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User Manual

eTron 5MWh Liquid-Cooled ESS

SU5016E2500KC-L

Version	02
Release Date	Oct 30, 2025

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Trademarks

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Important Notes

Retain this manual in an easily accessible location for immediate reference during product operation or maintenance. While we make every effort to ensure the accuracy of this manual, both the product and documentation are subject to continuous improvement and updates. Should there be any discrepancies between the descriptions/illustrations herein and the physical product, the actual device specifications shall prevail.

About This Manual

Overview

This manual is specifically compiled for SYL BESS products. It contains key content such as important safety precautions, product introduction, transportation and storage, product installation, electrical connections, system commissioning, system maintenance, and system troubleshooting. These contents will provide clear guidance and strong guarantees for your installation and use, helping to prevent installation failures or subsequent malfunctions caused by improper operation or neglect of critical details.

Please ensure that you read this manual thoroughly and carefully before performing any practical operations. If you have any questions about the content provided in this manual, feel free to contact SYL for consultation at any time. We will do our best to answer your questions. For contact information, please refer to Chapter 9 Technical Support and After-Sales Service.

Target Group

This manual is applicable to product sales engineers, technical support engineers, and operators of energy storage systems. All installation and usage operations must be

performed solely by qualified technical personnel. Qualified technical personnel must meet the following requirements:

- Have received specialized training, are familiar with relevant safety regulations of electrical systems, and possess the necessary knowledge and practical experience for performing related operations.
- Have read this manual thoroughly and carefully, are familiar with specific operational procedures, and have mastered relevant safety precautions.
- Have knowledge of relevant laws, regulations, and industry standards in the country or region where the project is located.

Symbol Explanations

This manual may contain the following symbols, which represent the following meanings:

⚠ DANGER
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious personal injury.

⚠ WARNING
Indicates a moderately hazardous situation which, if not avoided, could result in death or serious personal injury.

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⚠ CAUTION
Indicates a slightly hazardous situation which, if not avoided, may result in minor or moderate personal injury.

⚠ NOTICE
Indicates a potential risk which, if not avoided, may lead to equipment malfunction or property damage.

ℹ NOTE
Used to emphasize key points or provide supplementary explanations.

ℹ **Note:** Used to provide additional explanations for specific sections.

Underline: Indicates hyperlinked content that allows users to click and quickly navigate to relevant sections or directly access designated website pages.

Revision Record

Version 01 (2025-08-26)

First official release.

Version 02 (2025-10-30)

1. In the "6.1 Precautions", add the following description: When the product is placed for a long time without formal operation, auxiliary power should be supplied to ensure that the temperature - control and dehumidification equipment (such as liquid - cooled units, air - cooled air conditioners, heaters, dehumidifiers, etc.) operates normally, so as to ensure that the temperature and humidity inside the box meet the requirements, remain dry, and there is no accumulated water.
2. In "8.3.1 Abnormal System Data Display", add the content: Reproduction of short - board cells.
3. In 6.2.1, add the description of disconnection of the FFS start - up wire.
4. In 7.3 Fire Protection System Maintenance, add the precautions for the wiring of the fire - extinguishing device.
5. In 6.2.2, change "Ensure that the liquid cooling unit..." to "Ensure that the liquid cooling pipeline...".
6. In 9, the after - sales email address is changed from essmkt@risenstorage.com to service@sylbattery.com.
7. Update the product pictures and all kinds of schematic diagrams to the container version.

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Table of Contents

1 Safety Precautions

1.1 Declaration

Before installing, operating, or maintaining the equipment, read this manual thoroughly and follow all safety precautions indicated on the equipment and in this manual.

When installing, operating, or maintaining the equipment, comply with local laws, regulations, and standards. The safety precautions in this manual are provided solely as a supplement to local laws, regulations, and standards.

The 'DANGER', 'WARNING', 'CAUTION', 'NOTICE', and 'NOTE' statements in this manual do not represent all safety requirements that must be followed and are provided solely as a supplement to all safety precautions. SYL assumes no liability for any damages resulting from failure to follow safety operation requirements or violation of safety standards for equipment design, production, and use.

1.2 General Safety

⚠ DANGER

- It is strictly prohibited to install, operate, or handle outdoor equipment and cables under adverse weather conditions such as lightning, rain, snow, or level 6 strong winds, including but not limited to activities such as equipment transportation, equipment/cable operation, plugging/unplugging signal ports connected to outdoor equipment, high-altitude operations, and outdoor installation.
- In case of a fire, immediately evacuate the building or equipment area, activate the fire alarm, and call the fire emergency number. Under no circumstances should you re-enter the burning building.

⚠ WARNING

- Before touching any conductor surfaces or terminals, measure the voltage at the contact points to verify no risk of electric shock.
- Strictly prohibited to perform installation, wiring, maintenance, or replacement on energized equipment.
- Strictly prohibited to make unauthorized alterations to the equipment's structure or installation sequence under any circumstances.

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⚠ CAUTION

- Comply with the requirements of this manual, use appropriate tools, and properly operate them.

⚠ NOTICE

- When performing operations such as transportation, transfer, installation, wiring, and maintenance, you must comply with the laws, regulations, and relevant standards of the country and region where the operations take place.
- Permission from the local power department of the country and region must be obtained before grid-connection work can be carried out.
- You should be fully familiar with the composition and working principle of the entire energy storage system, as well as the relevant standards of the country and region where the project is located.
- In case of paint scratches during the transportation and installation of the equipment, timely repairs must be made to prevent the scratched parts from being exposed to the outdoor environment for a long time.

ⓘ NOTE

- It is strictly prohibited to conduct reverse engineering, decompilation, disassembly, disassembly (in the software-related sense), adaptation,

implantation, or other derivative operations on the equipment software.

- It is forbidden to study the internal implementation of the equipment, obtain the source code of the equipment software, steal intellectual property rights, etc. in any way.
- Do not disclose the results of any equipment software performance tests.

1.3 Personnel Safety

⚠ NOTICE

- Personnel responsible for installing and maintaining the equipment must undergo rigorous training, understand all safety precautions, master correct operating methods, and possess the knowledge and experience required to operate the relevant equipment.
- Only qualified professionals or trained personnel are permitted to install, operate, and maintain the equipment.
- Only qualified professionals are allowed to remove safety devices and conduct maintenance on the equipment.
- Personnel operating the equipment, including operators, trained personnel, and professionals, must possess the special operation qualifications required by the country and region where the project is located, such as high-voltage operation, working at heights, and special equipment operation

qualifications.

- Replacement of the equipment and its components, including software, must be carried out by professionals or authorized personnel.

Note:

- **Qualified professionals:** Individuals who have received training or possess experience in equipment operation, and are fully aware of potential hazard sources and the degree of hazard severity during equipment installation, operation, and maintenance.
- **Trained personnel:** Individuals who have undergone relevant technical training and have necessary experience, can recognize hazards posed by specific operations, and take measures to minimize risks to themselves or others.
- **Operators:** Personnel who may come into contact with the equipment, excluding trained personnel and qualified professionals.

1.4 Electrical Safety

General Requirements

⚠ WARNING

Before making electrical connections, ensure the equipment is undamaged. Failure to do so may result in electric shock or fire.

- All electrical connections must comply with the electrical standards of the country and region where the equipment is located.
- Permission from the local power department of the country and region must be obtained before grid-connected power generation can be carried out.
- Cables provided by the user should meet the requirements of local laws and regulations.
- When performing high-voltage operations, please use dedicated insulated tools.

Grounding Requirements

- For equipment that requires grounding, the protective grounding wire must be installed first during installation and removed last when disassembling the equipment.
- It is prohibited to damage the grounding conductor.
- Do not operate the equipment without the grounding conductor installed.
- Equipment shall be provided with permanent protective grounding. Before operating the equipment, check its electrical connections to ensure the equipment is reliably grounded.

DC Operation

⚠ WARNING
It is prohibited to install or remove the power cable with the power on. When the power cable core comes into contact with the conductor, arcs or sparks will be generated, which may lead to fire or personal injury.

- Before making electrical connections to the equipment, if there is a possibility of coming

into contact with live parts, the corresponding disconnection device at the previous stage of the equipment must be switched off.

- Before connecting the power cord, make sure to confirm that the labels and markings on the power cable are correct, and then proceed with the connection.
- If the equipment has multiple inputs, all inputs of the equipment should be disconnected. You can only operate the equipment after the equipment is completely powered off.

Wiring Requirements

- Using cables in high-temperature environments may cause aging and damage to the insulation layer. The distance between the cables and the periphery of heat-generating devices or heat source areas should be at least 50 mm.
- Cables of the same type should be bundled together. Cables of different types should be laid at least 30 mm apart. It is prohibited to wind or cross them with each other.
- Cables must be firmly connected, have good insulation, and be of appropriate specifications.
- At the positions where cables pass through pipes or wire holes, protection measures must be taken to prevent the cables from being damaged by sharp edges, burrs, etc.

Anti-static requirements

⚠ NOTICE
The static electricity carried by the human body may cause irreversible damage to

electrostatically sensitive components on the single board of the energy storage system, such as large-scale integrated circuits (LSI). Therefore, when touching the PCB board, you must wear anti-static equipment throughout the process, such as anti-static gloves and anti-static wristbands. At the same time, it is strictly prohibited to wear clothing that easily generates static electricity, such as clothing made of acrylic or chemical fiber materials, to ensure the stable operation of the system and the safety of the components.

1.5 Battery Safety

Declaration

SYL shall not be liable for equipment malfunctions, component damage, personal safety accidents, property damage, etc., caused by the following reasons:

- Damage to the battery, such as capacity loss or irreversible damage, caused by the user's failure to charge in a timely manner resulting in overdue storage.
- Battery damage, drops, leakage, etc., caused by improper operation or failure to connect the battery as required.
- Damage caused by over-discharge of the battery due to the customer's failure to power on in a timely manner after on-site installation and system connection.
- User's failure to properly set the battery operation management parameters.
- If the user or a third-party changes the battery usage scenario without informing our company. For example, connecting additional loads to the battery on their own, or mixing

the batteries provided by our company with other batteries, including but not limited to: mixing with batteries of other brands, mixing with batteries of different rated capacities, etc.

- Direct damage to the battery caused by the fact that the on-site equipment operating environment or external power parameters cannot meet the environmental requirements for normal operation. This includes the actual operating temperature of the battery being too high or too low, and the unstable power grid situation with frequent power outages.
- Abuse of the battery system, including but not limited to exceeding the rated current rate during operation and forced charging at low temperatures.
- The user does not properly maintain the battery in accordance with the maintenance manual.
- The battery gets stolen.
- The battery has gone beyond the warranty period.

Basic Requirements

⚠ DANGER

- Do not expose the battery to high-temperature environments or around heat-generating equipment such as open flames and transformers. Overheating of the battery may cause fire or explosion.
- Do not disassemble, modify, or damage the battery (e.g., inserting foreign objects, immersing in water or other liquids) to prevent battery short circuits, fires, or explosions.
- The battery energy storage system has a high fire risk. Before performing

battery operations, the following safety risks must be fully considered:

- The battery electrolyte is flammable, toxic, and volatile.
- Battery thermal runaway can generate various flammable and harmful gases.
- The accumulation of flammable gases produced after battery thermal runaway poses a risk of fire and explosion.

- Batteries should be stored independently within their original packaging. Avoid storing them together with other items, leaving them exposed to the open air, or stacking them to excessive heights.
- Batteries that have gone past their warranty period are not allowed to be used anymore.
- Under normal circumstances, do not take off the battery's original packaging. In case the battery needs to be recharged, it should be done by professional staff following the specified procedures. After the recharge is finished, the battery must be put back into its packaging.
- When handling batteries, they should be transported in the direction specified by the battery requirements. Inversion and tilting are strictly prohibited.
- Batteries should be protected from impact.
- Do not perform welding, grinding, or similar operations near the battery to prevent sparks or arcs from causing fire hazards.
- Use the battery within the operating temperature range specified in this manual. Refer to Section 2.3.1 Battery for the battery's operating temperature range.

- Do not use damaged batteries, such as those that have been dropped, collided, or have case dents. Damaged batteries may release flammable gases. Do not store damaged batteries near undamaged products.
- Damaged batteries should not be stored in areas containing flammable materials, and non-professional personnel should keep away.
- During storage, damaged batteries should be monitored to ensure there are no signs of smoke, fire, electrolyte leakage, or overheating.

Personal Safety

- During equipment operation, appropriate personal protective equipment (PPE) shall be worn. In case of malfunctions that may cause personal injury or equipment damage, immediately cease operation, report to the responsible personnel, and take timely and effective protective measures.
- Before using tools, ensure proper use methods are mastered to avoid personal injury or equipment damage.
- During equipment operation, the enclosure temperature is high, posing a risk of burns. Do not touch.
- To ensure personal safety and proper operation, reliable grounding shall be implemented before use.
- When a battery malfunctions, its surface temperature may exceed safe touch limits, presenting a burn risk. Avoid contact.

- Do not open or damage the battery. Released electrolyte may cause harm to skin and eyes. Avoid contact.
- Do not place unrelated items on top of the equipment or insert them into any part of the equipment.
- Do not store flammable items around the equipment.
- Batteries shall not be exposed to fire to prevent explosion and endanger personal safety.
- Do not immerse battery modules in water or other liquids.
- Never short-circuit battery terminals, as this may cause combustion.
- Batteries may pose risks of electric shock and large short-circuit currents. When using batteries, observe the following precautions:
  - Use tools with insulated handles.
  - Wear insulated gloves and shoes.
  - Do not place tools or metal parts on top of the battery.
  - Disconnect the charging power supply before connecting or disconnecting battery terminals.
  - Check if the battery is accidentally grounded. If so, remove the power supply from the ground.
- Do not use water or cleaning agents to clean the internal and external electrical components of the cabinet.
- Do not lean on the equipment or stand/sit on top of it.
- Do not damage any module of the equipment.

Battery Installation

- Before installing the battery, check whether the packaging is intact. Batteries with damaged packaging must not be used directly.
- During the battery installation process, pay attention to the positive and negative terminals. It is prohibited to short-circuit the positive and negative terminals of the battery.
- During the installation process, use a torque wrench to ensure that the screws are tightened without loosening, and check them regularly.
- After installing the equipment, remove the empty packaging materials in the equipment area, such as cartons, foam, plastics, and cable ties.

Hazards and Toxicity

⚠ DANGER
• Contact between battery terminals and other metals may cause overheating or electrolyte leakage. Since the electrolyte is flammable, immediately remove the battery from fire in case of leakage. • Vapors generated by burning batteries may irritate the eyes, skin, and throat.

Battery Abnormalities and Emergency Measures

⚠ DANGER

- When electrolyte leakage occurs or there is an unusual odor, avoid contact with the leaked liquid or gas. Non-professionals should not approach. Please contact professional personnel immediately for handling. Professional personnel should wear goggles, rubber gloves, gas masks, protective clothing, etc. to prevent the hazards caused by electrolyte spillage.
- The electrolyte is corrosive and contact may cause skin irritation and chemical burns. If exposed to battery electrolyte, take the following measures:
  - Inhalation: Immediately evacuate personnel from the contaminated area. After moving away, inhale fresh air and seek medical attention.
  - Eye contact: Flush eyes with plenty of water for at least 15 minutes. Do not rub and seek immediate medical help.
  - Skin contact: Wash the affected area with copious amounts of water and soap. Seek medical attention immediately.
  - Ingestion: Seek immediate medical attention.

Fire Emergency Measures

⚠ DANGER

- In case of fire, disconnect the system power supply when it is safe to do so

- Firefighters should avoid contact with high-voltage components during fire suppression. Otherwise, there may be a risk of electric shock.
- Excessive battery temperature may cause battery deformation and damage, as well as electrolyte spillage and toxic gas release. In such cases, wear respiratory protective equipment and do not approach to prevent skin irritation and chemical burns.

Flood Emergency Measures

⚠ DANGER

- Power off the system when it is safe to ensure personal safety.
- If any part of the battery is submerged in water, do not touch it to avoid an electric shock.
- Do not use flood-damaged batteries. Contact a battery recycling company for proper disposal.

Battery Drop Emergency Measures

⚠ DANGER

- When installing the battery, if it drops or sustains severe impact, internal damage to the equipment may occur. In such cases, do not continue to use it to avoid safety risks such as cell leakage or electric shock hazards.

- If a dropped battery exhibits distinctive odor, damage, smoke, or fire, immediately evacuate nearby personnel, alert emergency services, and contact professionals. Trained personnel should use fire-fighting equipment to extinguish flames while ensuring safety.
- If a dropped battery shows no visible deformation or damage, and there is no noticeable odor, smoke, or fire, contact professionals to transport the battery to an open and safe location or coordinate with a recycling company for disposal.

Battery Recycling and Disposal

- Follow local laws and regulations for proper disposal of used batteries. Do not dispose of batteries as household waste. Improper battery disposal may cause environmental pollution.
- If a battery leaks or becomes damaged, contact technical support or a battery recycling company for proper disposal.
- When a battery reaches the end of its service life, contact a battery recycling company for proper disposal.
- Avoid exposing used batteries to high temperatures or direct sunlight.
- Avoid exposing used batteries to high humidity or corrosive environments.

1.6 Handling, Transportation, and Storage Safety

⚠ WARNING

- Do not allow direct exposure to rain or snow to prevent water ingress.
- Avoid dropping or subjecting batteries to mechanical impact.
- Do not invert, tilt, or tip over batteries.
- Handle with care to prevent battery damage or short circuits, which could lead to accidents.
- Comply with national and regional laws, regulations, and industry standards for handling, transportation, and storage.

1.7 Maintenance and Replacement

⚠ DANGER

The equipment operates with high voltage, which can lead to electric shock accidents. These accidents may result in severe personal injury, even loss of life, or significant property damage. Before performing any maintenance tasks, it is essential to first cut off the equipment's power supply and strictly follow the safety guidelines outlined in this manual and other relevant documentation.

- Familiarize yourself with and understand the contents of this manual before performing maintenance on the equipment, and ensure that appropriate tools and testing equipment are available.

- Before conducting maintenance, cut off the equipment's power supply. Follow the instructions on the time-delay discharge label, wait the specified time to ensure the equipment is completely powered off, and then proceed with operations.
- During maintenance, prevent unauthorized personnel from entering the work area. Erect temporary warning signs or install barriers for isolation.
- If the equipment malfunctions, contact our company immediately for after-sales service. Contact information is provided in Chapter 9 Technical Support and After-Sales Service.
- The equipment must be fully repaired before powering up again. Failure to do so may cause the fault to escalate or equipment damage.
- Do not open the equipment without authorization. This poses a risk of electric shock, and resulting malfunctions will not be covered under warranty.
- Operators and maintenance personnel, as well as professional technicians, must receive adequate training on safe equipment operation and maintenance. Operations should be performed under sufficient preventive measures and with personal protective equipment (PPE).
- When moving or rewiring the equipment, first disconnect the power input. After internal energy dissipation is complete and a multimeter confirms no hazardous voltage on the DC bus and internal components to be repaired, maintenance may commence.
- Battery repairs must be performed or supervised by personnel familiar with batteries and required preventive measures.
- Replace the battery with the same type of battery.

- After maintenance operations, immediately inspect to ensure no tools or other components are left inside the equipment.
- When the equipment is not in use for an extended period, the battery should be stored and recharged according to the instructions in this manual.

2 Product Introduction

2.1 Product Information

Introduction

This product is a highly integrated containerized battery energy storage system solution. It integrates key components such as batteries, battery management systems (BMS), and Golden Shield (GS) within a standard 20-foot container, enabling high integration and modularity. This design streamlines transportation, installation, and rapid deployment, significantly reducing project construction timelines. The energy storage system delivers ultimate safety and stability alongside exceptional performance, providing real-time responsiveness to dynamic power demands and precise control of charging/discharging processes to optimize energy utilization efficiency. It plays a pivotal role in applications like photovoltaic-storage synergy and grid peak shaving with frequency regulation, laying a robust foundation for building a stable and efficient energy infrastructure.

