



Optim US- A1-M7A200-A-125/522- Outdoor Commercial & Industrial Integrated Energy Storage Cabinet User Manual

Information Version: 0.1

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About this Manual

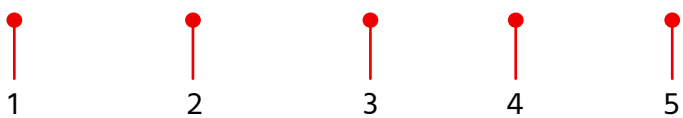
Purpose

This manual describes the outdoor integrated energy storage battery system Optim US-A1-M7A200-A-125/522 (hereinafter referred to as the "System" unless otherwise specified) developed by Pylon Technologies Co., Ltd. (hereinafter referred to as "Pylontech") from the aspects of overview, installation, commissioning, and maintenance.

Please read this manual before installing the system and follow the instructions carefully during installation. In case of any confusion, please contact Pylontech immediately for advice and clarification (Contact information can be found on the back cover of the manual).

Product Name Description

Optim US-A1-M7A200-A-125/522



No.	Designation	Description
1	Product Series	Optim US Series
2	Product Model Code	Energy Storage Integrated Cabinet
3	Battery Model Used in Product	This product uses the M7A200 battery
4	Product Version Number	A1
5	System Rated Power (kW) and Battery Energy (kWh)	The system rated power is 125kW; the battery energy is 522kWh.

Explanation of Symbols

Symbol	Description
 DANGER	Danger: Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
 WARNING	Warning: Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
 CAUTION	Caution: Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
 NOTE	Note: Indicates additional information, emphasized contents, or important points helping you use the product better.

Abbreviations

Abbreviation	Designation
Pylontech	Pylon Technologies Co., Ltd.
EU	European Union
AC	Alternating Current
DC	Direct Current
BMS	Battery Management System
BMU	Battery Management Unit
MSD	Manual Service Disconnect
PCS	Power Conversion System
SOC	State of Charge
SOH	Battery State of Health, in percent
UPS	Uninterruptible Power Supply
BESS	Battery Energy Storage System
EMS	Energy Management System
LEMS	Local Energy Management System
MCB	Micro Circuit Breaker
MCCB	Molded Case Circuit Breaker
PDU	Power Distribution Unit
PMU	Power Management Unit
CMU	Control Management Unit
SPD	Surge Protecting Device

Abbreviation	Designation
GND	Ground
DOD	Depth of Discharge
MCU	Microcontroller Unit
EPO	Emergency Power OFF Switch
OVC	Overvoltage Category

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1 Safety

1.1 Personal Requirements

This system is only operated by authorized personnel. Read all safety instructions carefully prior to any work and follow these instructions at all times when working with the system.

Incorrect operation or work may cause:

- Injury or death to the operator or a third party.
- Damage to the system hardware and other properties belonging to the operator or a third party.

Qualified personnel must have the following skills:

- Training in the installation and commissioning of the electrical system, as well as dealing with hazards.
- Knowledge of the manual and other related documents.
- Knowledge of local regulations and directives.

1.2 General Requirements

DANGER

Battery strings will produce high voltage DC power and can cause a lethal voltage and an electric shock. Only qualified personnel can perform the wiring of the battery strings.

DANGER

Lethal voltages are present in the battery terminals and cables. Severe injuries or death may occur if you touch the cables and terminals.

WARNING

Pulling out the connectors while the system is working could lead to battery system damage or personal injury. Do not pull out the connectors while the system is in operation. De-energize all multiple power sources and verify that there is no voltage.

WARNING

Whenever operating the battery system, wear suitable personal protective equipment (PPE) such as rubber gloves, rubber boots and goggles.

 WARNING

For this system, the working temperature is -25 °C ~ 50 °C and the optimum temperature is: 10 °C ~ 40 °C. Operation outside the specified working temperature range may trigger a high/low-temperature alarm or protection mechanism in the battery system. This will accelerate degradation, reduce cycle life, and may void the warranty.

 WARNING

For battery installation, the installer shall refer to IEC 60364 or similar local installation standard for operation.

 CAUTION

Improper settings or maintenance can permanently damage the battery.

 CAUTION

Incorrect PCS parameters will lead to the premature aging of battery or battery system failure.

There is high voltage in the system, and any accidental contact may lead to fatal electric shock. Be sure to observe the following when working with the system:

- Tag and lock the working area.
- There must be an escort to ensure personal safety.

1.3 Equipment Label Protection

- The warning labels on the outside and inside of the cabinet of this product contain important information for safe operation of this product. It is strictly prohibited to remove or damage them.
- This product is fitted with a nameplate that contains important information about the parameters related to the product. It is strictly prohibited to tear or damage it.

1.4 Establishment of Safety Warning Signs

When installing, performing routine maintenance, repairing, etc., on this product, to prevent uninvolved persons from approaching and causing accidental operations or accidents, please observe the following:

- Establish visible signs at all circuit breakers for this product to prevent accidents caused by accidental closing of the circuit breaker.
- Establish warning signage or set up safety caution tape near the operating area.
- Always remove the cabinet door key and keep it in a safe place after operations such as maintenance or overhaul.
- An emergency escape route must be available to ensure personal safety.

1.5 Precautions for Maintenance or Repairs

The product can be taken out of operation smoothly by performing the shutdown operation. When performing maintenance or overhaul operations on the equipment, please observe the following:

- Ensure that this product is not accidentally repowered.
- Use a multimeter to ensure that the product is completely free of electrical charge internally.
- Ensure the proper grounding connections.
- Cover potentially energized parts of the operating section with insulation using a cloth made of insulating material.
- Ensure that escape routes are completely clear throughout maintenance and repair.

1.6 System Operation Precautions

When the energy storage system is operating at power, it is prohibited to abnormally disconnect the grid-connection terminal, such as manually cutting off the breaker under load, or the breaker being tripped by the anti-reverse current device due to reverse current (this system has reverse current detection to prevent reverse power flow from the energy storage system in real time). If the external load side at the energy storage grid-connection terminal is disconnected, it will cause damage to the AC power supply equipment inside the cabinet.

1.7 Electrostatic Protection

- Contact or improper handling of printed circuit boards or other static-sensitive components can cause damage to the device.
- Avoid unnecessary contact with the circuit board.
- Observe electrostatic protection norms, such as wearing anti-static bracelets.

1.8 Moisture Protection

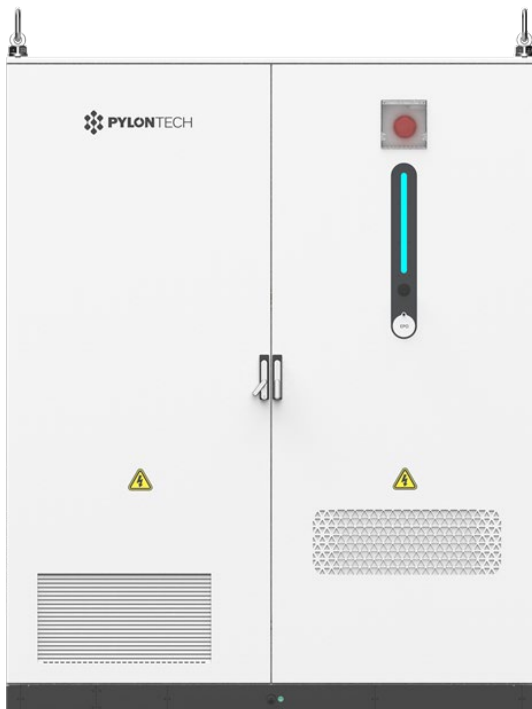
- Do not open the cabinet door when the air humidity exceeds 95%.
- Avoid installation operations in rainy or humid weather conditions.
- Intrusion of moisture will most likely damage the product.

2 System Introduction

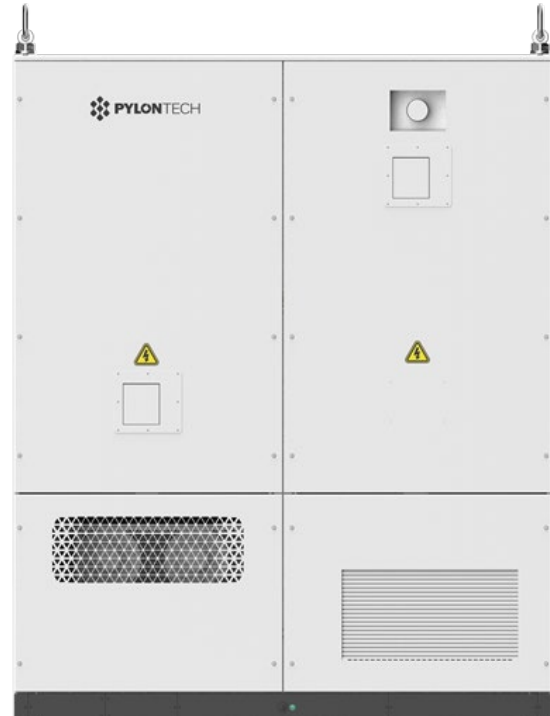
2.1 System Overview

Outdoor integrated energy storage power system connects the grid to the energy storage battery via a Power Conversion System (PCS), utilizing the AC/DC conversion principle to enable bidirectional energy transfer between the DC battery of the energy storage system and the AC grid. Through control strategies, it achieves the following:

- Charge and discharge management of the battery system.
- Tracking of grid-side load power.
- Control of charge and discharge power of the battery energy storage system, off-grid operation, etc.



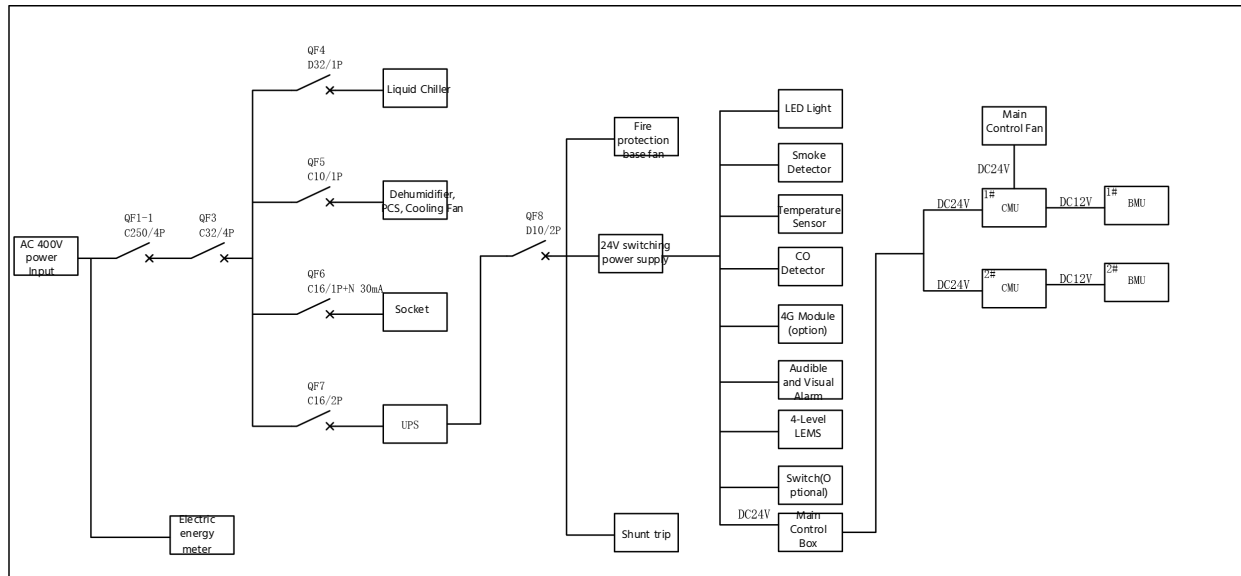
Front View



Rear View

NOTE

The above pictures are for reference only. The appearance of the product is subject to the actual delivery.



System topology

Main Functions:

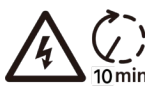
- Peak Shaving: Achieved by charging and discharging the energy storage system based on local electricity rate requirements and fixed durations.
- Anti-Reverse Power Function: The EMS (Energy Management System) samples the grid power in real time and adjusts the charging and discharging power of the energy storage system to prevent reverse power flow back to the grid.
- Demand Management: The EMS adjusts the charging and discharging power of the energy storage system to prevent exceeding the user transformer's capacity limit.
- Local Control and Remote Communication Control.
- Supports manual off-grid operation in the event of a grid power outage, serving as an emergency power supply.

2.2 System Specifications

Model Name		Optim US-A1-M7-A-125/522-EU-xx (where xx=01, 02, 03, 04, or 05)*	
Specifications		Value	Description
AC side Parameters	Rated Power (kW)	125	
	Rated Voltage (VAC)	230/400	
	Rated AC Current (A)	180	
	Max. Current (A)	198	
	Wiring Method	3P+N+PE	

Model Name		Optim US-A1-M7-A-125/522-EU-xx (where xx=01, 02, 03, 04, or 05)*	
Specifications		Value	Description
	Frequency (Hz)	50/60	
	THD (%)	≤3	Grid-connected
	Power Factor	-1 ~ +1	Grid-connected
DC side Parameters	Rated Energy (kWh)	261kWh*2	
	Rated Voltage (VDC)	832	1P52S
	Voltage Range (VDC)	728~936	5*1P52S
	Standard Current (A)	150	
	Max. Current (A)	180	
System Parameters	Size(mm) W*D*H	1900±5*1350±5*2480±5mm	
	Weight (kg)	5300kg±20kg	
	Working Temperature Range (°C) *	-25~50	
	Noise (dB)	75 @ 1 meter	
	Wire feeding-in-and-out Method	Bottom in and bottom out	
	Ingress Protection (IP) / Protective Class	IP 55/Class I	
	Max. Altitude (m)	≤ 3000 m	≤2000m, no derating
	Relative Humidity	5-95% RH, non- condensing	
	Fire suppression method	Aerosol	
	Cooling Type	Liquid Cooling	
	External Communication Interface	ETH/CAN/RS485	
	Cabinet Corrosion Resistance Level	C3-H	Optional C4/C5
	Remote Alarm	Cloud Platform	Via Local EMS System

2.3 Label Description

	Read the manual before installing and operating the battery system.		The certificate label for CE.
	Grounding label.		Separate Collection Symbol for regulation concerning batteries and waste batteries (2023/1542/EU)
	Do not connect the positive and negative reversely.		Label for Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU).
	Keep away from children.		Packages Transport packaging design and materials handling To indicate the center of gravity of the transport package which will be handled as a single unit
	Keep away from flame or ignition sources.		To indicate the location of where forklift operators should insert the forks to lift and transport goods.
	General warning label indicating potential hazards.		Delayed discharge. After the device is powered off, please wait 10 minutes until the capacitors are fully discharged.
	Warning: flammable materials.		The certificate label for Safety by TÜV Rheinland.
	Warning: electric shock.		Warning: battery charging

2.4 Reference Standards

2.4.1 System Related Standards

No.	Description	Code
1	CE LVD Directive 2014/35/EU	EN 62477-1
2	CE EMC Directive 2014/30/EU	EN IEC 61000-6-2 EN IEC 61000-6-4 IEC 61000-6-7
3	RoHS Directive 2011/65/EU and its amendment (EU) 2015/863	/
4	WEEE Directive 2012/19/EU	/
5	Safety Standard	IEC 62619, IEC 63056 VDE-AR-E 2510-50 VDE-AR-E 2510-2
6	Evaluating Fire Propagation Characteristics	UL 9540A
7	Installation Standard	IEC 62933-5-2 (applicable only to models: Optim US-A1-M7-B-125/261-EU-03/04/05) PGS 37-1
8	Standard on Explosion Prevention Systems	NFPA 69
9	Transportation Standard	UN 38.3, UN 3480

2.4.2 Battery Related Standards

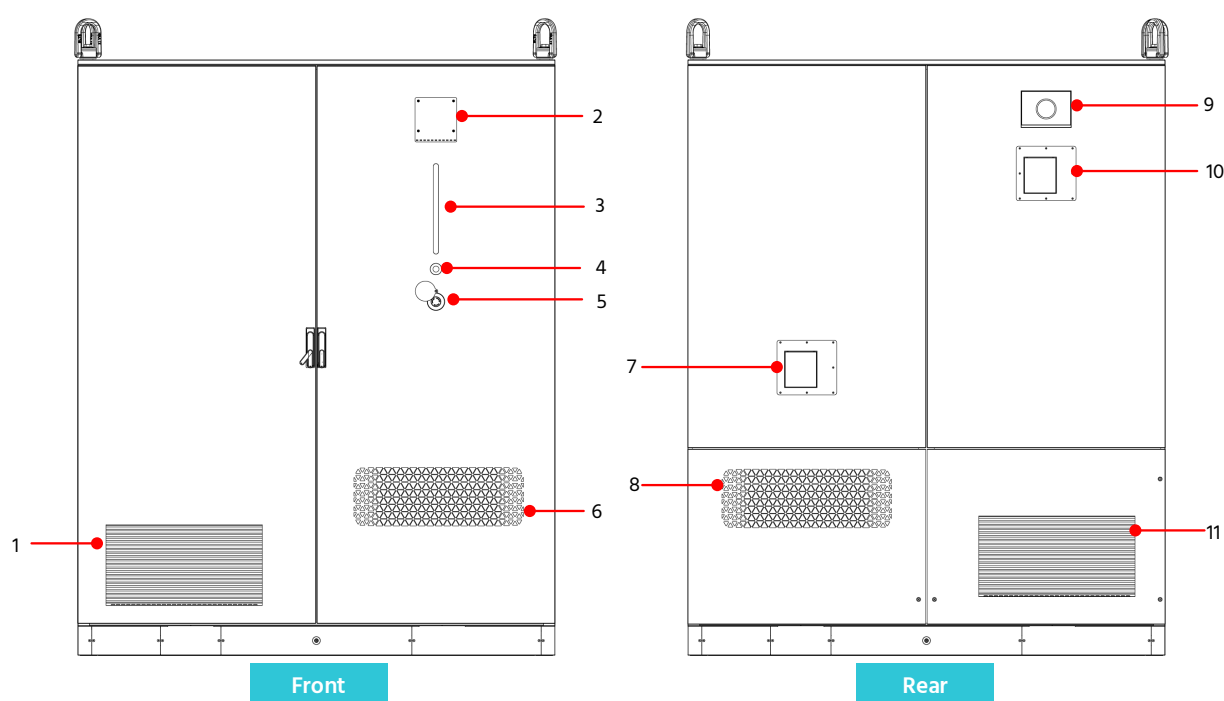
No.	Description	Code
1	Functional Safety for Secondary Lithium Batteries	ISO 13849-1
2	Battery Cell Safety Standard	IEC 62619, UL 1642, UL 1973

3 System Components

3.1 External Design

Outdoor Cabinet Overview

The outdoor integrated energy storage system adopts an integrated design. Its main internal components include: energy storage battery clusters, energy storage power conversion system (PCS), liquid cooling unit, fire suppression system, main control system, power distribution system, and other equipment. To meet the different protection and temperature requirements of the batteries, electrical equipment, PCS, and liquid cooling unit, the cabinet is divided into a battery compartment, an electrical compartment, a PCS compartment, and a liquid cooling unit compartment.



