HANCHU ESS

Version 01

User Manual

CESS-418K-S

Smart Energy,

Sustainable Solutions

Release Notes

Releases	Dates	Version Update Record	Authorize
V1.1	JANUARY 2024	UPDATING CABINET INTERIORS	LI XIAOFAN

Contents

1 Safety Instructions

1.1.Explanation of Safety Symbols

Before installing, operating, or maintaining the equipment, please read this manual thoroughly and follow all safety precautions identified on the equipment and in the manual. To ensure better use of this product and to safeguard personal and property safety, pay close attention to the following symbols:

Danger: Indicates a high potential hazard that, if not avoided, could result in death or serious injury.

Warning: Indicates a moderate potential hazard that, if not avoided, may lead to death or serious injury.

Caution: Indicates a low potential hazard that, if not avoided, could result in moderate or minor injury.

Note: Emphasizes content and may also provide tips for optimizing product use.

1.2.General Safety

Note:

This equipment should be used in an environment that meets the design specifications. Otherwise, equipment failure might occur, leading to abnormal device function or damage, personal safety accidents, or property loss, which are not covered under the equipment's warranty. Installation, operation, and maintenance of the equipment should comply with local laws, regulations, and standards. The safety precautions in this manual are intended to supplement, not replace, local laws, regulations, and standards. The company assumes no responsibility in the following situations:

- Installation and usage environments exceed the provisions of relevant international, national, or regional standards.
- Operation outside the conditions described in this manual.
- Unauthorized disassembly, alteration of the product, or modification of software codes.
- Failure to follow the operational instructions and safety warnings provided in the product documentation.
- Damage caused by abnormal natural environments (force majeure, such as earthquakes, fires, storms, floods, landslides, etc.).
- Damage due to failure to comply with transportation and installation requirements.
- Damage due to storage conditions that do not meet product documentation requirements.
- Damage to the equipment's hardware or data caused by the customer's negligence, improper operation, or intentional damage.
- System damage caused by third parties or customer reasons, including relocation and installation systems that do not meet the requirements of this manual, as well as adjustments, changes, or removal of identification marks that do not comply with this manual.

Danger:

The equipment operates at high voltage. Improper handling could lead to electric shock or fire, resulting in death, severe personal injury, or significant property damage. Please follow the operational sequence and safety precautions outlined in this manual and other relevant documents to ensure proper operation:

- Inspect the equipment for securely fastened pre-installed cable connections. Check for any damage to the equipment, such as holes, dents, or other signs of potential internal damage. Ensure internal components have not shifted and do not unauthorizedly alter the structure or installation sequence of the equipment.
- Do not use water to clean the internal electrical components of the equipment. If liquid enters the equipment, immediately press the emergency stop switch and notify the site management personnel.
- Avoid performing installation, wiring, maintenance, or replacement operations while the equipment is powered. Before touching any conductive surface or terminal, measure the voltage at the contact point and ensure that the equipment or parts to be serviced are properly grounded to avoid the risk of electric shock.
- Except for personnel operating the equipment, keep others away. Do not power up the equipment until it has been fully installed or checked by a professional. When powering up for the first time or conducting operations with the main circuit energized, ensure at least two people are present on-site.

Note

- The user's actions and tools used during transportation, handling, installation, wiring, and maintenance must comply with the laws, regulations, and relevant standards of the country or region.
- Before opening the cabinet doors, clean off any accumulated water, ice, snow, or other debris from the top of the cabinet to prevent foreign objects from falling inside.
- Reverse engineering, decompiling, disassembling, adapting, embedding, or other derivative operations on the equipment's software are prohibited. It is not allowed to study the internal implementation of the equipment, obtain the software source code, steal intellectual property, or disclose any results of the equipment software performance tests in any manner.

1.3.Electrical Safety

➢ *1.3.1.Wiring Requirements*

- Select cables that comply with local laws and regulations. Cables of the same type should be bundled together, while cables of different types should be laid separately, avoiding entanglement or cross-laying.
- If leaving the wiring temporarily unfinished or during the wiring process, immediately seal the cable entries and close the cabinet doors to prevent small animals from entering.
- Cables used in energy storage systems must be securely connected, well-insulated, and meet the required specifications. Protective measures must be taken where cables pass through conduits or holes to prevent damage from sharp edges or burrs.
- After wiring, cables should be securely fixed using cable supports and clamps. In areas where soil is backfilled, ensure cables are closely adhered to the ground to prevent deformation or damage from the backfilling pressure.
- Using cables in high-temperature environments may lead to insulation aging and damage. The distance between cables and heating devices or heat sources should be at least 30mm.
- To ensure construction safety, all cables should be laid and installed at temperatures above 0°C. Handle cables gently, especially in cold weather conditions, to avoid damage.

➢ *1.3.2.Grounding Requirements*

- Do not damage the grounding conductor. The equipment's grounding system should be permanently connected to the protective grounding network. Before operating the equipment, check the electrical connections to ensure the equipment is properly grounded.
- The equipment grounding impedance must meet the national standard GB 50054 and local electrical standards.
- Do not operate equipment without installing the grounding conductor. Equipment requiring grounding must have the protective ground wire installed first during installation and removed last during disassembly.

➢ *1.3.3.Maintenance Requirements*

- Before connecting or disconnecting cables, first switch off the protective circuit breaker for the corresponding circuit.
- Use a multimeter suitable for the voltage level to check for live circuits, ensuring the equipment is completely powered off.
- If there are live parts nearby, use insulation boards or insulation tape for covering or wrapping.
- After reliably connecting the circuit to be maintained with the ground circuit using a grounding wire, proceed with maintenance and operation.

Note:

- Before connecting cables, ensure the cable labels are correctly identified.
- If the equipment has multiple inputs, disconnect all inputs and wait for the equipment to be fully powered down before operating.
- After maintenance, disconnect the grounding wire between the maintenance circuit and the ground circuit.

1.4.Mechanical Safety

Caution:

- When not using a wooden box for fork-lifting, the bottom surround must be removed. Handle with care during lifting to avoid impact or vibration.
- During transportation, the center of gravity of the box should be positioned between the two forks of the forklift. Long-distance carrying, inversion, or tilting is prohibited.
- When transporting equipment, the large size of the equipment may obstruct the operator's view; it is necessary to arrange for auxiliary personnel to assist in the operation.

1.5.Battery Safety

Description

The company is not responsible for damage to the batteries provided due to the following reasons:

- Damage, capacity loss, or irreversible damage due to the customer's failure to charge or accept the battery in a timely manner, resulting in over-storage.
- Mechanical damage, leakage, rupture, etc., caused by improper operation or failure to connect the battery as required.
- The customer or a third party changing the battery usage scenario without informing the company. This includes, but is not limited to: connecting additional loads to the battery, mixing with batteries of other brands, or using batteries of different rated capacities together.

- Direct damage to the battery due to the operating environment of the on-site equipment or external electrical parameters not meeting the environmental requirements for normal operation. This includes the actual operating temperature of the battery being too high or too low, poor electrical grid conditions, frequent power outages, etc.
- Frequent over-discharge of the battery caused by the customer not correctly setting the battery operation management parameters or improper maintenance, expansion at the customer's site, or long-term inability to fully charge.
- Theft or loss of the battery.
- Batteries that have exceeded their warranty period.

Danger:

- Do not expose the battery to high temperature environments or near heating devices such as sunlight, fire sources, transformers, heaters, etc. Overheating of the battery may cause fire or explosion.
- Do not disassemble, modify, or destroy the battery (such as inserting foreign objects, immersing in water or other liquids, etc.) to avoid battery leakage, overheating, fire, or explosion.
- Thermal runaway of the battery can produce flammable gases, as well as harmful gases such as CO, HF, etc. The accumulation of flammable gases from thermal runaway poses a risk of deflagration and explosion, potentially causing personal injury and property loss.
- When installing or maintaining a battery, use insulating tape to wrap the exposed cable terminals on the battery. Also, avoid foreign objects (such as conductive objects, screws, liquids, etc.) entering the battery interior causing a short circuit.

Warning:

- Use the battery within the temperature range specified in this manual. Do not charge the battery when the environmental temperature is below the lower limit of the operating temperature, to avoid internal short circuits caused by crystallization during low-temperature charging.
- Dispose of used batteries in accordance with local laws and regulations, and do not treat batteries as household waste.
- If more than 8 months have passed since the last charge, the battery needs to be recharged. Failure to recharge as required may affect the battery's performance and service life.

Abnormal Battery Handling Measures

Danger:

- In the event of electrolyte leakage or abnormal odor, avoid contact with the leaked liquid or gas. Non-professionals should not approach; contact professionals immediately for handling.
- The electrolyte is corrosive, and contact may cause skin irritation and chemical burns. If contact with battery electrolyte occurs, immediately wash the affected area with plenty of water and soap, and seek medical help immediately.
- In the event of a battery drop resulting in obvious odor, damage, smoke, or fire, evacuate personnel immediately and report to the authorities promptly. Professional personnel should extinguish the fire using firefighting equipment, ensuring safety.

1.6.Maintenance and Replacement

Warning

- Do not open the cabinet doors in weather conditions such as rain, snow, thunder, sandstorms, or heavy fog.
- Before removing components from the cabinet, please ensure that other parts on the cabinet have not become loose.
- During equipment maintenance, insulating materials should be used to cover nearby live parts.
- Do not allow any objects to come into contact with the fan while it is operating (such as fingers, components, screws, etc.) before the fan is powered off and has stopped rotating.
- Do not power up the equipment before troubleshooting.
- When performing a live inspection of the system, pay attention to the hazardous warning signs on the equipment and avoid standing at the cabinet door.
- Except for the battery module, wait for 15 minutes after powering down the equipment to ensure it is de-energized before operating on the equipment.
- After replacing power components of the energy storage system or changing the wiring, manual wiring inspection is required to avoid abnormal system operation.
- After completing maintenance and replacement operations, the cabinet doors should be locked promptly, and the keys should be properly stored.

