Optim US-L260-Omni Lithium Iron Phosphate Battery Energy Storage System

User Manual

Information Version: 1.7

Legal Information

Disclaimer

The Manual contains instructions for the use of the product. All the pictures and charts in this manual are for description and explanation only. Pylon Technologies Co., Ltd. reserves the right to change the information in the manual which is subject to change without further notice.

Please read this manual carefully before using the product and keep this manual for further reference. Failure to use the product in accordance with the manual may result in serious injuries, property damages and may void the warranty, for which Pylon Technologies Co., Ltd. shall not be liable.

Pylon Technologies Co., Ltd. makes no representations or warranties express or implied, with respect to all the information in this manual.

In the event of any conflicts between this manual and the applicable law, the latter prevails.

The final interpretation of this manual belongs to Pylon Technologies Co., Ltd.

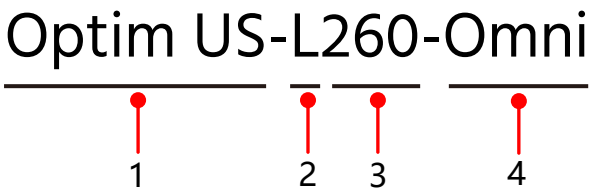
About this Manual

Purpose

This manual describes the Optim US-L260-Omni Lithium Iron Phosphate Battery Energy Storage System (hereinafter referred to as "the system" unless otherwise noted) from Pylontech in terms of its overview, installation, commissioning, maintenance, etc.

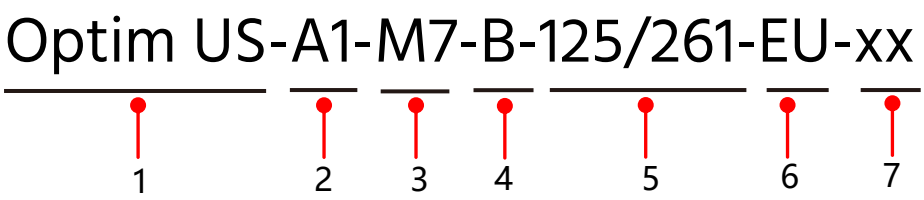
Please read this manual before installing the system and follow the instructions carefully during installation. In case of any confusion, please contact Pylontech immediately for advice and clarification (Contact information can be found on the back cover of the manual).

Product Name Description



No.	Designation	Description
1	Product Series	Optim US Series
2	Cooling type of the system	Liquid Cooling
3	The rated energy (in kWh) of the system	The rated energy of this system is about 260 kWh.
4	Type of the cabinet	“Omni” represents all in one cabinet (including the PCS).”

Product Model Description



No.	Designation	Description
1	Product Series	Optim US Series
2	"A" represents the type of cabinet system. "1" is the serial number.	"A" represents "all in one cabinet (including the PCS)."
3	Battery model used in the product	The product uses M7 battery.
4	Product Version	Version B
5	The rated power of the PCS (in kW) The rated energy (in kWh) of the system	The rated power of the PCS is 125 kW. The rated energy of this system is 261 kWh.
6	Sales territory	The product is intended for European market.
7	"xx" represents the fire and explosion safety configurations (Where xx=01, 02, 03, 04 or 05) *	The standard safety configuration: combustible gas detector + Explosion-proof ventilation fan

* For more details of the fire and explosion-proof safety configurations, please see *Section 2.3 System Specifications.*

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	Moulded Case Circuit Breaker
PDU	Power Distribution Unit
PMU	Power Management Unit
CMU	Control Management Unit
SPD	Surge Protecting Device
GND	Ground
DOD	Depth of Discharge
MCU	Microcontroller Unit
EPO	Emergency Power OFF Switch
OVC	Overvoltage Category

Contents

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 ^{o}C ~ 55 ^{o}C and the optimum temperature is: 15 ^{o}C ~ 55 ^{o}C. Out of the working temperature range may cause the battery system over/low temperature alarm or protection which will further lead to the cycle life reduction. It will affect the warranty terms as well.

⚠ 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.

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 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.

1.7 Moisture Protection

- Do not open the cabinet door when the air humidity is >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

The Optim US-L260-Omni is a high voltage battery storage system based on lithium iron phosphate battery. This system is especially suitable for industrial and commercial application scenarios such as grid peak shaving and valley filling, power capacity increase, photovoltaic storage charging system, and backup power.

	
Front View	**Rear View**

NOTE

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

2.2 System Description

The outdoor integrated battery energy storage system connects the power grid with the storage battery through the energy storage converter PCS, and realizes the bidirectional energy transfer between the DC battery of the battery energy storage system and the AC grid by applying the principle of AC/DC conversion. It is realized through the control strategy:

- Charging and discharging management of the battery system.
- Tracking the power of the load on the grid side.
- Control of the charging and discharging power of the battery energy storage system, on-grid operation, and so on.

Main functions of the product

- Peak reduction and valley filling: it is realized by charging and discharging from the energy storage system in accordance with the requirements of the local electricity tariff with a fixed duration.
- Anti-backflow function: EMS adjusts the charging and discharging power of energy storage in real time by sampling the power of the grid to prevent backflow to the grid.
- Demand management: EMS adjusts the charging and discharging power of the energy storage system to avoid over-limit of the user's transformer.
- Local control and remote communication control.

2.3 System Specifications

Specifications	Model Name	Optim US-A1-M7-B-125/261-EU-xx (where xx=01, 02, 03, 04 or 05, represents the firefighting configuration)
AC side Parameters	Rated Power (kW)	125
	Rated Voltage (VAC)	400
	Max current (A)	198
	Frequency (Hz)	50
	Wiring Method	3W+N+PE
	Auxiliary Power Input Voltage / Max. Current /Frequency	230VAC/18A/50Hz
	Overvoltage Category	III
DC side Parameters	Rated Energy (kWh)	261.248
	Rated Capacity (Ah)	314
	Nominal Voltage (V)	832
	Upper Limit Charging Voltage (V)	936
	End-of-discharge Voltage (V)	702
	Standard Current (A)	157
	Maximum Current (A)	200
	Overvoltage Category	II
System Parameters	External Dimensions of the cabinet (mm)	950 (W) x 1300 (D) x 2480 (H)
	Weight (kg)	2900
	Handling Type	Applicable for hoist and forklift handling
	Working Temperature range (℃) *	-25~55
	Ingress Protection (IP) / Protective Class	IP55/ Class I
	Relative Humidity	0-95% RH, non-condensing
	Noise (dB)	70 @ 1 meter
	Maximum Altitude (m)	≤ 4000 m, derating > 2000m
	Pollution Degree	PD3 (Outside), PD2 (Inside)
	Cooling Type	Liquid Cooling
	Coolant	50% water, 50% ethylene glycol
	Nominal Operating pressure (bar)	2.0~2.2

Specifications	Model Name	Optim US-A1-M7-B-125/261-EU-xx (where xx=01, 02, 03, 04 or 05, represents the firefighting configuration)
	Maximum Operating pressure (bar)	3
	Usable Extinguishing Agent	A/B/C/F
	Fire and Explosion Safety Configurations	01: Explosion relief panel 02: Explosion relief panel + Sprinkler system 03: Ventilation fan 04: Ventilation fan + Sprinkler system 05: Explosion relief panel +Ventilation fan + Sprinkler system
	External Communication Protocol	Modbus-TCP、Modbus-RTU
	Wire feeding in and out method	Bottom in and bottom out
	Connectable Power Supply System Types	TN, TT

* At cell temperatures above 55 °C or below 15 °C, the charging and discharging power of the battery system will be limited according to BMS operation logic.

2.4 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.		

2.5 Reference Standards

2.5.1 System Related Standards

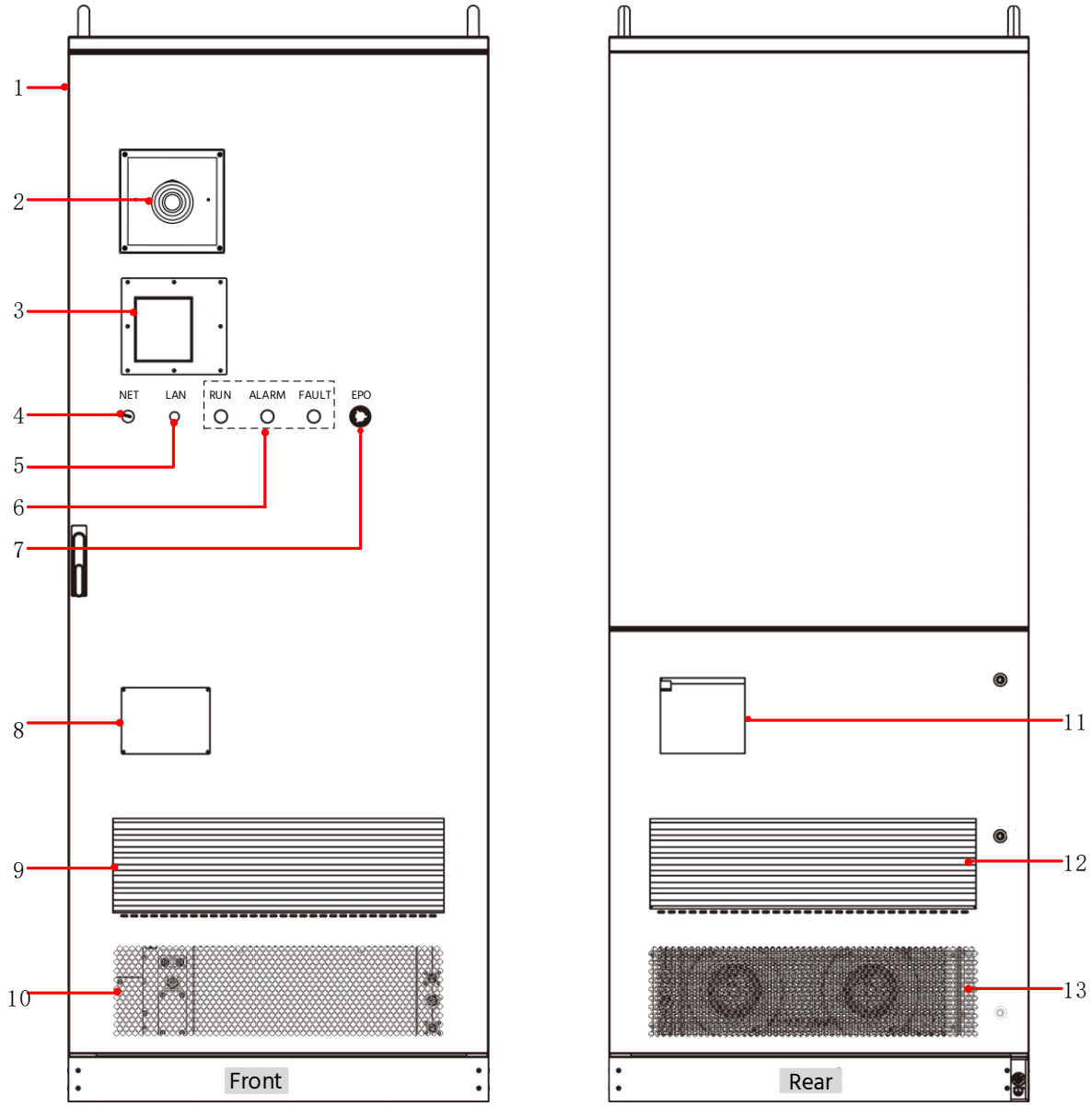
No.	Description	Code
1	CE LVD Directive 2014/35/EU	EN 62477-1
2	UN38.3 Safe Transport Standard	UN38.3
3	CE EMC Standard	EN IEC 61000-6-2 EN IEC 61000-6-4
4	Safety Standard for Secondary Lithium Batteries	IEC62619 IEC63056
5	Safety Standard for Lithium Battery (Germany)	VDE2510-50 VDE2510-2