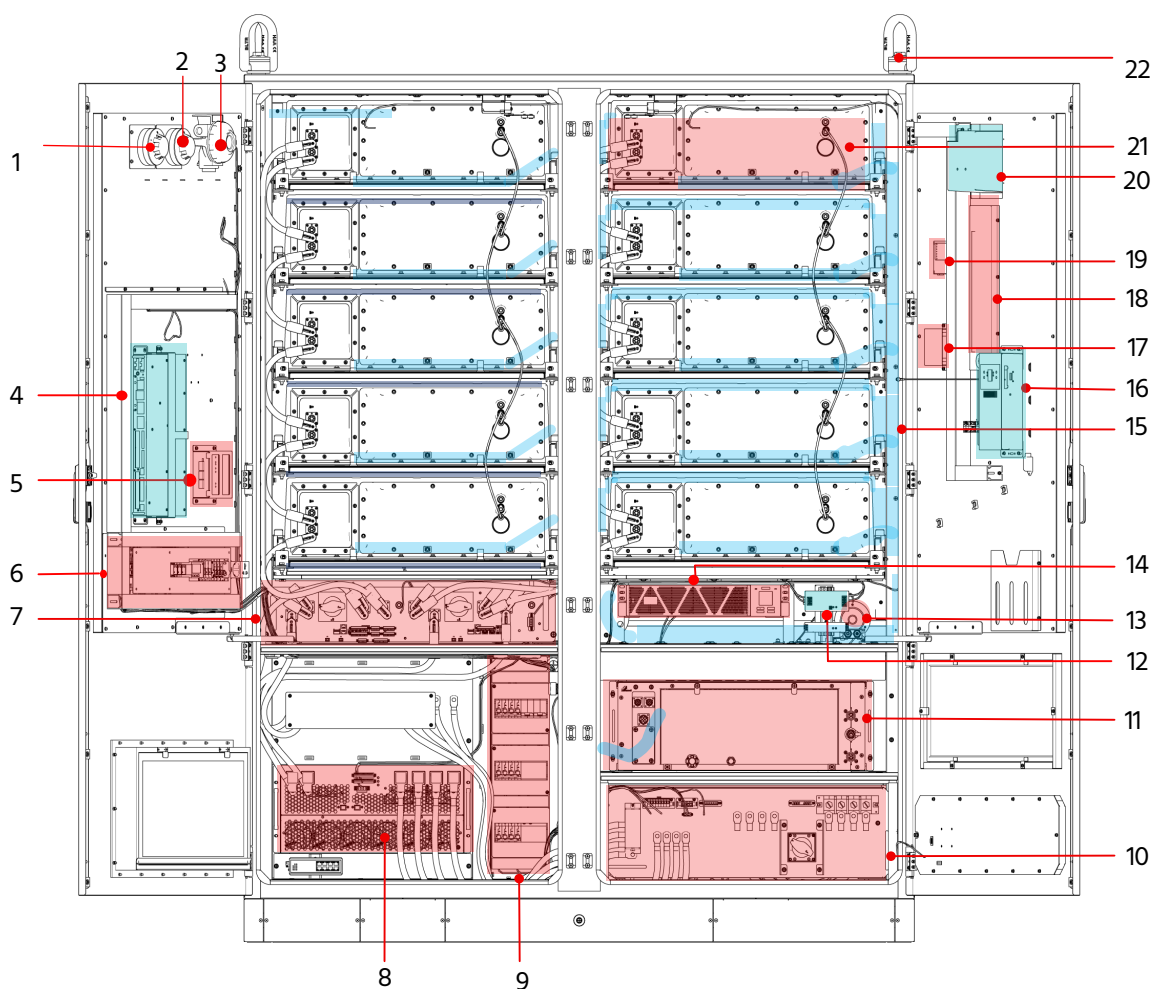
No.	Description	No.	Description
1	PCS Air Inlet Louver	7	Explosion-proof air inlet
2	Sound-light Alarm	8	Liquid Cooling Unit Air Outlet Vent
3	LED	9	Water Pipe Joint
4	4G Module(Optional)	10	Explosion-proof air outlet
5	EPO (Emergency Power Off)	11	PCS Air Outlet Louver
6	Liquid Cooling Unit Air Inlet		

3.1.1 Outdoor Cabinet

Outdoor Cabinet Parameters

Item	Parameters
Dimensions (W × D × H, mm)	1900±5*1350±5*2480±5mm
IP Rating/Protective Class	IP55/ Class I
Corrosion Resistance Grade of the Cabinet	Standard product C3-H; optional C4/C5 standard
Plate Material	Cabinet body: SGCC, Bottom Base: Q235NH
Maintenance	Equipment requires opening the front door for maintenance, and at least 600mm of space must be reserved at the rear to ensure PCS heat dissipation.
Safety Precautions	Outdoor lock
Safety signage	The cabinet is marked with signs such as "Danger : Electric Shock" and "Grounding Point".

3.2 Internal Design



Front View

No.	Description	No.	Description
1	Temperature Sensor	12	Aerosol
2	Smoke Integrated Sensor	13	Switch Mode Power Supply
3	CO Sensor	14	UPS (Uninterruptible Power Supply)
4	LEMS (Local Energy Management System)	15	Liquid Cooling Piping
5	EMS	16	Dehumidifier
6	Door Panel Distribution Area	17	LED driver
7	BMS	18	Light board
8	PCS	19	4G Module (option)
9	Electrical Protection Area	20	Sound-light Alarm
10	Distribution Box	21	Battery Pack
11	Liquid Chiller	22	M24 Demountable lifting ring

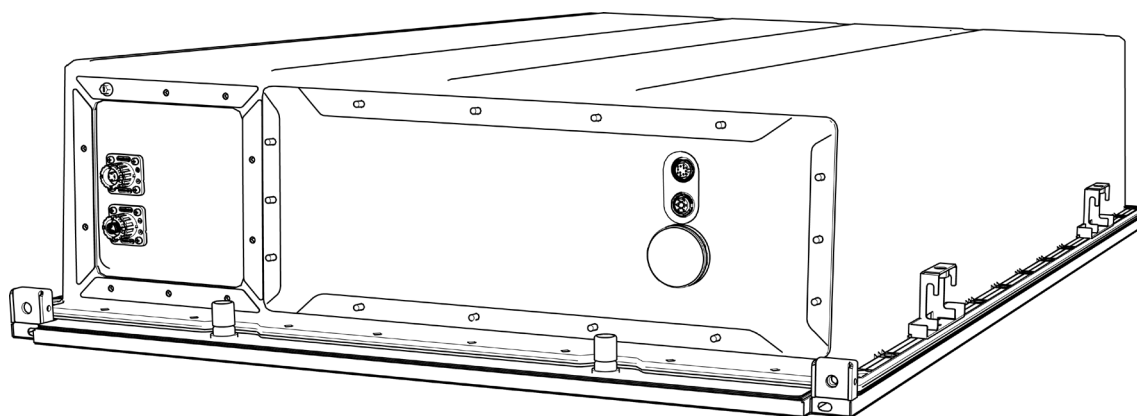
3.2.1 Battery String

The system has one battery string, including one control Module (BMS) and five battery modules.

3.2.1.1 Specifications of the Battery String

Battery String	PowerCube-M7A
Battery Module Model	HM7A200L
Control Module (BMS) Model	OPS10M7A200E
Humidity (%)	5 – 95 (without condensing)
Round-trip Efficiency (% , @ 0.5 C)	95%
Depth of Discharge (DOD) (%)	95%
Battery Module Quantity (pcs)	5
Standard Charge/ Discharge Current (A)	150
Max. Continuous Charge/ Discharge Current (Amps)	196
Peak Current (Amps)	250@15 seconds
Max. Short Circuit Current (Amps)	14 kA 5 milliseconds
System Rated Capacity (Ah)	314
Total Storage Energy (kWh)	261.2
System Rated Voltage (VDC)	832
Upper limit Charge Voltage (VDC)	936
End-of-discharge Voltage (V)	702

3.2.1.2 Battery Module

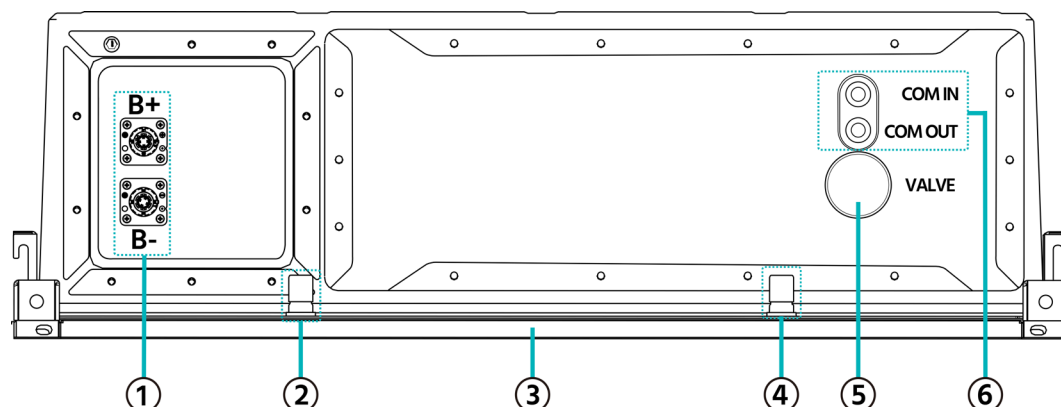


Battery Module Specifications

Specifications	HM7A200L
Cell Technology	Li-ion (LFP)
Battery Module Capacity (kWh)	52.25
Battery Module Voltage (VDC)	166.4
Battery Module Capacity (AH)	314
Dimension (W × D × H, mm)	790 ± 2 × 1145 ± 2 × 245 ± 2
Protection Class	IP67
Weight (kg)	336 ± 5
Charging Temperature Threshold of the cell (°C)	2~55
Discharging Temperature Threshold of the cell (°C)	-28~58
Storage Temperature (°C)	-40~60*
Transportation Certificate	UN38.3

* See *section 9.2 storage* for details.

Battery Module Interface



Item	Description	Item	Description
①	Power Terminal B+/B-	④	Liquid Outlet Connector
②	Liquid Inlet Connector	⑤	Pressure Relief Valve
③	Liquid Cooling Plate	⑥	Communication Port (COM IN/ COM/ OUT)

① Power Terminal B+/B-

Positive (B+) and negative (B-) DC input terminals for connecting batteries in series.

② Liquid Inlet Connector

Connects the liquid cooling pipe for coolant in.

③ Liquid Cooling Plate

Regulates battery temperatures by the coolant flowing through the internal channels to ensure optimal battery performance, longevity and safety.

④ Liquid Outlet Connector

Connects the liquid cooling pipe for coolant out.

⑤ Pressure Relief Valve

Prevents explosions caused by thermal runaway and automatically vents the internal pressure of the battery module in the event of a fire.

⑥ Communication Port (COM IN/ COM/ OUT)

Communication ports (CAN communication), between multiple serial battery modules and control module.

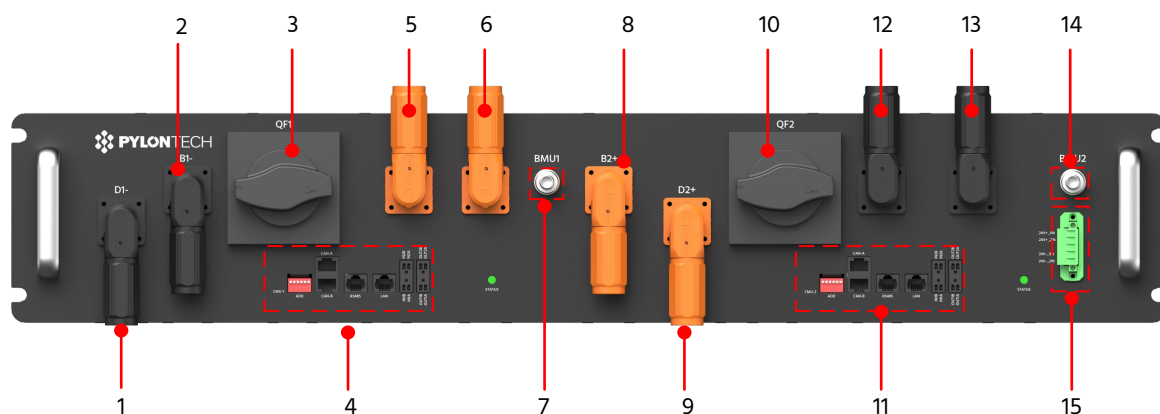
3.2.1.3 Control Module

Main Control Module Specification:

Specifications	Value
Model	S1000M7A200ND
DC Power Supply	24VDC
System Operation Voltage (VDC)	0 ~1000
Dimension (W × D × H, mm)	760 × 700 × 150
Communication	RS485\CAN\ETH
Protection Class	IP20
Weight (kg)	37

Control Module Interface Panel

Positive and negative terminal separation



Control Module Front Interface

Item	Description	Item	Description
①	External Power Terminal (D1-)	⑨	External Power Terminal (D2+)
②	Power Terminal (B1-)	⑩	QF2
③	QF1	⑪	CMU-2
④	CMU-1	⑫	Power Terminal (B2-)
⑤	External Power Terminal (D1+)	⑬	External Power Terminal (D2-)
⑥	Power Terminal (B1+)	14	Internal communication port BMU2
⑦	BMU1	15	Main control power supply terminals

Item	Description	Item	Description
⑧	Power Terminal (B2+)		

1/5/9/13 Battery cluster 2 external power supply negative/positive terminal D- /D +

Connect battery cluster 2 to the PCS.

2/6/8/12 Battery negative/positive terminal B- / B+

Used to connect battery modules in series.

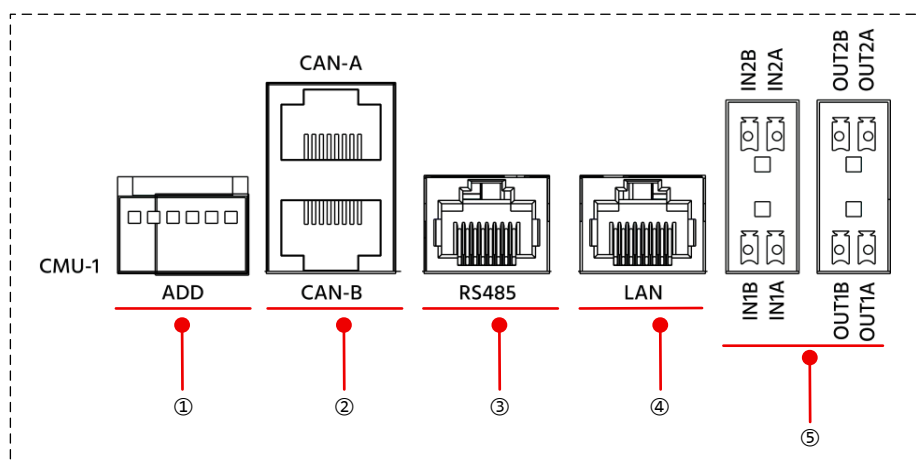
7/14 BMU1、 BMU2

Used for communication between multiple battery modules connected in series and the battery control module.

15 Main control power supply terminals

Used to connect an external 24 VDC power supply to power the battery control module.

4/11 CMU interface, including the following interfaces:



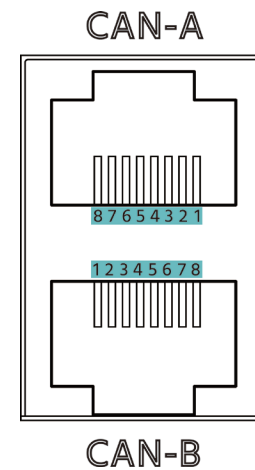
① DIP switch (ADD)

The 6-position DIP switch can be used to manually assign the communication address of the battery system. The down position is OFF, representing "0". The up position is ON, representing "1". The first to fifth positions are used for address assignment, and the sixth position controls the 120 Ω termination resistor.

② CAN A, CAN B Communication port

(RJ45 port), follows the CAN communication protocol, used for communication between the battery system and the PCS.

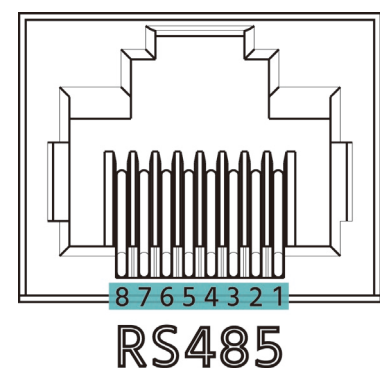
Pin Number	Definition	Description
1 3 6 7 8	NC	CAN cascade A interface
2	GNDS	
4	CAN_H	
5	CAN_L	
1 3 6 7 8	NC	CAN cascade B interface
2	GNDS	
4	CAN_H	
5	CAN_L	



③ RS485 Communication Port

(RJ45 port), following the Modbus protocol, used for control module debugging.

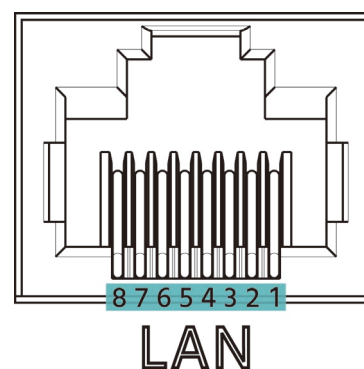
Pin Number	Definition	Description
1	NC	485 Port
2	NC	
3	NC	
4	NC	
5	NC	
6	GNDS	
7	RS485A	
8	RS485B	



④ LAN communication interface

(RJ45 Port), following the Modbus communication protocol, used to connect to a switch and communicate with the EMS.

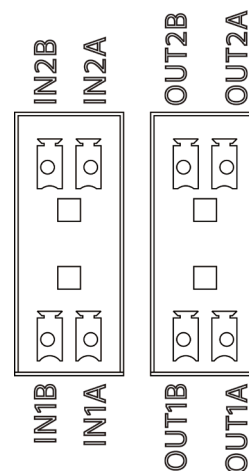
Pin Number	Definition	Description
1	TD+	Ethernet interface
2	TD-	
3	RD+	
4	3V3	
5	3V3	
6	RD-	
7	LAN_78	
8	LAN_78	



⑤ Input/Output dry contact

Provides 2 channels of input and 2 channels of output dry contact signals.

Pin Number	Silkscreen	Definition	Description
1	IN1A	IN1	Dry contact input interface
2	IN1B	IN1	
3	IN2A	IN2	
4	IN2B	IN2	
1	OUT1A	DO1	Dry contact output interface
2	OUT1B	DO1	
3	OUT2A	DO2	
4	OUT2B	DO2	



3.2.2 LEMS

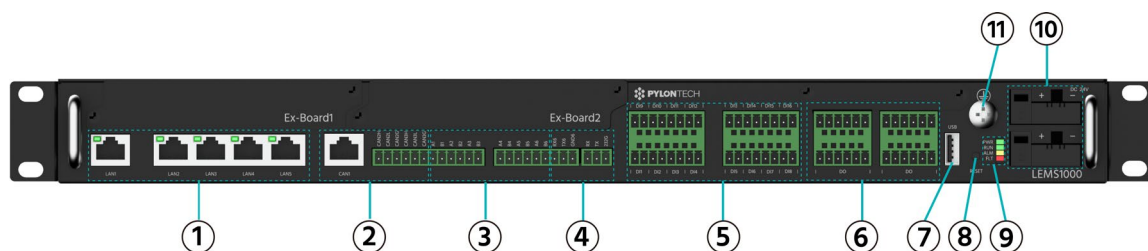
The outdoor cabinet adopts a local energy management system device LEMS 1000 for communication. It can communicate upwards with the devices as upper controller. It can also communicate downwards with devices such as battery control module, PCS, fire suppression control panel, power meter, UPS, thermal management device, detectors, etc.



Items	Parameter
Operating Voltage Range (VDC)	9~36
Communication Interface	LAN/CAN/RS485/RS232/USB
System Consumption (W)	12
Dimensions (L × D × H, mm)	482.6 ± 2 × 246.5 ± 2 × 44 ± 2
Protection Degree	IP20
Pollution Degree	PD2
Weight (kg)	4 ± 0.2

Items	Parameter
Working Temperature (°C)	-40~85
Storage Temperature (°C)	-40~85
LAN (Max. 10 Sockets)	Speed:100/1000Mbps
CAN (Max. 3 groups)	Baud rate: 500K; terminal resistance: 0/120Ω
RS485 (Max. 6 groups)	Baud rate:9600/115200
RS232 (Max. 2 groups)	Baud rate:115200
DI (Max. 16 connects)	Dry Digital Input
DO (Max. 8 connects)	Passive Digital Output
USB	USB 2.0
Operation Life (year)	15

3.2.2.1 Interface Panel of the LEMS



No.	Port	Silk-screen	Definition
1	LAN	LAN1/LAN2/LAN3/LAN4 /LAN5	LAN communication ports, for connecting BMS, external EMS, etc.
2	CAN	CAN1/ CAN2H/CAN2L/CAN2G/ CAN3H/CAN3L/CAN3G	CAN communication ports, for connecting PCS.
3	RS485	A1B1~A6B6	RS485 communication ports, for connecting external devices like air-conditioners, energy meters, sensors, air-cooled chiller, PCSs, dehumidifiers, etc.
4	RS232	RX6/TX6/GND6 RX/TX/232G	Debugging ports.
5	DI	DI1~16	Dry contact interface, compatible with passive signals or active signals ($\leq 5V$).
6	DO	DO1~8	Dry contact interface, provides 8 isolated passive digital outputs compatible with passive/active signals ($\leq 5V$), rated at DC 30V/2A.

No.	Port	Silk-screen	Definition
7	USB	USB	The USB 2.0 port supports device firmware upgrades and data export via USB flash drive.
8	RESET Button	RESET	Press this button to restart the system.
9	LED Indicators	PWR/RUN/ALM/FLT	See <i>Section 3.2.3.2 Front and Rear Interface Panel of the PCS</i> for detailed instructions.
10	9~36V DC input	DC 24V + -	Backup power input port, supports external 9-36 VDC power supply.
11	Grounding Bolt		For device grounding.

NOTE

For specific definitions of DI/DO/CAN/LAN ports, see *Section 5.5.3 Definitions of LEMS Ports*.

3.2.2.2 LED Indicators Instructions

LED Indicator	Silk-screen	Indication	Details
	PWR	Power LED	Green. LED indicator on indicates the device itself is Powered on. - When the device is powered on, it will flash once per two seconds (0.5Hz). - When the device is being upgraded or data-downloading, it will flash twice per second (2Hz).
	RUN	Run LED	Green. LED indicator on indicates the system is Running. When the device is running normally, it will be constant on.  NOTE DO NOT perform maintenance work when the system is running.
	ALM	Alarm LED	Yellow. LED indicator on indicates the system is in Alarm status. - When the LED flashes once per two seconds (0.5Hz), it indicates a minor alarm. - When the LED is constant on, it indicates a major alarm.

LED Indicator	Silk-screen	Indication	Details
	FLT	Fault LED	Red. LED indicator on indicates the device is in Fault status. When the system has a critical issue, it will be constant on. And most power supply will be shutdown. NOTE If this happens, the device needs check or repair prior to further work.

3.2.3 PCS

The directional PCS realizes the charge and discharge control of the energy storage battery. It is an important part of the smart grid, which can regulate power resources and ensure the normal operation of the grid. On one hand, the PCS can invert the direct current of the energy storage battery into alternating current to supply power to the load or input into the grid; on the other, the PCS can rectify the alternating current of the grid into direct current to charge the energy storage battery.