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Basic Information

Model	Certification
SU5016E2500KC-L	CE

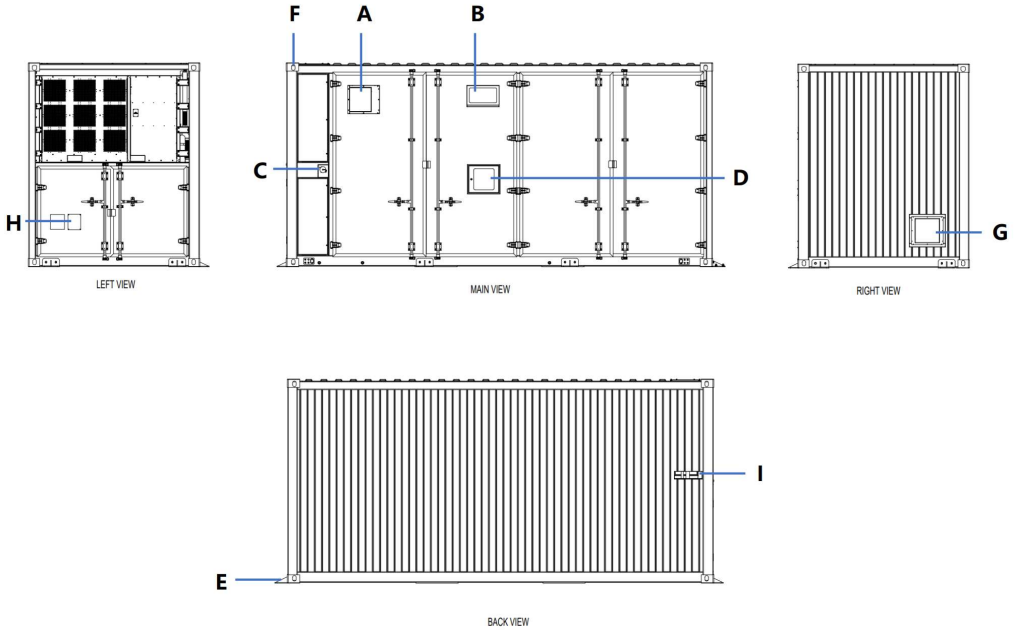
System Parameters

Parameter	Value
Dimensions	L: 6058mm
	W: 2438mm
	H: 2896mm
Weight	40.3±0.5t
Operating Ambient Temperature Range	-30~50℃
Charge/Discharge Rate	0.5C
Operating Ambient Humidity Range	0~95%RH
Corrosion Protection Grade	C4-M
IP Rating	IP55
Cooling Method	Intelligent liquid cooling solution
Fire Suppression Configuration	Fire Detection and Alarm System
	Ventilation and Air-Exchange System
	Aerosol Fire Suppression System
	Water-Based Fire Suppression System

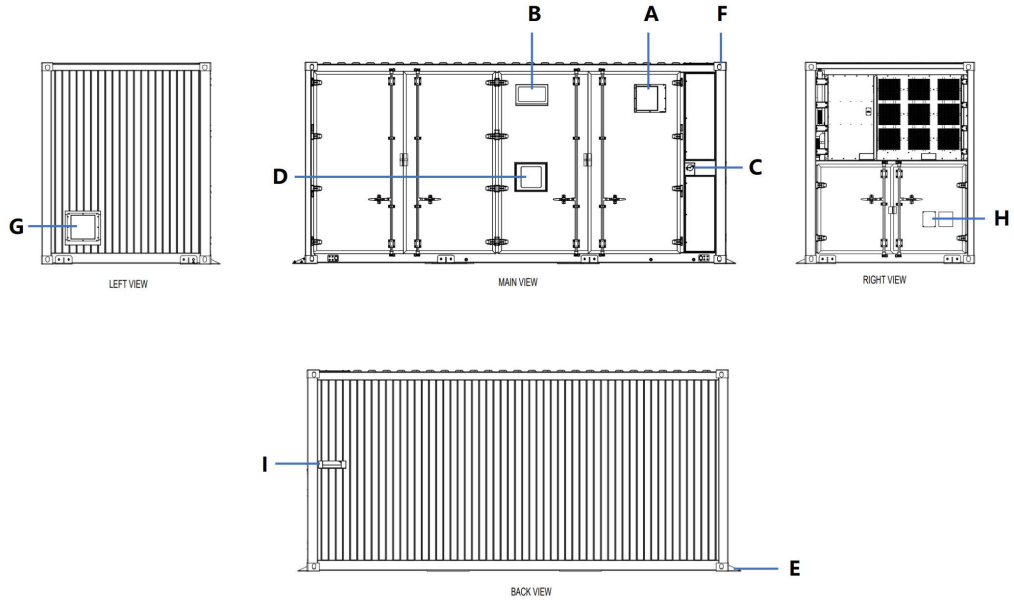
Allowable Operating Altitude	≤4000m
Noise Level	≤80dB@1m
Wind Load	66m/s
Snow Load	40psf
Seismic Grade	Zone 4
Cell Specifications	3.2V/314Ah
Battery Configuration	416S12P
Key Components	1 battery array
	1 BAU
Rated Energy	5015.96kWh
Rated Power	2500kW
Rated Voltage	DC 1331.2V
Operating Voltage Range	DC 1123.2~1497.6V

2.2 Product Design

2.2.1 Product Appearance



Container A



Container B

Product Appearance

No.	Components	Quantity	Function
A	FSS exhaust fan	1	Vent the combustible gas inside the container.
G	FSS air inlet	1	
B	Audible and visual alarm	1	When the fire suppression system in the container is triggered, it emits audible and visual alarms and the sound of an alarm bell.
	Alarm bell	1	
C	FSS water supply port	1	Connect to an external water source to provide an emergency water supply for the Water-Based Fire Suppression System.
D	System emergency stop button	1	Used to shut down the energy storage system in emergencies.
	FSS emergency stop button	1	Used to stop the discharge of fire suppressant in emergencies.
	Manual/Auto switching and emergency start device	1	Used for switching the fire suppression system to manual mode to prevent unintended discharge of fire suppressant, and for manually releasing the fire suppressant in emergencies.
	System debug Ethernet port	1	Used for the debugging of the energy storage system.
E	Fastener	4	Used for connecting and fixing the container to

			the foundation.
F	Top corner casting	4	Used for container lifting.
H	Container nameplate	1	Displays technical parameters of the container, production date, and other information.
I	Drain pipe	2	Used for condensate water drainage of the liquid cooling unit.

2.2.2 Product Markings

NOTE
Product markings may vary due to factors such as model, certification standards, production batch, and sales region. The markings listed in this manual do not cover all possible ones. Please refer to the actual markings on the product.

2.2.2.1 General Markings

Marking	Meaning
risen risen	Brand Marking

2.2.2.2 Exterior Markings

Marking	Meaning
	Danger: Electrical Hazard
	Caution: Hot Surface
	Height Limit
	Electric Arc Flash Hazard
	UN3536

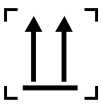
	Class 9 Dangerous Goods
E-STOP	Emergency Stop
	Left Door Opening
	Right Door Opening
 	Grounding Terminal

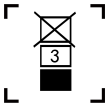
2.2.2.3 Nameplate Markings

Marking	Meaning
	Danger: Electrical Hazard
	Warning: Hazard
	Warning: Corrosion Hazard
	Warning: Explosive Hazard
	Caution: Heavy Load

	No Smoking or Open Flames
	Refer to User Manual
	Must Wear Protective Goggles
	Must Wear Protective Gloves
	First Aid
	Emergency Eye Wash Station
	Recycling
	WEEE Recycling
	CE Marking
	TÜV Rheinland Certified

2.2.2.4 Outer Packaging Markings

Marking	Meaning
	This Side Up

	Avoid Direct Sunlight
	Do Not Tumble
	Fragile
	Protect from Rain
	Maximum Stacking Layers
	Class 9 Dangerous Goods
un 50D/Y/xxxx CN/xxxxxxx 2190/730	UN Number & China Dangerous Goods Number

2.3 Key Components

2.3.1 Battery

2.3.1.1 Cell

Parameter	Value	Image
Chemical Composition	Lithium Iron Phosphate (LFP)	 (For reference only)
Form Factor	Prismatic	
Dimensions	W: 174mm	
	H: 207mm	
	T: 72mm	
Weight	5.6±0.1kg	
Rated Capacity	314Ah	
Rated Energy	1004.8Wh	
Rated Voltage	DC 3.2V	
Operating Voltage Range	DC 2.5~3.65V	
Operating Temperature Range	Charge: 0~60°C	
	Discharge: -30~60°C	

2.3.1.2 Battery Module

A battery module is composed of multiple cells connected in series and is equipped with one battery module management unit (BMU).

Parameter	Value	Image
Configuration	104S1P	 (For reference only)
Key Components	104 cells	
	1 BMU	
Dimensions	W: 790mm	
	H: 243mm	
	D: 2170mm	
Weight	650±10kg	
Rated Capacity	314Ah	
Rated Energy	104.4992kWh	
Rated Voltage	DC 332.8V	
Operating Voltage Range	DC 280.8~374.4V	

2.3.1.3 Battery Cluster

A battery cluster is composed of multiple battery modules connected in series and is equipped with one battery cluster management unit (BCU).

Parameter	Value
Configuration	416S1P
Key Components	4 battery modules
	1 BCU, located in the switchgear
Rated Capacity	314Ah
Rated Energy	417.9968kWh
Rated Voltage	DC 1331.2V
Operating Voltage Range	DC 1123.2~1497.6V

2.3.1.4 Battery Array

A battery array is composed of multiple battery clusters connected in parallel and is managed by the battery array management unit (BAU).

Parameter	Value
Configuration	416S12P
Key Components	12 battery clusters
	6 switchgears, each containing 2 BCUs

	1 BAU, located in the distribution panel
Rated Capacity	3768Ah
Rated Energy	5015.96kWh
Rated Power	2500kW
Rated Voltage	DC 1331.2V
Operating Voltage Range	DC 1123.2~1497.6V

2.3.2 Battery Management System (BMS)

The battery energy storage system (BESS) employs a multi-tiered battery management system (BMS) for system monitoring and control. Each BMS comprises multiple battery module management units (BMUs), multiple battery cluster management units (BCUs), and one or multiple battery array management units (BAUs).

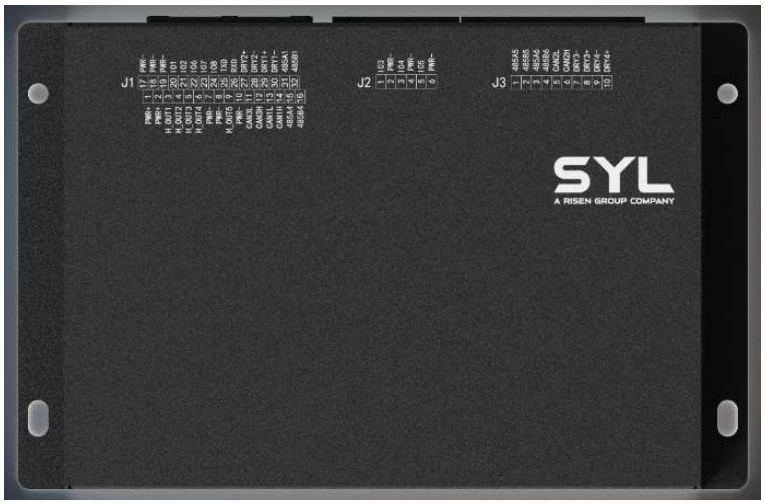


Figure 2-2 Battery Array Management Unit (BAU) (For reference only)

2.3.2.1 Battery Management Units and Functions

The BMU can be used to detect voltage and temperature and perform cell balancing. The BCU can manage BMUs, detect cluster voltage and cluster current, and execute protection functions by switching DC contactors. The BAU can manage BCUs and communicate with Golden Shield (GS).

Function		BMU	BCU	BAU
Measurement	Cell Voltage	✔		
	Cell Temperature	✔		
	Cluster Voltage		✔	
	Cluster Current		✔	
Calculation	SOC		✔	✔
	SOH		✔	✔
	Power Prediction		✔	
Control	Contactor Control		✔	
	Cell Balancing	✔	✔	
Communication	CAN2.0	✔	✔	✔
	RS485		✔	✔
	Ethernet			✔

2.3.2.2 Battery Management System Architecture

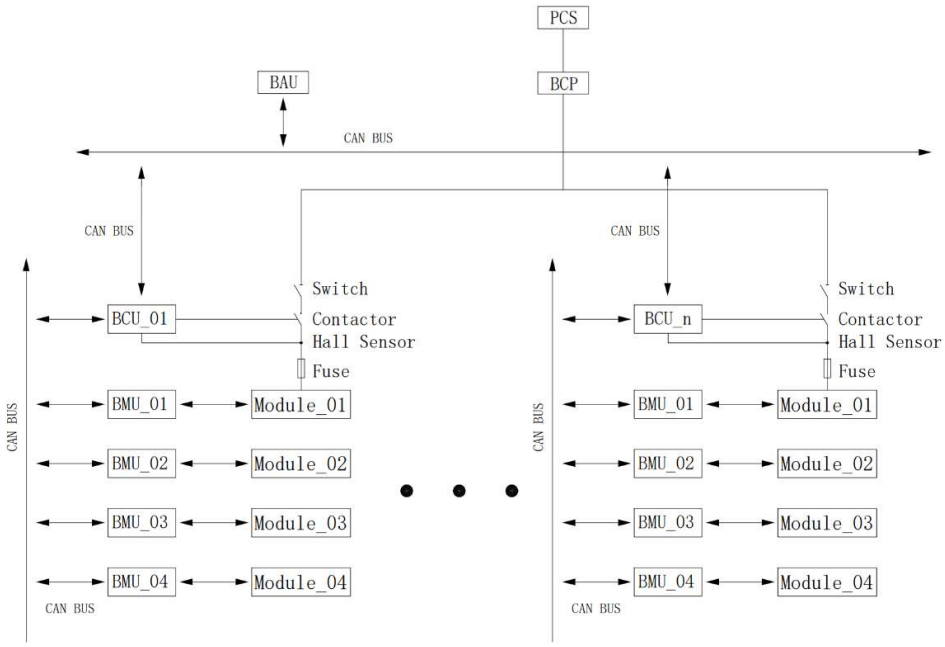


Figure 2-3 BMS Architecture

2.3.3 Golden Shield

To provide a universal communication port for battery systems equipped with the supervisory control and data acquisition (SCADA) system or the EMS and to free the EMS from basic system protection, a system controller, namely the Golden Shield (GS) shown in the following figure, is integrated and deployed in the BESS.

Figure 2-4 Golden Shield

2.3.3.1 Features and Functions

- Integration of battery system control, including the BMS, cooling devices, BCP, etc.
- Provide a universal communication port for battery systems equipped with SCADA or EMS.
- As a communication adapter, convert various communication protocols (such as RS485, CAN, dry contacts, etc.) of the balance of system (BOS) like BMS, PCS, HVAC, FSS into one communication protocol of the EMS for easy integration.
- Implement basic system protection to prevent equipment, such as batteries and PCS, from being damaged during operation.
- Record data for a short period for troubleshooting.

2.3.3.2 Communication Topology

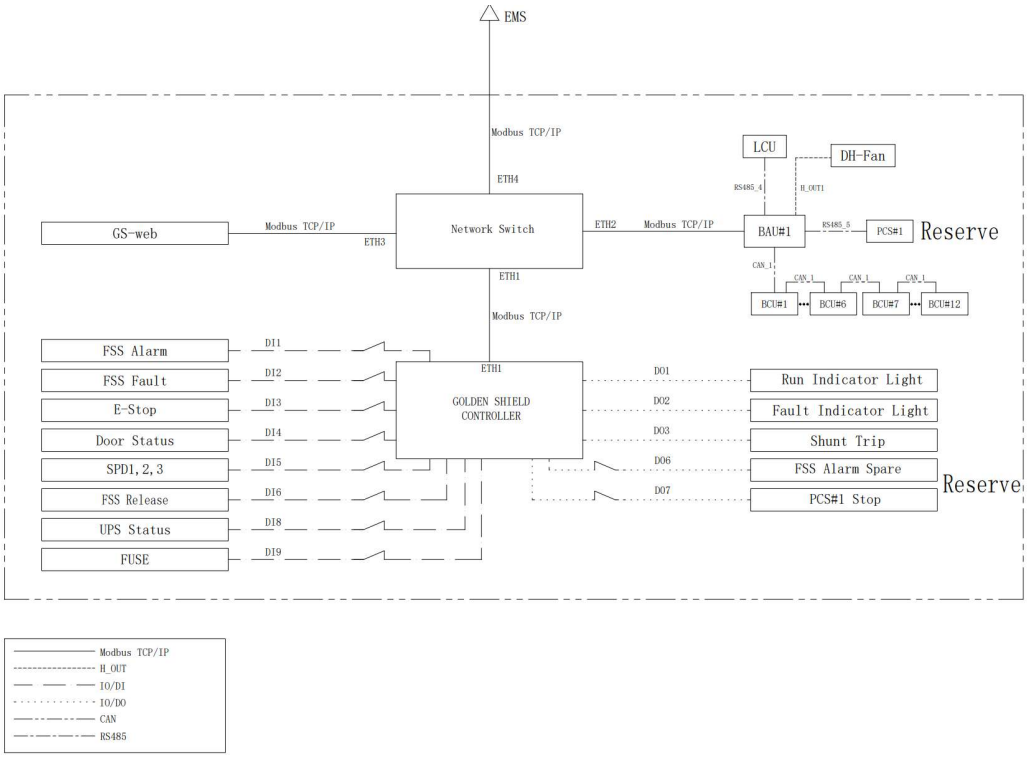


Figure 2-5 Golden Shield Communication Topology

2.4 Fire Suppression System

2.4.1 Precautions

⚠ DANGER

- If there is visible fire or even an explosion at the site, it is prohibited to approach the container for manual emergency discharge operation.
- When the equipment activates automatic fire suppression, it releases a large amount of gas that rapidly consumes oxygen inside the container through chemical reactions. Operators must not enter the container during this period to avoid the risk of death by asphyxiation.

⚠ NOTICE

- The container is equipped with an automatic fire suppression system. The FSS buttons must not be triggered casually under non-emergency circumstances.
- It is necessary to adhere to the fire suppression codes and regulations of the country and region where the project is situated.
- Fire suppression equipment should be inspected and maintained on a regular basis to ensure all functional parameters are normal.

ℹ NOTE

If users intend to utilize the Water-Based Fire Suppression System integrated into

the ESS (where applicable), they shall comply with the laws, regulations, standards, and codes of the project's location, and independently design and construct supporting fire wastewater treatment solutions and facilities based on the actual project conditions. It is necessary to ensure that such solutions and facilities fully meet the requirements regarding legality, safety, and long-term effectiveness. SYL assumes no liability for any matters related to fire wastewater treatment.

2.4.2 Fire Suppression System Overview

The fire suppression system is based on core subsystems such as the Fire Detection and Alarm System, Ventilation and Air-Exchange System, Aerosol Fire Suppression System, and Water-Based Fire Suppression System. Through seamless integration with the fire alarm control panel and the Golden Shield controller, it establishes a protection system covering the entire process of fire early warning, risk prevention, and fire response. Relying on a multi-layered protection mechanism, it provides all-dimensional fire safety for energy storage systems. It can implement efficient fire suppression in stages for different phases of fire germination, development, and spread, minimizing losses to the energy storage system.

2.4.3 Fire Suppression System Components

- **Fire Detection and Alarm System**

  Smoke detectors and heat detectors are deployed at key positions inside the container to monitor smoke concentration and temperature in real time. When the detected value

exceeds the preset safety threshold, an early warning signal is immediately sent to the fire alarm control panel to achieve early and accurate identification of fire hazards and intervention.

- **Ventilation and Air-Exchange System**

  Combustible gas detectors monitor the concentration of combustible gases inside the container in real time. When the concentration reaches the set safety threshold, it immediately sends an early warning signal to the fire alarm control panel and automatically activates the mechanical ventilation devices. Through forced convection, accumulated combustible gases are discharged to control the concentration within a safe range, reducing the risk of deflagration at the source.

- **Aerosol Fire Suppression System**

  It can quickly achieve total flooding protection inside the container. Through a dual fire-extinguishing mechanism of chemical inhibition of combustion chain reactions and physical oxygen isolation, it rapidly suppresses the spread of initial fires, effectively addressing electrical fires and battery thermal runaway.

- **Water-Based Fire Suppression System**

  As the ultimate fire-extinguishing measure, it can quickly connect to an external water source through the FSS water supply port, activate the water sprinkler devices to precisely cool and reduce the temperature in the open fire area, rapidly extinguish the open fire, and continue sprinkling to prevent lithium battery re-ignition. Meanwhile, a physical

isolation barrier is constructed through dense sprinkling to block the spread of fire, creating safe conditions for subsequent emergency response.

2.4.4 Fire Suppression System Logic Diagram

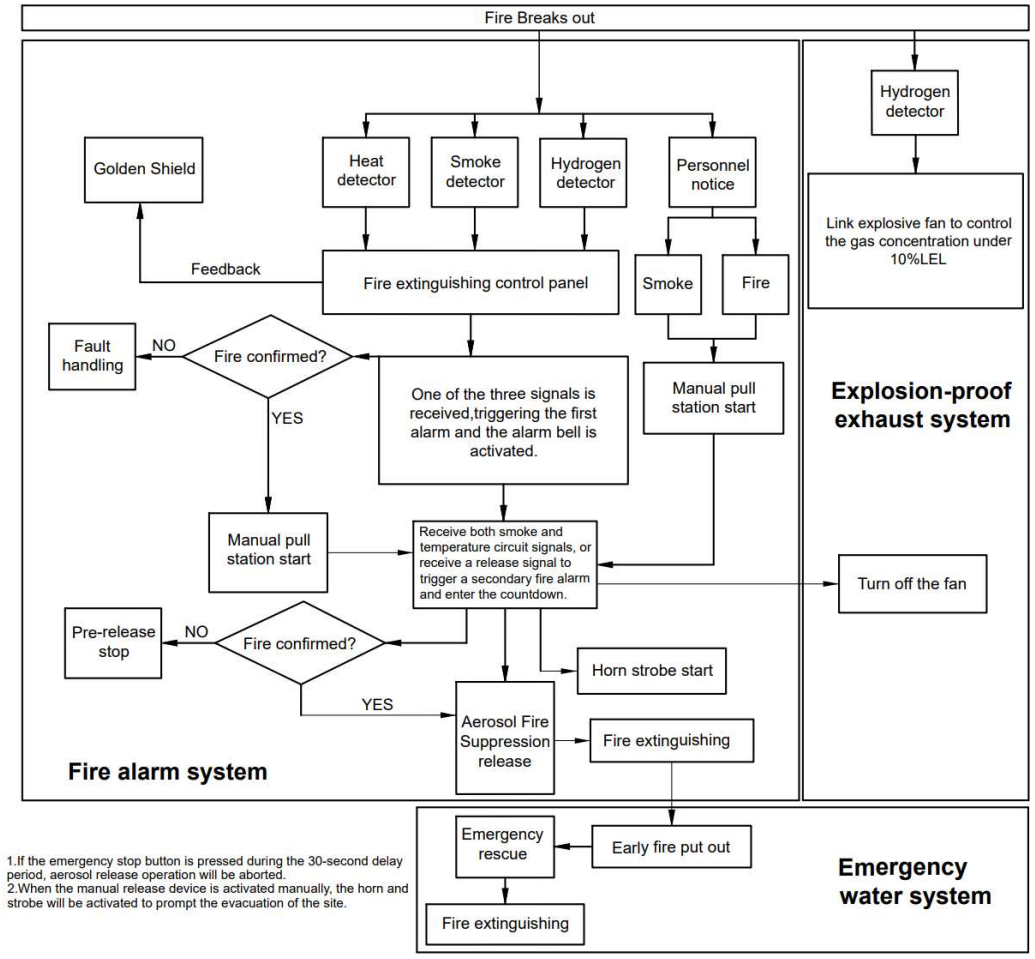


Figure 2-6 Fire Suppression System Logic Diagram

2.4.5 Water Supply for Water-Based Fire Suppression System

⚠ NOTICE
The piping of the Water-Based Fire Suppression System shall remain dry under

normal conditions. External water source connection via the FSS water supply port is strictly permitted only during emergency situations (e.g., fire incidents).

An FSS water supply port is preinstalled on the exterior of the container. On-site personnel may decide whether to connect the water supply pipeline in advance based on actual needs.

Figure 2-7 FSS Water Supply Port

2.4.6 Post-Discharge Handling Measures for Aerosol Fire Suppression System

2.4.6.1 Precautions

⚠ DANGER

- Flammable gases may be present inside the container. It is strictly prohibited to carry open flames, heat sources, or lit cigarettes into the hazardous area to prevent re-ignition or explosion.
- Toxic gases may be present. Before entering, personal protective measures must be taken, and respiratory protective equipment complying with local regulations must be worn to ensure life safety and health.

