



261 kWh All in One cabinet User Manual

PMU-A125K-261L-U

Ver 1.0

No.	Version	Revised date	Revised content	Revised by	Remarks
1	1.0	2025-07-31	First release	/	

Preface

Overview

This manual mainly introduces the product composition, installation, debugging, use and maintenance and troubleshooting methods of the 261kWh outdoor all in one cabinet (hereinafter referred to as outdoor cabinet). Before installation and use, please be sure to read this manual thoroughly, master the safety specifications and be familiar with the product functional features.

Readers

This manual is applicable to energy storage power station operators and electrical technicians with corresponding qualifications. All installation operations are limited to professional technicians, who must meet the following requirements:

- Professionally trained
- Read this manual completely and master relevant safety procedures
- Familiarity with local electrical safety standards

Manual Use

- Please read carefully before use and keep the manual properly for easy access
- In order to continuously improve customer satisfaction, this product and manual are continuously upgraded and improved. If there is any difference between the content and the actual product, please refer to the actual product
- The contents of this manual may be delayed or error. Please refer to the actual product function. The pictures and texts are for reference only

Symbol Conventions

The following signs may appear in this article, and they represent the following meanings.



Indicates a hazard with a high risk of death or serious injury if not avoided.



Indicates a hazard with an intermediate risk that could lead to death or serious injury if not avoided.



Indicates a hazard with a low-level risk that may lead to minor or moderate injury if not avoided.

NOTICE

Used to transmit equipment or environmental safety warning information. If not avoided, it may lead to equipment damage, data loss, equipment performance reduction, or other unpredictable results. NOTICE is used to address information not related to personal injury.



NOTE

Supplementary explanation of key information in the text. NOTE is not a safety warning information, and does not involve personal, equipment and environmental injury information.

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1 Safety Precautions

DECLARATION

Before installation, operation and maintenance, please be sure to read this manual and strictly abide by the equipment identification and safety provisions in the manual.

The "NOTE", "NOTICE", "WARNING" and "DANGER" in the manual do not represent all safety precautions to be observed, but only supplement all safety precautions. Our company does not accept any liability arising from any violation of general safe operation requirements or violation of safety standards for the design, production and use of equipment.

The equipment is limited to operating in an environment that meets the design specifications. Otherwise, failure, component damage, personal injury or property damage will not be covered by the warranty.

Local laws, regulations and specifications shall be observed when installing, operating and maintaining the equipment, and the safety clauses in the manual are only supplementary to local laws, regulations and specifications.

The Company shall not be liable in the event of any of the following circumstances.

- Beyond the conditions of use specified in the manual.
- The installation and use environment violate international or relevant national standards.
- Disassemble, alter the product or modify the software code without authorization.
- Failed to follow the operating instructions and safety warnings in the product and documentation.
- Equipment damage caused by force majeure (such as earthquake, fire, storm, etc.).
- Shipping damage caused by the customer's violation of shipping requirements.
- Damage caused by storage conditions that do not meet product requirements.

1.1 Personal Safety

DANGER

- It is forbidden to install and remove cables live to avoid fire or personal injury.
- When the system is abnormal (such as sparks, smoke or overheating, etc.), it is forbidden to approach the battery system.
- Do not touch the live parts of the battery system to prevent electric shock.

WARNING

- Special insulation tools must be used during operation, and the insulation withstand voltage level must meet the requirements of local laws, regulations, standards and specifications to avoid electric shock injuries or short circuit faults.
- It is strictly forbidden to wear conductive items (such as watches, bracelets, rings, necklaces, etc.) during operation to avoid being burned by electric shock.
- If the equipment has not been completely installed or confirmed by professionals, it is forbidden

to power on.

General requirements

- Solo work is prohibited, and workers must be certified to work.
- A complete set of special protective equipment (such as safety helmet, protective mask, protective clothing, insulating gloves, insulating safety shoes, etc.) must be worn during operation.
- Master the correct usage method before using the tool to avoid injuring people and damaging the equipment.
- During the operation of the equipment, if any failure that may cause personal injury or equipment damage is found, the operation should be terminated immediately, reported to the person in charge, and effective protective measures should be taken.
- The installation, operation and maintenance of the system must be performed by trained and qualified professionals. Relevant personnel should fully understand various safety precautions, be familiar with the relevant standards of the country/region where they are located, and receive strict professional training; For special scenarios, such as electrical operations, aerial or special aerial operations or special equipment operations, relevant personnel should obtain the approval of the local national/regional regulatory authorities and strictly comply with the regulatory requirements of the project location.
- Please do not approach the equipment except the professional technician operating the equipment.

1.2 Electrical Safety

DANGER

- Before making electrical connection, make sure that the equipment is not damaged, the external connecting cables and connectors are not damaged, and they are installed correctly, otherwise electric shock or fire may be caused.
- Before performing installation or maintenance, ensure that all power is completely disconnected.
- It is forbidden to operate the equipment without the ground conductor installed.

WARNING

- Equipment installation, operation and maintenance must be carried out in strict accordance with the sequence of steps specified in the manual. It is forbidden to modify or install equipment without authorization, change the equipment and installation sequence, etc.

CAUTION

- During operation, external objects must be strictly prevented from entering the equipment to avoid short circuit, failure or damage.
- It is forbidden to use water, alcohol, oil or other solvents to clean electrical components inside and outside the equipment.
- If liquid is found to enter the equipment, the power must be turned off immediately and stop using it.

General requirements

- All electrical connections must comply with the electrical standards of the country or region where they are located.

- Before the equipment is connected to the grid for operation, it must obtain permission from the local power department.
- When installing the cable, tighten the screws according to the torque requirements specified in this manual, and mark the torque mark (a straight line) at the junction of the locking parts. If the screw is loose or has been removed resulting in incomplete marking, the screw must be re-tightened as specified and re-marked for confirmation.

Grounding Requirements

- Equipment grounding shall meet the requirements of local electrical standards.
- Destroying the grounding conductor is prohibited.
- It is forbidden to operate the equipment without the ground conductor installed.
- The equipment shall be permanently and reliably connected to the protective ground wire. Before operating the equipment, it is important to confirm that the grounding is good. Poor grounding of the equipment may cause personal injury and damage to the equipment.

Wiring Requirements

- The selection, laying and routing of cables must comply with local laws, regulations and specifications.
- When laying the power cables, avoid circling or twisting. If the length of the power cables is insufficient, it should be replaced immediately. It is strictly forbidden to make connectors or solder joints in the power cables.
- All cables must be securely connected, well insulated, and of compliant specifications.
- Cable grooves and wire passing holes should be smooth and have no sharp edges. When the cable passes through the pipe or through the hole, protective devices must be installed to prevent the cable from being scratched and damaged by sharp edges, burrs, etc.
- Signal lines and power lines should be arranged in isolation. Similar cables should be tied neatly, and the layout spacing of different types of cables should be kept at least 30mm, and it is forbidden to entangle or cross each other.
- Cables should be kept away from heat sources. The distance from the periphery of the heating device or heat source area should be kept at least 30mm. When wiring, a sufficient safe distance should be kept from the DC busbar, shunt, fuse, etc. to avoid aging and damage of the insulation layer caused by high temperature.
- No cables are allowed to pass through the air inlets and outlets of the equipment.
- Fire retardant grade cables that meet the requirements of local laws and regulations must be selected.
- When the temperature is too low, severe impact and vibration may cause brittle cracking of the plastic skin of the cable, so be careful to handle it carefully.
- It is forbidden to directly push the cable down from a height (such as a car) and other irregular operations, so as to avoid cable damage, leading to performance degradation, affecting current carrying capacity and temperature rise, etc.

Anti-static Requirements

- Anti-static gloves must be worn before touching equipment or handheld circuit boards.
- When holding the circuit board, you must hold the edge of the circuit board that does not contain components, and it is forbidden to touch the components directly with your hands.
- The disassembled circuit board must be properly packaged with anti-static packaging materials before storage or transportation.

1.3 Mechanical Safety

General requirements

- Paint scratches generated during equipment transportation and installation must be repaired in time, and it is strictly forbidden to expose the scratched parts for a long time.
- Without the company's evaluation, it is forbidden to carry out arc welding, cutting and other operations on the equipment.
- It is forbidden to install other equipment on the top of the equipment without evaluation by our company.
- Please use the right tools and master their correct use.

Hoisting safety

- Follow the safety supervision and technical requirements for hoisting operations in the location, and consider the impact of weather conditions, lighting, and other factors.
- Hoisting operators and lifting equipment safety inspectors must pass relevant training and obtain the operation qualifications required by the project site before they can take up their posts.
- For hoisting operations, a hoisting plan must be prepared, and safety technical briefings must be made to operators.
- Temporary warning signs or fences must be installed in the hoisting area for isolation.
- The hoisting operation foundation must meet the load-bearing requirements of the crane.
- The hoisting tools must be complete and passed the inspection before they can be used.
- Before hoisting, it is necessary to ensure that the hoisting tool is firmly fixed to the fixture or wall that meets the load-bearing standard.
- When hoisting, it is strictly forbidden to walk or stay under the boom and hoisted objects.
- When hoisting, it is strictly forbidden to drag wire ropes or spreaders; It is strictly forbidden to use hard objects to hit the lifting objects. If it is necessary to adjust the posture of the lifting objects to prevent shaking, a walking rope or traction rope that meets the safety requirements should be installed.
- When using metal cables for hoisting, protective pads must be installed at the contact parts between the cables and the outdoor cabinets to prevent the surface of the cabinet from being scratched.

Drilling safety

- Local regulatory requirements, such as hot work permit, must be followed before drilling.
- Wear goggles and protective gloves when drilling holes.
- During the drilling process, the equipment must be blocked to prevent debris from falling into the equipment; Debris must be cleaned up in time after drilling.
- When drilling holes, avoid embedded pipes or lines to prevent short circuits or other hazards.

1.4 Battery Safety

Before performing battery work, you must carefully read the safety precautions and master the correct connection method of the battery.



- It is strictly forbidden to short the positive and negative poles of the battery.



- It is strictly forbidden to expose the battery to mechanical vibration, drop, collision, hard object puncture and pressure impact, otherwise it may cause battery damage or fire.
- It is strictly forbidden to disassemble, modify or destroy the battery.
- When the battery fails, the surface temperature may be too high, so contact should be avoided to avoid scalding.
- The specified type of battery recommended by the manufacturer must be used. Using or replacing the incorrect model battery will pose the risk of fire and explosion.
- Non-professionals are strictly prohibited from approaching the electrolyte spill area. Professionals must wear safety goggles, acid-resistant gloves and acid-resistant clothing when dealing with electrolyte spillage.
- If the electrolyte splashes on the skin or clothing, the affected area should be immediately rinsed with plenty of running water; If the electrolyte enters the eyes, mouth, nose and other parts, it should be rinsed with plenty of water immediately and seek medical attention immediately.

⚠ CAUTION

- The battery must be used under the specified charging rate or power conditions, and the upper charging voltage must not exceed the technical requirements of the product to prevent the battery from overcharging, so as not to affect the charging and discharging performance, mechanical performance and safety performance of the battery.
- The battery must be used under the specified discharge rate or power conditions, and the lower discharge limit voltage must not exceed the technical requirements of the product to prevent the battery from over-discharging, so as not to affect the charge and discharge performance, mechanical performance and safety performance of the battery.
- The battery should be installed in an area far away from liquid. It is strictly forbidden to install it under air-conditioning ports, vents, outlet windows of computer rooms, water pipes and other places that are prone to water leakage to prevent equipment failure or short circuit caused by liquid intrusion.
- During battery installation and commissioning, fire-fighting facilities (such as fire-fighting sand, dry powder fire extinguishers, etc.) must be equipped according to the requirements of construction standards and specifications, and meet the requirements of local laws and regulations.
- After the battery is discharged, the battery should be charged in time, otherwise the battery may be damaged due to undercharge.

Battery short circuit protection

⚠ DANGER

- It is strictly forbidden to operate the battery live (e.g. installation, maintenance).
- During installation and maintenance, the exposed cable terminals of the battery must be wrapped with insulating tape.
- Strictly prevent foreign objects (such as conductive objects, screws, liquids, etc.) from entering the battery.
- It is strictly forbidden to connect the positive and negative poles of the battery backwards.

Recycling

Please dispose of used batteries according to local laws and regulations, and do not dispose of batteries as domestic waste.

- If the battery leaks, is damaged or has exceeded its service life, please contact technical support or battery recycling company for scrapping.
- Avoid exposing used batteries to high temperatures, direct sunlight, high humidity, or corrosive environments.
- The faulty battery is forbidden to be used again, and the battery recycling company must be contacted as soon as possible for scrapping to avoid environmental pollution.

1.5 Environmental Requirements

DANGER

- It is strictly forbidden to place the equipment on uneven ground to prevent deformation of the equipment casing.
- It is strictly forbidden to place the equipment in an environment with flammable dust or conductive dust, and do not perform any operations in such an environment.
- It is strictly forbidden to set up hot work sites around the equipment area, and do not place any flammable materials around the equipment.

WARNING

- The equipment should be installed in an area far away from liquids, and it is strictly forbidden to install it below positions such as water pipes and air outlets that are prone to condensation; It is strictly forbidden to install it under air-conditioning ports, vents, outlet windows of computer rooms and other positions that are prone to water leakage, so as to prevent liquid from entering the equipment and causing equipment failure or short circuit.
- When the equipment is running, do not block the vent, heat dissipation system or cover it with other items to prevent damage to the equipment or fire caused by high temperature.

General requirements

- The temperature and humidity environment in which the equipment is stored should be suitable: a clean, dry, well-ventilated area, and protected from dust and condensation.
- Site selection shall comply with local laws, regulations and relevant standards.
- The installation environment should ensure that the ground is solid and there is no adverse geology such as rubber soil, soft soil or easy subsidence. It is strictly forbidden to choose low-lying areas such as water accumulation and snow accumulation. The site level must be higher than the highest flood level in local history.
- It is strictly forbidden to install and operate equipment outside the specified range of technical indicators, otherwise it will lead to equipment performance degradation or potential safety hazards.
- It is strictly forbidden to install and operate outdoor equipment and cables in severe weather such as lightning, rain, snow, strong winds above level 6 (including but not limited to handling, plugging and unplugging outdoor signal interfaces, aerial work, outdoor installation, door opening, etc.).
- It is strictly forbidden to install the equipment in an environment with dust, smoke, volatile gases, corrosive gases, infrared radiation and other radiation, organic solvents or excessive salt content.
- It is strictly forbidden to install the equipment in the environment with metal conductive dust and magnetic conductive dust.
- It is strictly forbidden to install the equipment in areas that are prone to fungi, mold and other microorganisms.
- It is strictly forbidden to install the equipment in areas with vibration, high noise sources and

strong electromagnetic field interference.

- If the equipment is installed in a place with lush vegetation, in addition to routine weeding, the ground below the equipment must be hardened (such as laying cement, stones, etc.).
- Before installation, operation and maintenance, it is necessary to clean the accumulated water, ice, snow or other debris on the top to prevent the debris from falling into the equipment when opening the door.
- All wiring holes must be sealed (use fireproof mud, rubber ring, etc.).
- When the equipment is running, it is strictly forbidden to block the vent or heat dissipation system to prevent high temperature fire.
- If liquid is found to enter the equipment, the power supply must be turned off immediately and the site management personnel must be notified.
- Recommended outdoor ambient environment: temperature 0°C~35°C; Relative humidity<75%RH, no condensation. If the ambient environment does not match, external auxiliary power supply should be connected to control the temperature and humidity in the cabinet. EU version & AU version voltage: 400V (-15% ~ +10%), NA version voltage: 480V (-12% ~ +10%).

1.6 Maintenance and Replacement



There is a high voltage when the equipment is running, and electric shock can occur, resulting in death, serious personal injury, or significant property damage. The equipment must be powered down before any maintenance work, and the safety precautions of this manual and related documents must be strictly observed.

- Maintenance personnel must be familiar with the contents of this manual and equipped with suitable tools and testing devices.
- Before maintenance, the equipment must be powered off, and then follow the instructions of the delayed discharge label, and wait for the corresponding time to ensure that the equipment has been completely powered down before operation.
- During the maintenance process, please try to avoid irrelevant personnel entering the maintenance site, and temporary warning signs or fences must be set up for isolation.
- If the equipment fails, please contact the supplier or professional operation and maintenance personnel to deal with it.
- The fault must be completely removed before it can be powered on again, otherwise the fault may expand or the equipment may be damaged.
- Unclear safety warning signs due to long-term use must be replaced in time.

2 Product Introduction

2.1 Term Abbreviation

BMS	Battery Management System
MBMU	Master Battery Management Unit
SBMU	Slave Battery Management Unit
VCMU	Voltage Collection Management Unit
BOL	Begin of Life
CAN	Control area network
CC	Constant Current
CCCV	Constant Current Constant Voltage
CP	Constant Power
EMS	Energy Management System
EOL	End of Life
ESS	Energy storage system
LAN	local area network
MSD	Manual Service Disconnect
PCS	Power Conversion System
SOC	State of Charge
SOE	State of Energy
SOH	State of Health
SOP	State of Power
UPS	Uninterruptible Power Supply

2.2 Product Description

2.2.1 Nameplates and Labels

The equipment nameplate is located on the lower right side of the outdoor cabinet door. You can view the equipment model, technical parameters and other information through the nameplate. Please refer to the illustration and specific meaning of outdoor cabinet label as follows:



Correctly ground electrical equipment to avoid fire and electric shock hazards.



Hazards of arc flash and electric shock. It is forbidden to open the door during operation, and appropriate personal protective equipment and tools are required when using this equipment.

2.2.2 Functions and Features

2.2.2.1 Product Functions

The main function of this outdoor cabinet is to store and transfer energy, and can monitor and manage battery status. It is suitable for application requirements in multiple scenarios such as microgrid, backup power supply, peak shaving and valley filling, distributed new energy consumption, and optical storage and charging

2.2.2.2 Product Features

The outdoor cabinet system adopts All in One design, integrating battery clusters (5 packs), BMS, PCS, EMS, fire protection and thermal management systems into a single standardized cabinet, which is safe, reliable, easy to install, efficient and economical.

- **High security**
The system adopts the strategy of active early warning + cabinet-level aerosol + external water fire protection interface, and is equipped with an explosion-proof exhaust system. Combustible gas detection is linked with the explosion-proof exhaust system to ensure product safety in extreme situations.
- **Efficient and economical**
Vertical single-row structure design effectively reduces the floor space; IP65 liquid-cooled PCS improves product reliability and improves the technical economy of the system.
- **High flexibility**
Vertical single-row All in one design, plug-and-play, supports overall transportation and multi-machine cabinet merging, and flexible capacity expansion.

2.3 System Introduction

2.3.1 System Architecture

This product adopts all in one design, single cabinet dimension: L1000mm × W1420mm × H2250mm, integrating battery cluster (5 packs), BMS, PCS, EMS, fire protection and thermal management system in a single standardized cabinet.

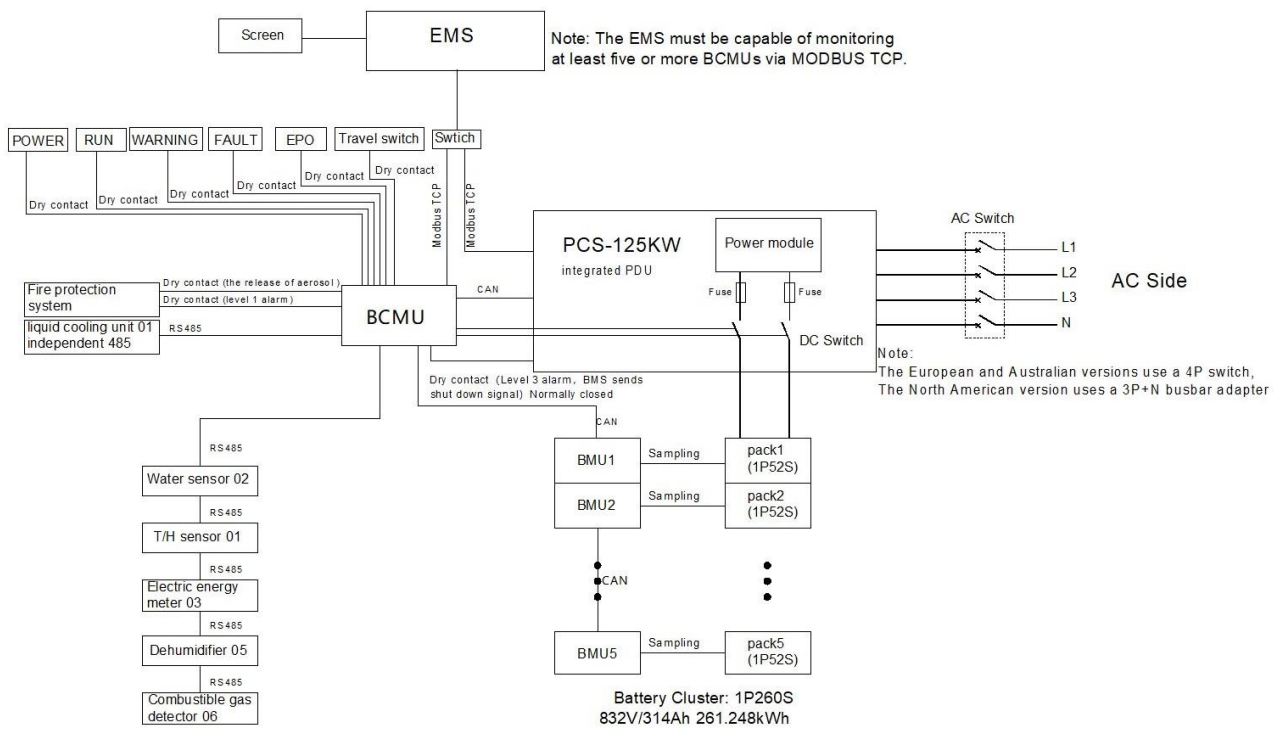


Figure 2-1: Diagram of system architecture

2.3.2 System Layout

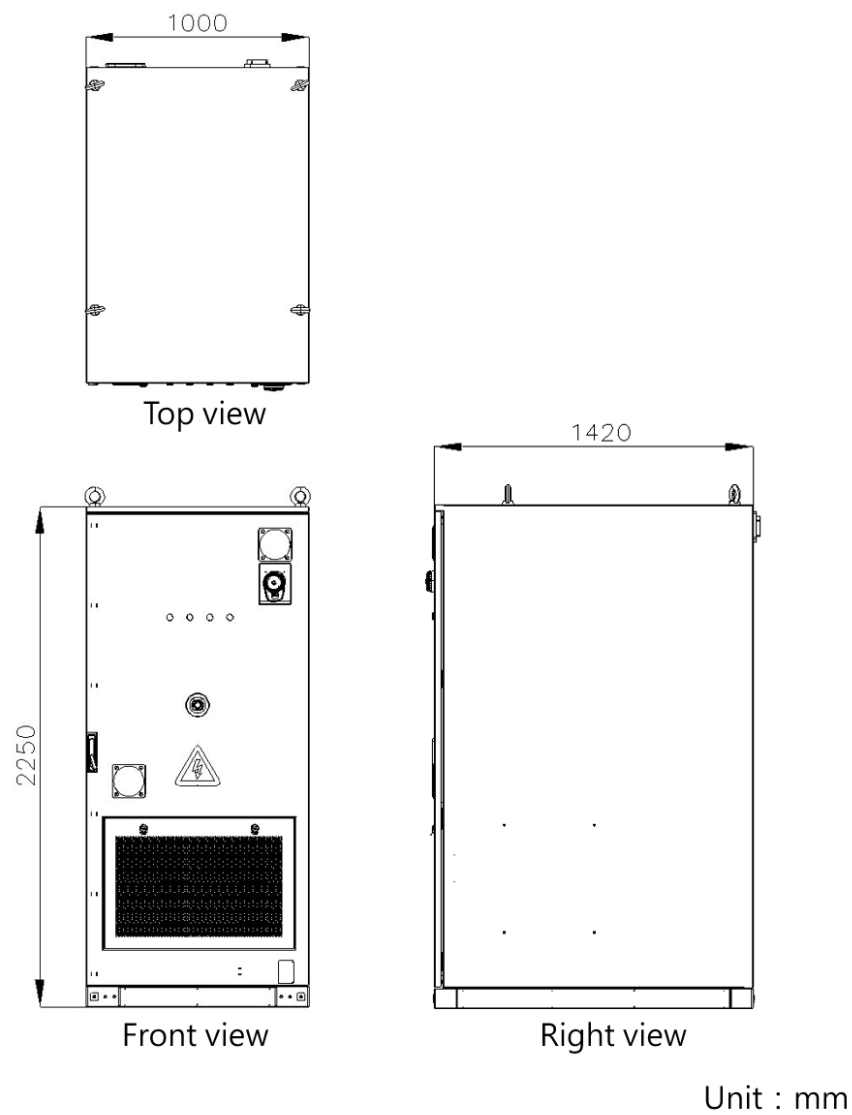


Figure 2-2: Cabinet dimensions

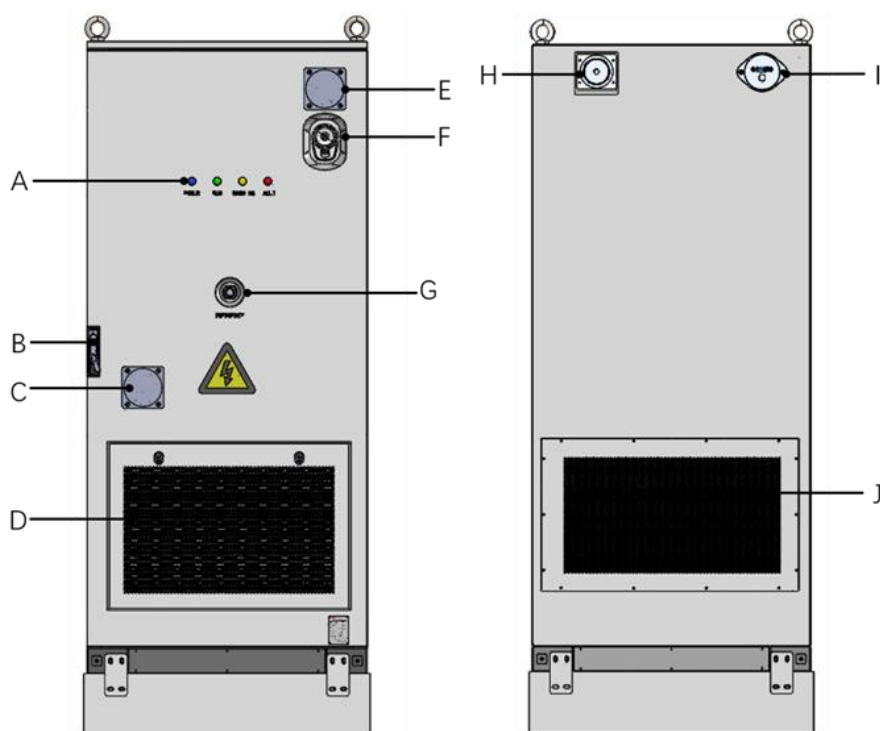


Figure 2-3: Diagram of the front and rear panels

Table 2-1: The front and rear introduction

No.	Items	Description
A	Indicator light	-Power: Power-on indicator -Run: Run indicator -Warning: Warning indicator light -Fault: Fault indicator light
B	Door lock	Safety guard
C	Explosion-proof air inlet valve	Air inlet
D	Air inlet	Air inlet of liquid cooler
E	Explosion-proof exhaust valve	Exhaust vent
F	Audible and visual alarm	System alarm device
G	Emergency stop button (EPO)	System emergency stop device
H	Firefighting coupling	DN65 fire water interface
I	Explosion relief valve	Pressure relief device
J	Air outlet	Air outlet of liquid cooler

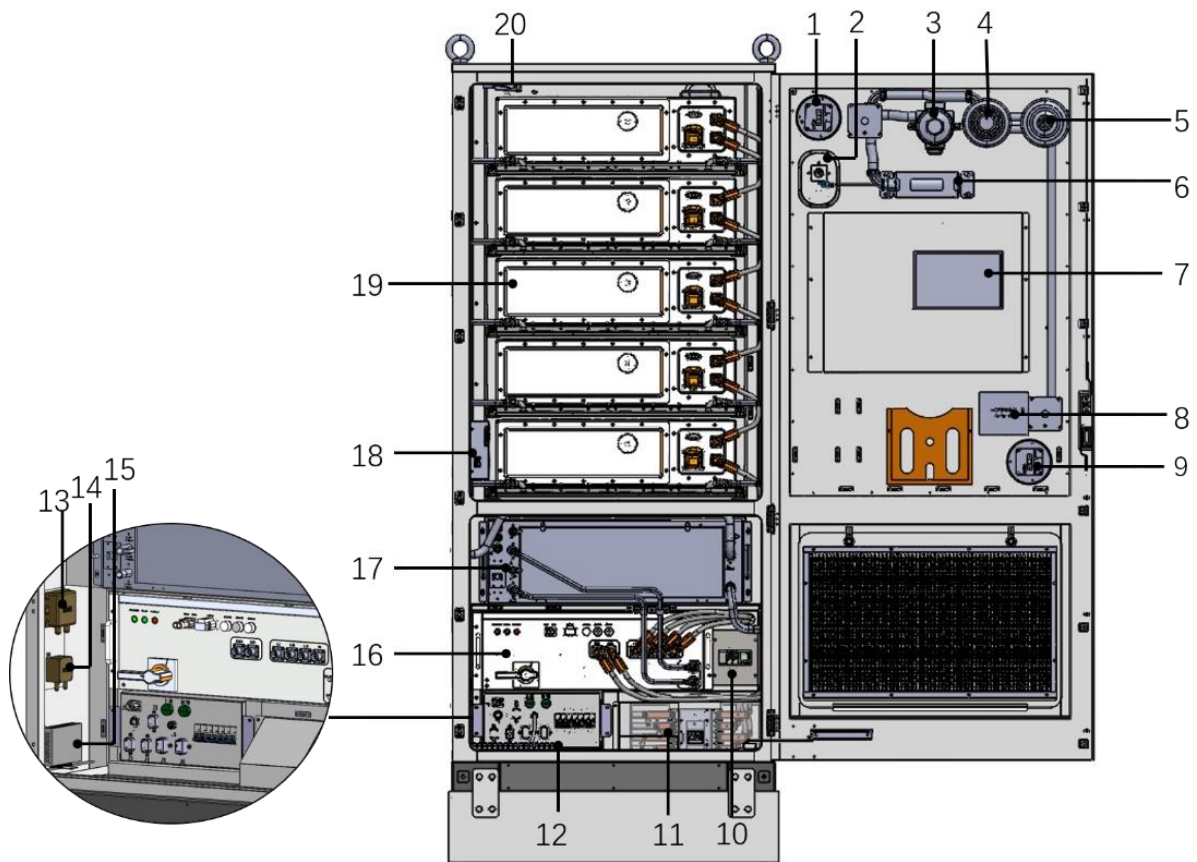


Figure 2-4: Cabinet interior layout

Table 2-2: Internal layout introduction

No.	Items	Functional Description
1	Explosion-proof exhaust valve	When the concentration value of the combustible gas in the cabinet reaches the threshold value, the explosion-proof air exhaust valve automatically opens to discharge the gas
2	Audible and visual alarm	Send an alarm signal
3	Hydrogen detector	Detect the hydrogen concentration in the cabinet
4	Smoke detector	Detect smoke in cabinet
5	Temperature detector	Detect the temperature in the cabinet
6	Aerosol	Extinguishing medium
7	EMS (optional)	View system status, control equipment operation, send instructions, and monitor data. In each set (1 ~ 5 cabinets) of energy storage system, only the main cabinet is equipped with one EMS, which is responsible for integrating the BMS and PCS of each cabinet as a unified central control unit connected with the upper EMS
8	Fire relay box	Fire signal control box