2.5.2 Battery Related Standards

No.	Description	Code
1	Safety Standard for Secondary Lithium Batteries	ISO 13849-1
2	UN38.3 Safe Transport Standard	UN38.3
3	Battery Cell Safety Standard	UL1642
4	Battery Cell Safety Standard	UL1973
5	Battery Cell Safety Standard	IEC60730-1 SIL B/II

3 System Components

3.1 External Design



No.	Description	No.	Description
1	Cabinet Body	8	Product Nameplate
2	Sound-Light Alarm	9	Ventilation Louver (air inlet)
3	Exhaust Fan (air outlet)	10	Ventilation Window (air inlet)
4	NET(optional, internet access module for data migration to the cloud)	11	Electric Ventilation Louver(air inlet)
5	LAN Port(for debugging)	12	Ventilation Louver (air outlet)
6	Status Indicator	13	Ventilation Window(air outlet)
7	EPO (Emergency Power OFF Switch)		

NOTE

Explosion relief panel and Water fire suppression device are **OPTIONAL** firefighting configurations per your specific system.

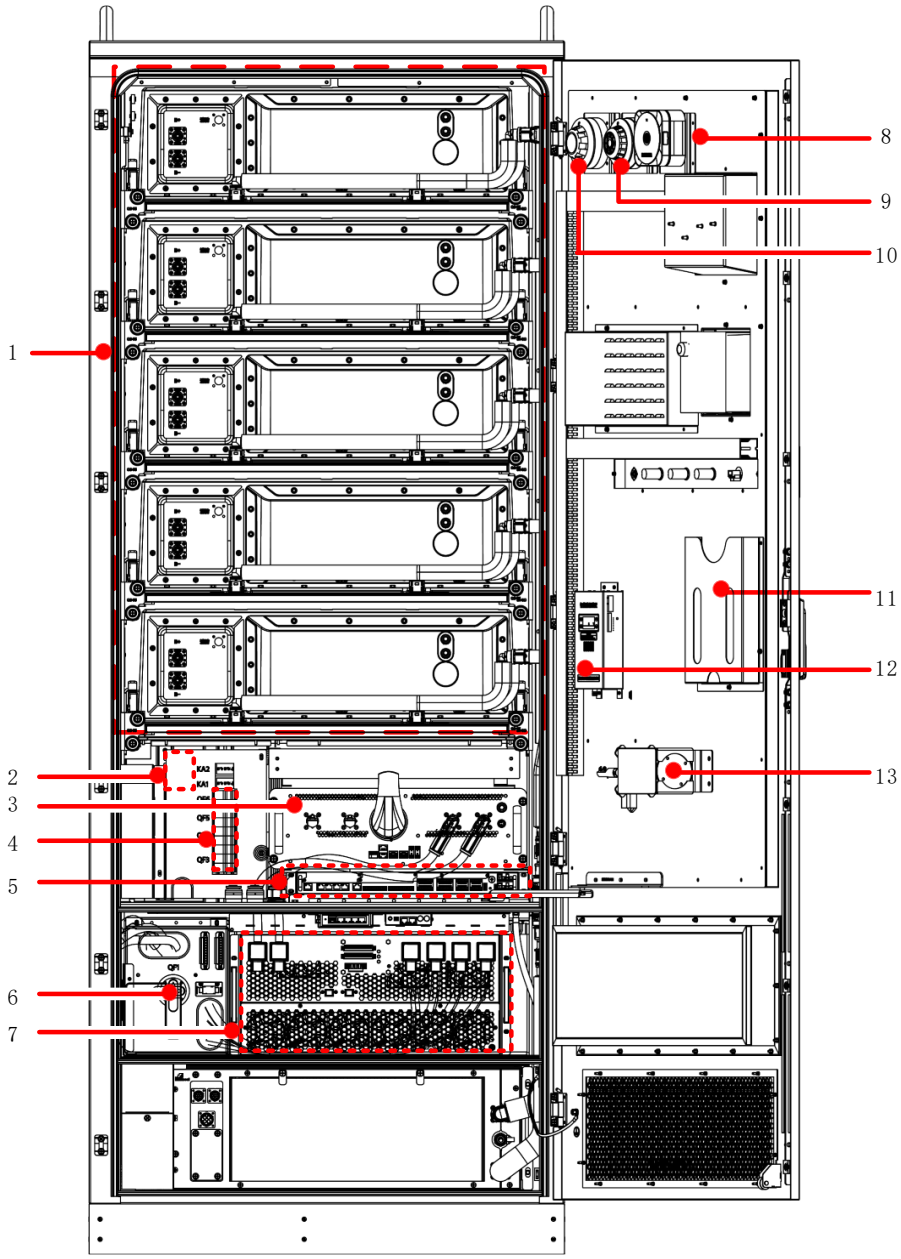
- Explosion relief panel is on the top of the cabinet.
- External joint of water firefighting is on the rear door of the cabinet.

3.1.1 Outdoor Cabinet

Outdoor Cabinet Parameters

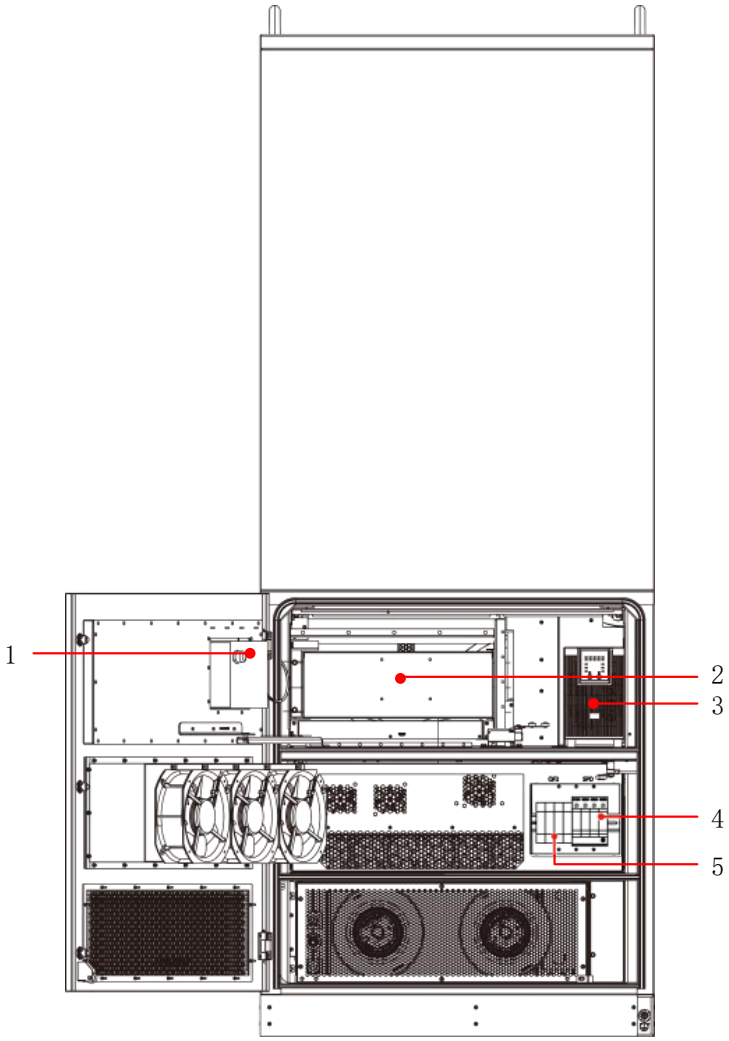
Item	Parameters
Dimensions (mm)	950 (W) × 1300 (D) × 2480 (H)
Color	Outdoor Orange Texture RAL9003
IP Rating	IP55
Plate Material	Cabinet body: SGCC, Bottom Base: Q235NH
Corrosion Resistance Grade	C3H
Maintenance	Front and back doors available
Safety Precautions	Outdoor lock

3.2 Internal Design



Front View

No.	Description	No.	Description
1	Battery Modules (5 pcs)	8	Gas Detector
2	Power Meter (under the cover plate)	9	Temperature Detector
3	BMS (Battery Control Module)	10	Smoke Detector
4	Circuit Breakers (QF3~QF6)	11	File Folder
5	LEMS	12	Dehumidifier
6	MCCB (Molded Case Circuit Breaker, QF1)	13	Fixed Aerosol Fire-extinguishing Device
7	PCS		



Rear View

No.	Description	No.	Description
1	Electric Ventilation Louver(air inlet)	4	SPD (Surge Protection Device)
2	BMS (Battery Control Module)	5	Circuit Breaker (QF2)
3	UPS (Uninterrupted Power Supply)		