- After firefighting, professional firefighters must assess the internal safety risks. The container door can only be opened after confirming that no hazards exist.

⚠ NOTICE

During the handling process, portable fire extinguishers must be equipped throughout to prevent re-ignition.

2.4.6.2 Handling Measures

Ventilation and Inspection

- After the aerosol fire suppression device is discharged, keep the protected area airtight for 10 minutes or more. Ventilation or opening doors, windows, fire doors, or other openings is prohibited during this period.
- Thoroughly ventilate the area using ventilation systems, fans, or by opening windows before entering. Wear respiratory protective equipment throughout the process to avoid inhaling toxic substances and aerosol fire extinguishing agents.
- Conduct a comprehensive inspection after entering to confirm the fire is extinguished and there are no localized heat sources or re-ignition points.

Residue Handling

- In high-humidity environments, dehumidification must be performed after ventilation to prevent residues from absorbing moisture, which could corrode metals and electronic

devices or cause circuit board short-circuits.

- For aerosol fire extinguishing agent residues remaining after ventilation, promptly inspect and completely remove them:

  1. For aerosol residues on equipment and circuit board surfaces, use a lint-free cloth to gently press and absorb the liquid.

     ℹ️ **Note:** Directly wiping circuit boards is prohibited to avoid scratches or component damage. Paper products are forbidden to prevent fiber residue.

  2. Gently brush off particulate matter and dried liquid residues with a toothbrush.
  3. Use compressed air to quickly blow in a single direction for a short time to remove remaining dust and fine residues.

Dismantling and Disposal

- The casing of the aerosol fire suppression device may remain hot for a period of time after activation. Wear protective gloves and follow standard procedures when dismantling—do not touch directly.
- Dispose of the dismantled aerosol fire suppression device in accordance with local regulations.
- Contact us as soon as possible to replace the aerosol fire suppression device and re-commission it. For contact information, please refer to Chapter 9 Technical Support and After-Sales Service.

2.5 Thermal Management System

2.5.1 Precautions

⚠ CAUTION

- No blocking of air inlets and outlets for the thermal management system.
- Caution: risk of burns. The surfaces of the thermal management system reach high temperatures during operation and remain hot for a period after shutdown.

2.5.2 Liquid Cooling System Parameters

Parameter	Value
Cooling Capacity	60kW
Heating Capacity	16kW
Supply Voltage	AC (380~480V) ±15%
	50/60Hz
	3P3L
Maximum Operating Current	70A
Operating Ambient Temperature Range	-30~55℃
Refrigerant Type	R410A
Coolant Type	50% Ethylene Glycol Aqueous Solution
Coolant Temperature	Cooling: 5~35℃

	Heating: ＜50℃
Coolant Replenishment Method	Automatic
IP Rating	Whole unit: IP26
	Electrical components: IP67
Corrosion Protection Grade	C5M
Permissible Operating Altitude	0~4000m ℹ️ **Note:** When exceeding 2000m, derated operation is allowed.
Noise Level	≤80dB(A)

3 Transportation and Storage

3.1 Handling and Transportation

3.1.1 Precautions

⚠ WARNING

- Do not expose to direct rain or snow to prevent water ingress.
- Avoid dropping or mechanical impact.
- Do not tilt or invert.

ℹ **Note:** In case of any of the above anomalies, refer immediately to the emergency measures in Section 1.5 Battery Safety for resolution.

⚠ NOTICE

This product is certified under UN38.3 (Section 38.3 of the Sixth Revised Edition of the *Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria*) and *SN/T 0370.2-2009 Rules for the Inspection of Export Dangerous*

Goods Packaging-Part 2: Performance Testing, and is classified as Class 9 dangerous goods.

NOTE

Energy storage systems are subject to various external conditions such as temperature, transportation, and storage. Their specifications shall be based on the date of manufacture.

3.1.2 Handling

WARNING

- Energy storage systems must comply with the laws, regulations, and industry standards of the country and region where they are located during handling operations.
- During handling operations, handle with care. Rough handling may cause battery short circuits or damage inside the enclosure, and may also result in battery leakage, rupture, fire, or explosion.

3.1.3 Transportation

Transportation Preparation

- Before commencing transportation, batteries must be inspected. Batteries shall be intact without visible damage, abnormal odors, smoke, fire, etc. If any of these conditions occur, transportation is prohibited, and emergency measures must be initiated immediately. For specific emergency measures, refer to Section 1.5 Battery Safety.
- Before commencing transportation, the outer packaging of the product must be inspected to ensure it is secure.
- Before commencing transportation, ensure the product and its outer packaging comply with the requirements of transportation vehicles (e.g., trucks, vessels).

Transportation Requirements

- During transportation, the product must be fully protected against moisture.
- For sea transportation, comply with the *International Maritime Dangerous Goods Code* (IMDG CODE).
- For road transportation, comply with the *European Agreement concerning the International Carriage of Dangerous Goods by Road* (ADR) or *Regulations Concerning Road Transportation of Dangerous Goods* (JT/T 617).
- Meet the regulatory requirements of the country of departure, transit countries, and country of destination.
- Comply with other applicable international dangerous goods transportation regulations.

3.2 Storage

3.2.1 Precautions

⚠ NOTICE

- Storage environments must meet local regulations and standard requirements.
- For extended storage, qualified personnel must perform inspections and tests before returning the battery to service.
- When storing batteries, place them according to the packaging markings and ensure proper orientation. Do not invert or tilt.
- When stacking battery packages, comply with the stacking limits specified on the outer packaging.
- Handle batteries with care during handling to avoid damage.

ℹ NOTE

- During storage, relevant data records (e.g., temperature, humidity, storage environment) must be maintained in accordance with the product storage requirements in this manual.
- During storage, battery maintenance must be performed according to the maintenance requirements in this manual. For details, refer to Section 7.2 Battery System Maintenance.

- Long-term storage of batteries is not recommended. Long-term storage of lithium-ion batteries causes irreversible capacity loss. After 12 months of storage at the recommended temperature, the typical irreversible capacity loss is 3% to 6%.

3.2.2 Storage Requirements

- Recommended storage ambient temperature: ≤35°C.
- Recommended storage ambient humidity: <60% RH.
- Recommended battery system/spare battery modules storage SOC: 30%~50%. During storage, all external power-consuming devices must be disconnected. Perform regular inspections, maintain detailed inspection records, and promptly address any abnormal conditions.
- Store in a dry, clean, and well-ventilated warehouse to prevent dust and moisture ingress and ensure no short circuits.
- Avoid contact with corrosive organic solvents or gases to prevent battery corrosion and rust.
- Avoid direct sunlight.
- During storage, if any questions arise, please contact the after-sales service for consultation and handling. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.

4 Product Installation

4.1 Precautions

⚠ WARNING

- Battery energy storage systems are high-voltage devices classified as dangerous goods. Improper operation by unqualified personnel may result in severe consequences such as electric shock, combustion, or explosion.
- Battery energy storage systems must be installed and maintained by qualified technical personnel and used strictly in accordance with relevant safety regulations.

4.2 Pre-Installation Inspection

4.2.1 Outer Packaging Inspection

Before opening the outer packaging of the product, inspect it for visible damage (e.g., tears, cracks, or other signs of potential internal damage) and verify the product model. If packaging irregularities or model discrepancies are found, contact us immediately. Contact

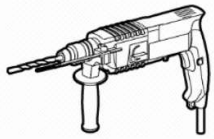
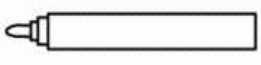
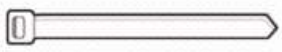
information is provided in Chapter 9 Technical Support and After-Sales Service.

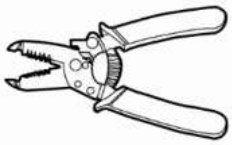
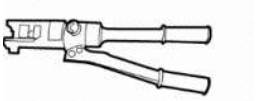
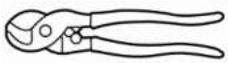
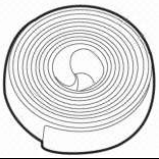
4.2.2 Delivered Items Inspection

After opening the outer packaging of the product, inspect the container itself and internal equipment for integrity and visible damage. Refer to the *Packing List* to check whether the spare parts and accessories provided are complete and intact. If any damage to the container/equipment or missing spare parts are found, contact us immediately.

4.3 Pre-Installation Preparation

4.3.1 Tools and Instruments

Name	Purpose	Image
Electric Drill and Φ16 Drill Bit	For making holes in expansion bolts.	
Screwdriver and Socket Set	For the installation of grounding wires, power cables, rubber conduits, and forklift hole covers.	
Torque Wrench	For confirming the torque of fasteners.	
Marker Pen	For torque markings.	
Zip Ties	For cable fixation.	

Level meter	For leveling the container.	
Multimeter	For continuity testing.	
Wire Stripper	For removing insulation from the ends of cables.	
Hydraulic Pliers	For crimping terminals and cables.	
Cable Cutter	For cutting cables.	
Tape Measure	For measuring dimensions.	
Heat Gun	For shrinking heat shrink tubing.	
Heat Shrink Tubing	For protecting wire and terminal connections.	
Cold Crimp Terminal Pliers	For crimping terminals and cables.	

4.3.2 Personal Protective Equipment

Name	Purpose	Image
Insulating Gloves	For electrical insulation protection.	
Insulating Shoes	For electrical insulation protection.	
Safety Goggles	For arc flash protection.	
Dust Mask	For dust protection.	

ℹ️ **Note:** Personal protective equipment of Category 1 or higher shall be worn.

4.3.3 Accessories

Name	Specifications	Purpose
Stainless Steel Shims	As required	For leveling the base.
Expansion Bolts	Recommended: M16×100	For connecting the foundation and container fasteners.
Steel Wire Rope	As required	For crane lifting.

Shackles	As required	For crane lifting.
Fasteners	Standard specifications	For connecting and securing the foundation and the container.
Assembly Bolts	M16×30 (property class 8.8)	For fastener installation.
Copper Cable Lug	Hole diameter compatible with M10 bolts	For grounding cable fabrication.
Grounding Cable	Copper wire with a cross-sectional area≥70 mm^2 or aluminum wire of equivalent ampacity	For equipment grounding.
Assembly Bolts	M10×30 (property class 8.8)	For grounding cable installation.
Fireproofing Mud	Standard specifications	For sealing cover plates.

4.4 Installation Requirements

4.4.1 Installation Environment Requirements

- Installation environments must comply with relevant international, national, and regional laws, regulations, and standards.
- For areas prone to natural disasters (e.g., floods, debris flows, earthquakes, typhoons),

appropriate preventive measures must be implemented during installation.

- Install in a dry, well-ventilated environment and securely fasten equipment to a solid, flat support surface.
- Ensure the installation location is clean, free of excessive infrared radiation, organic solvents, and corrosive gases.
- Keep the installation location away from ignition sources and heat sources. Do not store flammable or explosive materials near the equipment.
- Avoid water accumulation at the installation location. Keep it away from water sources to prevent water ingress.
- During operation, the heat dissipation area generates high temperatures. Avoid installing the equipment in easily accessible locations.
- Do not block vents or cooling systems during operation to prevent overheating and fire hazards.
- Never place the equipment in environments with flammable/explosive gases or fumes, and avoid any operations in such environments.

ℹ️ Note:

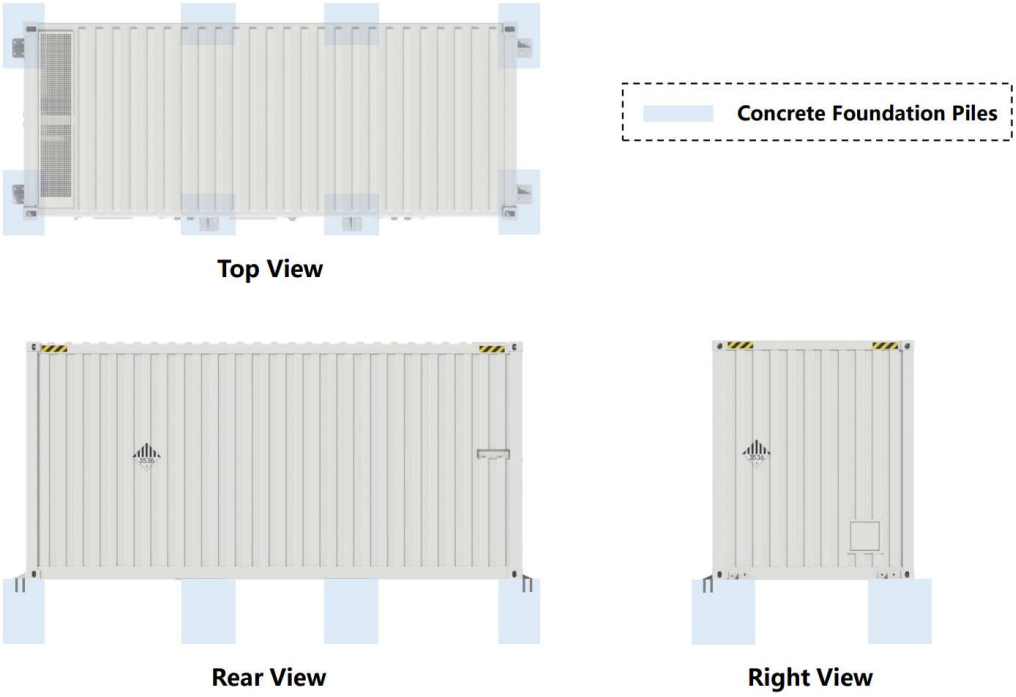
- The operation and service life of the energy storage system are related to the operating temperature. Install the equipment in an environment with a temperature equal to or better than the ambient temperature conditions.
- When the cell temperature is low, the system automatically derates charging power. If the cell temperature is below 0°C before system startup, the minimum cell temperature must

be heated to above 0°C before charging begins.

4.4.2 Installation Foundation Requirements

NOTE
The picture in this section is for illustrative purposes only. The on-site construction and fabrication of the installation foundation must be carried out in strict accordance with the final foundation drawing.

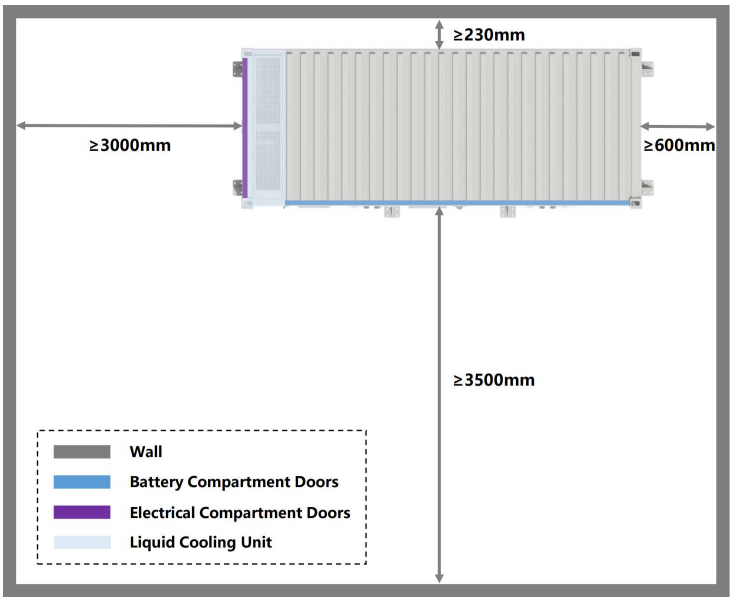
- The container bottom must be supported by a concrete foundation with sufficient strength to provide adequate support for the container body.
- Use a level meter to measure the foundation levelness, ensuring it is ≤5mm, particularly on the eight mounting surfaces. If the levelness exceeds 5mm, level it out with stainless steel shims. A levelness ≥5mm may cause long-term issues such as equipment frame deformation, insufficient door sealing leading to water ingress, door malfunctions, or liquid-cooling pipe leakage.



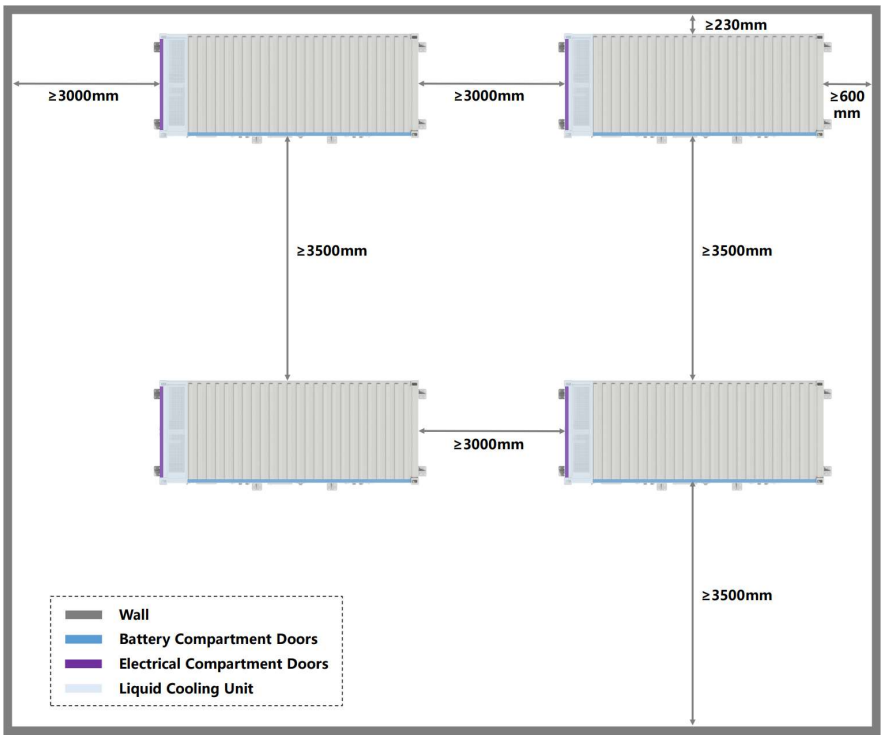
Installation Foundation

4.4.3 Installation Space Requirements

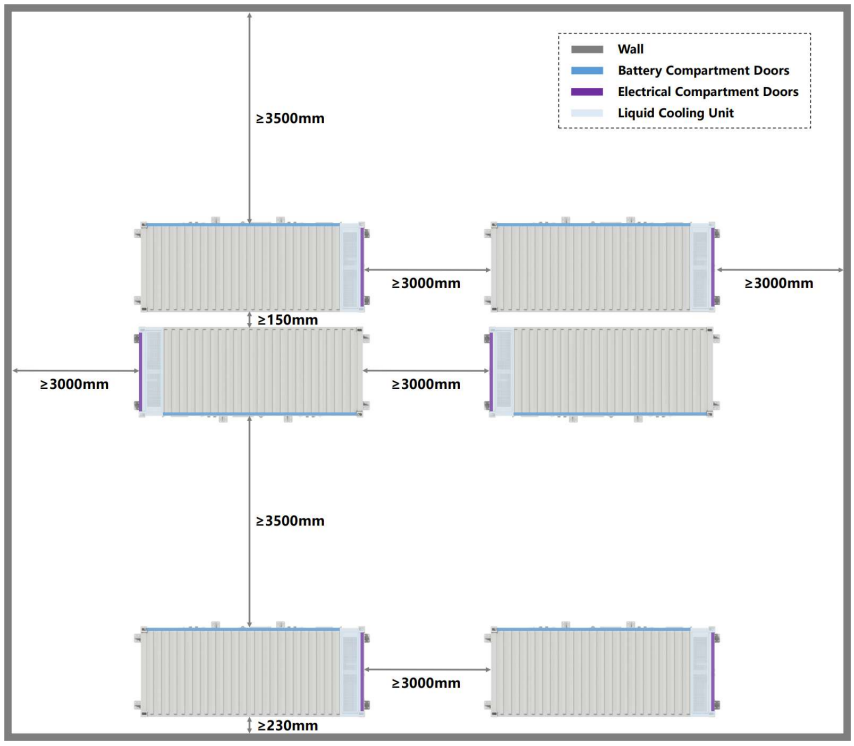
⚠ WARNING
When installing the equipment, ensure that there are no flammable or explosive materials in the vicinity and leave sufficient space for heat dissipation and safe separation.