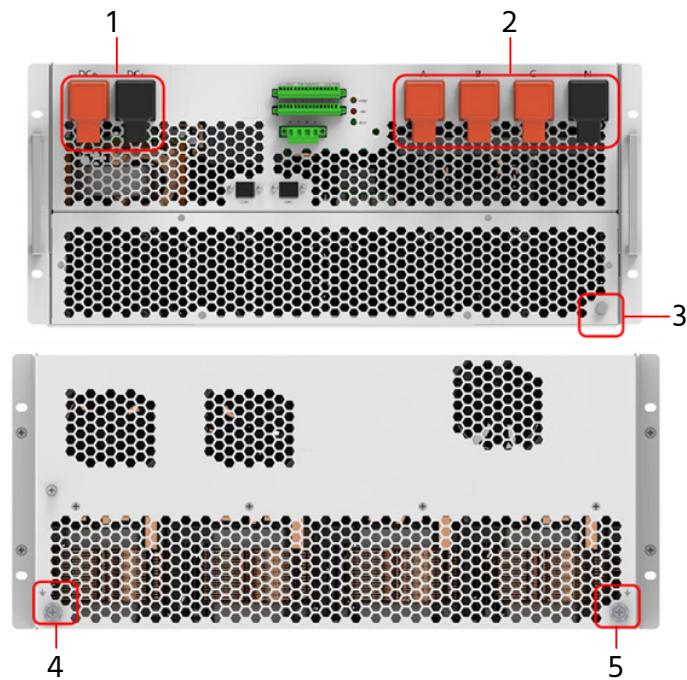


3.2.3.1 Specifications of the PCS

Model		INPPCS-125/0.4-W-14-A2-OS
Battery port	Max. DC Voltage (V)	1000
	Min. DC Voltage (V)	600
	DC Voltage Range (V)	630-950
	Max. DC Current (A)	217
	Rated DC power (kW)	125
	Max. DC Power (kW)	137.5

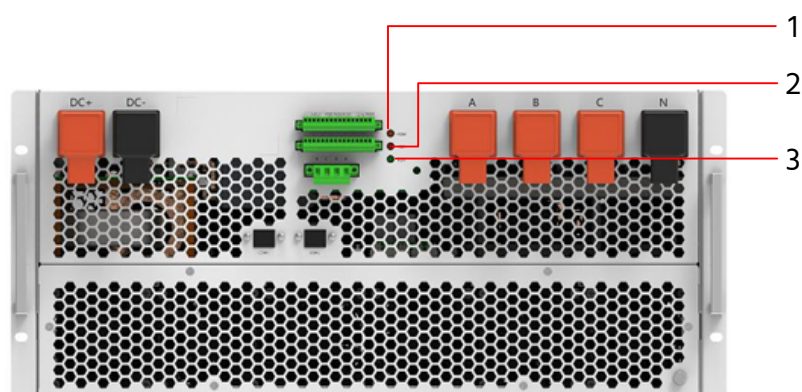
Model		INPPCS-125/0.4-W-14-A2-OS
	Overvoltage Category (OVC)	II
AC on-grid port	AC Rated Input/Output Active Power (kW)	125
	AC Rated Input/Output Apparent Power (kVA)	125
	Max. AC Input/Output Current (A)	198
	Nominal AC Voltage Ur (V)	3L/N/PE, 400/230
	AC Voltage Tolerance	-15%- +15%
	Nominal Frequency/Frequency (Hz)	50/60
	Harmonic (THDi)	≤ 3% (at nominal Power) , Linear load
	Power Factor	-0.99- +0.99, At nominal power
	Adjustable Reactive Power Range	-100%-100%
	Overvoltage Category (OVC)	III
	Rated Conditional Short-circuit Current (A)	10k
AC off-grid output	Nominal AC Voltage Ur (V)	3L/N/PE, 400/230
	AC Voltage Tolerance	AC 400V ± 3%
	AC Rated Input/Output Apparent Power (kVA)	125
	Max. AC Input/Output Current (A)	198
	Harmonic THDu	≤ 3%, Linear load
	DC Voltage Component	<0.5%, Linear load
	Unbalance Load Capacity	100%
	Nominal Frequency/Frequency (Hz)	50/60
System	Type of Inverter	Non-isolated
	Ingress Protection (IP)	IP20
	Operating Temperature Range (°C)	-30-55 °C (> 50 derating)
	Max. Operating Altitude (m)	4000 (> 2000 derating)
	Enclosure Dimensions (W × D × H, mm)	520 × 680 × 240
	Weight (kg)	≤ 70

3.2.3.2 Front and Rear Interface Panel of the PCS



No.	Items	Description
1	DC wiring port	Connect the DC cables from Battery String [D+] to PCS [D+], Battery String [D-] to PCS [D-].
2	AC wiring port	Connect the cables from AC side to the A, B, C, N phases of the PCS, ensuring correct phase sequence.
3/4/5	Grounding points	Choose one of the points for grounding connection.

3.2.3.3 LED Indicators



Description of LED indicators

No.	Display Color	Description
1	 Yellow LED Indicator	Power indication: it will stay on when DC input is above 60V.
2	 Red LED Indicator	Alarm indication: it will stay on when there is a fault in the module.
3	 Green LED Indicator	Operation indication: it will flash during standby/shutdown, and stay on when the module is running.

3.2.4 UPS (SP1K W)

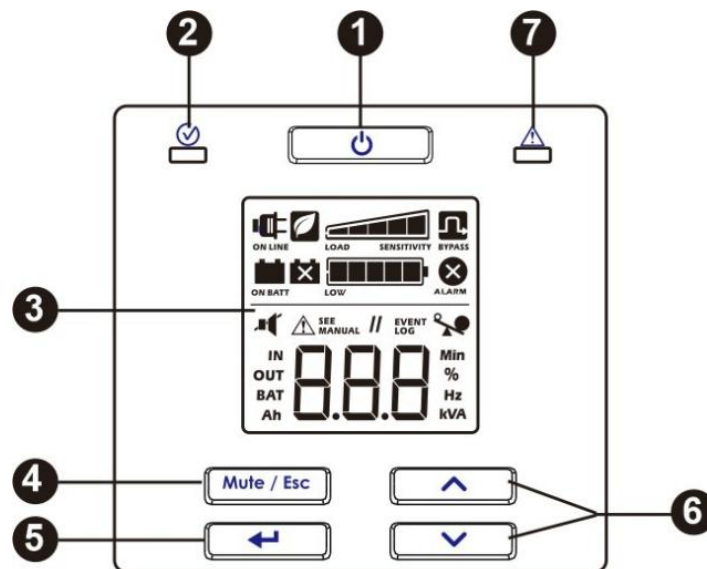
3.2.4.1 Specifications of the UPS

Model	SP1K-W
Input parameter	
Voltage Range	220 Vac
Frequency Range	40Hz ~ 70 Hz
Input Voltage Range (100% load)	160 Vac – 280 Vac
Input Voltage Range (50% load)	110 Vac – 300Vac
Input Power Factor (100% resistive load)	≥ 0.99 - Green mode ≥ 0.95 - Normal mode
Input Protection	Input circuit breaker
Output Parameter	
UPS Capacity	1000 VA / 800 W
Output Voltage	220 Vac
Other Programmable Voltages	230 Vac、 240 Vac
Efficiency at Rated Load	Up to 88%
Voltage Regulation	± 1% static
Output Voltage Distortion	• Max. 3% at full linear load • Max. 6% at full RCD load (100% VA, 0.8 PF) • 15% during last 60 seconds of backup time (full load, internal battery only)
Frequency – Battery Mode	50 Hz ± 0.5% or 60 Hz ± 0.5%
Frequency – AC Mode	50 Hz ± 3 Hz or 60 Hz ± 3 Hz
Crest Factor	3:1
Waveform	Sine wave

Model	SP1K-W
Output Connection	Refer to rear panel functions
Bypass	Internal bypass

3.2.4.2 UPS Panel Interface

UPS Front Panel Display



①	UPS Power On/Off Button	- Long press this button until you hear a beep, then release it immediately to turn ON the UPS. - Long press this button until you hear a beep, then release it immediately to turn OFF the UPS. - Press this button to reset the alarm.
②	status LED	- The status LED lights up green when the power is on. This LED indicates two different output power states: - Output OFF: LED flashes. Press the Power On/Off button to turn on the output power. - ON: LED lights solid green.
③	LCD Display	The display screen options can be viewed on this LCD. If the display is not lit, press the Up or Down button (⑥) to activate the LCD. (Refer to the table below for LCD display icons.)

④	Silent/Esc Button	- Temporarily acknowledges and mutes the audible alarm. - Exits the submenu and returns to the main menu.
⑤	Enter Button	Press this button to enter the menu or to select a menu item/value during navigation.
⑥	Up/Down Buttons	Press these buttons to scroll through the main menu options and display screens.
⑦	Alarm LED	This alarm LED lights up red when the UPS detects an error and flashes red to notify the user. For details, please refer to the UPS manual.

LCD Display Icons

	ON LINE: The UPS is connected to mains power and performing double conversion to supply power to connected equipment.
	ON BATT: The UPS is supplying battery backup power to connected equipment.
	Replace Battery: The battery is not securely connected or its service life is nearing the end; it should be replaced.
	Bypass: The UPS is in bypass mode, directly transmitting mains power to connected equipment. Bypass mode operation results from an internal UPS event or overload condition. Battery operation is not available while the UPS is in bypass mode. For details, please refer to the UPS manual. When this icon appears together with the Green Mode icon, it indicates the UPS is operating in Green Mode.
	Alarm: An internal fault has been detected. For details, please refer to the UPS manual.
	Overload: The power consumed by connected equipment exceeds the UPS rated capacity.
	Battery Charging Displays the battery charge level. When all five bars are lit, the UPS is fully charged. Each bar represents approximately 20% battery charge.
	Load Level Displays the load percentage. Each bar represents approximately 20% of the maximum load capacity.

	Mute If the line across the icon is lit, the audible alarm is disabled.
	Green Mode Energy-saving operating mode. When the input voltage and frequency are within configured limits, the UPS operates in energy-saving mode.
	Alarm or Notification the UPS has detected an error or is in configuration mode. For details, please refer to the UPS manual.
	Event This icon lights up when the user is viewing the event log.

3.2.5 Liquid Chiller

The thermal management control system consists of a battery compartment liquid cooling system (air-cooled liquid chiller and coolant circulation) and an electrical compartment air cooling system. Based on the temperature adaptability characteristics of the two compartments of the outdoor cabinet (the battery compartment, and the PCS & liquid chiller compartment), different methods are adopted for thermal management to achieve optimized management and energy saving.

3.2.5.1 Dehumidifier Design

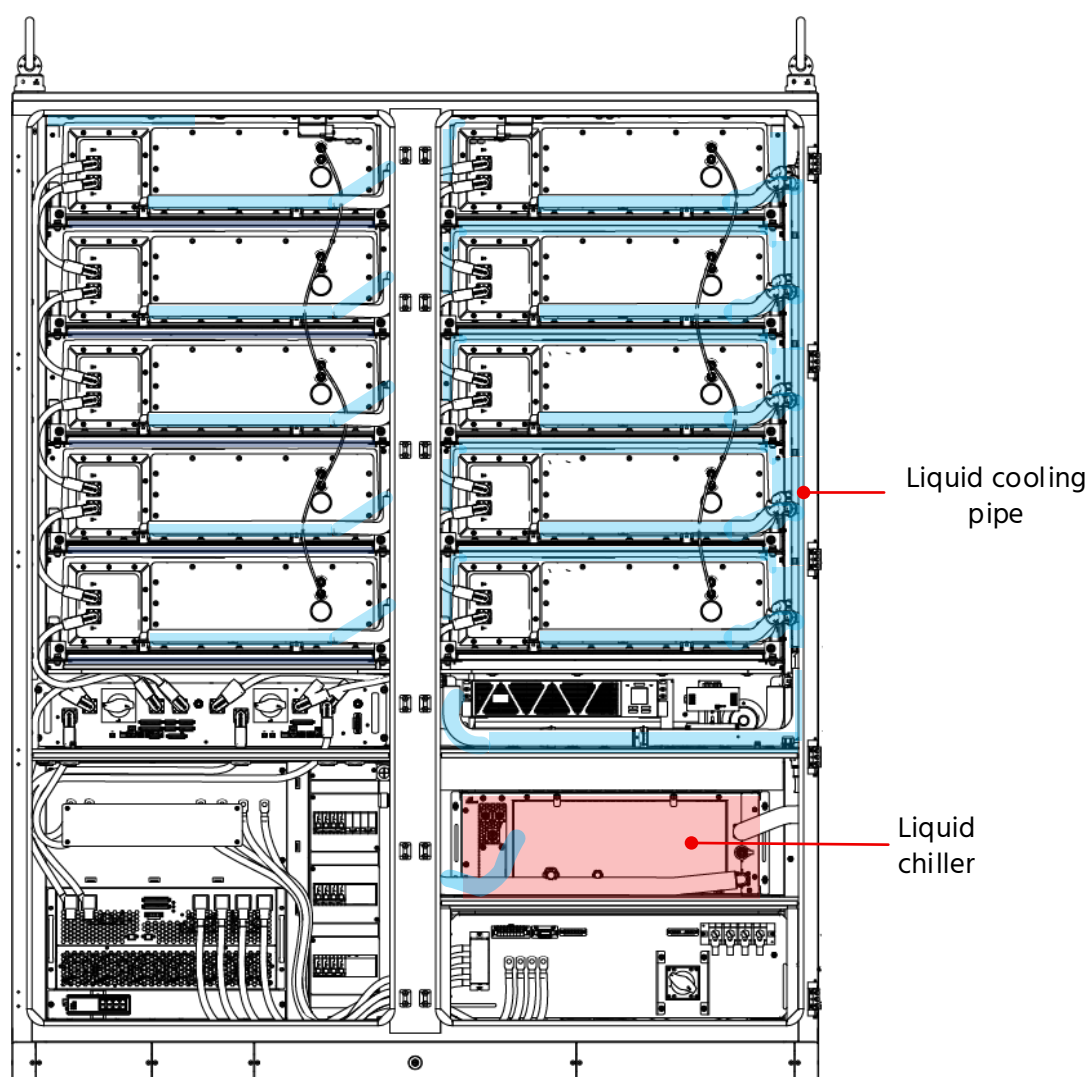
This product adopts semiconductor refrigeration dehumidification. It actively draws humid air from the enclosed space into the dehumidification air duct under the action of a fan. The water vapor in the air passes through the semiconductor refrigeration mechanism, condenses into water, and is then discharged out of the cabinet through a drain pipe, achieving good dehumidification effect.

3.2.5.2 Battery Compartment Liquid Cooling Design

The battery compartment mainly houses the battery modules and the battery control module. To ensure a suitable operating temperature within the battery compartment, the battery modules are cooled via the coolant circulation piping of the liquid chiller.

3.2.5.3 Electrical Compartment Cooling Design

The electrical compartment mainly houses the PCS and the liquid chiller. Since electrical equipment has a relatively wide operating temperature range and the PCS and liquid chiller are equipped with their own cooling fans, cooling vents are provided in this area for heat dissipation. The PCS compartment is also equipped with a cooling fan, which helps to exhaust heat out of the cabinet.

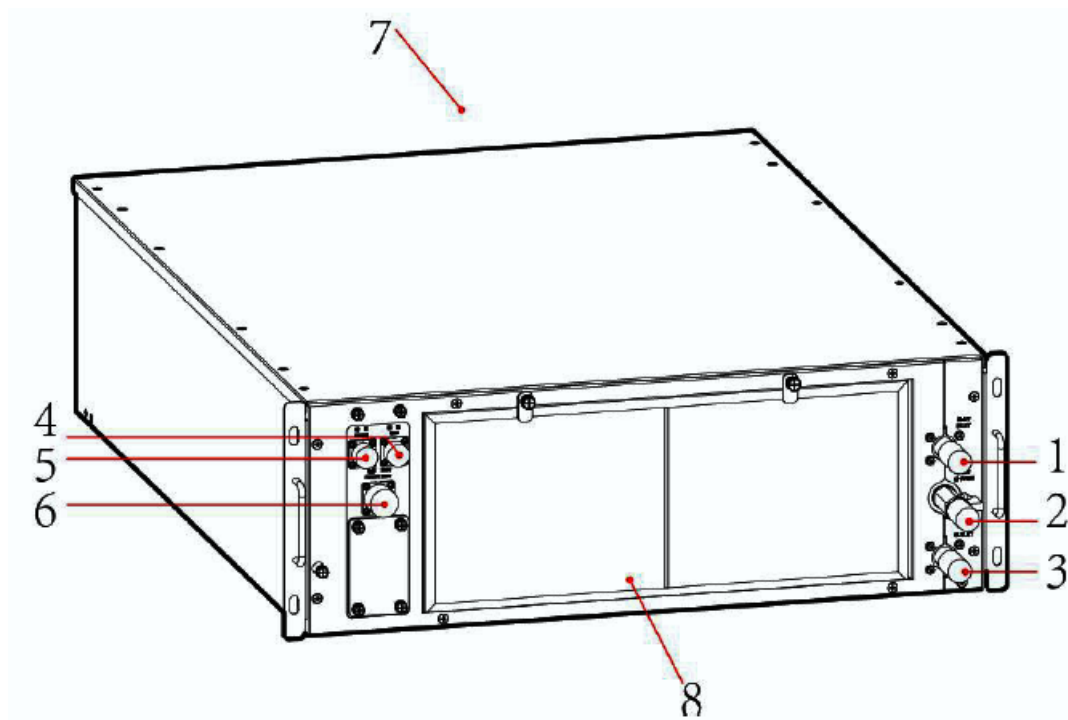


Liquid Chiller Specifications

Parameter	Specification
Operating voltage range	220V $\pm$ 15%, 50/60Hz $\pm$ 3Hz
Operating environment temperature range	-30°C - +55°C
Operating relative humidity range	5% - 95%
Storage environment temperature range	-40°C - +70°C
Storage environment relative humidity range	5% - 95%
Transport performance	Adapt to land, air and sea transportation, etc.
Working altitude	$\leq$ 1000m

Parameter	Specification
	The refrigerating capacity is derated when the altitude is above 1000m, and the refrigerating capacity will be derated by 5% for every 1000m increase. The highest application altitude is $\leq 4000\text{m}$
Unit size (W×D×H)	700mm×900mm×245mm (without flange)
Max. Flow(3kW/5kW)	30L/min/50L/min
IP level	IPX5 Note: meet IP55 application environment.
Inlet coolant temperature range	-30°C - 55°C
Outlet coolant temperature range	-5°C - 40°C
Allowable range of water pressure	0-1.6Mpa

Product Appearance



No.	Description	No.	Description
1	Coolant inlet	5	Debug interface
2	Coolant filling & drain port	6	Power interface
3	Coolant outlet	7	Air outlet
4	COM interface	8	Air inlet

 Note: For further details, please refer to the liquid chiller manual.

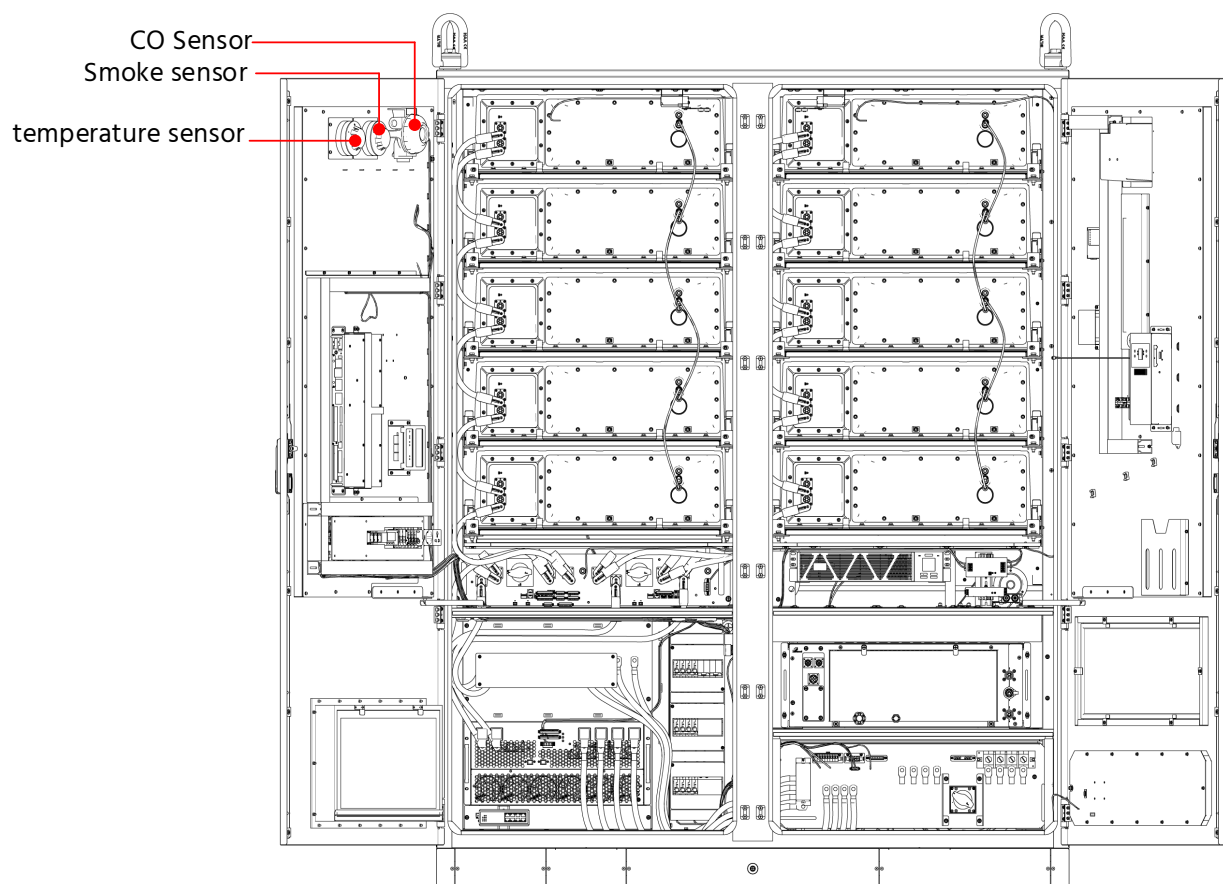
3.3 Safety Features (Fire Suppression System)

This system is equipped with safety features that include a fire protection system, an explosion proof ventilation system, and an explosion relief device.