2 Product description

2.1.Description of models

CESS – 418K - A/S

A: A:Air cooling integrated machine;S:Liquid-cooling split machine
Battery capacity:418kWh
Product Series

Note: Isolation transformer (external), rated output power and battery capacity can be flexibly configured according to project requirements.

2.2.Product Features

The CESS series outdoor energy storage cabinet integrates an energy storage battery, battery management monitoring system, distribution system, environmental control system, and fire control system. The outdoor cabinet adopts a modular design, facilitating maintenance and expansion, and employs front maintenance to reduce the footprint and maintenance passage. It is characterized by safety and reliability, rapid deployment, low cost, high energy efficiency, and intelligent management.

In common application scenarios, the operational strategy of the energy storage system is as follows:

Peak Shaving and Valley Filling: During off-peak times with lower electricity rates, the energy storage cabinet automatically charges and then stands by when full. During peak times with higher electricity rates, the storage cabinet automatically discharges to realize price arbitrage, improving the economic benefits of the photovoltaic storage charging system.

Dynamic Capacity Addition: Charges the battery when the load is light and discharges it when the load is heavy, increasing load capacity during peak times and expanding the distribution system's capacity.

Microgrid: Integrates with photovoltaic systems, charging systems, diesel generation systems, etc., to coordinate energy balance, improve renewable energy consumption, and dynamic capacity addition, thereby enhancing the economic benefits of the microgrid system.

2.3.Electrical Wiring Diagrams

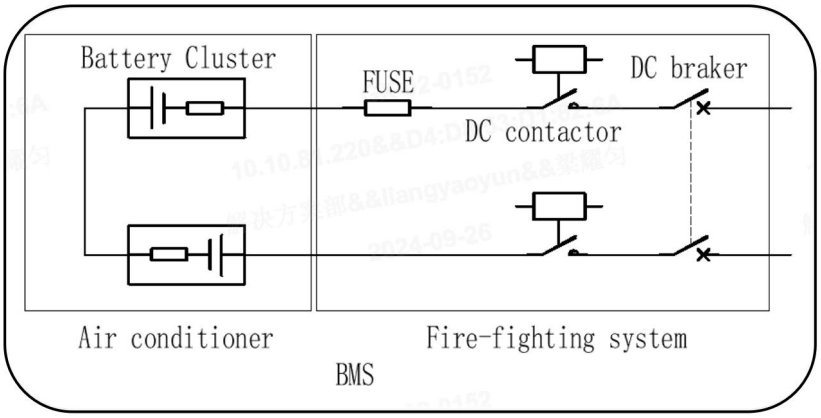


Figure 1 Electrical Primary Diagram

2.4.Product Characteristics

- Systematization: Integrates an energy storage battery, battery management monitoring system, distribution system, environmental control system, and fire control system, fully controlling the system's operational status and risks;
- High Safety: Utilizes lithium iron phosphate cells for stable and safe performance, with high-standard reinforced structural design, multiple levels of safety warnings, and protection, ensuring safety and reliability from the cell to the system.
- Excellent Thermal Insulation Design: The system uses an industrial liquid cooling unit combined with advanced thermal insulation design to efficiently and stably ensure that the energy storage system operates at an appropriate temperature.
- Supports Multiple Units in Parallel: Covers a wide power range of 50kW to 1MW, with multiple configuration options ranging from 2 to 5 hours.
- The system adopts an outdoor cabinet form, offering flexible and straightforward configuration while keeping each cabinet relatively independent and unaffected by others.
- Protection level of IP54, perfectly coping with various types of outdoor weather; the outdoor cabinet has a small footprint, facilitating transportation.

2.5.Product Specifications

The following are the typical configuration parameters for the GXC series outdoor cabinet-type energy storage systems. The actual supply will be in accordance with the technical agreement.

Table 1 Outdoor Cabinet System Parameters Table

Model	**CESS-418K-S**
DC Side	
Battery Rated Energy Storage Capacity	417.9968kWh
System Rated Voltage	1331.2V
System Voltage Range	1164.8V~1497.6V
Battery Type	Lithium Iron Phosphate Battery (LFP)
Battery Moudle Series-Parallel Connection Mode	1P*52S*8S
Maximum Charge/Discharge Current	157A
Conventional Parameters	
Waterproof Level	IP54
Relative Humidity	0~95% (No Condensation)
Charging Temperature	0°C~55°C
Discharging Temperature	-20°C~50°C
Cooling Method	Liquid Cooling
Altitude	2000m
BMS Communication	Ethernet/RS485/CAN
Dimensions (W*D*H)	(1250±5)*(1350±5)*(2335±5)mm
Weight (approx.)	3400±10kg

Note: Actual parameters are set before leaving the factory according to customer requirements.

2.6.Component Introduction

➢ *2.6.1.Battery System*

- The energy storage module specification is 1P52S, with a rated voltage of 166.4V and an energy capacity of 52249.6Wh.
- 314Ah, 0.5C battery cells, battery module, the system parameter table is as follows:

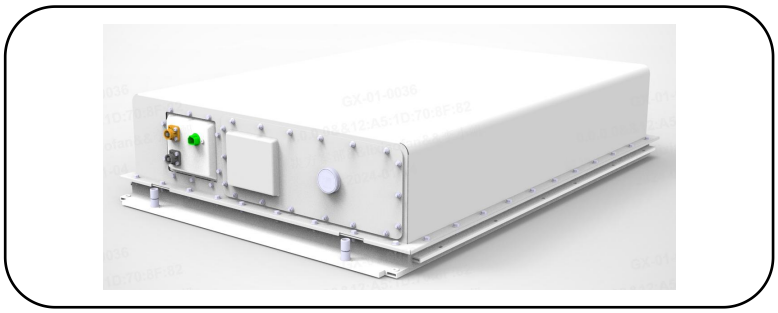


Figure 2 Module Schematic Diagram

Table 2 Battery System Parameters

No.	Name	Specification Parameters	Remarks
1	**Cell Parameters**		
1.1	Battery Type	Lithium Iron Phosphate Battery (LFP)	
1.2	Dimensions	(173.84±0.3) x (204.6±0.5) x (71.41±0.3), Without Terminal Posts (174.4±1.5) x (207.0±1.0) x (71.41±1.5), With Terminal Posts	Thickness Dimension Measurement Conditions: 20%SOC, 300±20 kgf
1.3	Battery Weight/kg	5.56±0.15	
1.4	Cell Nominal Voltage	3.2V	
1.5	Cell Voltage Range	2.5V~3.65V	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
1.6	Cycle Count	≥9000 times	25 ± 2 ℃, 0.5P, 2.8V-3.55V, Degraded to 224Ah;
1.7	Nominal Capacity	314Ah@0.5C,25℃	
1.8	Maximum Continuous Charge Rate	0.5C@25℃	
1.9	Maximum Continuous Discharge Rate	0.5C@25℃	
2	**Module Parameters**		
2.1	Dimensions	826(W)*1155.5(D)*243.5(H)	±2mm
2.2	Nominal Capacity	314Ah@0.5C,25℃	Test Capacity ≥98%, qualified
2.3	Nominal Voltage	166.4V (52cells)	Shipping Capacity 30%-40% SOC
2.4	Operating Voltage Range	145.6~187.2V	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety

			risks
2.5	Maximum Continuous Charge Rate	0.5C@25℃	Not to exceed 157A
2.6	Maximum Continuous Discharge Rate	0.5C@25℃	Not to exceed 157A
2.7	Nominal Weight	345kg	±5kg
2.8	Nominal Energy	52.2496kWh	25℃@1C rated
2.9	*Insulation Standard	Battery Box Insulation Resistance > 1GΩ(1000VDC)	Refer to GB36276-2018
2.10	*Pressure Resistance Standard	3110VDC , No breakdown or flashover phenomenon	Refer to GB36276-2018
2.11	Maximum Charge Voltage per Cell	3.65V	Any single cell, prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.12	Minimum Discharge Voltage per Cell	2.5V	Any single cell, prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.13	Charge High-Temperature Protection	50℃	Battery Module Temperature
2.14	Discharge High-Temperature Protection	50℃	Battery Module Temperature
2.15	Charge Low-Temperature Protection	0℃	Battery Module Temperature
2.16	Discharge Low-Temperature Protection	-20℃	Battery Module Temperature
2.17	Usage Environment	Indoor, dry, constant temperature	-
2.18	Waterproof Level	IP65	-
2.19	Operating Temperature Range (℃)	0 ~ 50	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.20	Storage Temperature Range (℃)	-30 ~ 55	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.21	Storage Environment Humidity (RH)	5% ~ 95%	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety risks
2.22	Operating Environment Humidity (RH)	≤85%	Prohibited from exceeding use, using beyond the specified range will damage the battery and poses safety

			risks
2.23	Operating Efficiency	≥92%	25℃±2℃ 1C charge/discharge @90%DOD
3	**System (Cluster) Parameters**		
3.1	System Rated Energy Storage Capacity	417.9968kWh	-
3.2	System Rated Voltage	1331.2V	-
3.3	System Voltage Range	1164.8V~1497.6V	-
3.4	Series and Parallel Connection Method	1P*416S	-
3.5	Number of Included Battery Modules	8	-

➢ *2.6.2.BMS (Battery Management System)*

➢ 2.6.2.1 Composition of BMS

Primary BMS (BMU)——Located within the battery module, the Battery Management Unit (BMU) is responsible for monitoring internal battery information such as individual cell voltage, temperature, and the total voltage of each module, as well as performing passive balancing functions. Each BMU collects data from one battery module and uploads this data to the BCMU via CAN BUS, while also balancing the cells within the battery module based on commands received from the BCMU.