9	Explosion-proof air inlet valve	When the combustible gas concentration value in the cabinet reaches the threshold value, the air inlet valve is automatically opened to introduce outside fresh air
10	Electric energy meter	Metering system electricity
11	MCCB	Molded case circuit breaker
12	Control box	Collect the operation information of the battery system and control the normal operation of the system
13	T/H detector	Detect the ambient temperature and humidity in the cabinet
14	Water immersion sensor	Detect water accumulation in cabinet
15	Switch	A networking device that forwards data packets
16	PCS	For AC/DC conversion
17	Liquid cooling unit	Control the cell temperature, ensuring it to work in an appropriate temperature range.
18	Dehumidifier	Reduce the humidity level inside the cabinet
19	Battery cluster	Consists of 5 battery packs
20	Door position sensor	Detect the door status

2.3.3 External Interface

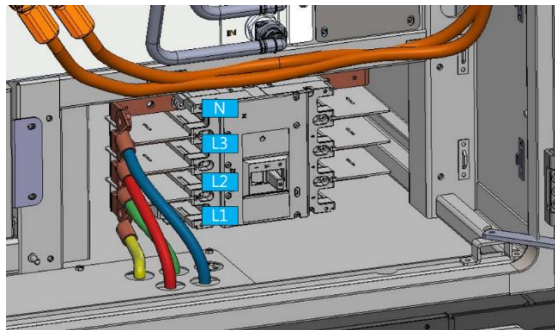


Figure 2-5: Diagram of external interface (example: EU version)

Table 2-3: External interfaces introduction (single cabinet)

No.	Name	Wire Diameter	Recommended Specifications	Quantity	Remarks
1	L1	95 mm ²	TL95-10	1	Multi-core flexible cord is recommended
2	L2	95 mm ²	TL95-10	1	
3	L3	95 mm ²	TL95-10	1	
4	N	95 mm ²	TL95-10	1	
5	PE	35 mm ²	TL35-8	1	Refer to 2.4.9 Grounding System
6	EMS	CAT-6	RJ45 Crystal Head	1	EMS external network cable

2.3.4 System Specifications

Table 2-4: System technical parameters

No.	Specifications	Parameters
1	DC side	Cell type
2		Pack configuration
3		System configuration
4		System voltage range
5		System energy
6		Charge/discharge rate
7	AC side	AC power rating
8		AC maximum power
9		PCS cooling method
10		AC current distortion rate
11		AC side voltage
12		AC wiring mode
13		Power factor
14		Power factor adjustable range
15	System parameters	Auxiliary power
16		Thermal management method
17		IP rating
18		Allowable ambient temperature
19		Allowable ambient humidity
20		Overall dimensions (width x depth x height)
21		Weight
22		Maximum working altitude

2.4 Component Introduction

2.4.1 Battery Pack

The battery pack is the smallest energy storage module that can be removed and assembled in the battery system. It consists of four 1P13S battery modules, VCMU modules, explosion-proof valves, fuses, liquid cooling plates, MSD and other related electrical and structural parts. The appearance and dimensions are shown in the following figures:

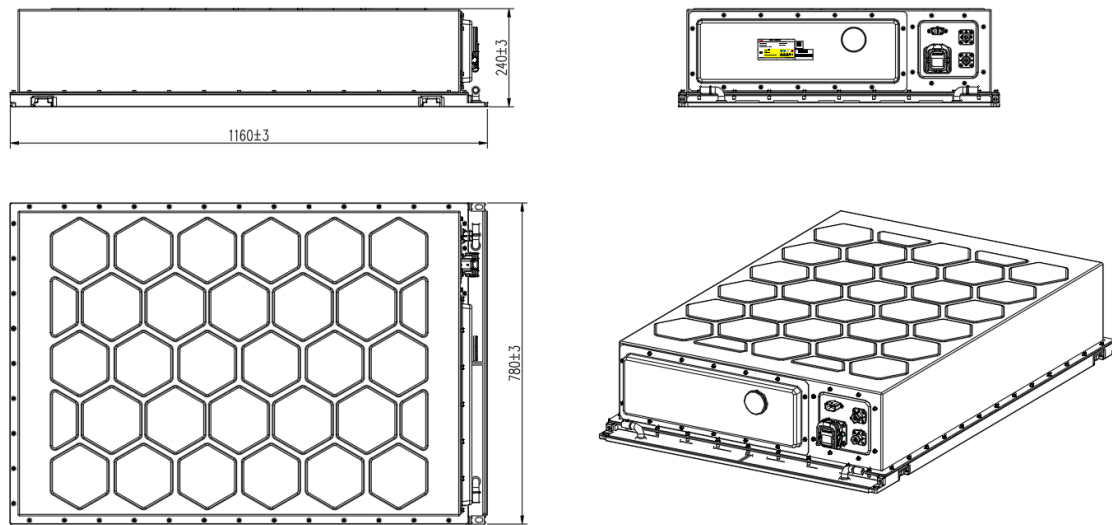


Figure 2-7: Battery pack dimension

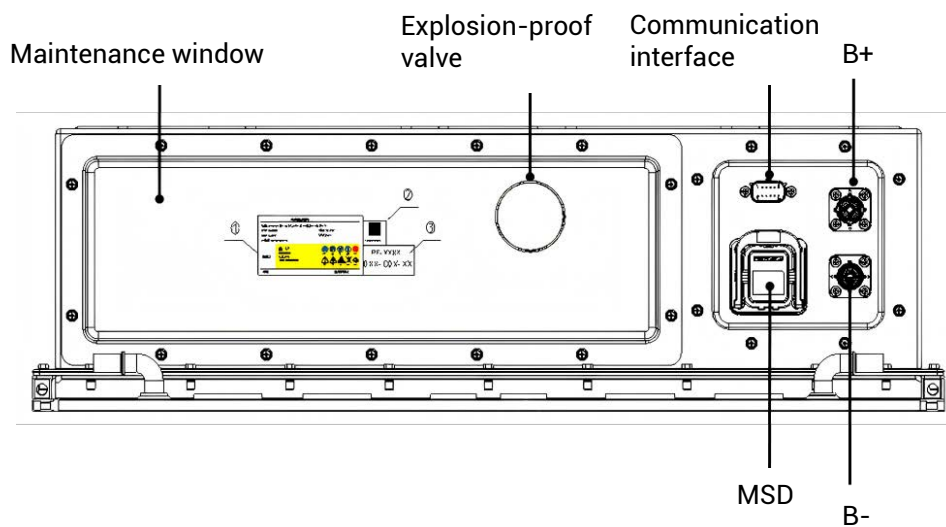
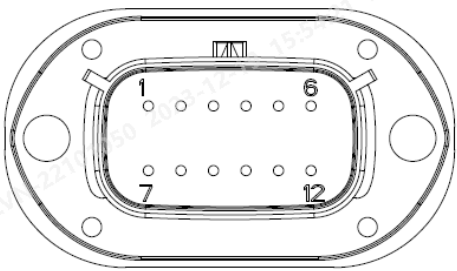


Figure 2-8: Battery pack interface

①: Nameplate ②: QR code ③: Battery pack number

Table 2-5: Definiton of communication interface

 Outside-to-inside view	Pin	Definitions
	1	VCMU POW
	2	CAN_H1
	3	CAN_G1
	4	CAN_H2
	5	CANRA
	6	CAN_G2
	7	VCMU Ground
	8	CAN_L1
	9	ADDR_DI
	10	CAN_L2
	11	CANRB
	12	ADDR_DO

Note: The specific interface model and pin definition are subject to confirmation before supply.

2.4.1.1 Specification Parameters

Table 2-6: Technical parameters of battery pack

No.	Items	Technical parameters	Remarks
1	Configuration	1P52S	
2	Cell model	MB31	
3	Nominal capacity	314Ah	
4	Nominal voltage	166.4V	
5	Voltage range	130V ~ 189.8V	Cell: 2.5V ~ 3.65V
6	Nominal energy	52.25kWh	0.5P @ 25°C ± 2°C
7	Dimensions	W780 × D1160 × H240mm	Tolerance ± 3mm
8	Weight	345 ± 5kg	Subject to actual conditions
9	IP rating	IP67	

2.4.2 Control Box

The outdoor cabinet control box is a control unit specially designed for the system. The control box has the functions of battery cluster operation information collection, battery cluster circuit contactor control and protection, etc. The battery cluster control main control unit (SBMU), switching power supply, etc. are installed in the control box. In the design of the control box, the electrical characteristics, heat dissipation performance, safety performance and operability and maintainability of each component have been fully considered. The space layout is reasonable, and it has the characteristics of compact structure, flexible configuration, safety and reliability.

2.4.2.1 Interface Description

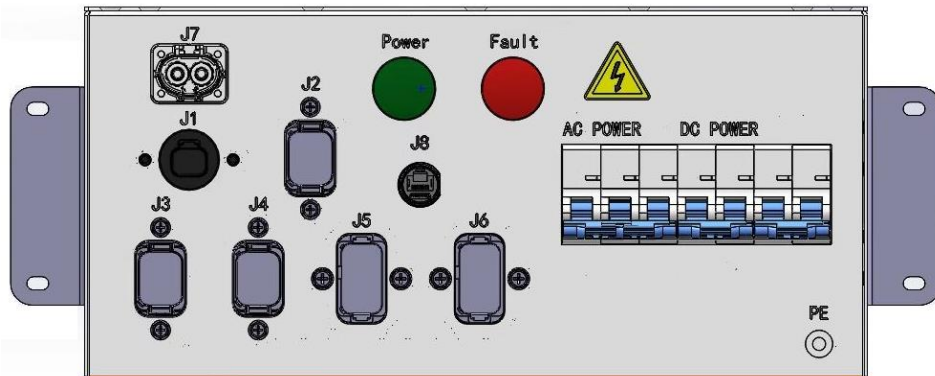


Figure 2-9: Interface of the control box

Table 2-7: control box interface description

No.	Interface	Description
1	J1	BMS AC power supply input interface
2	J2	Debug Diagnostic Interface (Reserved)
3	J3	BMS-PCS communication interface
4	J4	VCMU power supply communication interface
5	J5	Battery compartment I/O device control interface
6	J6	Battery compartment power supply communication interface
7	J7	BMS DC power supply input interface
8	J8	BMS network communication interface

2.4.2.2 Specification Parameters

Table 2-8: Control box technical parameters

No.	Items	Specifications
1	DC voltage range	DC 250V-1500V
2	AC voltage range	AC 180V-550V
3	Operating temperature range	-20°C~65°C
4	Dimension (W * D * H)	360*500*171.5mm
5	Low voltage power supply mode	AC 220V/AC 480V to DC 24V DC 1000V to DC 24V
6	Thermal management method	Natural heat dissipation
7	Communication interface	CAN/RS485/Ethernet

2.4.3 BMS

The battery system adopts a three-level BMS (Battery Management System). Consists of a battery management unit VCMU, a battery cluster management unit SBMU, and a battery stack management unit MBMU. The VCMU monitors the voltage and temperature in the battery pack, the SBMU monitors the voltage and current of the entire cluster terminal, and the EMS integrates the MBMU unit to collect the

total voltage, total current, total power, SOC/SOH and other information summary function of the system.

2.4.3.1 BMS Functions

The main functions of BMS are introduced as follows:

- Operation control functions: including start-stop control, charge and discharge control, operating parameter setting and thermal management control, etc.;
- Data acquisition function: BMS should be able to measure the electrical and thermal data related to the battery in real time, including single cell voltage, battery module temperature, battery module voltage, series loop current, insulation resistance and other parameters;
- Alarm protection function: BMS has electrical protection functions such as battery overvoltage protection, undervoltage protection, overcurrent protection, short circuit protection, over-temperature protection, low temperature protection, etc., and can send out alarm signals or trip instructions to implement local fault actions. Report alarm information at the same time;
- Fault diagnosis function: BMS should be able to monitor the running status of the battery in real time, diagnose the abnormal running status of the battery and BMS body, and upload alarm signals to the local monitoring system and power conversion system;
- Operation management function: BMS can effectively manage charging and discharging to ensure that the battery does not overcharge or over-discharge during charging and discharging, so as to prevent the charging and discharging current and temperature from exceeding the allowable value.

2.4.3.2 Parameter Specification

Table 2-9: BMS technical parameters

No.	Items	Parameters
1	Operating power supply (V)	24
2	Single device power consumption (W)	VCMU, 0.5W SBMU, 3W
3	Current acquisition accuracy	$\pm 0.5\%$
4	Cell voltage acquisition accuracy (mV)	± 5
5	System voltage acquisition accuracy	0.5% FSR
6	Temperature acquisition accuracy ($^{\circ}\text{C}$)	Temperature acquisition range: $-40^{\circ}\text{C}\sim 125^{\circ}\text{C}$ $-20^{\circ}\text{C}\sim 65^{\circ}\text{C}$: $\pm 1^{\circ}\text{C}$, other temperature $\pm 2^{\circ}\text{C}$
7	Cell voltage acquisition period (mS)	50
8	System voltage acquisition period (mS)	20
9	Current acquisition period (mS)	20
10	Temperature acquisition period (mS)	500
11	Equalization mode	Passive equalization
12	Equalization current (mA)	100
13	SOC measurement errors	Estimation accuracy $\pm 5\%$
14	Communication method with PCS and local monitoring layer	CAN, dry contact
15	Communication protocol with EMS and local monitoring layer	Modbus TCP

2.4.3.3 Electrical Protection Functions

The BMS has the electrical protection features listed in the table below. And can send out alarm signals or trip instructions according to the protection strategy to implement local fault isolation.

Table 2-10: Electricla protection function items

No.	Electrical protection function	Protection Response
1	Single battery overvoltage protection	Alarm or trip protection
2	Single battery undervoltage protection	Alarm or trip protection
3	Battery total voltage overvoltage protection	Alarm or trip protection
4	Battery total voltage undervoltage protection	Alarm or trip protection
5	Overcurrent protection	Alarm or trip protection
6	Charge high temperature protection	Alarm or trip protection
7	Charge low temperature protection	Alarm or trip protection
8	Discharge high temperature protection	Alarm or trip protection
9	Discharge high temperature protection	Alarm or trip protection

2.4.4 PCS

A bidirectional energy storage converter is a conversion device between the grid and the battery, which can charge and discharge the battery. The direct current from the battery can be inverted into alternating current that can be incorporated into the grid, and the alternating current from the grid can also be rectified into direct current that can be charged into the battery. The bidirectional energy storage converter used in this outdoor cabinet product can be used in grid-connected mode or off-grid mode.

2.4.4.1 PCS Interface

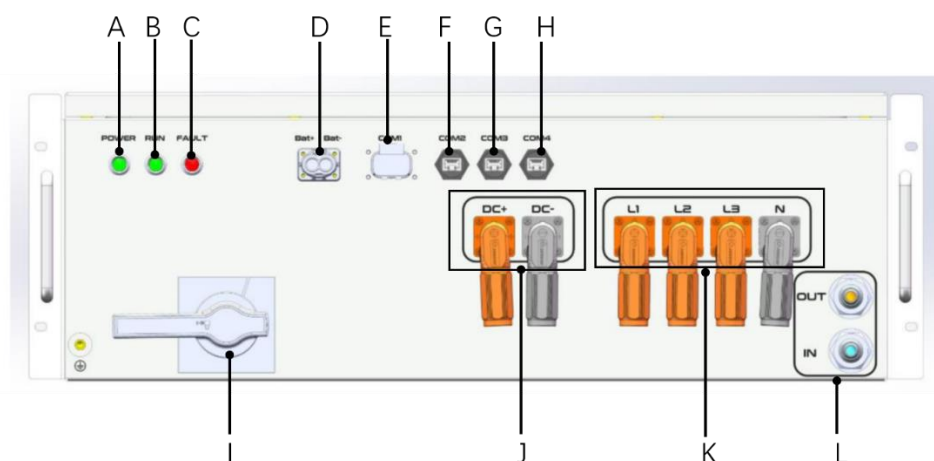


Figure 2-10: Diagram of PCS interface

Table 2-11: PCS interface description

No.	Items	Description
A	POWER	DC side power-on indicator
B	RUN	Operation LED, flashing in standby mode

C	FAULT	Fault indicator
D	Bat +/Bat-	DC high voltage output port
E	COM1	Communication and DIO interface
F	COM2	Parallel unit network port
G	COM3	Parallel unit network port
H	COM4	EMS Ethernet Interface
I	Disconnecter	High voltage isolation breaking switch
J	DC +/DC-	Connecting battery clusters
K	L1/L2/L3/N	AC side L1/L2/L3/N
L	OUT/IN	Coolant output/input port

2.4.4.2 PCS Specifications

Table 2-12: PCS technical parameters

DC side parameters	
Rated power	125kW
DC side maximum power	137.5kW
DC side voltage range	700~1000 (700 ~ 950 full load) Vdc 680~1000 (680 ~ 1000 full load) Vdc
DC side maximum current	178A
AC side parameters (on-grid)	
Rated AC power	125kW
Wiring method	Three-phase four-wire 3W + N + PE
Voltage range Operating voltage range	340-440Vac 422.4-528Vac
Allowable voltage variation range	400V (-15% ~ +10%) 480V (-12% ~ +10%)
Long-term operating current range	0 ~ 198A 0 ~ 165A
Allowable grid frequency	50/60 (-3 ~ +3) Hz
THDi	≤ 3%
Power factor/Adjustable range	0.99/-1~1
AC side parameters (off-grid)	
Rated output power	125kW
Rated output frequency	50/60Hz 60Hz
AC voltage harmonics	<3%
System parameters	

Maximum conversion efficiency	98.6%
Allowable ambient temperature	-20 ~ 50°C
Thermal management	Liquid cooling
Allowable relative humidity	0 ~ 95% (no condensation)
Allowable altitude	≤ 2000m
Communication method	Communication interfaces RS 485, Ethernet, CAN
Communication protocol	Modbus TCP/RTU, CAN
BMS Access	Support

2.4.5 EMS

2.4.5.1 Functional Overview

The EMS local control system has the functions of operating status control and monitoring of outdoor cabinets. It supports the access of all single cells and temperature data of outdoor cabinets, as well as PCS, liquid cooling and other equipment information, comprehensively monitors the operating status of the system, and the local data supports 10 years of rolling storage. At the same time, it supports the unified control of multiple groups of outdoor cabinet systems in parallel, and the group adjustment and group control power can be delivered with one click, which is convenient for users to operate.

The local control system supports external meter access, and has built-in operating strategies such as peak shaving and valley filling, intelligent peak shaving, anti-backflow, demand control, and intelligent optical storage and charging. It comprehensively covers industrial and commercial energy storage application scenarios and helps users use low-cost and unmanned, intelligent operation and maintenance.

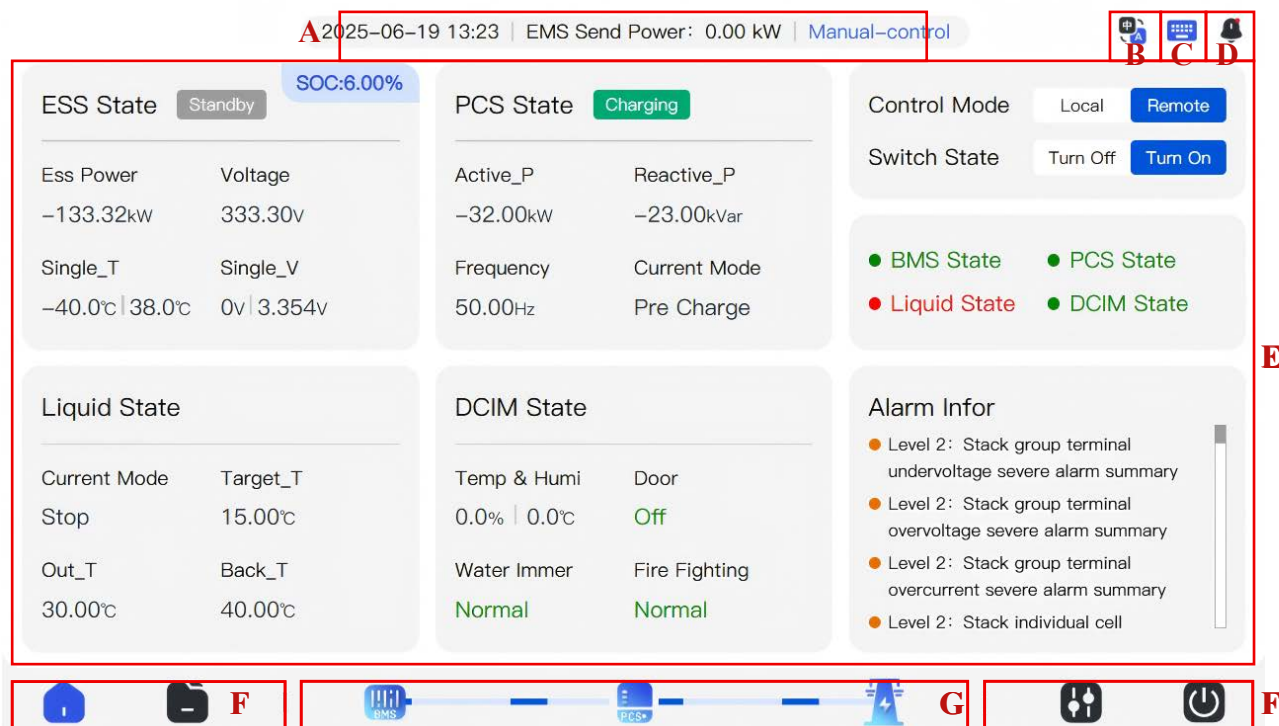


Figure2-11: Diagram of EMS home page interface (not actual operation)

Table 2-13: Description of EMS home page

No.	Name	Description	
A	EMS status	Display EMS real-time power and control modes	
B	Language switching	Switch between Chinese and English	
C	Virtual keyboard	Activate the virtual keyboard	
D	Bell alarm	Left-click to display all current alarms	
E	Function display area	Energy storage state	Real-time display of energy storage equipment status and parameter information
		Liquid cooling state	Real-time display of liquid cooling equipment status and parameter information
		PCS status	Real-time display of PCS equipment status and parameter information
		Dynamic environment equipment	Real-time display of dynamic ring equipment status and parameter information
		Control mode	Real-time display of current mode of EMS equipment
		switching state	Real-time display of on/off status of PCS devices
		Indicator state	Real-time display of system status: green represents normal communication, and red represents abnormal communication.
		Alarm message	Real-time display of system alarm information
F	Navigation bar	Display the main function modules of Web, which are Overview, Device Monitoring, Control Center, and Exit.	
G	Energy flow display area	Demonstration of energy storage charge and discharge status in animation form	

2.4.5.2 Specification Parameters

Table 2-14: EMS technical parameters

Items	Specifications
CPU	Cortex-A55, 2.0 GHz
USB	2 x USB 3.0 Type-A Ports
RS485	5-Channel RS485
CAN	2-Channel CAN
DI	8-Channel Dry Contact Inputs
DO	6-Channel Dry Contact Outputs (rated capacity: AC 250V/5A)
Ethernet	2 x RJ45, 10/100/1000 Mbps 1 x RJ45, 10/100 Mbps
Power	DC 24V operating voltage Range: 18 ~ 28V Power consumption: ≤ 12W
Humidity	10-90% RH (no condensing)
Operating temperature	-20°C ~ 60°C

Dimension (W * D * H)	273 × 213 × 35.5mm
Weight	~ 2350g

2.4.6 Fire Suppression System

2.4.6.1 Working Principle

This fire fighting system can be divided into aerosol fire fighting system, explosion-proof exhaust system and emergency water fire fighting (water injection and flood irrigation). When thermal runaway occurs in the battery and combustible gas overflows, the explosion-proof exhaust system responds in time to perform exhaust and ventilation; When a fire breaks out, the fire extinguishing system quickly intervenes to detect, alarm, extinguish and other actions; If the fire spreads or re-ignites, and the fire extinguishing system cannot control the fire, emergency water sprinkler can be connected for emergency treatment to prevent serious consequences such as deflagration and fire.

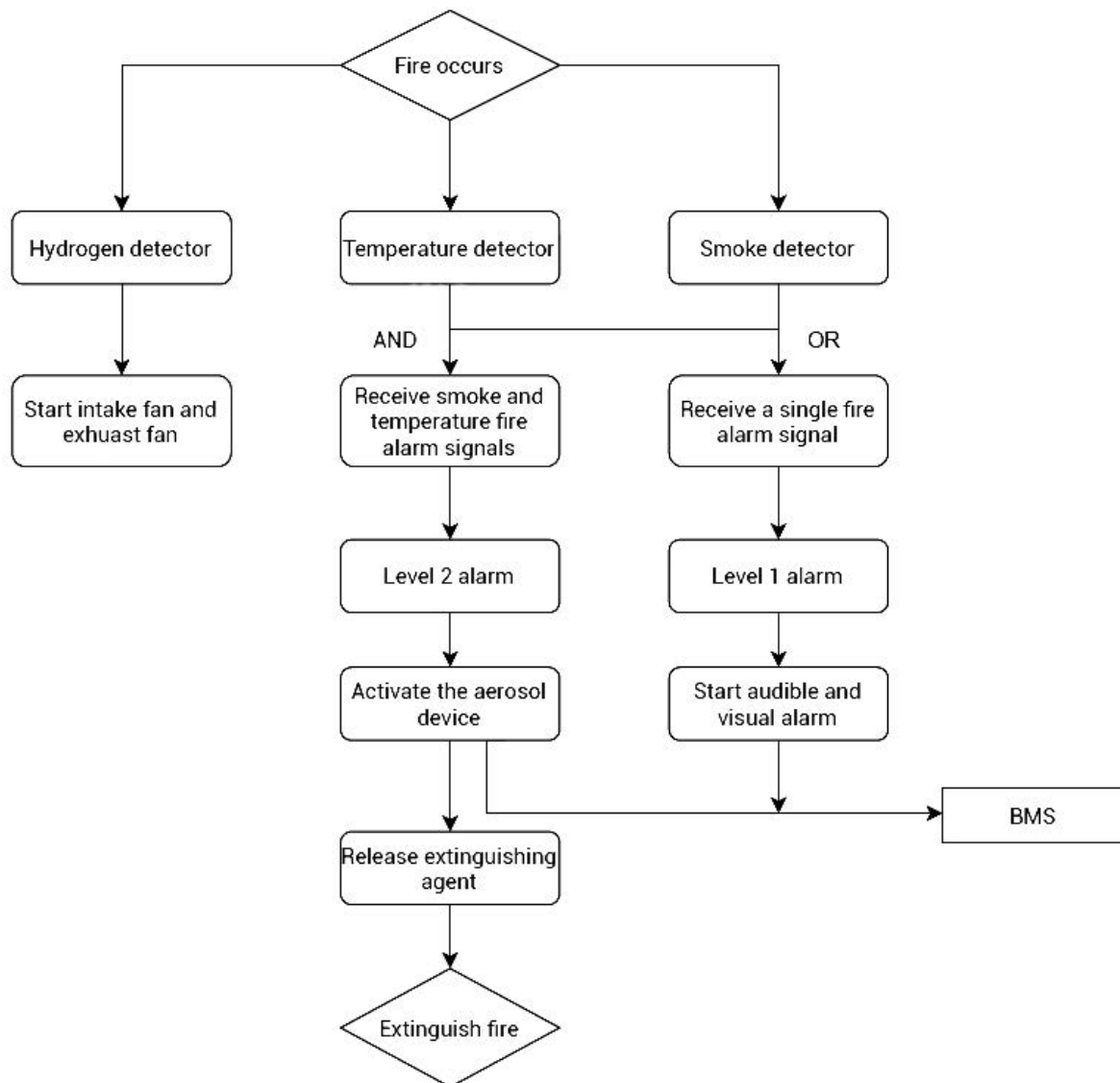


Figure 2-12: Working principle of fire suppression system

2.4.6.2 Specification Parameters

Table 2-15: Parameters of fire suppression system

No.	Items	Parameters
1	Operating voltage	24V
2	Extinguishing medium	Aerosol
3	Start mode	Electric start
4	Spray time	15s (± 5s)
5	Work Environment	-40°C ~ + 54°C, ≤ 95% RH

2.4.7 Liquid Cooling System

2.4.7.1 Working Principle

The liquid cooling unit is used to adjust the temperature of the battery pack in the energy storage system to ensure that it always works within the appropriate temperature range to maintain the optimal working condition. This product adopts a dual-water liquid cooling product that can thermally manage PACK and PCS at the same time.

The liquid cooling unit is mainly composed of compressor, condenser, water pump, fan, heat exchanger and necessary control components. 5 operating modes are supported: cooling, heating, self-circulation, fully automatic and stop.