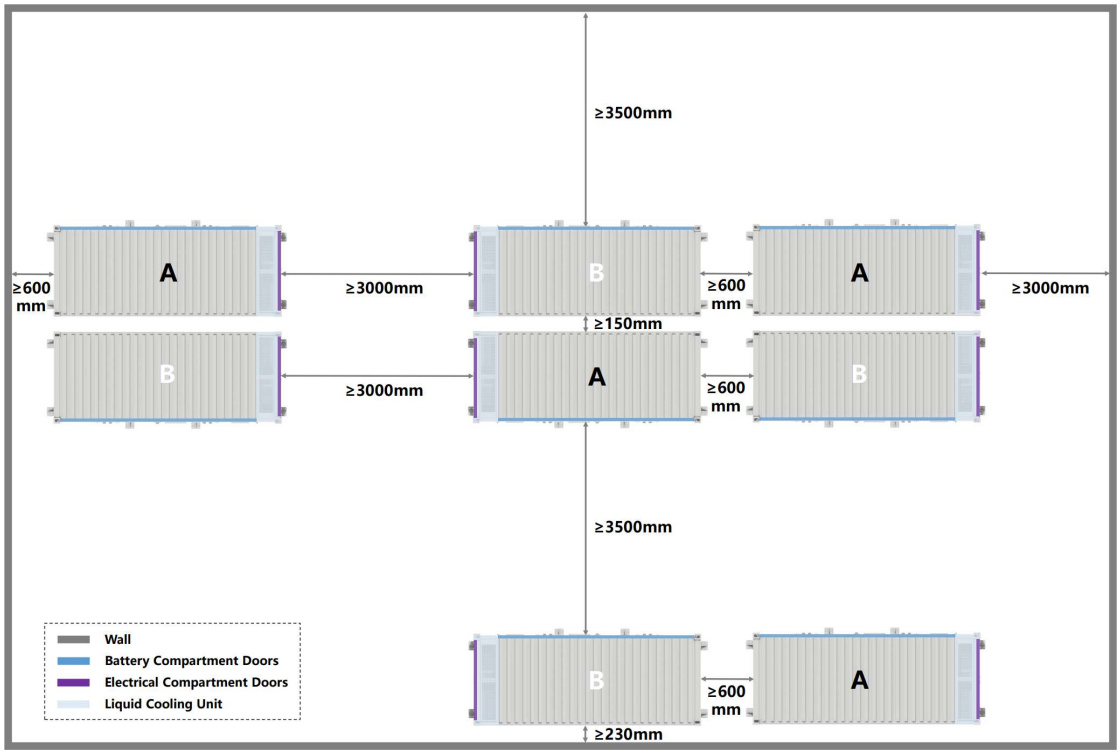
Single Container Installation Space Requirements



Installation Space Requirements for Multiple Containers (Shoulder-to-Shoulder)



Installation Space Requirements for Multiple Containers (Back-to-Back)



Installation Space Requirements for Multiple Container A and Container B Units

4.5 Equipment Installation

4.5.1 Equipment Lifting

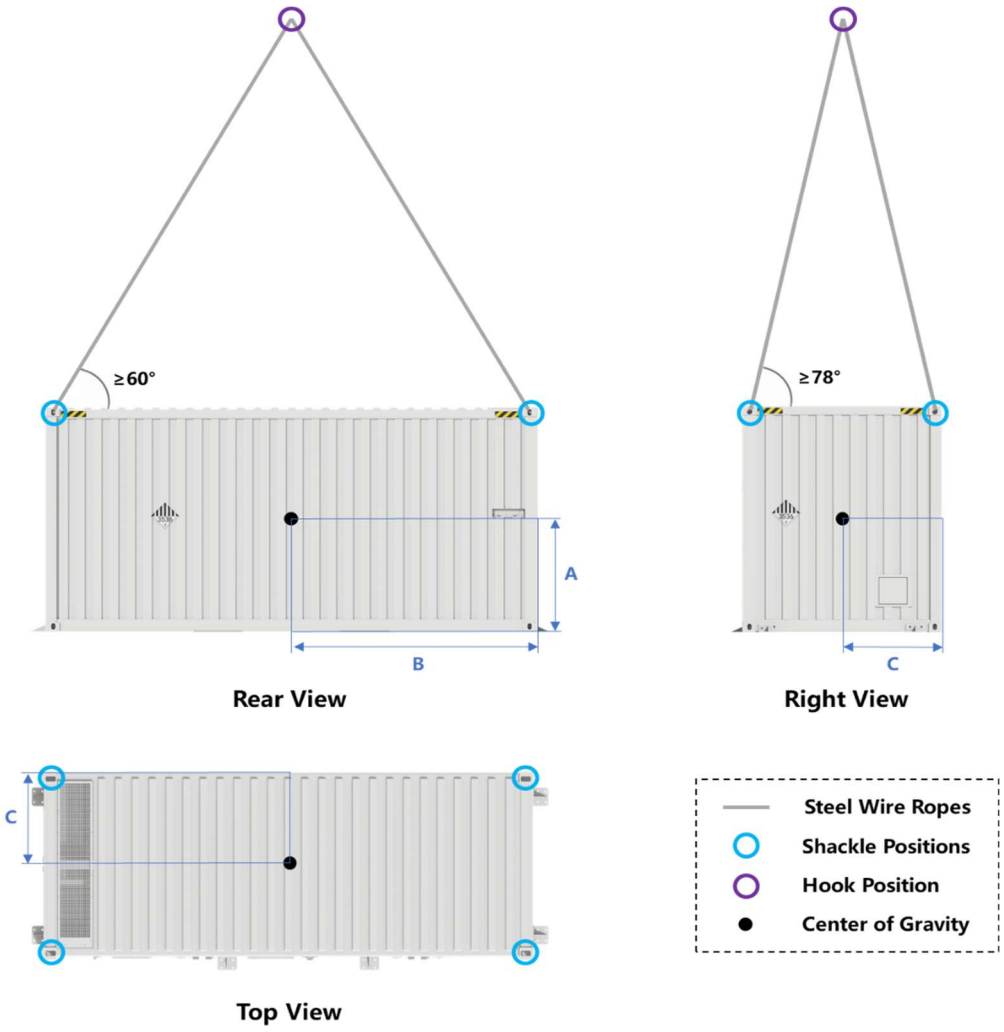
⚠ WARNING

- During crane operations, no personnel are allowed within a 5m to 10m radius of the operation area.
- Never stand under the crane boom or beneath lifted/moving machinery to prevent injury or fatality.
- Lifting angles must be ≥60°. Ensure no personnel or obstacles are present in the vicinity before lifting.
- Suspend lifting operations during adverse weather conditions such as wind force ≥ Beaufort scale 6, heavy rain, snow, or fog.
- Immediately halt operations if abnormal conditions occur, including unusual noises, deformation, or weld cracks in the equipment.

⚠ CAUTION

- Select an appropriate crane based on site conditions and the weight of the product.
- Equip 4 steel wire ropes and 4 shackles according to the dimensions and weight of the product, ensuring they have suitable lengths and load-bearing capacities for safe and reliable operation.

- Lifting or lowering processes must be conducted at a constant speed, ensuring acceleration ≤0.1g (i.e., ≤0.98 m/s²).



Container Lifting

Marking	Value (mm)
A	1495
B	3212
C	1246

4.5.2 Equipment Fixing

⚠ NOTICE
Before lifting the equipment, ensure the foundation levelness meets requirements (i.e., foundation levelness ≤5mm), particularly on the eight mounting surfaces. If the foundation levelness exceeds 5mm, use stainless steel shims for leveling.

4.5.2.1 Equipment Leveling

1. After the container is placed, use a level to measure the levelness of the eight mounting surfaces. The levelness must be ≤5mm. If it exceeds 5mm, use stainless steel shims for leveling.
2. After leveling, perform open/close operations on all container doors to ensure smooth movement. If doors do not operate smoothly, re-adjust the leveling until all doors function properly.

4.5.2.2 Installation of Fasteners

1. Determine the positions of expansion bolt fixing holes and drill holes to embed M16×100 expansion bolts.
2. Install the fasteners on the foundation.
3. Use M16×30 assembly bolts to secure the fasteners to the container. Tightening torque: 127.50~150.00N·m.

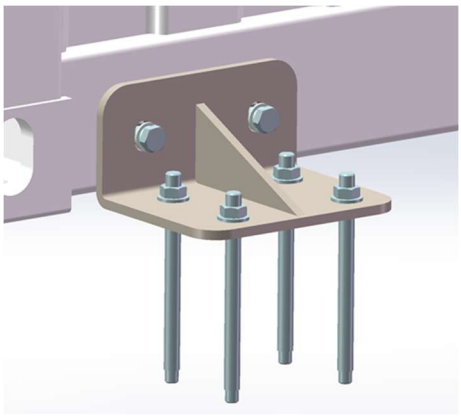


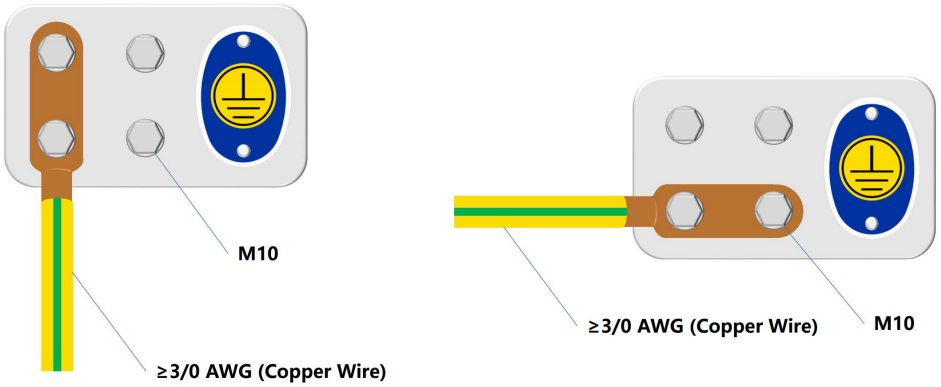
Figure 4-8 Fastener Installation

4.5.3 Equipment Grounding

The container is equipped with two grounding terminals on its side, either of which can be selected for grounding based on site requirements. Each grounding terminal features a layout of two rows and two columns with a total of four fastening points, supporting horizontal or vertical orientations for grounding cable arrangements to meet diverse on-site installation needs.

Installation of Grounding Cables

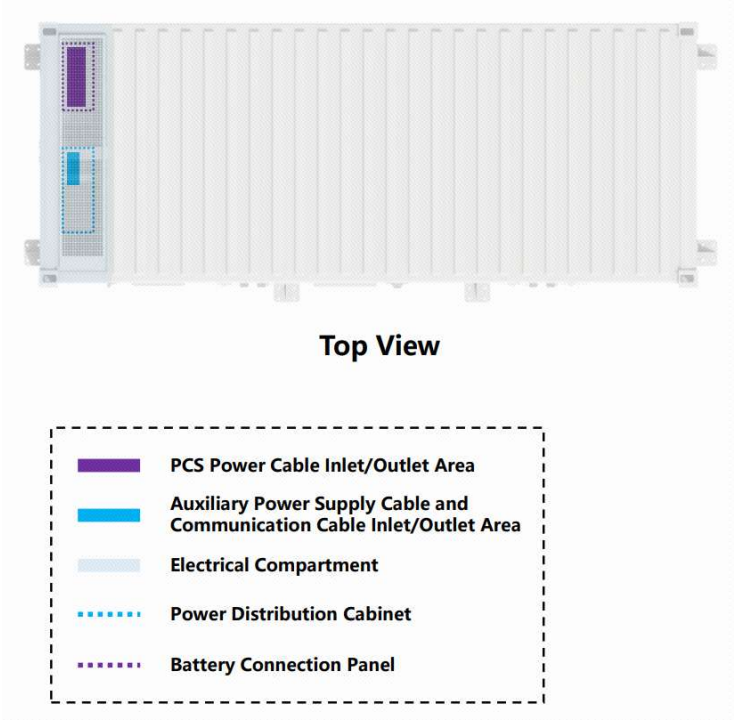
1. Grounding Cable Fabrication: It is recommended to use a copper cable lug compatible with M10 bolt holes, crimped with a copper wire of ≥70 mm^2 cross-sectional area or aluminum wire of equivalent ampacity to form the grounding cable.
2. Secure the grounding cable with M10×30 assembly bolts. Tightening torque: 37.49~44.10N·m.



Grounding Cable Connection

4.5.4 Wiring and Sealing

For external wiring operations, refer to the content described in Section 5.4 Auxiliary Power Supply Cable Connection and Section 5.5 PCS Power Cable Connection. The bottom of the electrical cabin has pre-reserved cable inlet/outlet areas for power cables and auxiliary power cables, located below the connection panel and distribution panel, as shown in the figure below. Aluminum cover plates are installed for sealing at these two cable inlet/outlet areas during shipment. On site, drill holes in the cover plates as needed, and after wiring, seal the cover plates with the fireproofing mud provided with the container to ensure the internal tightness of the electrical cabin.



Cable Inlet/Outlet Areas

4.6 Post-Installation Inspection

- Use a level to check the levelness of the eight mounting surfaces, ensuring that the levelness is ≤5mm.
- Perform open and close operations on all container doors to ensure smooth movement without abnormal noise.
- Inspect the tightness of each container fastener to confirm the secure connection between the container and the foundation.
- Check the grounding cable for a secure connection and verify effective grounding using a multimeter.
- Ensure the bottom cover plate is tightly sealed with fireproofing mud after wiring.

5 Electrical Connection

5.1 Precautions

⚠ DANGER

- Before performing electrical connections, fully read Chapter 1 Safety Precautions of this manual and follow all requirements therein.
- Never touch live parts.

⚠ WARNING

- Electrical connection operations must be performed by qualified electrical personnel.
- Operators must wear personal protective equipment (PPE) during electrical connections.

⚠ CAUTION
Tools used for battery power connection installation shall be insulated or shall minimize exposed metal areas. At least the handle portion must be insulated.

⚠ NOTICE
Equipment damage resulting from incorrect wiring shall not be covered under the equipment warranty.

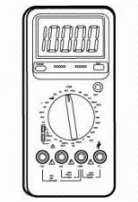
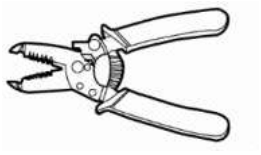
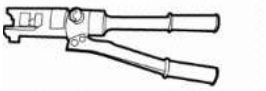
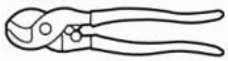
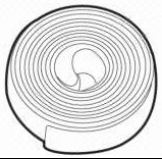
5.2 Pre-Connection Inspection

- Ensure that both AC and DC sides are not energized.
- Before connecting the cables, if the auxiliary power supply is supplied by a station-level transformer, it is necessary to confirm that the voltage between the neutral wire and the ground wire on the line side of the auxiliary power supply inlet is lower than 2V.

5.3 Pre-Connection Preparation

5.3.1 Tools and Instruments

Name	Purpose	Image
Screwdriver and Socket Set	For cable installation.	
Zip Ties	For cable fixation.	

Multimeter	For continuity testing.	
Wire Stripper	For removing insulation from the ends of cables.	
Hydraulic Pliers	For crimping terminals and cables.	
Cable Cutter	For cutting cables.	
Tape Measure	For measuring dimensions.	
Heat Gun	For shrinking heat shrink tubing.	
Heat Shrink Tubing	For protecting wire and terminal connections.	
Cold Crimp Terminal Pliers	For crimping terminals and cables.	

5.3.2 Personal Protective Equipment

Name	Purpose	Image
Protective Clothing	For electrical insulation protection.	
Insulating Gloves	For electrical insulation protection.	
Insulating Shoes	For electrical insulation protection.	
Safety Goggles	For arc flash protection.	

ℹ️ **Note:** Personal protective equipment of Category 1 or higher shall be worn.

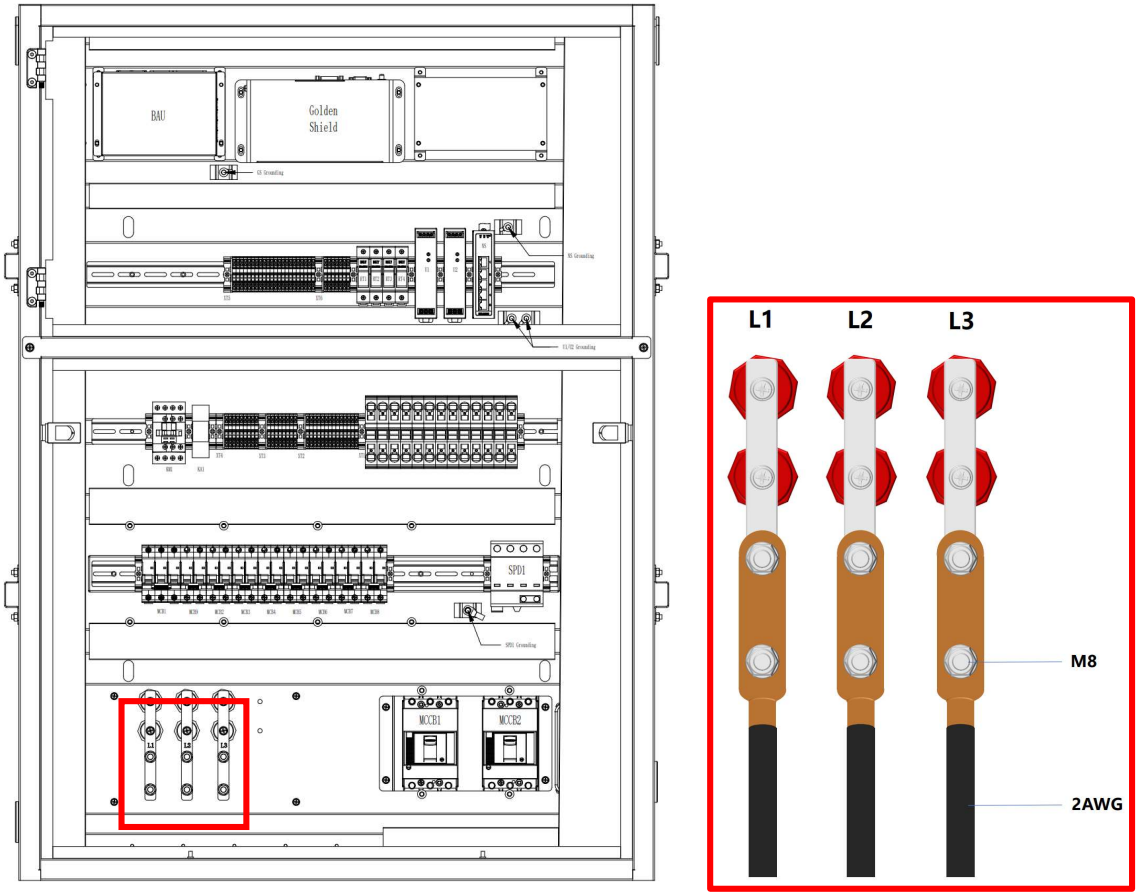
5.3.3 Accessories

Name	Specifications	Purpose
Cable	Cross-sectional area≥ 25mm^2	Connecting to the auxiliary power copper busbar terminals of the distribution panel.
Copper Cable Lug	Hole diameter compatible with M8 bolts	For cable fabrication.
Assembly Bolts	M8 (property class 8.8)	For cable connection.

Cable	Cross-sectional area≥ 120mm²	Connecting to the PCS power cable interfaces of the connection panel.
Copper Cable Lug	Hole diameter compatible with M12 bolts	For cable fabrication.
Assembly Bolts	M12 (property class 8.8)	For cable connection.
Network cable	As required	For Ethernet communication port connection.
Cable	Cross-sectional area 1.0mm²	Connecting to the PCS dry contact interface.
Tubular Terminal	Suitable for crimping cables with a cross-sectional area of 1.0mm²	Cable fabrication.

5.4 Auxiliary Power Supply Cable Connection

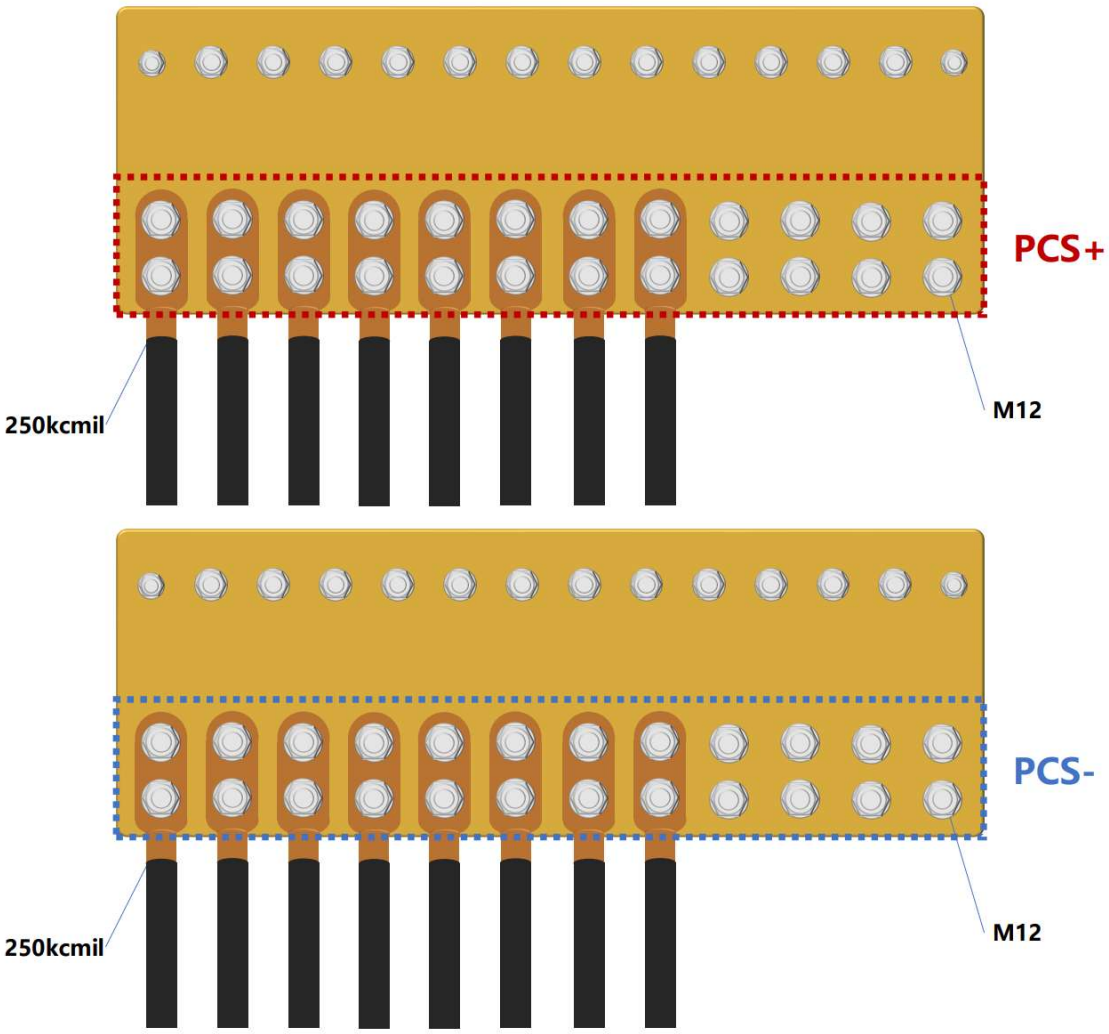
Connect the L1, L2, L3, and N interfaces as per the markings on the auxiliary power supply copper busbar of the distribution panel. Use 4 cables, each with a cross-sectional area of not less than 25mm², to separately connect the interfaces. The cable ends shall be crimped with copper cable lugs compatible with M8 bolt hole diameters and secured with M8 assembly bolts. Tightening torque: 20.83~24.50N·m.



Auxiliary Power Supply Copper Busbar Cable Connection

5.5 PCS Power Cable Connection

Connect the PCS power cable interfaces on each copper busbar of the connection panel according to the polarity markings. Each interface area shall be connected using 8 cables, each with a cross-sectional area of not less than 120mm². The cable ends shall be crimped with copper lugs compatible with M12 bolt holes and secured with M12 assembly bolts. Tightening torque: 66.73~78.50N·m.



