easily conductive object, such as rings, watches, etc. when operating the energy storage system.

- When operating, cover the electrical components close to the operation area by insulating cloth.
- Inspection is required at the end of maintenance to ensure that the screws of maintained parts have been tightened and without tools left inside the energy storage system.
- Users do not need to operate the MSD under normal circumstances. When there is a possibility that the upper terminals or cable of DC breaker (as ⑧ shown in Figure2-9) may be touched, it is recommended to remove the MSD on the battery pack (as ④ in Figure2-9) to ensure that the upper end of the DC breaker is disconnected from the power supply. Refer to Figure6-3for the operation of the MSD.

7.1.2 Preventive Maintenance

To improve the efficiency and reliability of the energy storage system, perform the following preventive maintenance operations periodically.

Before maintenance, first of all, it is necessary to shut down the energy storage system and disconnect the breaker of DC side and AC side. The external power supply should be operated in the following cases.

External Power Supply Requires to be Powered Down

Check item	Check method	Cycle
System cleaning	1. Check the cleanliness of the electric cabin and battery cabin of the energy storage system, and clean them in time. 2. Check the temperature of the heat sink as well as the surrounding dust. If necessary, clean the heat sink by dust collector to avoid affecting the normal operation of the heat sink.	Once every three months/half year/one year depending on the used environment.
Terminals and cables connection	1. Check whether the terminal of main circuit is in poor connection and whether the screws is overheating. 2. Check whether the screws of control end are loose, if so, tighten them with a screwdriver. 3. Check whether there is any color change of the wiring copper bar or screw. 4. Check whether there is scratch on the cable in contact with	Every three months once

Check item	Check method	Cycle
	the metal surface, if so, please maintain it in time. 5. Check whether the insulating wrapping tape of the cable terminals is off, if so, please tie it up in time. 6. Check whether the cable connection is loose, and tighten it again according to the specified torque.	
Component maintenance	1. Check the corrosion condition of all metal components. 2. Annual inspection for contactors (auxiliary switches, breakers and micro breakers). Ensure them with good mechanical operation. 3. Check the operating parameters.	Every half to one year once

External Power Supply Without Power-down Requirement

Check item	Check method	Cycle
System cleaning	Check the filter mesh and filter cotton of each part and clean or replace it in time.	Once every three months/half year/one year depending on the used environment.
System operating condition and environment	1. Listen to the operation sound of the energy storage system to see if it is abnormal. 2. Check whether the operation parameters of the energy storage system are normal, for detailed operation, please refer to **5.3.2 Monitoring Page**. 3. Observe whether the air inlet and outlet are normal and whether there is any abnormal noise. 4. Check whether the heat generated by the cover of the energy storage system is normal and monitor the heat generated by the system, and the maximum temperature	Every half year once

Check item	Check method	Cycle
	should not exceed the maximum use ambient temperature of the energy storage system. 5. Check whether the key components are normal, such as dehumidifier, liquid cooling unit, etc., you can check whether there is alarm of them on APP. 6. Check whether filtration functions of all air inlet are normal. 7. Check whether the humidity and dust of the environment around the energy storage system are normal. 8. Check whether the temperature of the surrounding environment meets the operation of the energy storage system. Note: Ventilation of the air inlets must be checked. Otherwise, the module may not be cooled efficiently, and causing the energy storage system fault due to overheating.	
Cabinet maintenance	Observe the energy storage system for damage or deformation. Check the warning signs and other device markings on the cabinet and replace them n time if they are blurred or damaged.	Every half year once
Safety Function	Check whether the E-STOP button is not pressed down. Simulate the halt operation and check whether the halt signal communication is normal.	Every half to one year once
Software maintenance	Check whether the parameter setting of each device on APP is normal and is the same as the initial setting.	Every half year once
Door lock maintenance	Check whether the door locks etc. of each door panel of the energy storage system are normal and in good condition. If necessary, lubricate the door lock holes appropriately.	Every half year once
Liquid cooling unit maintenance	1. Check whether the power cables and communication cables are loose, and whether the operation and communication are abnormal. 2. Check whether there is no abnormality in appearance, fastening and grounding.	Every three months to six months once

Check item	Check method	Cycle
	3. Check whether the fan and condenser work normally, whether there is any foreign matter blocked at the air outlet, whether there is any abnormal vibration during normal operation. 4. Check whether there is leakage in the water circuit system; whether there is leakage in the connectors and whether there is cracking and deformation in the hoses. 5. Check whether the balloon of the expansion tank is damaged (press the thimble at the inflatable place by hand, if the water continues to come out, then it is damaged), and the balloon needs to be replaced. 6. 1) Acidity and alkalinity test: check the PH value of the coolant, need to prepare PH test paper to test the PH value of the coolant, if the PH value is lower than 7, then the coolant needs to be replaced; (recommended to test once a year), the coolant testing acidity and alkalinity refer to the "**7.2.2 Coolant Acidity and Alkalinity Test**". 2) When the service life of the coolant reaches 5 years, it also needs to be replaced. The above 1) and 2) replacement conditions are based on the conditions achieved first. Please contact the manufacturer for coolant recharge or replacement. Note: If there is any abnormality in the fan, it needs to be replaced in time to avoid temperature problems, which may lead to failure of the energy storage system. There is no need to power down the liquid cooling unit when communicating, replacing the coolant, or replenishing the coolant.	

NOTE

- The table above is only the recommended routine maintenance cycle, the actual product should be maintained based on the specific installation and use environment. The size of the power plant, the location, and the site environment and other factors will affect the product's routine maintenance cycle.

- If the energy storage system is installed in a harsh environment with heavy wind and sand or dense dust, please shorten the maintenance cycle and increase the frequency of maintenance.

7.2 Key Components Maintenance

CAUTION

Do not use any solvents, abrasives or corrosive materials to clean the energy storage system.

7.2.1 Clean or Replace the Filter Cotton

CAUTION

To ensure normal heat dissipation of the system, clean and maintain the filter cotton and filter mesh of air inlet and outlet regularly. If the surrounding environment is good and without blowing sand, it is recommended to clean the filter cotton once every three months. If the sand and dust are heavy, it is recommended to clean the filter cotton once every month.

When cleaning and replacing the filter cotton, FO NOT operate by excessive force to avoid damage.

Front Air Inlet Holes

Step 1 Open the door of electric cabin.

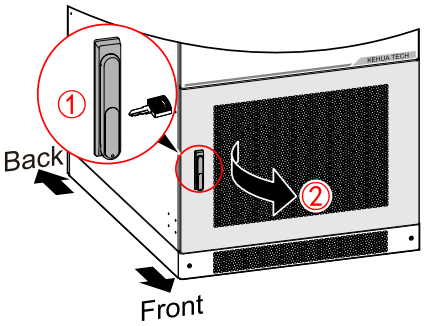


Figure7-1 Open the door of electric cabin

Step 2 Turn the paddle clockwise to open the filter cotton box and remove the filter cotton.