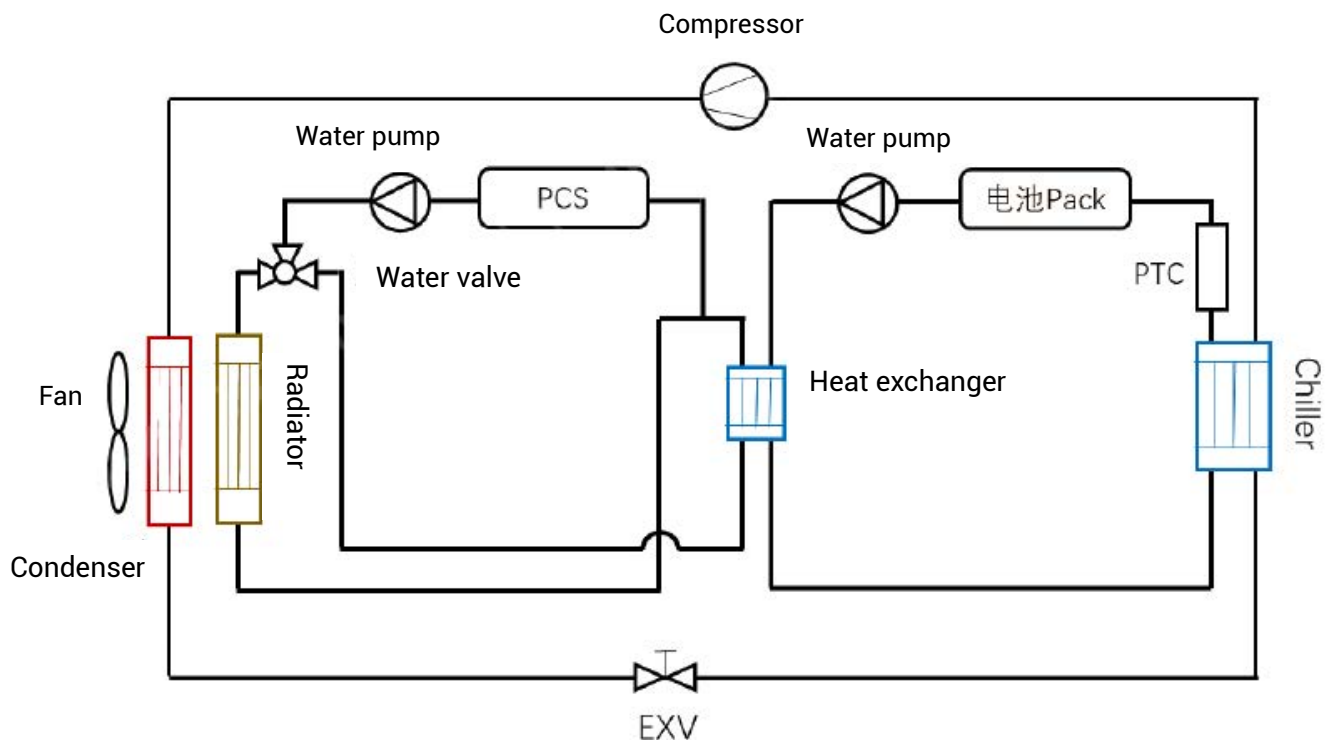


Figure 2-13: Principle diagram of liquid cooling unit

The workflow of liquid cooling unit is as follows:

- 1) After the outlet temperature of the battery side reaches the refrigeration start-up value, the compressor starts to compress the gaseous refrigerant. After the outlet temperature of PCS side reaches the cooling opening value, turn on the fan and three-way valve for cooling. The chiller supports the execution of temperature control logic based on the outlet temperature of the battery side and PCS side of the chiller, and the cell temperature and PCS temperature issued by the host computer. The default is to perform temperature control based on the outlet temperature of the cold machine.
- 2) The condenser condenses the high-temperature refrigerant, and the refrigerant changes from gaseous to liquid.
- 3) The fan sucks in the outside air and discharges the heat released when the refrigerant condenses and the heat absorbed by the water tank during PCS cooling to the surrounding ambient air.
- 4) A throttle element (electronic expansion valve) throttles and depressurizes the condensed refrigerant.
- 5) The refrigerant enters the plate heat exchanger and evaporates, absorbing the heat of the coolant flowing through the plate heat exchanger.
- 6) The battery circulating water pump continuously delivers the coolant to the plate heat exchanger, exchanges heat with the refrigerant, and delivers the cooled coolant to the container to cool the battery pack. The PCS circulating water pump continuously delivers the coolant to the heat exchanger and the cooling water tank, exchanges heat with the coolant at lower temperature on the battery side, dissipates heat into the air through a fan, and delivers the cooled coolant to the container to cool the PCS.
- 7) The three-way valve controls the ratio of the heat of the PCS dissipated into the air through the fan and the cooling amount reduced through the heat exchange of the battery-side coolant.

The control logic of liquid cooling unit is as follows:

Table 2-16: Logic of liquid cooling system

Category	Working mode	Control logic
Battery side	Refrigeration	When the temperature of the outlet liquid on the battery side is higher than the refrigeration start value, the refrigeration is turned on.
		When the temperature of the outlet liquid on the battery side is lower than the refrigeration stop value, the refrigeration is stopped.
	Heating	When the temperature of the outlet liquid on the battery side is lower than the heating starting value, the heating is turned on.
		When the temperature of the outlet liquid on the battery side is higher than the heating stop value, the heating is stopped.
PCS side	Refrigeration	When the temperature of the outlet liquid on the PCS side is higher than the cooling start value, the cooling is turned on.
		When the temperature of the outlet liquid on the PCS side is lower than the cooling stop value, the cooling is stopped.
	Heating	When the temperature of the outlet liquid on the battery side is lower than the heating starting value, the heating is turned on.
		When the temperature of the outlet liquid on the battery side is higher than the heating stop value, the heating is stopped.

2.4.7.2 Specification Parameters

Table 2-17: Technical parameters of liquid cooling system

Category	Items	Parameters
Voltage	Rated operating voltage	220VAC, 50/60Hz
	Voltage range	220 ± 15%VAC, 50/60 ± 3Hz
Communication	Communication method	RS485 or CAN
Refrigeration and heating capacity	Refrigeration capacity (battery side)	5.0kW (W22/L45)
	Refrigeration capacity (PCS side)	3.0kW (W50/L45)
	Heating capacity (battery side)	2.0kW
	Heating capacity (PCS side)	1.0kW
	Coolant flow (battery side)	50L/min @ 60kpa
	Coolant flow (PCS Side)	20 L/min @ 60kpa
Environmental characteristics	Operating ambient temperature	-30°C ~ + 55°C
	Storage ambient temperature	-40°C ~ + 70°C
	Working altitude	≤2000m, 3% derating for every exceeding 1000m
	Noise rating @ L45/W18	73dB (A)
	IP rating	IPX5 (core components meet IP67)
	Refrigerant	R1234yf-R134a
Dimensions, Weight, Installation	Coolant	50% aqueous ethylene glycol
	Overall dimensions (width × depth × height)	790 × 1000 × 260mm
	Weight	90kg
	Installation method	Drawer type

2.4.8 Environmental Control System

The cabinet environmental control system includes a dehumidifier and a water immersion sensor. Dehumidification control: When the environmental humidity in the cabinet is greater than the set threshold, the dehumidifier automatically starts to reduce the humidity in the cabinet and keep it within a safe range that is not easy to produce condensation. When the humidity is lower than the set value, the dehumidifier stops working.

Water immersion protection: When the water immersion sensor detects liquid (accumulated water) in the cabinet, the system will immediately trigger an alarm and actively protect the equipment to avoid damage due to water immersion.

2.4.9 Grounding System

There are two grounding points at the front and back of a single outdoor cabinet system, and the fixing points of grounding bolts form a reliable equipotential connection with the non-functional

conductive conductors of the whole outdoor cabinet.

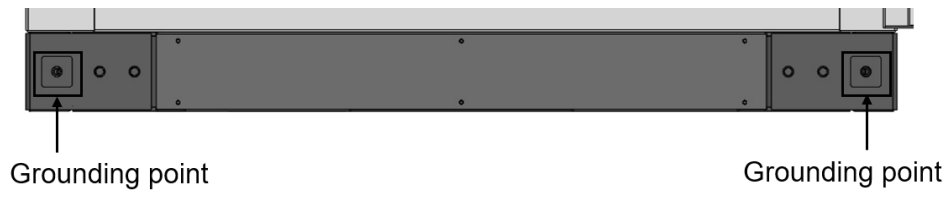


Figure2-14: Grounding points

3 Transportation and Storage

3.1 Transportation

DANGER

- Roughly loading and unloading the battery is prohibited, otherwise it may lead to short circuit, damage (leakage, cracking, etc.), fire or explosion, etc.

WARNING

- Do not transport batteries by their terminals, bolts, or cables.
- When moving the battery, follow the specified direction. Do not invert, tilt, drop, subject to mechanical impact, expose to rain or snow, or allow to fall into water.

General requirements

- This product has passed UN38.3 certification and belongs to Class 9 dangerous goods.
- Comply with international dangerous goods transportation regulations and regulatory requirements of the country of origin, transit countries, and destination countries.
- Maritime transport complies with the International Maritime Dangerous Goods Code (IMDG Code) transportation requirements.
- Transportation service providers must be qualified for transporting dangerous goods.
- Transportation in convertible vehicles is strictly prohibited.
- When transporting, choose sea transport or roads in good condition. Rail and air transport are not supported.
- All parts must be properly packed or boxed, and protective measures must be taken to prevent loss, damage or theft during transportation.
- Packaging materials shall ensure that all parts are protected from damage, loss, deformation, moisture and corrosion during transportation.
- The technical information supplied with the product shall be complete.
- When handling the battery, handle it carefully and smoothly; It is strictly forbidden to bump the battery and pay attention to personal safety.
- Logistics vehicles must be equipped with basic safety facilities such as three-layer rain tarpaulins and dry powder fire extinguishers that meet the requirements, and the goods loaded must not be exposed to the sun and rain.
- During transportation, it is necessary to ensure that the goods are leveled to prevent violent vibration, and to ensure that there will be no upside down, offset, bump, collapse and other phenomena.
- Unless otherwise specified, dangerous goods cannot be mixed with goods containing food, medicines, animal feed and other additives in the same vehicle or container.
- Before handling the faulty battery (carbonization, leakage, expansion, water ingress, etc.), the positive and negative terminals of the battery must be insulated. They must be properly packaged

and put into the insulated explosion-proof box as soon as possible, and records should be made in the outer box, including the site name, address, time, phenomenon and other information.

- On the way to remove the faulty battery from the site, it is necessary to avoid combustible storage areas, residential areas or crowded places, such as public transportation or elevators.
- During transportation, the battery SOC is recommended to be kept at 30%~50%.

3.2 Storage

WARNING

- Batteries must be stored separately and must not be stored together with other equipment. The site must be equipped with appropriate firefighting equipment (such as fire sand, fire extinguishers, etc.).
- When storing batteries, they must be placed correctly according to the markings on the packaging box. It is strictly prohibited to place them upside down, on their sides, or at an angle. When stacking, the outer packaging stacking requirements must be followed to avoid stacking batteries too high.
- If the battery malfunctions (carbonization, leakage, expansion, water ingress, etc.), it must be disposed of as soon as possible.

CAUTION

- It is recommended to use the battery in time. For the battery stored for a long time, please recharge it every 3 months and charge and discharge it every 6 months, otherwise the battery may be damaged.

Storage environment requirements

- Ambient temperature: storage time ≤ 6 months, $0^{\circ}\text{C}\sim 35^{\circ}\text{C}$; storage time ≤ 1 month, $-20^{\circ}\text{C}\sim 45^{\circ}\text{C}$.
- Relative humidity: $< 75\%$ RH, no condensation.
- Dry, ventilated, clean, non-dusty environment, non-strong electrostatic and strong magnetic field environment.
- Avoid contact with corrosive organic solvents, gases and other substances.
- Avoid direct sunlight or rain.
- Keep away from fire and heat sources.
- Complies with fire protection requirements.

General requirements

- During the storage period, relevant certificates of compliance with product storage requirements (such as temperature and humidity log data, storage environment photos and inspection reports, etc.) must be kept.
- The main power circuit must be disconnected during storage, and it is recommended to turn on the auxiliary power supply to make the monitoring system work normally.
- Regular inspection (at least once every half month) to check whether the cabinet and internal equipment are intact.

4 Installation and Commissioning

4.1 Installation Process

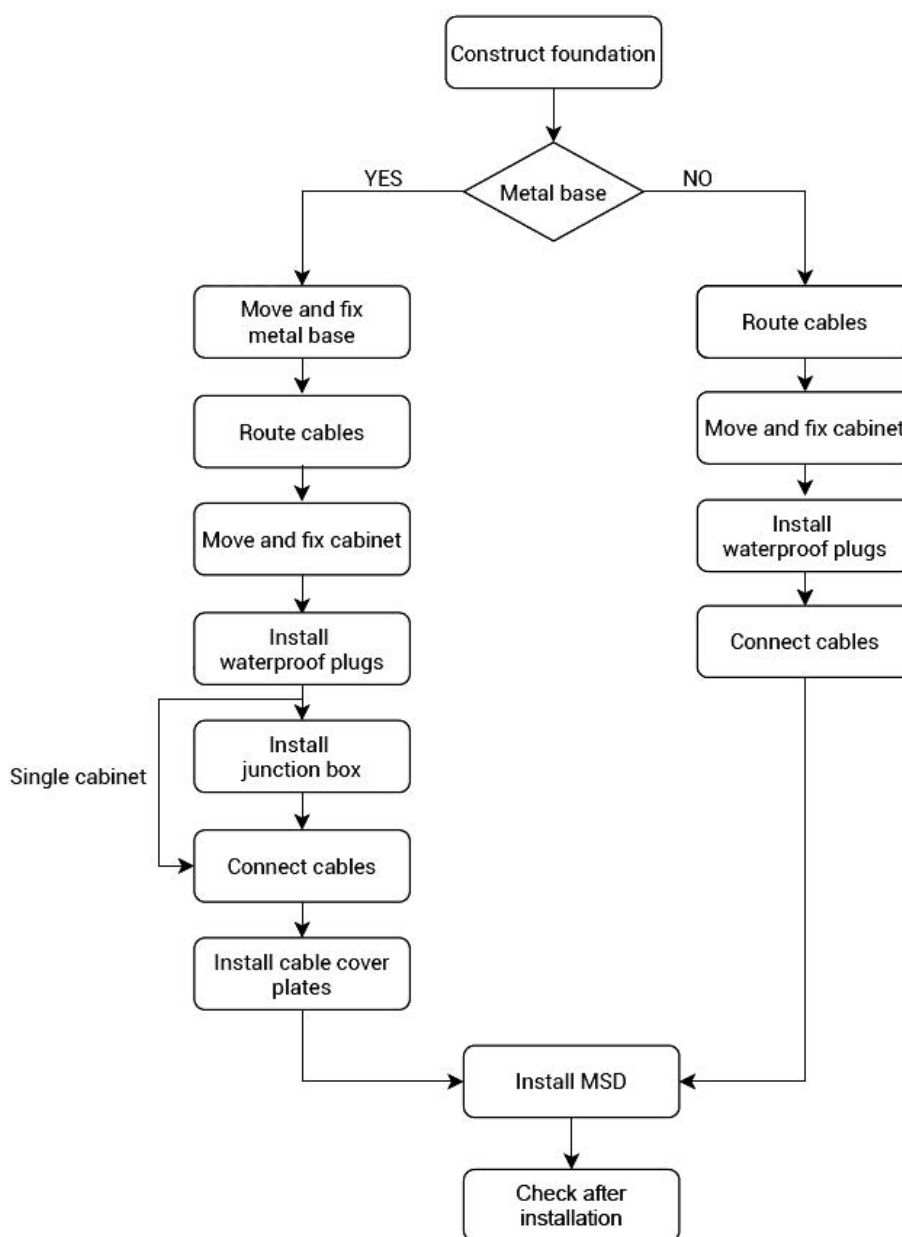


Figure 4-1: Installation flow

4.2 Tool Preparation

NOTE

- The tools shown below are for reference only, please refer to the actual product.
- Due to different on-site conditions, the below list cannot fully cover a few possible tools. Please inform on-site installers and users to prepare the unlisted tools according to the actual situation.

Table 4-1 Installation tool list

No.	Tools	Specifications	Remarks
1	Crane/Forklift	Load capacity greater than 3.5T, fork width less than 160mm	Handling equipment
2	Sleeve and Torque Wrenches	Torque range: 0 ~ 180N·m	Fastening bolt
3	Screwdriver	Phillips Screwdriver Slotted Screwdriver	M4-M8 screw removal and fastening
4	Wire-stripping pliers	Conventional	Making cable terminals heads
5	Crimping pliers	Conventional	Making cable terminals heads
6	Heat gun	Conventional	Making cable terminals heads
7	Electric drills and drill bits	Conventional	Drilling
8	Hammer	Conventional	Install expansion bolts
9	Marker pen	Conventional	Mark hole position
10	Ink bucket	Conventional	Base positioning marking
11	Multimeter	Range 1000VDC	Detect voltage and resistance values
12	Safety protection tools	Meets local safety standards	Including but not limited to insulating gloves, insulating shoes, safety helmets, anti-arc clothing, etc

4.3 Pre-installation Inspection

4.3.1 Inspection Overview

- Check that the quantities listed on the packing list match the actual items.
- Check that all factory documents and accessories are complete.
- Check the product shell for deformation, paint peeling and looseness.
- If the quantity of physical items is consistent with the packing list, Party A and Party B shall jointly sign and confirm the packing list. At the same time, in order to protect the equipment and facilitate the subsequent investigation for the cause of equipment damage, the equipment storage site environment, packaging boxes and packaging materials should be photographed and archived.
- If damage or corrosion is discovered during the unpacking inspection, it shall be reported and

handled in a timely manner, and photographs shall be taken for archival purposes.

4.3.2 Packing List

Table 4-2: Packing list

No.	Items	Quantity	Remarks
1	Product factory inspection report	1 copy	
2	Certificate of conformity	1 copy	
3	Shipping bill of Materials	1 copy	

4.4 System Installation

4.4.1 Mounting Base Requirements

CAUTION

- Before construction, confirm proper planning and design implementation for the ground grid, drainage infrastructure and fire prevention facilities.
- Consultation with local civil, structural, and fire engineers is recommended to confirm compliance of foundation designs with relevant regulations. Key considerations include drainage slope, drainage ditches, and fire wastewater collection and discharge system to ensure structural safety and water management meet required standards.
- Only after electrical and civil design drawings undergo a complete review and obtain approvals from electrical engineers/ structural engineers, as well as receive approvals from our company, can the EPC proceed with foundation constructions.

4.4.1.1 Metal Base Foundation Requirements (Optional)

- The bottom of the base foundation must be tamped and filled flat, the bearing capacity of the base soil must meet $FAK \geq 120kpa$, and the concrete thickness must be $\geq 130mm$.
- The allowable deviation of ground flatness is $4mm/2m$.
- The foundation should extend at least 300mm beyond the surrounding of the metal base.

4.4.1.2 Concrete Foundation Requirements

- The bottom of the base foundation must be tamped and filled flat, the bearing capacity of the foundation soil must meet $FAK \geq 120kpa$, and the concrete thickness must be 400mm.
- The allowable deviation of ground flatness is $4mm/2m$.
- The foundation is at least 300mm higher than the ground, and it should be 125mm larger than the surrounding base of the cabinet to ensure the stability of the foundation.
- When building the foundation, it is necessary to consider the cable outlet and reserve the trench in advance.

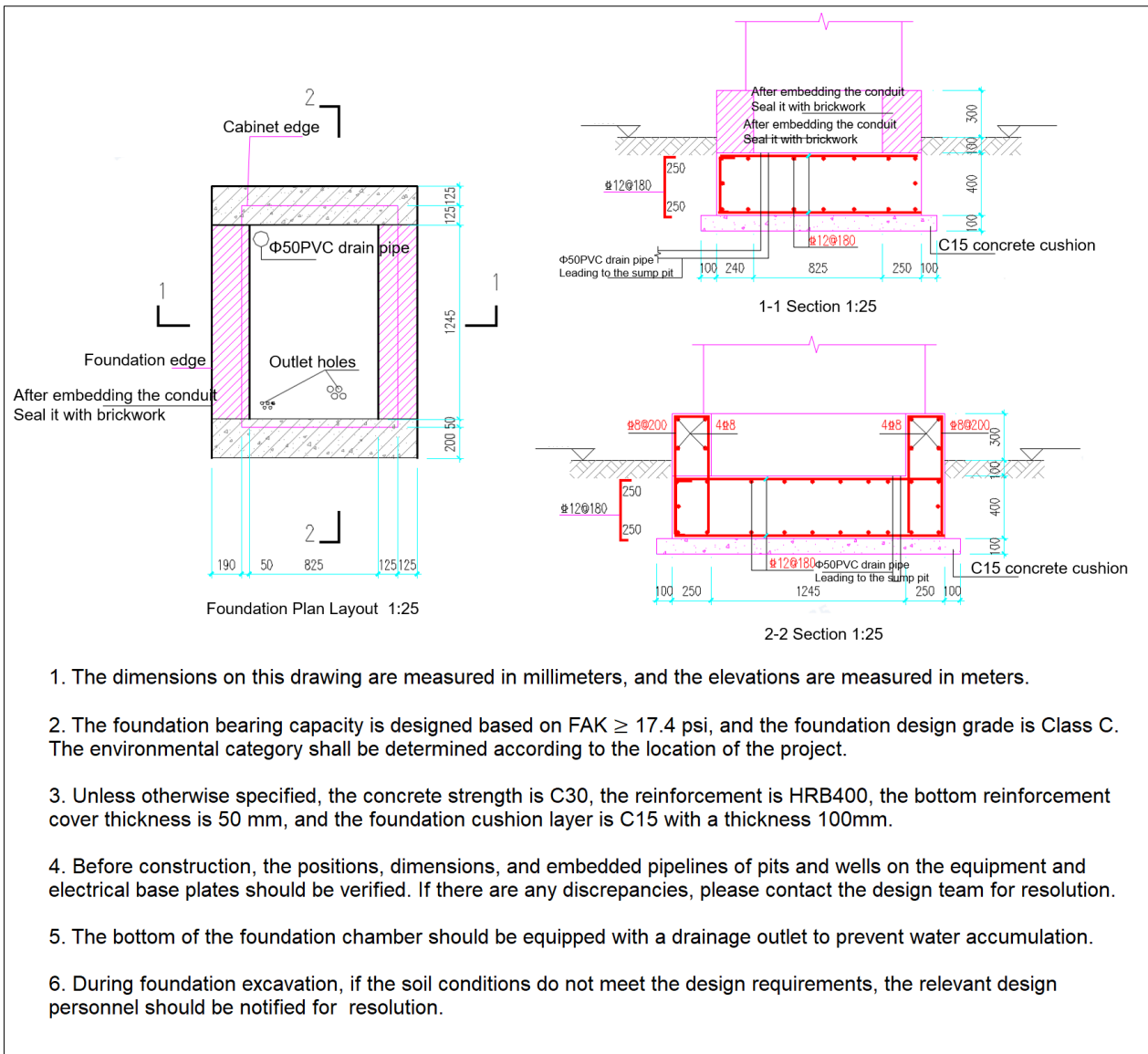


Figure 4-2: Non-metal base foundation design drawing (for reference only)

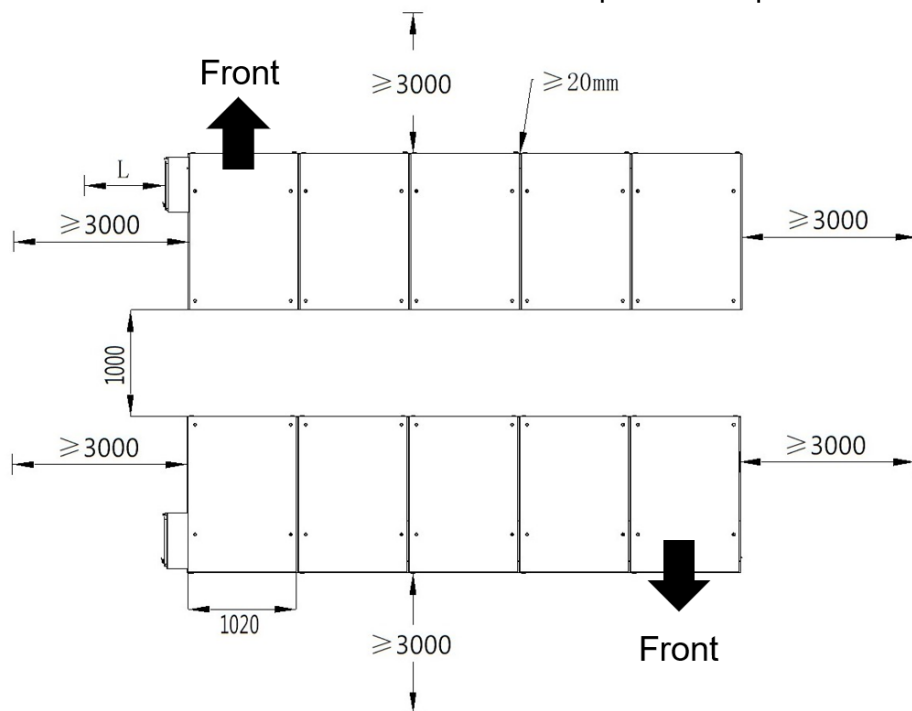
4.4.2 Layout Space Requirements

4.4.2.1 Single Cabinet Arrangement

- At least 3000mm should be reserved in front of the cabinet.
- At least 500mm should be reserved behind the cabinet.
- It is recommended to reserve 3000mm on the left and right sides of the cabinet, which can be adjusted according to local fire regulations, but the "L" distance shown in the figure should be greater than 1000mm to ensure sufficient maintenance space for the power distribution box.

4.4.2.2 Parallel Cabinet Arrangement

- At least 20mm should be reserved between cabinets.
- At least 3000mm should be reserved in front of the cabinet.
- At least 500mm should be reserved behind the cabinet; At least 1000mm should be reserved for back-to-back arrangement.
- It is recommended to reserve 3000mm on the left and right sides of the cabinet, which can be adjusted according to local fire regulations, but the "L" distance shown in the figure should be greater than 1000mm to ensure sufficient maintenance space for the power distribution box.



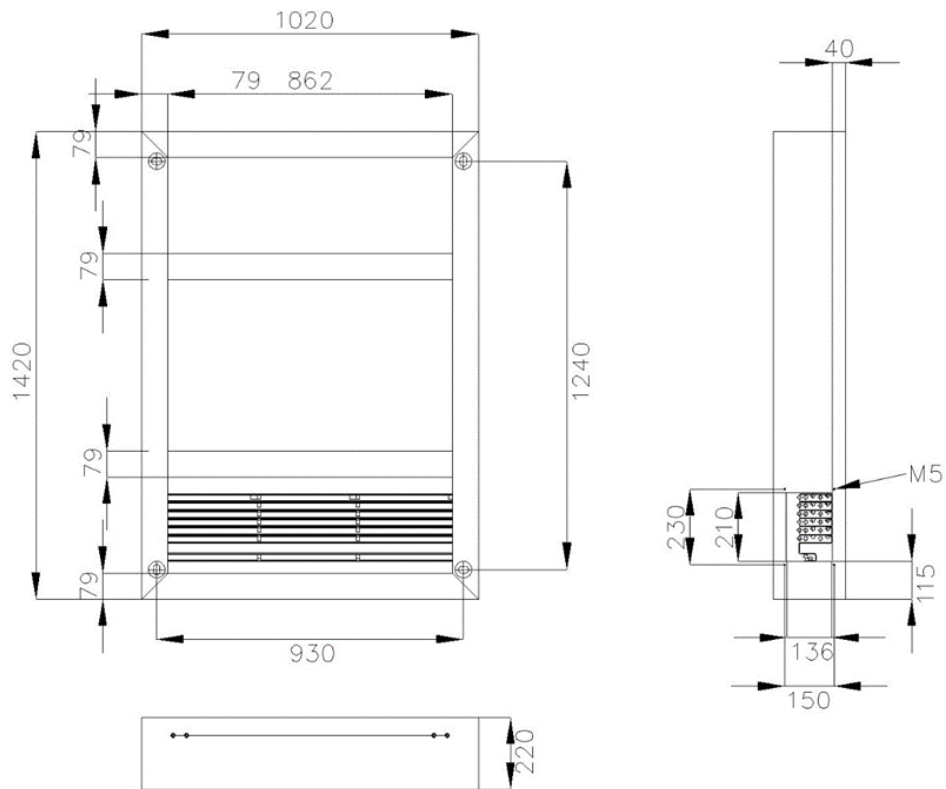
Unit: mm

Figure 4-3: Diagram of maintenance space

4.4.3 Positioning

4.4.3.1 Optional Metal Base: Expansion Bolt Positioning

When the outdoor cabinet is equipped with a metal base, it is positioned by expansion bolt positioning. The specific steps are as follows:



Unit: mm

Figure 4-4: Metal base dimensions

Step 1: Use an ink fountain to draw a reference line ① on the horizontal axis of the foundation. Then draw a reference line ② on the vertical axis on one side of the foundation, ensuring that the two lines are perpendicular to each other.

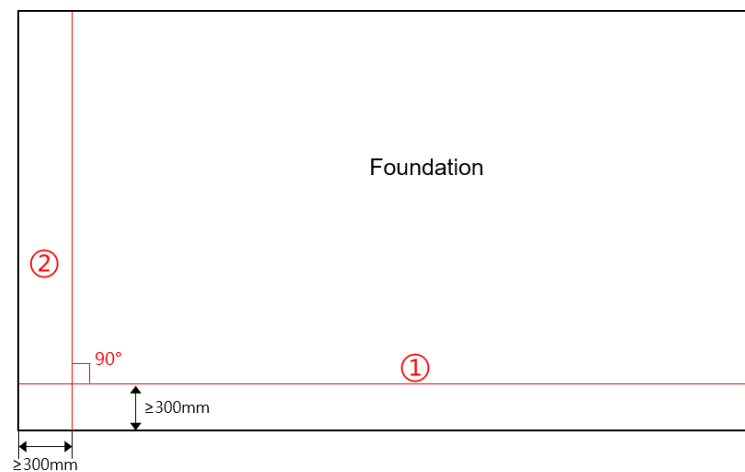


Figure 4-5: Metal base positioning-Drawing lines

Step 2: Align one corner of the drilling template with the intersection of the two reference lines (marked in blue as shown in the figure below), and use a marker to mark the positions of the four drilling points (labeled as positions A, B, C, and D in the figure below).

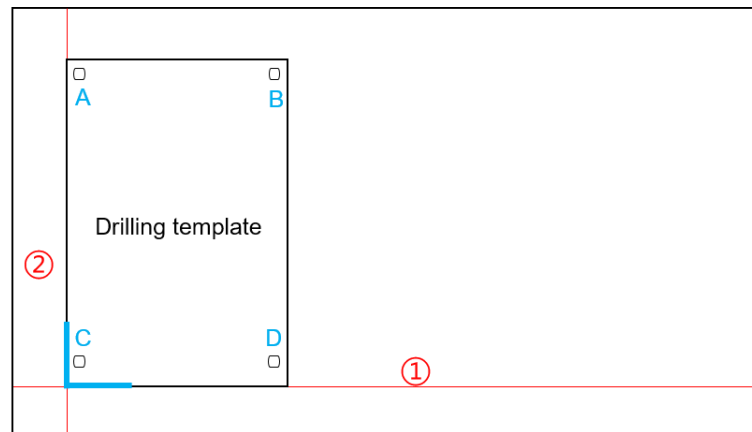


Figure 4-6: Metal base positioning-Marking

Step 3: Use an electric drill to drill holes vertically at the marked drilling points (hole depth: 110mm, hole diameter: 18mm). After drilling, clean out the debris from the holes.

Step 4: Insert the M16 expansion bolts into the hole, tap the bolts with a hammer until they are flush with the ground, and remove the washers and nuts to prepare for the installation of the metal base.

Step 5: If multiple devices are to be installed in a row, after installing the first metal base, align the drilling template with the base to locate the drilling points for the second base. Repeat this process sequentially for additional bases.

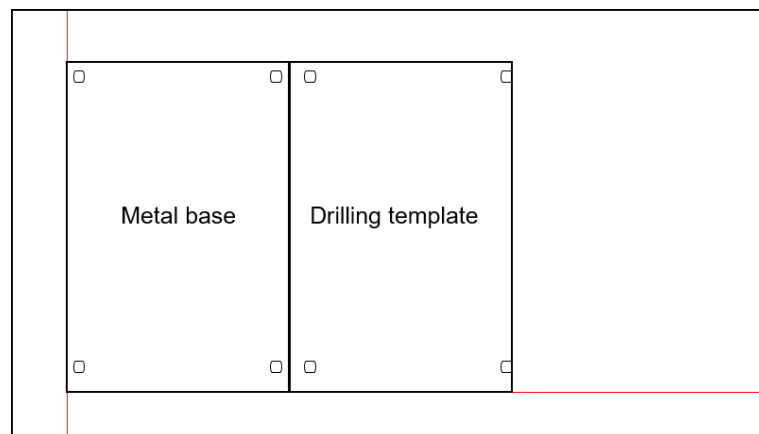


Figure 4-7: Metal base positioning-Alignment

4.4.3.2 None Metal Base: Cabinet Direct Positioning

When the outdoor cabinet is not equipped with an optional metal base, the positioning can be realized through the cabinet directly. The specific steps are as follows:

Step 1: Use an ink fountain to draw a reference line ① on the horizontal axis of the concrete foundation. On the vertical axis of the foundation, mark another reference line ②, ensuring the two lines are perpendicular to each other.