Connection Panel Copper Busbar Cable Connection

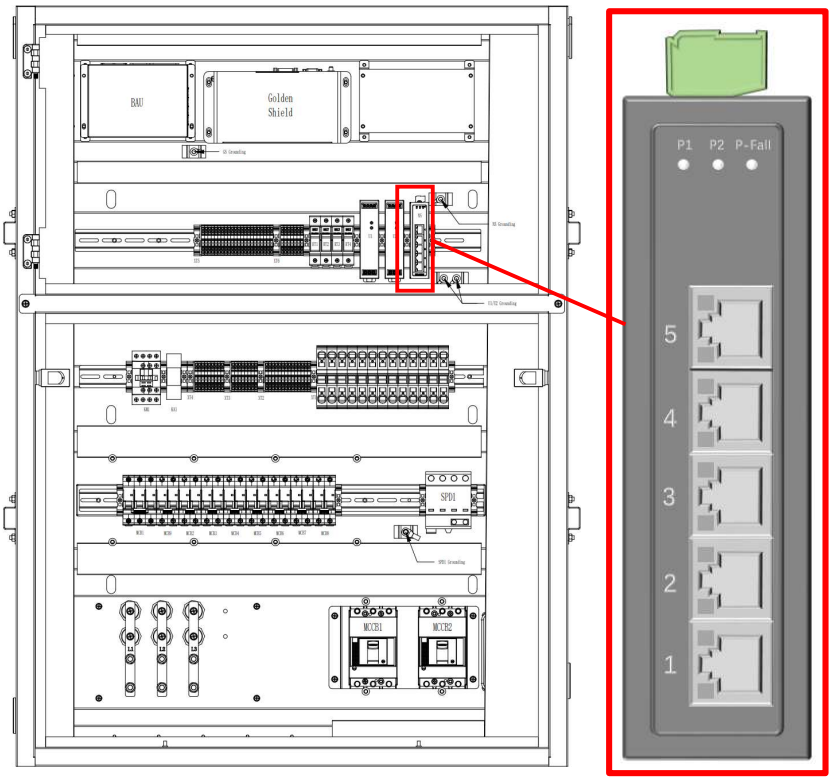
5.6 Ethernet Communication Port Connection

As shown below, the distribution panel provides multiple Ethernet communication ports inside.

Use network cables to connect them to other devices.

Markings	Name	Description
1	ETH1	Ethernet communication port, connected to Golden

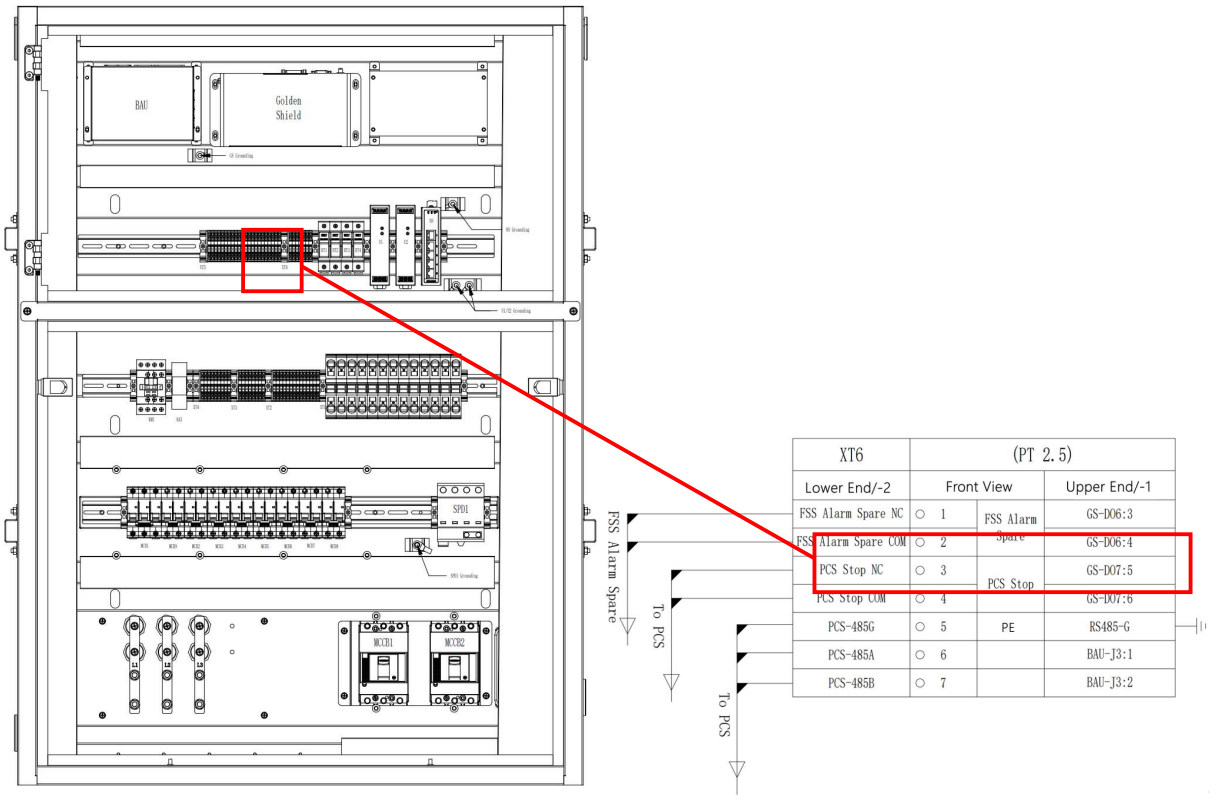
		Shield.
2	ETH2	Ethernet communication port, connected to BAU1.
3	ETH3	System maintenance Ethernet port.
4	ETH4	Ethernet communication port, connected to EMS.
5	ETH5	Reserved Ethernet port.



Ethernet Communication Port

5.7 Reserved Dry Contact Interfaces

Multiple dry contact interfaces are reserved inside the distribution panel. Select appropriate cables to connect to the corresponding dry contacts according to actual needs.



Reserved Dry Contact Interfaces

5.8 Panel and Functions

5.8.1 Battery Module Panel

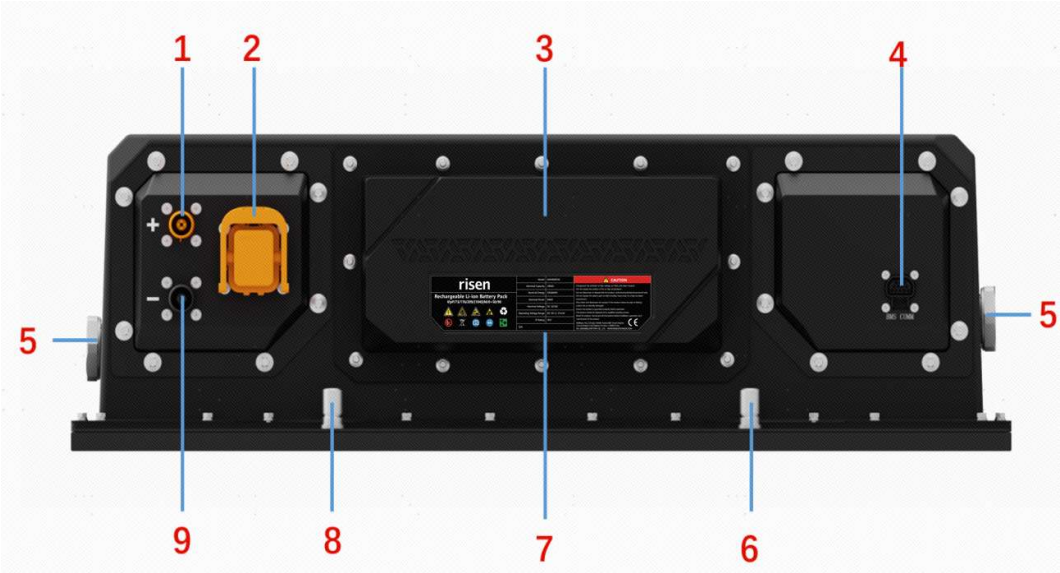


Figure 5-5 Battery Module (For reference only)

No.	Name	Description
1	+	Positive terminal of the battery module.
2	MSD	Manual service disconnect switch. Remove it before transportation and install it before operation.
3	BMU	BMU mounting panel
4	BMS COMM	Supplies power for BMU communication, including a 24V power source and CAN communication.
5	Explosion-proof valve	Balances the pressure difference between the

		inside and outside of the battery module.
6	Coolant outlet	Battery module liquid cooling coolant outlet.
7	Nameplate	Display battery module parameters.
8	Coolant inlet	Battery module liquid cooling coolant inlet.
9	–	Negative terminal of the battery module.

5.8.2 Switchgear Panel

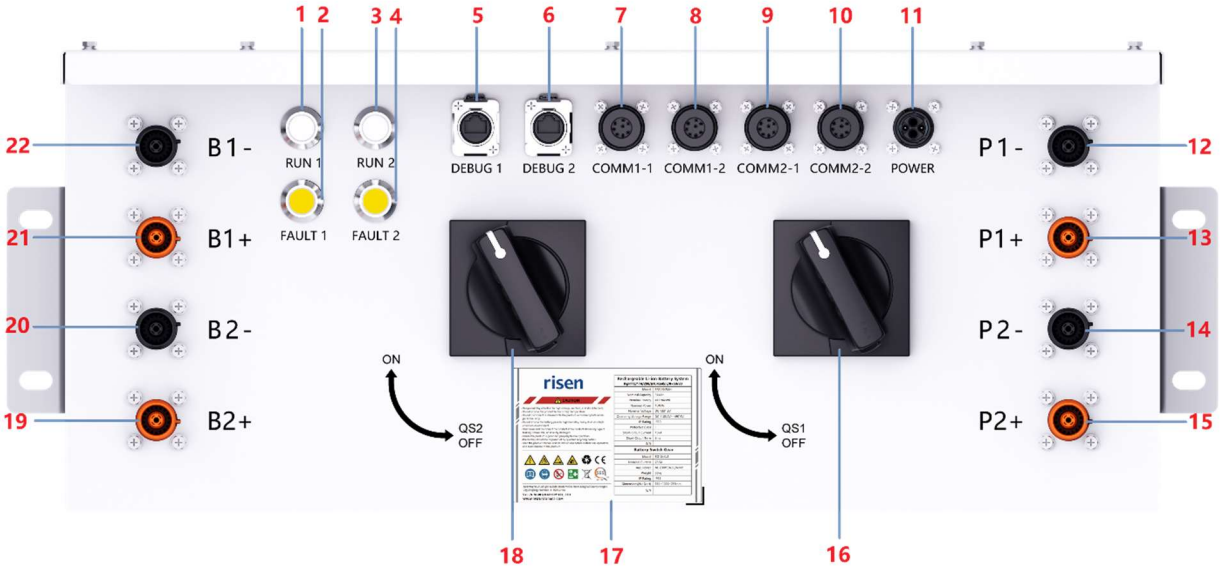


Figure 5-6 Switchgear Panel

No.	Name	Description
1	RUN1	Cluster 1 operation indicator.
2	FAULT1	Cluster 1 fault indicator.
3	RUN2	Cluster 2 operation indicator.

4	FAULT2	Cluster 2 fault indicator.
5	DEBUG1	BCU1 debug interface.
6	DEBUG2	BCU2 debug interface.
7	COMM1-1	Inter-cluster communication: Connect to COMM2-1 of the previous cluster's switchgear or to BAU.
8	COMM1-2	Intra-cluster communication: Connect to all BMUs in the cluster.
9	COMM2-1	Inter-cluster communication: Connect to COMM1-1 of the next cluster's switchgear or to the terminal resistor.
10	COMM2-2	Intra-cluster communication: Connect to all BMUs in the cluster.
11	POWER	BMS AC 220V auxiliary power input.
12	P1-	BCP Negative: Connect to DC Bus Negative.
13	P1+	BCP Positive: Connect to DC Bus Positive.
14	P2-	BCP Negative: Connect to DC Bus Negative.
15	P2+	BCP Positive: Connect to DC Bus Positive.
16	QS1	Circuit Breaker 1: Connect and disconnect Main Circuit 1.
17	Nameplate	Display switchgear parameters.

18	QS2	Circuit Breaker 2: Connect and disconnect Main Circuit 2.
19	B2+	Battery Positive: Connect to the nearest battery module Positive below the switchgear.
20	B2-	Battery Negative: Connect to the farthest battery module Negative below the switchgear.
21	B1+	Battery Positive: Connect to the farthest battery module Positive above the switchgear.
22	B1-	Battery Negative: Connect to the nearest battery module Negative above the switchgear.

5.9 Post-Connection Inspection

- Check all wiring points to ensure that the cables are firmly connected and there are no missing or loose connections.
- Ensure that the wiring terminals are firmly and reliably connected.

6 System Commissioning

6.1 Precautions

⚠ WARNING

- Operations related to system commissioning must be performed by qualified electrical personnel.
- Do not touch any original equipment or metal components before powering on.
- When the product is placed for a long time without formal operation, auxiliary power should be supplied to ensure that the temperature - control and dehumidification equipment (such as liquid - cooled units, air - cooled air conditioners, heaters, dehumidifiers, etc.) operates normally, so as to ensure that the temperature and humidity inside the box meet the requirements, remain dry, and there is no accumulated water.

6.2 Pre-Commissioning Inspection

6.2.1 Cable Connection

- After checking all wiring points, ensure that no cables are missing or loose.
- Maintain a safe distance and ensure that wiring terminals are firmly and reliably connected.
- Before putting the FSS system into use, ensure that the start - up wires (EXTING. + and EXTING. -) of the fire - extinguishing device are in a disconnected state.

6.2.2 System Setup

Before powering on, carefully check the following items and ensure all electrical connections comply with this manual's requirements.

- The container enclosure has been effectively grounded.
- The system emergency stop button is in the normal state.
- All AC circuit breakers inside the distribution panel are switched off, i.e., all are in the "OFF" position. At this time, all indicator lights on the distribution panel are off.
- All isolating switches in the switchgear are in the "ON" position. At this time, all indicator lights on the switchgears are off.
- Manual service disconnects (MSDs) of all battery modules are inserted and properly locked.
- Ensure the automatic exhaust valve of the liquid cooling pipeline is in the open position.

6.3 Power-On Commissioning

6.3.1 Wiring Diagram for Auxiliary Power Supply

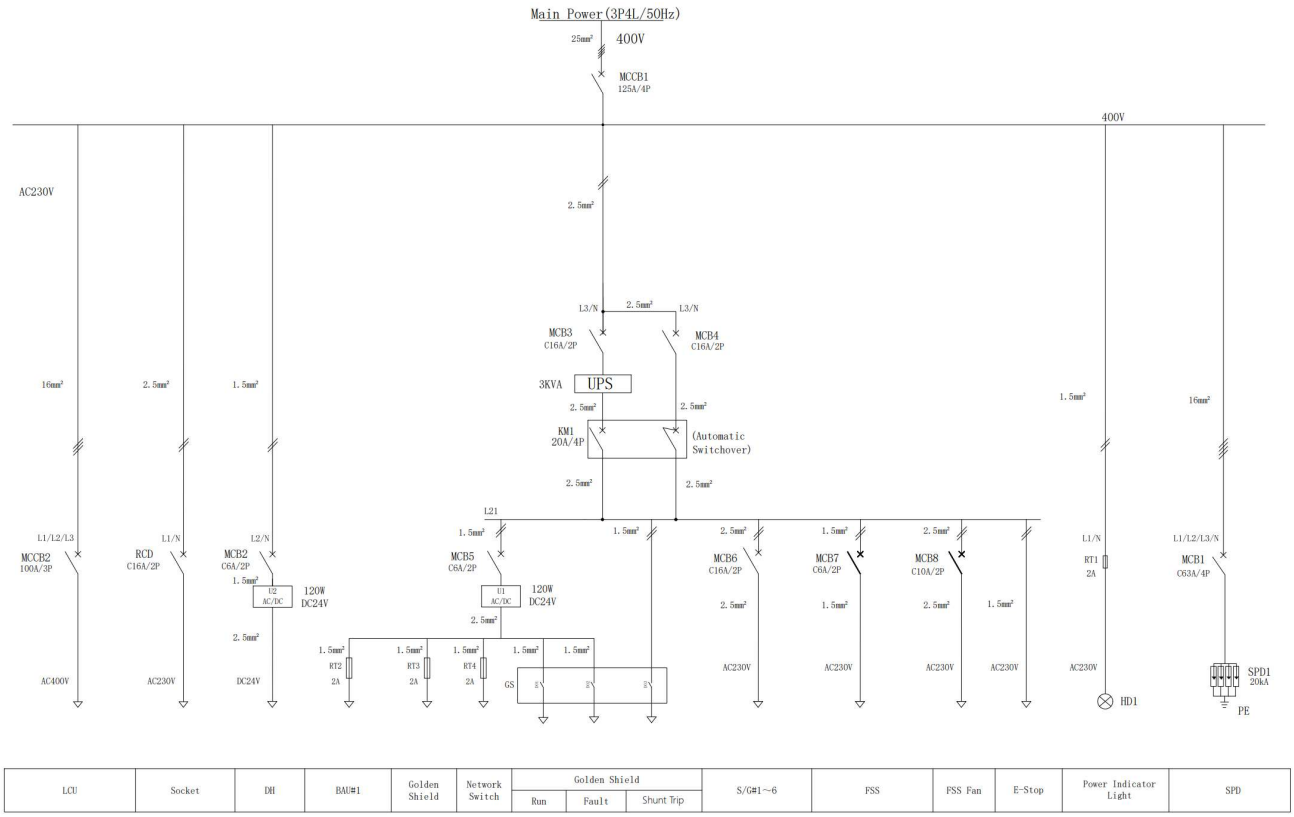


Figure 6-1 Wiring Diagram for Auxiliary Power Supply

6.3.2 Circuit Breakers and Control Objects

Circuit Breaker	MCCB1	MCCB2	MCB1	RCD
Control Object	400V Power Supply	Liquid Cooling Unit	Surge Protective Device	Socket

MCB2	MCB3	MCB4	MCB5	MCB6
Dehumidifier	UPS	UPS Bypass	Switch Mode Power Supply	Switchgear#1~6

MCB7	MCB8
FSS	FSS Fan

6.3.3 Auxiliary Power Supply

1. When powering up the ESS for the first time, ensure the UPS is properly connected to its internal battery, then start the UPS via cold start (battery-powered).
2. Close the MCB5 Switch Mode Power Supply. When DC 24V outputs normally, devices such as GS, network switch, and BAU are powered up.

Figure 6-2 GS-web Maintenance Mode Switch

3. Connect the computer to the GS-web port on the container or the distribution panel

network switch via a network cable. Enter 192.168.1.136 in the computer browser to access the GS-web terminal, and change the GS operation mode from normal mode to maintenance mode (as shown in Figure 6-2).

ℹ️ **Note:** Exit the maintenance mode after normal operation. This change will automatically revert to normal mode when the GS is powered down.

4. After the 400V 3P4L power supply is properly connected, measure the voltage between the neutral wire and the ground wire at the line side of the MCCB1. Ensure that the voltage is less than 2V before closing the MCCB1 400V power supply switch.

   ℹ️ **Note:** If the voltage between the neutral wire and the ground wire at the line side of the MCCB1 is greater than or equal to 2V, it is strictly prohibited to close the MCCB1 power supply switch.

5. Close the MCB1 AC surge protective device switch. The AC surge protective device operates normally.
6. Close the MCB3 UPS power switch. The UPS operates normally and switches to utility mode.
7. Close the MCB4 UPS bypass power switch. When the UPS malfunctions, it can be automatically switched to the bypass mode.
8. Close the MCB6 switchgear power switch. The switchgears' AC power supply operates normally, and the power indicator green light is on.
9. Open the fire alarm control panel. After completing the 24V backup power connection, close the MCB7 FSS power supply switch, and the fire alarm control panel will be powered

normally.

10. Close the MCB8 FSS fan power switch. The fan is powered normally.
11. Close MCCB2 and MCB2. The liquid cooling unit and dehumidifier operate after the power supply is applied.
12. Close the RCD socket power switch. The socket of the container is powered normally.

6.3.4 Operational Status Overview

After the auxiliary power supply is powered normally, the operation status information of the energy storage system (Figure 6-3), all battery clusters (Figure 6-4), and auxiliary devices such as HVAC (Figure 6-5) can be viewed on the GS-web terminal.