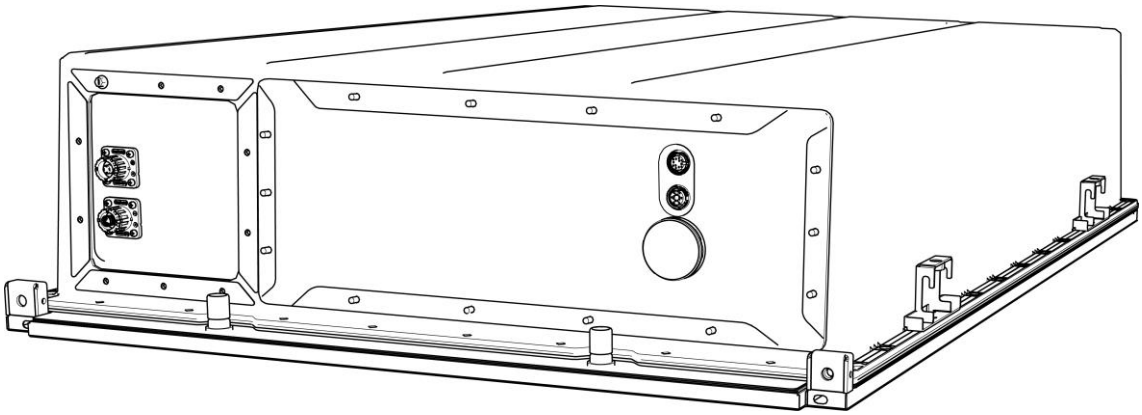
3.2.1 Battery String

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
Maximum Continuous Charge/ Discharge Current (Amps)	196
Peak Current (Amps)	250@15 seconds
Maximum 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

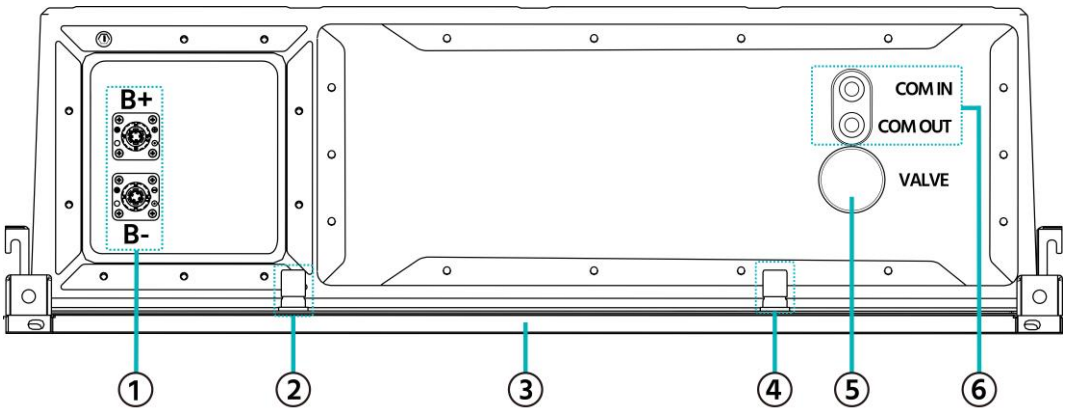


Battery Module Specifications

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 (W) ×1145 (D) ×245 (H)
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-) battery DC input terminals for connecting the batteries in serial.

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)

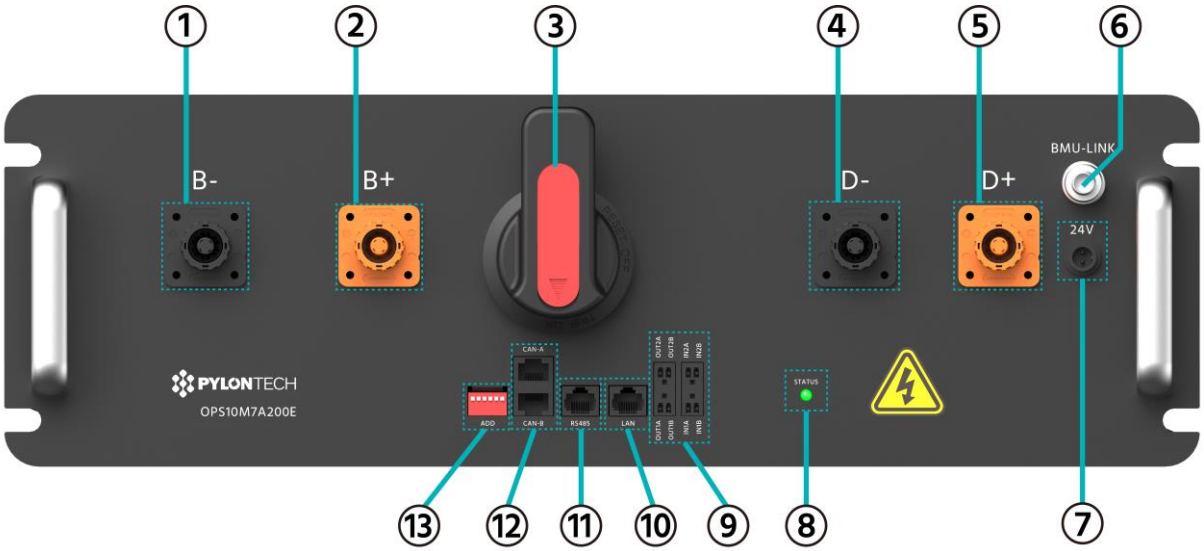
Communication ports (CAN communication), between multiple serial battery modules and control module.

3.2.1.3 Control Module

The appearance and the specifications of the control module are shown as follows.

Specifications	OPS10M7A200E
AC Supply for BMS	230VAC/50Hz/1.3A
System Operation Voltage (VDC)	0~1000
Dimension (mm)	460 (W) × 758 (D) × 160 (H)
Communication	RS485\CAN\LAN
Protection Class	IP20
Weight(kg)	21.25
Operation Life (Years)	15+

Control Module Front Interface



Item	Description	Item	Description
①	Power Terminal B-	⑧	Status LED
②	Power Terminal B+	⑨	Dry Contact
③	Circuit Breaker	⑩	LAN Port
④	External Power Terminal D-	⑪	RS485 Port
⑤	External Power Terminal D+	⑫	CAN-A, CAN-B Ports
⑥	BMU-LINK	⑬	ADD Switch
⑦	24VDC IN		

① Power Terminal B-

The battery ‘s DC connection for the negative pole.

② Power Terminal B+

The battery ‘s DC connection for the positive pole.

③ Circuit Breaker

On/Off switch for the control module, and carries out shunt tripping function when system is overcurrent or short circuit.

④ Power Terminal D-

DC connection for the battery string to the negative pole of PCS.

⑤ Power Terminal D+

DC connection for the battery string to the positive pole of PCS.

⑥ BMU-LINK

Communication port to connect the battery module.

⑦ 24VDC IN

Connects to 24VDC external power for supplying power to the control module.

⑧ STATUS (LED)

Indicates the status of the battery string (Normal🟢, Abnormal🔴).

⑨ Dry Contact

(Dry Contact Terminals): provide 2 input and 2 output dry contact signals.

Dry Contact definitions

In/Out	Function	Open and close state
In1	Reserved	N/A (Not Applicable).
In2	Reserved	N/A (Not Applicable).
Out1	Reserved	N/A (Not Applicable).
Out2	Reserved	N/A (Not Applicable).

⑩ LAN Port

RJ45 port, follows Modbus protocol, used for communication between the battery system and LEMS, switch or upper controller.

⑪ RS485 Port

Console Communication Terminal: (RJ45 port), for manufacturer or professional engineer to debug or service.

⑫ CAN A, CAN B Ports

CAN Communication Terminal: follows CAN protocol, for communication between the battery system and the PCS.

CAN A connects to another BMS (Battery control module).

CAN B connects to PCS.

⑬ ADD Switch

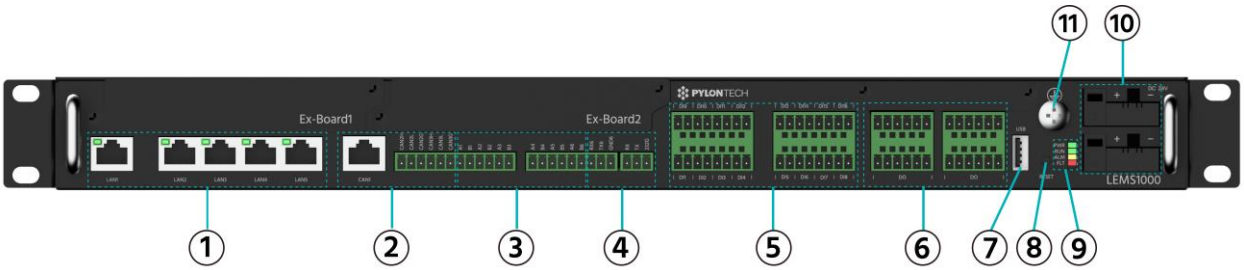
6-bit dial switches to manually distribute the communication addresses of the battery system. The lower position is OFF, means "0". The upper position is ON, means "1". 1st bit to 5th bit are for address, and the 6th bit dial switch supports a 120Ω resistance.

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.