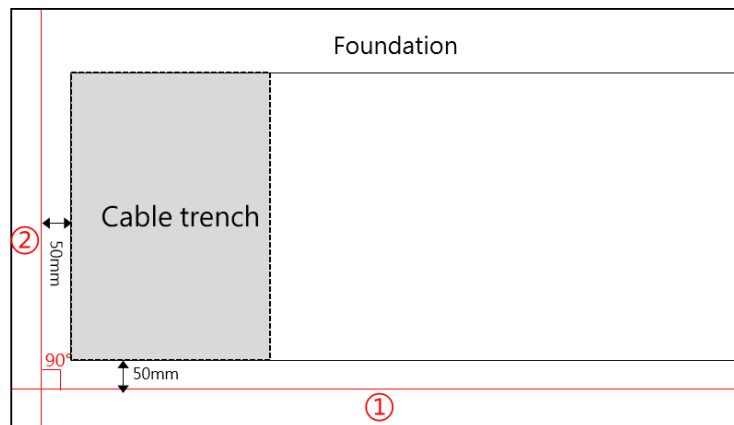


Figure 4-8: Cabinet Positioning-Drawing lines

Step 2: The intersection angle of the two reference lines determines the cabinet placement position (marked in blue as shown in the figure below). Align one corner of the cabinet with the intersection angle and position the cabinet accordingly.

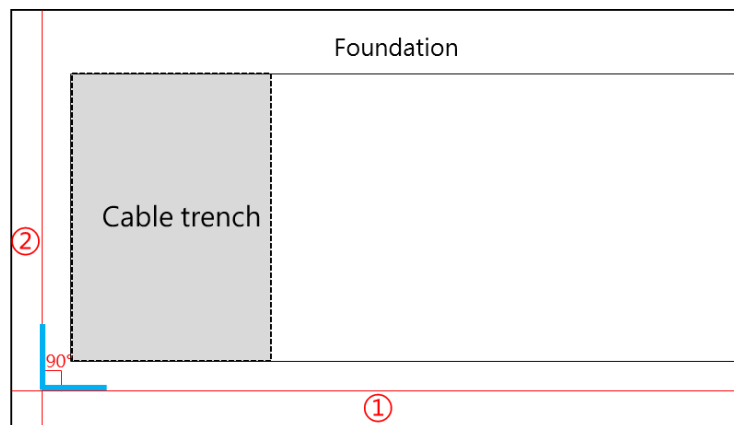


Figure 4-9: Cabinet Positioning-Marking

Step 3: After the first cabinet is in place, extend a line ≥ 20 mm from the side edge of the cabinet and mark the point. Using this mark, draw a new reference line ③ on the vertical axis of the foundation, ensuring lines ① and ③ are perpendicular. The intersection angle of these two lines defines the placement position for the second cabinet (marked in blue as shown in the figure below). Subsequent cabinets should be installed following the same method.

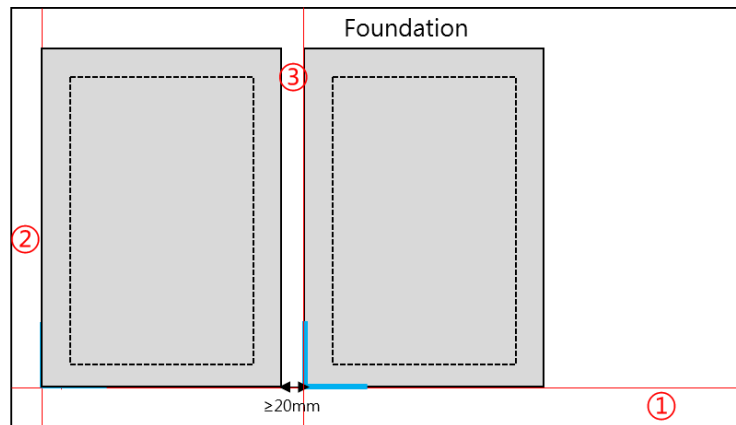


Figure 4-10: Cabinet Positioning-Alignment

4.4.4 Moving and Fixing Metal Base

NOTICE

- Select appropriate steel wire ropes or slings according to the weight of metal base (196kg). During transportation, ensure that the center of gravity remains stable and move at a constant speed.
- Mounting hooks must face upward.

Step 1: Attach the hooks of the wire rope / lifting sling to the four holes on the base, as shown in positions ①, ②, ③, ④ in the figure below:

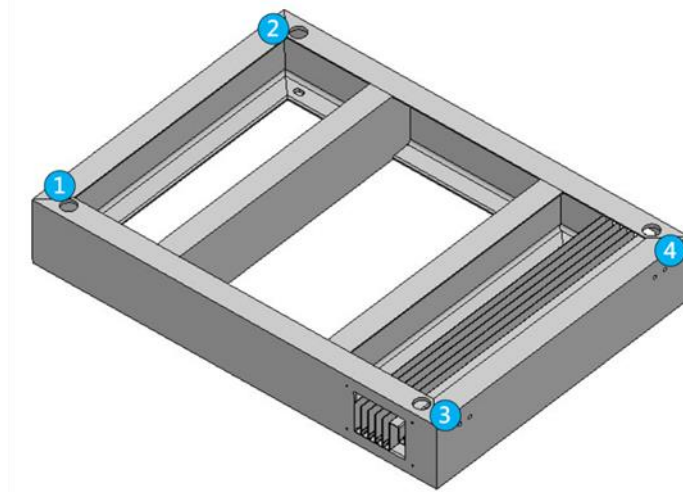


Figure 4-11: Metal base hook location

Step 2: Insert one of the forklift arms into the ropes and then slowly lift the base.

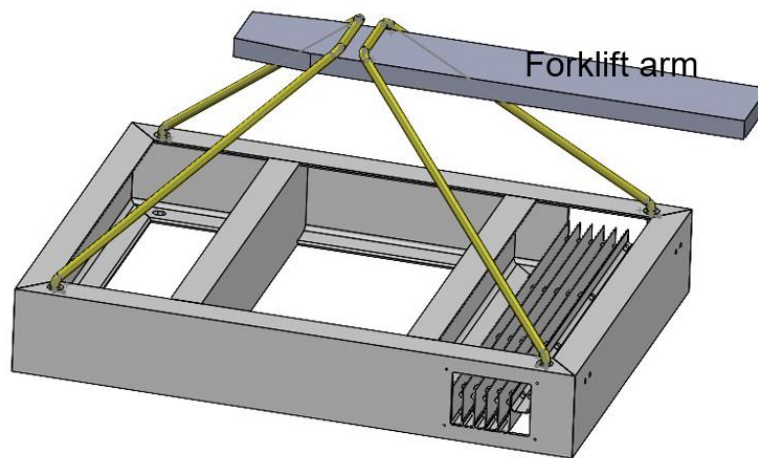


Figure 4-12: Diagram of moving metal base

Step 3: Move the base to the installation position, aligning the four bolt holes on the base with the pre-embedded expansion bolts one by one, then slowly lower the base.

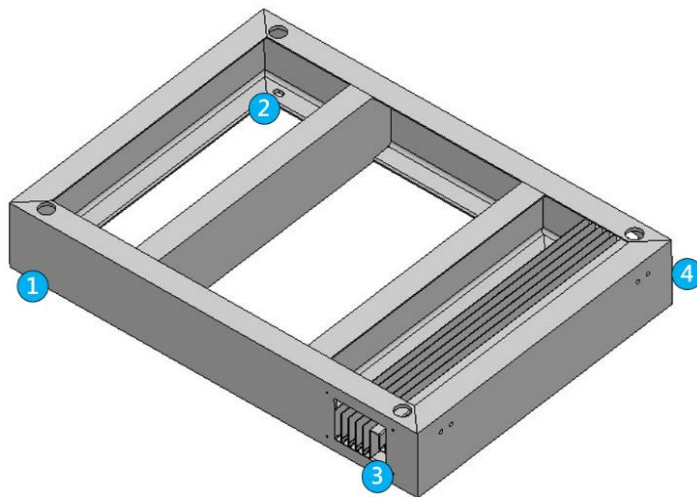


Figure 4-13: Positions of bolt holes for metal base

Step 4: Place the washer and nut onto the expansion bolt, then use a wrench to tighten the nut. The recommended torque is $160 \pm 5 \text{ N}\cdot\text{m}$.

4.4.5 Routing Cables

NOTICE

- If not using a metal base, the requirements for self-dug cable trenches are listed below:
 - Communication cables and power cables must be routed separately. Same type cables should be bound together; different type cables should be laid at least 30mm apart from each other. Do not interwind or cross cables.
 - Attach labels to both ends of each cable, clearly indicating cable information to ensure easier future maintenance.

4.4.5.1 Routing a Single Cabinet

Routing the following cables in the metal base slots:

- ① 4 AC power cables (R/S/T/N)
- ② 1 EMS communication cable
- ③ Auxiliary power supply cable (optional, project-dependent).

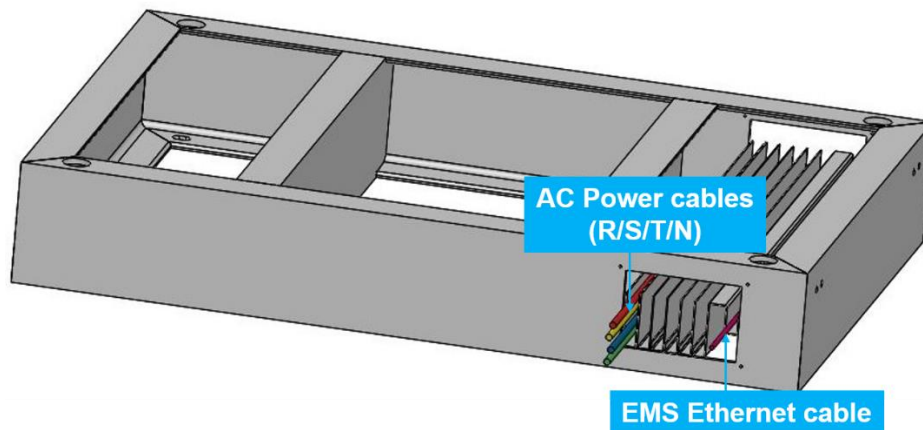


Figure 4-14: Single cabinet wiring diagram

4.4.5.2 Routing Parallel Cabinet

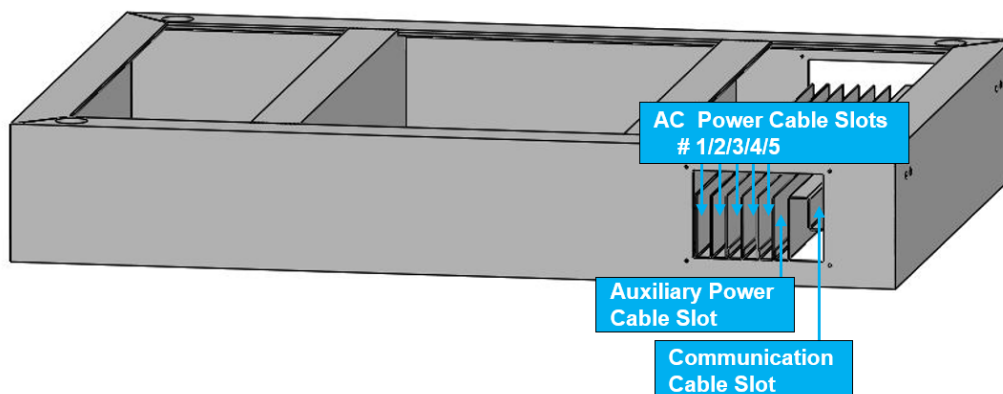


Figure 4-15: Diagram of cable slot layout

- ① AC power cables: Each cabinet is equipped with 4 AC power cables (R/S/T/N). Route each power cable through the base of the master unit, then route it to the corresponding cabinet's base. For example, arrange Cabinet #1 power cables (R/S/T/N) in the Slot 1; Cabinet #2 power cables (R/S/T/N) in the Slot 2, and so on.

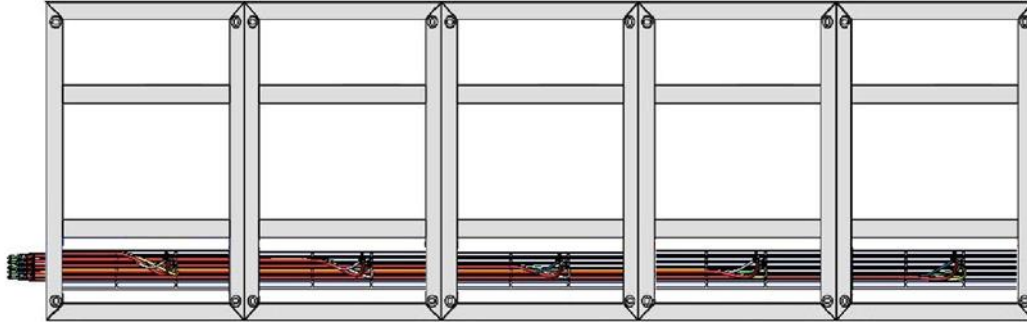


Figure 4-16: Parallel cabinet wiring-AC power cables (top view)

- ② Inter-cabinet communication cables: Route two Ethernet cables between every two bases. For example, two cables between Cabinet #1 and Cabinet #2, also two cables between Cabinet # 2 and Cabinet #3, and so on.
- ③ EMS communication cable of master unit: Each set of paralleling cabinets prepares one external Ethernet cable. Route a cable in the metal base of the master cabinet.
- ④ Auxiliary power supply cables (optional, project-dependent): Route the auxiliary power cables through Slot 6 to the corresponding cabinet base.

4.4.6 Moving and Fixing Cabinet

4.4.6.1 Moving Cabinet

Use a crane or fork-lift to move the cabinet to the installation position. It is necessary to confirm the size and weight of the cabinet prior to moving (Dimensions: W1000mm*D1420mm*H2250mm; weight 2.7T). The load capacity of the crane or forklift must meet the maximum load-bearing weight of the device.

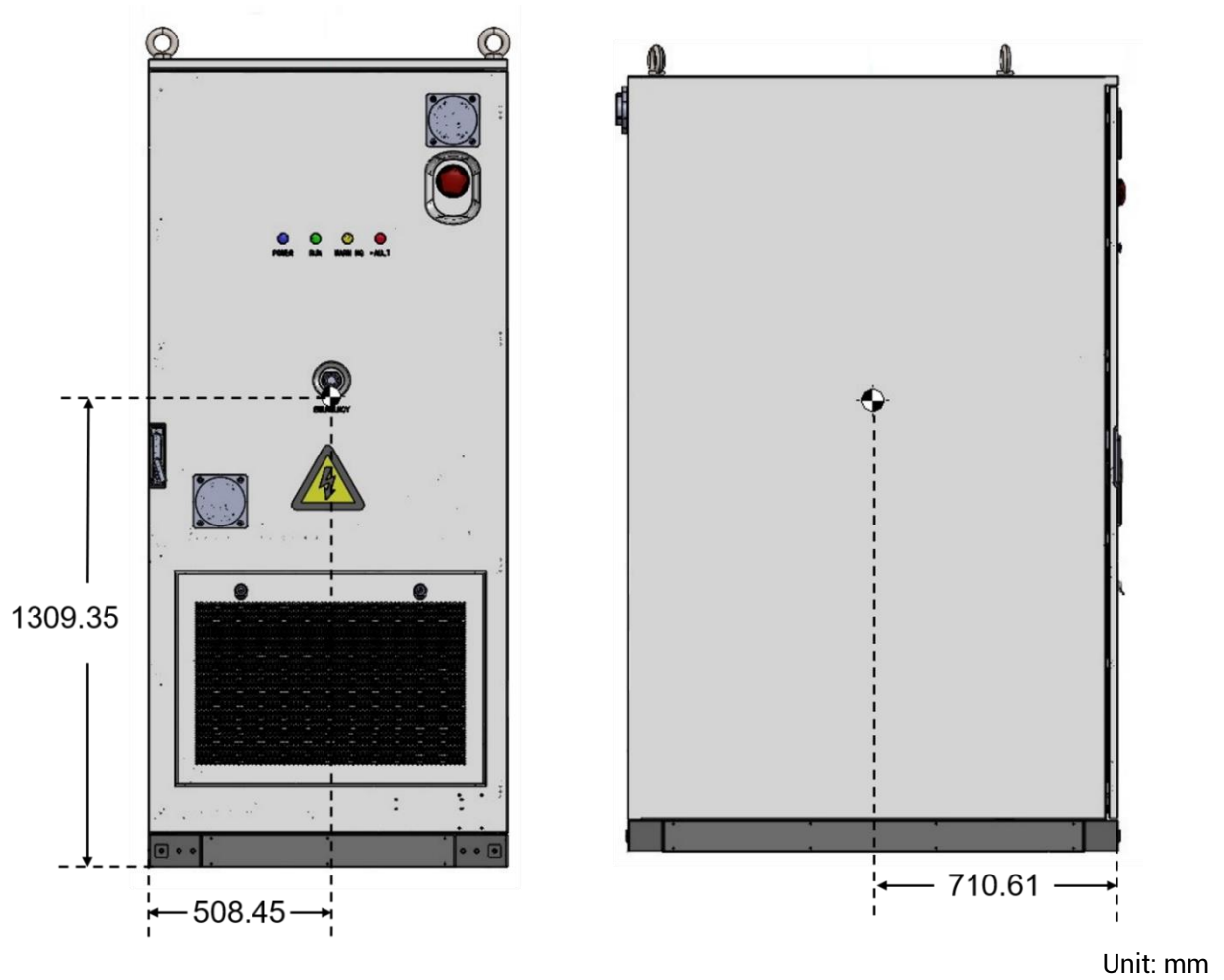


Figure 4-17: Diagram of the gravity of the cabinet

4.4. 6.1. 1 Crane Lifting

CAUTION

- Before lifting, ensure that the operators have been trained and qualified to operate the crane.
- Before lifting, ensure that the crane and slings meet the safety requirements for lifting operations.
- Before lifting, ensure that all cabinet doors are locked.
- During lifting, ensure that the cabinet remains parallel to ground.
- During lifting, avoid twisting cabinet or shifting the center of gravity

Step 1: Insert the lifting rings into the holes on the top of the cabinet in sequence; tighten them clockwise using a wrench. The recommended torque is 720N·m.

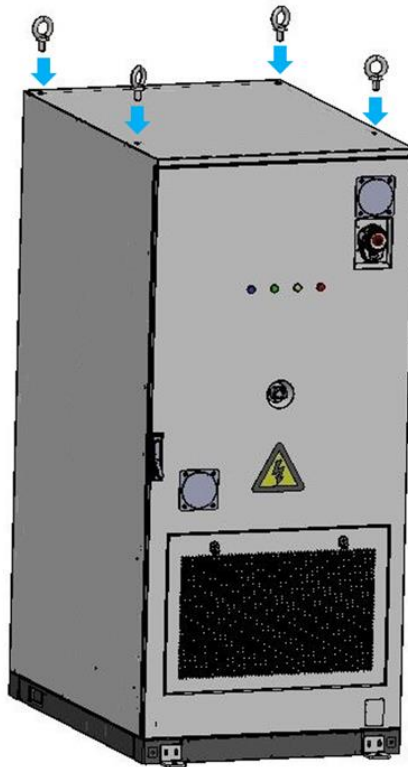


Figure 4-18: Installing lifting rings

Step 2: Insert the hoisting ropes into the lifting lugs and fix the other end to the hook of the crane. When the hoisting ropes are in a straightened state, the angle between them and the top of the cabinet should be $\geq 60^\circ$. Make sure that the cabinet is not tilted and then lift it slowly, and move the cabinet to the installation position.

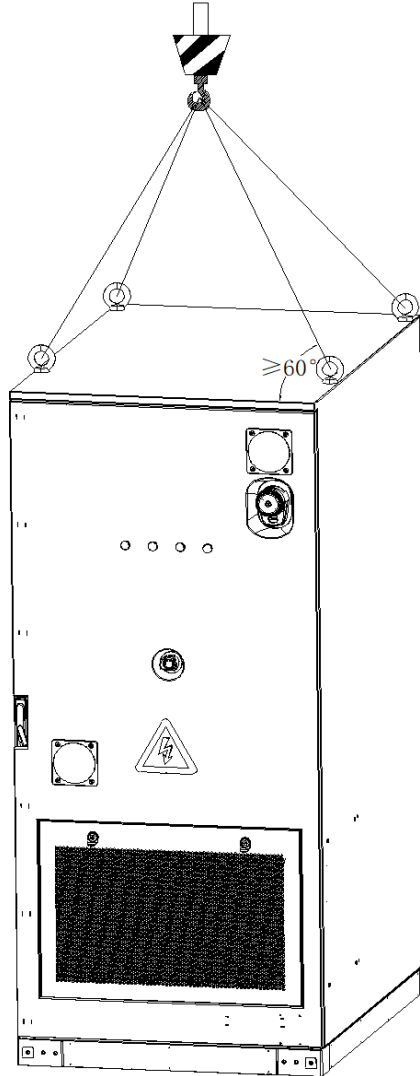


Figure 4-19: Diagram of cabinet lifting

4.4. 6.1. 2 Move with Fork-lift

⚠ CAUTION

- Make sure the operator is trained and qualified to operate the fork-lift.
- Perform the operation on level ground. When positioning forks, insert the forks of the fork-lift into channel steel's openings on the cabinet, ensuring that the forks remain parallel to the ground and the cabinet's gravity is in the middle of the forks to avoid imbalance.
- After securing the cabinet, drive the fork-lift at a safe and controlled speed when lifting cabinet. Avoid sudden movement, sharp turns and driving over uneven ground, so as not to affect its stability when traveling.

NOTICE

- At least two trained personnel are required to operate together.
- Safety shoes, protective gloves, and safety helmets are required.

Step 1: The cabinet base has square fork holes as shown in the figure below. Insert the forklift arms from one side of the holes to the other side, then slowly lift the equipment and move it to the installation position.

- Single cabinet: Lift from sides (side plates already removed)
- Parallel cabinet: Lift from front/rear (remove front/rear plates first)

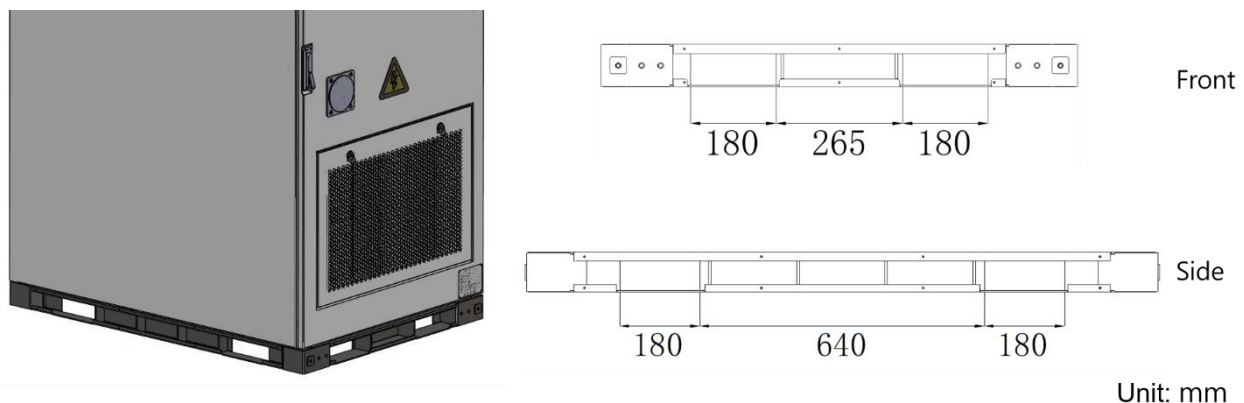


Figure 4-20: diagram of fork hole location and dimensions

Step 2: Suspend the cabinet above the metal base. Use a fixing connector to align the mounting holes between the cabinet and the metal base. Once the holes are properly aligned, slowly lower the cabinet onto the base.

Step 3: Take out the left- and right-side plates, then align them with the screw holes at the bottom of the cabinet. Secure them using M4 screws, tightening in a diagonal sequence step by step. The recommended torque is $2 \pm 0.5 \text{ N}\cdot\text{m}$.

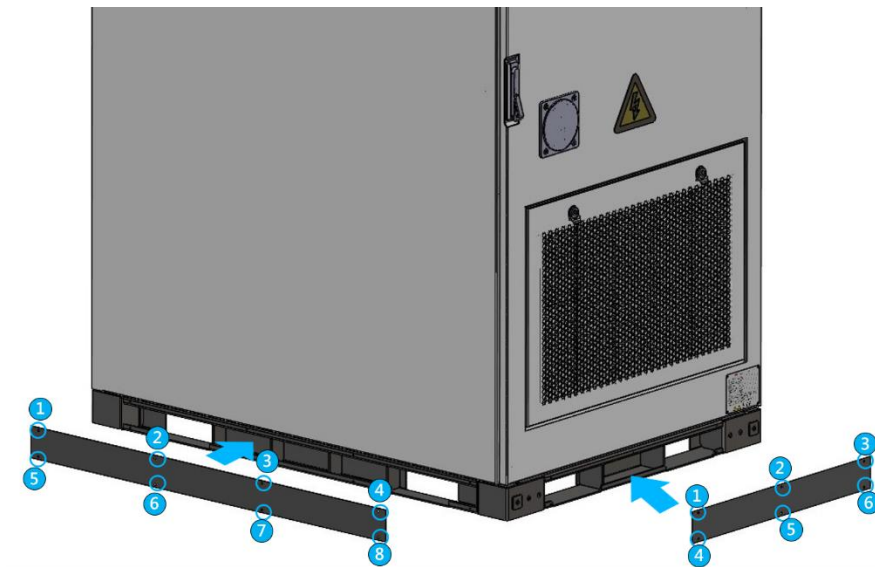


Figure 4-21: diagram of mounting positions of plates

4.4.6.2 Cabinet Fixation

There are 2 fixing points (4 in total) at both the front and rear sides of the bottom of the cabinet, as shown in the figure below. Please select the appropriate fixing method according to the actual base conditions.



Figure 4-22: Fixing points of cabinet

4.4. 6.2. 1 Optional Metal Base

Move the cabinet onto the metal base, aligning the fixing holes of the cabinet with those of the base. Secure the cabinet to the base using 4 fixing connectors and 16 M10 bolts (front and rear). The recommended torque is $52 \pm 5\text{N}\cdot\text{m}$.

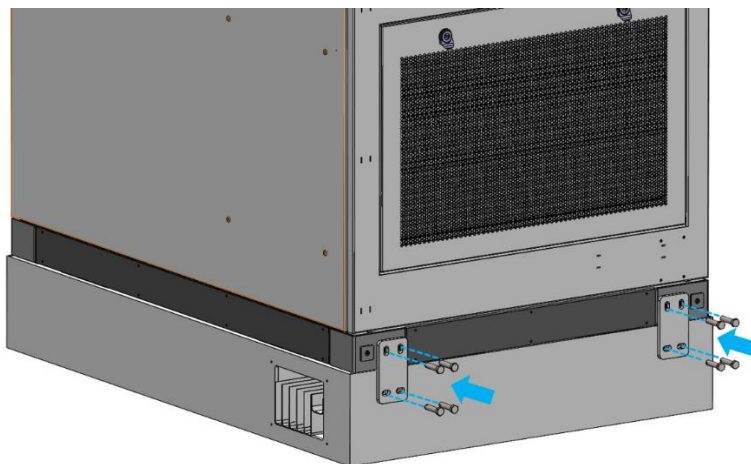


Figure 4-23: Diagram of fixing cabinet on the metal base

4.4. 6.2. 2 Concrete Foundation

Step 1: Move the cabinet to the marked installation position and keep it suspended temporarily without placing it on the ground. Once the cabinet is aligned with the marked position, slowly lower it into place.

Step 2: Align the four L-shaped connectors with the front and rear fixing holes of the cabinet, and use a marker to mark the drilling points on the concrete foundation.

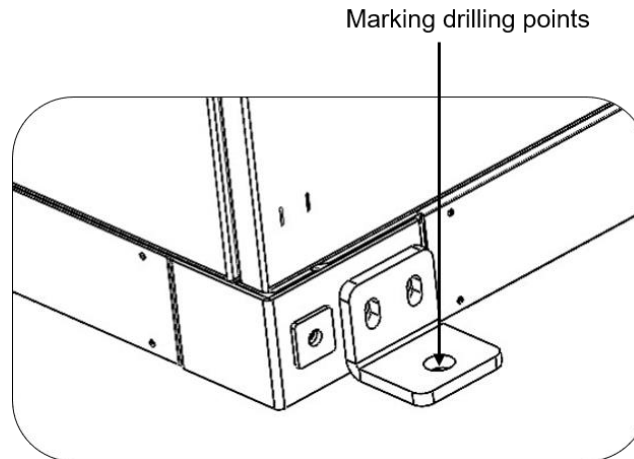
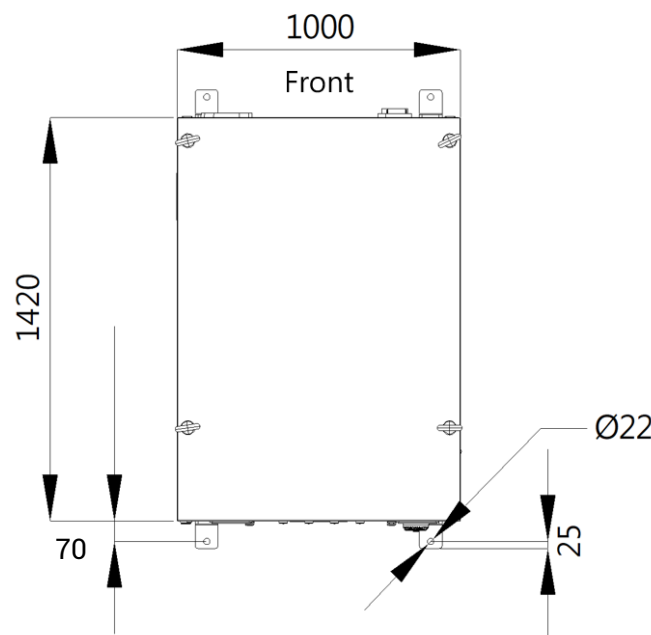


Figure 4-24: Aligning L-shaped connector with cabinet



Unit: mm

Figure 4-25: L-shaped connector dimensions (top view)

Step 3: Move the L-shaped connectors. Use an electric drill to drill holes vertically at the marked drilling points (hole depth: 110mm, hole diameter: 18mm). After drilling, clean out the debris from the holes.

Step 4: Align the L-shaped connectors with holes. Insert M16 expansion bolts between the L-shaped connectors and the ground, use a hammer to tap the bolts until they are flush with the ground, and then tighten the nuts using a wrench, with a recommended torque of 160 ± 5 N·m.

⚠ CAUTION

If the connectors cannot be level with the ground, perform the following steps:

- ① Insert shims into the gap between the connectors and the ground.
- ② Use a feeler gauge to check the gap. Stop adding shims when the gap is $\leq 0.5\text{mm}$.
- ③ Secure the expansion bolts.

Step 5: Use M10 bolts to secure the L-shaped connectors and the cabinet, and the recommended torque is $52 \pm 5\text{N}\cdot\text{m}$.