The fire protection system is mainly composed of fire alarm system and fire suppression system. The former consists of detectors and audible visual alarm. The latter consists of a fixed aerosol fire-extinguishing device.

When a fire or other emergency occurs or the temperature reaches a certain point, aerosols will be released from the fire extinguisher to suppress the fire. At the same time, the fire alarm will sound until the system is powered off.

3.3.1 Fire Alarm System

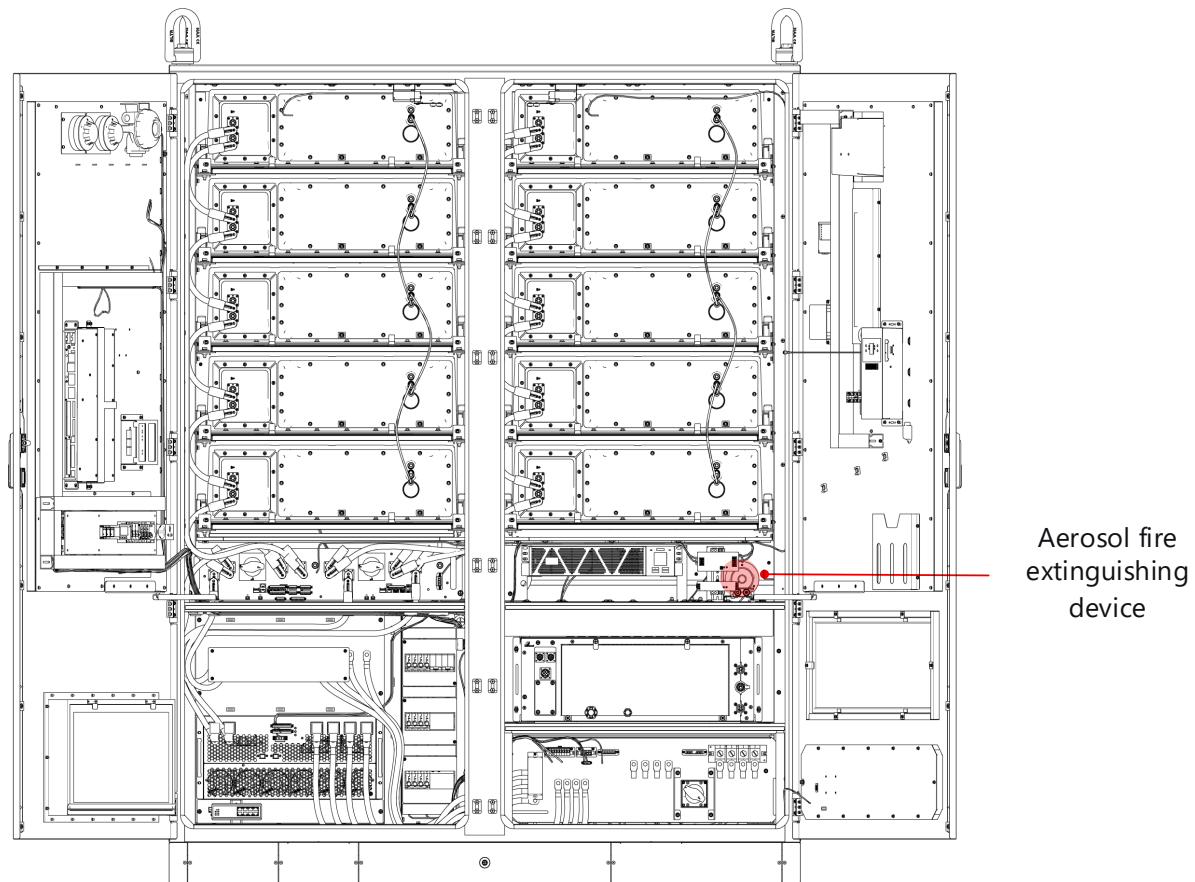


3.3.2 Fire Suppression System

The outdoor battery cabinet is equipped with an aerosol fire extinguishing solution. The fire extinguishing mechanism of aerosol is mainly reflected in two aspects:

- The cooling effect of endothermic decomposition.

- The chemical inhibition of the gas phase and the solid phase play a synergistic role between each other.



Specifications of Fixed Aerosol Fire-extinguishing Device

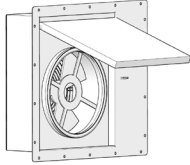
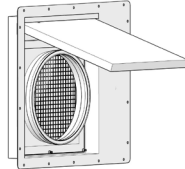
- Cooling effect through endothermic decomposition;
- Gas-phase and solid-phase chemical inhibition, working synergistically.

The outdoor cabinet is equipped with an aerosol fire extinguishing device system. The specifications are as follows:

Item	Parameter
Model & Specification	QRR0.5G-U03
Net Weight per Unit	3200g±150g
Operating Temperature Range	- 40°C ~ + 54°C
Dimensions	76mm(±1mm)×425mm (±3mm)
Activation Method	Electrical activation

Item	Parameter
Protection Space	8.34 m ³
Discharge Time	16 s (±5 s)
Device Finished Product Electrical Resistance	1.1 ± 0.2 Ω
Oxidizer Name and Content	Potassium Nitrate 59% – 69%
Electric Initiator Rated Current	2 A / 5 ms
Thermal Clearance Distances	0.15 m, 0.6 m, 1.5 m
Feedback	Passive dry contact signal (normally open, closed upon action)
Minimum Design Application Density:	- Class A: 97.5 g/m³ - Class B: 78 g/m³ - Class C: 78 g/m³ - Mixed Fuel: 97.5 g/m³
Shelf Life	15 years
Harness Outlet Length:	250 mm ± 30 mm

3.3.3 Fire Protection Device Interface Information

Fig.	Description and Icon	Fig.	Description and Icon
1	Smoke Detector 	4	Water suppression joint 
2	Gas Detector (CO) 	5	Exhaust Fan 
3	Aerosol 	6	Electric Ventilation Louver 

4 Mechanical Installation

4.1 Checking Before the Installation

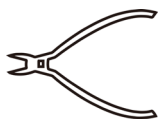
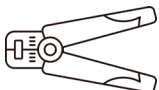
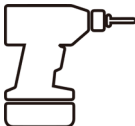
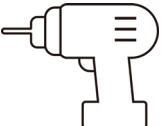
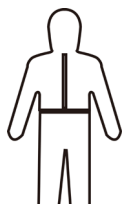
Checking the Outer Packing

After receiving the product, check the outer packing for damage, such as holes, cracks, deformation and so on. If any damage is found, contact us as soon as possible.

Checking Deliverables

After unpacking the product, check that the deliverables are complete. If any item is missing or damaged, contact us as soon as possible.

4.2 Preparing Tools and PPE

Tools					
					
Wire Cutter	Crimping Modular Plier	Adjustable Wrench	Wire Stripper	Torque Wrench	Screwdriver
					
Cable Tie	Socket Wrench set	Electric Drill	1000VDC Multimeter	Electric Screwdriver	
PPE (Personal protective equipment)					
					
Insulating Gloves	Anti-arc Flash Suit	Safety Shoes	Ear Protector	Safety Goggles	Anti-static Bracelets

NOTE

Use properly insulated tools to prevent accidental electric shock or short circuits. If insulated tools are not available, cover the entire exposed metal surfaces with available insulated alternatives, except their tips, with electrical tape.

4.3 Selecting the Installation Sites

4.3.1 Working Environment Requirements

The outdoor integrated cabinet has a protection rating of IP55, meeting the requirements for normal outdoor placement.

The standard product has a corrosion protection level of C3H. Therefore, care should be taken to keep it away from high salt spray, highly corrosive environments, as well as heat sources and flammable/explosive materials.

The following requirements must be met for installation:

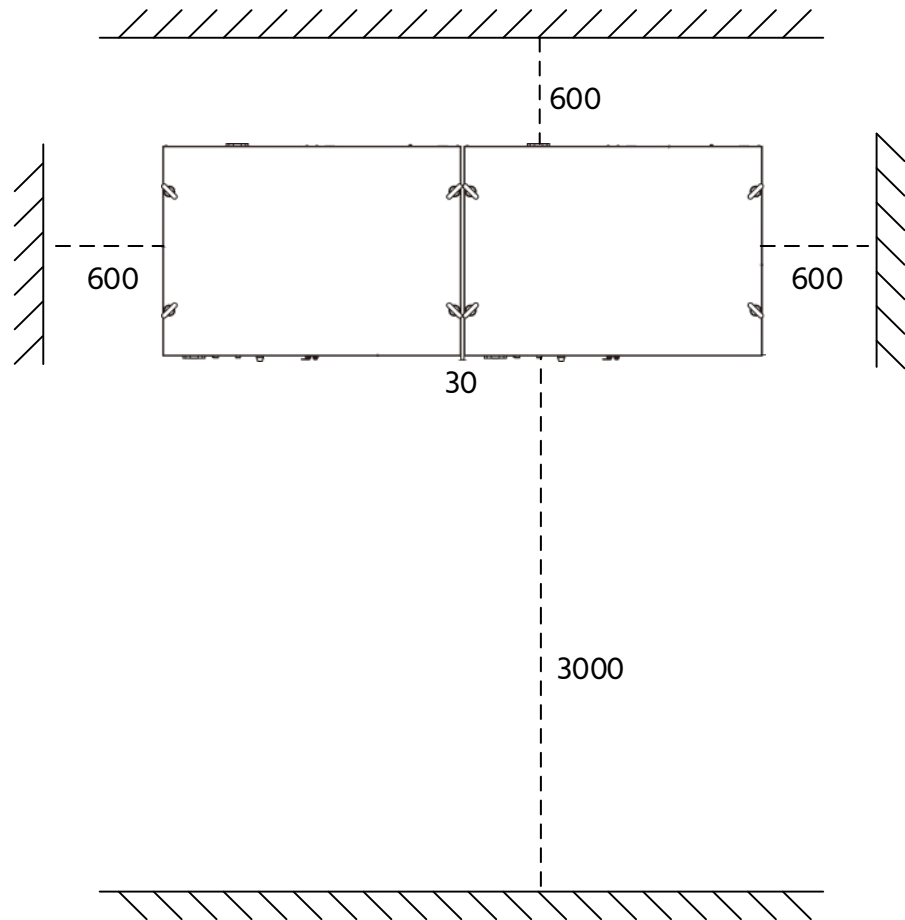
Be sure to keep the cabinet away from high salt spray, corrosive environment, away from heat source and flammable and explosive materials.

The installation environment should be as far away from the living area as possible. If there is a large flow of people around the installation site, it is recommended to install a fence.

The ambient temperature should be guaranteed between -25-55°C to ensure that the outdoor integrated cabinet can operate normally.

4.3.2 Installation Space Requirements

- The external dimensions of the energy storage system are 1900mm (W) x 1350mm (D) x 2480mm (H). The installation site must have sufficient space to accommodate the equipment.
- The installation space for a single cabinet system is shown in the figure below (recommended clearances). If site conditions permit, it is recommended to leave more space between the cabinet and surrounding equipment or walls to facilitate operation and maintenance.



Single-row arrangement (Unit: mm)

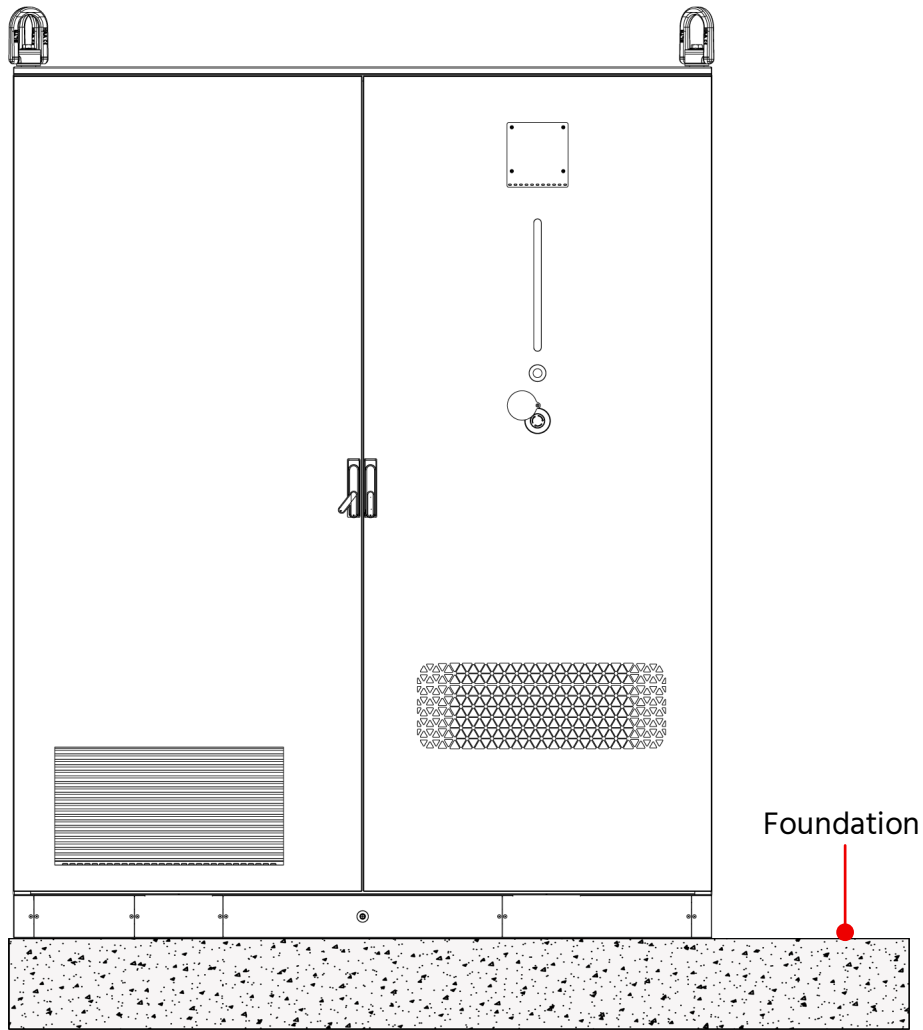
4.3.3 Installation Foundation Requirements

The installation site needs to meet the following requirements:

The installation foundation should be able to bear the total weight of the whole outdoor cabinet system (5300 kg).

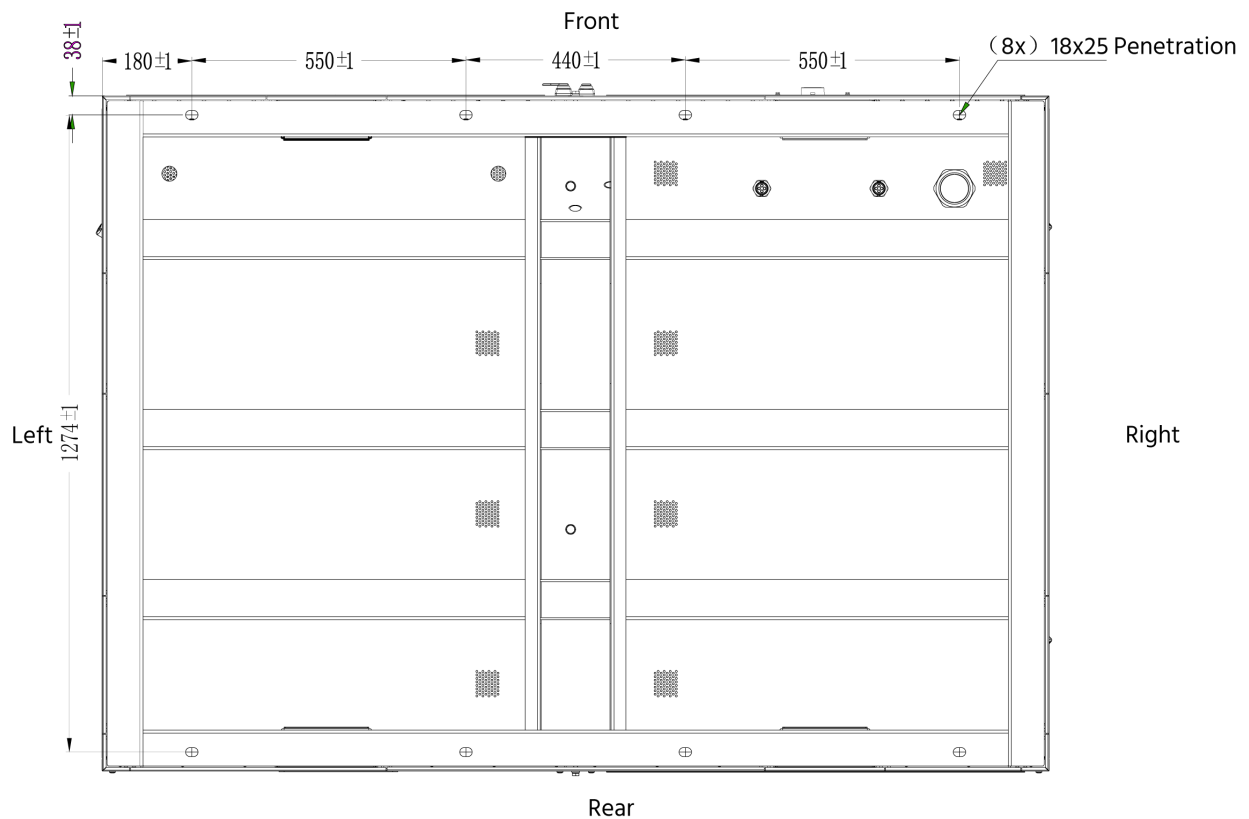
The installation foundation should be concrete or channel steel support structure, which should be flat, firm, safe and reliable. The installation foundation must meet the following height requirements, whichever is higher:

- above the highest water level in the history of the area
- at least 300mm above the level ground



NOTE

- The foundation must meet certain height requirements based on actual site conditions, and cable routing channels shall be reserved.
- The installation environment should be kept as far away from residential areas as possible. If the installation site has heavy foot traffic, it is recommended to install a fence.
- The cabinet shall be fixed at the bottom. Holes shall be pre-drilled in the foundation according to the bottom mounting holes (marked in red) of the energy storage system. The hole dimensions must match the mounting holes of the system cabinet. Refer to the figure below.



Positioning holes of the cabinet base (Unit: mm)

WARNING

The inlet and outlet holes in the lower part of the outdoor cabinet need to be sealed with fireproof mud after the cable is connected.

And the entire outdoor cabinet base needs to be sealed with fireproof mud, waterproof and insect-proof mud.

4.4 Handling of the Cabinet

The outdoor cabinet can be transported by crane or forklift.

DANGER

Pay attention to the falling risk which can cause severe injury or death. Do not stand under a lifted load. Make sure no unauthorized personnel are in the vicinity of a lifted load.