Item	Parameter
Operating voltage range (VDC)	9~36
Communication interface	LAN/CAN/RS485/RS232/USB
System Consumption (W)	12
Dimensions (mm)	482.6(L) x 246.5 (D) x 44 (H)
Protection degree	IP20
Pollution degree	PD2
Weight (kg)	4.0
Working temperature (^{O}C)	-40~85
Storage temperature (^{O}C)	-40~85
LAN (maximum 10 Sockets)	Speed:100/1000Mbps
CAN (maximum 3 groups)	Baud rate: 500K; terminal resistance: 0/120Ω
RS485 (maximum 6 groups)	Baud rate:9600/115200
RS232(maximum 2 groups)	Baud rate:115200
DI (maximum 16 connects)	Dry Digital Input
DO (maximum 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, and 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, and etc.
4	RS232	RX6/TX6/GND6 RX/TX/232G	Debugging ports.
5	DI	DI1~16	Dry contacts. Passive signal or active signal not higher than 5V.
6	DO	DO1~8	Dry Contact, 8 Isolated passive Digital Outputs, specification is DC 30V/2A.
7	USB	USB	USB2.0 port is used for device upgrades or downloading data using a USB flash drive.
8	RESET Button	RESET	Press this button restart the system.
9	LED Indicators	PWR/RUN/ALM/FLT	See *Section 3.2.2.2 LED Indicators Instructions* for detailed instructions.
10	9~36VDC input	DC 24V + -	Device backup power ports. 9~36VDC external 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.
	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

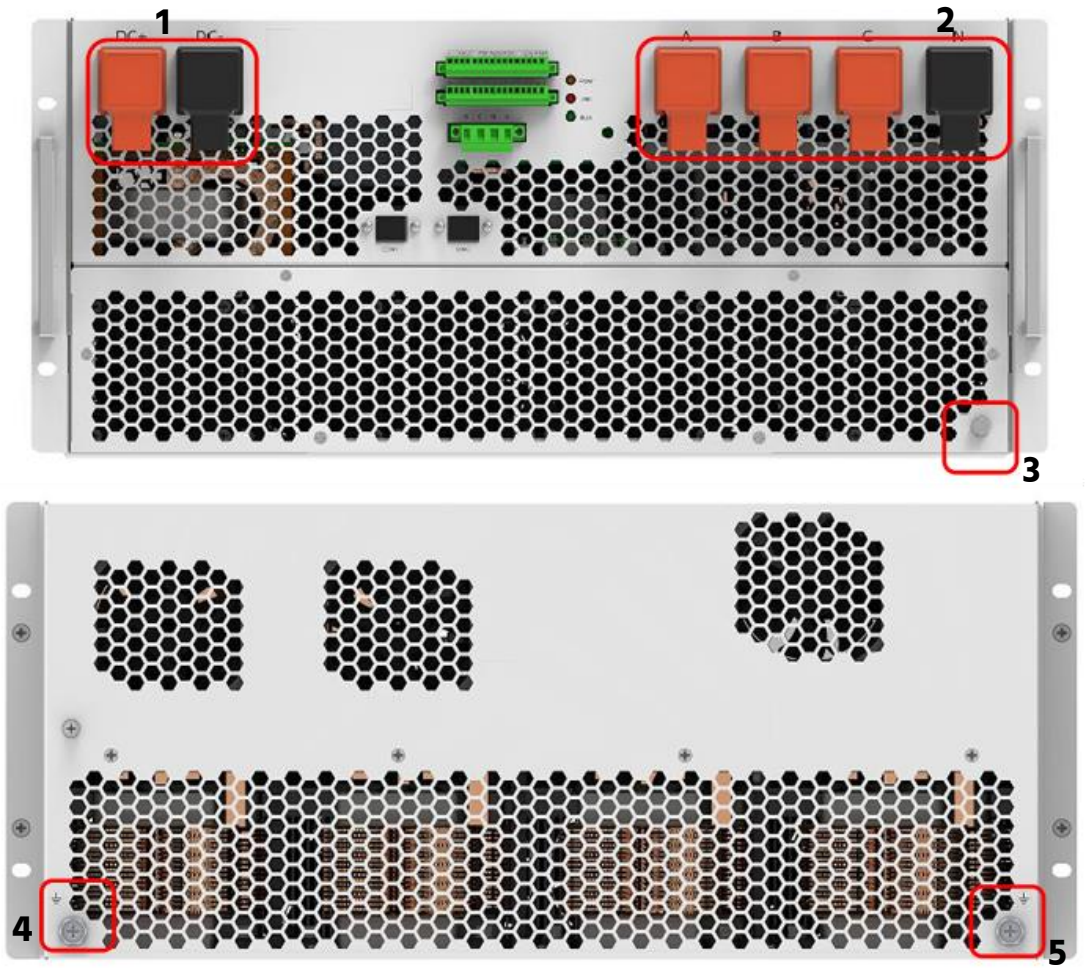
The directional PCS realizes the charge and discharge control of the energy storage battery. It is an important part of the smart grid, which can regulate power resources and ensure the normal operation of the grid. On one hand, the PCS can invert the direct current of the energy storage battery into 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
	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

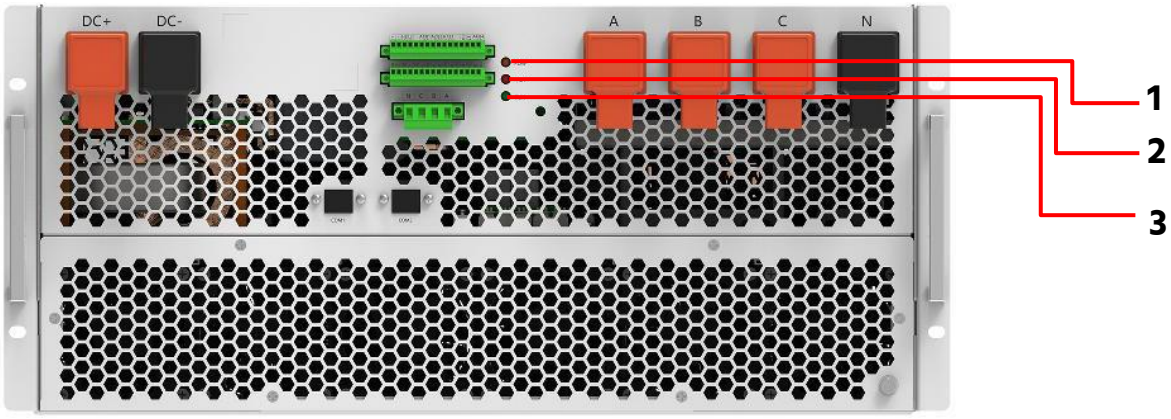
	Adjustable Reactive Power Range	-100%-100%
	Overvoltage Category (OVC)	III
	Rated Conditional Short-circuit Current (A)	10k
AC off-grid output	Nominal AC Voltage Ur (V)	3L/N/PE, 400/230
	AC Voltage Tolerance	AC 400V ± 3%
	AC Rated Input/Output Apparent Power (kVA)	125
	Max. AC Input/Output Current (A)	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 (℃)	-30-55℃ (>50 derating)
	Max. Operating Altitude (m)	4000 (>2000 derating)
	Enclosure Dimensions (W × H × D, mm)	520 × 240 × 680
	Weight (kg)	≤70

3.2.3.2 Front and Rear Interface Panel of the PCS



No.	Item	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 Liquid Chiller

The outdoor cabinet is equipped with a 5kW liquid chiller to control the temperature and of the battery compartment.

The energy storage battery system inside the cabinet is the main heat source. And the liquid chiller's parameters are selected based on the battery system's total heat generation to meet the requirements in the target environment.

Product Specifications

Product Model	EMW50HFNC1A
Dimensions, Weight & Mounting Method	
Dimensions (mm)	700 (W) ×900 (D) × 245 (H)
Weight (kg)without coolant)	75
Installation Method	Horizontal Embedded
Inlet and Outlet Connection	DN20 Quick Connector
Environmental Protection & Performance	
Working Temperature Range (^{O}C)	-30~+55
Storage Temperature Range (^{O}C)	-40~+70
Working altitude (m)	≤3000m (The refrigerating capacity is derated when the altitude is above 1000m, and the refrigerating capacity will be derated by 5% for every 1000m increase.)
Noise Level (@1 meter, dB(A))	75
Corrosion-proof Grade	C3M
IP Protection Level (for outdoor side)	IPX5
Appearance	RAL7035 Outdoor Orange Stripe
Refrigerant	R134a
Coolant	50% glycol solution
Design Life (year)	10
Air Outlet Method	Rear Air Outlet
RoHS Compliant	Yes
Cooling/Heating Capacity	
Cooling Capacity @ W18/L35 (kW)	5.0
Heating Capacity @Tu=10°C (kW)	2.0
Outlet Coolant Temperature (°C)	18

Parameter Determination	
Outlet Temperature Setting Range (°C)	10～35（Heating Point≤ Cooling Point)
Default Cooling Set Point (°C)	18
Default Heating Set Point (°C)	15
Communication Protocol	RS485/CAN
Recycled Flow	
Rated Circulating Flow (L/Min)	46.5@60kpa
Power Consumption	
Cooling Input Consumption@ W18/L35 (kW)	2.50
Heating Input Consumption@ Tu=10°C (kW)	2.35
Self-cycling Mode (Single pump operation) Consumption (kw)	0.25
Maximum Power Consumption (kW)	3.60
Power Supply	
Rated Operating Voltage (V, HZ)	220~240V 50/60Hz
Power Supply Range (V, HZ)	220±15%, 50/60±3Hz
Max. Operating Current (A)	19.2

Product Appearance

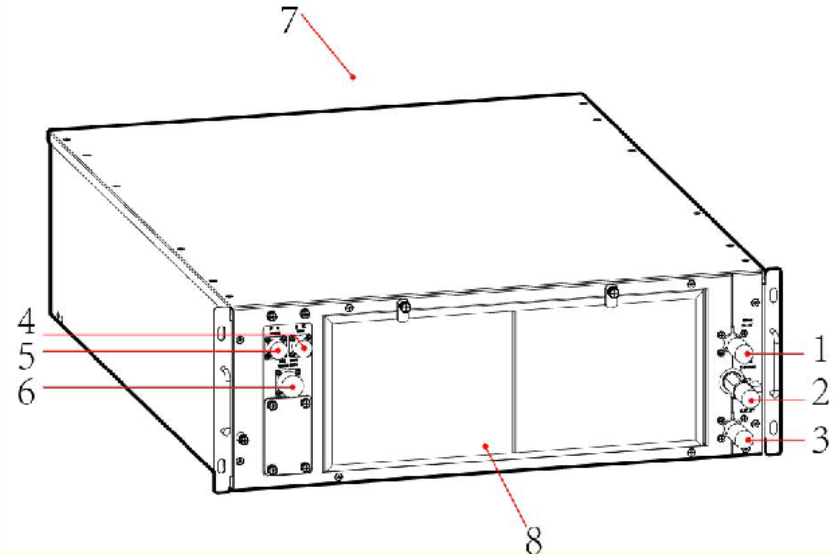


Figure	Description	Figure	Description
1	Coolant inlet	**5**	Debug interface
2	Coolant filling & drain port	**6**	Power interface
3	Coolant outlet	**7**	Air outlet
4	COM interface	**8**	Air inlet