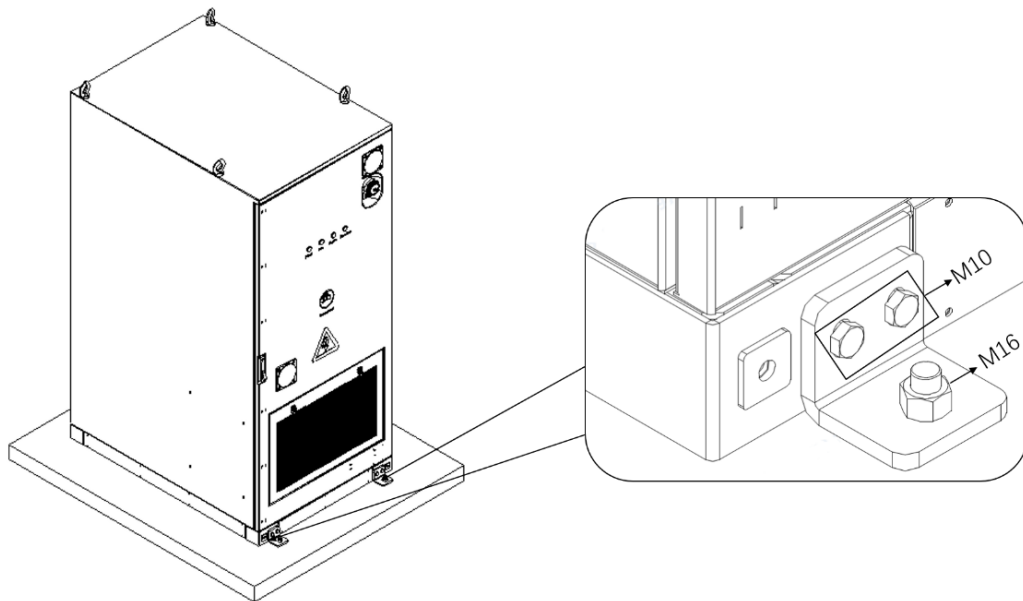


Figure 4-26: Diagram of fixing cabinet on the concrete foundation

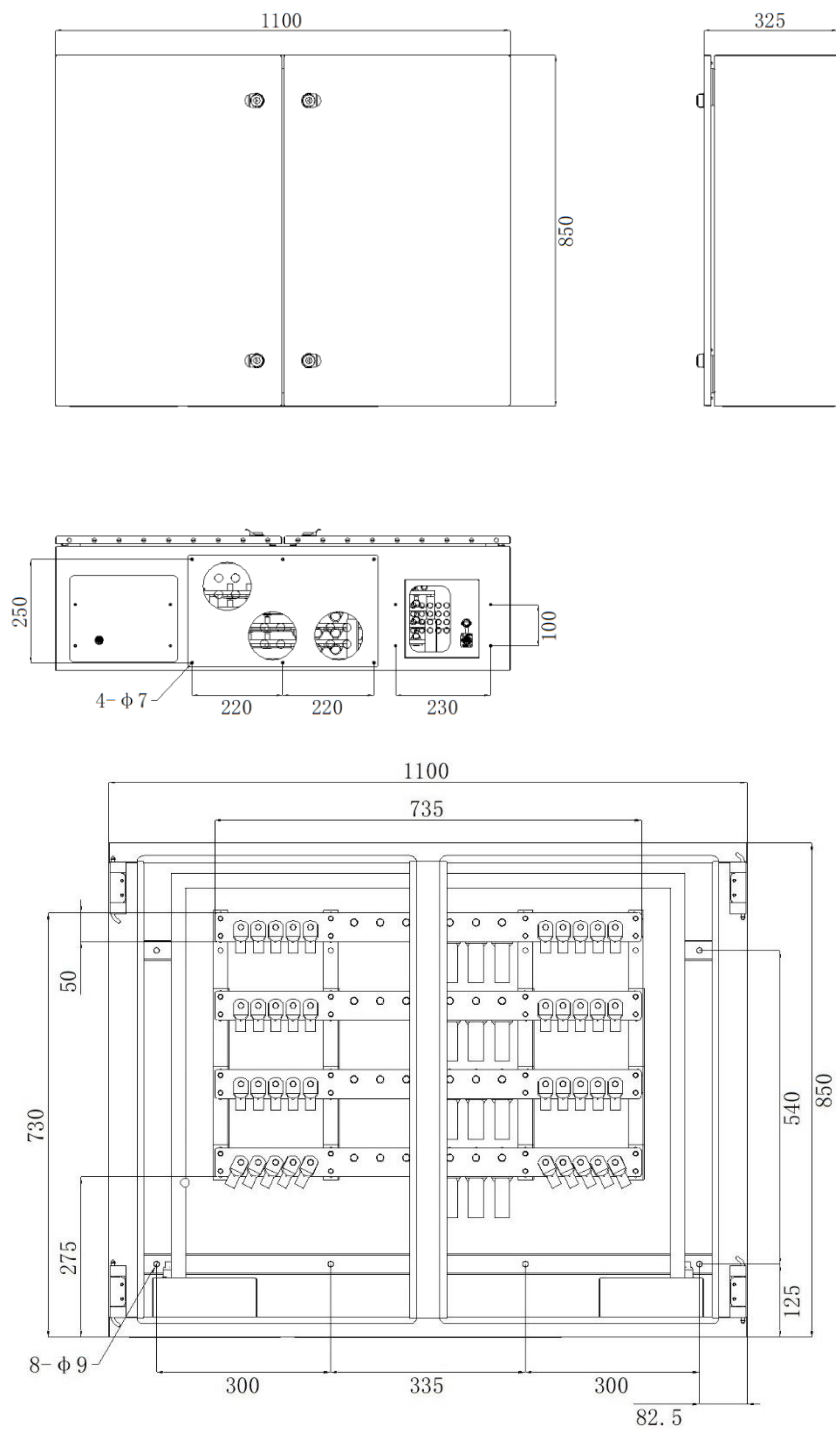
4.4.7 Waterproof Plug Installation

Step 1: Use a wrench to rotate the lifting rings counterclockwise at the top of the cabinet and remove them in turn.

Step 2: Align the waterproof plugs with the top mounting holes and insert them vertically, then gently tap them with a rubber hammer until fully seated.

4.4.8 Distribution Box Installation

For multiple cabinets installed in parallel, all AC power cables from the cabinets must be consolidated through the distribution box before being connected to the external AC power supply.



Unit: mm

Figure 4-27: Drawing of distribution box and cable inlet hole dimensions

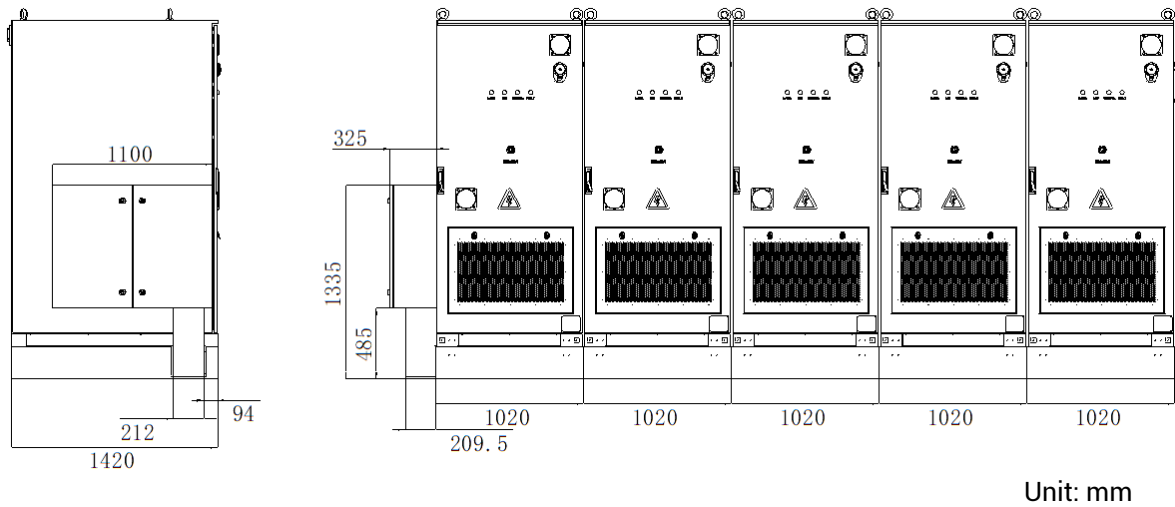


Figure 4-28: Drawing of dtribution box installation location

Step 1: Open the junction box door and align the four bolt holes inside the box with the mounting holes on the side of the master cabinet.

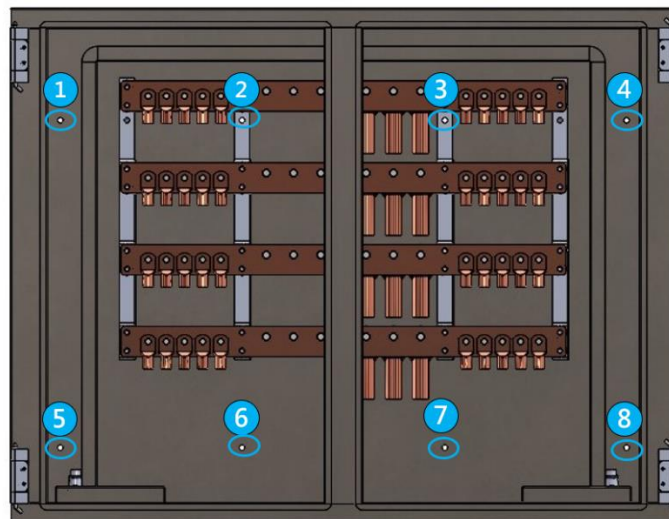


Figure 4-29: Mounting holes of dtribution box

Step 2: Use 8 M6 bolts to fix the distribution box on the side of the master cabinet. The recommended torque is $8 \pm 1 \text{ N}\cdot\text{m}$.

4.4.9 Cables Installation

4.4.9.1 Grounding Connection

⚠ WARNING

- The grounding connection must comply with the grounding standards and regulations of the country/region where the project is located.
- Before connecting the AC side and DC side wiring harnesses, connect the grounding cable first.

NOTICE

- Each set of cabinets has two grounding points at the front and rear. Each cabinet must be grounded using a grounding cable with a cross-section $\geq 35\text{mm}^2$.
- For parallel operation of two or more cabinets, an additional main grounding cable must be installed. The recommended specifications are as follows:
2 cabinets in parallel: For the main grounding cable, it is recommended to use cross section $\geq 120\text{mm}^2$.
3~5 cabinets in parallel: For the main grounding cable, it is recommended to use cross section $\geq 240\text{mm}^2$.

Step 1: Secure the grounding cable using M8 bolts with a recommended torque of $25 \pm 1\text{N}\cdot\text{m}$.

Step 2: After grounding is completed, the grounding resistance should be measured, and the resistance value must be less than 4Ω .

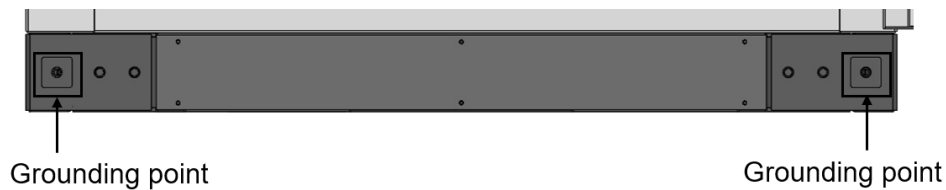


Figure 4-30: Grounding points (2 grounding points at the front and rear of the bottom of the cabinet)

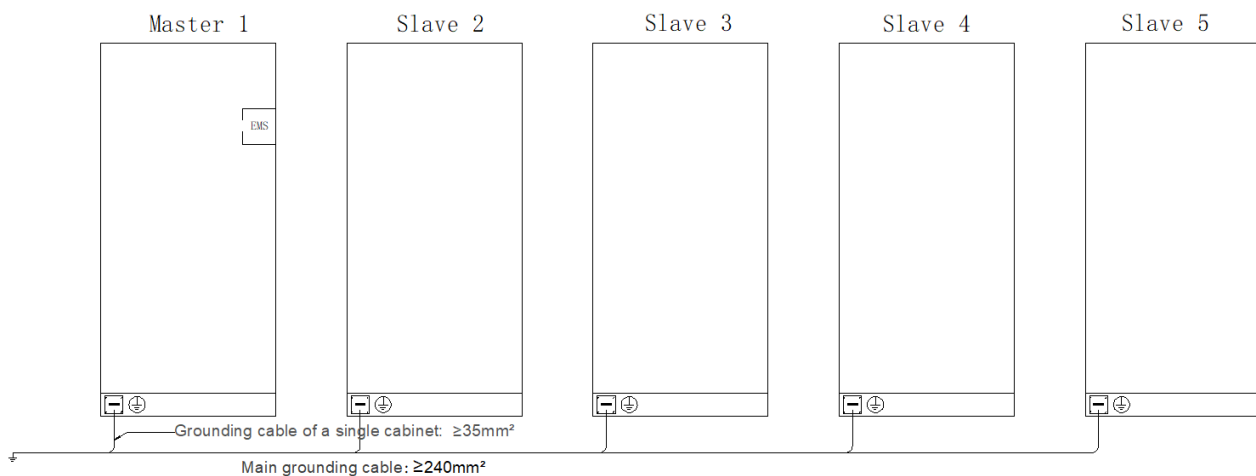


Figure 4-31: Diagram of parallel grounding

4.4.9.2 Electrical connection



- Before making electrical connections, ensure that all switches are in the OFF position, otherwise the high voltage of the system may cause a hazard of electric shock.
- Before contacting any conductor surface or terminal, measure the contact voltage and verify that the device is reliably grounded.

4.4.9.2.1 Single cabinet

(1) AC power cable connection

Step 1: Use a screwdriver to remove the protective cover on the MCCB inside the cabinet, and then remove the cable inlet plate.

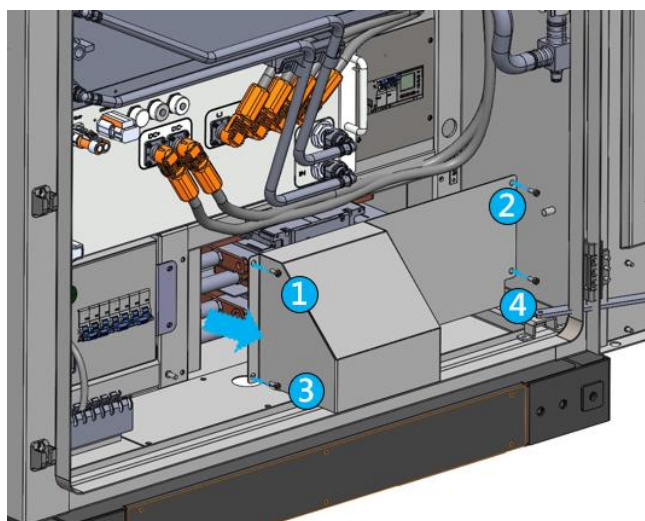


Figure 4-32: Diagram of removing the protective cover

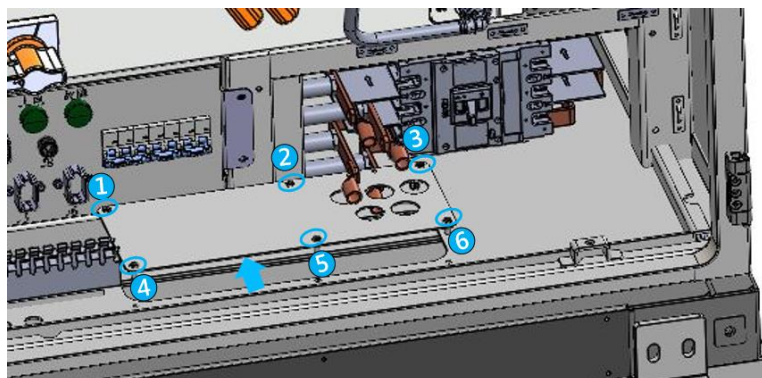


Figure 4-33: Diagram of removing the cable inlet plate

Step 2: Route four power cables through the four cable holes from the bottom of the inlet plate, and guide them to the MCCB.

NOTICE

In this step, first introduce the EMS communication cable and auxiliary power cable into the cabinet as shown in the figure below, then place the rubber ring on the cable, and finally secure the rubber ring to the cabinet.



Figure 4-34: Routing communication cable

Step 3: Secure one end of the four cables to the L1/L2/L3/N positions on the MCCB respectively using four M10 bolts with a recommended torque of 52 ± 5 N·m, and the other end to the external AC side.

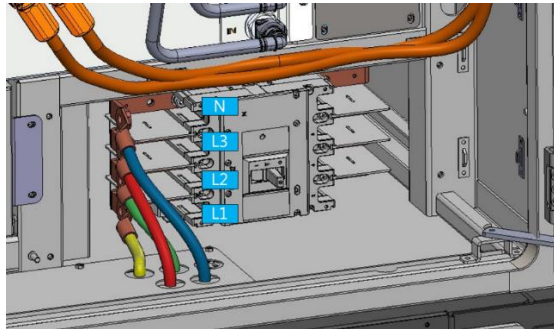


Figure 4-35: AC power cable connection positions (EU Version)

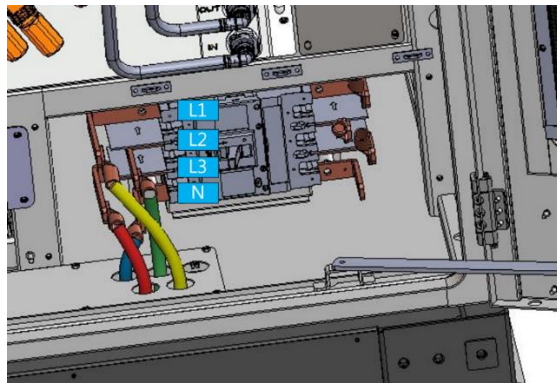


Figure 4-36: AC power cable connection positions (NA Version)

Step 4: Reinstall the cable inlet plate using six M5×14 bolts in its original position. Then secure the protective cover with four M5×14 bolts. The recommended torque is 5 ± 0.5 N·m.

(2) EMS communication cable connection

Connect the EMS network cable deployed in advance to the reserved interface shown in the figure below.

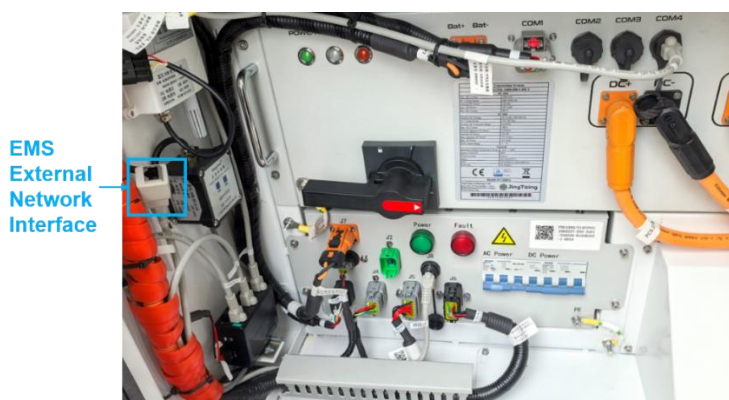


Figure 4-37: EMS external network interface

(3) Auxiliary electrical connection (optional operation, choose one of the following methods)

Method 1: External power supply for liquid cooling unit, BMS, fire suppression system, and in-cabinet environmental control equipment

Step 1: Power off the system and verify voltage absence using multimeter.

Step 2: Remove the original power supply wiring:

- **EU&AU version:** Loosen and remove the fixing bolts for the L and N wires (cables indicated by arrows in the figure below).



Figure 4-38: Auxiliary power cable position (EU&AU version)

- **NA version:** Loosen and remove the fixing bolts for the L1/L2/L3/N wires (cables indicated by arrows in the figure below).



Figure 4-39: Auxiliary power cable position (NA Version)

Step 3: After removing the wiring, the copper busbar will loosen with the wiring harness, so it needs to be re-fixed in the original position on the circuit breaker (M8 bolts with a recommended torque of 12 N·m).

Step 4: Route the auxiliary power cable through the inlet hole at the bottom of the cabinet and connect it to the previously removed wires.

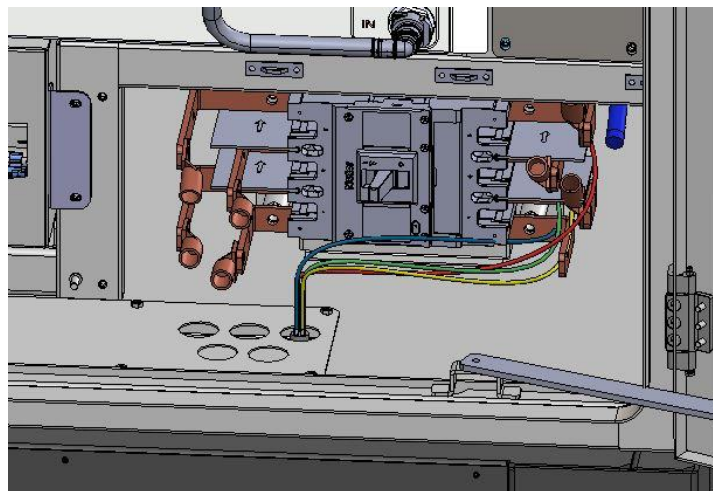


Figure 4-40: Diagram of auxiliary power cable inlet hole

Step 5: Pass the opposite end of the power cable through the metal base cover plate (a hole must be pre-drilled) and connect it to the external power switch.

Method 2: External power supply for BMS, fire suppression system, and in-cabinet environmental control equipment

Step 1: Unplug the original wiring harness from the J1 interface of the control box.

Step 2: Introduce the auxiliary power supply cable through the inlet hole and connect it to the J1 interface of the control box.



Figure 4-41: Control box J1 interface position

Step 3: Pass the other end of the power cable through the metal base cover plate (a hole must be pre-drilled) and connect it to the external power switch.

4.4. 9.2. 2 Parallel cabinets

The cabinet can be used independently or in parallel. A maximum of 5 cabinets can be in parallel at off-grid mode and 15 cabinets can be in parallel at on-grid mode.

(1) Cabinet AC Power Cable Connection

Step 1: Remove the MCCB protective cover and cable inlet plates of each cabinet. Connect the AC power cables of each cabinet to the L1/L2/L3/N positions of the MCCB in sequence (please refer to section [4.4.9.2.1 Single cabinet](#) for details).

NOTICE

After removing the cable inlet plates, simultaneously route the pre-laid communication cable and auxiliary power cable into the cabinet to prepare for their connection.

Step 2: Connect the other end of the cables to the L1/L2/L3/N positions of the distribution box, and secure them using M10 nuts with a recommended torque of $52 \pm 5\text{N}\cdot\text{m}$.

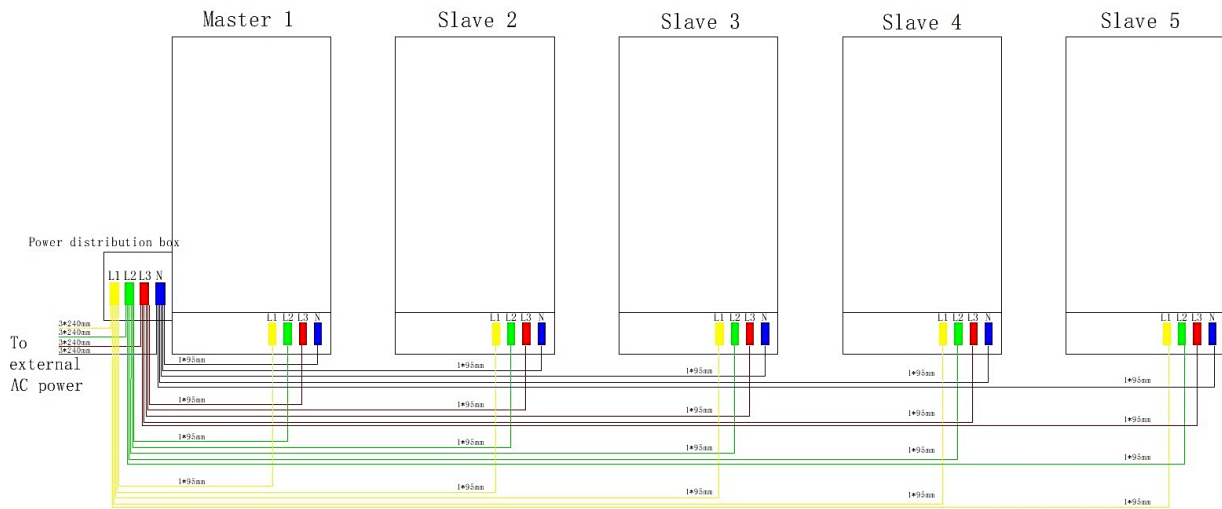


Figure 4-42: Diagram of AC power cable connection in parallel

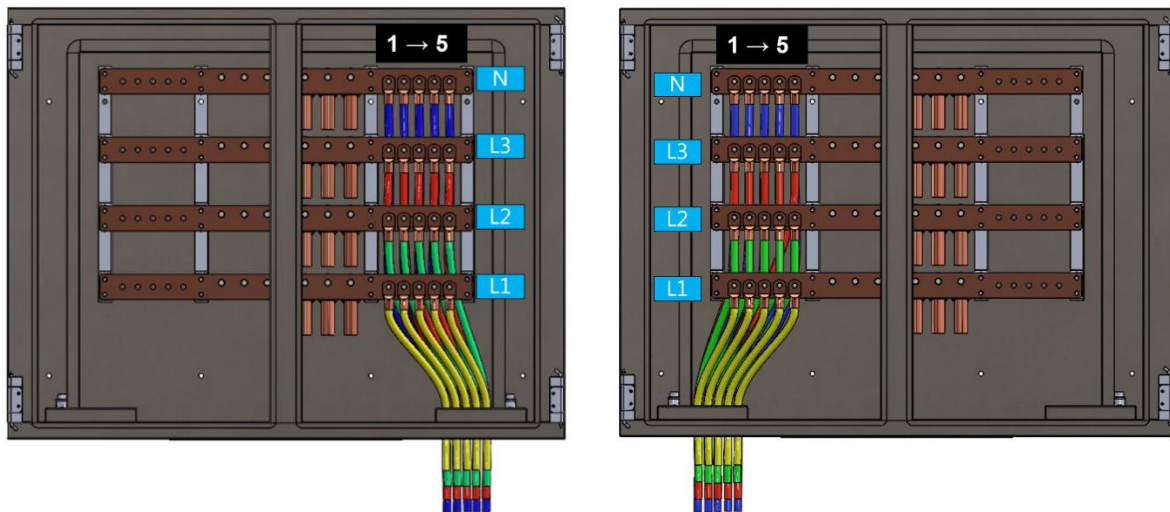


Figure 4-43: AC power cable position from cabinet to distribution box (select either side for connection)

(2) AC total power cable connection

Connect the AC total power cables to the L1/L2/L3/N positions on the left busbar inside the distribution box using M12 nuts with a recommended torque of $90 \pm 10\text{N}\cdot\text{m}$.

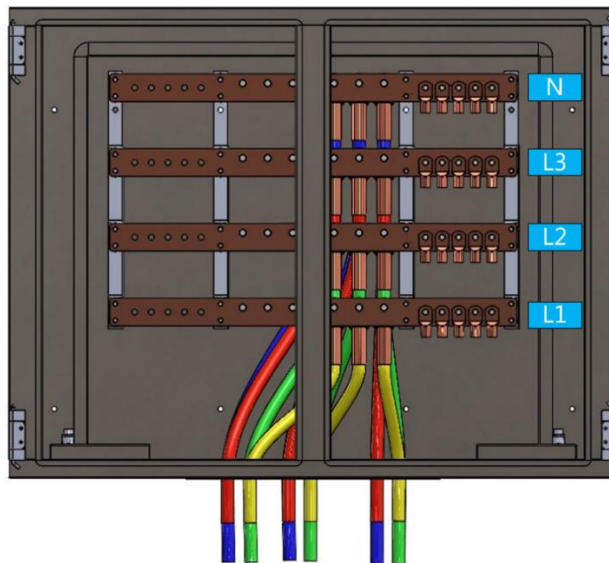


Figure 4-44: Total AC power cable position

(3) Parallel communication cable connection

Connect the switches and PCS communication interfaces of each cabinet in series, then connect the master EMS to the external network port.

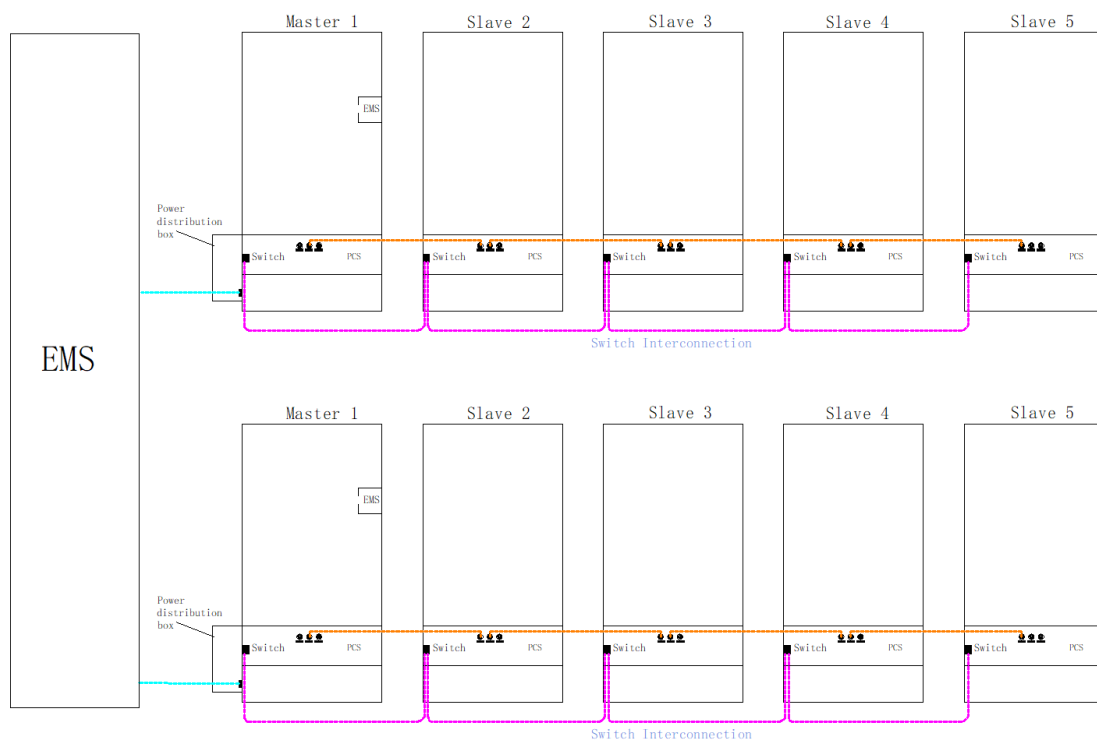


Figure 4-45: Diagram of parallel communication cable connection

PCS parallel connection

- ① Use Ethernet cables to connect the COM 2 and COM 3 parallel networking interfaces between every two units in series. For example, connect the COM 3 interface of Cabinet #1 to the COM 2 of Cabinet #2, COM3 of Cabinet #2 to COM 2 of Cabinet #3, and so on.
- ② Install communication terminators on COM2 of the master (Cabinet #1) and COM3 of the last slave cabinet.