Secondary BMS (BCMU)——Located inside the high-voltage box, the Battery Cluster Management Unit (BCMU) is in charge of managing the battery cluster. It receives detailed data uploaded from the BMUs within the battery rack and samples the total voltage and current of the battery cluster to calculate and correct SOC (State of Charge) and SOH (State of Health). It manages the pre-charging and charging/discharging of the battery module by controlling relay switches and uploads relevant data to the BAMS (Battery Area Management System) via CAN BUS.

➢ 2.6.2.2 BMS Functional Overview

1) High Precision Monitoring and Reporting of Battery Analog Quantities

This includes real-time voltage detection of the battery cluster, detection of charging and discharging current of the battery cluster, detection of individual cell terminal voltage, multi-point temperature detection of the battery module, and insulation monitoring of the battery cluster.

2) Battery System Operation Alarm, Local Display, and Reporting Function

This includes alarms for battery system over-voltage, under-voltage, over-current, high temperature, low temperature, leakage, communication abnormalities in the battery management system, and internal anomalies of the battery management system.

3) Battery System Protection Function

The Battery Management System will take the battery out of operation in the event of analog quantities like voltage, current, and temperature exceeding safety protection thresholds, simultaneously reporting protection information and displaying it locally.

The BMS has three levels of software protection functions, detailed in the following table：

Table 3 Three-Level Software Protection Items

First Level Alarm (Request Power Reduction)	Second Level Alarm (PCS Standby)	Third Level Protection (Relay Cut-off)
Single Cell Overcharge/Overdischarge Warning Large Voltage Difference Warning for Single Cells High/Low Temperature Warning for Single Cell Charging/Discharging Large Temperature Difference Warning High/Low Total Voltage Warning High Charging/Discharging Current Warning Low Insulation Warning	Single Cell Overcharge/Overdischarge Large Voltage Difference for Single Cells High/Low Temperature for Single Cell Charging/Discharging Large Temperature Difference High/Low Total Voltage High Charging/Discharging Current Low Insulation	Single Cell Overcharge/Overdischarge Large Voltage Difference for Single Cells High/Low Temperature Protection for Single Cell Charging/Discharging Large Temperature Difference Protection Overvoltage/Undervoltage of Total Voltage Overcurrent during Charging/Discharging Low Insulation BMU Communication Timeout BCU Communication Timeout Communication Timeout with EMS or PCS Cell Fault NTC Fault

4) Self-Diagnostic Function

The Battery Management System is equipped with a self-diagnostic capability, which allows it to report communication interruption alarms when internal communication within the battery management system or external communication encounters a disruption. Furthermore, the system has the functionality for fault self-diagnosis, local display, and reporting to the local monitoring system for other anomalies, such as abnormal analog quantity collection.

5) Balancing Function

The Battery Management System employs a passive balancing strategy to effectively maintain the uniformity of the battery module.

6) Operating Parameter Setting Function

The Battery Management System provides the capability to locally modify various operating parameters of the battery management system. The parameters that can be set include:

- Upper limit voltage for individual cell charging
- Lower limit voltage for individual cell discharging
- Maximum operating temperature for the battery
- Minimum operating temperature for the battery
- Overcurrent threshold for the battery

7) The Battery Management System can locally display various operating statuses of the battery system, including:

- System operation status display
- Individual cell voltage/temperature inquiry and display
- Battery module voltage/temperature inquiry and display
- Battery cluster current/SOC/SOH inquiry and display
- Alarm information display
- Display of other abnormal information

The Battery Management System can perform a full charge and discharge of the battery module in conjunction with the PCS (Power Conversion System), completing the battery system capacity calibration as well as SOC (State of Charge) calibration function.

8) External Communication

Table 4 BMS Communication Table

Sequence Number	Communication Equipment	Communication Method	Remarks
1	BMS-PCS	485	
2	BMS-PCS	Dry Contact	Normally closed, open in case of failure
3	BMS-EMS	Ethernet	

Note: In the absence of a technical agreement from the customer, it is provided by the supplier. Any modifications later on require business coordination.

➢ 2.6.2.3 BMS Parameters

Table 5 Technical Parameters Table

No.	project	parameters
1	BMS Operating Voltage Range	24V
2	Low Voltage System Power Consumption	≤2.5W@24V (Single board power consumption, excluding BMU, BCU, and relay control power consumption)
3	BMS Static Current	≤0.1mA
4	BMS Operating Temperature Range	-40 ~ 85℃
5	BMS Storage Temperature Range	-40 ~ 85℃
6	BMS Storage Humidity Range	10% to 90% (Non-condensing)
7	Single Cell Voltage Detection Range	0 ~ 5V
8	Single Cell Voltage Detection Resolution	1mV
9	Single Battery Voltage Detection Accuracy	≤±5mV
10	Single Battery Voltage Detection Frequency	＜200ms
11	Total Voltage Detection Channel Number	1
12	Total Voltage Measurement Range	0V ~ 1500V
13	Total Voltage Detection Resolution	100mV
14	Total Voltage Detection Accuracy	<0.5% FSR (Full Scale Range)
15	Temperature Measurement Range	-40 ~ 125℃
16	Temperature Detection Resolution	1℃
17	Temperature Detection Accuracy	-40 ~ 75℃≤±1℃ 75 ~ 125℃≤±2℃
18	Number of BMU Voltage Detections	52S
19	Number of Slave Board Temperature Detections	52
20	Total Current Detection Range	-300A ~ 300A
21	Current Detection Accuracy	<0.2%FSR (Full Scale Range)
22	Current Detection Cycle	50mS
23	Current Detection Channel Number	1
24	Insulation Monitoring	Three levels of insulation fault detection: 0: No fault (>500Ω/V), 1: General fault (250~500Ω/V), 2: Severe fault (<100Ω/V)
25	Insulation Detection Accuracy	<10% (Compared to the actual insulation value, deviation

		not exceeding 10%)
26	SOC Estimation Accuracy	SOC <8% (Charge-discharge calibration performed once a month)
27	SOC Calibration	Yes
28	Balancing Mode	Passive Balancing
29	Passive Balancing Current	Not less than 80mA
30	Supported Communication Interfaces	CAN, RS485, Ethernet
31	Number of BCU Relay Control Channels	6 channels
32	BCU Relay Control Current	- Rated at 1A, peak 5A (for 1s)
33	Number of BMU Relay Control Channels	2 channels
34	BMU Relay Control Current	Rated at 1A, peak 5A (for 1s)
35	Fault Data Recording	Equipped with an integrated real-time clock module, providing large capacity memory to record battery data detected during the operation of the battery management system and the time of occurrence, for system diagnosis and performance optimization.
36	Relay Adhesion Detection	Yes
37	Power-on Self-test	Yes

➢ 2.6.2.4 Operating Strategy

When the battery is fully charged, a "fully charged" status should be sent, maintaining this status to notify the PCS (Power Conversion System) to stand by and prohibit charging (although discharging is allowed). The prohibition on charging can only be lifted when the average cell voltage drops below 3.265V, and a discharge current of more than 5A is simultaneously detected.

After the battery has been fully discharged, a "fully discharged" status should be sent, maintaining this status to notify the PCS to stand by and prohibit discharging (requiring timely charging). It is forbidden to draw power from the DC side while the PCS is in standby mode until the prohibition on discharging can be lifted, which is allowed only when the average cell voltage is above 3.2V, and a charging current of more than 5A is simultaneously detected.

Note: The charging and discharging strategy should use the battery voltage as a reference. If the battery's State of Charge (SOC) value is used as a reference for the charging and discharging strategy, it must be confirmed with our company in advance. If not confirmed with our company, we will not bear any responsibility!

Alarm Threshold Table and Treatment Measures (These thresholds are factory default values, and should be adjusted based on actual site application conditions)

Table 6 Fault Threshold Table

Fault name	Fault level	Failure value	Latency	Release value	Latency	Treatment program
High Total Voltage	Level 1	1476.8	3S	1466.8	5S	Alarm, operation at reduced power of 50%.
	Level 2	1497.6	3S	1487.6	5S	Request PCS to standby, prohibit charging, allow discharging.
	Level 3	1518.4	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Total Voltage during Discharge	Level 1	1123.2	3S	1023.2	5S	Alarm, operation at reduced power of 50%.
	Level 2	1081.6	3S	981.6	5S	Request PCS to standby, prohibit discharging, allow charging.
	Level 3	1040	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
High	Level 1	3.55V	3S	3.35V	5S	Reduce power by 50%.