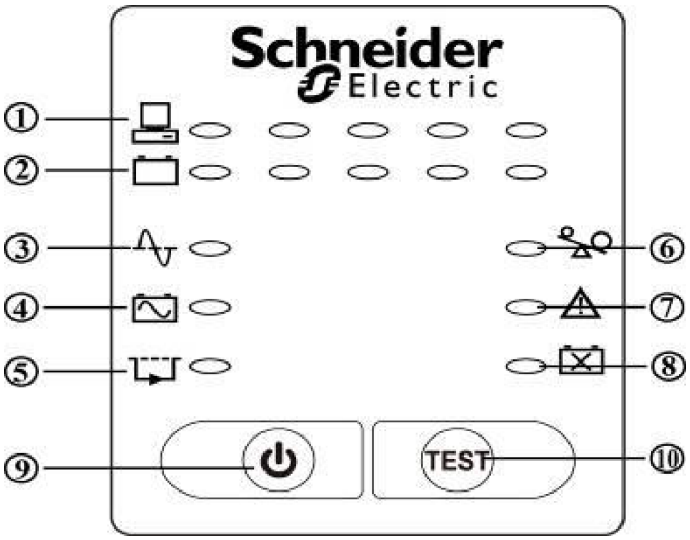
3.2.5 UPS (SP1K W)

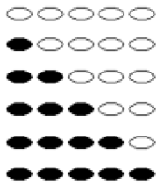
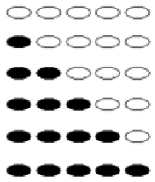
3.2.5.1 Specifications of the UPS

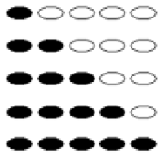
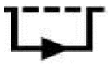
Model		SP1K-W
Capacity		1000 VA / 800 W
Input parameter		
Voltage range		110-300v; 110V under 60% of load, 110-160V under loaded linear derating; 300V under full load
Frequency range		40Hz ~ 70 Hz
Input mode		Single phase (L, N, PE)
Power factor		0.99
Output parameter		
Output voltage		220/230/240VAC
Voltage regulation		±1%
Frequency range (synchronizing range)		47 ~ 53 Hz @50Hz or 57 ~ 63 Hz@60Hz
Frequency range (battery mode)		50 Hz ± 0.25 Hz or 60Hz ± 0.3 Hz
Overload		100%-110%: warning only 110%-130%: power off automatically after 60 seconds or switch to bypass when mains supply is input normally. >130%: power off immediately, or switch to bypass when mains supply is input normally.
Current crest ratio		3:1
Harmonic distortion		≦ 3 % @ 100% linear load; ≦ 6 % @ 100% non-linear load
Switching time	Mains supply⟵⟶ Battery	0ms
	Inverter⟵⟶Bypass	4 ms (typical)
Output waveform		Pure sine wave
Bypass input		
Bypass input voltage		187V-253V AC
Bypass frequency		47-53Hz
Overload		Less than 30 minutes for 110%-120%; less than 10 minutes for 120%-130%; less than 1 minute for over 130%

Efficiency		
Mains mode		87%
Battery		
Battery form		12 V / 7 AH
Number of batteries		3
Charging time		Achieving 90% capacity of internal battery in 4 hours
Charging current (maximum)		1.0 A
Standby time		4 min.
Charging voltage		41.0VDC±1%
Appearance		
Size (D x W x H) (mm)	Tower	397 X 145 X 220 (mm)
Net weight (kg)	Tower	13
Environment		
Working temperature		-25℃ ~ 55℃ 40℃-55℃ 400W load -5℃ ~ 40 battery&online full load -25℃~-5℃ online full load -25℃ online full load start up
Operating temperature		20-90 % RH (non-condensing)
Noise		Less than 50dBA @ 1m
Altitude		1000m, derating 1% per 100m over 1000m
Management and monitoring		
Intelligent RS-232		Support Windows®2000/2003/XP/Vista/2008/7, Linux, Unix and MAC
Optional SNMP, Relay I/O and Modbus		After SNMP is selected, EMD module can also be added to monitor the ambient temperature and humidity
Certification		
Conformity certification		TLC, CE

3.2.5.2 Front Display Panel

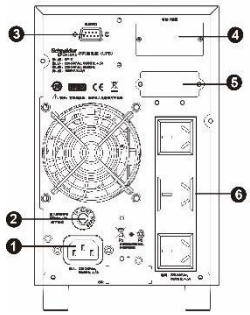


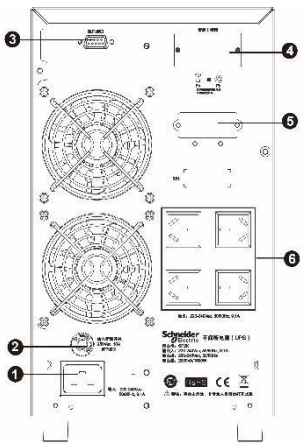
No.	Icon / Indicator	Description	
1	Load indicator	Load indication is divided into six grades: <5%- All indicators are off 5%~25%- First left indicator is on 25%~45% - First and second left indicators are on 45%~65% - First to third left indicators are on 65%~85% - First to fourth left indicators are on >=85% - All indicators are on	
2	Battery capacity/input voltage indicator	Battery capacity indication is divided into five grades: <24% - First left indicator is on 24%~48% - First and second left indicators are on 48%~72% - First to third left indicators are on 72%~96% - First to fourth left	

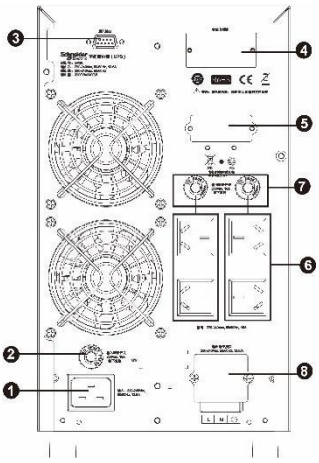
		indicators are on >=96% - All indicators are on Input voltage indication is divided into six grades: <192V - All indicators are off 192~210V - First left indicator is 210~229V - First and second left indicators are on 229~248V - First to third left indicators are on 248~266V - First to fourth left indicators are on >=266V - All indicators are on	
3	 On-line indicator	Mains supply is used for UPS to realize the dual power supply conversion between the power supply and the connected equipment that is, it works in the online mode.	
4	 Battery-powered indicator	Battery is used for UPS to supply the connected equipment, that is, works in the battery mode.	
5	 Bypass-powered indicator	Bypass mains supply is used for UPS to supply the connected equipment, that is, it works in the bypass mode.	
6	 Overload indicator	UPS detects that the load exceeds the rated output power.	
7	 Fault indicator	UPS detects internal fault.	
8	 Indicator for battery replacement	The battery is disconnected or the battery needs to be replaced.	
9	 UPS on / off button	After pressing this button for 1 second, UPS will operate as follows, depending on the current mode of operation: 1) If UPS is not powered on and the mains supply is normal, UPS will be turned on and enter the online mode.	

		2)If UPS is not powered on and the mains supply is abnormal, UPS will be turned on and enter the battery mode. 3)If UPS is in online mode, UPS will be shut down and stop supplying power. If UPS is in battery mode, UPS will be shut down and stop supplying power.
10	TEST Battery self test / input voltage display/mute button	1) Battery self-test In online mode, after pressing this button for about 3 seconds, UPS will start battery self-test. 2) Input voltage display In bypass mode and online mode, after pressing this button for about 0.5 seconds, UPS will switch the battery capacity indicator to the input voltage indicator, and switch it back to the battery capacity indicator after 5 seconds. 3) Mute: In battery mode, after pressing this button for about 0.5 seconds, UPS will turn off the buzzer. Note -the buzzer can be turned on manually after it is silent.

3.2.5.3 Back Panel of Tower-type UPS







S/N	Functional component	Description
	Input connector	For IEC input port, power cord attached is used to

		connect UPS to mains supply. 1K and2K UPS 10A input connectors, 3KVA UPS 16A input connector.
	Input circuit breaker	Press this button to reset the input circuit breaker in case of overload.
	RS232 interface	It supports UPS to communicate with power management software through serial communication line, so as to realize the monitoring and management of UPS.
	Intelligent slot	It is used to install optional SNMP card (network management card), Relay I/O card and Modbus card to achieve more advanced communication and monitoring functions. After selecting SNMP card, you can also choose EMD card to monitor the ambient temperature and humidity.
	External battery pack connector	External battery connection cable attached is used to connect the external battery pack to UPS. Limited to extension.
	Output connector	With GB 10A. it connects electronic devices such as computers, monitors or printers to these connectors. The detailed specifications of each kind of machine are shown in the table below.
	Output circuit breaker	For 10A switch, reduce load of the connected equipment before pressing this button to reset the input circuit breaker in case of overload.
	Output terminal	A hard cable is used to connect the AC equipment.

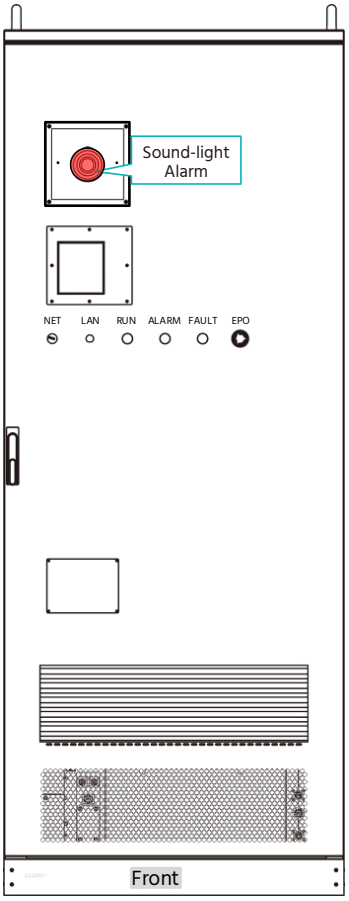
3.3 Safety Features

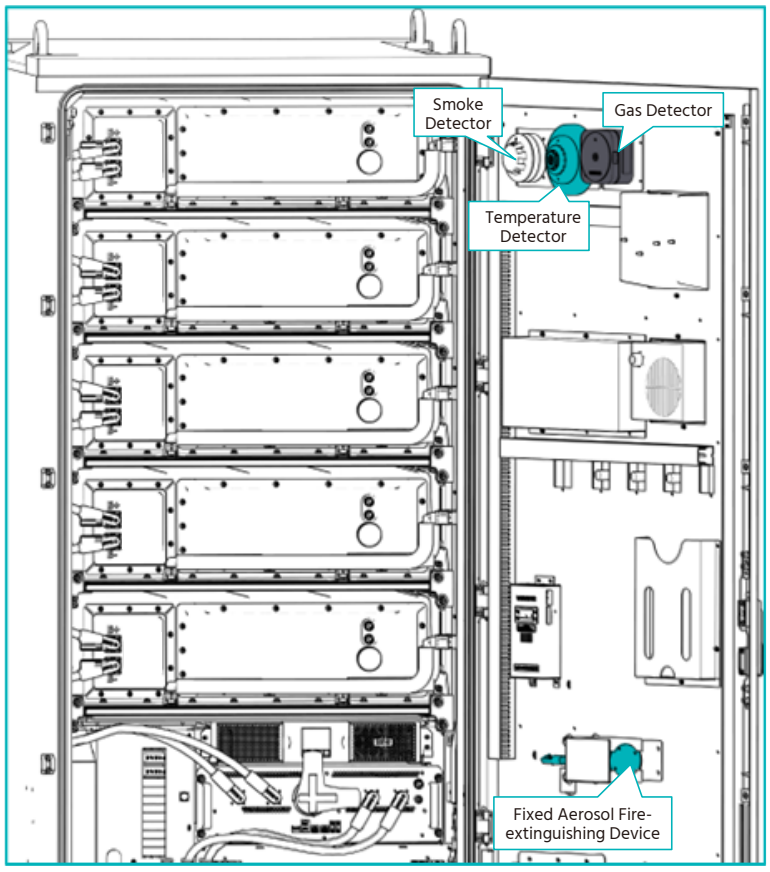
This system is equipped with safety features that include a fire protection system as well as an explosion proof and vent system.