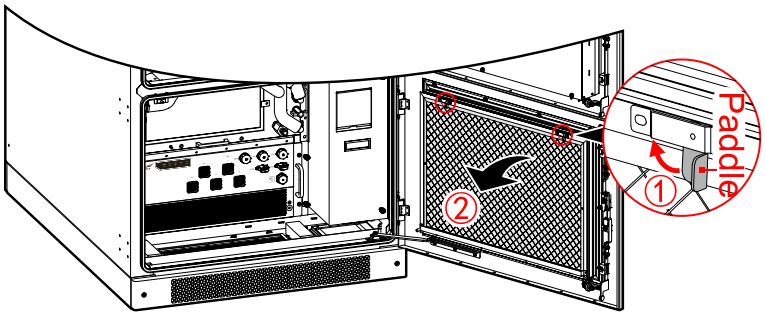


Figure7-2 Remove the filter

Step 3 Clean the filter mesh and filter cotton with a soft brush.

Step 4 Reinstall the cleaned or new filter mesh and filter cotton back into place in reverse order.

CAUTION

After cleaning the filter cotton, it needs to be dried before installation.

Step 5 Close the door of electric cabin and lock it with the key.

----End

Rear Air Outlet Holes

Step 1 Remove the filter by key and take out the filter cotton.

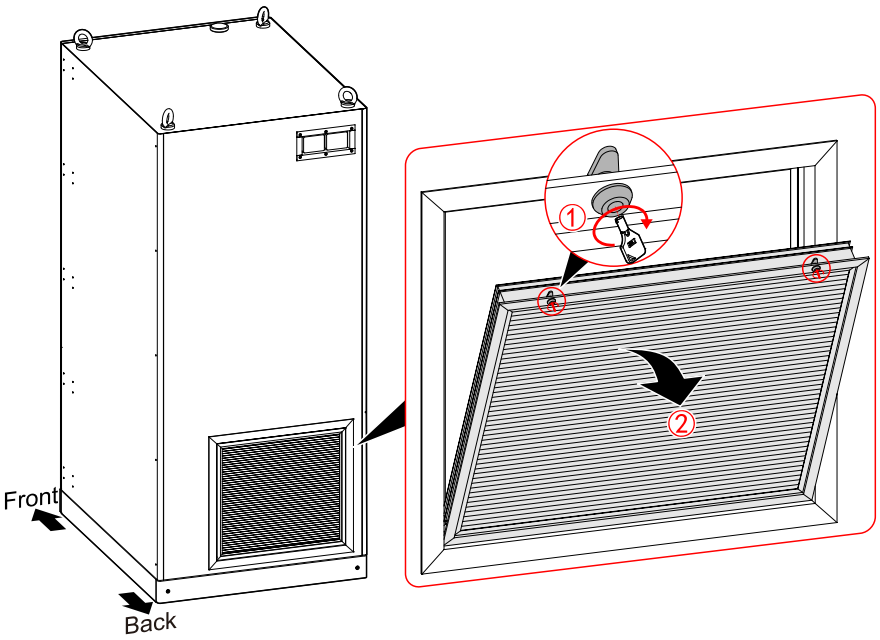


Figure7-3 Remove rear louver

Step 2 Clean the filter mesh and filter cotton by soft brush or replace them directly.

Step 3 Reinstall the filter mesh and filter cotton back to the original position.

CAUTION

After cleaning the filter cotton, it needs to be dried before installation.

----End

Bottom Air Inlet Holes

Step 1 Open the door of electric cabin.

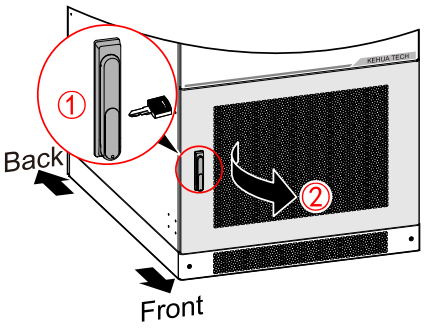


Figure7-4 Open the door of electric cabin

Step 2 Remove the bottom filter.

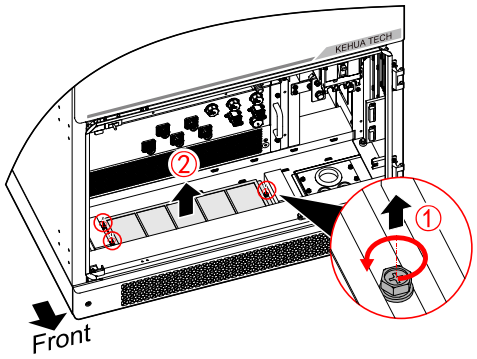


Figure7-5 Remove the bottom filter

Step 3 Clean the filter cotton by soft brush or replace it directly, and check whether there is any stain around the air inlet holes, if so, clean it.

Step 4 Reinstall the filter cotton back to the original position.

CAUTION

After cleaning the filter cotton, it needs to be dried before installation.

----End

Air Inlet Holes of Liquid Cooling Unit

Step 1 Open the door of electric cabin.

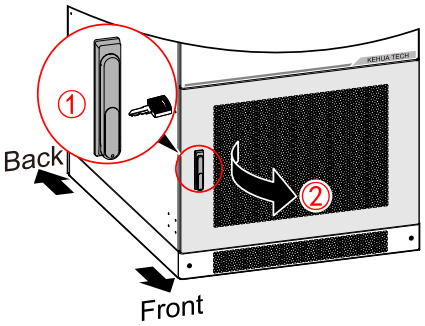


Figure7-6 Open the door of electric cabin

Step 2 Dismantle the filter screen at the front of the liquid cooling unit.

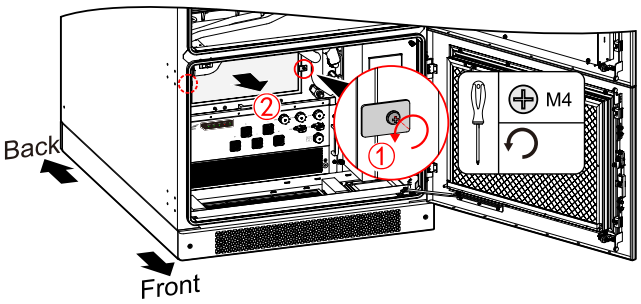


Figure7-7 Dismantle the filter screen

Step 3 Clean the filter cotton by soft brush.

Step 4 Reinstall the filter screen back to the original position and ensure the installation is firm.

CAUTION

After cleaning the filter screen, it needs to be dried before installation.

----End

7.2.2 Coolant Acidity and Alkalinity Test

CAUTION

- Ethylene glycol coolant belongs to low-toxicity non-hazardous chemicals, there is no special requirement for the environment when replacing it, and it will not cause flammability, explosion and other safety problems.
- The purpose of acidity/alkalinity test is to keep the coolant in neutral or weak alkaline environment to reduce the corrosion inhibition effect of the coolant on all kinds of metals.
- These products belong to low-toxicity substances, even if they are biodegradable, they should not be discharged at will and should be treated centrally.