CAUTION

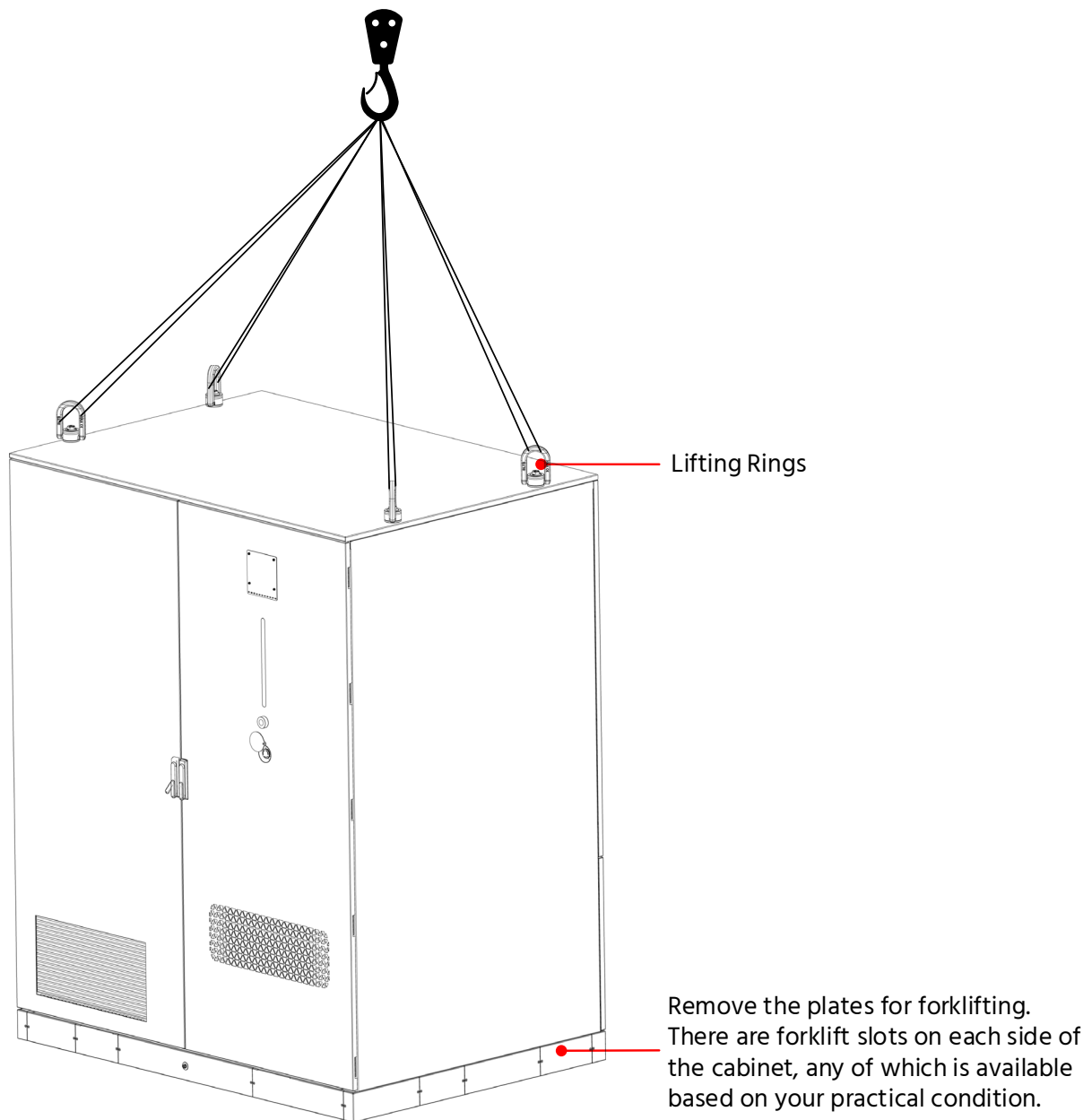
Pay attention to the center of gravity when lifting or forking the cabinet and keep the moving process slow, smooth and balanced.

During the moving process, the equipment should not be tilted at an angle of more than 5° and should not be suddenly lowered or lifted.

NOTE

During the transportation by forklift, the radial acceleration of the forklift cannot exceed 2.35m/s^2 . The lifting acceleration should be less than 1.4G and the sustained acceleration should be less than 1.2G .

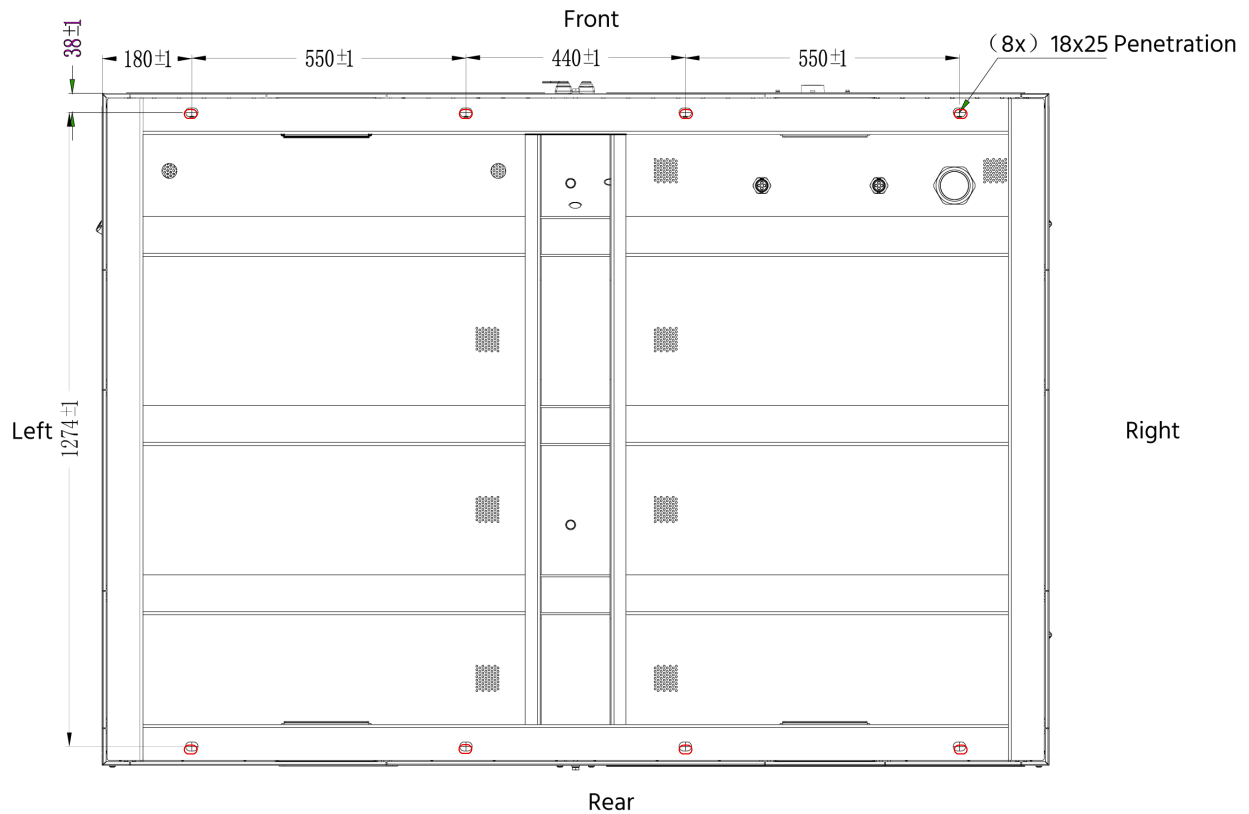
Positions of the lifting rings and forklift slots



4.5 Mechanical Installation Steps

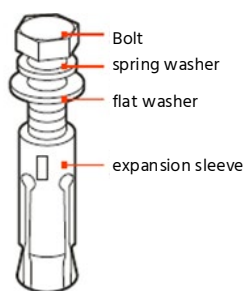
1. Before installation, make sure that the mounting dimensions of the foundation are consistent with the mounting holes of the cabinet bottom base, as shown in the figure below.

2. Use a crane or forklift to place the cabinet on the mounting foundation, aligning the 8 mounting holes.



Positioning Holes in the Mounting Foundation

3. Use M16 expansion bolts to secure the cabinet to the foundation (refer to the 8 mounting holes shown in the figure above). The expansion bolts are shown in the figure below.



1. Drill a hole in the mounting surface using a hammer drill.
2. Lightly tighten the expansion bolt, insert it vertically into the hole, and tap it with a rubber mallet until the expansion sleeve is completely seated in the hole.
3. Pre-tighten the expansion bolt.
4. Unscrew the bolt and remove the spring washer and flat washer.

 **Note:** If installing a single cabinet or multiple cabinets with sufficient operating space between them, the mounting holes on the left and right sides can be secured.

4. Apply anti-corrosion paint to protect the mounting bolts and prevent rusting during outdoor use.

5 Electrical and Communication Wiring

⚠ DANGER

This system is a high voltage AC system, operated by qualified and authorized person only.

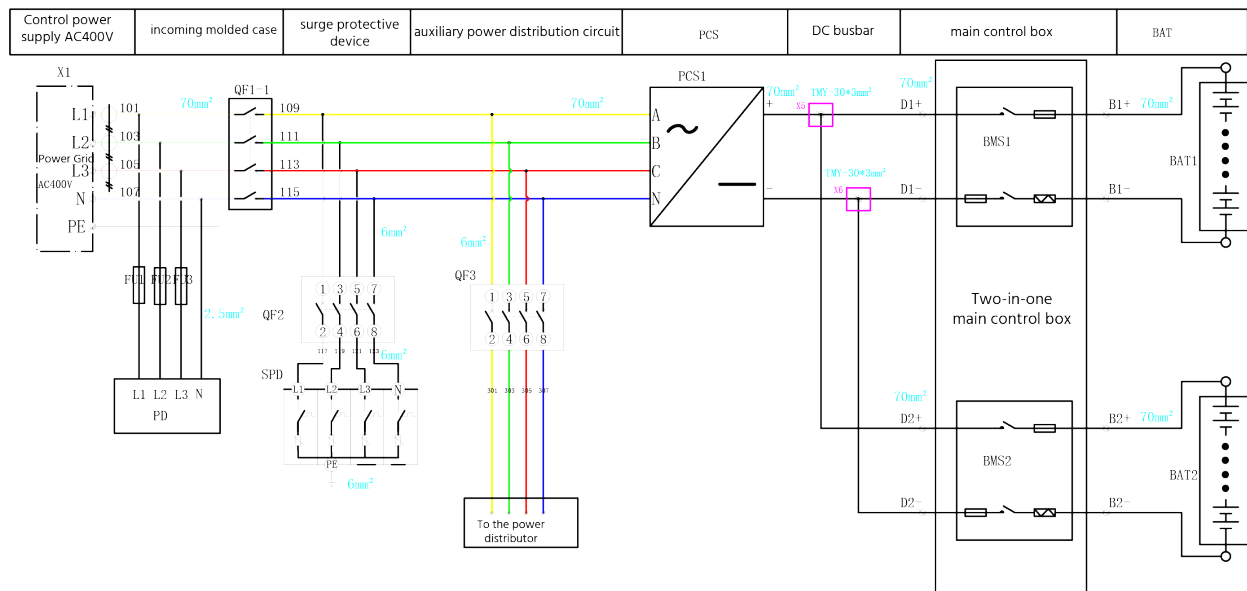
⚠ DANGER

Whenever operating the system, wear suitable personal protective equipment (PPE) such as rubber gloves, rubber boots and goggles.

⚠ DANGER

When wiring the cables, ensure that the energy storage system DC side and AC side are all disconnected.

5.1 System Electrical Schematic Diagram



5.2 Cables and Installation Requirements

Cable Requirements

The wire gauge used for the energy storage battery cabinet must be selected based on the maximum current on the AC side and DC side of the converter, and an appropriate margin must be reserved. When configuring the cables, users should follow the specifications below for selection:

Cable	Function	Diameter Requirements	Terminal hole diameter	Suggested Torque
AC side Phase L1 (1,2)	AC side wiring	1 core (single-core) 70~120mm ² bare copper wire	M10	20±1N•m
AC side Phase L2 (1,2)				
AC side Phase L3 (1,2)				
AC side Phase N (1,2)				
Ground PE-(1,2)Cable	Grounding	1 core (single-core) 35~50 mm ² bare copper wire	M6	5±0.5 N•m
Ground PE-galvanized flat iron	Grounding	4x 30 mm	M6	7±0.5 N•m
External Ethernet communication cable	1) Connection of site gateway and EMS; 2) Communication cable for parallel operation of multiple battery cabinets.	Ultra Category 5 shielded cable	\	\
External RS485 cable	Connection of anti-reverse power meter	Twisted shielded cable ≥ 1.5mm ²	M4/M3	1.5~2N.m/0.5N.m

● Bolt Torque

When fixing electrical cables, make sure that the cable terminals are completely tightened with the copper bars or terminal blocks to avoid heating or even fire of the cables caused by poor contact, and the following torque requirements should be met when the cables are connected.

Screw Size	Screw Material	Screw Strength	Suggested Torque ±10%
M5	Carbon Steel / Stainless Steel A2-70	8.8	3.5
M6			5
M8			12
M10			20

Screw Size	Screw Material	Screw Strength	Suggested Torque ±10%
M12			35.5
M16			88

NOTE

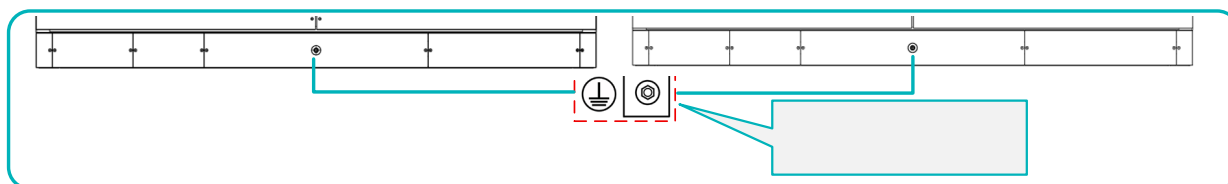
This torque value is for general reference. Follow the specific torque requirements for designated wiring positions stated in other sections if available; otherwise, comply with the requirements here.

5.3 Grounding

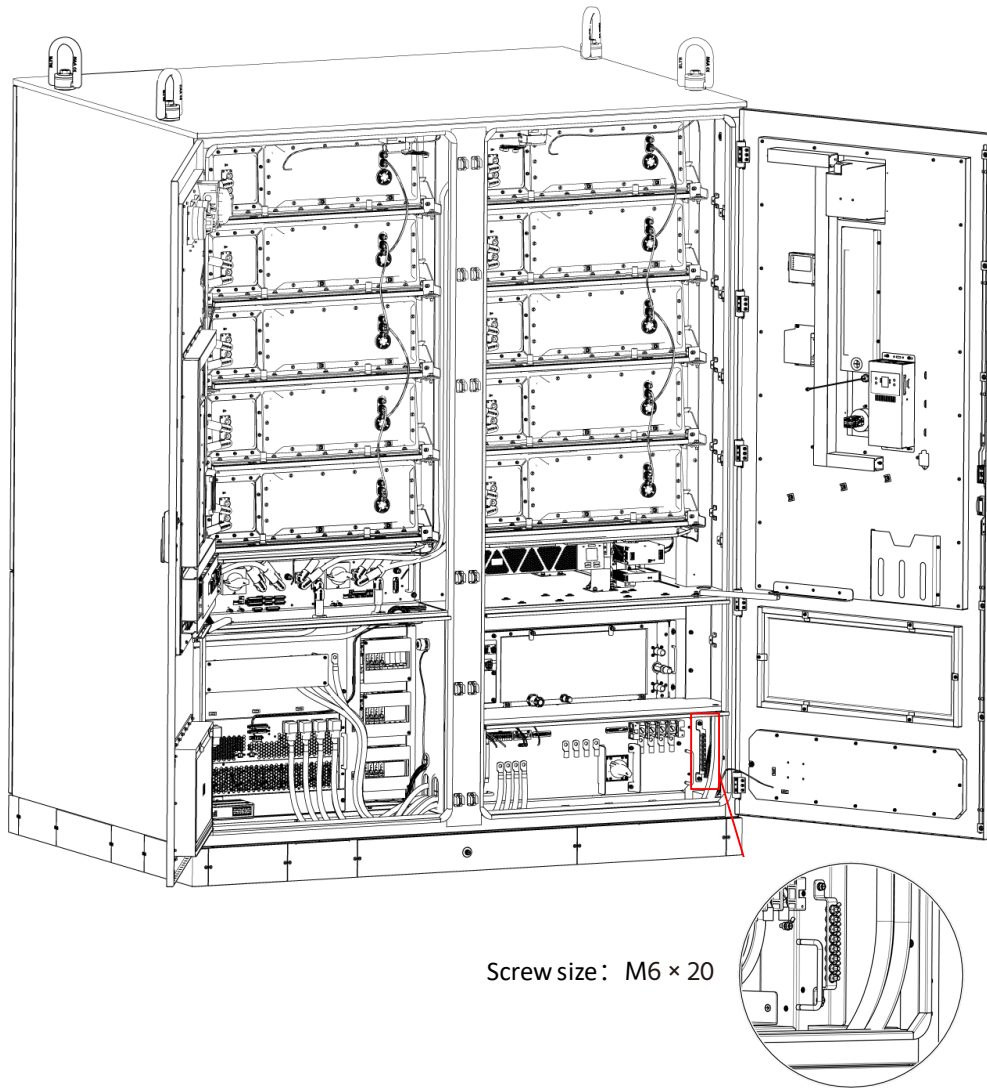
DANGER

Life-threatening electric shock may occur if the grounding is insufficient or absent. Before installation, make sure that the grounding points of the battery energy storage system are stable and reliable.

- PE (to the ground): There is one grounding point at the rear of the cabinet base.



- Grounding copper busbar (inside the cabinet): used for connecting grounding cables.



5.4 Battery Energy Storage System Connection

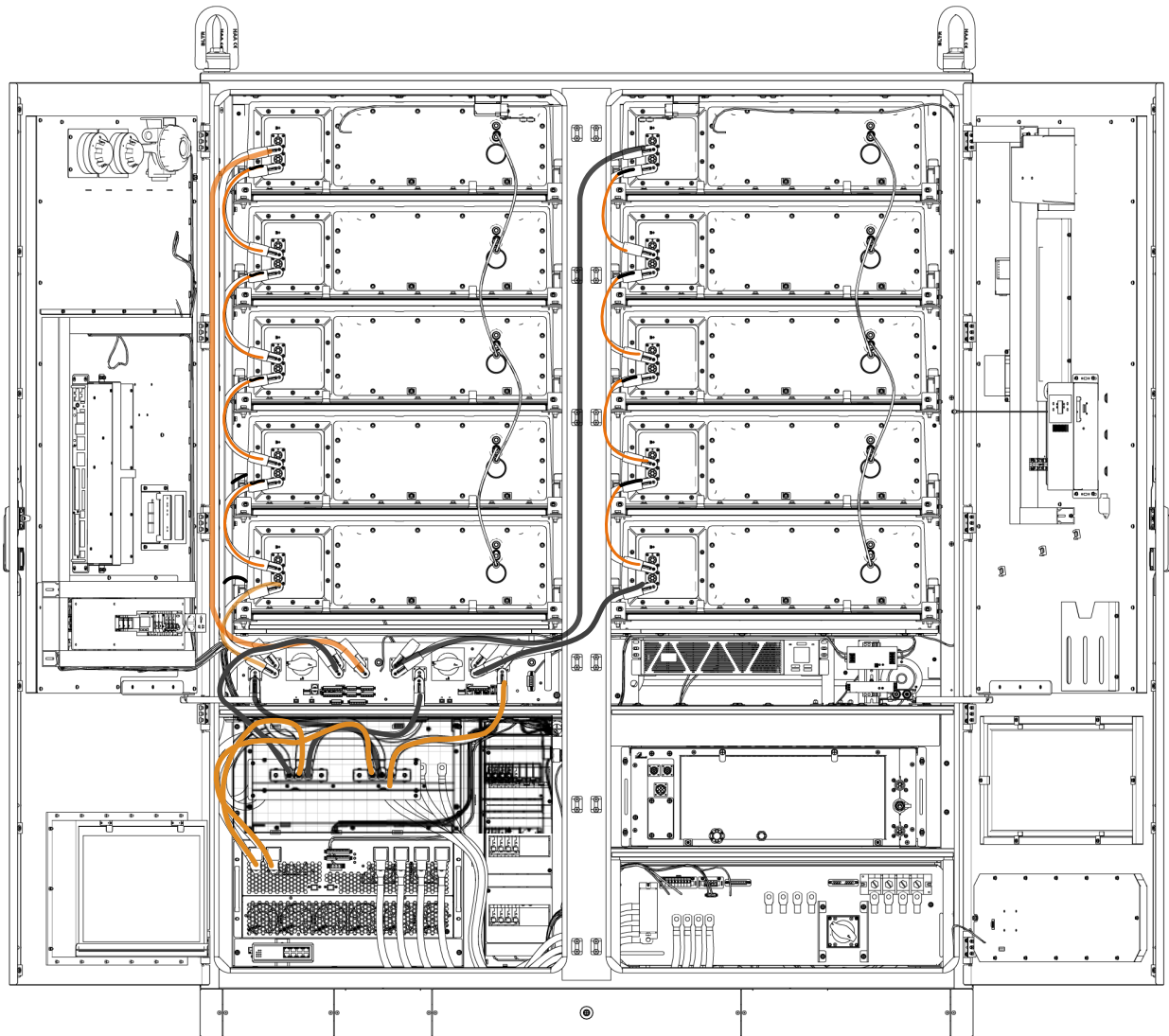


Do not connect the positive and negative reversely.

- (1) Connect the positive and negative electrodes of the battery modules in series.
- (2) Connect the internal and external communication cables of the battery string

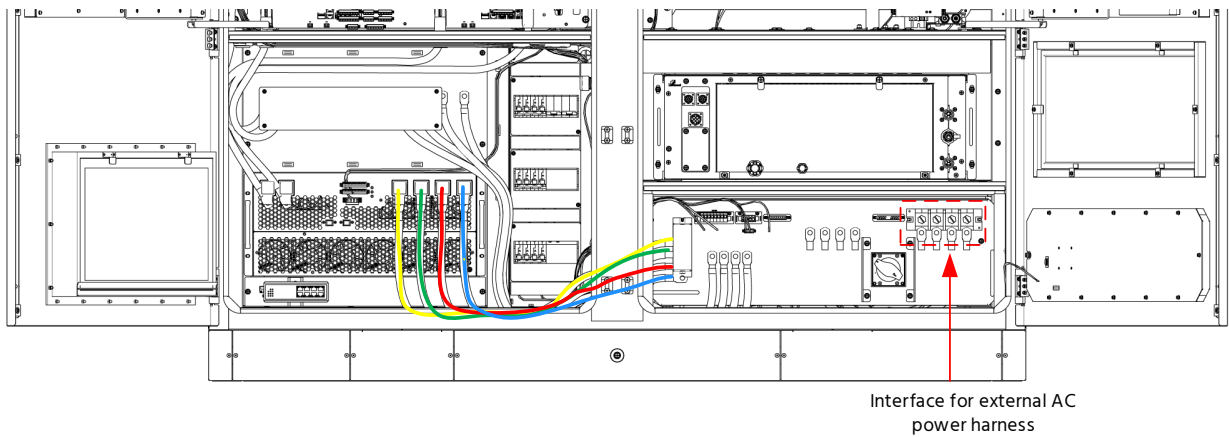
5.4.1 Battery String DC Wiring

For the battery string system, the DC wiring should be done according to the drawing below.