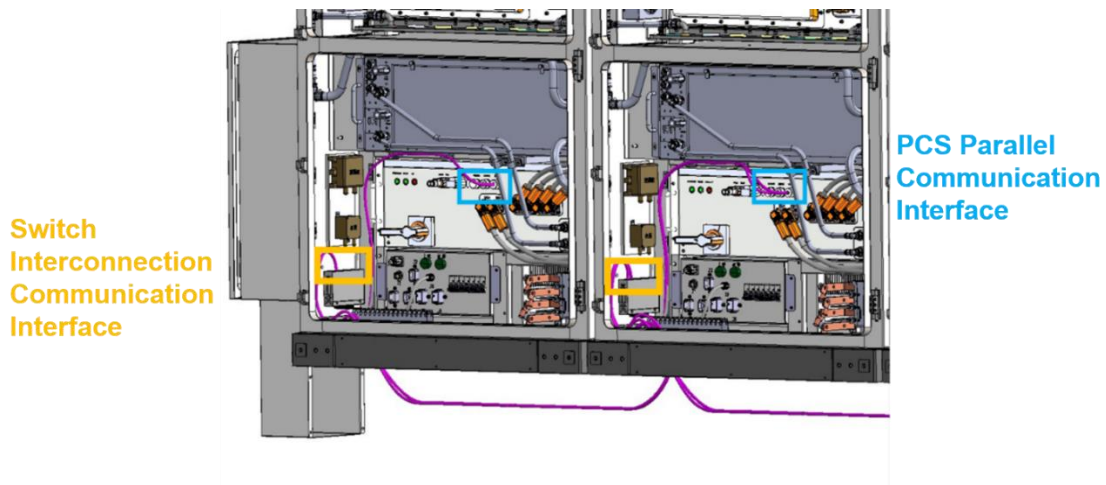


Figure 4-46: Diagram of PCS communication cable connection



Figure 4-47: Diagram of PCS parallel communication interface

Switch interconnection

Interconnect the switches in each cabinet using Ethernet cables. For example, connect the Ethernet port of the switch in Cabinet #1 to the Ethernet port of the switch in Cabinet #2, Cabinet #2 to Cabinet #3, and so on.

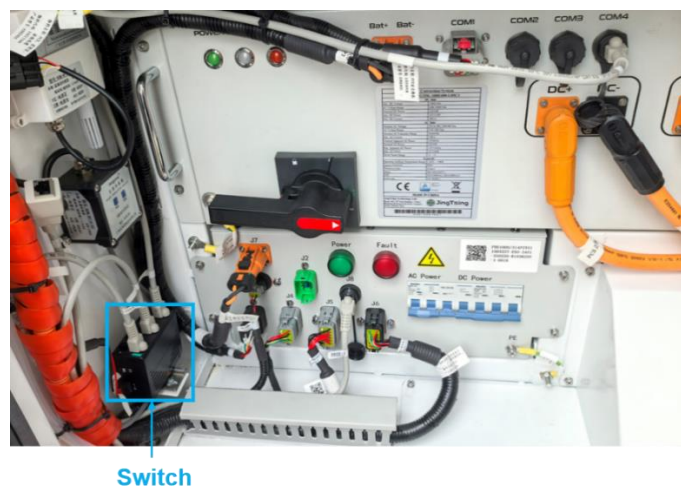


Figure 4-48: Switch position

EMS communication connection

Connect one end of the pre-laid EMS Ethernet cable to the reserved interface shown in the figure below.

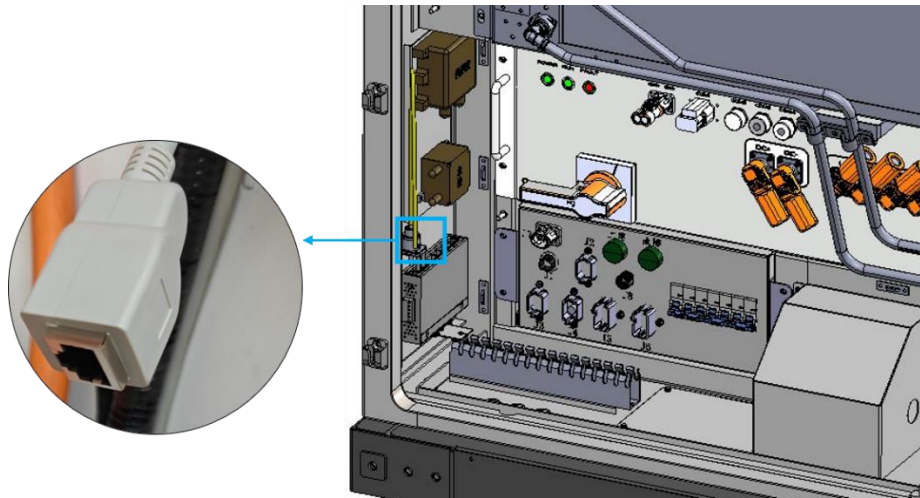


Figure 4-49: EMS external network interface

(4) Auxiliary power connection (optional operation, choose one of the following methods)

Method 1: External power supply for liquid cooling unit, BMS, fire suppression system, and in-cabinet environmental control equipment

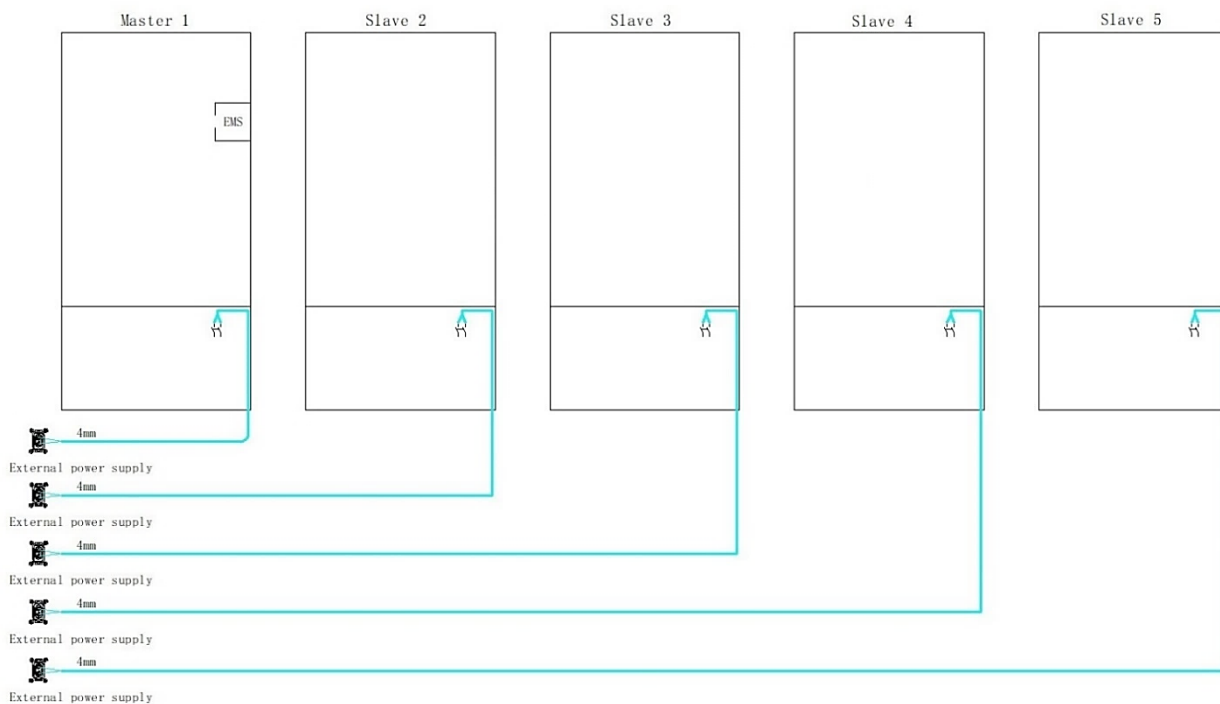


Figure 4-50: Auxiliary power connection in parallel (Method 1)

Step 1: Power off the system and verify voltage absence using multimeter.

Step 2: Remove the original power supply wiring:

- **EU&AU version:** Loosen and remove the fixing bolts for the L and N wires (cables indicated by arrows in the figure below).

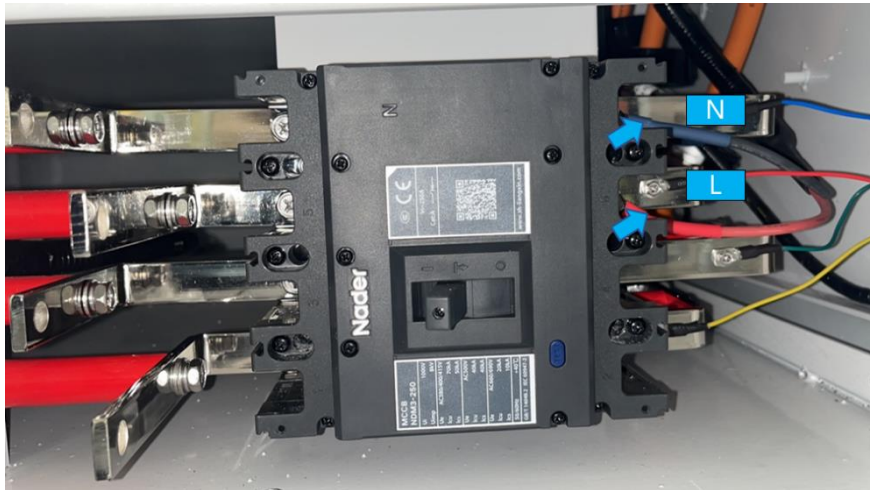


Figure 4-51: Auxiliary power cable position (EU&AU version)

- **NA Version:** Loosen and remove the fixing bolts for the L1/L2/L3/N wires (cables indicated by arrows in the figure below).



Figure 4-52: Auxiliary power cable position (NA Version)

Step 3: After disconnecting the wires, the copper busbar come loose with the wiring harness and must be re-secured to its original position on the circuit breaker (M8 bolts with a recommended torque of 12 N·m).

Step 4: Route the auxiliary power cable through the inlet hole at the bottom of the cabinet and connect it to the previously removed wires.

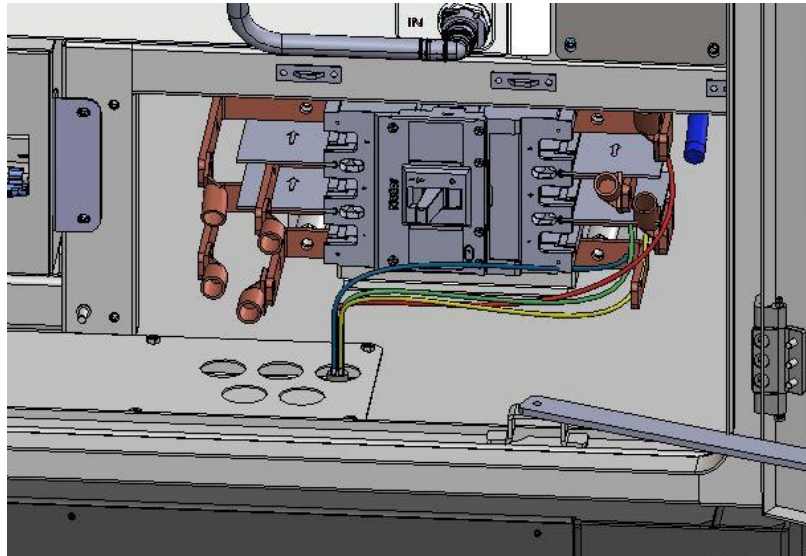


Figure 4-53: Auxiliary power cable inlet hole

Step 5: Pass the opposite end of the power cable through the metal base cover plate (a hole must be pre-drilled) and connect it to the external power switch.

Method 2: External power supply for BMS, fire suppression system, and in-cabinet environmental control equipment

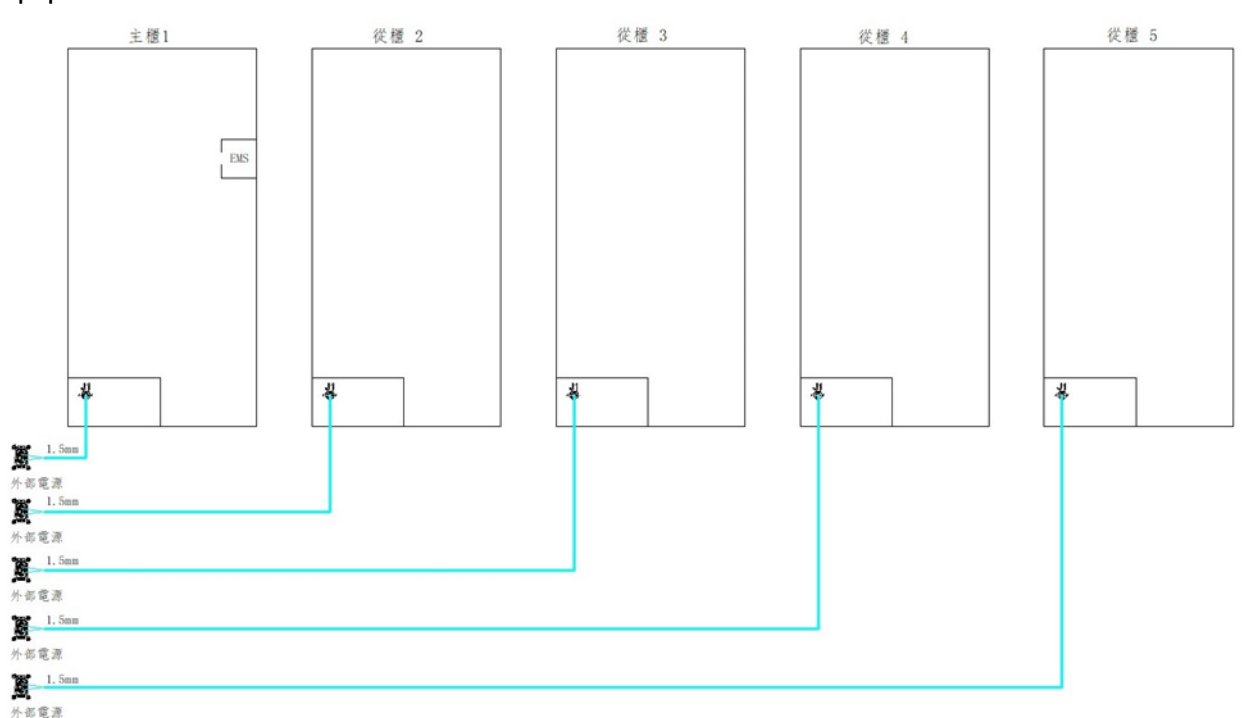


Figure 4-54: Auxiliary power connection in parallel (Method 2)

Step 1: Unplug the original wiring harness from the J1 interface of the control box.

Step 2: Introduce the auxiliary power supply cable through the inlet hole and connect it to the J1 interface of the control box.



Figure 4-55: auxiliary power connection position in control box

Step 3: Pass the other end of the power cable through the metal base cover plate (a hole must be pre-drilled) and connect it to the external power switch.

4.4.10 Fire Extinguishing Device Connection

As shown in the figure below, tighten the fixing ring of the fire extinguishing device, and confirm that the fire extinguishing device is well connected before running the equipment.

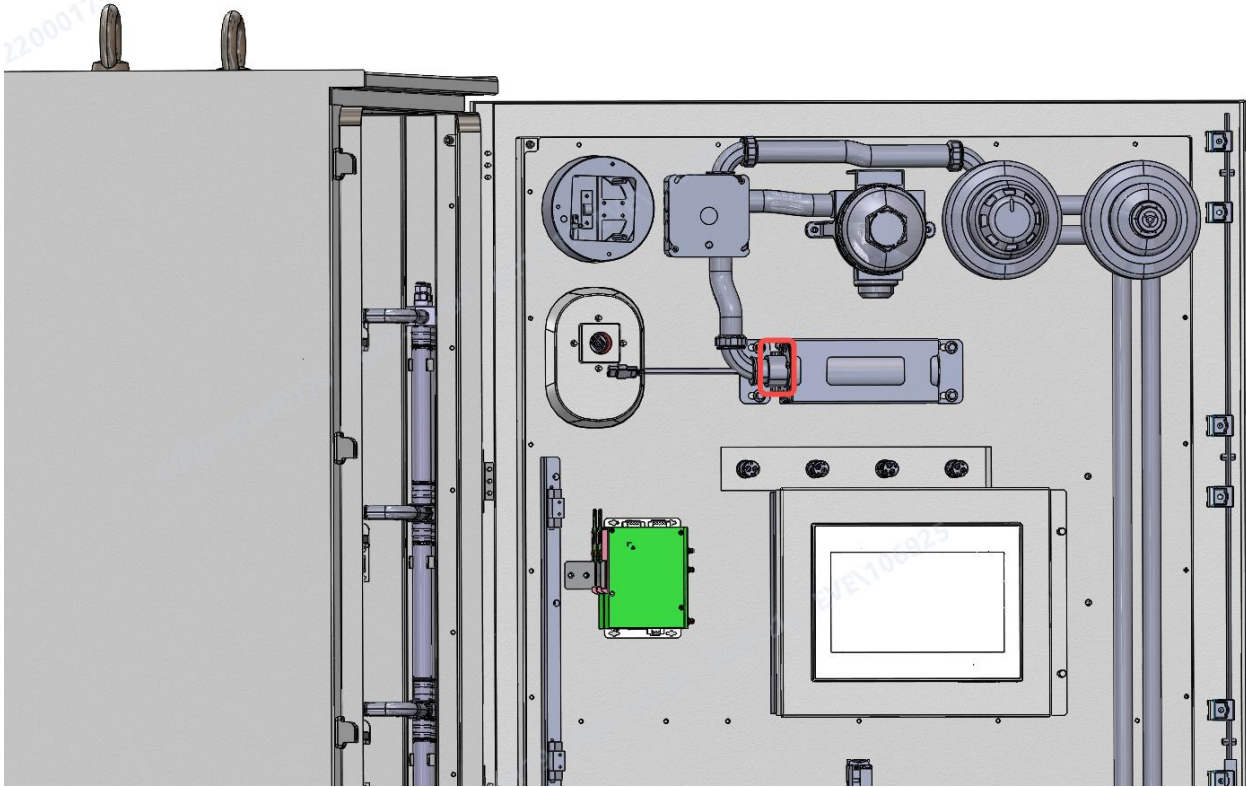


Figure 4-56: Diagram of fire extinguishing device connection

4.4.11 Inlet Hole Seal

⚠ CAUTION

The inlet hole and the opening of the sealing plate shall be properly sealed to prevent animals and moisture from entering the cabinet.

4.4.11.1 Single Cabinet

Right Side (wire-inlet): Route the 4 power cables and 1 external network cable through the cable holes on the metal base cover plate. Secure the ① cover plate using four M5×14 bolts, with a recommended torque of $5 \pm 0.5\text{N}\cdot\text{m}$.

Left Side (wire-outlet): Secure the ② cover plate on the opposite side of the metal base using four M5×14 bolts, with a recommended torque of $5 \pm 0.5\text{N}\cdot\text{m}$.

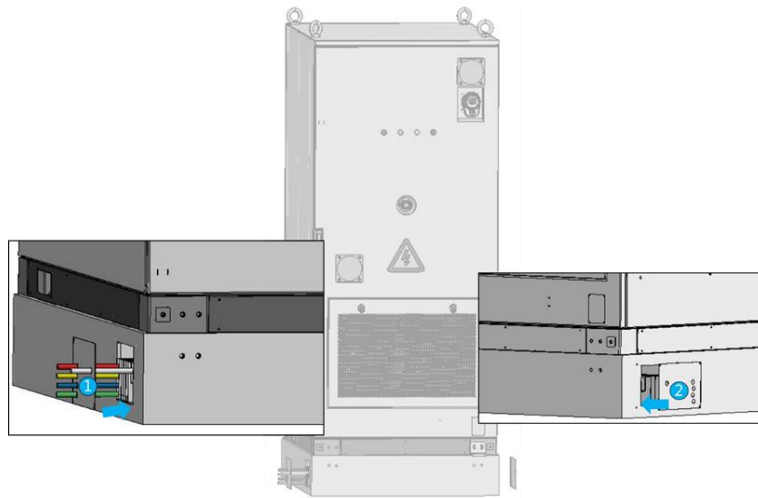


Figure 4-57: Sealing inlet holes (Single cabinet)

4.4.11.2 Parallel Cabinets

Right side (wire-inlet): Use four M5*14 bolts to secure the left and right sides of the ① cover plate to the cable entry/exit side of the metal base. Then, use four M5*14 bolts to fix the top of the cover plate to the junction box, with a recommended torque of $5 \pm 0.5 \text{ N}\cdot\text{m}$.

Left side (wire-outlet): Secure the ② cover plate on the opposite side of the metal base using four M5*14 bolts, with a recommended torque of $5 \pm 0.5 \text{ N}\cdot\text{m}$.

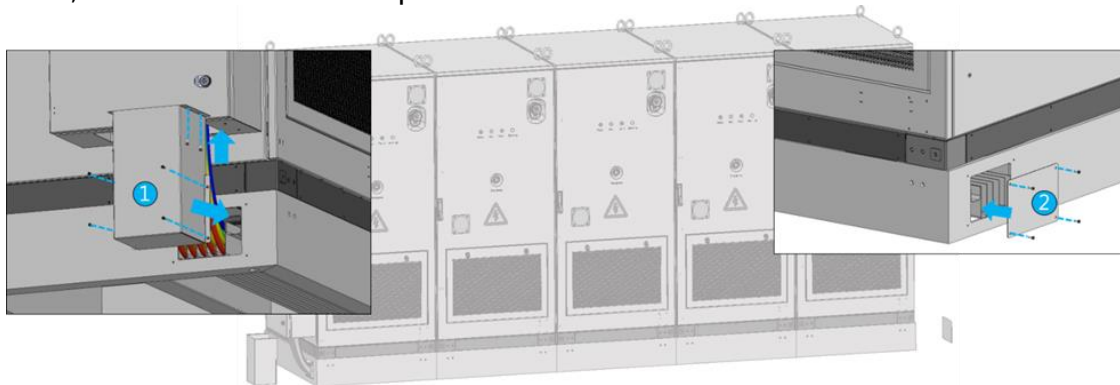


Figure 4-58: Sealing inlet hole (Parallel cabinet)

4.4.12 MSD Installation

The Manual Service Disconnect (hereinafter referred to as MSD) is a connection device for quickly disconnecting a high voltage circuit to ensure safety during operation and maintenance.

4.4.12.1 Installation

Step 1: Press the key as shown in figure ① to open the black handle ②.

Step 2: Insert the MSD into the battery pack, as shown in figure ③.

Step 3: Push the black handle up to top and press the red key to lock the MSD, as show in figure ④.

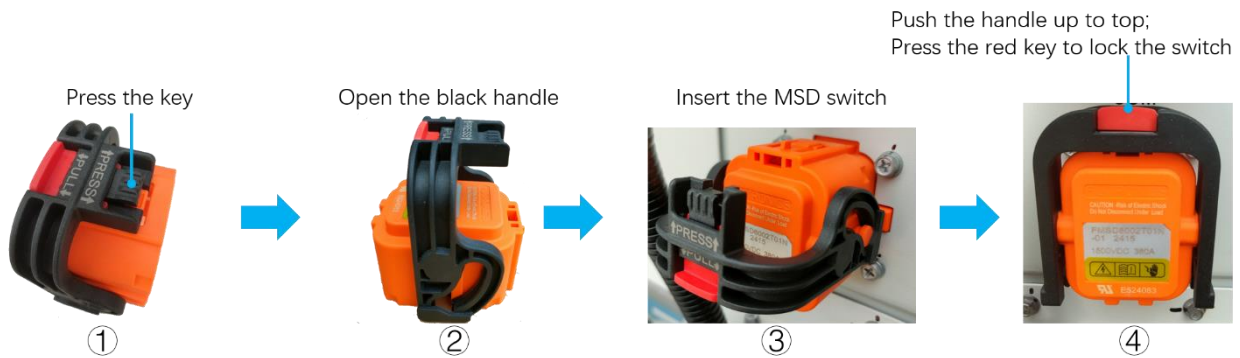


Figure 4-59: MSD installation

4.4.12.2 Removal

- Step 1:** Pull the red key outwards to unlock the MSD, as shown in figure ①.
Step 2: Press the lock and pull the handle outwards, as shown in figure ②.
Step 3: Press the latch at the top of the switch, as shown in figure ③.
Step 4: Remove the MSD.

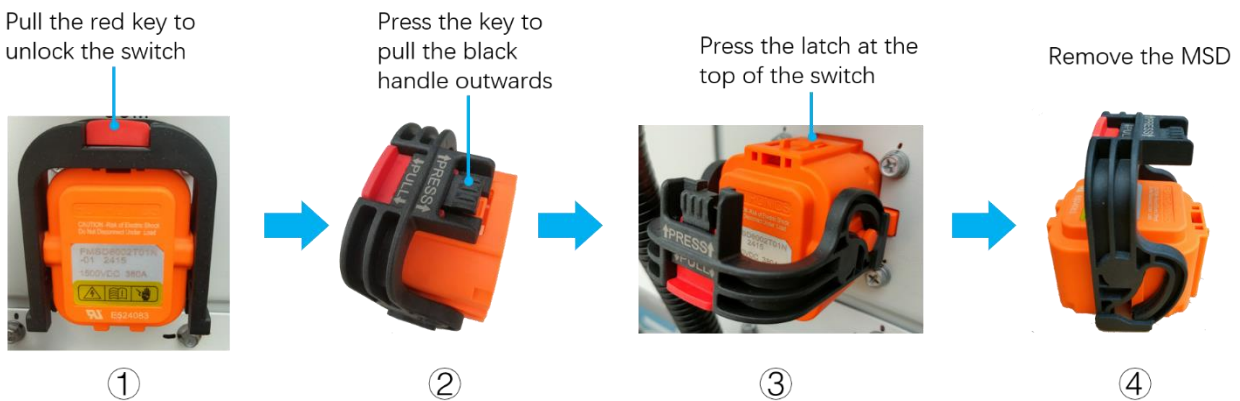


Figure 4-60: MSD removal



Figure 4-61: MSD installation position

4.5 Post-installation Inspection

Table 4-3 Checklist-Appearance

No.	Inspection Items
1	No paint peeling, damage or deformation on the appearance of the cabinet
2	The cabinet is firmly connected with the foundation.
3	Equipment installation space meets maintenance and ventilation requirements
4	The cable connection conforms to the installation drawings and are firmly connected.
5	Mark a torque mark (a straight line) at the junction of the fastened parts.
6	MSDs are all installed and locked.
7	The installation area has been cleaned up with no tools or foreign objects left behind.
8	All protective covers and insulating sleeves for electrical components are in place.

Table 4-4 Checklist-Testing

No.	Inspection Items
1	Measure the grounding resistance, the resistance value is less than 4Ω .
2	Check the torques of each power cable connection to ensure them meets the requirements; perform random checks on the torque of other installation parts.

4.6 System Debugging

4.6.1 Debugging Process

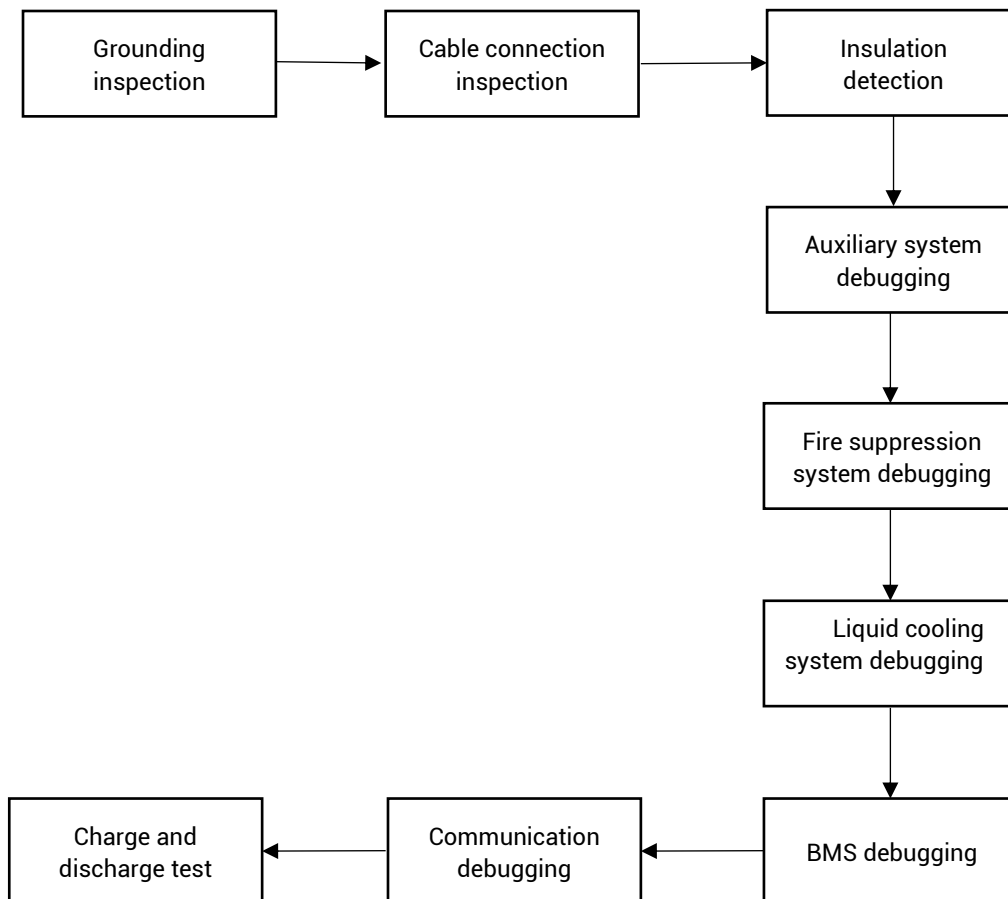


Figure 4-62: System debugging flow chart

4.6.2 Battery System

Before debugging, the battery system should be checked again to avoid abnormalities in the battery system caused by transportation from the integrated site to the project site.