Step 1 Perform the "**6.3 Shutdown**" operation.

Step 2 Take out the exhaust pipe, bend one end and fix it with tape or zip-tie (just don't pop it off), and insert the other end into the exhaust port (as shown in Figure7-9) directly, at this time, part of the coolant will enter into the pipe, then pull out the exhaust pipe in time. Pay attention to that you need to hold down the exhaust port and pull out the air pipe (while pulling out the exhaust pipe, release exhaust

port synchronously). In this process, there may be liquid drips or spatter, you can prepare rags or paper for wiping in advance. (The liquid itself is non-toxic, please clean the liquid in time).

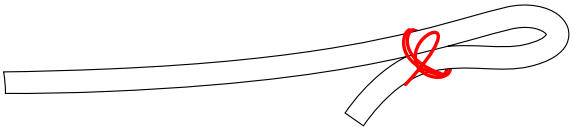


Figure7-8 Bending method of exhaust pipe

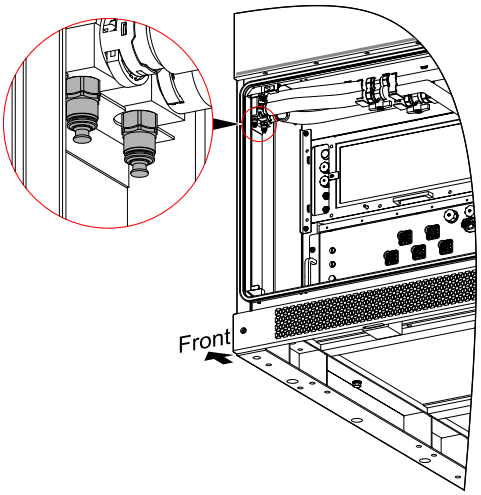


Figure7-9 Position diagram of exhaust port

CAUTION

Ensure that the external pipe is securely connected to the refill valve to avoid coolant leakage into the energy storage system.

Step 3 Take out the prepared PH test paper and test the coolant sample, if the PH value is less than 7, we suggest contacting the manufacturer for replacement, if the PH value is more than 7, it can continue to be used without replacement.

Step 4 After finishing the test, the device can continue to be used normally.

----End

7.2.3 Dispose for Coolant Leakage

Step 1 Perform the "**6.3 Shutdown**" operation.

Step 2 Open the door of electric cabin.

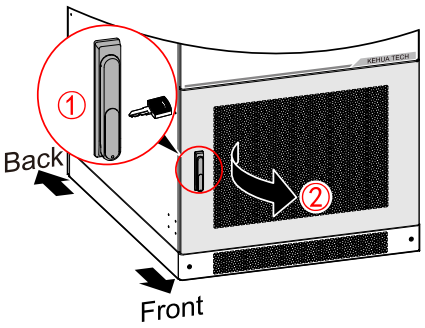


Figure7-10 Open the door of electric cabin

Step 3 Connect the refill port (as shown in Figure7-11) of the liquid cooling unit to the special collection bucket by external liquid drain pipe (as shown in Figure3-3) , and open the liquid refill valve (as shown in Figure7-11).

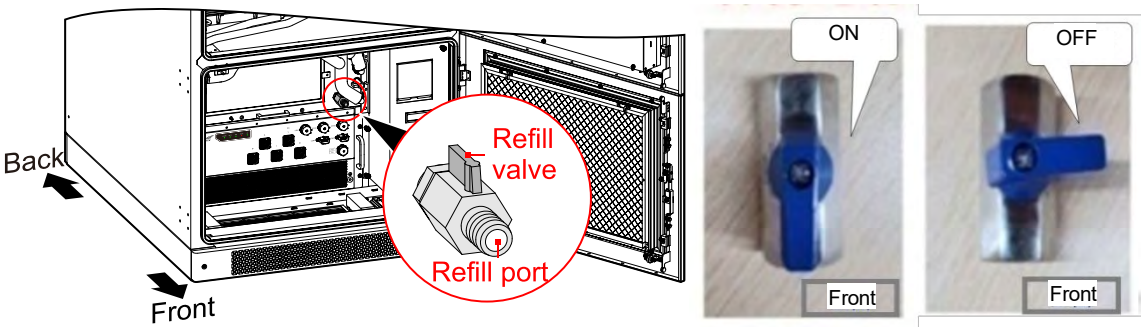


Figure7-11 Position diagram of refill port and refill valve

Step 4 After the coolant is drained, close the refill valve and disconnect the pipe from the refill port.

----End

CAUTION

Ensure that the external pipe is securely connected to the refill valve to prevent coolant from leaking into the energy storage system.

7.2.4 Expansion Tank Maintenance of Liquid Cooling Unit

WARNING

The maintenance of the expansion tank should be carried out by professionals. If the expansion tank or the liquid cooling unit is damaged due to improper operation, Kehua Company shall not be responsible for any damage caused to the device.

Step 1 Perform the "**6.3 Shutdown**" operation.

Step 2 Open the door of electric cabin.

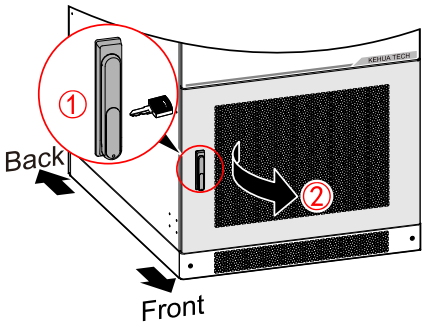


Figure7-12 Open the door of electric cabin

Step 3 Remove the filter screen at the front of the liquid cooler unit.

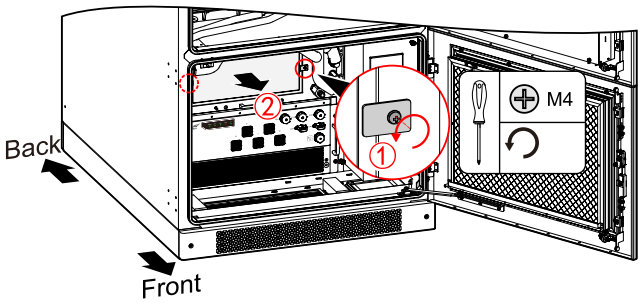


Figure7-13 Remove the filter screen

Step 4 Open the needle valve cover at the bottom of the expansion tank, use the inflation tool (with pressure gauge) to fill up the expansion tank to the pressure of the pipeline to about 1.5Bar (refer to the return pressure of liquid cooling unit in "**5.3.2 Monitoring Page**" for the pressure); if there is no air at all, you need to check the thimble and the expansion tank flange after filling up the tank. If it is damaged, please replace it in time.