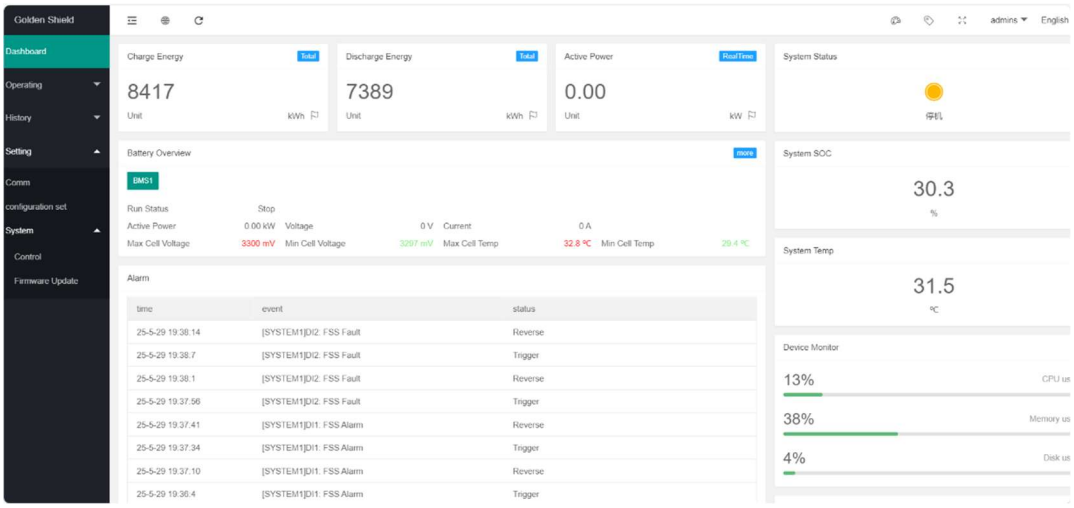


Figure 6-3 Operational Status Overview of the ESS

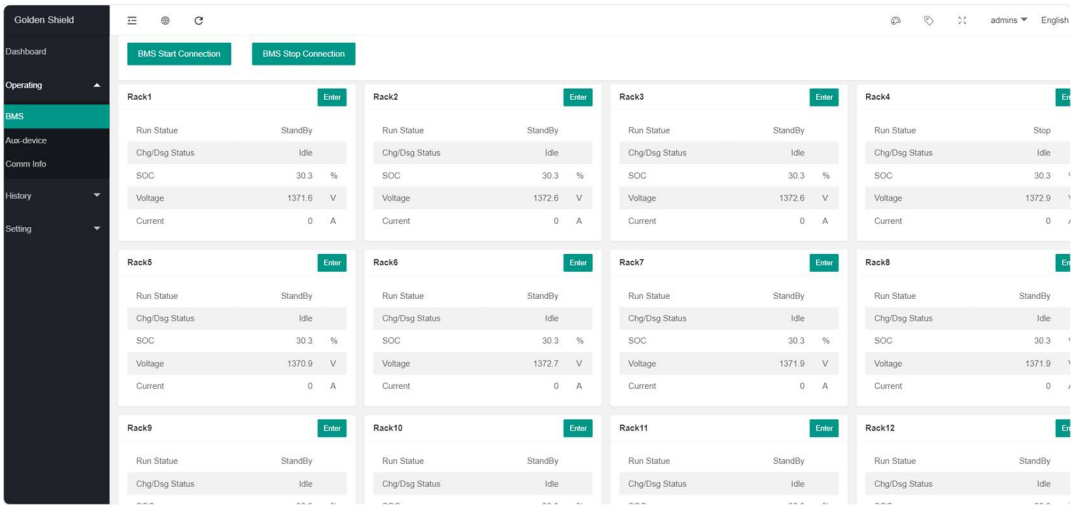


Figure 6-4 Operational Status Overview of the Battery Clusters

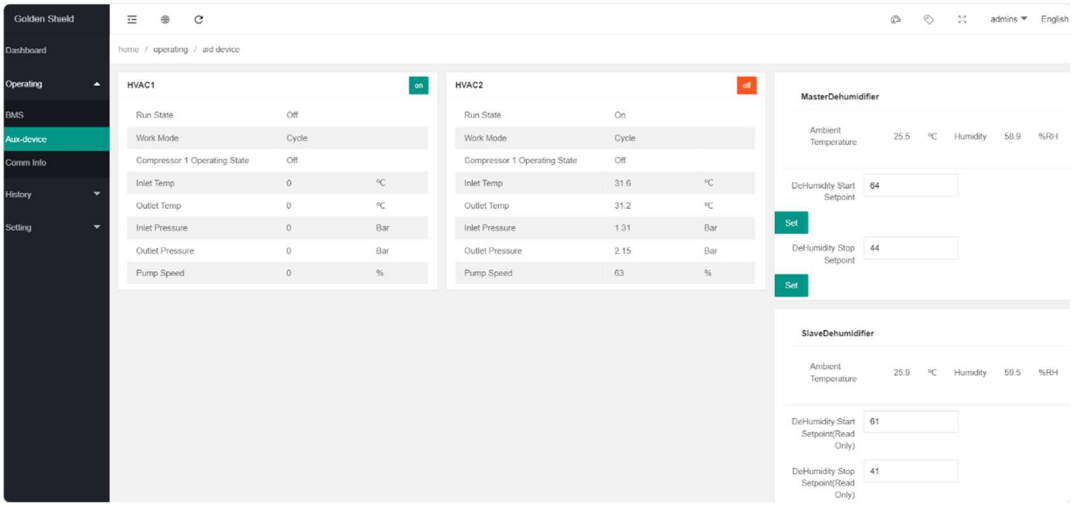


Figure 6-5 Operational Status Overview of Auxiliary Devices

6.3.5 High-Voltage DC Power On/Off Operations

NOTE
• When the energy storage system is in standby state under non-maintenance mode, charging and discharging operations cannot be performed.

- When the energy storage system is in operation state, the active power and reactive power parameters of PCS will be automatically set to 0.

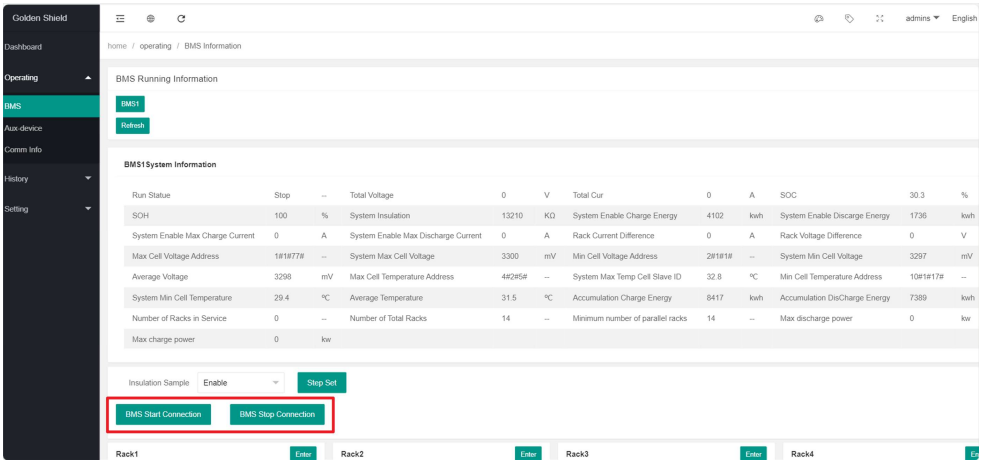


Figure 6-6 BMS Real-time Operational Information

When communication is normal and there are no alarms, perform high-voltage DC power on/off operations for the battery array via the GS web interface, as shown in Figure 6-6.

- Click the "BMS Start Connection" button. All contactors in the switchgear of battery clusters will close, completing the DC side power-on. The battery system is now in a charge/discharge enabled state.

- Click the "BMS Stop Connection" button. All contactors in the switchgear of battery clusters will open, completing the DC side power-off. The battery system cannot perform charge/discharge operations at this time.

ℹ️ **Note:** During charging or discharging, do not manually turn off the energy storage system. Failure to follow this instruction may damage contactors or isolating switches.

6.3.6 Powering Off the Auxiliary Power Supply

1. Disconnect MCB5 and MCB6 in sequence.
2. Disconnect MCCB2 and MCB2.
3. Disconnect MCB7 and MCB8.
4. Disconnect MCB3 and MCB4, turn off the UPS power supply.
5. Disconnect RCD, turn off the socket power.
6. Disconnect MCB1 and MCCB1, turn off the 400V 3P4L power supply.

7 System Maintenance

7.1 Precautions

⚠ DANGER

Before performing system maintenance, carefully read and strictly follow the safety precautions listed in Section 1.7 Maintenance and Replacement.

Declaration

- The maintenance cycles mentioned in this manual are the minimum requirements. If the Authority Having Jurisdiction (AHJ) at the project location specifies more stringent cycle requirements, its regulations shall be complied with.
- This chapter does not fully and exhaustively describe all system maintenance requirements. Applicable maintenance management systems shall be developed in compliance with the laws, regulations, and standards of the country or region where the project is located.
- The system maintenance content described in this chapter is for reference only. In case of

discrepancies between the maintenance specifications provided by the equipment manufacturer and the content of this chapter, the maintenance specifications provided by the equipment manufacturer shall take precedence.

Maintenance Personnel

⚠ NOTICE

- Personnel responsible for operating and maintaining the equipment must undergo rigorous training, understand all safety precautions, master correct operation and maintenance methods, and possess the knowledge and experience required for maintaining relevant equipment.
- Only qualified professionals or trained personnel are permitted to operate and maintain the equipment.
- Only qualified professionals are allowed to remove safety devices and overhaul equipment.
- Replacement of equipment and components (including software) must be performed by qualified professionals or authorized personnel.

Qualified maintenance personnel shall meet any of the following requirements:

- Have received training provided by the manufacturer and obtained a certification for the relevant equipment issued by the manufacturer.
- Have obtained relevant certifications from an accredited certification body accepted and

recognized by the AHJ.

- Are registered, licensed, or certified by the authorities of the country or region where the project is located to service the relevant equipment.

7.2 Battery System Maintenance

7.2.1 Precautions

⚠ WARNING

- Incorrect operation may lead to serious personal injury or property damage.
- Be cautious of hazardous voltages in battery modules and be aware of the risk of short circuits.
- If a rapid temperature rise in cells is detected, cease operation immediately and seek assistance promptly.
- In the event of emergencies such as short circuits, fires, or electric shocks, remain calm, stop charging immediately, apply appropriate emergency measures, and seek professional help.

⚠ CAUTION

- Ensure a dry and well-ventilated environment is selected, and operations are conducted in designated areas.
- Keep the work area free of debris, especially metal fragments or liquids that

may cause short circuits.

- Verify that the balancer settings match the cell recharging requirements.
- Before performing recharging operations, inspect the external condition of cells for damage, dents, swelling, or liquid leakage.
- When charging battery modules, never wear metal jewelry like necklaces, rings, or watches.

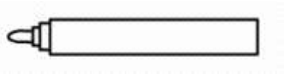
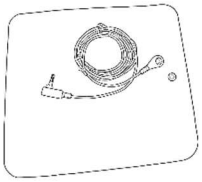
⚠ NOTICE

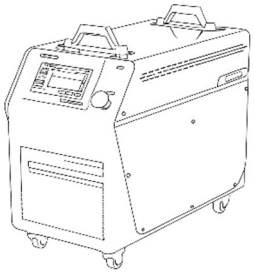
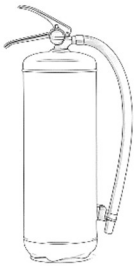
- Conduct safety training for operators in advance to familiarize personnel with the chemical properties and potential risks of cells, and understand emergency handling procedures.
- When temporarily storing cells, handle them with care to avoid impact, extrusion, or puncture. Terminals must be protected to prevent positive-negative short circuits.
- Regularly inspect and maintain equipment related to cell use to ensure normal operation. If cell issues or equipment damage are detected, take appropriate measures immediately (e.g., discontinue use, repair, or replacement).
- Follow the instructions strictly during operations to ensure compliance with specifications at every step.
- At least two personnel must be present during maintenance, and all must

wear PPE.

- Long-term storage of energy storage systems without use may cause irreversible battery damage. Ensure regular maintenance!

7.2.2 Tools and Instruments

Name	Purpose	Image
Electric Screwdriver Kit	For battery module installation and removal.	
Marker Pen and Labels	For recording inspection and maintenance dates.	
Utility Knife	For removing outer packaging.	
Multimeter (0.1mV precision)	For measuring insulation resistance, voltage, AC internal resistance, and other data.	
Grounding Mat	For electrostatic protection.	

Charger	For charging, discharging, and voltage balancing of batteries.	
Fire Extinguisher	For preventing thermal runaway in LFP batteries due to short circuits.	

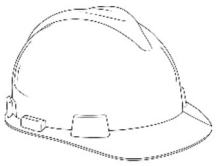
Recommended Charger Specifications

Parameter Name	Value
Input Voltage	AC 100~240V
	50/60Hz
Operating Temperature Range	-10~40℃
Operating Humidity Range	< 80% RH
Storage Temperature Range	-20~80℃
Storage Humidity Range	< 80% RH
Charging Mode	Supports constant current charging mode
DC Output Voltage Range	0~500V
DC Output Current Range	0~200A

Voltage Stability	≤0.2%
Current Stability	≤0.5%
Load Stability	≤0.5%
Ripple and Noise	≤1% (RMS)
Display Accuracy	±0.5%
(Optional) Human-Machine Interface	Charging voltage, charging current, charging capacity, charging time, and other data can be read from the charging interface.

7.2.3 Personal Protective Equipment

Name	Purpose	Image
Protective Clothing	For electrical insulation protection.	
Insulating Gloves	For electrical insulation protection.	
Insulating Shoes	For electrical insulation protection.	
Safety Goggles	For arc flash protection.	

Safety Helmet	For head protection.	
Anti-static Wrist Strap	For electrostatic protection.	

ℹ️ **Note:** Personal protective equipment of Category 1 or higher shall be worn.

7.2.4 Terminology

- **Normal Operation:** Refers to the continuous and alarm-free operation of the system in accordance with the conditions agreed upon in the agreement.
- **Intermittent Operation:** Indicates that the operating frequency of the system is not fixed, and a continuous operation cannot be guaranteed.
- **Long-term Idle Operation:** Refers to the system not being started and operated for more than six consecutive months.
- **Voltage Difference at the End of Charging/Discharging:** Refers to the voltage difference between the cell with the highest voltage and the cell with the lowest voltage within the battery system or battery module when charged/discharged to its maximum/minimum cutoff voltage.
- **A Full Charge-Discharge Cycle:** Refers to the cycle in which the battery system or battery module is first charged to its maximum cut-off voltage and then discharged to its minimum cut-off voltage.

- **Round-trip Efficiency:** The ratio of discharge energy to charging energy, typically expressed as a percentage.
- **Spare Battery Module:** Refers to the battery modules independently purchased by customers from Risen Storage and not pre-installed in energy storage systems.

7.2.5 Maintenance Requirements

System in Normal Operation

- The system must undergo an SOC calibration and voltage balancing, with voltages adjusted to the normal range prior to its first operation.
- Conduct charge-discharge activation on the system once every 12 months to prevent potential battery damage.
- Perform routine inspection of the system once every 12 months, maintain detailed inspection records, and promptly address any detected abnormal conditions.
- If the system operates in a shallow charging and discharging state continuously for more than 6 months (i.e., the state of charge (SOC) is not 0% at the end of discharge and not 100% at the end of charge), an SOC calibration must be performed for the system.

System in Intermittent Operation

- For a system unused within six consecutive months, conduct a charge-discharge activation when restarting to prevent potential battery damage.
- When the system remains unused for more than 6 consecutive months, adjust its SOC to

30%~50% before storage and promptly disconnect all power-consuming devices.

- Perform routine inspection of the system once every 3 months, maintain detailed inspection records, and promptly address any detected abnormal conditions.
- Conduct charge-discharge activation on the system once every 3 months to prevent potential battery damage.
- Before reusing a system that has been unused for an extended period, it must undergo at least one charge-discharge activation to activate the battery and restore it to optimal performance.

System in Long-term Idle Operation

- When the system has no immediate plans for use or will transition to an unused state, adjust its SOC to 30%~50% before storage and promptly disconnect all power-consuming devices.
- Perform routine inspection of the system once every 3 months, maintain detailed inspection records, and promptly address any detected abnormal conditions.
- Conduct charge-discharge activation on the system once every 3 months to prevent potential battery damage.
- Before reusing a system that has been unused for an extended period, it must undergo at least one charge-discharge activation to activate the battery and restore it to optimal performance.
- Before reusing a system that has been unused for an extended period, an SOC calibration

must be performed on the system.

Spare Battery Modules

- Perform routine inspection of the spare parts once every 3 months, maintain detailed inspection records, and promptly address any detected abnormal conditions.
- Perform charge-discharge activation on the spare battery modules once every 6 months.
- The recommended SOC for long-term storage of spare battery modules is 30%~50%.

7.2.6 Inspection Items

Item	Checklist
Power-On Check	Check all devices and the host computer interface, record parameters such as total voltage, individual cell voltage, cell temperature, cell voltage difference, etc., and observe for any anomalies.

7.2.7 Abnormal Condition Handling

	Abnormal Condition	Handling Solution
Battery System	An abnormal voltage difference among cells is detected at the end of charging/discharging in the battery system.	Perform voltage balancing until the voltage difference at the end of charging/discharging for all cells in the system meets the requirements.
	The voltage of any single cell in	The battery module containing the cell may

	the battery system is lower than 2V.	be permanently damaged. Contact the after-sales service promptly for handling. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.
	Cell temperature within the battery module exceeds the average temperature by 5°C or more during charging/discharging.	1. Inspect the cell temperature acquisition harness for aging, disconnection, damage, pin retraction, cold solder joints, etc. If any issues are found, repair or replace the harness. 2. Check the AC internal resistance of the cell at 1kHz AC frequency and 30% SOC, and verify that the measured value is less than 1.8mΩ. If the measured value is greater than or equal to 1.8mΩ, the entire battery module containing the abnormal cell shall be replaced.
Spare Battery Modules	The voltage of any single cell in the battery module is lower than 2V.	1. The module may be permanently damaged. Contact the after-sales service promptly for handling. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.

	2. Repack the module completely in its original packaging and store it in a separate area to avoid placing it together with functional modules.
The voltage of any single cell in the battery module is 2~3V (inclusive).	1. Conduct charge-discharge activation on the battery module. 2. If an abnormal voltage difference among cells at the end of charging/discharging is detected in the battery module, perform voltage balancing until the voltage difference at the end of charging/discharging for all cells in the module meets the requirements.
Cell temperature within the battery module differs from the average temperature by 5°C or more.	1. Inspect the cell temperature acquisition harness for aging, disconnection, damage, pin retraction, cold solder joints, etc. If any issues are found, repair or replace the harness. 2. Check the AC internal resistance of the cell at 1kHz AC frequency and 30% SOC, and verify that the measured value is less

	than 1.8mΩ. If the measured value is greater than or equal to 1.8mΩ, the entire battery module containing the abnormal cell shall be replaced.

7.2.8 Pre-Maintenance Checks

Item	Checklist
Wiring Harness Check	Inspect the wiring harness for aging, disconnection, damage, pin retraction, cold solder joints, etc. If any issues are found, repair or replace the harness.
Insulation Check	Use an insulation meter to test the insulation resistance between the positive/negative terminals and the grounding point. The insulation resistance of the battery module must be greater than 10MΩ. If it is less than or equal to 10MΩ, immediately stop all subsequent operations and contact the after-sales service for handling. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.

7.2.9 Charge-Discharge Activation

Steps

1. Discharge the battery system or spare battery modules at 0.25P until reaching the cut-off voltage.
2. Stand idle for a duration adjusted based on actual conditions.

3. Charge the battery system or spare battery modules at 0.25P until reaching the cut-off voltage.
4. Stand idle for a duration adjusted based on actual conditions.
5. Discharge the battery system or spare battery modules at 0.25P until reaching the cut-off voltage.
6. Stand idle for a duration adjusted based on actual conditions.
7. Charge the battery system or spare battery modules at 0.25P until the SOC reaches 30%~50%.

7.2.10 Voltage Balancing

Spare Battery Modules

- When the voltage difference at the end of charging among the cells in the battery module is ≤250 mV, it is within the normal range, and no voltage balancing is required. When the voltage difference at the end of charging does not meet the above conditions, perform the following voltage balancing steps:
    1. Perform a full charge on the battery module at rated power until the voltage reaches the maximum protection value, then stop. Record the voltage data of all cells in the battery module at the moment of charging termination.
    2. Allow the battery cluster to stand idle for 30 minutes after charging termination.
    3. Export the recorded voltage data at the moment of charging termination and compile it into a table. Use a scatter plot to identify the serial numbers and quantity of cells

with voltage differences exceeding the normal range, then perform individual charging on each out-of-range cell one by one.

4. For all high-voltage cells (i.e., cells with a voltage difference at the end of charging ≥ 250 mV), use a balancer to discharge them at a constant current of 2.5A until their voltage drops to 30 mV below the average voltage of non-high-voltage cells in the battery module. After discharging, let the cells stand idle for 30 minutes.
5. Continue charging the battery module at rated power until the voltage reaches the maximum protection value, then stop. Re-collect and evaluate the voltage data at the moment of charging termination to verify the balancing effect. If any cell still has a voltage difference at the end of charging ≥250 mV, repeat Step 4 and continue charging until all cells in the battery module have a voltage difference at the end of charging <250 mV. The balancing process is then completed.
6. After confirming that the voltage differences at the end of charging of all cells in the battery module meet the requirements, perform a full charge-discharge cycle at rated power. Then, verify the charge-discharge energy data to ensure they comply with the standards specified in the technical agreement.

- When the voltage difference at the end of discharging among cells in the battery module is ≤300 mV, no voltage balancing is required. If the voltage difference at the end of discharging does not meet the above conditions, perform the following voltage balancing steps:

  1. Perform a full discharge on the battery module at rated power until the voltage

reaches the minimum protection value, then stop. Record the voltage data of all cells in the battery module at the moment of discharging termination.

2. Allow the battery cluster to stand idle for 30 minutes after discharging termination.
3. Export the recorded voltage data at the moment of discharging termination and compile it into a table. Use a scatter plot to identify the serial numbers and quantity of cells with voltage differences exceeding the normal range, then perform individual charging on each out-of-range cell one by one.
4. For all low-voltage cells (i.e., cells with a voltage difference at the end of discharge ≥ 300 mV), use an equalizer to charge them at a constant current of 2.5A until their voltage exceeds the average voltage of non-low-voltage cells in the battery module by 30 mV. After charging, let the cells stand idle for 30 minutes.
5. Continue to fully discharge the battery module at rated power until the voltage reaches the minimum protection value, then stop. Re-collect and evaluate the voltage data at the moment of discharge termination to confirm the balancing effect. If any cell still has a voltage difference at the end of discharging ≥300 mV, repeat Step 4 and continue individual charging until all cells in the battery module have a voltage difference at the end of discharging <300 mV.
6. After confirming that the voltage differences at the end of discharge of all cells in the battery module meet the requirements, perform a full charge-discharge cycle at rated power. Then, verify the charge-discharge energy data to ensure they comply with the standards specified in the technical agreement.

Battery System

- When the voltage difference at the end of charging among cells in the system is ≤380 mV, it is within the normal range, and no voltage balancing is required. If the voltage difference at the end of charging does not meet the above conditions, perform the following voltage balancing steps:

  1. Perform a full charge on the system at rated power until the voltage reaches the maximum protection value, then stop. Record the voltage data of all cells in the system at the moment of charging termination.
  2. Allow the battery system to stand idle for 30 minutes after charging termination.
  3. Export the recorded voltage data at the moment of charging termination and compile it into a table. Then, use a scatter plot to confirm the numbers and quantity of the cells whose voltage differences exceed the normal range. Next, charge the out-of-range single cells one by one.
  4. For all high-voltage cells (i.e., cells with a voltage difference at the end of charging ≥ 380 mV), use a balancer to discharge them at a constant current of 2.5A until their voltage drops to 30 mV below the average voltage of non-high-voltage cells in the system. After discharging, let the cells stand idle for 30 minutes.
  5. Continue charging the system at rated power until the voltage reaches the maximum protection value, then stop. Re-collect and evaluate the voltage data at the moment of charging termination to confirm the balancing effect. If any cell still has a voltage difference at the end of charging ≥380 mV, repeat Step 4 and continue individual

charging until all cells in the system have a voltage difference at the end of charging <380 mV.