Table 4-5: Battery system test items

No.	Test Items		Test methods	Test standards	Test tools	Remarks
1	Insulation testing	battery cluster	Use an insulation tester set to the DC 1000V range. Clip the black test lead of the insulation tester to the grounding point of the PACK. Use the red test lead to	Insulation resistance $\geq 50\text{M}\Omega$	Insulation meter DC 1000V	

			sequentially touch the metal cores of the output positive terminal (B+) and output negative terminal (B-). After each contact with the test point, press the test button on the insulation tester to start the test. The test duration is 60 seconds.			
2	Voltage detection	battery cluster	Measure the positive and negative voltages of the battery cluster using a multimeter 1000VDC	The measurement voltage range should be: 855.4V ~ 859.3V	Voltmeter DC 1000V	SOC 30% ~ 50%
3	Grounding detection	cabinet	Using a multimeter, measure the resistance between the grounding point of the cabinet and the external grounding bar	Grounding resistance not greater than 4Ω	multimeter	
4	Cable Connection inspection	battery rack	Visual inspection/plug/unplug test	Check the wiring harness connections and wire labels against the electrical schematic diagram: ① Power wiring harness: the installation is tight, the installation position is correct, and the wire marking is clear; ② Communication wiring harness: the installation is tightly	Visual inspection	

				installed, the installation position is correct, and the wire marking is clear;		
5		auxiliary power distribution	Visual inspection/plug/unplug test	Check the harness connections against the electrical schematic using a multimeter conduction diagram, and check the wire labels: ① Power supply cables (including liquid cooling units, electric meters, control boxes, etc.): the installation is tight, the installation position is correct, and the line marks are clear;	Visual inspection	
6		PCS	Visual inspection/plug/unplug test	Check the wiring harness connections and wire labels against the electrical schematic diagram: ① Power wiring harness: the installation is tight, the installation position is correct, and the wire marking is clear;	Visual inspection	

				② Power supply wiring harness: the installation is tight, the installation position is correct, and the wire marking is clear; ③ Communication wiring harness: the installation is tightly installed, the installation position is correct, and the wire marking is clear;		
7		liquid cooling unit	Visual inspection/plug/unplug test	Check the wiring harness connections and wire labels against the electrical schematic diagram: ① Power supply line: the installation is tight, the installation position is correct, and the line mark is clear; ② Communication line: the installation is tight, the installation position is correct, and the line marking is clear; ③ Dry contact: installation is tight, installation position	Visual inspection	

				is correct, and line markings are clear;		
8		dehumidifier	Visual inspection/plug/unplug test	Check the wiring harness connections and wire labels against the electrical schematic diagram: ① Power supply line: the installation is tight, the installation position is correct, and the line mark is clear; ② Communication line: the installation is tight, the installation position is correct, and the line marking is clear;	Visual inspection	
9		fire suppression system	Visual inspection/plug/unplug test	Check the wiring harness connections and wire labels against the electrical schematic diagram: ① Power supply line: the installation is tight, the installation position is correct, and the line mark is clear; ② Communication line: the installation	Visual inspection	

				is tight, the installation position is correct, and the line marking is clear;		
10	Distribution section	switching voltage confirmation	Measure the voltage of each circuit with a multimeter	The voltage of each distribution circuit is normal (NA version: N, L3, L2, L1, EU version & AU version: L1, L2, L3, N), and the sub-system can supply power normally after the switch is connected	Multimeter	NA version voltage: 480V, EU version & AU version voltage: 380V
11		battery-powered	When the system is running normally, switch the DC switch after the AC switch of the control box is turned off	The system runs normally when the DC switch is closed, and the system shuts down when the DC switch is disconnected	Visual inspection	

4.6.3 Auxiliary System

The following auxiliary system tests require functional verification after the equipment reaches the project site and installation is completed.

Table 4-6: Auxiliary system test items

No	Test Items		Test methods	Test standards	Test tools	Remarks
1	Electricity meter function	metering meter function	View the meter data displayed on the screen before and after charging and discharging, and compare it	Data is displayed correctly	Display screen/meter	

			with the meter displayed data			
2		meter communication failure	Unplug the electricity meter communication cable	The display screen has relevant alarm information	Host computer/display screen	
3	Dehumidifier	dehumidifier function	Set the cold point of the dehumidifier to be higher than the current value, and the dehumidification point of the dehumidifier to be lower than the current value. Close the outdoor cabinet door and run for about 10 minutes	When the dehumidifier is in working state, whether there is condensation water flowing out of the pipeline when the ambient humidity is high	Dehumidifier Display	
4		dehumidifier communication failure	Unplug the communication wiring harness and observe the alarm message	① Unplug the communication cable, and the real-time alarm on the screen shows the communication failure of the dehumidifier; ② Connect back to the communication cable, and	Host computer/display screen	

				the screen will warn in real time that there is no communication failure of the dehumidifier; ③ The real-time alarm and historical alarm information on the screen are displayed correctly.		
5	Thermohygrometer	temperature and hygrometer function check	Check that the temperature and humidity meter display is normal and communication with the BMS is normal.	The display shows temperature and humidity values	Host computer/display screen	
6		communication failure between thermometer and hygrometer and BMS	Unplug the communication wiring harness and observe the alarm message on the display screen	① Unplug the communication cable, and the real-time alarm on the screen will show the temperature and humidity communication failure; ② Connect back to the communication	Host computer/display screen	

				n cable, and the screen will warn in real time that there is no temperature and humidity communication failure; ③ The real-time alarm and historical alarm information on the screen are displayed correctly.		
7	Water immersion sensor	water immersion function check	Wet the water immersion sensor probe wire or short-circuit the probe head, and the screen will display a sensor alarm. After drying or disconnecting, the fault will disappear. Confirm the relevant information in the history record.	① Trigger the flooding alarm, and the display screen displays the flooding alarm and system protection; ② Restore alarm, real-time alarm on the screen without flooding alarm; ③ The real-time alarm and historical alarm information on	Host computer/display screen	

				the screen are displayed correctly.		
8		communication failure between water immersion sensor and BMS	Unplug the communication wiring harness and observe the alarm information of BMS	① Unplug the communication cable, and the real-time alarm on the screen will show the flood communication failure; ② Connect back to the communication wire, and the screen will warn in real time that there is no flooding communication failure; ③ The real-time alarm and historical alarm information on the screen are displayed correctly.	Host computer/display screen	

4.6.4 Fire Suppression System

Before testing, disconnect the fixing ring of the fire extinguishing device (as shown in the figure below) to ensure that the fire extinguishing reagent will not be sprayed by mistake.

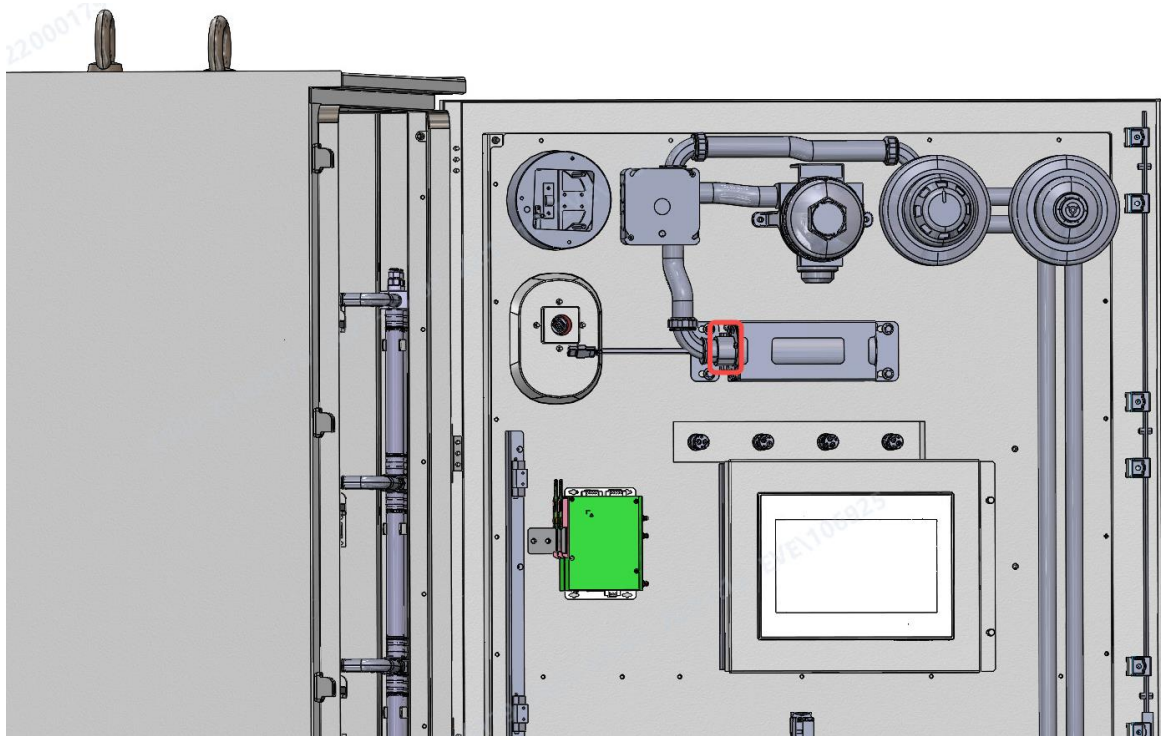


Figure 4-63: Fire extinguishing device disconnection

Table 4-7: Fire suppression system test items

No.	Test Items	Test methods	Test standards	Test tools	Remarks
1	Power-on self-test	Power-on self-test	Self-test successful, no fault alarm	detector indicator	
2	Simulated single alarm	Simulated trigger single smoke detector/temperature detector	The system automatically starts the audible and visual alarm	Fire suppression nozzle	Before testing, disconnect the fire extinguishing device fixing ring.
3	Simulated composite alarm	Simulate triggering two detectors in the battery compartment: a smoke detector and a temperature detector, and the system will automatically activate the fire alarm.	The system automatically activates the audible and visual alarms, the fire protection system enters the sprinkler activation sequence, simulates dry contact outputs, and the	Fire suppression nozzle	Before testing, disconnect the fire extinguishing device fixing ring.

			Building Management System (BMS) receives the dry contact signals to initiate protective actions.		
4	Fire fan	Simulated triggering of combustible gas detector	Explosion-proof fan start-up	Fire suppression nozzle	
5	Water firefighting	Visual inspection	The fire hydrant can be connected normally	Visual inspection method	

4.6.5 Liquid Cooling System

Before debugging, it is essential to ensure that the electrical connections of the liquid cooling system are complete and that all safety hazards have been eliminated. Additionally, the liquid cooling system must be filled with coolant. Under no circumstances should the liquid cooling unit be activated if these conditions are not met.

Table 4-8: Liquid cooling system test items

No.	Test Items	Test methods	Test standards	Test tools	Remarks
1	Power-on self-test	View fault information on the display screen	No fault report of liquid cooling unit	Liquid cooling unit display/EMS display	
2	Static pressure	View inlet and outlet water pressures at static state	Double-branch static water pressure range unit supply and return fluid pressure: 1.2-2.2 bar	Liquid cooling unit display/EMS display	
3	Self-circulation function & dynamic pressure	Controlling forced self-circulation of liquid cooling units	The liquid cooling unit enters self-circulation mode, with no significant changes in outlet water temperature and return water temperature, but significant changes in inlet and return water pressure. Dynamic water pressure range:	Liquid cooling unit display/EMS display	Both branch test

			Unit liquid supply pressure: 1.2-3.5 bar Unit liquid return pressure: 1.2-2.5 bar		
4	Heating function	Controlling forced heating of liquid cooling unit	The liquid cooling display screen shows that it is in the heating state. Wait for about 10 (30) minutes, and the outlet water temperature rises	Liquid cooling unit display/EMS display	
5	Refrigeration function	Controlling forced refrigeration of liquid cooling unit	The liquid cooling display shows that it is in the cooling state. Wait for about 10min, and the outlet water temperature will drop	Liquid cooling unit display/EMS display	
6	Communication fault test between liquid cooling system and BMS	① Unplug the communication wiring harness, or power off the liquid cooler, and observe the alarm information on the BMS display screen ② Restore the communication wiring harness, or turn on the liquid cooler, and observe the alarm information on the BMS display screen	① Communication failure between BMS display and TMS ② BMS does not display TMS communication failure	Display screen	
7	Liquid cooling system failure	Fault alarm from simulated liquid cooling system to BMS	The liquid cooling system display shows fault alarm information, and the display shows liquid cooling unit fault alarm information.	Liquid cooling unit display/EMS display	

4.6.6 BMS/EMS/PCS Commissioning

Before BMS debugging, confirm whether the power cables and communication wire of the cabinet system are connected correctly.

Table 4-9: BMS commissioning items

No.	Test Items		Test methods	Test standards	Test tools	Remarks
1	BMS/EMS	The upper computer sets the battery cluster address	Set the battery cluster address through the host computer. The cluster ID must be set strictly according to the physical address of the battery cluster switchgear unit. Confirm that the set address corresponds to the actual address by sequentially turning the device on/off or plugging/unplugging the communication cable on the display screen.	The host computer has successfully viewed the address settings, and the cluster address read is consistent with the physical address.	Host computer/display screen	Applicable when paralleling cabinets
2		Single-cell voltage acquisition, display, and communication function test	The voltage acquisition, display and communication functions of all cells are tested through the host computer	Communication is normal, all data can be read, and static pressure difference ≤10mV	Host computer/display screen	Cell voltage 260pcs
3		Cabinet system voltage/current collection, display, and communication function testing	The voltage/current acquisition, display and communication functions of all battery clusters are tested through the host computer	Communication is normal, all data can be read	Host computer/display screen	
4		Temperature acquisition, display and	Test the temperature collection, display, and communication functions of	Communication is normal, all data can be	Host computer/display screen	130 cell temperatures, 20

		communication test	all batteries through the host computer.	read, static temperature difference $\leq 5^{\circ}\text{C}$		pole temperatures
5		Threshold alarm test	Change the threshold via the display screen/host computer to trigger the alarm system.	The system currently displays the alarm correctly. After resetting, the current alarm disappears, and the occurrence time, alarm item, and end time are correctly displayed in the historical alarms.	Host computer/display screen	
6		Communication interruption fault test between slave and master controllers	Unplug any communication line inside the battery cluster	Relevant alarms are generated on the upper computer and display screen, and the fault indicator light of the outdoor cabinet lights up	Host computer/display screen	
7		Fault test of communication interruption	Unplug the communication line between the master control and the EMS	Relevant alarms are generated on	Host computer/display screen	

		between master control and EMS		the upper computer and display screen, and the fault indicator light of the outdoor cabinet lights up		
8		Other Equipment Communications	Check the host computer, the water immersion sensor, fire suppression system, temperature and humidity sensor, dehumidifier, electric meter and liquid cooling system are normal	Related equipment is faultless	Host computer/display screen	
9		Power control	Power control is delivered through EMS screen/host computer	System responds correctly to controls	EMS host computer/display screen	Including power control, plan control, etc
10	P C S	Operation/Fault indicator lamp	Equipment normal/operating/malfunctioning	When powered on, the POWER indicator lights up green. When running, the RUN indicator lights up green. When a fault occurs, the FAULT indicator lights up red.	PCS panel	

11		BMS Information	Use PCS host computer or EMS to view BMS upload information	Uploaded information meets standards	Computer/EMS	
12		On-grid/off-grid function	Use EMS or a computer to access the PCS host computer, click on Control Scheduling, and set the power on/off command.	PCS normal operation	EMS/PCS host computer	
13		PCS and EMS communication fault test	① Unplug the PCS-EMS communication cable and observe the alarm information on the BMS display screen ② Restore the PCS-EMS communication cable and observe the alarm information on the BMS display screen	PCS/EMS displays fault status	PCS Panel/EMS Display	

4.6.7 System Charge and Discharge

This charge and discharge test are only used for debugging the charge and discharge function of the cabinet system. First, run at low power to ensure normal operation, then charge and discharge at rated power. After the main equipment (or part) has been inspected and debugged, and all safety devices and emergency switches are confirmed to be functioning normally, system load interconnection testing and cycle testing can be performed.

Table 4-10: Cahrge and discharge test steps

Steps	Descriptions
Step 1	Pwer on system, and then stand for 1min;
Step 2	Charge the cabinet system at a constant power of 62.5 kW (0.25 P) for 10 minutes, and left to stand for 10 minutes;
Step 3	Discharge the cabinet system at a constant power of 62.5 kW (0.25 P) for 10 minutes, and left to stand for 10 minutes;
Step 4	Discharge the cabinet system at a constant power of 125kW until a certain cell voltage reaches 2.8 V or the system discharge is cut off, and left to stand for 30 minutes;
Step 5	Charge the cabinet system at a constant power of 125kW until a certain cell voltage reaches 3.6 V or the system charging is cut off, and left to stand for 30 minutes;
Step 6	Discharge the cabinet system at a constant power of 125kW until a certain cell voltage reaches

	2.8 V or the system discharge is cut off, and left to stand for 30 minutes;
Step 7	After the trial test is completed, charge the cabinet system at 0.5 P rated power for 50 minutes to SOC $40\% \pm 10$, and then left to stand for 5 minutes, and the charging and discharging are completed

Note:

- Record the charging and discharging capacity of the system, as well as the charging and discharging efficiency. Based on the results of the first cycle, determine whether to conduct a retest.
- During charging and discharging, observe whether the liquid cooling machine activates the corresponding mode according to the predetermined thermal management strategy.
- After testing is complete, record the system charging energy, discharging energy, charging/discharging efficiency, charging end voltage difference, discharging end voltage difference, system charging/discharging temperature rise, and system charging/discharging temperature difference.

5 Operating Instructions

5.1 Pre-power-on Check

- ① Confirm that MCCB inside the cabinet is in the OFF position. Ensure the PCS handle is set to OFF.



Figure 5-1: MCCB and PCS handle position

- ② Check whether all power cables are connected reliably.
③ Check whether all communication and low-voltage supply cables are reliably connected.
④ Ensure the E-stop button on the cabinet door is fully reset.

5.2 System Power-on

Step 1: Close the QF0 switch of the MCCB.



Figure 5-2: Close MCCB QF0 switch

Step 2: Set the circuit breaker of the PCS to ON position (clockwise).



Figure 5-3: Closing PCS circuit breaker

Step 3: Turn on the AC and DC switches on the control box, then the POWER indicator is on.



Figure 5-4: Turn on AC/DC switches

NOTICE

- When turning on AC switch only (keep DC switch OFF), the system is powered solely by external AC supply;
- When turning on DC switch only (keep AC switch OFF), the system is powered exclusively by internal batteries;
- When turning on both AC and DC switches, the system normally operates on external AC power. If external power fails, system switches to battery supply without interruption.

Step 4: Turn on the liquid cooling power switch.



Figure 5-5: Turn on liquid cooling power switch

After completing the above steps, charge and discharge operations can be performed by delivering power commands through EMS.

5.3 Indicator Light Introduction

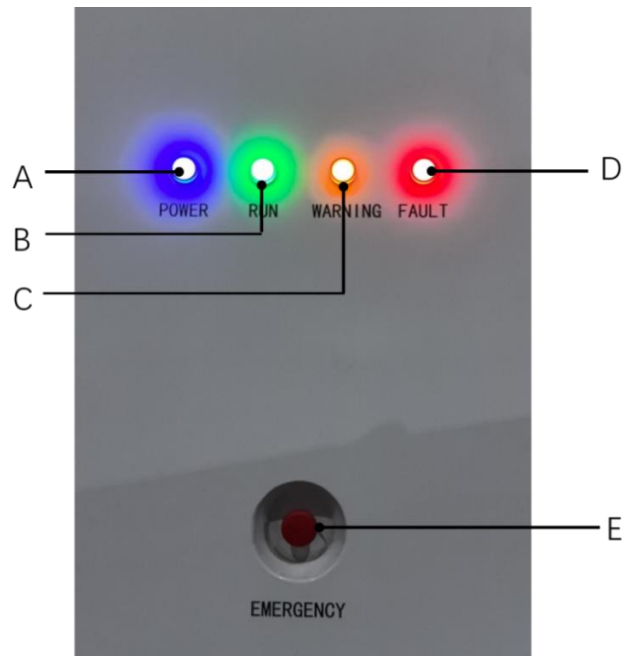


Figure 5-6: Indicator lights/button layout

Table 5-1: Cabinet indicator lights/button introduction

No.	Indicator light/button	Meaning	Description
A	POWER	System power-on indicator	If the indicator light is on, it means that the system is powering by AC mains
B	RUN	System running indicator	If the indicator light is on, it means that the system is running
C	WARNING	System warning indicator	If the indicator light is on, it means that the DC switch is turned off
D	FAULT	System fault indicator	If the indicator light is on, it means that the system is in failure
E	EMERGENCY	System emergency-stop button	After pressing the button, the high-voltage circuit is disconnected

5.4 System Power-off

Step 1: Send a “stop” command by EMS: Enter the EMS [Manual] control page, click [Turn Off], and EMS will automatically issue “0” power.

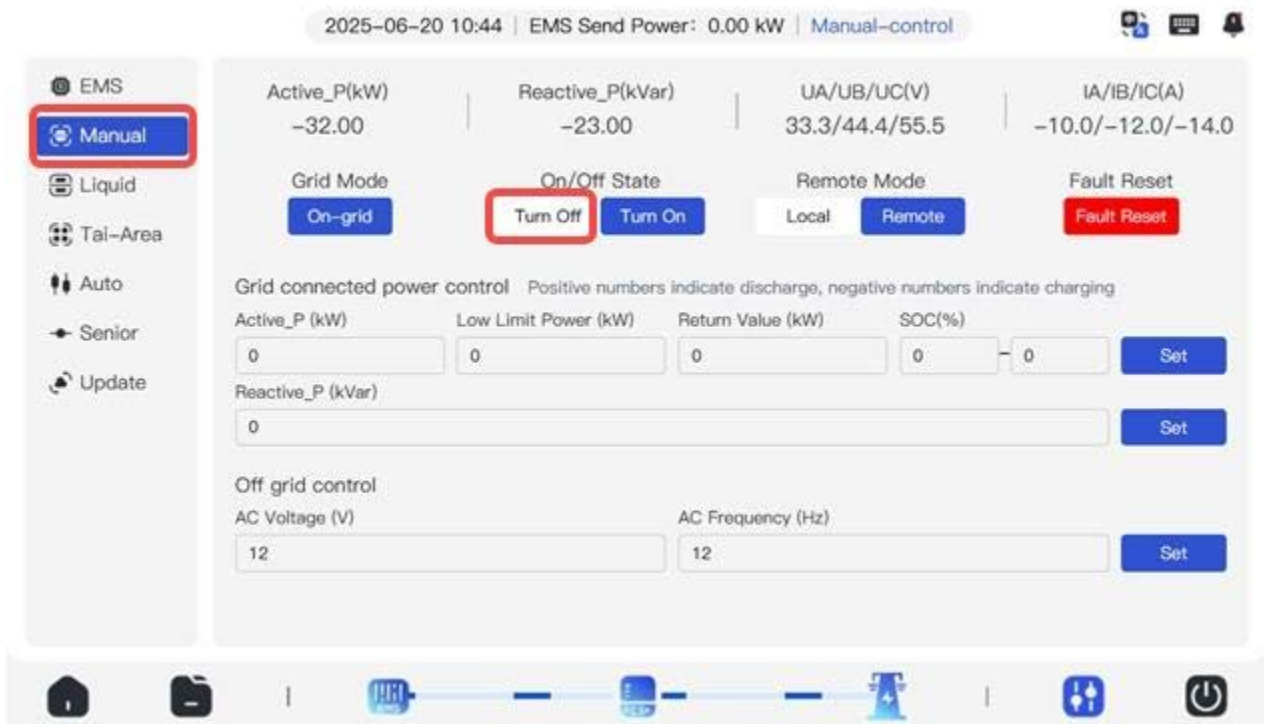


Figure 5-7: EMS shutdown interface

Step 2: Turn off the liquid cooling power switch.



Figure 5-8: Turn off liquid cooling power switch

Step 3: Turn off the DC and AC power switches on the cabinet control box.



Figure 5-9: Disconnect AC/DC switches and disconnector

Step 4: Turn the PCS disconnecter handle to OFF (counterclockwise).



Figure 5-10: Disconnect the PCS circuit breaker

Step 5: Disconnect the QF0 switch of MCCB.



Figure 5-11: Disconnect MCCB QF0 switch

5.5 Emergency Stop

In case of an emergency, perform the following operation:

Step 1: Press the EMERGENCY button on the cabinet door to disconnect the high voltage circuit, then the system stops running.

Step 2: If the system is powered by external AC mains, disconnect the external power supply.

6 Product Maintenance

6.1 Precautions

DANGER

- When performing maintenance operations such as system cleaning, electrical connection or grounding reliability inspection, the system must be powered off first, and confirm that there is no voltage before proceeding.

WARNING

- System maintenance operations are limited to trained and qualified professionals. During maintenance, safety precautions should be followed, and the necessary tools and personal protective equipment should be used correctly.
- It is strictly forbidden to carry out equipment maintenance in severe weather conditions such as thunderstorms, humidity or strong winds to ensure the safety of personnel and equipment.
- Under any circumstances, it is strictly forbidden to touch the positive and negative high-voltage poles of the system at the same time, or short-circuit the positive and negative poles.
- When plugging and unplugging wiring, the operation should be standardized, and violent operation should not be allowed.
- If the system operation and maintenance personnel have any questions about the operation and maintenance of the equipment, please contact the manufacturer for consultation, and must not do it without authorization.

6.2 Maintenance Checklist

NOTICE

- The design life is only used as a reference for the maintenance plan, which does not mean that there will be no failure within this period, nor does it mean that it must be replaced after reaching this period.

Table 6-1: Maintenance checklist

No.	Component	Quantity	Recommended replacement cycle
1	Dehumidifier	1	5 ~ 8 years
2	Electric energy meter	1	10 years
3	Explosion relief valve	1	10 years
4	Electric energy meter transformer	1	10 years
5	Emergency stop button	1	Electrical life: 100,000 times
6	Water immersion sensor	1	5 years

7	Temperature and humidity sensor	1	5 years
8	Door position switch	1	Electrical life: 5 million times
9	Indicator light	4	5 years
10	Hot aerosol fire extinguishing device	1	15 years
11	Smoke detector	1	10 years
12	Temperature detector	1	10 years
13	Audible and visual alarm	1	10 years
14	Hydrogen detector	1	3 years
15	Explosion-proof exhaust valve	1	15 years
16	Explosion-proof air inlet valve	1	15 years
17	Liquid cooling unit	1	10 years
18	Control box	1	15 years
19	Battery pack	5	20 years
20	Switch	1	20 years
21	PCS	1	20 years
22	MCCB	1	Electrical life: 4000 times

6.3 Maintenance Items and Cycles

The following is the recommended maintenance cycle, and the actual maintenance cycle should be adjusted according to the specific installation environment of the product. Factors such as power station size, installation location and site environment will all affect the product maintenance cycle. If the operating environment is sandy or dusty, it is necessary to shorten the maintenance cycle and increase the maintenance frequency.

6.3.1 Tool List

- The following tools are for reference only, please refer to the actual product.
- Due to different on-site conditions, the following list cannot fully cover a few possible tools. Please inform on-site installers and users to prepare the unlisted tools according to the actual situation.

Form 62: 6-2nance Checklist

No.	Tools	Description
1	Socket and torque wrench	Removing/Fastening bolts
2	Screwdriver	Disassemble component
3	Marker pen	Make a torque mark
4	Fire bong	Detect smoke detectors
5	Insulation meter	Detect insulation resistance
6	Multimeter	Check voltage and ground resistance
7	Coolant tester	Test coolant
8	Vacuum cleaner	Clean up the dust

9	Personal protective tools	Including but not limited to safety helmet, insulating gloves, insulating shoes, five-point safety rope, etc.
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6.3.2 Annual Maintenance

Table 6-3: Maintenance checklist

No.	Components	Inspection Items	Handling methods
1	Integral cabinet	Check that the cabinet door lock is not damaged	Replace the door lock
2		Check that there is no obvious paint peeling or rust on the cabinet	Touch up paint in time
3		Check whether the warning signs and nameplates are clearly visible and free of defacement	Replace signs/nameplate
4		Check whether the sealing strip etc. is well secured	Replace the sealing strip
5		Check the cabinet vents free from dust accumulation	Clean air vents
6		Check that the explosion-proof air inlet valve and exhaust valve of the cabinet are not covered by foreign matter	Clean up accumulations in a timely manner
7		Check that there are no potential hazards and pollutants around	Avoidance of potential hazards
8		Check whether the inlet and outlet wire holes in the cabinet are sealed	Sealed wire inlet/outlet hole
9		When the system is running, press the emergency stop button of the cabinet door to simulate emergency stop and disconnect the system at high voltage (this shall be simulated without causing any economic loss)	Contact us
10		Check whether the cabinet indicator lights up normally	Check the wiring
11	Power distribution box	Check that the door lock of the distribution box is not damaged	Replace the door lock
12		Check whether the sealing strip of the distribution box is in good condition	Replace the sealing strip
13		Check whether the fixing bolts of the distribution box are tightened	Fastening bolt
14		Check that the power cable connection is tight	Fastening cable
15	Concrete foundation	Check the foundation for settlement	Foundation reinforcement
16		Check the cable trench for water accumulation	Drainage treatment
17	Metal base (if any)	Check the metal base foundation for settlement	Foundation reinforcement

18		Check the metal seat fixing bolts for looseness	fastening bolt
19		Check metal base for rust	Remove rust
20	Grounding system	Check that the grounding of the system is firm and the grounding resistance is not greater than 4Ω	Contact EPC
21	Battery pack	Check that there is no obvious damage, paint peeling or rust on the appearance.	Touch up paint in time
22		Check the cable connection for detachment or looseness	Fastening cable connection
23		Check the cable for damage, especially for cut marks on the skin in contact with the metal surface	Replace faulty cable
24		Check whether there is any leakage or leakage in the liquid cooling plate and water inlet/outlet of the battery pack	Contact us
25		Check the battery pack for any peculiar smell such as burning	Contact us
26		Check whether the temperature and pressure of all cells are displayed normally on EMS	Contact us
27	PCS	Check that there is no obvious damage, paint peeling or rust on the appearance.	Touch up paint in time
28		Check the cable connection for detachment or looseness	Fastening cable connection
24		Check the cable for damage, especially for cut marks on the skin in contact with the metal surface	Replace faulty cable
25		Check whether the grounding wire is reliably grounded	Ensure reliable grounding
26		Check whether there is any leakage or leakage at the water inlet/outlet of PCS	Contact us
27		When the equipment is running, check whether PCS communication is normal on EMS and whether instructions can be issued normally; The indicator lights on the PCS can light up normally.	Contact us
28	Liquid cooling pipe	Check the liquid cooling pipe for leakage	Replace liquid cooling pipes
29		Check all pipes for breakage	Replace faulty pipes
30		Check all pipes for blockages	Clear the shelter
31	Liquid cooling unit	Check that there is no dust accumulation in the vents of the liquid cooler	Clean air vents

32		Check whether there is abnormal vibration and noise in the operation of the liquid cooler	Contact us
33		Check whether the fan is blocked by dust or foreign matter	Clean the fan and clean foreign matter
34		Check whether the fan blades are damaged	Replace the fan
35		Check the inlet and outlet water pressure range of the liquid cooling machine. Static water pressure—supply/return liquid pressure: 1.2–2.2 bar. Dynamic water pressure—supply liquid pressure: 1.2–3.5 bar. Return liquid pressure: 1.2–2.5 bar	Liquid replenishment

6.3.3 Semi-annual Maintenance

Table 6-4:Semi-annual maintenance checklist

No.	Compoments	Inspection Items	Handling methods
1	Fire suppression system	Check whether the detector appearance in normal state	Clean detector
		Check the detector for dust or foreign material blockage	Clear the blockage
2		Check whether the detector inspection light is flashing normally	Check the wiring
3		Use fire smoke bong or other special detection instruments to conduct smoke or heating sampling inspection on temperature detectors, smoke detectors and combustible gas detectors, and test the action of the detectors (disconnect the aerosol spraying device before testing to prevent accidental spraying)	Check the wiring Replace equipment
4		Check if the aerosol is within the expiration date	Replacement aerosol
5	SOC status	When the outdoor cabinet system is not in use for a long time, charge the system every 6 months to make the SOC of the system reach 30% ~ 50%. (Before using the system for the first time after a long period of storage, fully charge it at least once to restore the battery to its optimal performance.)	/
6	Coolant maintenance	Take a small amount of coolant from the refill port: ① Check whether the liquid is free of dirt, sediment, and algae. ② Use a coolant tester to check the pH value of the liquid	Maintenance every 6 months (replacement every 2 years under normal circumstances)

		(normal value: pH 7.5–9.5) and electrolyte concentration (normal value: 50% ethylene glycol).	
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6.4 Common Maintenance Treatments

6.4.1 Change Coolant

6.4.1.1 Tool Preparation

Table 6-5: Tool list

No.	Tools	Description	Acquisition methods
1	Display screen and communication harness of liquid cooling unit	/	Contact our company to purchase
2	Liquid injection pump and liquid guide hose	/	Customer-supplied or contact our company to purchase
3	Coolant	Water + ethylene glycol (1: 1)	Customer-supplied
4	Coolant storage tank	> 25L	Customer-supplied
5	Safety protection tools	Goggles, masks, rubber gloves, etc.	Customer-supplied

6.4.1.2 Coolant Drainage

Prerequisite: Power off the system

PCS side

Step 1: Connect one end of the fluid guide hose to the PCS refill port, and place the other end at the bottom of the coolant storage tank.