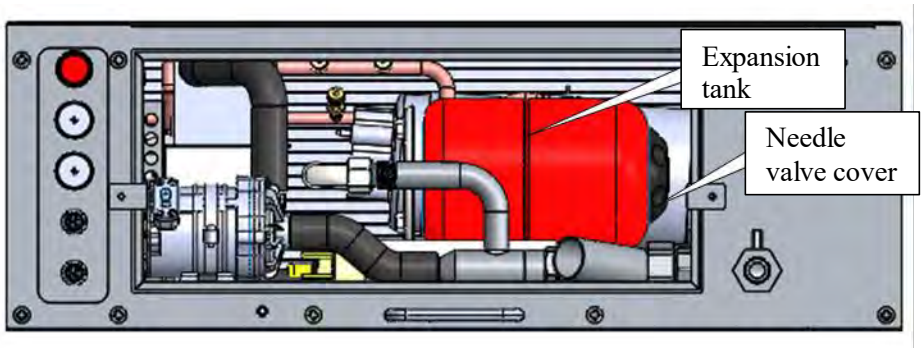


Figure7-14 Expansion tank diagram

Step 5 After finishing the maintenance, install the baffle plate back to the liquid cooling unit, paying attention to whether it is firmly installed.

----End

7.2.5 SPD Replacement

Step 1 Perform the "**6.3 Shutdown**" operation.

Step 2 Open the door of battery cabin and remove the internal cover plate.

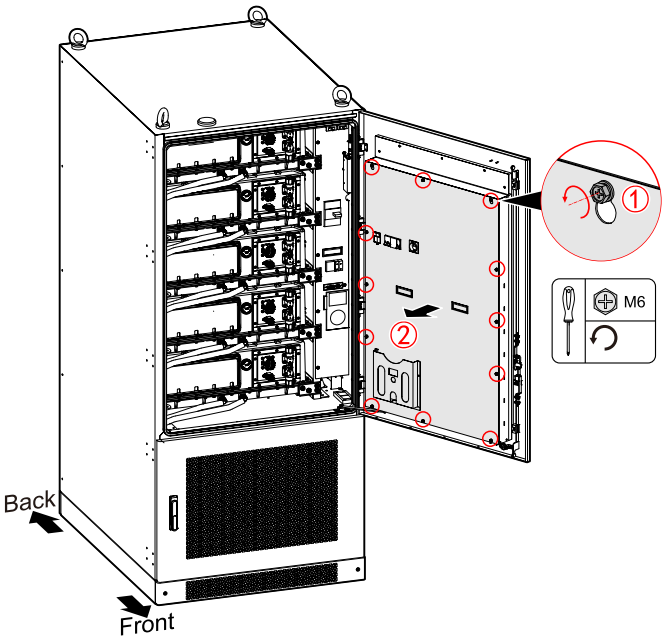


Figure7-15 Remove the internal cover plate

Step 3 Dismantle the cable connection of SPD, remove the SPD.

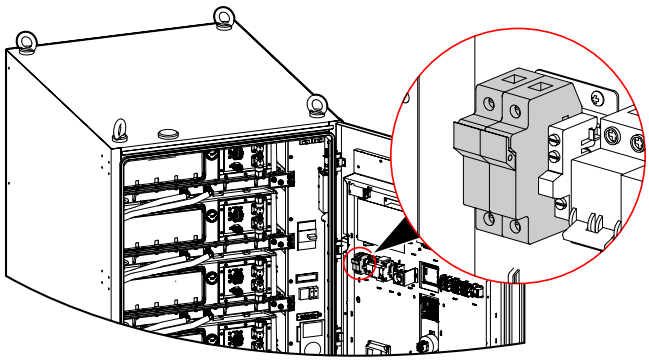


Figure7-16 Position diagram of SPD

CAUTION

Before removing the cables, take photos to record the actual cable connection relationship, so as to facilitate the recovery of cable connection.

Step 4 Install the replaced SPD and connect the cables.

Step 5 After replacement, restore the cover plate and close the door.

----End

7.2.6 Input Side Fuse Replacement

Step 1 Perform the "**6.3 Shutdown**" operation.

Step 2 Open the door of battery cabin and remove the internal cover plate.

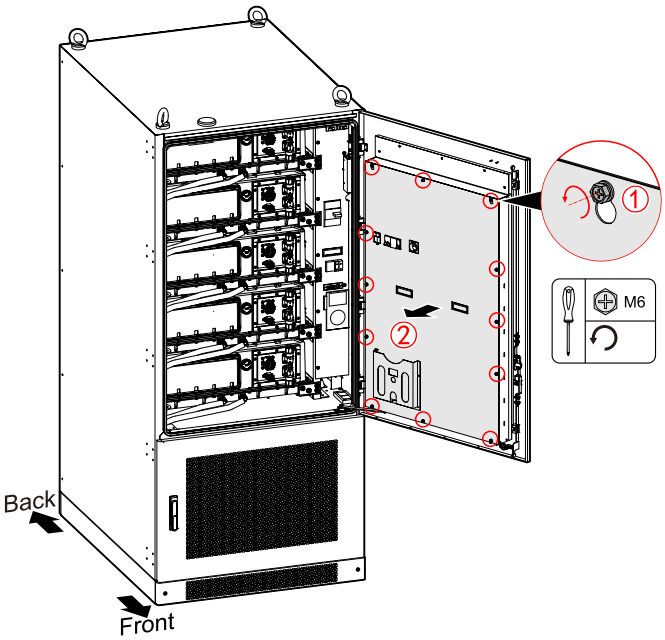


Figure7-17 Remove the internal cover plate

Step 3 Remove the fuse and replace it.

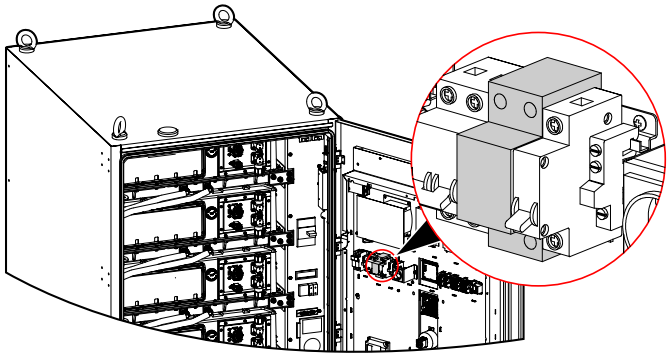


Figure7-18 Position diagram of fuse

CAUTION

DO NOT operate by excessive force to avoid damaging the fuse base.

Step 4 After replacement, restore the cover plate and close the door.

----End

WARNING

Most maintenance operation requires to remove the internal cover plate. Be sure to restore the removed cover plate to original status and ensure that all screws are tightened after maintenance operation is completed.

7.2.7 Fan Maintenance

WARNING

It is necessary to shut down the energy storage system before maintenance and disconnect all power inputs to the energy storage system.