6. After confirming that the voltage differences at the end of charging of all cells in the system meet the requirements, perform a full charge-discharge cycle at rated power. Then, verify the charge-discharge energy data to ensure they comply with the standards specified in the technical agreement.

- When the voltage difference at the end of discharging among cells in the system is ≤480 mV, it is within the normal range, and no voltage balancing is required. When the voltage difference at the end of discharging is >480 mV, and the discharge energy and round-trip efficiency meet the requirements of the technical agreement, voltage balancing may not be performed. If the voltage difference at the end of discharging does not meet any of the above conditions, perform the following voltage balancing steps:

  1. Perform a full discharge on the system at rated power until the voltage reaches the minimum protection value, then stop. Record the voltage data of all cells in the system at the moment of discharging termination.
  2. Allow the battery system to stand idle for 30 minutes after discharging termination.
  3. Export the recorded voltage data at the moment of discharging termination and compile it into a table. Then, use a scatter plot to confirm the numbers and quantity of the cells whose voltage differences exceed the normal range. Next, charge the out-of-range single cells one by one.
  4. For all low-voltage cells (i.e., cells with a voltage difference at the end of discharge ≥

480 mV), use a balancer to charge them at a constant current of 2.5A until their voltage exceeds the average voltage of non-low-voltage cells in the system by 30 mV. After charging, allow the cells to stand idle for 30 minutes.

5. Continue discharging the system at rated power until the voltage reaches the minimum protection value, then stop. Re-collect and evaluate the voltage data at the moment of discharge termination to confirm the equalization effect. If any cell still has a voltage difference at the end of discharge ≥480 mV, repeat Step 4 and continue individual charging until all cells in the system have a voltage difference at the end of discharge <480 mV.
6. After confirming that the voltage differences at the end of discharge of all cells in the system meet the requirements, perform a full charge-discharge cycle at rated power. Then, verify the charge-discharge energy data to ensure they comply with the standards specified in the technical agreement.

7.2.11 SOC Calibration

Steps

1. Discharge the battery system at rated power until reaching the cut-off voltage.
2. Stand idle for a duration adjusted according to actual conditions. The recommended idle time is greater than 1 hour.
3. Charge the battery system at rated power until reaching the cut-off voltage.

7.3 Fire Suppression System Maintenance

NOTE

- The maintenance cycles below are for reference only. The actual maintenance cycles shall be adjusted according to the natural environment at the project location. If the natural environment is harsh, the maintenance cycles should be shortened.
- To ensure the normal operation of the detector, it should be replaced promptly after it reaches the service life specified by the manufacturer.

NOTE

When the energy storage system is in long-term storage, the battery of the fire suppression system needs to be regularly charged according to the ambient temperature.

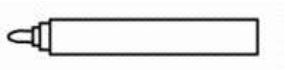
- Storage ambient temperature: -20~40℃, recommended storage ambient temperature: 20~30℃.
- Recharging cycle: below 25℃ (once every six months), 25~30℃ (once every four months), 30~35℃ (once every three months), 35~40℃ (once every two months).
- Maximum storage time: 18 months (at 25℃).

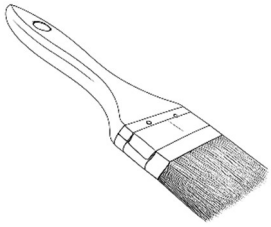
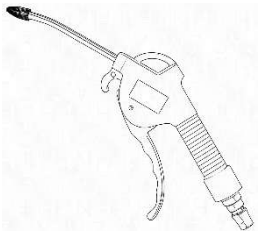
⚠ NOTICE

When the FSS system has completed all joint - commissioning tests and is about to be put into operation, the following operations need to be carried out:

- After the main power and standby power are powered on, wait for 5 minutes for the fire control panel to operate normally. Measure the output voltage of the EXTING. + and EXTING. - ports on the fire control panel, which should be approximately 0V (operation is prohibited when there is voltage), and then power off again.
- Remove the diode at the EXTING position on the fire control panel, and connect the start - up wires (EXTING. + and EXTING. -) of the fire - extinguishing device to the EXTING. + and EXTING. - of the fire control panel correspondingly.
- Power on again.

7.3.1 Tools and Instruments

Name	Purpose	Image
Marker Pen and Labels	For recording inspection and maintenance dates.	
Screwdriver and Socket Set	For installation and removal of components.	

Brush	For removing dust.	
Air Blower	For blowing away dust.	
High-Purity Alcohol/Non-Corrosive Cleaner	For removing stubborn dirt.	

7.3.2 Maintenance Items

Item	Frequency	Checklist	Abnormal Condition Handling
FSS air inlet	Every 6 months	Visual inspection for deformation or damage.	Repair or replace deformed and damaged FSS air inlets.
		Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.
FSS exhaust fan	Every 6 months	Visual inspection for deformation or damage.	Repair or replace deformed and damaged FSS exhaust fans.
		Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.

Smoke Detector	Every 6 months	Visual inspection for deformation or damage.	Repair or replace detectors with physical damage or abnormal operation.
		Observe if the status indicator light blinks every 1-3 seconds (normal operation).	
		Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.
Heat detector	Every 6 months	Visual inspection for deformation or damage.	Repair or replace detectors with physical damage or abnormal operation.
		Observe if the status indicator light blinks every 1-3 seconds (normal operation).	
		Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.
Combustible Gas Detector	Every 6 months	Visual inspection for deformation or damage.	Repair or replace detectors with physical damage or abnormal operation.
		Conduct a functional test. If failed, inspect and calibrate as needed.	
		Check for dirt, dust, or	Remove dirt, dust, and blockages.

		blockages.	
Water-Based Fire Suppression System Piping	Every 12 months	Visual inspection for deformation or damage.	Repair or replace deformed and damaged piping.
Sprinkler Head	Every 12 months	Visual inspection for deformation or damage.	Repair or replace deformed and damaged sprinkler heads.
FSS Water Supply Port	Every 12 months	Visual inspection for deformation or damage.	Repair or replace the deformed and damaged FSS water supply port.

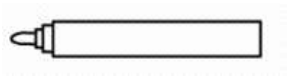
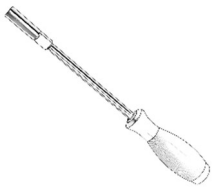
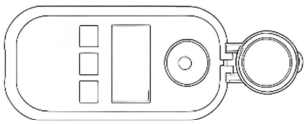
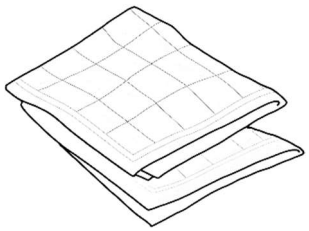
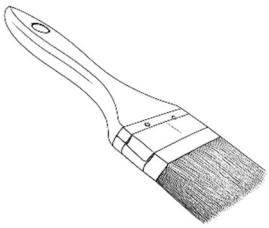
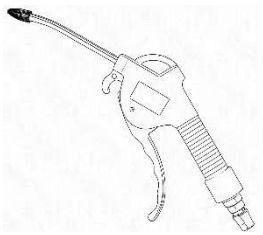
7.4 Thermal Management System Maintenance

NOTE

The maintenance cycles below are for reference only. The actual maintenance cycles shall be adjusted according to the natural environment at the project

location. If the natural environment is harsh, the maintenance cycles should be shortened.

7.4.1 Tools and Instruments

Name	Purpose	Image
Marker Pen and Labels	For recording inspection and maintenance dates.	
Screwdriver and Socket Set	For installation and removal of components.	
Coolant Tester	For checking the concentration of coolant.	
Clean Cloth	For wiping dirt.	
Brush	For removing dust.	
Air Blower	For blowing away dust.	

High-Purity Alcohol/Non-Corrosive Cleaner	For removing stubborn dirt.	

7.4.2 Maintenance Items

Item	Frequency	Checklist	Abnormal Condition Handling
Intake and Exhaust Vents	Every 6 months	Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.
Fan	Every 6 months	Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.
		Inspect fan blades for cracks or breakage.	Repair or replace cracked and damaged fan blades.
		Inspect fan rotation for abnormal noise.	Repair or replace the fan with abnormal noise.
Electrical Cables and Terminals	Every 6 months	Inspect for looseness or detachment.	Reconnect and retighten loose or detached electrical cables and terminals.
		Inspect for visible damage.	Replace damaged electrical cables and terminals.
Filter	Every 6	Check for dirt, dust, or	Remove dirt, dust, and blockages.

	months	blockages.	
Condenser	Every 6 months	Check for dirt, dust, or blockages.	Remove dirt, dust, and blockages.
		Check the condenser fins for deformation or damage.	Repair or replace the deformed and damaged condenser fins.

7.4.2.1 Coolant Maintenance

Item	Checklist	Frequency	Inspection Method	Abnormal Condition Handling
Coolant	• Concentration meets range requirements • The PH value and the concentration of each electrolyte meet the requirements. • No dirt, precipitation, algae, etc.	Every 6 months	• Coolant tester • Visual inspection	Replace the coolant at least 1 minute after power off.

Coolant Specification Requirements

Color	Odor	PH@20℃	Conductivity@25℃	Reserve alkalinity	Turbidity

Blue	No irritating odor	7.5~9.5	2000~4000 μS/cm	>1.5 mL	<5 NTU

Cu	Al	Fe	Si	Chlorine ion	Sulfate ions	Total hardness
<5 mg/L	<5 mg/L	<5 mg/L	<10 mg/L	<20 mg/L	<50 mg/L	<20 mg/L

Coolant Replacement Steps

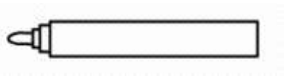
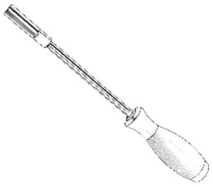
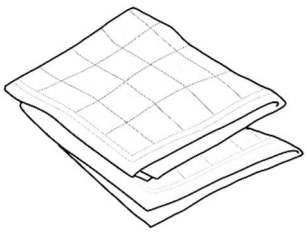
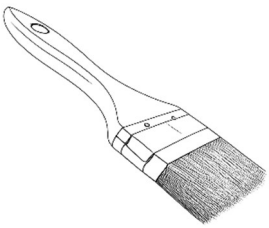
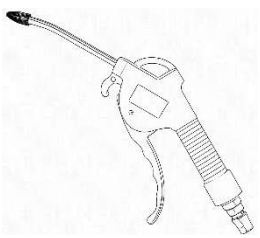
1. Cut off the power and wait at least 1 minute.
2. Use a drain hose to connect the drain port.
3. Open the ball valves at the coolant drain port to drain the coolant to the coolant storage tank. After draining, close the valve and remove the drain pipe.
4. Remove the filter element of the filter for cleaning or replacement.
5. Add the coolant, check the PH value and electrolyte concentration of the coolant.
6. After the coolant replenishment is completed, close the ball valve at the coolant filling port and remove the pipe.

7.5 Container Maintenance

NOTE
The following maintenance cycles are for reference only. The actual maintenance

cycle should be adjusted according to the natural environment of the equipment location. If the natural environment is severe, the maintenance cycle should be shortened.

7.5.1 Tools and Instruments

Name	Purpose	Image
Marker Pen and Labels	For recording inspection and maintenance dates.	
Screwdriver and Socket Set	For installation and removal of components.	
Clean Cloth	For wiping dirt.	
Brush	For removing dust.	
Air Blower	For blowing away dust.	

High-Purity Alcohol/Non-Corrosive Cleaner	For removing stubborn dirt.	
Paint	For repainting the damaged painted surface.	

7.5.2 Maintenance Items

Item	Frequency	Checklist	Abnormal Condition Handling
Container Exterior	Every 12 months	Check for dirt, dust, or foreign objects.	Remove dirt, dust, and foreign objects.
		Check for any damage to the exterior surface, such as cracks, deformation, fractures, holes, etc.	Repair the damaged exterior surface.
		Check for any component issues, such as missing parts, loose connections, or protrusions.	Repair or replace components with issues.
Container Interior	Every 12 months	Check for dirt, dust, foreign objects, or condensation.	Remove dirt, dust, foreign objects, and condensation.

		Check for any damage to the interior wall lining, floor, and threshold, such as cracks, deformation, fractures, or holes.	Repair the damaged interior wall lining, floor, and threshold.
		Check for any component issues, such as missing parts, loose connections, or protrusions.	Repair or replace components with issues.
Painted Surface	Every 12 months	Check for any damage to the painted surface, such as topcoat peeling or primer damage.	After rust removal, repaint the damaged areas on the painted surface.
Door Lock and Hinges	Every 12 months	Inspect the door lock and hinges for proper function.	Repair or replace malfunctioning door locks and hinges.
Sealing Strip	Every 12 months	Inspect the sealing strip for wear or damage.	Replace damaged sealing strips.
Product Markings	Every 12 months	Inspect whether the markings are clear, legible, and free of damage.	Clean dirty markings and repair or replace damaged ones.

7.6 UPS Maintenance

7.6.1 Precautions

⚠ WARNING

The device contains potentially hazardous voltage. Please do not disassemble the device. This device does not include user repairable components. Repair work must be carried out by trained maintenance personnel.

⚠ NOTICE

- Before connecting or disconnecting the battery terminals, discharge the charging power source first.
- If a battery leak occurs, do not let the liquid come into contact with the skin or eyes. If contact occurs, rinse the contact area with plenty of water and seek medical attention.

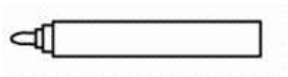
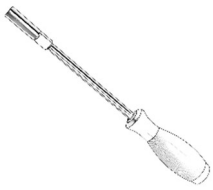
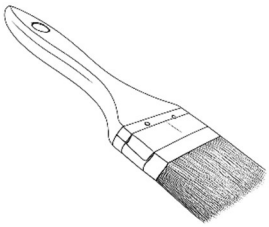
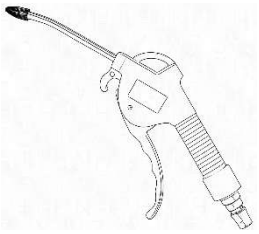
ℹ NOTE

- The battery life is usually two to five years. Environmental factors can also affect battery life. Frequent short-term discharges caused by rising environmental temperatures and poor quality of utility power can shorten battery life.
- To extend battery life, the ambient temperature should be maintained

between 20 and 25°C.

- Keep the battery and battery pack clean and dry.

7.6.2 Tools and Instruments

Name	Purpose	Image
Marker Pen and Labels	For recording inspection and maintenance dates.	
Screwdriver and Socket Set	For installation and removal of components.	
Brush	For removing dust.	
Air Blower	For blowing away dust.	

7.6.3 Maintenance Requirements

Equipment Care

- **Charge and discharge maintenance**: If the load is below 20% of the UPS rated load or the utility power supply is stable, it is recommended that you perform a complete charge

and discharge maintenance once a month. After fully charging the UPS, switch to the battery discharge state (it is recommended to control the load within 20%~60%). When the battery is discharged to near depletion (the product displays only one battery level, or a low battery alarm occurs), switch back to the utility power supply and charge it to full charge. This process helps activate battery activity and maintain its optimal state.

- **Timely charging**: When the utility power is cut off, the UPS built-in battery will discharge to the cut-off voltage and automatically shut down. At this point, it is recommended to charge the battery as soon as possible to avoid prolonged battery depletion, irreversible decline in battery performance, and shortened lifespan.
- **Regularly perform battery maintenance tests**: It is recommended that you regularly perform maintenance tests on the battery, provided that the bypass power supply is within the specification range and the battery level is not less than 25%. During the testing period, the UPS system will switch to battery mode and discharge to the low voltage alarm level of the battery, which helps detect the status of the battery.
- **Regular battery maintenance**: It is recommended that you regularly check the appearance of the battery (such as swelling, deformation, rupture, leakage, etc.) and use professional equipment to detect internal resistance and open circuit voltage, promptly detect and replace faulty batteries, and ensure the performance and lifespan of the entire battery pack. Do not use batteries that are incompatible with UPS when replacing batteries. Mixing batteries of different brands and models can lead to inconsistent performance of the battery pack, which may cause overheating, expansion, or even damage.

Equipment Storage

- **Storage management**: During the idle period of UPS, it is recommended to ensure that the battery is fully charged before shutting down. If the UPS system is stored for a long time, it is recommended that you disconnect the battery after fully charging it (unplug the connection cable or plug of the built-in battery, if applicable) to reduce the impact of battery self-discharge.
- **Regular maintenance charging**: Regularly perform maintenance charging on the battery based on the storage environment temperature:
  - When the storage temperature is -15~25°C, it is recommended to charge at least once every six months (the charging time should not be less than 8 hours, depending on the charging speed).
  - When the storage temperature is 25~45°C, it is recommended to charge at least once every three months (the charging time should not be less than 8 hours, depending on the charging speed).
  - If batteries stored for a long time are not regularly maintained and charged, their performance may decrease or even fail due to self-discharge. Therefore, regular maintenance should be carried out according to the above charging cycle to ensure that the battery remains in a healthy state during storage.

Battery Replacement

- Replace the battery at least every 5 years or at the end of its service life (whichever comes

first).

- When the UPS indicates that the battery needs to be replaced, replace the battery immediately.
- Replace the battery with the same number and type as originally installed in the device.
- When the UPS displays a high battery temperature or signs of electrolyte leakage, replace the battery immediately. Turn off the UPS, unplug the AC input plug, and then disconnect the battery connection. Do not operate the UPS before replacing the battery.

Power Outage Handling Suggestions

- **Instant response**: In the event of a power outage, first confirm that the UPS has automatically taken over the power supply to ensure the normal operation of critical equipment.
- **Turn off the upstream switch**: If the UPS continues to alarm or the expected power outage time is long, it is recommended to first turn off the power switch upstream of the UPS (i.e. the utility power input switch) to protect the UPS from the impact current that may be generated when the utility power is restored. After the utility power is completely stable (which can be determined by observing whether other electrical equipment is working properly), restart the UPS power supply system.

8 Troubleshooting

8.1 Precautions

⚠ WARNING

When dealing with a fault, make sure that the device is effectively grounded, otherwise, there may be a risk of electric shock.

⚠ NOTICE

- After a fault occurs, it is recommended to keep the initial fault state and log all relevant information about the fault as comprehensively as possible.
- Do not perform non-standard operations. Refer to this chapter for preliminary diagnosis and handling of the fault.
- If the fault remains unresolved or if you have any questions, please contact technical support and after-sales service, and provide logged fault information.

8.2 Logging Fault Information

Information Type	Description
Basic Information	Model and serial number of the ESS
	The model number of faulty devices
Operating Status	Pre-fault system parameters (e.g., voltage, current, temperature, SOC, etc.)
Fault Details	Fault type (e.g., abnormal system data display, communication failure)
	Fault occurrence time
	Fault duration
	Operational logs at fault occurrence
	Alarm level and fault code (if applicable)
Fault Photos	Faulty device photos
	Internal component photos (if accessible)
	Alarm interface screenshots (if applicable)
Environmental Information	Ambient temperature and humidity at fault occurrence
	Surrounding influencing factors (e.g., other device failure, external grid fluctuations, extreme weather)

8.3 Common Fault Troubleshooting and Solutions

8.3.1 Abnormal System Data Display

Fault Description	Causes	Troubleshooting and Solutions
Displayed cell voltage does not match the actual voltage	• Voltage acquisition harness loose • Voltage acquisition harness damaged • BMU defective	1. Use a multimeter to measure the actual voltage of the battery cell. 2. Replug the voltage acquisition harness connector and check wiring integrity. 3. Replace with a new BMU and observe whether the displayed voltage values are accurate. 4. Replace the voltage acquisition harness and observe whether the displayed voltage values are accurate.
Cell voltage fluctuation	• Voltage acquisition harness loose • Voltage acquisition harness damaged • Significant on-site interference	1. Replug the voltage acquisition harness connector and check wiring integrity. 2. Replace with a new BMU and observe whether the displayed voltage values are accurate. 3. Replace the voltage acquisition harness and observe whether the displayed voltage

	• BMU defective	values are accurate.
Abnormal cell acquisition quantity	• Project configuration error • Abnormal acquisition harness • BMU defective	1. Check the project configuration to confirm whether it is normal. If not, modify the relevant configuration. 2. Replug the acquisition harness connector and check circuit integrity. 3. Replace with a new BMU and observe whether the displayed values are accurate. 4. Replace the acquisition harness and observe whether the displayed values are accurate.
Temperature display shows -40°C or 125°C	ℹ **Note:** -40℃ indicates an open circuit, 125℃ indicates a short circuit. • Thermistor damaged or temperature acquisition harness damaged • BMU defective	1. Replug the temperature acquisition harness connector and inspect wiring integrity. 2. Replace with a new BMU and observe whether the displayed values are accurate. 3. Replace the temperature acquisition harness and observe whether the displayed values are accurate.
Abnormal	• Project configuration	1. Check the project configuration to confirm

temperature acquisition quantity	error • Abnormal acquisition harness • BMU defective	whether it is normal. If not, modify the relevant configuration. 2. Replug the acquisition harness connector and check circuit integrity. 3. Replace with a new BMU and observe whether the displayed values are accurate. 4. Replace the acquisition harness and observe whether the displayed values are accurate.
Temperature jumps upward	• External interference • BMU defective	Replace with a new BMU and observe whether the displayed values are accurate.
Temperature jumps downward	• External interference • High connector impedance • BMU defective	1. Replug the BMU acquisition harness connector and observe whether the displayed values are accurate. 2. Replace with a new BMU and observe whether the displayed values are accurate.
Abnormal total battery voltage acquisition	• Acquisition circuit open • Fuse blown • Incorrect wiring	1. Open the switchgear and perform a fuse continuity test to verify fuse integrity. 2. Inspect acquisition circuit wiring positions

	position • BCU defective	for correctness. 3. Measure acquisition circuit continuity to confirm circuit integrity. 4. Replace with a new BCU and observe whether the displayed values are accurate.
Abnormal total load voltage acquisition	• Acquisition circuit open • Relay sticking • Incorrect wiring position • BCU defective	1. Measure acquisition circuit continuity to confirm circuit integrity. 2. Test relay status to check for sticking. Replace it if stuck. 3. Inspect acquisition circuit wiring positions for correctness. 4. Replace with a new BCU and observe whether the displayed values are accurate.
Current is 0	• Hall sensor power loss • CAN Hall baud rate error • Abnormal communication harness • Incorrect configuration scheme selection	1. Check Hall sensor power supply status. 2. Verify CAN Hall baud rate. Correct if abnormal. 3. Inspect communication harness integrity. Replace if faulty. 4. Confirm Hall configuration scheme in settings. Adjust if incorrect.