5.5 AC Side Cable Wiring

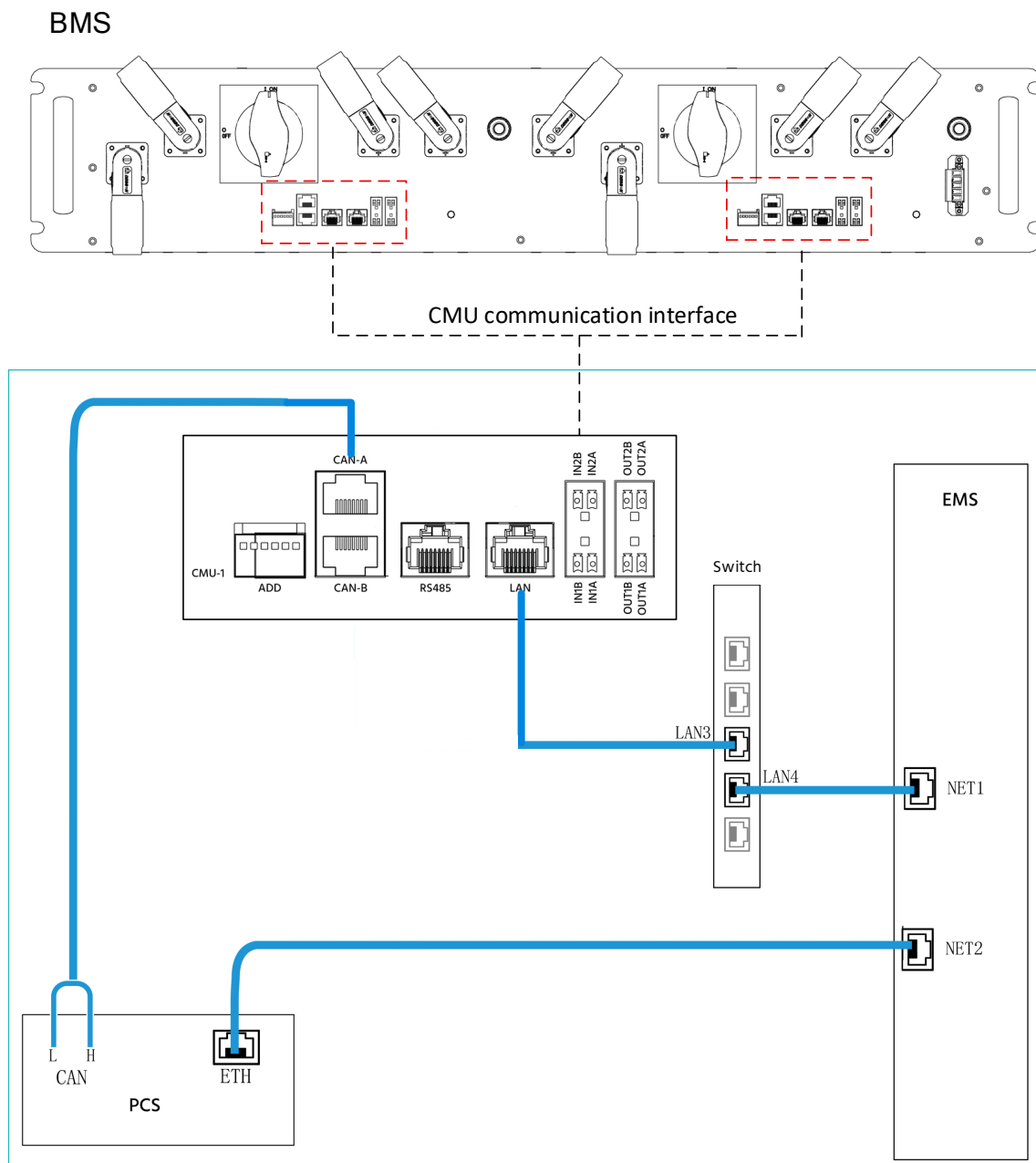
1. Remove the rubber plug from the opening at the bottom plate.
2. Feed the cables from AC Grid through the pre-opened hole at the bottom and connect to the cable inlet terminal.



3. According to the labeling, connect the cables of each phase sequence in turn, three opposite sequences are not allowed.
4. Finish wiring and ensure that all connections are correct, and there is no overlap and no stress between the wires and sheet metal.
5. After finishing wiring, make sure that all the cable inlets and outlets are sealed with suitable material to ensure fireproof, waterproof and insect-proof.

5.6 Communication Wiring Diagram

5.6.1 System Electrical Diagram



5.6.2 Definitions of LEMS Ports

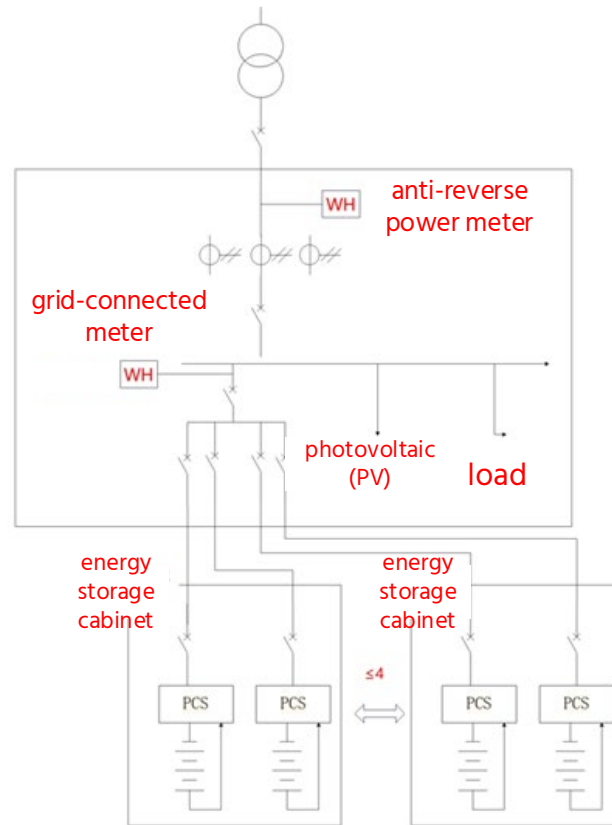
Port	Silk-screen	Definition
LAN	LAN1	Reserved
	LAN2	Reserved
	LAN3	PCS
	LAN4	CMU-1
	LAN5	CMU-2
RS485	RS485-1	Dehumidifier
	RS485-2	Light panel
	RS485-3	Meter Inside Cabinet
	RS485-4	CO Combustible Gas Detector
	RS485-5	Anti-reverse power meter
	RS485-6	External metering meter
RS232	RS232-1/RS232-2	Reserved
CAN	CAN-1	Reserved
	CAN-2	PCS
	CAN-3	5kW liquid chiller
DI	DI-01	Emergency Power Off signal (EPO)
	DI-02	Temperature Sensor Feedback Status
	DI-03	Smoke sensor feedback status
	DI-04	Fire extinguishing agent release signal
	DI-06	Main Circuit AC Switch Status
	DI-09	Product hazardous area door open status
	DI-10	Main circuit SPD1
	DI-12	AC combiner cabinet fan fault
	DI-05, DI-07, DI-08, DI-11, DI-13~DI-16	Reserved
DO	DO-01	Reserved
	DO-02	Reserved
	DO-03	Main circuit AC switch open control
	DO-04	Explosion-proof exhaust fan electric louver open control
	DO-05	Reserved
	DO-06	PCS Fan Control
	DO-07	Reserved
	DO-08	Comprehensive fault alarm to PCS

5.7 Multiple System Parallel Cabinet Connection

This product supports parallel connection of multiple systems (up to 8 energy storage power systems can be connected in parallel).

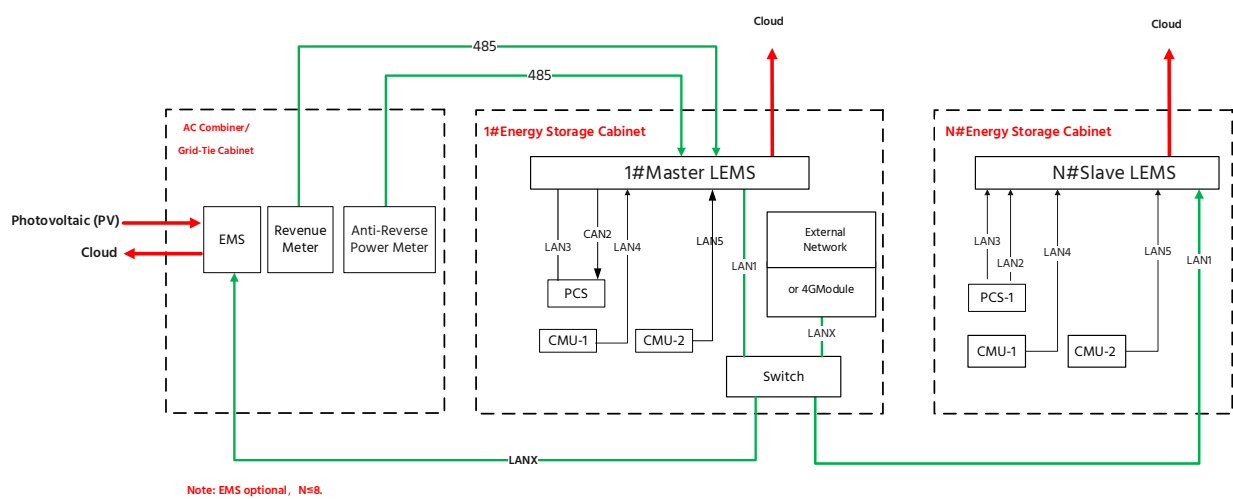
5.7.1 Power Cable Wiring

The power cable wiring schematic diagram for multiple system parallel cabinet connection is as follows:



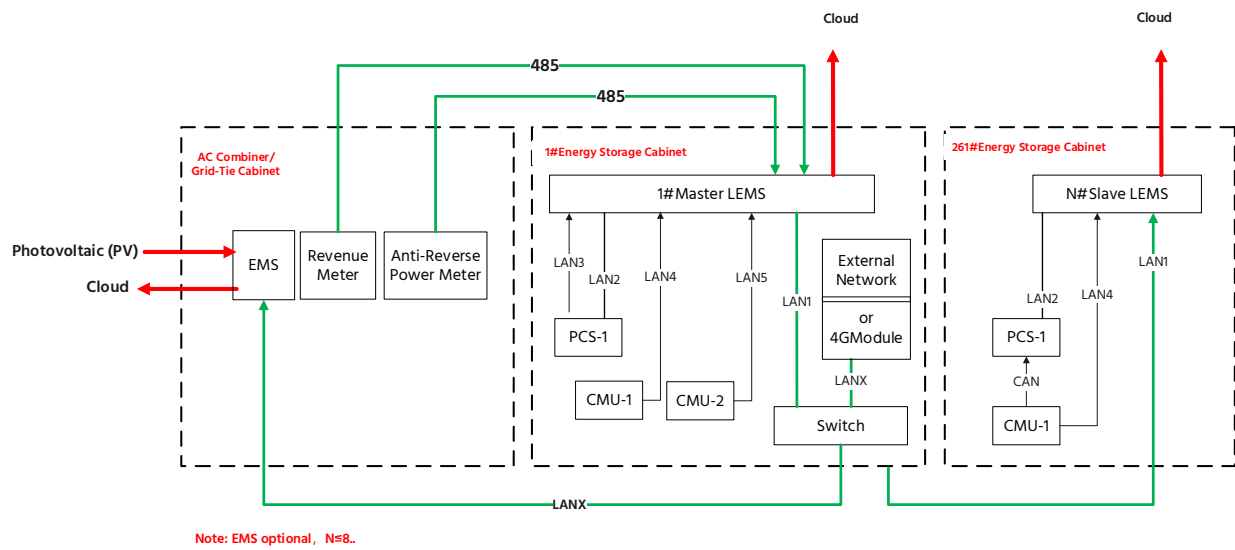
5.7.2 Communication Cable Wiring

125kW/522kWh*N+ External Network/4GModule



125kW/522kWh*N+125kW/261kWh*M+ External Network/4Gmodule

When the 125kW/522kWh and 125kW/261kWh systems are used together, the LAN port configuration of the 125kW/261kWh system needs to be changed as shown in the figure below.



6 Commissioning

6.1 System Operating Status

This system has two states: Running and Fault.

6.1.1 Running

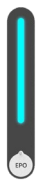
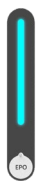
When the operating conditions are met, the system can enter the running mode from standby mode, and the "Running" indicator light will illuminate. When the system receives a shutdown command, it will switch from running mode to standby mode, and the "Running" indicator light will turn off.

Grid-connected and Off-grid Operation:

When the system is operating in grid-connected (or off-grid) mode, it can charge and discharge. This system does not have automatic grid-connected/off-grid functionality. It is necessary to manually check the grid status at the grid-connection point and follow the instructions in the "Grid-connected/Off-grid Manual" to achieve off-grid operation.

6.1.2 Fault

The battery cabinet system status can be viewed through the Status LED.

Equipment Status	Light Color	Dynamic Effect	Descriptions
Power-on Self-test	Colorful	Upward running light (from bottom to top)	
Charging	Pylon Blue 	Steady on (SOC) + Running light (from bottom to top)	SOC:10%~100%
Discharging	Pylon Blue 	Steady on (SOC) + Running light (from top to bottom)	SOC:10%~100%
Low Battery	Red	Slow blink: off 5s, on 2s	$SOC \leq 10\%$

Equipment Status	Light Color	Dynamic Effect	Descriptions
			
Shutdown	Off 		
Standby	Pylon Blue 	Steady on	10%~100%
Warning	Warning Yellow 	Fast blink: off 2s, on 1s	² System fault code: Level 2 warning status; or Battery string/Battery pack fault code: Level 2 warning status;
Fault	Red 	Steady on	² System fault code: Level 0, 1 warning status; or Battery string/Battery pack fault code: Level 0, 1 warning status.

6.2 Pre-Operation Inspection

To ensure the safe operation of the equipment, after all installation and wiring are completed, the following checks must be performed:

- Check whether the equipment installation environment meets the requirements.
- Check whether the installation clearance is sufficient to allow normal maintenance of the equipment.
- Check whether the equipment is securely fixed to the installation ground.

- Check whether the cable connections are correct, whether the positive and negative terminals on the DC side are connected properly, and whether the phase sequence of U, V, W on the AC side is correct.
- Check whether the connection points of each cable are secure.
- Check whether any cables are excessively bent or under excessive strain.
- Check whether there is any risk of crimping or scraping between any cables and sheet metal parts.

6.3 System Turning On

WARNING

Double check all the power cables and communication cables. Ensure that the voltage of the PCS matches the voltage of the battery system. Check to make sure that all the power switches are OFF.

WARNING

The switches or breakers between PCS and battery string must be off before the battery system power on. Make sure that all micro circuit breakers in the cabinet are off.

Fire Protection System Prerequisites

CAUTION

Before turning on the system, be sure to do the following:

- 1) Pull out the safety ring and pin on the fixed aerosol fire-extinguishing device.
- 2) Remove the plastic cover from each detector.

Steps

1. First close the circuit breakers QF1-1 and QF2-1 of the main control box.
2. Close the AC main circuit breaker QF1-1、 QF2-1.
3. Close the QF1-1、 QF2-1 backup protection switch to activate the lightning protection system.
4. Close the QF3 switch to power the distribution circuit.
5. Close the QF4 switch to start the liquid cooling unit.
6. Close the QF5 switch to start the dehumidifier and the PCS cooling fan.
7. Close the QF6 switch to supply power to the XS maintenance socket.
8. Close the QF7 switch to supply power to the UPS. Press and hold the power button on the UPS panel, then release it immediately upon hearing a beep. Press and hold for 1 second to start the UPS.
9. Close the QF8 switch to supply power to the low-voltage side of the system (such as the fire

protection system, BMS low-voltage system, etc.).

10. The outdoor integrated cabinet startup is complete. Parameters can be set on the cloud interface.

7 Maintenance

DANGER

This system is a high voltage AC system, operated by qualified and authorized person only.

DANGER

Maintenance personnel must wear suitable personal protective equipment (PPE) such as rubber gloves, rubber boots and goggles.

NOTE

Before maintenance or long-term storage, ensure to turn the system off.

WARNING

- - To perform maintenance safely and successfully, be sure to comply with relevant safety requirements. Qualified tools and test equipment must be used, and qualified maintenance personnel must be involved. It is recommended to have two or more persons.
- - Before performing maintenance operations, all AC and DC switches must be disconnected. Turn off the UPS power supply.
- - If maintenance is required after shutdown, wait at least 10 minutes before carrying out the corresponding inspection and repair operations.

 Note: Before system maintenance or long-term storage, ensure that the system is turned off.

7.1 System Turning Off

Turning-off Procedure

WARNING

Under normal operating conditions, do not turn off the circuit breaker of the high-voltage box (unless in an emergency, as this may cause a current surge to other battery clusters). If the circuit breaker must be turned off under normal operating conditions, the PCS must be turned off first.

1. Check whether the outdoor integrated cabinet has power input or output, i.e., ensure that the PCS is in standby mode and the AC and DC currents are 0 A.
2. Disconnect the main control circuit breakers QF1-1 and QF2-1 to cut off the battery.
3. Disconnect the QF8/QF7/QF6/QF5/QF4/QF3 switches in sequence to disconnect the system auxiliary power supply circuit, cutting off power to the BMS, EMS, local fire protection, etc.
4. Disconnect the main control circuit breaker to cut off the external circuit of the battery.

5. Disconnect the QF1-1, QF2-1 backup protection switch to deactivate the lightning protection system.
6. Disconnect the main control circuit breaker to cut off the external circuit of the battery.
7. Press the power button on the UPS panel, then release it immediately upon hearing a beep. Press and hold for 1 second to shut down the UPS.
8. The outdoor integrated cabinet shutdown is complete.

WARNING

After shutdown, wait at least 10 minutes before powering on again to ensure that the internal capacitors are fully discharged before performing any further operations on the product.

7.2 Safety Precautions

- When performing maintenance or inspection on the energy storage system, the following safety requirements must be observed to ensure the safety of personnel:
- Check whether the grounding wire is normal; if any abnormality is found, perform necessary grounding connections.
- During maintenance, all external connections to the energy storage system, as well as the connection to the internal power supply of the equipment, must be disconnected.
- Ensure that the energy storage system cannot be accidentally powered on or started during maintenance.
- Use a multimeter to measure and confirm that both the AC and DC sides inside the energy storage system are completely de-energized.
- Maintenance tools used must be properly insulated.
- Do not disassemble internal components without authorization.
- After maintenance, count the tools to ensure no tools are left inside the cabinet; if in doubt, contact Pylontech personnel promptly.

7.3 Routine Maintenance

Recommended Schedule of Routine Maintenance Table

Inspection Content	Inspection method	Maintenance Intervals
System operation status and environment	(1) Observe the appearance of the energy storage system for damage or deformation. (2) Check whether there is any abnormal sound in the operation of the energy storage system. (3) Check whether the parameters are correct during	Every 6 months.