Single Cell	Level 2	3.60V	3S	3.28V	5S	Request PCS to standby, prohibit charging, allow discharging.
	Level 3	3.65V	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Single Cell	Level 1	2.8V	3S	3.1V	5S	Reduce power by 50%.
	Level 2	2.7V	3S	3.25V	5S	Request PCS to standby, prohibit discharging, allow charging.
	Level 3	2.6V	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Single Cell Voltage Difference	Level 1	0.4V	5S	0.2V	5S	Alarm, operation at reduced power of 50%.
	Level 2	0.6V	5S	0.3V	5S	Request PCS to standby, prohibit both charging and discharging.
	Level 3	0.8V	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
High Temperature during Charging	Level 1	45°C	5S	40°C	5S	Alarm, operation at reduced power of 50%.
	Level 2	50°C	5S	45°C	5S	Request PCS to standby, prohibit both charging and discharging.
	Level 3	55°C	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
High Temperature during Discharge	Level 1	45°C	5S	40°C	5S	Alarm, operation at reduced power of 50%.
	Level 2	50°C	5S	45°C	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	55°C	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Temperature during Discharge	Level 1	0°C	5S	5°C	5S	Alarm, operation at reduced power of 50%.
	Level 2	-10°C	5S	0°C	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	-20°C	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low Temperature during Charging	Level 1	5	5S	10°C	5S	Alarm, operation at reduced power of 50%.
	Level 2	0°C	5S	5°C	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	-5°C	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Temperature Difference	Level 1	10°C	5S	8°C	6S	Alarm, operation at reduced power of 50%.
	Level 2	15°C	5S	13°C	6S	Request PCS to standby, prohibit charging and discharging.
	Level 3	20°C	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Overcurrent during Charging	Level 1	130A	5S	110A	5S	Alarm, operation at reduced power of 50%.
	Level 2	150A	5S	130A	5S	Request PCS to standby, prohibit charging.
	Level 3	170A	3S		5S	Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.

Overcurrent during Discharge	Level 1	130A	5S	110A	5S	Alarm, operation at reduced power of 50%.
	Level 2	150A	5S	130A	5S	Request PCS to standby, prohibit discharging.
	Level 3	170A	3S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Low SOC	Level 1	10%	5S	15%	5S	Alarm only, no action taken.
	Level 2	5%	5S	10%	5S	Alarm only, no action taken.
	Level 3	/	/	/	/	
High SOC	Level 1	95%	5S	90%	5S	Alarm only, no action taken.
	Level 2	100%	5S	95%	5S	Alarm only, no action taken.
	Level 3	/	/	/	/	
Insulation Leakage	Level 1	1000 Ω/V	5S	1200Ω/V	5S	Alarm, operation at reduced power of 50%.
	Level 2	500Ω/V	5S	600Ω/V	5S	Request PCS to standby, prohibit charging and discharging.
	Level 3	100Ω/V	5S	200Ω/V	5S	Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
Cell Fault	/		1S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
NTC Fault	/		1S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
BCU and BMU Communication Fault	/	/	5S	/	/	Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
BAU and BCU Communication Fault	/	/	5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.
EMS (PCS) Communication Fault			5S			Request PCS shutdown and provide dry contact output, delay 3 seconds before cutting off all contactors, restore upon restart.

Note: The dry contact of BMS-PCS is normally closed and opens in case of a fault.

Explanation: BCU, BMU, BAU are terms used by some battery manufacturers for the three levels of BMS, and different manufacturers may have different terminologies.

➢ *2.6.3.Environmental Control System*

The energy storage system is equipped with smoke detectors, temperature detectors, water immersion sensors, limit sensors, emergency stop buttons, and fire suppression units among other environmental control elements, allowing for comprehensive monitoring of the system's operational status. Schematic of the environmental control system：

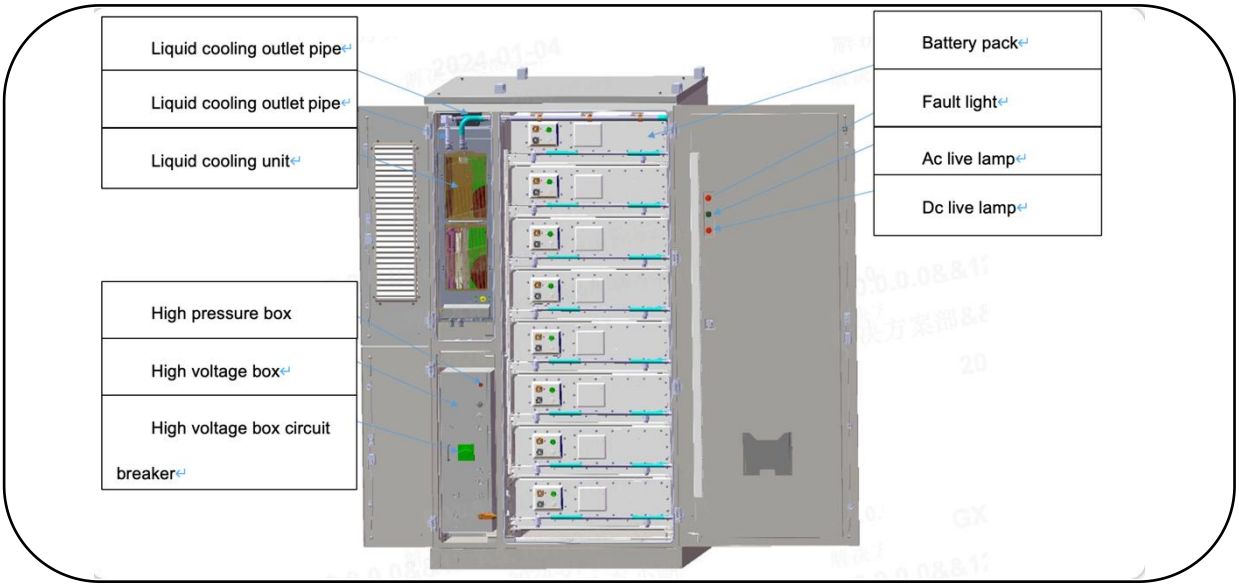


Figure 3 Cabinet Interior Structure Diagram

➢ 2.6.3.1 Precision air-conditioning parameters

Table 7 Precision air-conditioning parameters

Project	Unit	Value
Dimensions, Weight & Installation Method		
Model		EMW90HDNC1U
External Dimensions (Height x Width x Depth)	mm	275×1150×1040
Weight (excluding refrigerant)	kg	115
Installation Method		Plug-in type
Application Environment		Outdoor model
Inlet and Outlet Pipe Interface Form		DN20 quick connector
Environmental Protection & Performance		
Operating Environmental Range	℃	-30~+55
Storage Environmental Range	℃	-40~+70
Noise Level @L45/W18	dB(A)	75
Anti-corrosion Grade		C3
Equipment Exterior Color		Outdoor orange-peel texture RAL7035
IP Protection Level		IP54
Refrigerant		R134a
Refrigerant Charge		Pure water, containing 50% ethylene glycol solution
RoHS Certification		
Cooling/Heating Capacity		
Cooling Capacity @L35/W18	kW	8.0
Heating Capacity	kW	2.0
Outlet Water Temperature	℃	15
Parameter Setting		
Liquid Temperature Setting Range	℃	10 to 35 (Heating point ≤ Cooling point)
Default Cooling Setpoint	℃	15
Default Heating Setpoint	℃	10

Communication Method		RS485
Communication Protocol		Modbus RTU
Circulating Water Flow		
Rated Circulating Water Flow	L/min	50
Rated External Circulation Head	Kpa	90
Power Consumption		
Cooling Input Power @L35/W18	kW	4.3
Cooling Input Power @L45/W18	kW	4.7
Heating Input Power @Tu=10°C	kW	2.7
Self-circulating Model (Single Pump Operation) Power	kW	0.5
Maximum Power Consumption	kW	4.8
Power Supply Standard		
Rated Working Voltage	V, Hz	220V 50/60±3Hz
Supported Voltage Range	V, Hz	220±15%,50/60±3Hz
Maximum Working Current	A	25

➢ 2.6.3.2 Water Immersion Detection Device

The water immersion detection device checks whether there is any leakage in the energy storage system.

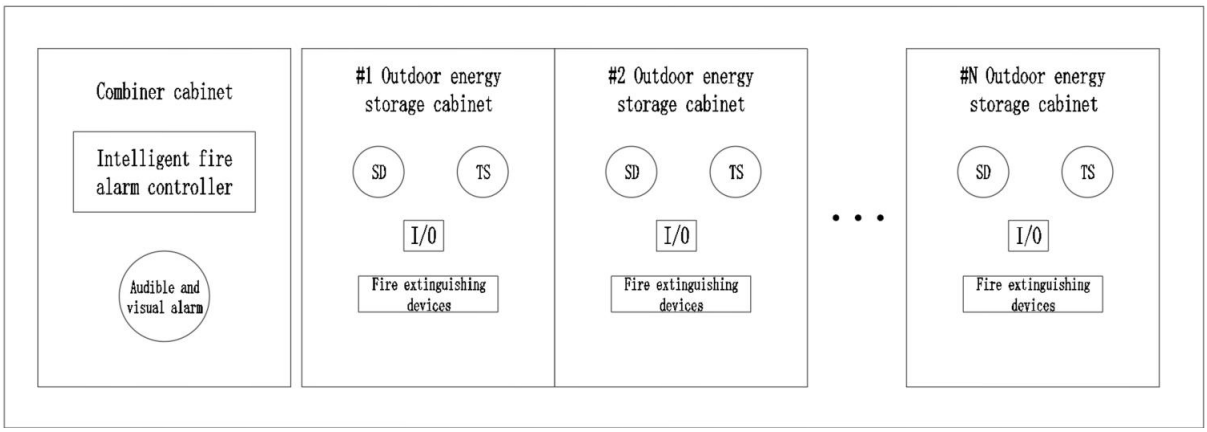
Table 8 Parameters of Water Immersion Sensor

Name	Parameters
Working Voltage	DC24V (permissible range 10V~30V)
Working Current	≤0.1A
Detection Channel	1 channel, 2-core leak detection cable
Response Time	<2s
Relay Output	Normally open, contact capacity 1A 30VDC
Operating Environment	Temperature: -10°C~+65°C Relative Humidity: <95% RH (no condensation)