Current sensor direction reversed	Incorrect selection of current sensor direction in the configuration	Check whether the Hall configuration scheme in the settings is correct. Adjust configurations if incorrect.
Reproduction of short - board cells	● The battery cell itself is damaged or has excessive self - discharge. ● There is a hardware failure in the BMS (Battery Management System).	1. Check whether the BMS sampling board and the voltage sampling wires inside the PACK are normal. Perform charge - replenishment treatment on the short - board battery cell. If this battery cell remains a short - board one within one month after the charge - replenishment is completed, the PACK needs to be replaced.

8.3.2 Communication Fault

Fault Description	Causes	Troubleshooting and Solutions
BCU-BMU communication abnormality	● Abnormal communication harness ● Terminal resistor not added ● Inconsistent baud rates for master-subordinate	2. Inspect the communication harness for integrity. Replace it if abnormal. 3. Confirm the presence of the Terminal resistor. Install it if missing. 4. Verify the baud rate settings in the configuration. Adjust configurations if

	communication • BMU address not assigned	incorrect. 5. Check the address assignment for the BMU. Adjust configurations if incorrect.
BAU-BCU communication abnormality	• Abnormal communication harness • Terminal resistor not added • Inconsistent baud rates for BAU-BCU communication • BCU address not assigned or duplicate address • Excessively long bus	1. Inspect the communication harness for integrity. Replace it if abnormal. 2. Confirm the presence of the terminal resistor. Install it if missing. 3. Verify the baud rate settings in the configuration. Adjust configurations if incorrect. 4. Check the address assignment for the BCU. Adjust configurations if incorrect. 5. Adjust the baud rate and check if BAU-BCU communication is normal.
BMS-PCS communication abnormality (if any)	• Communication point list mismatch • Abnormal communication harness • BMS hardware failure	1. Verify the communication point list used by both BMS and PCS. Correct mapping errors if detected. 2. Inspect BMS-PCS communication harness integrity. Replace if faulty. 3. Replace with new BMS hardware and

	• Configuration issues	observe if communication normalizes. 4. Check if point lists and dry contacts exist in the configuration, and verify their settings. Modify relevant configurations if incorrectly set.
BMS-GS/EMS communication abnormality	• Communication point list mismatch • Abnormal communication harness • BMS hardware failure • Configuration issues	1. Verify the communication point list used by both BMS and GS/EMS. Correct mapping errors if detected. 2. Inspect BMS-GS/EMS communication harness integrity. Replace if faulty. 3. Replace with new BMS hardware and observe if communication normalizes. 4. Check if point lists and dry contacts exist in the configuration, and verify their settings. Modify relevant configurations if incorrectly set.

8.3.3 Fire Suppression System Fault

Fault Description	Causes	Troubleshooting and Solutions
Fire alarm control	• Fire alarm control panel	1. Check the power supply of the fire

panel shows system failure	displays main power supply fault • Fire alarm control panel displays ZONE circuit fault	suppression system. Take relevant actions if abnormal. 2. Inspect heat detector and smoke detector circuits per the fire wiring diagram. Verify connection of 470Ω and 6.8kΩ resistors. Reconnect if incorrect.
Disable switch abnormality	Abnormal feedback from the auxiliary contact of the disable switch	1. Inspect the disable switch feedback wiring harness integrity. Replace if faulty. 2. Check if the disable switch auxiliary contact is properly plugged in. If not, replug it. 3. Check if the auxiliary contact of the disable switch is normal. Take relevant actions if abnormal.

8.3.4 Liquid Cooling System Fault

Fault Description	Causes	Troubleshooting and Solutions
Level 1 fault: The liquid cooling unit stops operating.		
High-voltage relay fault	When BTMS does not request high-voltage Relay 1 or 2, collect the feedback voltage of Relay 1 or	Check the status of the high-voltage relay and replace it if needed.

	2 through AD sampling. The average value of the feedback voltage remains less than or equal to 3.7V for 2 consecutive seconds.	
Level 2 fault: The compressor and the condenser stop operating.		
Compressor communication fault	BTMS does not receive the information transmitted by the compressor controller within 7 seconds.	1. Check the wiring harness for CAN communication inside the unit. 2. Confirm if there is CAN information.
ACDC overvoltage fault	Collect the ACDC output voltage through AD sampling. The output voltage value is greater than the standard value for 2 consecutive seconds: ● The output voltage of ACDC1 is greater than 16V. ● The output voltage of ACDC2 is greater than 32V. ● The output voltage of ACDC3 is greater than 32V.	1. Check if the input power supply is normal. 2. Check if the CCU is normal.

ACDC undervoltage fault	Collect the ACDC output voltage through AD sampling. The output voltage value is lower than the standard value for 2 consecutive seconds: ● The output voltage of ACDC1 is less than 9V. ● The output voltage of ACDC2 is less than 18V. ● The output voltage of ACDC3 is less than 18V.	1. Check if the input power supply is normal. 2. Check if the CCU is normal.
DCDC PFC fault	Collect the DCDC PFC output through AD sampling, with the output remaining below 5V for 2 consecutive seconds.	1. Check if the input power supply is normal. 2. Check if the CCU is normal.
Water pump PFC failure	Collect the water pump PFC output through AD sampling, with the output remaining below 5V for 2 consecutive seconds.	1. Check if the input power supply is normal. 2. Check if the CCU is normal.
Compressor	The compressor feedback status is	1. Check if the power supply is

controller failure	in fault status.	normal。 2. Check for refrigerant leaks. 3. Check if the ambient temperature is too high. 4. Check if the heat exchanger is dirty and blocked.
Fan failure	In cooling mode, with no faults in ACDC2, collect the feedback voltage of Fan 1 through AD sampling. The feedback voltage remains greater than 1.2V for 2 consecutive seconds.	1. Check whether the ACDC2 output is less than 18V or greater than 32V. 2. Check the status of the fan fuse. 3. Check whether there is any foreign object inside the fan.
Water pump failure	In cooling, heating, and self-circulation modes, collect the feedback voltage of the water pump through AD sampling. The feedback voltage value remains greater than 0.6V for 2 consecutive seconds.	1. Check for ethylene glycol leaks. 2. Check if the water circuit system is blocked. 3. Check if the water pump voltage is normal. 4. Check the status of the water pump fuse.
PTC	In heating mode, collect the	1. Check for ethylene glycol leaks.

overtemperature failure	feedback voltage of Relay 2 through AD sampling. The average value of the feedback voltage remains greater than 4.5V for 2 consecutive seconds.	2. Check if the water circuit system is blocked. 3. Check whether the water pump and its fuse are normal. 4. Check the control output of the CCU.
High pressure is too high	In cooling mode, the high-pressure value exceeds 2400 KPa for three consecutive times.	1. Check if there are foreign objects or a large amount of dust on the heat exchanger. 2. Check if the fan is operating normally and if the fan fuse is in good condition.
Low pressure is too low	In cooling mode, the low-pressure value is below 150 Kpa for three consecutive times. ℹ️ **Note:** During the start-up phase of the unit, this fault is suppressed for 3 minutes.	1. Check for refrigerant leaks. 2. Check for ethylene glycol leaks. 3. Check whether the water pump and its fuse are normal. 4. Check if the water circuit system is blocked.
High-pressure switch failure	In cooling mode, collect the feedback voltage of Relay 1	1. Check if there are foreign objects or a large amount of dust on the heat

	through AD sampling. The average value of the feedback voltage remains greater than 4.5V for 2 consecutive seconds.	exchanger. 2. Check if the fan is operating normally and if the fan fuse is in good condition. 3. Check if Relay 1 is normal. 4. Check the control output of the CCU.
Water valve communication failure	In cooling mode, BTMS does not receive the information sent by the water valve within 7 seconds.	Check the water valve communication wiring harness and connectors.
Water valve failure	● The water valve feedback status is in fault status. ● The target position and the real-time position feedback from the water valve differ by more than 20 steps for 90 consecutive seconds.	1. Check the water valve connector and wiring harness. 2. Check for rotation blockage of the water valve and foreign objects in the water passage.
High-pressure sensor fault	Collect the voltage at the high-pressure sensor end through AD sampling. The voltage value is less	1. Check for ground short circuit. 2. Check for power supply short circuit.

	than 0.24V (i.e., 0Kpa) or greater than 4.51V (i.e., 3200Kpa) for two consecutive seconds.	3. Check if the wiring harness plug is not connected.
Low-pressure sensor fault	Collect the voltage at the low-pressure sensor end through AD sampling. The voltage value is less than 0.12V (i.e., 0Kpa) or greater than 4.71V (i.e., 3100Kpa) for two consecutive seconds.	1. Check for ground short circuit. 2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.
Inlet water pressure sensor failure	Collect the voltage at the inlet water pressure sensor end through AD sampling. The voltage value is less than 0.12V (i.e., 10Kpa) or greater than 4.71V (i.e., 750Kpa) for two consecutive seconds.	1. Check for ground short circuit. 2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.
Outlet water pressure sensor failure	Collect the voltage at the outlet water pressure sensor end through AD sampling. The voltage value is less than 0.12V (i.e., 10Kpa) or greater than 4.71V (i.e., 750Kpa) for	1. Check for ground short circuit. 2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.

	two consecutive seconds.	
Inlet water temperature sensor failure	Collect the voltage at the inlet water temperature sensor end through AD sampling. The voltage value is less than 0.18V (i.e., -40℃) or greater than 4.51V (i.e., 100℃) for two consecutive seconds.	1. Check for ground short circuit. 2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.
Outlet water temperature sensor failure	Collect the voltage at the outlet water temperature sensor end through AD sampling. The voltage value is less than 0.18V (i.e., -40℃) or greater than 4.51V (i.e., 100℃) for two consecutive seconds.	1. Check for ground short circuit. 2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.
Ambient temperature sensor failure	Collect the voltage at the ambient temperature sensor end through AD sampling. The voltage value is less than 0.18V (i.e., -40℃) or greater than 4.51V (i.e., 120℃) for two consecutive seconds.	1. Check for ground short circuit. 2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.
Exhaust	Collect the voltage at the exhaust	1. Check for ground short circuit.

temperature sensor failure	temperature sensor end through AD sampling. The voltage value is less than 0.18V (i.e., -30℃) or greater than 4.51V (i.e., 130℃) for two consecutive seconds.	2. Check for power supply short circuit. 3. Check if the wiring harness plug is not connected.
Level 3 fault: The liquid cooling unit continues to operate.		
BMS communication loss failure	BTMS does not receive the 'mode' parameter setting sent by BMS within 60 seconds.	1. Check the BMS communication harness. 2. Verify if there are BMS communication messages.
Water supply pressure is too high	The water supply pressure is greater than 3 BarG for 120 consecutive seconds.	1. Check if the water circuit is blocked and inspect the water valve. 2. Check if the liquid injection pressure is too high.
Inlet water pressure is too low	The return water pressure is less than 0.1 BarG for 120 consecutive seconds.	1. Check for ethylene glycol leaks. 2. Check whether the water pump and its fuse are normal.
Temperature and humidity sensor failure	Collect the voltage at the sensor through AD sampling. The voltage value is less than 0.18V or greater	1. Check for ground short circuit. 2. Check for power supply short circuit.

	than 4.51V (i.e., 130℃) for two consecutive seconds.	3. Check if the wiring harness plug is not connected.
Low water pressure difference failure	In cooling, heating, and self-circulation modes, when the water pump has no faults, the pressure difference between the inlet and outlet water is continuously less than 30 KPa for 3 minutes.	1. Check for ethylene glycol leaks. 2. Check whether the water pump and its fuse are normal.
High water pressure difference failure	In cooling, heating, and self-circulation modes, when the water pump has no faults, the pressure difference between the inlet and outlet water is continuously greater than 200 KPa for 3 minutes.	Check if the water circuit is blocked and inspect the water valve.

8.3.5 UPS Fault

8.3.5.1 Status Indicator

Indicator	UPS Status
Continuously beep once every half second	Battery Low: The battery is nearly fully discharged and the UPS is about to turn itself off.

	Overload: The total power consumed by the devices connected to the UPS exceeds the allowable rated range.
Beep 4 times every 30 seconds (Starts after four seconds from when the UPS entering the battery mode)	Battery Power Status: The UPS is using the battery backup power to power the connected devices.
The beeper rings continuously	Alarm Status: The UPS detected an error. Refer to Section 8.3.5.2 Alarms and Section 8.3.5.3 Notification.
One short beep every 2.5 seconds	The battery is disconnected.
Half-second beep continuous for 1 minute and repeat this every 5 hours	The battery is damaged (and needs to be replaced).
Two short beeps every 5 seconds	Event bypass status: The UPS detected an error. The connected devises is now being powered by the utility power through the bypass relay.

8.3.5.2 Alarms

Code	Description	Solution
	The UPS detected a short	Check if the UPS output is short-circuited. After

	circuit event on the output side. The device will try to recover itself automatically from this state.	resolving the short circuit, wait for the device to automatically recover itself, or pressing the  button to start the UPS. **Note:** When this alarm happens, the UPS stops powering all connected devices.
	The UPS is overloaded.	Disconnect unnecessary devices from the UPS to decrease the load.
	The UPS detected high DC voltage.	Contact the after-sales service. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.
	The UPS detected low DC voltage.	Contact the after-sales service. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.
	The inverter soft start failed.	Contact the after-sales service. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.
	The UPS detected the output voltage of the inverter is abnormal.	Contact the after-sales service. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.
	The battery voltage is too	Contact the after-sales service. For contact

	high.	information, refer to Chapter 9 Technical Support and After-Sales Service.
	EEPROM data error.	Contact the after-sales service. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.
	The temperature of the unit exceeds the limit.	Disconnect unnecessary devices from the UPS to decrease the load. Make sure that the ambient temperature is within the limit. Make sure enough clearance is around the Unit.
	The UPS detected a charger error.	Contact the after-sales service. For contact information, refer to Chapter 9 Technical Support and After-Sales Service.

8.3.5.3 Notification

Code	Description	Solution
	The battery is not connected.	Connect the battery to the UPS.

8.3.5.4 Fault

Fault Description	Causes	Troubleshooting and Solutions
The utility power input is available, but the UPS does not turn on or there is no power output.	The UPS is not powered on.	Press  button to power on the UPS.
	The UPS is not connected to the utility power.	Check if the security of the both ends of the power cables between the UPS and the utility power.
	The input thermal breaker on the UPS trips.	Press the input thermal breaker reset button which can be found on the rear panel.
When connected to the utility power, the UPS switches into battery mode.	The input voltage or frequency is too high, too low, or unstable.	By connecting the UPS to other outlets of other circuits, test the utility power to ensure that the connected devices receive the input power. If the display is on, navigate and check the input voltage and frequency.
The UPS connected to the battery did not supply power to the connected devices.	The UPS is not powered on.	If the UPS is off (the display is not on), press the  button once. When the display panel lights up, press the  button one more time. Then, the connected devices become powered by the UPS battery.
	The UPS is not connected to the battery.	Connect the battery to the UPS.
	Insufficient battery capacity.	Wait for the utility power to recover and charge

	Maybe because of a power failure, the battery has been discharged or depleted and stopped outputting.	the battery. To turn on the power output after the utility power restores, press  the button.
UPS keeps beeping for a long time.	The UPS operates normally in battery mode.	The UPS detected an error. Refer to Section 8.3.5.2 Alarms and Section 8.3.5.3 Notification.
Alarm LED lights up. The UPS displays an alarm message and beeps continuously.	The UPS detected an error.	Refer to Section 8.3.5.2 Alarms and Section 8.3.5.3 Notification.
The UPS does not make a sound even if the alarm LED is lit.	The audio alarm feature has been disabled.	Change the UPS configuration to enable the feature.
The UPS cannot provide enough delay time.	The UPS battery has been discharged due to a recent power failure.	The battery needs to be charged after a long power failure. If the battery is used frequently and not charged correctly, or it is often operated at high temperatures, the battery wear will be accelerated.
	The service life of the	If the battery is near the end of its life, consider

	battery is about to end.	replacing the battery even if the replacement battery indicator is not yet lit.
Cannot power off the UPS.	Did not press the shutdown button properly.	To turn off the UPS, hold down the  button and release it after you hear a beep.
	The utility input power is available.	If the utility input power is available, the UPS logic power cannot be turned off. To turn off the UPS, turn off the utility input first and, then, press down the  button and release it after you hear a beep.
The UPS is in bypass mode and the LED is not lit red.	The UPS is in Green mode.	You can choose to disable the green mode.
	The UPS is configured to remain in bypass mode.	Change the configuration to exit bypass mode.
	The UPS is still in bypass mode even after the overheat alarm is resolved.	Reduce the connected load to <90% to allow the UPS to switch to online mode.
	The UPS switched to bypass mode because of overload.	The total load of the connected devices exceeds the "Maximum Load". The alarm will persist until the overload is resolved. Disconnect unnecessary devices from the UPS to solve the overload problem.

		As long as operating in bypass mode and the circuit breaker does not trip, the UPS continues to supply power. If the utility power fails, the UPS will not provide power to the battery.
	The UPS detected an error and switched to bypass mode.	Refer to Section 8.3.5.2 Alarms and Section 8.3.5.3 Notification.

8.3.6 Other Faults

Fault Description	Causes	Troubleshooting and Solutions
Insulation withstand fault	Conduct simultaneous insulation withstand tests on the PCS and BMS	Verify if PCS insulation withstand test is active. Disconnect PCS and check if a fault is triggered. Revise the insulation withstand detection in the configuration.
Relay Abnormality	● Abnormal relay feedback wiring harness ● Relay sticking	1. Inspect the relay feedback wiring harness integrity. Replace if faulty. 2. Test relay status to check for sticking. Replace it if stuck.
Access control fault	● Display reversed ● No response	1. Check access control wiring integrity. Take relevant actions if abnormal.

	• Configuration not written • Access control damaged	2. Verify configuration settings. Modify incorrect configurations. 3. Replace the access control and observe if it works normally.

9 Technical Support and After-Sales Service

SYL (Ningbo) Battery Co., Ltd. has always adhered to the "Customer First" service philosophy, establishing a full product lifecycle service system. On technical support, the company is supported by a senior engineer team providing end-to-end support from pre-sales consultation to after-sales service. Backed by 23 global service centers, it achieves 24/7 rapid response, delivering comprehensive technical support and efficient after-sales service to customers worldwide.

Contact Information

After-sales Hotline	+86 400-101-8585
After-sales Email	service@sylbattery.com

Warranty

SYL (Ningbo) Battery Co., Ltd. provides warranty services for its products. The duration and specific terms of free warranty coverage shall be exclusively governed by the signed contract clauses.

To protect your rights and clarify service scope, the following scenarios are explicitly

excluded from free warranty coverage, and SYL shall not be liable for them:

Improper Operation

- System damage or failure caused by not following the operating instructions and safety precautions in the user manual.
- System damage or failure due to unauthorized disassembly, modification of the product, or alteration of software code by the user.
- Damage or failure to system hardware caused by user negligence, improper operation, or intentional damage.
- System damage caused by third parties or users, including handling and installation not in line with manual requirements, and unauthorized adjustments, modifications, or removal of identification marks.
- After a system failure, the user fails to promptly contact technical support and after-sales service, and performs unauthorized operations, leading to a loss of fault-related information and hindering effective fault identification and resolution.

Improper Use

- Functional abnormalities, component damage, personal injury, or property damage caused by using the system in an environment that does not meet the design requirements.
- System damage or failure due to non-compliance with relevant electrical safety regulations for wiring and power supply.

- Installation and usage environments that do not conform to regulations stipulated in relevant international, national, or regional standards.
- System damage or failure caused by battery usage that does not satisfy the requirements of this manual.
- System damage or failure caused by storage conditions that do not meet the requirements of this manual.
- System damage or failure caused by force majeure natural factors, such as typhoons, earthquakes, floods, fires, mudslides, or adverse environmental conditions like high temperatures, low temperatures, high humidity, and acid rain.

Feedback

If you have any comments or suggestions regarding this manual, please share them with us via email. Your feedback is highly valued as it enables us to constantly enhance the manual's quality, ensuring that we deliver more excellent content and a superior user experience.

Appendix

Abbreviations

Abbreviations	Full Term
AC	Alternating Current
Ah	Ampere-hour
AHJ	Authority Having Jurisdiction
BAU	Battery Array Management Unit
BCP	Battery Connection Panel
BCU	Battery Cluster Management Unit
BESS	Battery Energy Storage System
BMS	Battery Management System
BMU	Battery Module Management Unit
BOS	Balance of System
BTMS	Battery Thermal Management System
CAN	Controller Area Network
CCU	Communication Control Unit

DC	Direct Current
EMS	Energy Management System
FSS	Fire Suppression System
GS	Golden Shield
HMI	Human Machine Interface
HVAC	Heating, Ventilation, and Air Conditioning
IP	Ingress Protection
kV	Kilovolt
kW	Kilowatt
LFP	Lithium Iron Phosphate
LSI	Large-Scale Integration
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
MSD	Manual Service Disconnect
MW	Megawatt
MWh	Megawatt-hour
PCB	Printed Circuit Board
PCS	Power Conversion System
PLC	Programmable Logic Controller
SCADA	Supervisory Control and Data Acquisition

SMPS	Switch Mode Power Supply
SOC	State of Charge
SPD	Surge Protective Device
UPS	Uninterruptible Power Supply

Fastening Torque

Bolt	Recommended Torque (N•m)	Torque Range (N•m)
M4	2.59	2.38~2.80
M5	5.18	4.76~5.60
M6	9.07	8.33~9.80
M8	22.67	20.83~24.50
M10	40.80	37.49~44.10
M12	72.62	66.73~78.50
M16	138.75	127.50~150.00

Notes:

- The recommended torque values and torque ranges listed above apply only to fasteners with a property class of 8.8 and not to fasteners of other property classes.
- The torque values listed above are for reference only. Please adjust them according to actual conditions.

risen

SYL (Ningbo) Battery Co., Ltd.

Address Risen Energy Meiqiao Phase I, Ninghai County, Ningbo City, Zhejiang Province

Tel +86 400-101-8585

Website www.risenstorage.com