3.3.1 Fire Protection System

The fire protection system is mainly composed of fire alarm system and fire suppression system. The former consists of detectors and sound-light 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.





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

(1) The cooling effect of endothermic decomposition.

(2) The chemical inhibition of the gas phase and the solid phase plays a synergistic role between each other.

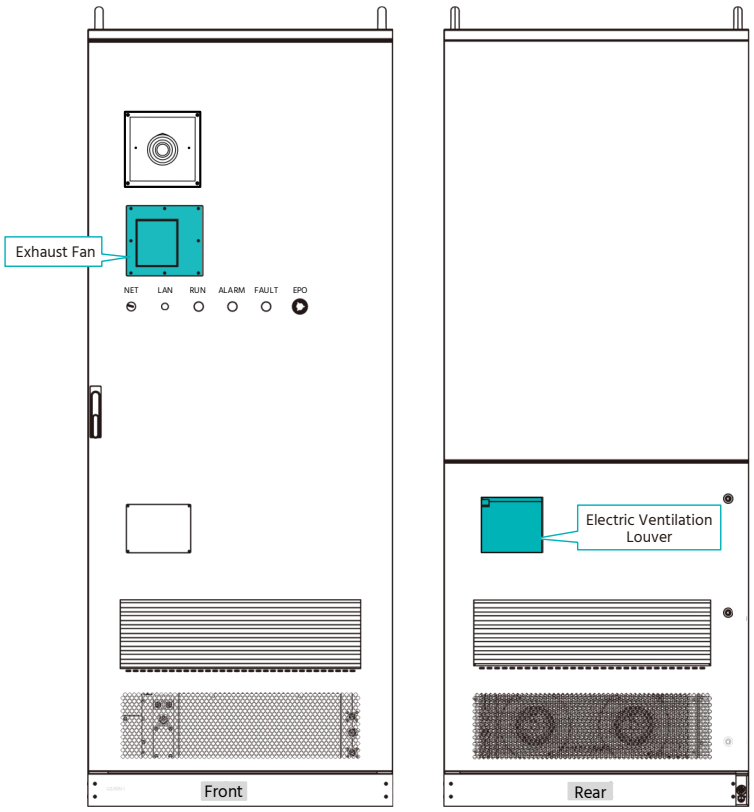
Specifications of Fixed Aerosol Fire-extinguishing Device

FP-200S	Technical Information	
	Product Model	FP-200S

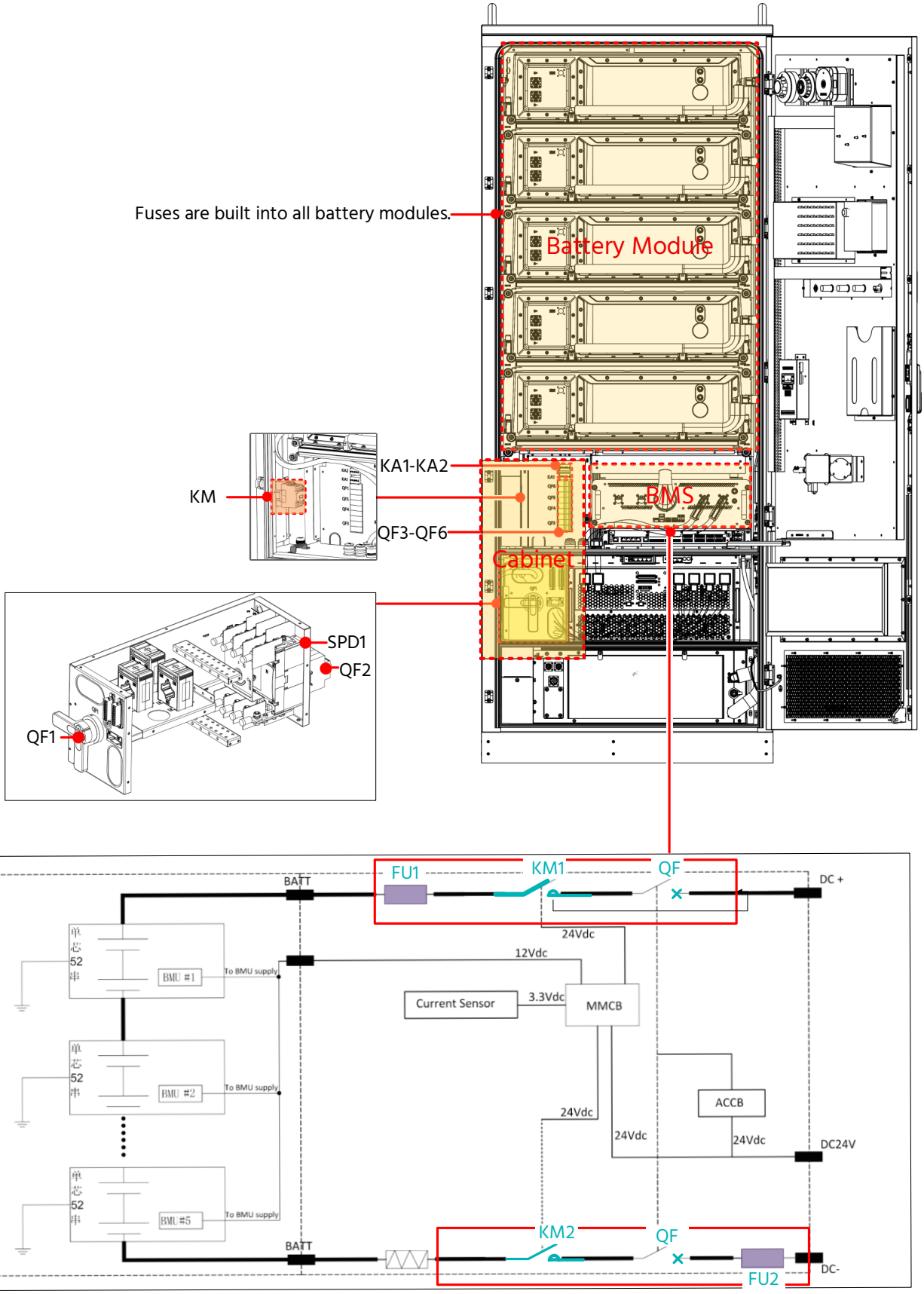
	Activation Mechanism	Thermal Activation Electrical (minimum 1.5VDC, minimum 0.8A in 3~4 seconds)
	Activator Type	Heating Element with 2.3 ohm Resistance
	Activate Line Supervision Current	Maximum 5 mA
	Wight Gross (g)	1840
	Mass of FPC Compound (g)	200
	Operational Discharge Time (seconds)	5~10
	Discharge Outlet	1
	Discharge Length (meter)	2
	Size (mm)	185 x 84 (including connector housing)
	Self-Activation Temperature (°C)	300
	Fire Class	A, B, C, F

3.3.2 Explosion proof and vent System

The explosion proof and vent system includes an electric ventilation louver and an exhaust fan. The gas detector also contributes to the system. Please see the following for details.



3.3.3 Protected Electrical Components


Fuses are built into all battery modules.
Battery Module
KA1-KA2
KM
QF3-QF6
BMS
Cabinet
SPD1
QF2
QF1
FU1
KM1
QF
DC +
BATT
24Vdc
12Vdc
单芯52串
BMU #1
To BMU supply
Current Sensor
3.3Vdc
MMCB
BMU #2
ACCB
24Vdc
24Vdc
24Vdc
DC24V
BMU #5
KM2
QF
BATT
DC-
FU2

Classification	Device	Specifications
Battery Module	Fuse	Model：A372102-400 DY Specification：Rated Voltage: 250Vd.c. Rated Current: 400A, Rated Breaking Capacity: 50kA
BMS	FU1-2	Model：ESH3061 Specification：Rated Voltage: 1000Vd.c. Rated Current: 400A, Rated Breaking Capacity: 50kA@1000Vdc
	Contactor KM1-2	Model：GPR-H350-A-24Vdc Specification：Rated Voltage: 1500Vd c. Rated Current: 400A,Rated coil voltage: 24Vd.c
	Molded Case Circuit Breaker QF	Model：CM3DC- 250HUZ/3340 Specification: Rated Voltage: 1500Vd.c. Rated Current: 250A
Cabinet	Load Molded Case Circuit Breaker QF1	Model：GSM3-250LZ/4340B Specification：Rated Voltage: 400Va.c. Rated Current: 250A
	Miniature Circuit Breaker QF2	Model：GSB1-63M/4PC32A Specification：Rated Voltage: 400Va.c. Rated Current: 32A
	Miniature Circuit Breaker QF3	Model：GSB1-63L/3PC4A Specification：Rated Voltage: 415Va.c. Rated Current: 4A
	Miniature Circuit Breakers QF4-5	FUS: GSB1-63L/2P C32A Specification：Rated Voltage: 400Va.c. Rated Current: 32A
	Miniature Circuit Breaker QF6	Model：GSB1-63L/2P C16A Specification：Rated Voltage: 400Va.c. Rated Current: 16A
	AC Contactor KM	Model：GSC1-3210 AC220V Specification：Rated Voltage: 380Va.c. Rated Current: 32A Rated coil voltage: 220Va.c.