Wait at least 10 minutes for the capacitors inside the energy storage system to discharge completely before carrying out the maintenance operation.

Only professional electrical personnel should perform the maintenance and replacement operation of fan.

NOTE

When the cover plate of DC breaker or AC breaker needs to be removed, you can measure the voltage at the lower end of the DC breaker or the voltage at the upper end of AC breaker to judge the discharge condition. If the measured voltage is close to 0V, that means the energy storage system is completely discharged.

The energy storage system has built-in fans to cool the system during operation. If the fan does not work properly, the energy storage system cannot be cooled effectively, which will affect the efficiency of the energy storage system or cause derating operation. Therefore, it is necessary to keep the fan clean and replace damaged fans in a time. The steps for fan cleaning and replacement are as follows.

Clean/Replace the Fan of PCS

Step 1 Shut down the energy storage system on the APP.

Step 2 Disconnect all the breakers of the energy storage system and connected with the energy storage system.

Step 3 Open the bottom door of the energy storage system, dismantle the connected cables (including three-phase cables, DC positive and negative cables, communication cables) between PCS and the energy storage system.

Step 4 Dismantle the screws fastened on the energy storage system, and then pull out the PCS.

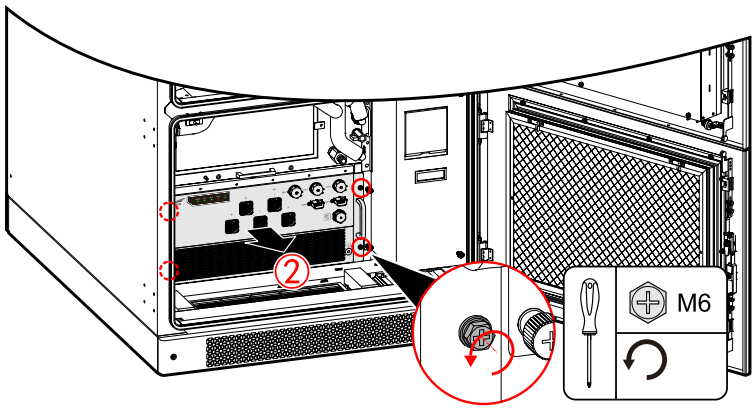


Figure7-19 Pull out the PCS

CAUTION

When pulling out the PCS, avoid squeezing the cables. Place the storage converter carefully and gently.

Step 5 Dismantle the screws of the fan module, as shown in Figure7-20.

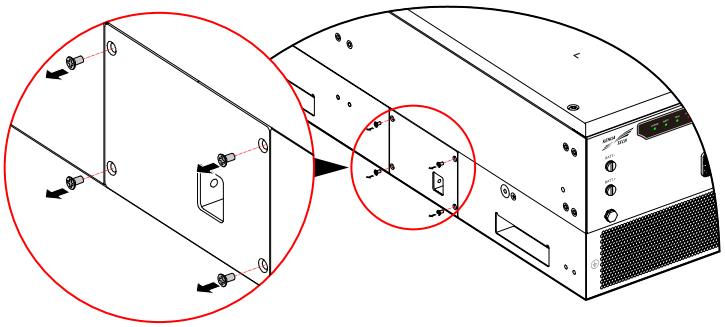


Figure7-20 Dismantle the screws of fan cover

Step 6 Pull out the fan module gently and loosen the connectors of fan, as shown in Figure7-21.

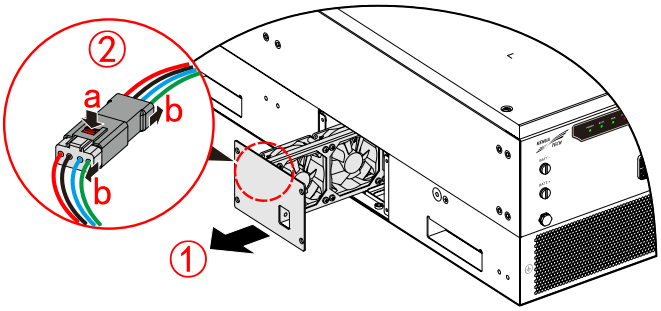


Figure7-21 Loosen the wiring of fan module

Step 7 Pull out the fan module (as shown in Figure7-22), clean the fan by brush or cleaner or replace the damaged fan.

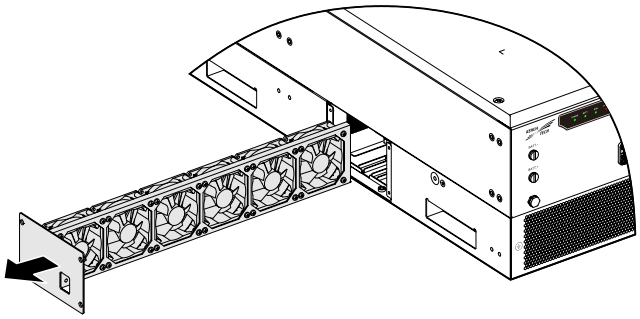


Figure7-22 Pull out fan module

CAUTION

When replacing the fan, pay attention to the direction of air blowing.

Step 8 Install the fan module in reversed order and lock the screws, and install the PCS to the energy storage system.

CAUTION

Ensure that the PCS is installed firmly.

Step 9 Re-connect the cables of PCS, and start the energy storage system according to "**6.2 Startup**".

----End

Procedure to Clean and Replace the Fan of Liquid Cooling Unit

Step 1 Set the energy storage converter to shut down on the APP.

Step 2 Disconnect all the breakers of input and output to power off the energy storage system.

Step 3 Remove the rear louvres of the energy storage system.

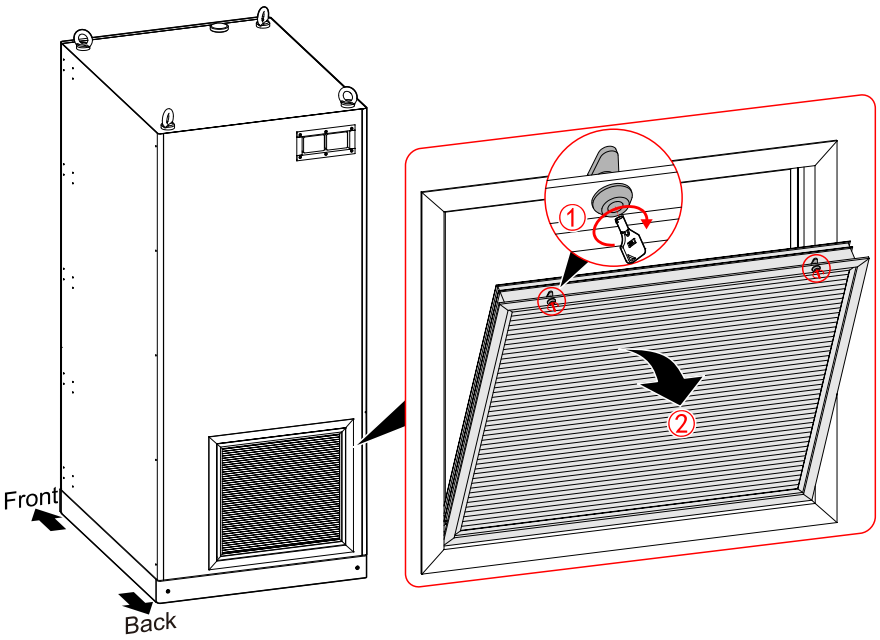


Figure7-23 Remove the rear louvre

Step 4 Loosen the fixing screws around the fan, pull out the fan module gently, and loosen the connection plug of the fan.