Inspection Content	Inspection method	Maintenance Intervals
	system operation. (4) Check whether the main devices are normal. (5) Check whether the humidity and dust in the environment around the energy storage system, and all air inlet filters are functioning properly.	
System cleanliness	(1) Check the cleanliness of the components. (2) If necessary, a compressed air machine must be used to clean the system.  NOTE The system must be powered off when cleaning dust.	Every 6 months to 1 year (depending on the dust content of the environment in which it is used).
Power circuit connection check	(1) Check power cable connections for looseness and retighten to the torque specified above. (2) Check power cables and control cables for damage, especially cut marks on the skin in contact with metal surfaces. (3) Check that the insulating wraps of the power cable terminals are not detached.	Officially run for six months, then every six months to one year thereafter.
Terminal and wiring connection check	(1) Check whether the control terminal screws are loose and tighten them with a screwdriver. (2) Check whether there is any color change in the wiring, copper or screws. (3) Visually inspect the connections such as equipment terminals and the distribution of wiring. (4) Check the main circuit terminals for poor contact and screw locations for signs of overheating.	Officially run for six months, then every six months to one year thereafter.
Circuit breaker maintenance	(1) Routine inspection of all metal components for corrosion. (2) Annual inspection of contactors (auxiliary switches and micro-switches) to ensure that they are in good mechanical working order. (3) Check the operating parameters (especially voltage and insulation).	Officially run for six months, then every six months to one year thereafter.
Battery maintenance	(1) Perform normal charging and discharging operations on the battery system to check whether there are any abnormalities in the operating status of the battery, and to check whether the battery system indicator status is normal.	Every 6 months to 1 year

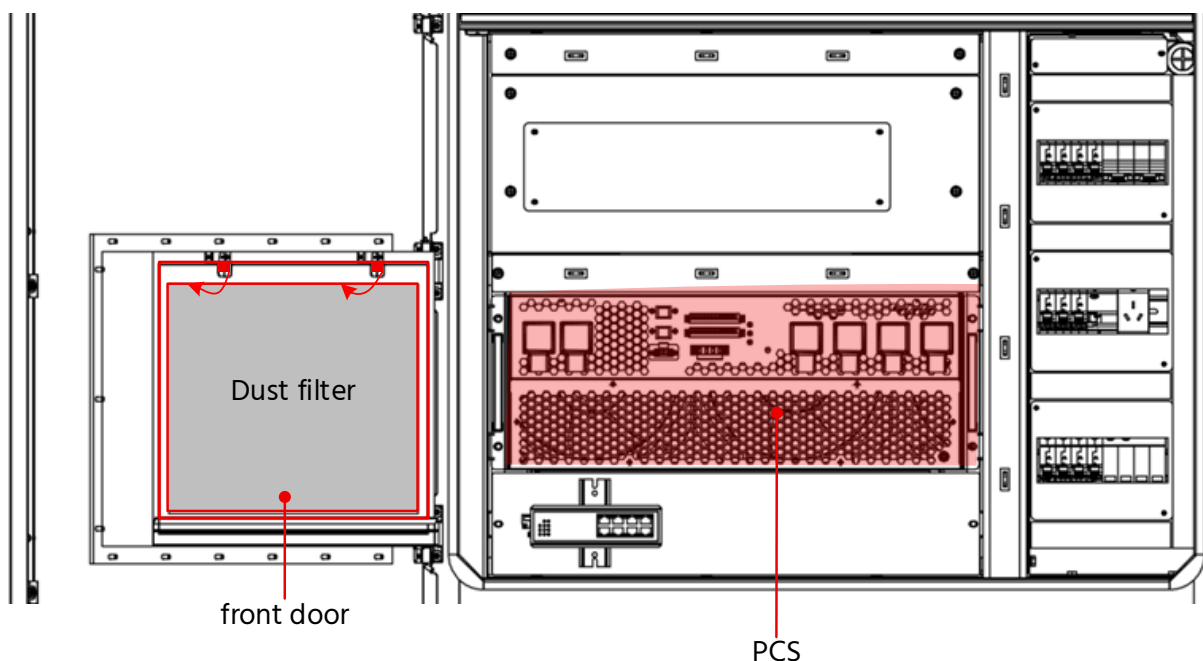
Inspection Content	Inspection method	Maintenance Intervals
	(2) It is recommended that the battery be fully charged and equalized on a regular basis.	
Aerosol fire extinguisher inspection	When the fire extinguishing equipment is in normal working condition, it is necessary to check the starting device (JR10 starter box, etc.) to make sure that the line is normal. The fire extinguishing equipment is maintenance-free for its own validity period.	Officially run for six months, then every six months to one year thereafter.
Safety Functions	(1) Check the stop function of the emergency stop button. (2) Simulate a shutdown and check shutdown signal communication. (3) Check the body warning signs and other equipment markings and replace them if they are found to be blurred or damaged.	Officially run for six months, then every year thereafter.

7.4 Maintenance Items

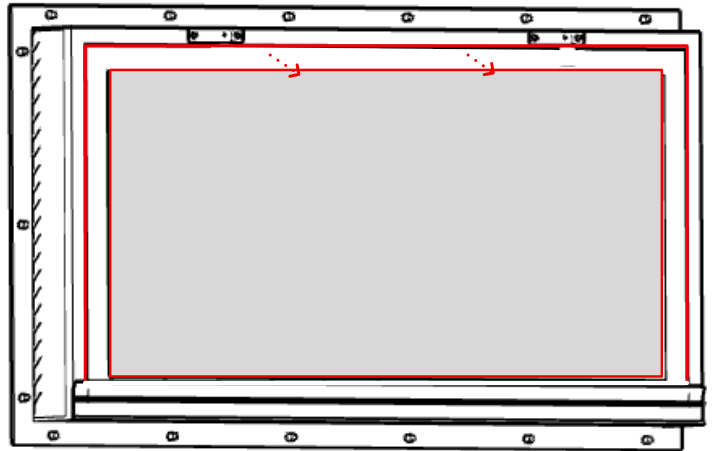
7.4.1 Maintenance of the Outdoor Cabinet PCS Compartment Cooling Vent

The dust filter screen of the PCS air intake vent can be removed for cleaning or replacement. The removal procedure is as follows:

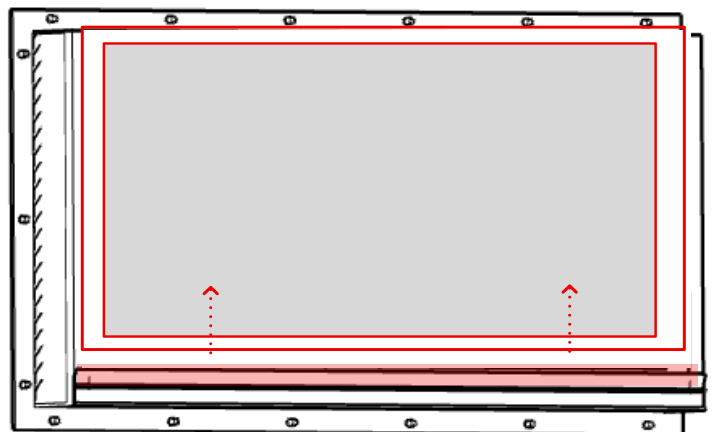
1. In the direction shown in the figure, unscrew the retaining strip of the dust filter screen.



2. Pull downward at an angle to loosen the upper edge of the dust filter screen so that it disengages from the slot.



3. . Move the lower edge of the dust filter screen upward to disengage it from the slot (the red part at the bottom in the figure), and then the dust filter screen can be removed.

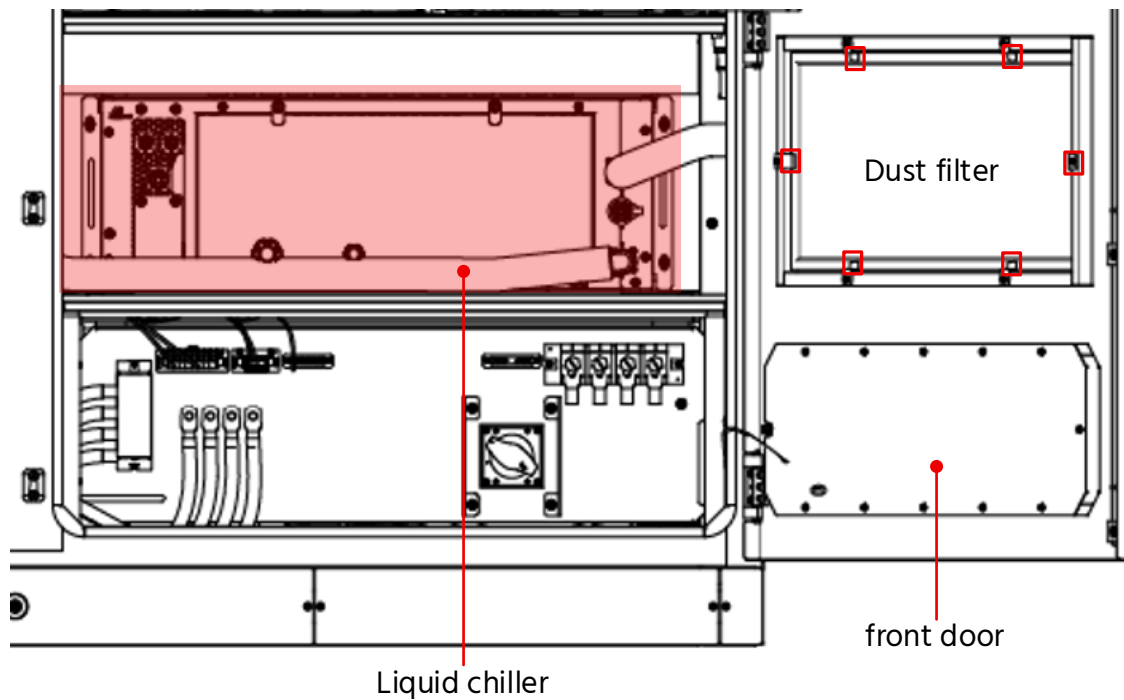


7.4.2 Maintenance of the Outdoor Cabinet Liquid Chiller

For detailed liquid chiller maintenance information, please refer to the after-sales maintenance manual.

The dust filter screen of the liquid chiller air intake vent can be removed for cleaning or replacement. The removal and reinstallation procedure is as follows:

1. Use a Phillips screwdriver to remove the retaining strip screws around the dust filter screen of the air intake vent. (The 6 red box areas in the figure below)



2. Gently remove the retaining strip and take out the dust filter screen.
3. After cleaning the dust filter screen, reinstall it. If the dust filter screen has aged, consider replacing it with a new one.
4. Reinstall the retaining strip and tighten the retaining strip screws.

7.4.3 PCS and UPS Maintenance

For PCS and UPS maintenance information, please refer to the after-sales maintenance manual.

7.4.4 Fault Handling

For faults related to the battery system/PCS/liquid chiller/fire protection, etc., that occur during installation, commissioning, or operation of the energy storage system, please refer to the after-sales maintenance manual to identify the cause of the fault and the corresponding solution.

If this manual cannot resolve your issue, please contact us. To help us assist you better, please provide the following information:

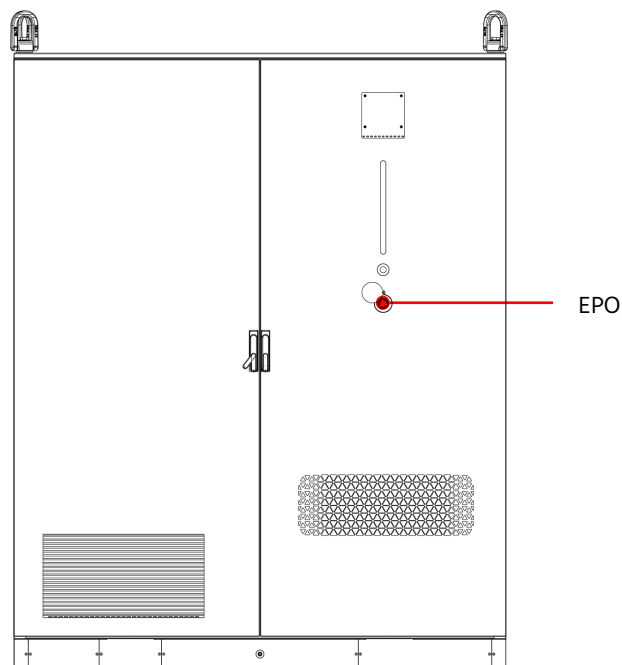
- Product serial number and manufacturing date.
- Equipment manufacturer, model, and configuration information.
- A brief description of the fault.
- Photos of the fault site.

7.4.5 Emergency Handling

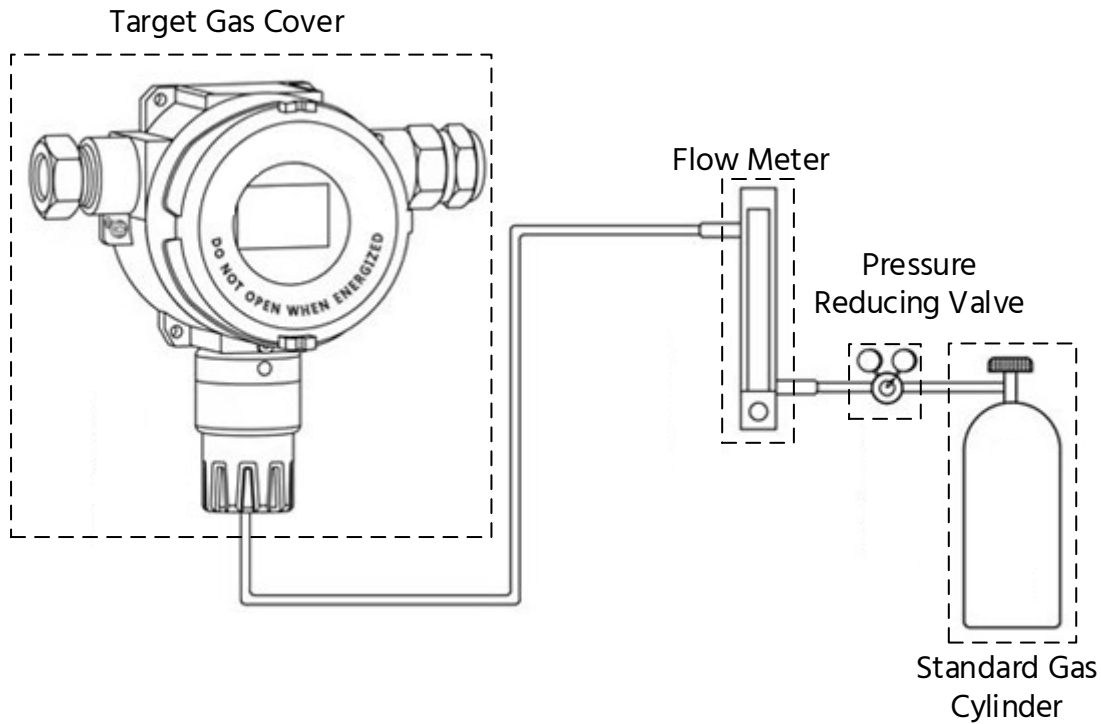
⚠ WARNING

The emergency stop button should only be used in critical situations. It is strictly forbidden to use the emergency stop button for shutdown under non-emergency circumstances.

- When a fault occurs, the system will automatically shut down.
- In critical situations, the emergency stop button can be pressed, and the system will automatically shut down.
- When a fire occurs, the system will automatically extinguish the fire internally; the EMS system controls the shunt release to automatically disconnect the main circuit breaker, shuts down the liquid cooling system, and the system automatically shuts down.



7.4.6 Carbon Monoxide (CO) Detector Calibration Procedure



7.4.6.1 Preparations

1. Prepare one cylinder of standard CO test gas, with a concentration of 250 ppm (i.e., half the full-scale range), balanced in air; also prepare one pressure-reducing valve and flow regulator set.
2. Prepare one dedicated calibration hood for the gas detector.
3. Set the flow controller of the gas cylinder flowmeter to 0.5 L/min.

7.4.6.2 Recommended Calibration Frequency

Calibration is recommended every 12 months. Customers may adjust the frequency according to their specific operational requirements.

7.4.6.3 Calibration Steps

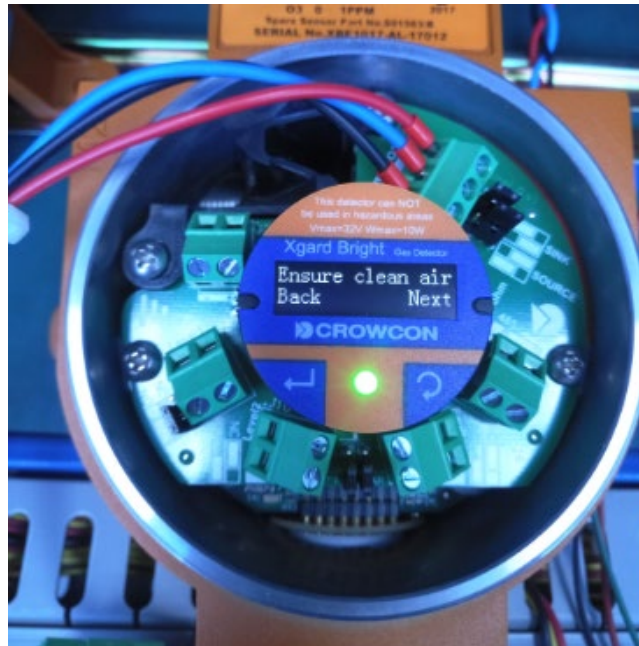
1. Power on the instrument and allow sufficient warm-up time—preferably over 1 hour—until the displayed readings stabilize at zero. Inadequate warm-up may cause calibration inaccuracies and compromise measurement accuracy.
2. Perform zero-point calibration in clean ambient air. By default, the hydrogen concentration in clean ambient air is assumed to be zero.
3. Use a magnetic rod to briefly press the left button (i.e., the “Confirm” key) to enter the password input interface. The Level-1 password is “0000”; the Level-2 password is “1001”. For the “Curs/OK” key: a brief press moves the cursor position (“Curs”), while pressing and holding for 2 seconds confirms the selection (“OK”). After entering the password, press and hold the left button for 2 seconds to enter the menu.



4. The menu structure is shown in the figure below.



- 1) Press the right button repeatedly to cycle through menu items until "Zero" (zero-point calibration) is selected. Press the left button to confirm entry into the zero-point calibration interface, as shown in the figure below.



- 2) The display prompts: "Ensure calibration is performed in clean ambient air." If calibration is indeed being performed in clean ambient air, press the right button ("Next") to initiate the zero-point calibration procedure. A 10-second countdown will then begin, as shown in the figure below.



- 3) Upon completion of the 10-second countdown, zero-point calibration ends, and a "Zero Calibration Successful" message appears, as shown in the figure below.



- 4) After zero-point calibration, press the right button repeatedly to cycle through the menu until "Cal Gas" (calibration gas) is selected. Press the left button to confirm entry into the calibration gas concentration setting interface, as shown in the figure below.



- 5) Use the left button to move the cursor position, and the right button to increment numeric values, adjusting the displayed calibration gas concentration to match the certified concentration indicated on the standard gas cylinder. Then press and hold the left button for 2 seconds to confirm.
- 6) After confirmation, the interface switches to the "Actual Value" screen, as shown in the figure below. Once the "Real" value stabilizes, press the right button ("Mark") to perform calibration. After calibration completes, press the left button ("DONE") to proceed.



5. After pressing “DONE” (i.e., the left button), the display transitions to the interface shown in the figure below, which remains visible for 2 seconds before automatically returning to the main menu. From the main menu, select “TO main menu” to return to the home screen.



8 Trouble Shooting

8.1 Battery String Trouble Shooting

Section A before starting up:

Failure Mode	Possible Reason	Solution
Battery system doesn't start up after correct wiring connection and starting procedure.	Power cable issue	1. Check the wiring connection and connectivity of the power cables.
	Internal cable issue	2. Open BMS case, check the connectivity and reliability of the internal power supply cables.
	PMU issue	3. Open BMS case, use multimeter to check PMU 12VDC output and CMU LEDs. If neither is on, please swap the PMU.
	Other error	4. If problem persists, contact Pylontech service engineer.

Section B During operation:

You can directly view system fault information on the related pages of the upper computer software. If you use the debugging interface to read the fault information, enter the "fault" command in the debugging port to obtain the system fault information.

The meaning and solution methods of the fault codes can be found in *Annex 1*.

8.2 UPS Trouble Shooting

Please refer to the separate *UPS product manual* for trouble shooting.



8.3 PCS Trouble Shooting

Please refer to the separate *PCS product manual* for trouble shooting.



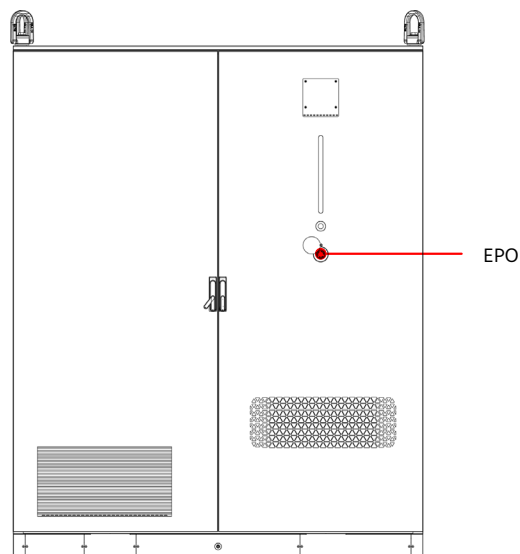
8.4 Liquid Chiller Troubleshooting

Please refer to the separate *Liquid Chiller product manual* for trouble shooting.



8.5 Emergency Disposal (EPO)

In case of fire or any situation beyond the control of anyone, please immediately press the emergency stop button (EPO) to stop the system. DO NOT touch the EPO during normal operation. To restore the system, firstly rotate the EPO button in the operating direction on the door to make the button pop up, and then power on the system according to the power on steps.



9 Shipment and Storage

9.1 Shipment

Attention should be paid to the following matters during transportation:

- (1) The BESS system is transported with batteries installed. During transportation, it should not be subjected to severe impact.
- (2) During transportation, it should be securely fixed and not displaced inside the carriage.
- (3) During transportation, it should be placed and transported strictly in the vertical direction, with a tilt angle less than 5°, and should not be transported horizontally or sideways to avoid damaging the components due to vibration.
- (4) During transportation, it is not allowed to ship together with flammable, explosive, or corrosive goods.
- (5) The equipment is not allowed to withstand washing and mechanical damage from rain, snow, or liquid substances.
- (6) During the transportation by forklift, the radial acceleration of the forklift cannot exceed 2.35m/s^2 . The lifting acceleration should be less than 1.4G and the duration should be less than 1.2G.