	Relays KA1-KA2	Model：MY2IN-GS-R DC24V with PYFZ-08-E base Specification：Rated Load Voltage: 250Va.c. Rated Load Current:7A Rated Coil Voltage: 24Vd.c. Contact Configuration: 2P
	SPD1	Model：DS44-400 Specification：Type 2 Voltage: 230/400Va.c.

4 Mechanical Installation

4.1 Checking Before the Installation

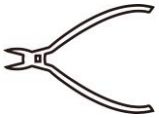
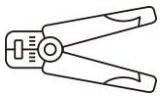
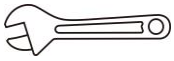
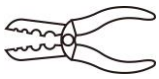
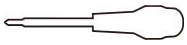
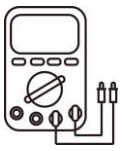
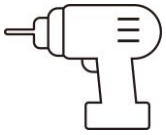
Checking the Outer Packing

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

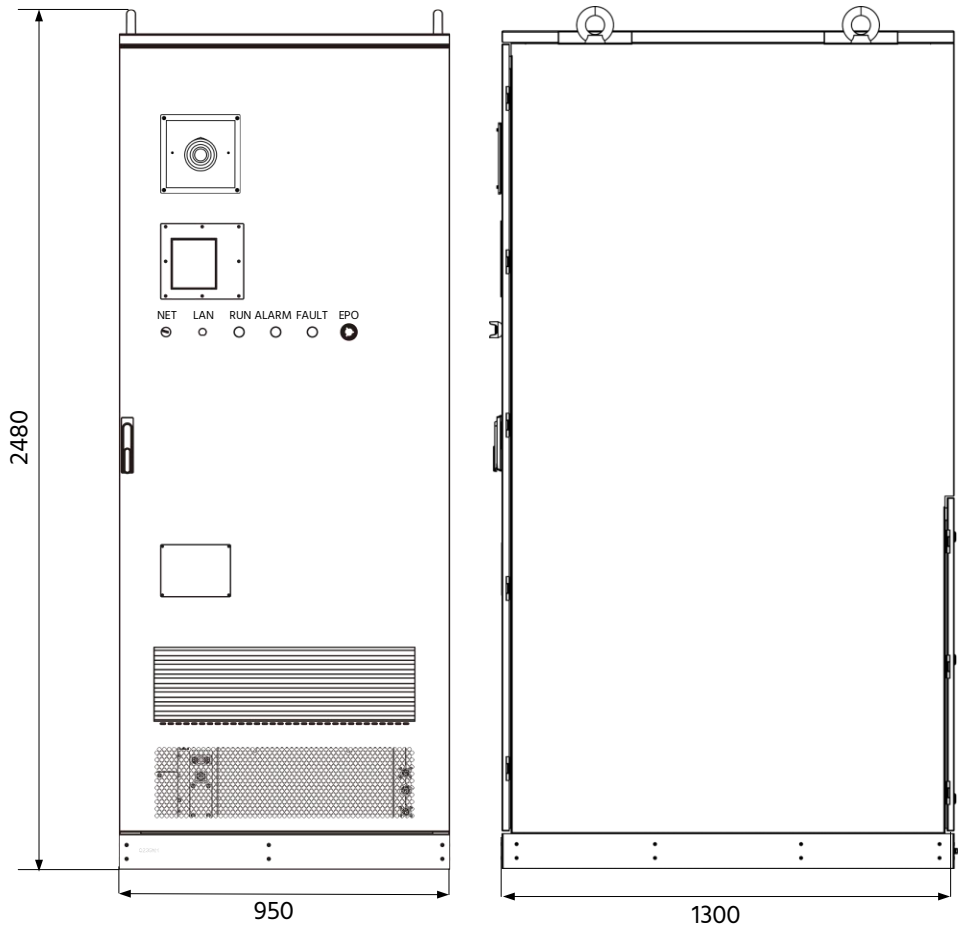
4.3.1 Working Environment Requirements

The 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.

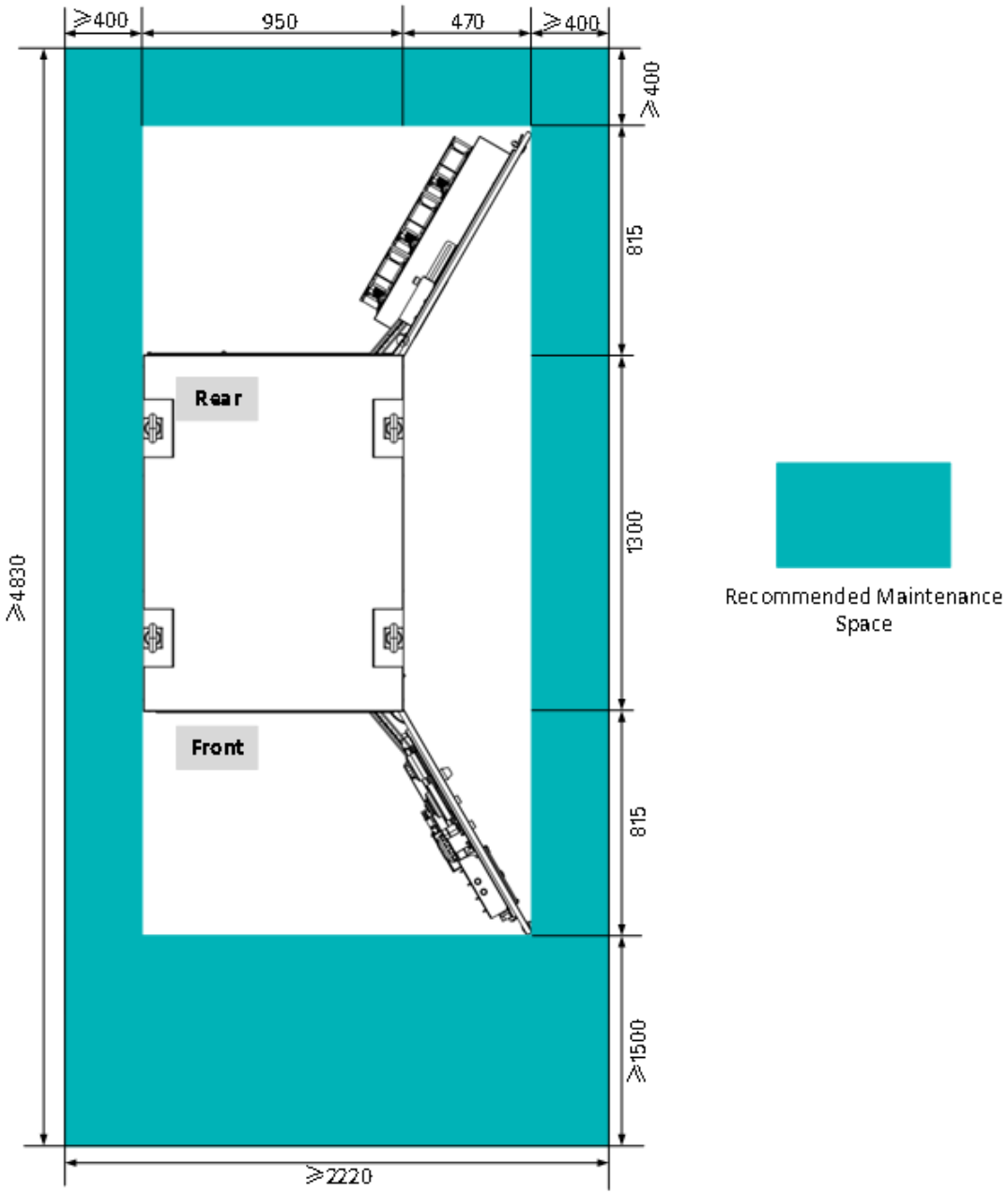
4.3.2 Installation Space Requirements

- The external dimensions of the storage system are 950 mm (W) x 1300 mm (D) x 2480 mm (H). And the installation site must have enough space to place the equipment.