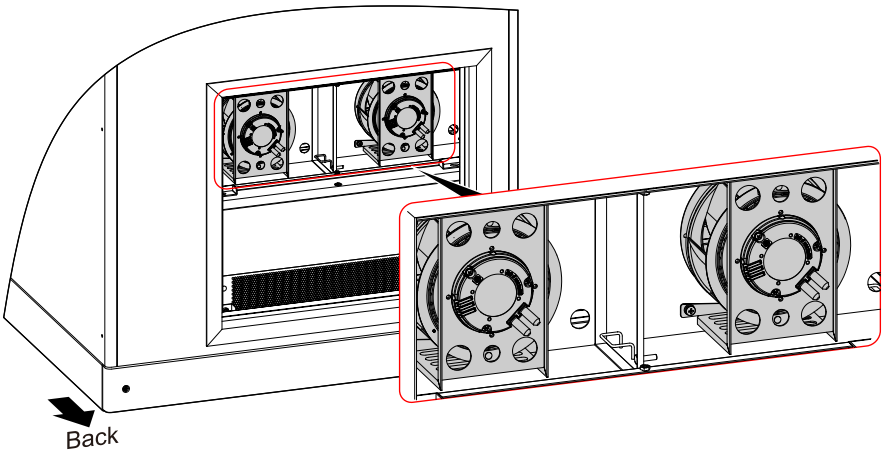


Figure7-24 Fan position diagram

Step 5 Clean the fan by a soft brush or dust collector or replace the damaged fan.

Step 6 Restore the fan by reverse steps of removing and ensure the fans are securely installed.

Step 7 Restore the fan wiring correctly and start the energy storage system according to "**6.2 Startup**".

NOTE

It is recommended that the maintenance and replacement of the fan should be carried out by professional electrical personnel maintain and replace the fan.

----End

7.2.8 Battery Maintenance

Safety Precautions for Battery Maintenance

- The battery should be away from fire and all electrical equipment that is easy to cause sparks, so as not to cause explosion.
- Do not short circuit the battery terminals. Short-circuiting the battery will cause burning.
- Do not open the battery to prevent the electrolyte from harming the human body.

Battery Maintenance

Regular maintenance should be performed to ensure the service life of the battery.

Check item	Check method	Cycle
Battery cycle maintenance	The battery system should be fully charged and discharged periodically to ensure the battery performance.	Once every three months
Battery maintenance for long term storage	If the battery system is not used for more than 6 months, the battery must be replenished to 40%~50% of SOC to ensure the battery performance.	Once every six months
Maintenance in case of system failure or half	During the use of the system, if there is a halt for fault, and the halt time is more than 1 month, you need to confirm the SOC status of the battery system in advance. Ensure that the SOC is maintained at 40% ~ 50% state to avoid the battery in a low SOC state for long-term storage, and resulting in battery over-discharge.	Once every month

Check item	Check method	Cycle
Maintenance for battery pack	1. Check the battery case and cover for bulging, liquid leakage and damage. 2. Check the connecting cables, terminals, etc. for corrosion and rust, and the fastening bolts and nuts for looseness. 3. Check the surface temperature of the battery terminals and battery case with thermal imager or other tools, which should be below 45°C. 4. For the temporarily unused battery pack, regular recharge it within three months. 5. Batteries that have been in a charging status for a long time should be forcibly discharged once every month. 6. Battery packs equipped with BMS should pay special attention to whether the cell's voltage difference, cell temperature difference is too large, and whether the insulation resistance is normal. 7. Regularly check whether the battery temperature, voltage, current, SOC and other information are normal via APP.	Once every three to six months

NOTE

When the battery voltage or SOC is in the following conditions, it is necessary to charge the energy storage system in time according to the following recommended time, it is recommended to be charged to 40%~50% SOC, the capacity loss caused by not replenishing the battery within the recommended time is not covered by the warranty:

- 5%< battery SOC<10%: within 20 days.
- Battery SOC is 0 % or minimum cell voltage below 2.7V: within 5 days.
- The minimum cell voltage is less than 2.6V: within 2 days.

CAUTION

When the cell voltage is less than 2.5V, the recharge operation must be carried out by a professional with skillful training, please contact the manufacturer to carry out the operation in time.

Battery Replacement Announcements

- For battery replacement, please consult a professional engineer.

- The replaced battery must be with the same capacity, type and manufacturer of the energy storage system.
- The replaced old batteries should not be discarded at will, they should be disposed by professional recycling organization.

8 Troubleshooting

This chapter mainly introduces how to deal with the common fault.

8.1 Deal with Common Fault

Once fault occurs, the indicator on the panel will show in red, the current fault will be showed on the APP, and at the same time, the energy storage system may halt.

When fault occurs, please power off the energy storage system according to **6.3 Shutdown**, and then, corresponding check and maintenance can be done. The typical fault and dispose as follows.

CAUTION

If fault occurs, DO NOT restart the energy storage system by APP directly. Please check and confirm that the fault is removed, then restart the energy storage system, otherwise, it will damage the energy storage system.

8.1.1 Fault of PCS

Table8-1 Fault list of PCS

No.	Fault info	Solution
1	Grid over-voltage	Check whether the actual voltage of grid is higher than the requirement of the energy storage system. When the grid voltage restores normal, the energy storage system will recover normal operation. If the fault still exists, please contact the local dealer or service centre.
2	Grid under-voltage	Check whether the actual voltage of grid is lower than the

No.	Fault info	Solution
		requirement of the energy storage system, When the grid voltage restores normal, the energy storage system will recover normal operation. If the fault still exists, please contact the local dealer or service centre.
3	Over-frequency	Check whether the actual frequency of grid is higher than the requirement of the energy storage system, When the grid voltage restores normal, the energy storage system will recover normal operation. If the fault still exists, please contact the local dealer or service centre.
4	Under-frequency	Check whether the actual frequency of grid is lower than the requirement of the energy storage system, When the grid voltage restores normal, the energy storage system will recover normal operation. If the fault still exists, please contact the local dealer or service centre.
5	Phase sequence abnormal	Shut down and power off the energy storage system according to **6.3 Shutdown**, after confirming that the grid is disconnected, check whether the cables connection at AC side are corresponding to phase L1/L2/L3. If the fault still exists, please contact the local dealer or service centre.
6	Phase lock abnormal	Check the grid. If the phase lock abnormal still exists after the grid restores normal, please contact the local dealer or service centre in time.
7	AC grounding abnormal	Shut down and power off the energy storage system according to **6.3 Shutdown**, wait for the inner discharged completely, and then check whether there is a short circuit to ground on the AC side. If the fault still exists, please contact the local dealer or service