NOTE

The SOC of a single battery is around 20-30% before shipment. The remaining capacity of batteries after shipment and before charging varies depending on storage time and storage conditions. The battery module complies with the UN38.3 certification standard.

9.2 Storage

CAUTION

Be sure to follow the instructions below for long-term storage. Otherwise, the battery's cycle life will decrease.

1. Relative humidity is less than 65%, the environment is clean, ventilated and free of corrosive gases. The temperature requirements are as follows:

Storage Temperature (T)	SOC	Storage Duration
$T < -40\text{ }^{\circ}\text{C}$	/	Not allowed
$-40\text{ }^{\circ}\text{C} \leq T < -30\text{ }^{\circ}\text{C}$	20% ~ 40%	≤ 7 days
$-30\text{ }^{\circ}\text{C} \leq T < -20\text{ }^{\circ}\text{C}$	20% ~ 40%	≤ 30 days
$-20\text{ }^{\circ}\text{C} \leq T < 35\text{ }^{\circ}\text{C}$	20% ~ 40%	≤ 180 days (After 180 days of storage, a full charge and discharge is required.)
$35\text{ }^{\circ}\text{C} \leq T < 50\text{ }^{\circ}\text{C}$	20% ~ 40%	≤ 30 days
$50\text{ }^{\circ}\text{C} \leq T < 60\text{ }^{\circ}\text{C}$	20% ~ 40%	≤ 7 days
$T \geq 60\text{ }^{\circ}\text{C}$	/	Not allowed

2. Keep away from all kinds of harmful gases, flammable, explosive items and corrosive chemicals. And there should be no strong mechanical vibration, impact or strong magnetic field of the storage site.

Annex 1: Troubleshooting Codes

No.	Fault Info	Fault Description	Solution
0	INIT_BATNUM	Power-On Self-Test: Cell Count Mismatch	Check for incorrect module usage. - If confirmed, replace the faulty module. - If all modules are normal, check if there is any problem with the communication. Command to use: Use the command "bmuinfo" to view the information of BMU.
1	INIT_COUL	Power-On Self-Test: Module Capacity Mismatch	Use the command "bmuinfo" to check the module information. Check if the cell type of any module is not configured, or if there are cells with different capacities in a string. - If there are cells that have not been configured, use the fixture/upper computer for configuration. - If the capacities of the cells are different, replace the cells to ensure that all cells have the same capacity. Command to use: Use the command "bmuinfo" to view the information of BMU.
2	INIT_BMUCFG	Power-On Self-Test: Module Configuration Mismatch	Use the command "bmuinfo" to check if the module configuration is inconsistent. - Check the configuration information. If there is an error, update the configuration using the tooling or the host computer. - Check the hardware configuration. If there are inconsistencies, update the hardware configuration. Command to use: Use the command "bmuinfo" to view the information of BMU.
3	FAULT_MCU	STL: Chip Self-Test Anomaly	Replace the CMU board or BMU board.
4	UNIT_ADDR	BMU Address Assignment Failure	Check if the communication of all modules is normal and if any device is offline. Ensure that the communication wiring of all BMUs is normal.

No.	Fault Info	Fault Description	Solution
5	DAISYBRK	Daisy Chain Disconnection	Check if the hardware uses a loop daisy chain or a single daisy chain, and configure the relevant information according to the actual situation. If the configuration is correct and the daisy chain is broken, replace the BMU board. Command to use: Use the command “bmuinfo” to view daisy chain configuration information.
6	AFETH	AFE Chip Overtemperature	NULL
7	BALANCE	Equalization Circuit Disconnection	NULL
8	BTSAMPLINE	Cell Temperature Sampling Wire Disconnection	Remove the front panel of the BMU and verify the functionality of cell voltage and temperature sampling lines
9	BVSAMPLINE	Cell Voltage Sampling Wire Disconnection	
10	BVINV	Invalid Cell Voltage	To diagnose cell voltage failure root causes via data event logs. Fault bit definitions: - Bit 0: Cell voltage sampling line fault (1: Abnormal, 0: Normal) - Bit 1: Cell balancing sampling line fault (1: Abnormal, 0: Normal) - Bit 2: MCU-AFE communication parity error (PEC validation failure) (1: Abnormal, 0: Normal) - Bit 3: AFE internal device fault (e.g., ADC) affecting voltage sampling (1: Abnormal, 0: Normal) - Bit 4: AFE sampled data out of valid range (0–5V) (1: Abnormal, 0: Normal) - Bit 5: AFE on-chip voltage register Data Redundancy Check (DRC) fault (1: Abnormal, 0: Normal) - Bit 6: AFE reference voltage Vref2 fault (1: Abnormal, 0: Normal)

No.	Fault Info	Fault Description	Solution
			• Bit 7: AFE digital filter fault (1: Abnormal, 0: Normal) • Bit 8: Multiplexer channel fault (1: Abnormal, 0: Normal) • Bit 9: AFE analog power supply fault (1: Abnormal, 0: Normal) • Bit 10: AFE digital power supply fault (1: Abnormal, 0: Normal) • Bit 11: AFE overlap test fault (1: Abnormal, 0: Normal) • Bit 12: AFE status register digital redundancy check fault (1: Abnormal, 0: Normal) Command to use: Check cell voltage fault codes in data event logs.
11	BVHC	Single Cell Charging Overvoltage	It can be restored once the rated value is reached.
12	BVLD	Single Cell Discharging Undervoltage	It can be restored once the rated value is reached.
13	BVL	Single Cell Resting Undervoltage	It can be restored once the rated value is reached.
14	MVH	High Module Voltage	It can be restored once the rated value is reached.
15	MVL	Low Module Voltage	It can be restored once the rated value is reached.
16	BVDH_C	Large Voltage Difference of Single Cells During Charging within the Cluster	It can be restored once the rated value is reached.
17	BVDH_D	Large Voltage Difference of Single Cells During Discharging Within the Cluster	It can be restored once the rated value is reached.
18	BVDH	Large Static Voltage Difference among Single Cells within	It can be restored once the rated value is reached.

No.	Fault Info	Fault Description	Solution
		the Cluster	
19	MVDH_C	Large Charging Voltage Difference between Modules within the Cluster	It can be restored once the rated value is reached.
20	MVDH_D	Large Discharging Voltage Difference between Modules within the Cluster	It can be restored once the rated value is reached.
21	MVDH	Large Static Voltage Difference between Modules within the Cluster	It can be restored once the rated value is reached.
22	BT_INV_M	Cell Temperature Failure	Check cell temperature failure reasons via data event: • Bit 0: Cell voltage sampling line fault (1: Abnormal, 0: Normal) • Bit 1: MCU-AFE communication parity error (PEC validation fault) (1: Abnormal, 0: Normal) • Bit 2: AFE internal device fault (e.g., ADC) affecting temperature sampling (1: Abnormal, 0: Normal) • Bit 3: AFE on-chip temperature register redundancy check fault (1: Abnormal, 0: Normal) • Bit 4: AFE sampled data out of valid range (0–5V) (1: Abnormal, 0: Normal) • Bit 5: AFE reference voltage Vref2 fault (1: Abnormal, 0: Normal) • Bit 6: AFE digital filter fault (1: Abnormal, 0: Normal) • Bit 7: Multiplexer channel fault (1: Abnormal, 0: Normal) • Bit 8: AFE analog power supply fault (1: Abnormal, 0: Normal) • Bit 9: AFE digital power supply fault (1: Abnormal, 0: Normal)
23	BT_INV_P		

No.	Fault Info	Fault Description	Solution
			- Bit 10: AFE overlap test fault (1: Abnormal, 0: Normal) - Bit 11: AFE status register digital redundancy check failure (1: Abnormal, 0: Normal) Command to use: Check cell voltage fault codes in data event logs.
24	BTHC	High Cell Charging Temperature	It can be restored once the rated value is reached.
25	BTLC	Low Cell Charging Temperature	It can be restored once the rated value is reached.
26	BTHD	High Cell Discharging Temperature	It can be restored once the rated value is reached.
27	BTLD	Low Cell Discharging Temperature	It can be restored once the rated value is reached.
28	BTDHC	Large Temperature Difference of Battery Cells in the String During Charging	It can be restored once the rated value is reached.
29	BTDHD	Large Temperature Difference of Battery Cells in the String During Discharging	It can be restored once the rated value is reached.
30	SAMPLE_CURR_INV	Invalid Original Current Sampling	Check if there are any problems with the current detection board or the wiring harness.
31	SYSTEM_CURR_INV	Invalid System Current	
32	CURR_DRIFT	Zero - drift in the Current Sensor	1. Check if the current has been calibrated. 2. Check if there are any problems with the current detection board. Command to use: Use the command "analog" to check the sampled data value of the current.
33	COC	Excessive Charging Current	It can be restored once the rated value is reached.

No.	Fault Info	Fault Description	Solution
34	DOC	Excessive Discharging Current	It can be restored once the rated value is reached.
35	SC	Battery Cluster Short-Circuit	It cannot be restored automatically. Please troubleshoot the cause of the short - circuit, clear the fault, and then restart the system
36	BTERV_INV	Invalid Voltage at Terminal B	Check if there are any problems with the sampling circuit, the power supply, and the sampling chip.
37	DTERV_INV	Invalid Voltage at Terminal D	
38	HIGHV_INV	Invalid High-voltage Sampling of the System	
39	BTERV_RV	Reverse Connection of Voltage at Terminal B	Check if the power cable is connected reversely.
40	DTERV_RV	Reverse Connection of Voltage at Terminal D	1. It can be recovered once the rated value is reached. 2. Check if there is really a reverse connection.
41	BTERV_DIFF	Large Voltage Sampling Error at Terminal B	1. Check if the sampling chip of Terminal B is normal. 2. Check if the wiring of the sampling points and the voltage at the sampling points within the battery control module are normal. 3. Check if the fuse in the battery control module is normal and measure its voltage.
42	HVBREAK	Open Circuit in the Cluster's High-Voltage Circuit	1. Check if the voltage sampling at Terminal B in the battery control module is normal, including sampling line continuity, voltage values at sampling points, fuse status, and high-voltage circuit integrity. 2. Check if there are MSDs and if all the MSDs are closed. 3. Check if the high-voltage circuit of battery string and the overall voltage is normal.
43	PVH	Excessive Total Voltage	It can be restored once the rated value is reached.
44	PVL	Insufficient Total	It can be restored once the rated value is

No.	Fault Info	Fault Description	Solution
		Voltage	reached.
45	MSDT_INV	Invalid Temperature of Pack MSD	1. Check if there are MSDs and if the configuration is consistent with the physical device. If not, re-configure through the tooling process. 2. If the temperatures of MSDs, FUSEs, and module terminals are invalid and the configuration is correct, check if the sampling wires are normal, if there are open-circuits or short-circuits, and check if the sampling chips are normal, including their power supplies. Command to use: Use the command "bmuinfo" to view the configuration information.
46	FUSET_INV	Invalid Temperature of Pack FUSE	1. Check if there is fuse and if the configuration is consistent with the physical device. If not, re-configure through the tooling process. 2. If the temperatures of MSDs, FUSEs, and module terminals are invalid and the configuration is correct, check if the sampling wires are normal, if there are open-circuits or short-circuits, and check if the sampling chips are normal, including their power supplies. Command to use: Use the command "bmuinfo" to view the configuration information.
47	BMUTERT_INV	Invalid Temperature of Pack Terminal	1. Check if the terminal temperature sampling wire is normal and if there is any open-circuit or short-circuit condition. 2. Check if the temperature sampling chip is normal, including its power supply. Command to use: Use the command "bmuinfo" to view the configuration information.
48	CMUTERT_INV	Invalid Temperature of High-voltage Box Terminal	1. Check if the terminal temperature sampling wire is normal and if there is any open-circuit or short-circuit.

No.	Fault Info	Fault Description	Solution
			2. Check if the temperature sampling chip is normal. 3. Check if there is also an abnormality in the current sampling. When the current- sensing board is abnormal during initialization, it can cause the temperature sampling chip to reset repeatedly, making it unable to sample and resulting in an abnormality.
49	MSDTH	High Temperature of Pack MSD	It can be restored once the rated value is reached.
50	FUSETH	High Temperature of Pack FUSE	It can be restored once the rated value is reached.
51	BMUTERT_H	High Temperature of Pack Terminal (B+B-)	Check if the terminal wiring is loose.
52	MODULEBOLTT_HT	Bolts of Pack Module	It can be restored once the rated value is reached.
53	CMUTERT_H	High Temperature of Terminals (B+/B-/D+/D-) in the High-Voltage Box	Check if the terminal wiring is loose.
54	BMUTER_TD	High Temperature Difference of Pack Terminals (B+ and B-)	It can be restored once the rated value is reached.
55	CMUTER_TD	High Temperature Difference of the Terminals (B+/B-/D+/D-) in the high-Voltage Box	It can be restored once the rated value is reached.
56	BT_RISE	Too Rapid Temperature Rise of the Battery	The risk of thermal runaway may arise if the temperature of the cell rises quickly. • Troubleshoot the battery packs with an excessively fast temperature rise. • Check if there are any abnormalities in these cells. Command to use: Use the data event to view the recorded BMU

No.	Fault Info	Fault Description	Solution
			fault records.
57	THERRA	Thermal Runaway Fault	It is necessary to troubleshoot the battery packs that have experienced thermal runaway and conduct inspections on these battery packs.
58	SMOKE_DEV	Malfunction of the Smoke Sensor in the Pack	1. Check if the terminals of the smoke sensor and the BMU board are properly connected. 2. Replace the smoke sensor to check if it is functioning properly. 3. If the smoke sensor is normal, try to replace the BMU board to troubleshoot issues with the BMU board. 4. Check if the smoke sensor is correctly configured to ensure the configuration matches the physical device. Command to use: Use the command "bmuinfo" to view the configuration information.
59	SMOKE_H	High Smoke Concentration in the PACK	1. It is necessary to troubleshoot if the environment of the PACK has a high concentration of smoke and dust. 2. It is necessary to check if the smoke sensor of the PACK is malfunctioning.
60	FIRECTRLERR	Fire Protection Execution Failure Fault	It is necessary to troubleshoot the reasons for the inaction of the solenoid valve, such as power supply failure, jamming, abnormal coil, etc.
61	FUSE_OPEN	Fuse Open-Circuit Fault	1. Check the bmuinfo to confirm that the FUSE configuration is in line with the physical object. 2. Use a multimeter to measure whether the FUSE is open-circuited to determine if it is blown. 3. Observe the status of the red feedback point of the FUSE. It may pop open in case of an abnormality. Command to use: Use the command "bmuinfo" to view the configuration information.
62	MSD_OPEN	Pack MSD Open - Circuit Fault	1. Check the bmuinfo to confirm that the MSD configuration matches the physical device.

No.	Fault Info	Fault Description	Solution
			2. If the MSD is configured, check whether it is properly closed and not loose. Command to use: Use the command “bmuinfo” to view the configuration information.
63	INS_L	Low High-voltage Insulation	Use a tester to check the insulation condition of the entire battery system. If an insulation abnormality is detected, it is necessary to troubleshoot the root cause of the problem and take corresponding measures.
64	INS_RELAYERR	Insulation Detection Relay Failure	It is necessary to troubleshoot if there are any adhesion or short-circuit conditions in the relay of the insulation resistance detection circuit on the CMU main control board.
65	INS_INV	Invalid Insulation Detection	Check the insulation resistance of the battery pack voltage sampling circuit to see if there are any abnormalities that cause sampling failure. If there is an abnormality in the sampling circuit, it can be addressed by replacing the main control board of the CMU.
66	SHUT	Auxiliary power supply circuit fault	NULL
67	NRLY_SHORT	Main Negative Relay Adhesion Fault	Check whether the main negative relay is in the open state. If the main negative relay is open but there is still an abnormality, it is necessary to check whether its feedback signal is normal.
68	NRLY_OPEN	Main Negative Relay Open-Circuit Fault	Check whether the main negative relay is closed. If the main negative relay is in the open state and there is still an abnormality, check whether its feedback signal is normal.
69	PRLY_SHORT	Main Positive Relay Adhesion Fault	Check whether the main positive relay is open. If the main positive relay is in the open state and there is still an abnormality, check whether its feedback signal is normal.
70	PRLY_OPEN	Main Positive Relay Open-Circuit Fault	Check whether the main positive relay is closed. If the main positive relay is in the

No.	Fault Info	Fault Description	Solution
			open state and there is still an abnormality, check whether its feedback signal is normal.
71	BKR_SHORT	Main Circuit Breaker (or Load Switch) Adhesion Fault	1. Check whether the circuit breaker or the load switch is configured with a feedback signal (command line: dev). 2. Check whether the signal of the feedback status is normal (command line: switch). 3. Check whether the circuit breaker is in the open state (command line: switch). 4. Check whether the feedback contacts of the circuit breaker are normally open or normally closed, and whether they are consistent with the hardware definition of the circuit breaker. 5. If there are still abnormalities when the circuit breaker is open, check whether the feedback of the circuit breaker is normal (check the hardware). Command to use: 1. Use the command "dev" to check the device information. 2. Use the command "switch" to check the control and feedback status of the circuit breaker.
72	BKR_OPEN	Main Circuit Breaker Open-Circuit Fault	1. Check whether the circuit breaker or the load switch is configured with a feedback signal (command line: dev). 2. Check whether the feedback status signal is normal (command line: switch). 3. Check whether the circuit breaker is in the open state (command line: switch). 4. Check whether the feedback contacts of the circuit breaker are normally open or normally closed, and whether they are consistent with the hardware definition of the circuit breaker. 5. If there are still abnormalities when the circuit breaker is open, check whether the feedback of the circuit breaker is normal. (Check the hardware.)

No.	Fault Info	Fault Description	Solution
73	CIR_SHORT	Main Circuit Adhesion Fault	1. Check if there is any abnormality in the voltage sampling at terminal B and terminal D. • If there is an abnormality, check if the sampling chip is normal. 2. Check if there is any adhesion fault in the main positive/negative relay. • If there is a relay adhesion fault, it is necessary to troubleshoot the cause of the sticking, with reference to the handling methods in items 67 and 69.
74	MODHUMID_I NV	Invalid Humidity Inside the Pack	1. Check whether a humidity sensor is configured and verify the presence of the component on the board. 2. Inspect the humidity sensor on the BMU board for abnormalities, including communication status verification and power supply validation.
75	MODHUMID_H	High humidity Inside the PACK.	1. Check if the humidity sampling is normal. 2. Check if the humidity inside the pack is normal. • If the humidity level is high, perform dehumidification procedures.
76	FAN_ERR	Abnormal Operation of the High-Voltage Box Fan	NULL
77	CURR_DIFF	Large Cumulative Current Error	NULL
78	SOCL	Low SOC of the Battery Cluster	Charge the battery, and it will be restored once the rated value is reached.
79	SOEL	Low SOE of the Battery Cluster	Charge the battery, and it will be restored once the rated value is reached.
80	SOHL	Low SOH of the Battery Cluster	Check the battery's SOH. If the SOH is abnormally low, evaluate battery health based on the battery's service duration and operating environment.
81	BAT_SELFDSG DIFF	Excessive Difference in Self-Discharge of the	NULL

No.	Fault Info	Fault Description	Solution
		Battery Cells	
82	BAT_SOLDER_ERR	Battery Virtual Soldering Fault	NULL
83	COMM_BMUSMOKE	Communication Loss of the Smoke Sensor in BMU to Pack	Check if the smoke sensor meets all of the following criteria: power supply voltage is normal, wiring connections are secure, and device functionality is operational.
84	COMM_BMU	Communication Loss Between CMU and BMU	Check if the wiring between CMU and BMU is normal, or if BMU has entered the SHUT state due to low voltage.
85	COMM_SMU	Communication Loss Between CMU and SMU (Default Enabled)	1. Check if the communication wiring between the CMU and the MBMS_LC or LEMS is normal. 2. Check if the DIP switch of the CMU is bound to the IP address and if the IP address has been manually modified.
86	COMM_PCS	Communication Loss Between CMU and PCS (Not Enabled by Default, Configured with Tooling Equipment)	Check if the communication cable between the PCS and the CMU is loose.
87	POSRELAYUSE_LOW	Low Service Life of the Positive Relay	Check the number of switching operations of the positive relay under various conditions. If the relay has truly reached the end of its service life, replace the relevant equipment, clear the statistical data, and resume normal use after restoration.
88	NEGRELAYUSE_LOW	Low Service Life of the Negative Relay	Check the number of opening and closing operations of the negative relay under various conditions. If the service life of the relay has indeed been exhausted, replace the relevant equipment, clear the statistical data, and resume use after it returns to normal.
89	BREAKERUSE_LOW	Low Service Life of the Circuit Breaker	Check the number of opening and closing operations of the circuit breaker under various conditions.

No.	Fault Info	Fault Description	Solution
			If the service life of the circuit breaker has indeed been exhausted, replace the relevant equipment, clear the statistical data, and resume using it after it returns to normal.
90	CONFIGDATA LOAD	Configuration Parameter Data Reading Error	Check if the FLASH of the CMU is working properly.
91	TRAVEL_SWITCH	Failure of the Protective Door to Open	Check if the protective door is open (it needs to be closed during operation).



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