Figure 6-1: PCS refill port position

Step 2: Open the blue valve of the PCS refill port (rotate the valve by 90°, with the horizontal direction of the valve to the refill port indicating the open state), allowing the liquid to drain naturally.

Step 3: Remove the inlet pipe of the PCS to completely drain the coolant.

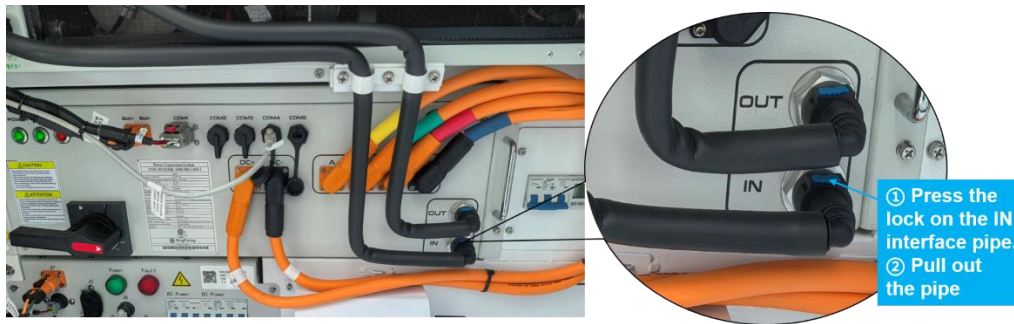


Figure 6-2: PCS IN port

Step 4: After the liquid drainage is completed, reconnect the PCS inlet pipe to the IN port; Close the refill port valve on the PCS side (rotate the valve 90°, with the vertical direction of the valve perpendicular to the refill port indicating the closed state).

Battery side

Step 1: Connect one end of the fluid guide hose to the battery refill port, and place the other end at the bottom of the coolant storage tank.

Step 2: Open the blue valve of the battery refill port (rotate the valve 90°, with the horizontal direction of the valve parallel to the refill port indicating the open state), allowing the liquid to drain naturally.



Figure 6-3: Refill port position of battery side

Step 3: After the liquid drainage is completed, close the refill port valve (rotate the valve 90°, with the vertical direction of the valve to the refill port indicating the closed state).

6.4.1.3 Coolant Filling

Prerequisites:

- ① Power off high-voltage.
- ② Remove the original communication cable of the liquid cooler, and then connect the communication cable of the liquid cooling display screen to the communication interface.
- ③ Turn on the power switch of the liquid cooler.

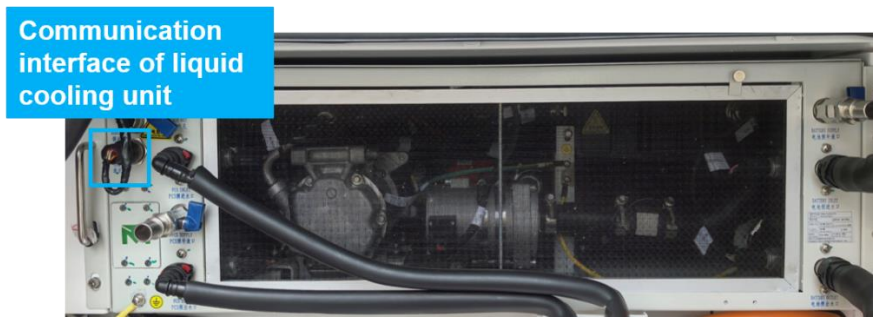


Figure 6-4: Communication interface position of liquid cooling unit

Step 1: Connect hoses

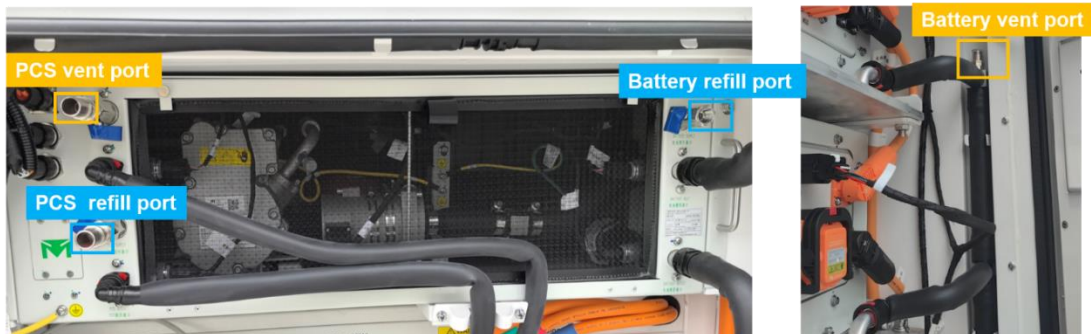


Figure 6-5: Refill and vent port positions

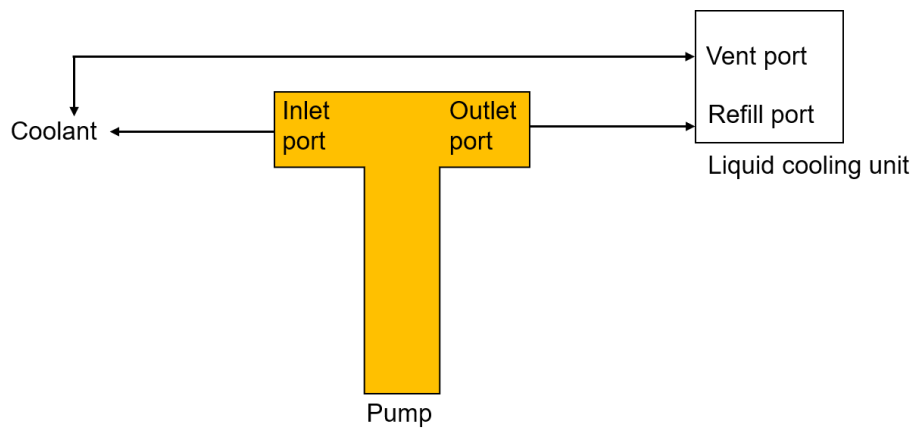


Figure 6-6: Diagram of coolant filling connection

PCS side

- ① Connect the outlet hose of the pump to the PCS-side refill port, and place the inlet hose of the pump into the coolant.
- ② Take an additional vent hose and connect it to the PCS-side vent port, with the other end of the vent hose placed in the coolant.

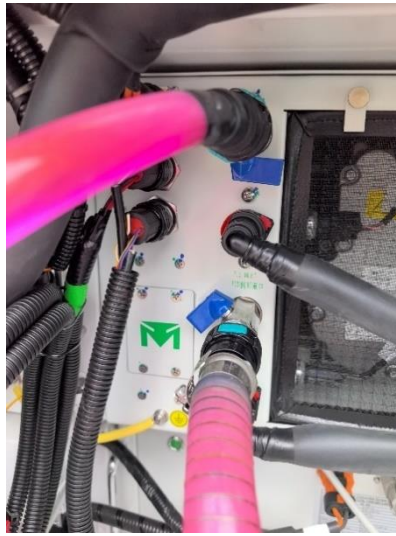


Figure6-7: PCS coolant filling connection

Battery side

- ① Connect the outlet hose of the pump to the battery-side refill port, and place the inlet hose of the pump into the coolant.
- ② Take an additional vent hose and connect it to the battery-side vent port, with the other end of the vent hose placed in the coolant.

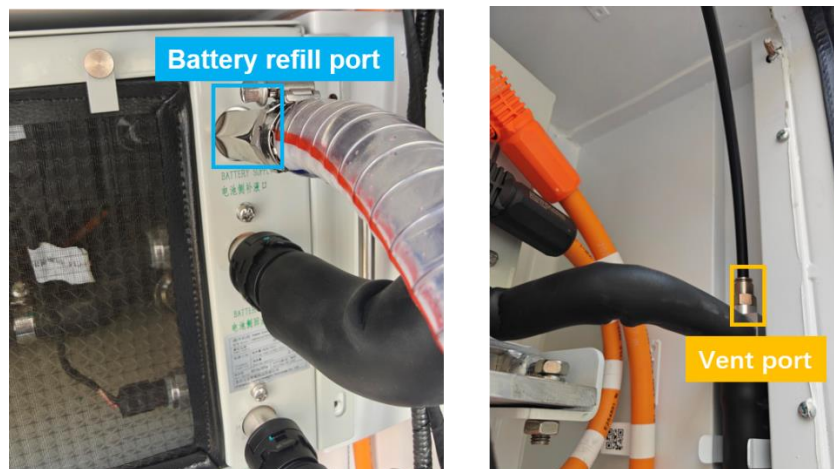


Figure 6-8: Battery side coolant filling connection

Step 2: Control the valves (Rotate the valve 90°, with the horizontal direction of the valve to the port indicating the open state).

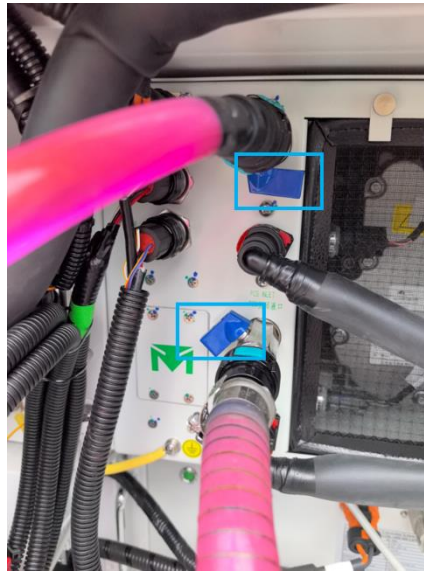


Figure 6-9: Liquid cooler valve position (in closed state)

PCS side

Open the valves of PCS-side vent port and PCS-side refill port.

Battery side

Battery-side vent port has no valve (no action needed). Open the valve of battery-side refill port.

Step 3: Start filling

PCS side

- ① Set the PCS thermal management mode to "Refill Mode" on the liquid cooling display.
- ② Turn on the power supply of the pump.
- ③ Observe the bubbles in the vent hose. If no bubbles are present in the hose, it indicates that air venting is complete, and the vent port valve should be closed.

Battery side

- ① Turn on the power supply of the pump.

Step 4: Stop filling

Observe the pressure value on the liquid cooling display. Stop filling when the inlet/outlet pressure reaches 1.8-2.2 Bar:

- ① Turn off the power supply of the pump.
- ② Close the refill port valves (Rotate the valve 90°, with vertical direction of the valve to the port indicating closed state).

Step 5: After coolant filling is complete, following:

- ① Remove the liquid filling hoses.
- ② Reconnect the communication cable of liquid cooling unit to ensure that the system communication is normal.
- ③ Reinstall the dust caps on the refill port and vent port.

6.4.2 Clean Ventilation Window

6.4.2.1 Tool Preparation

Table 6-6: Tool list

Tools	Description	Acquisition methods
Socket and torque wrench	/	User-provided

Water gun	/	User-provided
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6.4.2.2 Clean the Air Intake Window

Prerequisite: Power off the system

Step 1: Use the triangular key to loosen the fixing latch of the front intake louver. Hold both sides of the louver with both hands and remove the entire assembly.

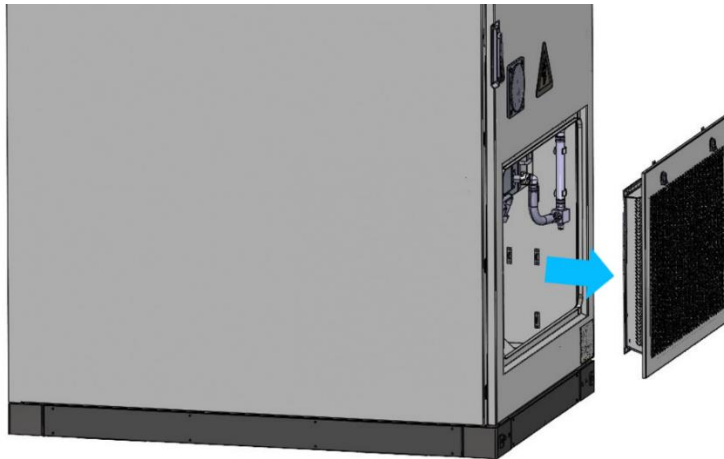


Figure 6-10: Remove the air intake window

Step 2: Remove the fixing screws of the filter net and take out the filter cotton.

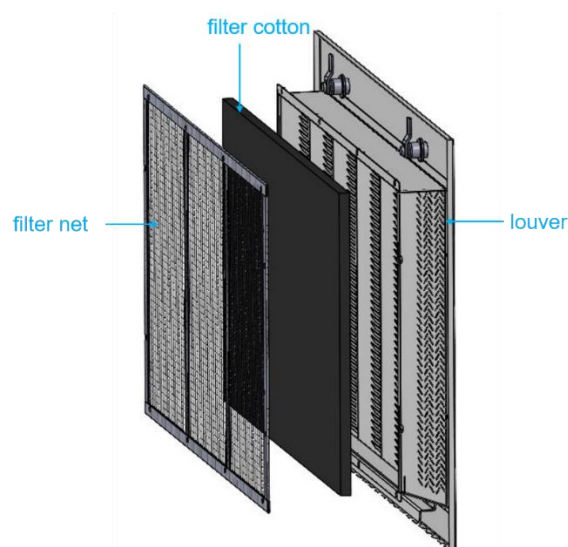


Figure 6-11: Disassemble the air intake window

Step 3: Use a water gun to clean the filter net, filter cotton, and louver grille.

Step 4: After the components are air-dried, reinstall them in their original positions:

- ① Assemble the components in order: filter net → filter cotton → louver. Secure the filter net using M5 screws (recommended torque: 5 ± 0.5 N·m).
- ② Align the slots of the assembled intake louver with the edges of the cabinet window. Ensure the louver is flush with the cabinet, then tighten it using the triangular key.

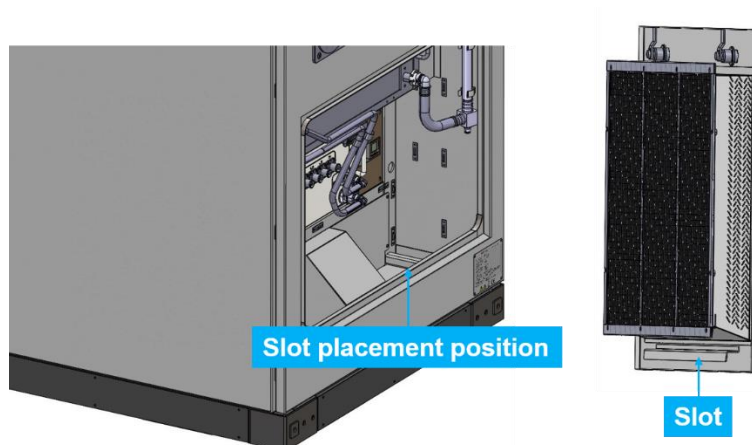


Figure 6-12: install air intake window

6.4.2.3 Clean the Exhaust Vent Window

Prerequisite: Power off the system

Step 1: Remove all screws from the rear exhaust vent window of the cabinet and detach the entire window.

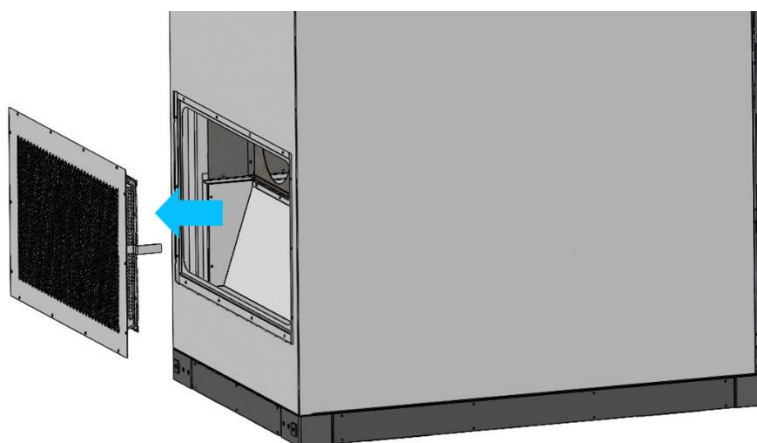


Figure 6-13: Remove the exhaust vent window

Step 2: Remove the fixing screws of the filter net to separate the filter net from the louver.

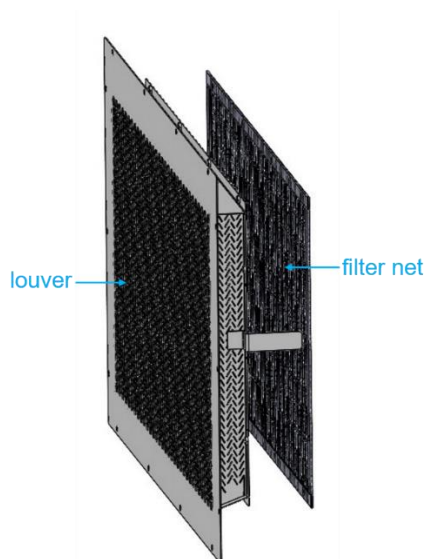


Figure 6-14: Disassemble the exhaust vent window

Step 3: Use a water gun to clean the filter net and louver grille.

Step 4: After air-drying the components, reinstall them in their original positions:

- ① Install the filter net onto the backside of the louver and secure it with M5 screws. The recommended torque is $5 \pm 0.5 \text{ N}\cdot\text{m}$.
- ② Mount the reassembled exhaust louver back in place and fasten it with M5 screws. Tighten the screws in a diagonal sequence step by step. The recommended torque is $5 \pm 0.5 \text{ N}\cdot\text{m}$.

7 Fault Handling

7.1 Troubleshooting Measures

NOTICE

- If routine troubleshooting (restart, parameter verification, external connection check, etc.) has been completed, but the fault has not been resolved, please contact our company for professional technical support.

7.1.1 BMS Troubleshooting

Table 7-1: BMS related faults

No.	Type of failure	Common causes	Troubleshooting methods
1	MSD not inserted	MSD not inserted	Insert the MSD and confirm that it is locked in place.
2	System trip failure	Circuit breaker trip Emergency stop button is pressed	Reset circuit breaker. Reset emergency stop button.
3	Total system underpressure	Low system voltage BMS total pressure acquisition wiring harness abnormal	Confirm whether the total voltage triggers the alarm threshold, and if it triggers normally, perform charging operation; If the total pressure abnormality triggers a three-level alarm, check the pressure collection wiring harness and wiring harness connection.
4	Total system overpressure	High system voltage BMS total pressure acquisition wiring harness abnormal	Confirm whether the total voltage triggers the alarm threshold, and if it triggers normally, carry out discharge operation; If the total pressure abnormality triggers a three-level alarm, check the pressure collection wiring harness and wiring harness connection.
5	Cell overvoltage	Single cell overcharge Voltage acquisition harness	Stop charging and check whether the voltage protection threshold is correct;

		abnormal Failure of equalization function	Check whether the voltage acquisition harness is loose or has poor contact; Replace VCMU.
6	Cell under-voltage	Single cell over-discharge Voltage acquisition harness abnormal Failure of equalization function	Stop discharging and check whether the voltage protection threshold is correct; Check whether the voltage acquisition harness is loose or has poor contact; Replace VCMU.
7	SOH low	Battery degradation	Conduct capacity tests to confirm the degree of aging. If individual cells are severely aged, replace them. If the entire battery system is severely aged, perform retirement procedures. (Contact our company for troubleshooting)
8	Excessive pressure difference	Loose voltage acquisition harness Poor cell consistency	Check whether the voltage acquisition harness is loose or has poor contact; Export cell data via the EMS display screen and contact our company for troubleshooting.
9	Battery temperature is too low	The heating function is not activated in low temperature environment	Check whether the heating mode of the liquid cooler is started, and if not, update the liquid cooling operating parameters.
10	Battery temperature is too high	The cooling function is not activated in high temperature environment.	Check whether the cooling mode of the liquid cooler is started, and if not, update the liquid cooling operating parameters.
11	Voltage detection fault	Loose voltage acquisition harness VCMU abnormal	Check whether the voltage acquisition harness is loose; Replace VCMU. (Contact our company for troubleshooting)
12	Temperature detection failure	Loose temperature acquisition harness VCMU abnormal	Check whether the temperature collection harness is loose; Replace VCMU. (Contact our company for troubleshooting)

13	Flood warning	Water accumulation occurred in the cabinet End-to-end wire harness winding of water-immersed wire	Check whether there is accumulated water in the cabinet, if so, drain the accumulated water and dry the water immersion sensing wiring harness; If there is no water, check if the black wires at the beginning and end of the water immersion harness are twisted together. If the two black wires of the transmitter touch each other to form a circuit, it will also cause a water immersion alarm.
14	High pole temperature	Loose connection Temperature acquisition harness abnormal	Check whether the pole fixing bolts are loose; Check whether the temperature acquisition harness is loose. (Contact our company for troubleshooting)
15	High humidity	Dehumidifier not starting	Check if the dehumidifier is running
16	Fire alarm	System thermal runaway	If the battery system experiences thermal runaway or a fire, and there is visible smoke or flames, please contact the local fire department immediately.
17	Travel switch failure	Cabinet door not closed	Close the cabinet door
18	① Fire communication failure ② Dehumidifier communication failure ③ Flood communication failure ④ Temperature and humidity sensor communication failure ⑤ Meter communication failure	① Loose communication cable or incorrect wiring ② The equipment is not powered ③ Wrong baud rate setting ④ Communication bus address conflict	① Reconnect the communication cable, or check whether the A/B cables are connected correctly. ② Confirm that the device is receiving power normally (the device power indicator light is on). ③ Use a serial port tool to reset the baud rate of the faulty device. ④ Capture and analyze the communication messages.
19	PCS and EMS communication failure	Wiring error Loose network cable	① Check whether the wiring is correct according to the electrical schematic

		Network cable damage IP address setting error	diagram; ② Check whether the network port indicator light is always on. If not, unplug and replug the network cable; ③ Replace the network cable; ④ Connect the computer to EMS or PCS, modify the computer network segment to the same network segment as EMS or PCS, and after the modification is complete, try pinging the EMS or PCS address. If the ping is successful, the connection is normal.
20	EMS and BMS communication failure	Wiring error Loose network cable Network cable damage IP address setting error	① Check whether the wiring is correct according to the electrical schematic diagram. ② Check whether the network port indicator light is always on. If not, unplug and replug the network cable. ③ Replace the network cable. ④ Connect the computer to the EMS or BMS, modify the computer network segment to the same network segment as the EMS or BMS, and after the modification is complete, try pinging the BMS or EMS address. If the ping is successful, the connection is normal.
21	Liquid cooler communication failure	Device not powered Loose communication wire	Check whether the power switch of the liquid cooling machine is turned on. Check whether the communication line between the liquid cooling machine and the BMS is connected properly.
22	Liquid cooler failure	Abnormal pressure, pipe blockage, mechanical failure	Contact our company for troubleshooting

7.1.2 PCS Troubleshooting

Table 7-2: PCS related faults

No.	Type of failure	Common causes	Troubleshooting methods
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1	Grid voltage abnormal	PCS does not detect grid voltage	Check whether the grid voltage is normal
2	High instantaneous grid voltage	Instantaneous grid voltage exceeds upper limit	Check whether the grid voltage is normal
3	Grid line voltage effective value fault	The effective value of grid voltage exceeds the allowable operating range	Check whether the grid voltage is normal
4	Grid voltage imbalance	Grid voltage imbalance exceeds upper limit	Check whether the grid voltage balance is normal
5	Grid current imbalance	Grid current imbalance exceeds upper limit	Check PCS Inverter Current
6	Grid frequency abnormal	Grid frequency exceeds the operating range	Check AC power supply frequency
7	Grid frequency high/low	Grid frequency exceeds high/low limit	Check AC power supply frequency
8	Grid frequency mismatch	The grid frequency deviates too much from the default value	Check AC power supply frequency
9	DC bus overvoltage	DC bus voltage exceeds upper limit	Check DC bus voltage and control parameters
10	Large DC bus voltage deviation	Large deviation of positive and negative DC bus voltages	Check positive and negative bus voltages and control parameters
11	Current bus undervoltage	DC bus voltage exceeds low limit	Check DC bus voltage and control parameters
12	Battery overvoltage/undervoltage	Battery voltage over/below limit value	Check battery voltage
13	Battery overcurrent	Battery current exceeds limit value	Check Battery Current
14	CPLD failure	CPLD detects fault	Check the specific CPLD fault code
15	Inverter current sampling offset value fault	Inverter current sampling offset value and default value exceed normal range	Check the sampling current (contact our company for troubleshooting)
16	Inverter current overcurrent	Inverter current exceeds upper limit	Check Hall and Sampling Line
17	Inverter current abnormality	The deviation between the inverter current and the set value is too large	Check the wiring

18	AC relay failure	AC relay closing fault	Check AC Relay
19	Pre-grid connection detection fault	Abnormal inverter voltage before closing	Check filter capacitor wiring and sampling line
20	Reactor overtemperature 1	The temperature of reactor 1 exceeds limit value	Check the temperature sampling line of reactor 1, water machine flow rate, water machine inlet temperature, and limit parameters (if you need to modify the limit parameters, please contact our staff to confirm before operating)
21	Reactor overtemperature 2	The temperature of the reactor 2 exceeds the limit value	Check the temperature sampling line of reactor 2, water machine flow rate, water machine inlet temperature, and limit parameters (if you need to modify the limit parameters, please contact our staff to confirm before operating)
22	Internal overtemperature	Internal temperature exceeds limit value	Check the internal environment temperature sampling line, water machine flow rate, water machine inlet temperature, and limit parameters (if you need to modify the limit parameters, please contact our staff in advance to confirm before proceeding)
23	AC relay sticking fault	AC relay stuck	Check AC Relay
24	A/B/C phase IGBT over-temperature	A/B/C phase IGBT temperature exceeds limit value	Check the temperature sampling lines of the A/B/C phase IGBTs, the water machine flow rate, the water inlet temperature of the water machine, and the limits (if you need to modify the limit parameters, please contact our staff to confirm before proceeding)
25	DC reverse connection fault	DC lines connected inversely between DC+ and DC-	Check DC+, DC-wiring
26	Over-temperature of water-cooling plate	Water cooling plate temperature exceeds limit value	Check the water-cooling plate temperature sampling line, water machine flow rate, water machine inlet

			temperature, and limit parameters (if you need to modify the limit parameters, please contact our staff to confirm before operating)
27	High/low penetration fault	PCS detects high and low penetration out of curve range	Check the grid voltage
28	Emergency stop detection	External emergency stop signal	Check emergency stop signal
29	Insulation detection	Calculated value of insulation detection is too low	Check the insulation system
30	Grid phase voltage effective value fault	The effective value of grid phase voltage exceeds the allowable operating range	Check whether the grid voltage is normal
31	AC lightning protection failure	Lightning protection failure occurs	Check lightning protection fuses and wiring
32	Reactor thermal trip fault	Reactor thermal trip fault occurs	Check the reactor
33	Resonance fault detection	Resonance occurs inside and outside of the PCS	Adjust the resonance coefficient
34	Fan failure	Fan damage	Check fan status
35	Leakage current fault detection	Leakage current fault occurs	Check Leakage Current Signal
36	Power failure	CPLD detection	Check the power supply
37	R/T/S phase drive protection	CPLD detection	Check the driver board and power supply
38	R/T/S phase overcurrent	CPLD detection	Check the driver board and power supply, Check CPLD version number
39	Battery overcurrent Battery overvoltage	CPLD detection	Check battery current/voltage and control parameters; Check CPLD version number
40	Positive/negative bus overvoltage	CPLD detection	Check the control parameters, Check CPLD version number
41	External emergency stop	CPLD detects emergency stop signal	Check emergency stop signal
42	Verification error Communication timeout	CPLD detection	Check the core board

8 Emergency Response

8.1 Emergency Treatment Measures

Customers should organize emergency-related personnel such as fire rescue, operation and maintenance, formulate emergency response plans under the guidance of our company, conduct planning training and drills, and communicate with local regulatory authorities as early as possible to ensure that all parties agree on the emergency response plans; If there are changes to the emergency plans, information should be updated in timely manner and relevant personnel should be notified and trained.

The outdoor cabinet system has multiple layers of protection and is extremely safe under normal operating conditions. However, in the event of an accident or failure due to objective factors, prompt manual intervention should be taken to ensure safety and prevent accidents.

8.1.1 In the Event of Dropping or Impact

- Under safe conditions, promptly transfer damaged batteries to an open, safe location to avoid affecting nearby batteries.
- If obvious odor, damage, smoke, fire, etc. are found, immediately evacuate the area, call the fire department, and contact a professional; Professionals shall use fire-fighting facilities to extinguish fires and other treatments in a safe manner.

8.1.2 In the Event of a Flood

- On the premise of ensuring personal safety, power off the system.
- If any part of the battery is submerged by water, do not touch the battery to avoid electric shock.
- It is strictly forbidden to use flooded batteries. Contact the battery recycling company for scrapping.

8.1.3 In the Event of Activated Audible and Visual Alarm

When the device warning light flashes or beeps:

- No approach
- No door opening
- Stay away immediately
- Remotely cut off the power supply under the condition of ensuring your own safety

8.1.4 In the Event of a Fire



- When the battery temperature is too high, the battery will be deformed and damaged, and the electrolyte will overflow, leaking toxic gases. Respiratory protective equipment should be worn to avoid skin irritation and chemical burns.

- Use carbon dioxide or dry powder fire extinguishers to put out the fire.
- Firefighters need to avoid contact with high-voltage components during fire extinguishing, otherwise it may lead to the risk of electric shock.
- Under any circumstances, it is forbidden to re-enter the burning equipment area, open the cabinet door, isolate and care the site, and prohibit irrelevant personnel from approaching.

When a fire occurs in the equipment, follow the following procedure to handle it:

- In the event of a fire, evacuate the equipment area and press the fire alarm bell. Immediately shut down the system remotely while ensuring your own safety.
- After confirming the presence of smoke and flames, call the fire department, notify professional firefighters, and provide them with relevant product information.
- After professional firefighters have confirmed that the fire has been extinguished, follow local regulations and have the cabinet door handled by professionals. Do not open the cabinet door yourself.
- Post-disaster product maintenance: Contact our service engineer for evaluation.



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