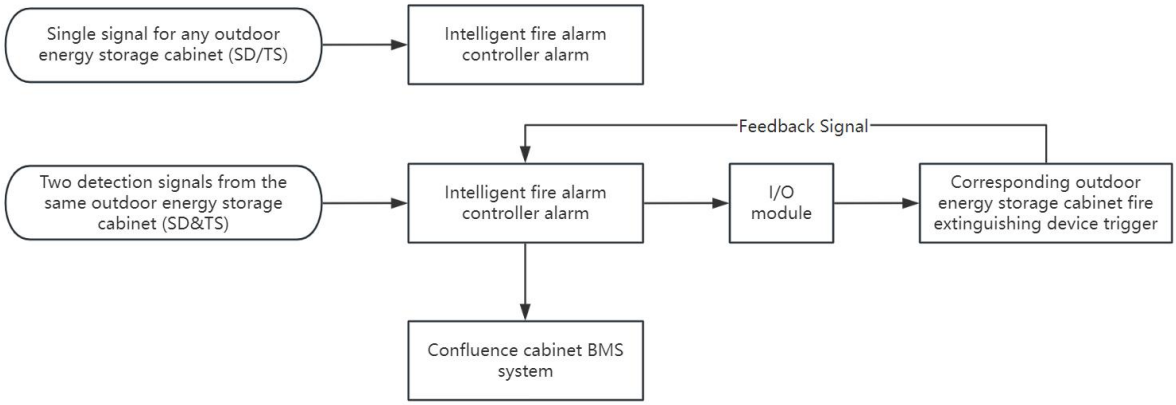
➢ *2.6.4.Firefighting System*

An energy storage cabinet serves as a protection unit, and each protection unit contains one I/O module, one point-type photoelectric smoke detector, one point-type temperature-sensitive fire detector and one fire extinguishing device. Intelligent fire alarm controller according to the set control logic to the relevant controlled equipment issued by the linkage control signal, and accept the linkage feedback signal of the relevant equipment, its power capacity to meet the controlled fire equipment to start and maintain the work of the control capacity requirements. Intelligent fire alarm controller linkage control of a protective unit of the fire extinguishing device, the linkage trigger signal using the same protective unit of two independent alarm trigger device alarm signal "and" logic combination.

➢ 2.6.4.1 Firefighting System Layout Diagram



➢ 2.6.4.2 Control Logic Flowchart



➢ 2.6.4.3 System Device Composition

2.6.4.3.1 Perfluorohexanone Fire Extinguishing Device

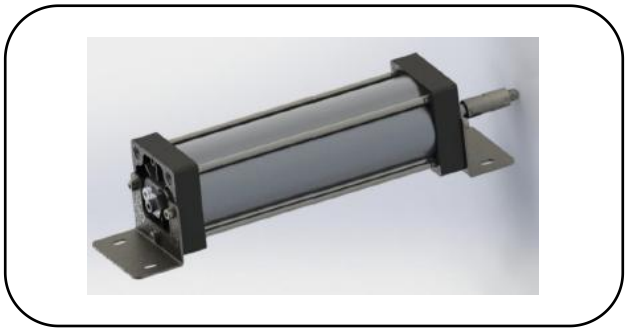


Figure 4 Physical Display

Table 9 Technical Parameters

Project	Parameters	Project	Parameters
Model Specification	YF2.0Q-HS	Net Weight per Unit	6600g ± 150g (excluding bracket)
Operating Temperature Range	- 30℃ ~ + 70℃	Dimensions	Length: 535 ± 5mm, Width: 121 ± 0.5mm, Height: 121 ± 0.5mm
Operating Relative Humidity	≤95%RH	Activation Method	Electrical/Thermal Activation
Reliable Starting Current	≥700mA	Safety Current	≤150mA
Heat Initiator Activation Temperature	185±10℃	Feedback Type	Normally open, active close
Effective Discharge Time	≤60s	Injection Lag Time	<10s
Extinguishing Agent Name	Perfluorohexanone	Extinguishing Agent Charge	2600g
Protected Space	$5m^3$	Shelf Life	10 years

2.6.4.3.2 Fire alarm controllers/fire linkage controllers

Content		Technical Parameters
AC Mains Power	Input Voltage	100-240VAC
	Frequency	50~60Hz
	Input Current	1.5 A
	Fuse	2A delay
Standby Power	Battery Voltage	24VDC
	Battery Maximum Operating Current	2.82 A
	Quiescent Current under Full-loaded Condition	0.75 A
	Maximum Internal Resistance	1 Ω
	Maximum Charge Voltage	27.6 V
	Maximum Charge Current	1.2 A
	Maximum Charge Capacity	Two 12V/21Ah batteries
	Type	Sealed lead acid batteries
Detector Loop Parameters	Number of addressable devices	Maximum 235
	Output Voltage	21V ~ 27V pulse
	Output Current	0mA ~ 300mA
	Type of Loop	Class A loop
FIRE ALARM OUTPUT	Output Voltage	21VDC ~27VDC
	Output Current	0mA ~500mA
	End of Line Resistor	4.7kΩ
F.P.E. OUTPUT	Output Voltage	21VDC ~27VDC
	Output Current	0mA ~500mA
	End of Line Resistor	4.7kΩ
SOUNDER CIRCUIT OUTPUT	Output Voltage	21VDC ~27VDC
	Output Current	0mA ~500mA
	End of Line Resistor	4.7kΩ
FAULT OUTPUT	Contact Capacity	24VDC @1.0A
	Fault State	NC and COM are open, NO and COM are closed.
Dimensions		420mm×580mm×202mm

2.6.4.3.3 I/O module

Content	Technical Parameters
Operating Voltage	Loop 24VDC(16VDC - 28VDC)
Standby Current	≤0.26 mA
Action Current	Loop≤ 0.7mA
Relay Output	NO or NC
Output Capacity	2A@30VDC. Contact resistance is 30kΩ in normal. It closes after starting.
Programming	Electronically addressing
Address Range	Two options preset by manufacturer: Option 1: Both Input and Output occupy one address that ranges from 1 to 242. Option 2: Occupy two addresses representing Input and Output. Input address range is 1 to 241. Output

	address is automatically programmed as input address plus 1.	
LED	Input LED: Red. It lights in receiving feedbacks, lights 0.5s on, 0.5s off in input faults, and flashes in other states. Output LED: Red. It lights in relay action, 0.5s on and 0.5s off as there is output fault. It turns off in other states.	
Ingress Protection Rating	IP30	
Linear	Nonpolarized 2-bus	
coding method	Electronic coding, can be set anywhere from 1 to 242	
External Dimension	85.3mm × 78mmm ×33mm	
Operating Temperature	-10℃ - +55℃	
Relative Humidity	≤ 95%，non-condensing	
Compatible DIN-Rail	35mm DIN-Rails	
Materials of the Enclosure	ABS, white(RAL9016)	
Dimension(L×W×H)	85.3mm×78mm×33mm	
Weight	About 66.5g	

2.6.4.3.4 Point-type photoelectric smoke detectors

Content	Technical Parameters	
Operating Voltage	Loop 24V(16V ~ 28V)	
Standby Current	≤0.8mA	
Alarm Current	≤1.8mA (without remote indicator) ≤3.8mA (with remote indicator)	
Fire LED	Red, Flash in polling, and illuminate in alarming.	
Remote indicator output	Polarity-sensitive output, directly connect to remote indicator (built in 10k resistor in series, max. output current is 2mA); Flash in alarming and do not illuminate in normal.	
Programming	Electronically addressed.	
Programming Range	Occupying one address within 1 ~ 242.	
Setting of sensitivity and range	The sensitivity can be set by programmer with two levels: Level 1(default), level 2.	
Wiring	Loop: two wire, polarity-insensitive	
Environmental Temperature	-10℃ ~ +50℃	
Relative Humidity	≤95%, non-condensing	
Material and Color	ABS white (RAL 9016)	
Ingress Protection Rating	IP2X	
Dimension	Diameter: 100mm	

	Height: 44.5mm(without base)	
Mounting Hole Distance	45mm ~ 75mm	
Weight	About 110g	

2.6.4.3.5 Point-type photoelectric temperature sensing fire detectors

Content	Technical Parameters	
Operating Voltage	Loop 24V(16V ~ 28V)	
Standby Current	≤0.6mA	
Alarm Current	≤1.5mA (without remote indicator) ≤3.5mA (with remote indicator)	
Indicator	Red, Flashes in polling, and illuminates in alarm	
Remote indicator output	Polarity-sensitive, directly connects to remote indicator (built in 10k resistor in series. Maximum output current is 2.0mA); The remote indicator is quiet in normal and flashing in alarm.	
Programming Method	Electronically programmed	
Code Range	One address within 1~242.	
Classes and Setup	3 classes (A1R, A2S, BS) programmable	
Wiring	Non-polarized 2-core for loop. Polarized 2-core for remote indicator.	
Ingress Protection Rating	IP2X	
Ambient Temperature	Class A1: -10℃~+50℃ Class A2: -10℃~+50℃ Class B: -10℃~+65℃	
Typical Fixed Temperature	Class A1: 58℃ Class A2: 62℃ Class B: 77℃	
Relative Humidity	≤95%, non-condensing	
Material	ABS	
Dimensions	Diameter: 100mm Height: 53.3mm (with base)	
Mounting Hole Distance	45mm~75mm	
Weight	About 110g (with base)	

➢ *2.6.5.Configuration lists*

In summary, the overall configuration list of the energy storage system in a typical configuration is as follows:

Table 10 Outdoor cabinet energy storage system overall configuration list

Name	Model	Unit	Number	Remarks
Battery System	314Ah, 417.9968kWh	Cover	1	With control box
Distribution System	Plastic case, miniature circuit breaker, lightning protection, sockets, indicator lights	Cover	1	
Air Conditioning System	AC 220±15%VAC~50Hz, 8kW cooling, 2kW heating	Cover	1	Precision air conditioning
Firefighting System	Temperature sensor, smoke sensor, Perfluorohexanone device	Cover	1	Thermally activated type
Auxiliary System	Leak sensor, limit switch, emergency stop button, lighting	Cover	1	Auxiliary support equipment

The actual supply configuration shall prevail.