No.	Fault info	Solution
		centre.
8	Insulation impedance abnormal	Shut down and power off the energy storage system according to **6.3 Shutdown**, check whether the environment around the converter is humid; check whether the grounding point inside the converter is loose. If the fault still exists, please contact the local dealer or service centre.
9	Leakage current abnormal	
10	Temperature switch fault	Check whether the air inlet and outlet of the PCS are blocked. Check whether the ambient temperature where the PCS is located is too high or too low. If the above are all normal, please contact the local dealer or service centre.
11	Inner over-temperature	
12	Heat sink over-temperature	
13	Power module over-temperature	
14	Soft start abnormal	Disconnect the AC breaker and DC breaker, wait for 5 minutes, and then close them again to restart the PCS. If the fault still exists, please contact the local dealer or service centre.
15	Main contactor abnormal	
16	Output voltage abnormal	
17	Overload protection	Set the load or grid-tied power reasonably. If the fault still exists, please contact the local dealer or service centre.
18	Overload alarm	
19	Short circuit protection	Shut down and power off the energy storage system according to **6.3 Shutdown**, check whether the output cables on AC side is broken and short-circuited. If the above are all normal, please contact the local dealer or service centre.
20	Output voltage does not meet off-grid conditions	Check whether the grid-tied/off-grid mode is set incorrectly. If the setting is correct and the fault still exists, please contact

No.	Fault info	Solution
		the local dealer or service centre.
21	Inverter software overcurrent	Shut down and power off the energy storage system according to **6.3 Shutdown**, check whether the connection of AC output is short-circuited, whether the overcurrent value is set incorrectly. If the setting is correct and the fault still exists, please contact the local dealer or service centre.
22	Inverter hardware overcurrent	Shut down and power off the energy storage system according to **6.3 Shutdown**, check whether the connection of AC output is short-circuited. If there is no circuit-short, please contact the local dealer or service centre.
23	Communication abnormal	Check whether the connection of communication is in good condition and whether the PCS is powered on. Magnetic ring can be added to improve the communication quality. If the fault still exists, please contact the local dealer or service centre.

8.1.2 Fault of Battery

Table8-2 Fault list of battery

No.	Fault info	Solution
1	Charge overcurrent	Shut down and power off the energy storage system according to **6.3 Shutdown**, restart the energy storage system. If the fault still exists, please contact the local dealer or service centre.
2	Discharge overcurrent	
3	Low insulation resistance alarm	
4	Short circuit protection	
5	BMS system abnormal	
6	Cell voltage sampling fault	

No.	Fault info	Solution
7	Cell temperature sampling fault	
8	Temperature rise alarm	
9	PCS communication fault	
10	Large difference between total cluster voltage and sampling value	
11	Cell under-voltage alarm	It is a regular alarm during use. The battery is close to full or empty state at this time, there is no need to deal with it. If there is a big difference between the battery voltage and the full or empty state, then shut down the energy storage system, contact your local dealer or service centre.
12	Cell over-voltage alarm	
13	Total voltage under-voltage alarm	
14	Total voltage over-voltage alarm	
15	High SOC	
16	Low SOC	
17	BMS charge disabled	
18	BMS discharge disabled	
19	Large voltage difference of cell	Shut down and power off the energy storage system according to **6.3 Shutdown**. 5 minutes later, restart the energy storage system. If the fault still exists, please contact the local dealer or service centre.
20	High charging temperature of cell	Check whether the temperature sampling of cell is normal, if normal, check whether the liquid cooling unit is normally turned on, if not, check the unit and ensure that the unit is normal and then turn on it. The unit will take a certain time to heat or cool the battery to normal temperature slowly. If the unit has been working normally, please contact the
21	Low charging temperature of cell	
22	High discharge temperature	

No.	Fault info	Solution
	of cell	local distributor or service centre.
23	Low discharge temperature of cell	
24	Large temperature difference of cell	

8.1.3 Fault of Liquid Cooling Unit

Table8-3 Fault list of liquid cooling unit

No.	Fault info	Solution
1	Communication abnormal of the liquid cooling unit	Check whether the self-start setting of the liquid cooling unit is set to enable, and whether the communication cable is loose. If the fault still exists, please contact the local dealer or service centre.
2	Low temperature protection alarm	Check whether the parameter setting of heating point and heating return difference of the liquid cooling unit is reasonable. If the fault still exists, please contact the local dealer or service centre.
3	High temperature protection alarm	Check whether the parameter setting of heating point and heating return difference of the liquid cooling unit is reasonable. If the fault still exists, please contact the local dealer or service centre.
4	Low/high temperature alarm of return water	If the ambient is in extremely high or low temperature, the alarm is a normal pre-alarm, and there is no need to deal with it. If the temperature is moderate, and the parameters setting of return water is reasonable, contact the local dealer or service centre in time.

No.	Fault info	Solution
5	AC input over-voltage alarm	Disconnect the AC breaker and DC breaker as well as the external power supply breaker, and then check whether the external power supply is normal; if normal, restart the energy storage system. If the fault still exists, please contact the local dealer or service centre.
6	AC input under-voltage alarm	
7	External fan fault	Shut down and power off the energy storage system. 1. Check if the wiring of external fan is loose, if so, please connect the cable correctly. 2. Check if there is any object blocking the external fan, if so, please clear the blockage. 3. Check if the external fan is damaged, if so, please replace it in time. If the fault still exists, please contact the local dealer or service centre.
8	High temperature of exhausting air	Shut down and power off the energy storage system according to **6.3 Shutdown**. 5 minutes later, restart the energy storage system. If the fault still exists, please contact the local dealer or service centre.
9	Low pressure alarm	
10	Compressor overcurrent fault	
11	Compressor frequency changer communication fault	
12	Insufficient water flow alarm	
13	Electric heating overload	
14	High pressure switch alarm	
15	Compressor overload alarm	
16	Return water temperature	

No.	Fault info	Solution
	sensor fault	
17	Outlet water temperature sensor fault	
18	Exhausting air temperature sensor fault	
19	Suction air temperature sensor fault	
20	High pressure sensor fault	
21	Low pressure sensor fault	
22	External ambient temperature sensor fault	
23	Pressure sensor of return water fault	
24	Pressure sensor of outlet water fault	
25	Pump service time out	The relevant device may have expired, please contact your local dealer or service centre.
26	Compressor service time out	
27	PTC electric heating service time out	
28	Electric heating belt service time out	
29	1# external fan AO service time out	
30	2# external fan AO service time out	