3 Installation and Wiring

3.1.Transportation and Handling

➢ *3.1.1.Product Transportation*

- To ensure the equipment is in a good protective state, it is recommended to transport it with packaging;
- Equipment transportation must follow the requirements indicated on the packaging to prevent personal injury and equipment damage;
- It is not recommended to transport energy storage batteries by rail or air. Speed limits for land transportation: 80 km/h on flat roads and 60 km/h on rugged roads. In case of any conflict, local traffic regulations should prevail。

➢ *3.1.2.Product Handling*

- When using a forklift for moving, ensure the forklift has sufficient load capacity and that the center of gravity of the equipment is between the forks to prevent personal injury and equipment damage;
- For transportation with batteries, the forklift's load capacity needs to be ≥5t; for transportation without batteries, the forklift's load capacity needs to be ≥1.5t;
- The recommended fork blade length is ≥1.5m, width between 80cm to 160cm, and thickness between 25cm to 70cm.

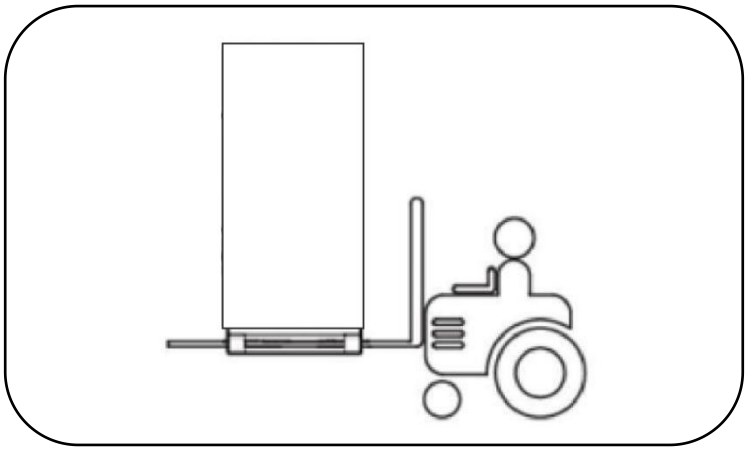


Figure 5 Handling Diagram

3.2.Packaging and Storage

➢ *3.2.1.Product Packaging*

To keep the product in a good protective state during transportation, specific wooden crate packaging is used. The equipment packaging has the following basic parameters (including but not limited to), which need to be carefully verified according to project requirements.:

Table 11 Table of Packaging Garameters

Parameters	Description
Model	Product Model
Dimensions	Dimensions after packaging
Weight	Total weight after packaging
Label	Instructions such as "This side up", "Handle with care", and "Center of gravity location"

➢ *3.2.2.Product Storage*

If the product is not to be immediately transported or installed for use, it must be stored indoors, and the storage location must meet the following conditions:

Table 12 Requirements for Product Storage Conditions

Parameters	Requirements
Storage Temperature (excluding battery)	-25°C to +60°C
Battery	20°C to 30°C
Storage Relative Humidity	<95% (no condensation)
Altitude	<3000m

Note:

Long-term storage of batteries is not recommended. Long-term storage of lithium batteries can lead to capacity loss, with an irreversible capacity loss of 3% to 10% after 12 months of storage at the recommended storage temperature. The total storage and transportation time of the battery module should not exceed 8 months (starting from the time of dispatch). If exceeding 8 months, recharging and SOC calibration are required, with at least 50% SOC needed. Failure to recharge as required may affect the battery's performance and service life.

3.3.Installation Environment Requirements

The layout for the installation of energy storage systems must meet the local standards for fire protection distances or firewall requirements, including but not limited to the "GB 51048-2014 Electrochemical Energy Storage Station Design Specification" and the "NFPA 855 Standard for the Installation of Stationary Energy Storage Systems." Energy storage systems are only suitable for outdoor scenarios and require outdoor arrangements; indoor arrangements are not supported. The general requirements for site selection are as follows:

- The installation site should be above the highest historical water level of the area. The distance from airports, buried garbage disposal sites, riverbanks, or dams should be ≥2km.
- Choose a location with good ventilation. During equipment operation, do not block the ventilation ports and cooling systems to prevent overheating and fire. Ensure sufficient installation space to prevent nearby equipment from being affected by the heat generated by the product; ensure there is enough external wiring space at the installation site. The location should have convenient transportation conditions and reliable fire suppression system equipment.

- The installation site should be away from sources of fire, and flammable or explosive materials should not be placed around the equipment. If the equipment is installed in areas with dense vegetation, in addition to routine weeding, the ground below the equipment should be hardened to prevent weed overgrowth.
- Do not install energy storage systems outdoors in salt-damaged areas to prevent equipment corrosion and potential fire hazards. Salt-damaged areas refer to regions within 2km of the coast or areas affected by sea breeze.
- Energy storage systems must have protective measures such as fences or walls, with safety warning signs erected for isolation, to prevent unauthorized personnel from entering during the operation of the equipment, thereby avoiding personal injury or property damage.
- Equipment should be installed away from liquids, not under locations prone to condensation, such as water pipes and air vents; it should not be installed under air conditioning vents, ventilation ducts, or windows where equipment exits rooms, to prevent liquid from entering and causing short circuits in the equipment.

Description

When the safety distance of the selected site cannot meet the relevant national standards, it is recommended to reconsider the site selection. The site selection should avoid scenarios not recommended by industry standards and regulations, including but not limited to the following areas and places：

- Areas with strong vibrations, noise sources, and strong electromagnetic field interference.
- Places that produce or contain dust, cooking fumes, harmful gases, corrosive gases, etc.
- Places that produce or store corrosive, flammable, or explosive materials. Within the danger range of blasting.
- Locations with existing underground facilities. Places with dense populations, high-rise buildings, or underground constructions.
- Areas with adverse geological conditions such as rubbery soil, weak soil layers, prone to water accumulation and subsidence.
- Within the boundaries of mining collapse (fault displacement) areas. Areas that could be flooded after the breach of dams or levees.
- Seismic faults and earthquake zones with a design intensity of more than 9 degrees. Areas directly endangered by mudslides, landslides, quicksand, karst caves, etc.
- Important water source sanitation protection areas.
- Historical and cultural heritage protection areas.

If no more suitable site is available, it is recommended to install a firewall with a fire resistance of not less than 3 hours for safety protection, while also considering the space requirements for equipment transportation, installation, and maintenance. It is recommended to refer to T/CEC 373-2020: The length and height of the firewall should exceed the outer contour of the energy storage cabinet by 1m each.

3.4.Preparation Before Installation

1) Before installing the product, check whether the product is intact. If any damage is found, please retain evidence and contact Jiangsu Nantong Energy Technology Co., Ltd.
2) If the product is confirmed to be normal, please check against the delivery list to see if all accessories are complete.

Table 13 Delivery List

No.	Name	Quantity	Remarks
1	Outdoor Cabinet Energy Storage System	1 set	Includes cabinet door keys
2	User Manual	1 copy	
3	Certificate of Conformity	1 piece	
4	Factory Inspection Report	1 piece	

3) Before installation, users are required to prepare relevant installation tools.

Table 14 List of Installation Tools

No.	Name	Quantity	Remarks
1	Screwdriver Set	1 set	
2	Socket Set	1 set	
3	Multimeter	1 unit	
4	Forklift	1 unit	
5	Screws, Nuts, Washers	Several	

3.5.Mechanical Installation

- After confirming that the product is normal and all accessories are complete, the following suggestions for mechanical installation can be considered:：
- Choose the equipment installation location based on the product dimensions in advance, and make proper positioning and fixing; the foundation is recommended as shown in Figure 6.
- Considering the product weight, the selected installation location needs to have sufficient load-bearing strength；
- Ensure a reliable grounding point, with a ground resistance of less than 4Ω。
- To prevent rainwater from entering, it is recommended to install the product on a cement pedestal, with a recommended height of 300-400mm.

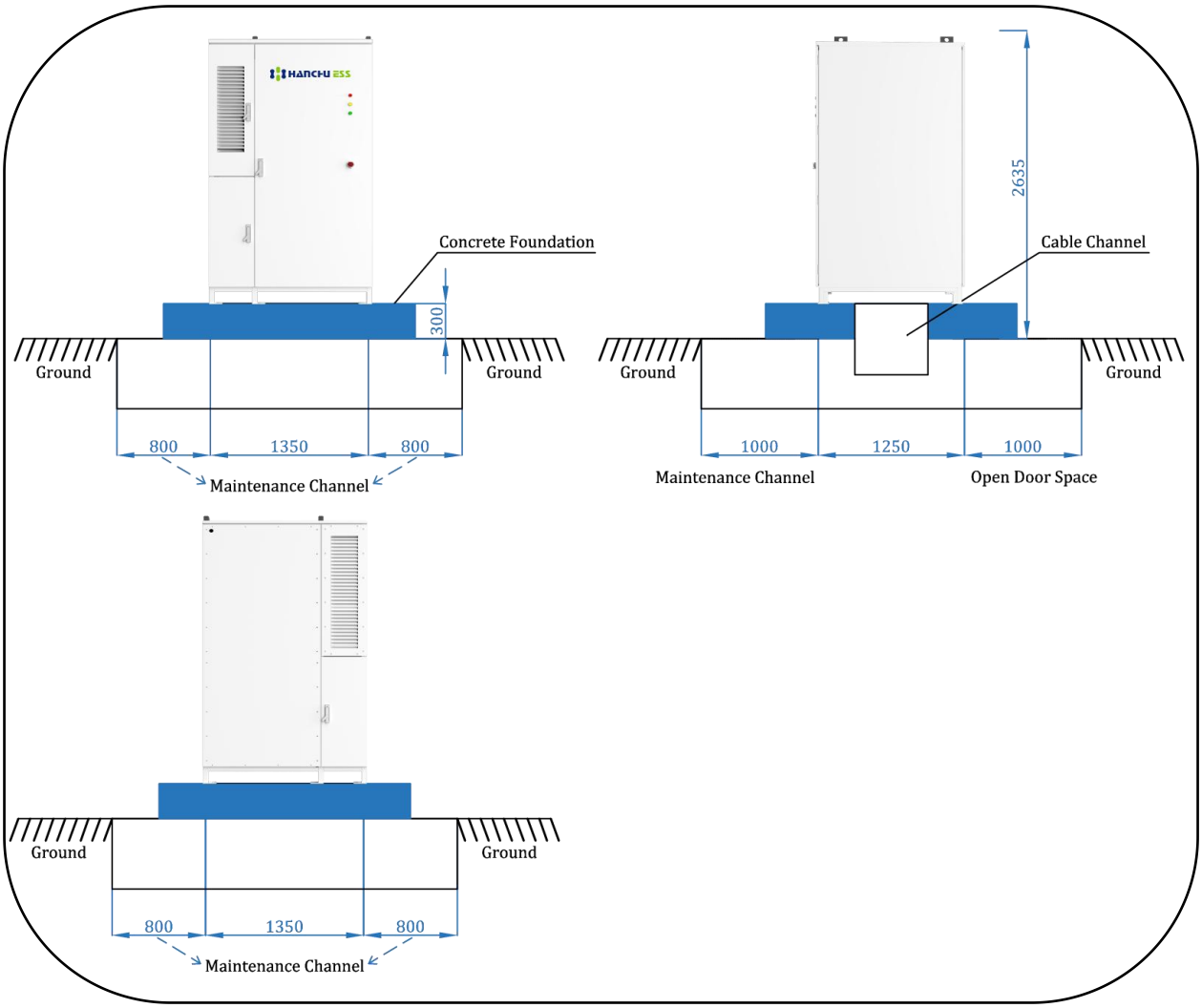


Figure 6 Equipment Installation in Place

3.6.Electrical Cable Installation

This product uses an integrated structure, with the DC side internally wired, requiring only the AC side and external communication for electrical cable installation on-site. The company provides wiring references as per Table 15, based on the product power and cable specifications. The selection of cable diameter should comply with local cable standards. Factors affecting cable selection include rated current, cable type, laying method, environmental temperature, and maximum acceptable line loss.

Table 15 Cable Diameter Comparison Table

Model Capacity	AC Cable	Neutral Line	Ground Wire	Positive and Negative DC Input (busbar level)
100kW	≥3*50mm²	≥50mm²	≥50mm²	Single module≥50mm2

Danger:

When performing electrical installations, the following suggestions may be considered:

(1) Before wiring, check that all switches within the equipment are in the off position, ensuring the equipment is de-energized.

(2) Disconnect the power grid switch before wiring, ensuring the cables are de-energized;

(3) Ensure correct cable phase sequence, which can be differentiated with different colored insulation sleeves or markings such as yellow, green, red, and black, to prevent phase sequence errors;

(4) Cable wiring terminals and busbar connections must be tightened, and screw length should be appropriate to avoid affecting insulation and fastening;

(5) Communication wires and power cables should be laid separately as much as possible, ensuring the cable insulation is not damaged during laying;

(6) Grounding cables must be reliably connected to the grounding busbar, and the cable cross-sectional area must meet design requirements;

(7) All AC cables should enter and exit the equipment through the bottom holes and then be connected to the corresponding phase sequence;

(8) After wiring is completed, use fireproof putty to seal the wiring crevices to prevent external rodents from entering and damaging the equipment or cables.

To prevent contact resistance increase and heating due to loosened terminal connections from force, ensure the bolts fastening the terminals meet the torque requirements listed in Table 16:

Table 16 Wiring Torque Requirements

Screw Size	M4	M5	M6	M8	M10	M12	M14	M16
Torque (N*m)	1.8~2.4	4~4.8	7~8	22~29	44~58	76~102	121~162	189~252

The entry and exit method of the energy storage system's cables is from the bottom. After removing the switch baffle, the power output terminals can be seen and wired in sequence.

- When using copper-core cables or copper-clad aluminum cables, please use copper connection terminals.
- When using aluminum alloy cables, please use copper-aluminum transition terminals or aluminum terminals with copper-aluminum transition pads.

3.7.Communication Cable Installation

When installing external communication wires, ensure they are laid separately from power cables. When communication wires are laid parallel to power cables, it is recommended to maintain a distance of no less than 300mm. When communication wires must cross power cables, try to ensure a 90° angle between the two types of cables to minimize electromagnetic interference from power cables. Communication wires should be supported close to the ground as much as possible, such as through wire ducts, metal rails, etc. If support is not available, zip ties can be used for basic fixation.

The system's back-end communication can use RS485 or Ethernet, with system communication protocols using Modbus RTU or TCP; double-foot shielded wire or industrial Ethernet cable for wiring.

4 Power On and Commissioning

4.1.Typical System Architecture

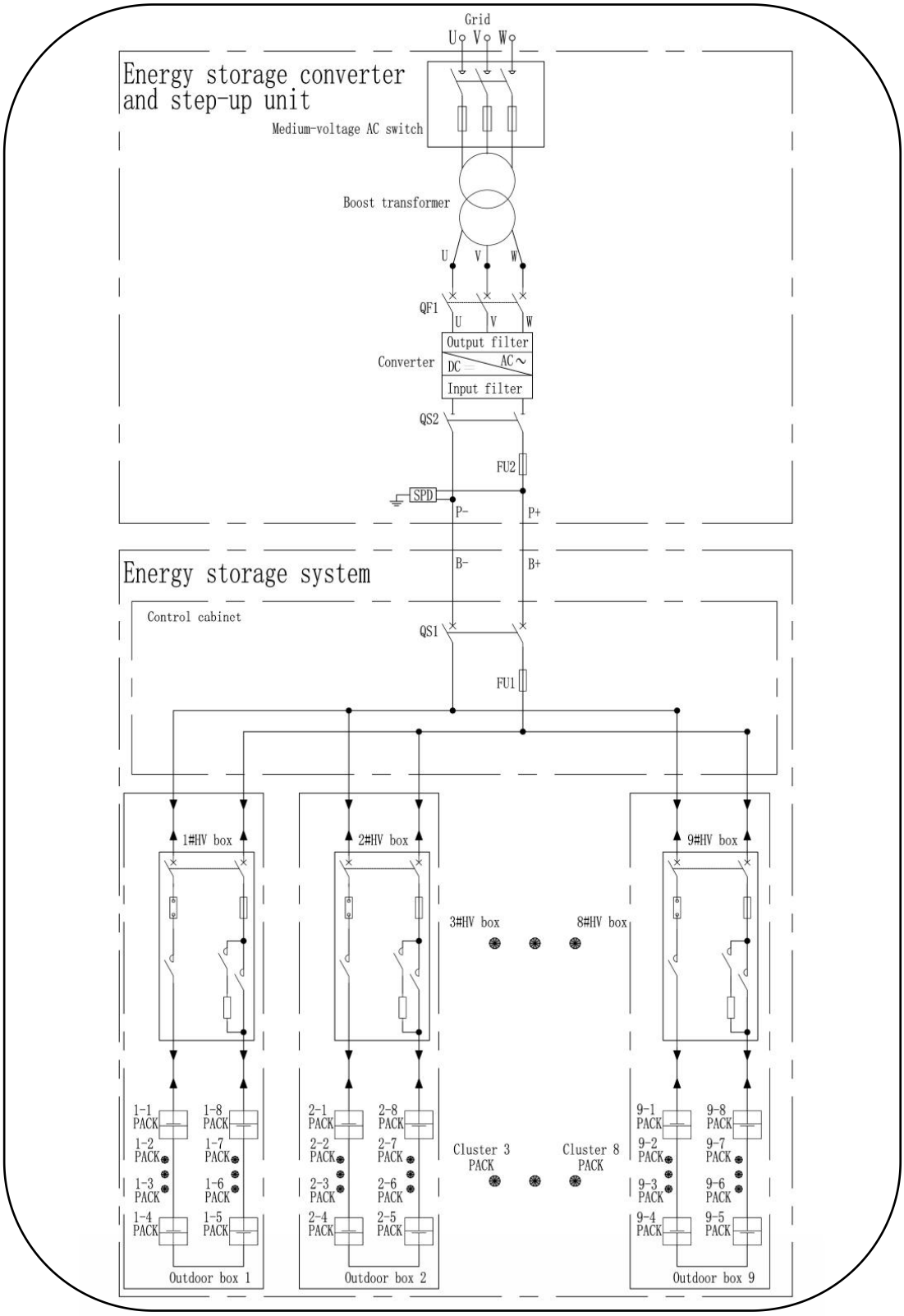


Figure 7 Typical Architecture Diagram For Outdoor Cabinet Use

In the Hanchu commercial split-type liquid-cooled outdoor cabinet, each cabinet only contains the DC side and needs to be used in conjunction with AC side equipment such as a combiner box and inverter to form a complete energy storage system. Based on the characteristics of the outdoor cabinet, the system configuration is relatively flexible and can be applied to various scenarios. Figure 7 presents the most typical usage scenarios, including configuration in large-scale energy storage scenarios such as new energy generation side, grid side for voltage and frequency regulation, and large-scale industrial and commercial energy storage. It can replace traditional forms of containerized energy storage systems, offering several advantages such as easy transportation, small footprint, and independence of each outdoor cabinet. Additionally, the outdoor cabinet can also be used alone, in conjunction with inverters or photovoltaic storage integrated machines, to build new energy microgrid systems serving small industrial and commercial scenarios.