8.1.4 Other Faults

Table8-4 Other system fault list

No.	Fault info	Solution
1	Dehumidifier communication abnormal	Check whether the connection of communication cables is in good condition and whether the dehumidifier is normally powered on. The communication quality can be improved by adding magnetic rings. Magnetic ring can be added to improve the communication quality. If the fault still exists, please contact the local dealer or service centre.
2	Emergency stop fault	Check whether the E-STOP button is pressed down by mistake. If the fault still exists after the E-STOP button recovers normal, please contact the local dealer or service centre.
3	SPD abnormal	Disconnect the AC breaker and DC breaker. 5 minutes later, close them again to restart the energy storage system. If the fault still exists, please contact the local dealer or service centre.
4	Fire-fighting fault	If there is a fire alarm, please wait for 30 minutes at a distance, if no phenomenon occurs, please contact a professional to check the energy storage system and replace the related fire device.
5	Leak detection alarm	Check whether there is liquid leakage inside the battery cabin. If there is no liquid leakage, check whether the wiring of water immersion is normal, if the wiring is also normal, please contact the local dealer or service centre.

NOTE

This manual may not cover all possible situations during maintenance and troubleshooting. If the energy storage system has other problems not covered in this manual, please contact our local agency or service center.

Before contacting us, please prepare the following information.

1. S/N of the energy storage system.

2. Distributor/ dealer of the energy storage system (if has).
3. The date of first startup.
4. Problem description.
5. Your detail contact information.

9 Dismantle, Discard

This chapter introduces the dispose way for dismantling, discarding the energy storage system.

9.1 Dismantle the Energy Storage System

WARNING

After the connection between the energy storage system and grid, load, and battery pack is completely disconnected, it is necessary to wait for 10min at least to make the inner capacitor discharge completely, and then the energy storage system can be dismantled.

NOTE

When the cover plate of DC breaker or AC breaker needs to be removed, you can measure the voltage at the lower end of the DC breaker or the voltage at the upper end of AC breaker to judge the discharge condition. If the measured voltage is close to 0V, that means the energy storage system is completely discharged.

Step 1 Disconnect all connection of the energy storage system successively in reversed procedure of **Figure4-1Wiring** diagram, including the cables of AC output, communication, external power supply, grounding.

Step 2 Dismantle the energy storage system in reversed procedure of **3.6 Mechanical Installation**.

Step 3 If the energy storage system will be installed and used in the future, please package and store the energy storage system properly (see section **3.2**).

----End

9.2 Discard the Energy Storage System

If the energy storage system or inner components reach the max use limit, DO NOT dispose them as household waste, user needs to discard them according to related provision.

⚠ CAUTION

The battery, module and other components inside the energy storage system may pollute the environment, please do corresponding dispose on the basis of related provision.

A Technical Specifications

Index \ Model	ESI215-100K-M
Battery side	
Cell grouping mode	1P240S
Battery capacity (kWh)	215 (@25±3℃，BOL，0.5P，100%DOD)
Rated voltage of battery cluster (V)	768
Operating voltage of battery cluster (V)	672~864
Charge / discharge rate	0.5P
Recommend charging method declared by the manufacturer	Charged with constant power 100kW till the cell voltage reaches 3.6V, at the temperature of 25±3℃
Recommend discharging method declared by the manufacturer	Discharged with constant power 100kW till the cell voltage reaches 2.8V, at the temperature of 25±3℃
AC output side	
Rated power (kW)	100
Max. output power (kW)	110
AC input method	3W+PE
Reactive power range (kvar)	-100~+100

Model / Index	ESI215-100K-M
External power supply	
Input voltage range (Vac)	230±15%
Max. input current (A)	25
Inner socket	
Voltage range (Vac)	230±15%
Max. output current (A)	10
Grid-tied parameters	
Rated grid voltage (V)	400
Allowed grid voltage (V)	340~440
Rated grid frequency (Hz)	50
Allowed grid frequency (Hz)	50±5
THDi (%)	＜3% (full load)
Power factor	-1~+1
Off-grid parameters[1]	
Rated output voltage (V)	400
Voltage deviation	Amplitude deviation should not exceed ±5% of rated voltage, phase deviation should not exceed 3°.
THDv (%)	3
Rated output frequency (Hz)	50
Dynamic voltage transient range (%)	10
Common parameters	
System efficiency (%)	Max efficiency: ≥90.2

Model / Index	ESI215-100K-M
Allowable environment temperature (℃)	-35~55 (device running temperature, for storage temperature, please see 3.2)
Allowable relative humidity (RH)	0%~95%
Size (W×D×H) (mm)	1000×1300×2250 (without lifting ring) 1000×1300×2340 (with lifting ring)
Weight (t)	<2.5
Noise (dB)	<75
Over-voltage category	II(DC); III(AC)
Pollution degree	II
Protection grade	Battery cabin: IP54
Cooling mode	Battery pack: liquid cooling; PCS: air cooling
Display and communication	
Communication port	LAN/WIFI
HMI	APP
Communication standard	Modbus/IEC104/IEC61850

- [1] When the output connects with electromotor in off-grid status, the power of electromotor cannot exceed 15kW.
- Specifications are subject to change without prior notice.

B Quality Assurance

If the device fault in guarantee period, Kehua Company will maintenance it free or replace new product.

Evidence

In guarantee period, user needs to show the purchase invoice of the product, and the trademark on the product must be clearly visible, or Kehua Company have right to refuse the quality assurance.

Condition

- The replaced product must be returned to Kehua Company to dispose.
- Reasonable time should be reserved for Kehua Company to maintain the fault device.

Disclaimer

If any situation below occurs, Kehua Company have right to refuse the quality assurance.

- Beyond the free quality assurance period.
- Damaged by transportation.
- Improper installation, transformation or use.
- Used in the harsh environment that not allowed in the User Manual.
- Damaged by installation, maintenance, transformation or dismantling of other company server.
- Damaged by using component or software of non-standard or other company except Kehua Company.
- Beyond the installation and use range of related national standard.
- Damage caused by abnormal nature environment.

If the fault is caused by above situation and user requires to maintain it, we can provide paid maintenance service after our service organization decided.

To improve users' satisfaction continuously, our product and User Manual is upgrading. If the User Manual has difference with product, it may be caused by the version difference, please take the actual product as standard. If any question, please contact our company.

Software authorization

- It is prohibited to use part or whole data of the hardware or software of Kehua Company in any way for commercial purpose.
- It is prohibited to decompile, decrypt or destroy the original program design of the software developed by Kehua Company.

C Acronyms and Abbreviations

A

AC	Alternating Current

D

DC	Direct Current
DSP	Digital Signal Processor

E

EPO	Emergency Power Off

M

MPPT	Maximum Power Point Tracking

P

PV	Photovoltaic

R

RS232	Recommend Standard232

RS485	Recommend Standard485

U

USB	Universal Serial Bus

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