4.2.Pre-Startup Inspection

Before operating the product, ensure it has been installed according to specifications and perform a comprehensive and detailed inspection of the machine. Only after ensuring all indicators meet the requirements can the machine be started.

1) Exterior Inspection：
   a、 The equipment's exterior is intact, without damage, rust, or paint loss. If there is paint loss, carry out repainting operations；
   b、 Equipment labels are clear and visible; damaged labels should be replaced in time.
2) Grounding Inspection: The cabinet has a grounding point, and the grounding is secure; the grounding conductor inside the cabinet is reliably connected to the cabinet's grounding busbar.
3) Cable Inspection：
   a、 The cable protective layer is intact without obvious damage；
   b、 Terminals are made according to specifications, and connections are secure and reliable；
   c、 Labels at both ends of each cable are clear and precise, the routing complies with the principle of separation between high and low voltage, with slack left at bends, without being pulled tight；
   d、 Cable installation bolts are tightened, and cables do not loosen when pulled; sealing of cable through holes is complete.
4) Busbar Inspection: Busbars have no obvious cracks or deformation, screws at joints are tightened, marking lines are correctly positioned, and there are no foreign objects on the busbars.
5) Component Inspection: Referencing Figure 8, all circuit breakers are in the open position; surge protector indicators are green.

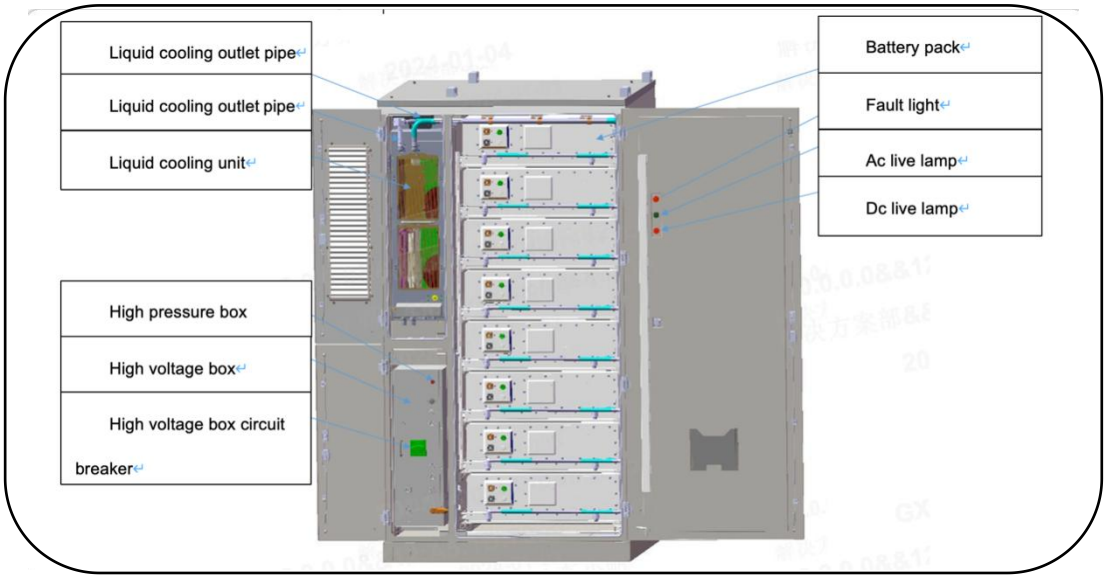


Figure 8 Distribution Switch Location Diagram

4.3.Startup Operation

The operation process for starting the product (AC side startup) is as follows:

1) After powering up the AC side system, use a multimeter to confirm that the grid voltage is within the preset range (400V±10%), the three-phase sequence is correct, and the AC power has been normally delivered to each outdoor cabinet. Also, check whether the AC live indicator light on the outdoor cabinet is working.
2) Refer to Figure 8, close the QF0 DC molded case circuit breaker;
3) Wait for the BMS to complete its self-check without any faults, automatically closing the high-voltage cabinet's internal contactor. At the same time, check whether the AC live indicator light on the outdoor cabinet is working.
4) Confirm that the display is normal, there are no fault alarms, and confirm that the fault indicator light on the outdoor cabinet is off.
5) Start the PCS through the AC side software system, set the grid-tied mode, constant power charging mode, and issue charging and discharging power (positive values for discharging, negative values for charging). The system begins operating (if a peak-valley plan curve is set, it will run automatically according to the set periods).

4.4.Shutdown Operation

When the product requires routine maintenance and needs to be shut down, the normal shutdown operation is as follows:

1) First, shut down through the EMS system on the software, ensuring the inverter is turned off, then disconnect the combiner box's DC and AC side power switches, including the AC auxiliary power switch and the UPS power switch;
2) Refer to Figure 8, open the system's high-voltage cabinet DC main switch;
3) Wait for the busbar to finish discharging, confirm that all the AC and DC indicator lights on the outdoor cabinet door panel are off, and the equipment is shut down.

4.5.Emergency Shutdown

In the event of a fault or emergency situation requiring an emergency shutdown, the following emergency shutdown operation can be performed:

1) Press the emergency shutdown button "EPO"; the molded case circuit breaker will automatically trip, the PCS will shut down, and the high-voltage cabinet's contactor will be disconnected.
2) After the fault or danger is resolved and operation needs to be resumed, reset the EPO button.

Note

After pressing the "EPO" emergency shutdown button, wait for 10 minutes before starting up again!

4.6.System Lock

1) When an emergency stop of the energy storage system is manually triggered, the system automatically stops and undergoes a power cut. After manually resetting the emergency stop button, the system needs to be manually restarted.
2) When a fire alarm occurs in the energy storage system, the system automatically shuts down and cuts off the power. After the fire alarm disappears, the system needs to be manually restarted.
3) When a water intrusion alarm occurs in the energy storage system, the system automatically shuts down and cuts off the power. After the water intrusion alarm disappears, the system needs to be manually restarted.
4) When a communication loss alarm of important devices such as BMS occurs in the energy storage system, the system automatically shuts down. After the problem is resolved, the system needs to be manually restarted.
5) When a third-level alarm of the BMS of the energy storage system occurs (for example, excessive cell voltage, excessive low cell voltage, high battery discharge temperature, etc. exceed the set threshold of the third-level alarm, causing a BMS third-level alarm), the system automatically goes through a shutdown process. The faults and alarms need to be manually reset, and then the system is restarted.

5 Equipment Maintenance

5.1.Routine Maintenance

Due to the influence of environmental temperature, humidity, dust, vibration, and the aging of internal components of the inverter, the system may encounter some potential problems during operation. To ensure the energy storage system can operate long-term and stably, it is necessary to arrange for maintenance personnel to conduct regular inspections according to Table 17, to promptly identify and address issues. Systems installed in areas with severe dust, high salt fog, or heavy industrial parks are recommended to be maintained quarterly, while those in areas with good climate environments are recommended to be maintained every six months.

Table 17 Routine Maintenance Tasks

Maintenance Object	Actions	Reference Standards
Cabinet	● Inspect the overall appearance of the machine ● Check the ventilation ports ● Examine the condition of door locks	● No obvious peeling of the coating, scratches, or corrosion ● No apparent signs of water leakage ● No accumulation of dust in the ventilation ports ● No damage to the door locks
Air Conditioning	● Check for noise and vibration ● Clean the filter	● Fans and compressors rotate normally, with no sticking or abnormal noises ● The surface of the filter is clean, with no blockages
Electrical	● Inspect the surge protector ● Check the contact surfaces of the cable busbars	● Surge protector functioning normally ● No looseness or detachment in screw sockets and connection lines ● No corrosion, discoloration, or dust accumulation on busbars and contact surfaces
Battery Module	● Check for noise and vibration ● Check the contact surfaces of the cable busbars	● Battery module fans rotate without sticking or abnormal noises ● The surface of the front panel ventilation port is clean, with no blockages ● No looseness or detachment in screw sockets and connection lines ● No corrosion, discoloration, or dust accumulation on busbars and contact surfaces

5.2.Warranty Service

➢ *5.2.1.Warranty Period*

The warranty period shall be in accordance with the commercial contract, provided the product is used correctly.

➢ *5.2.2.Warranty Scope*

Within the warranty period, for faults caused by the product's own quality issues, the company will repair or replace the product for the customer free of charge. Customers should allow reasonable response time for the company to make repairs, and the replaced products will be handled by the company. Customers must present related proof of purchase and ensure the product brand is clearly visible, otherwise, the company reserves the right to refuse warranty service.

➢ *5.2.3.Disclaimer*

The company reserves the right not to provide a quality guarantee, but may still offer paid repair services under the following conditions.

- The warranty period has expired;
- Unable to provide related proof of product purchase;
- Damage caused during transportation or loading and unloading;
- Damage caused by incorrect installation, modification, or repairs by unauthorized personnel;
- Damage caused by operating under abnormal conditions or environments;
- Machine failure or damage caused by using non-Hanchu parts or software;
- Faults caused by force majeure factors such as fire, earthquake, flood, etc.

6 Company Information

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