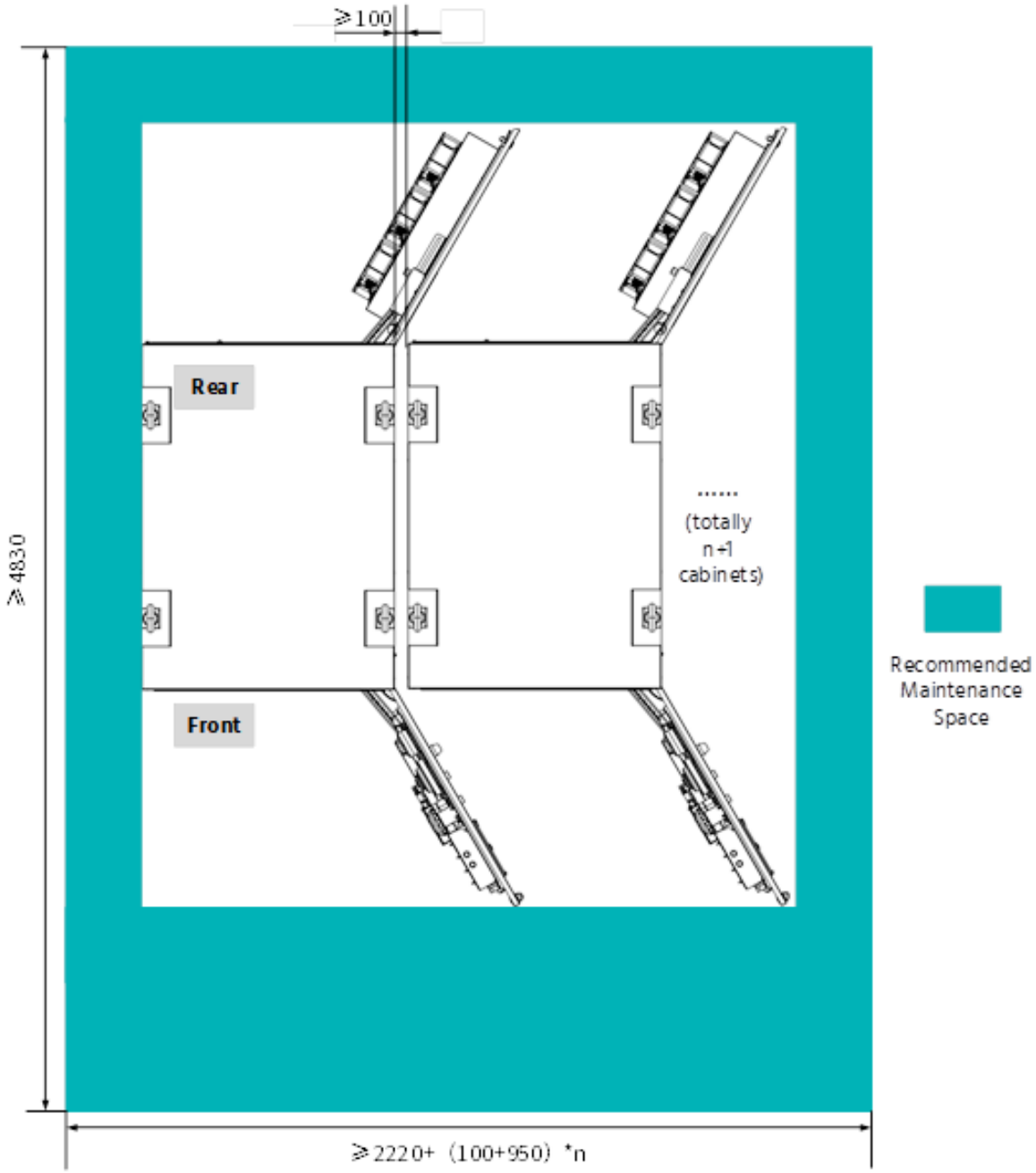


(Unit: mm)

- The installation space for a single cabinet system is shown below (recommended spacing).



- When multiple cabinets are installed, the spacing between each cabinet is **100mm**. In the **grid-connected** application scenario, a maximum of **20** cabinets can be connected. In the **off-grid** application scenario, a maximum of **5** cabinets can be connected.

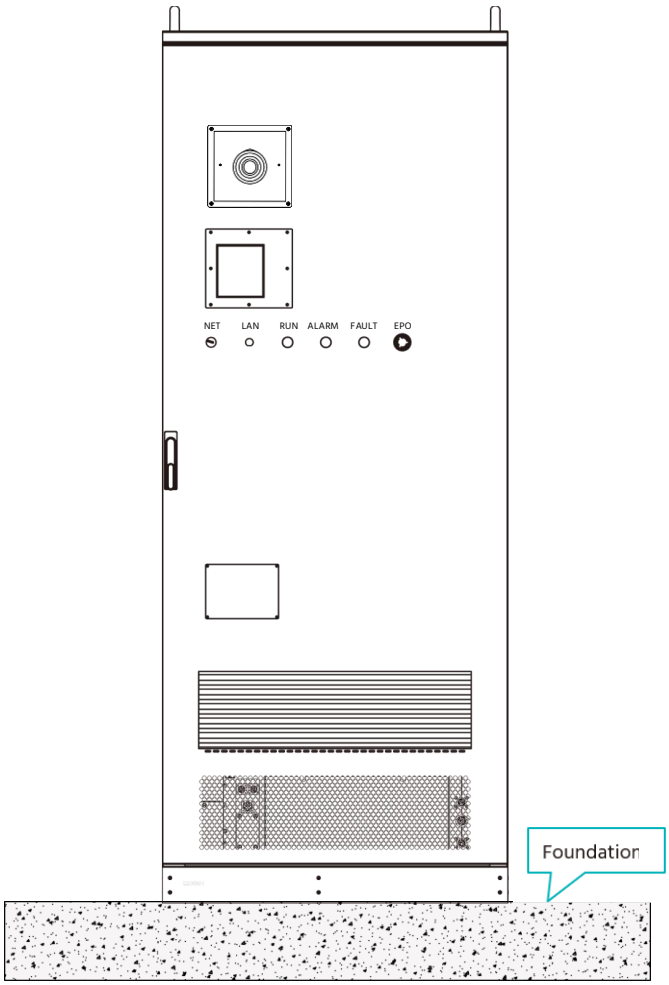


4.3.3 Installation Foundation Requirements

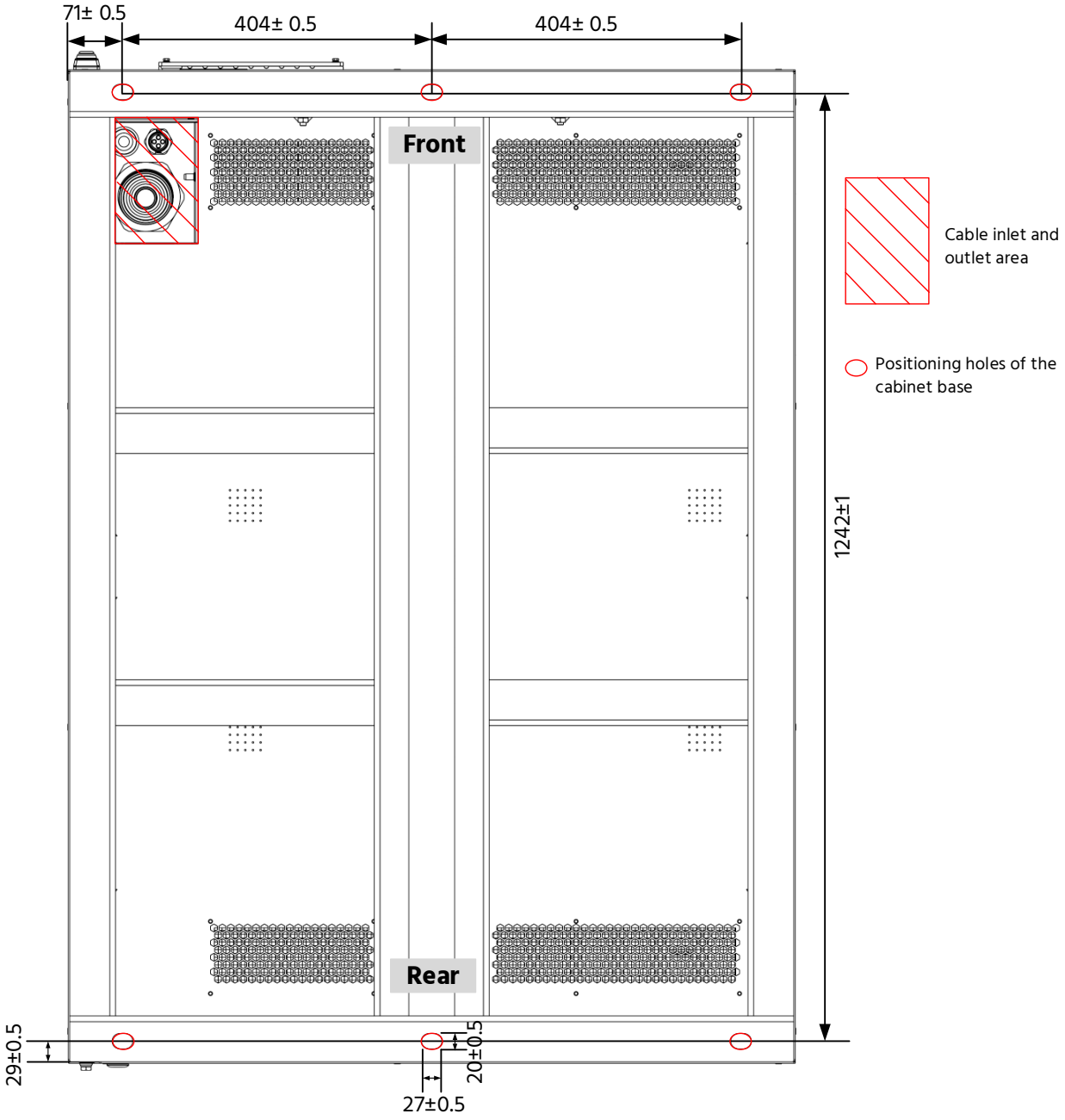
The installation site needs to meet the following requirements:

- The installation foundation should be able to bear the total weight of the whole outdoor cabinet system (about 2900kg).
- 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; or
  - at least 300mm above the level ground

NOTE: The angle of inclination of the installation ground should not exceed 15°.



- The cabinet is fixed at the bottom, and holes should be pre-opened on the installation site in accordance with the fixed holes (marked in red) in the base of the cabinet. See the drawing 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

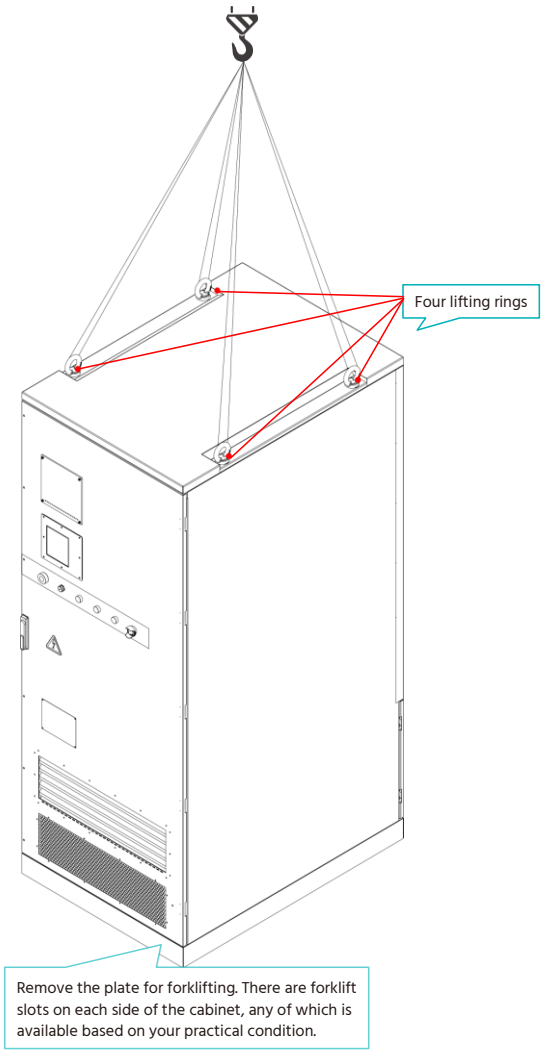
Pay attention to the falling risk which can cause severe injury or death. Do not stand under a lifted load. Make sure no unauthorized personnel are in the vicinity of a lifted load.

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.

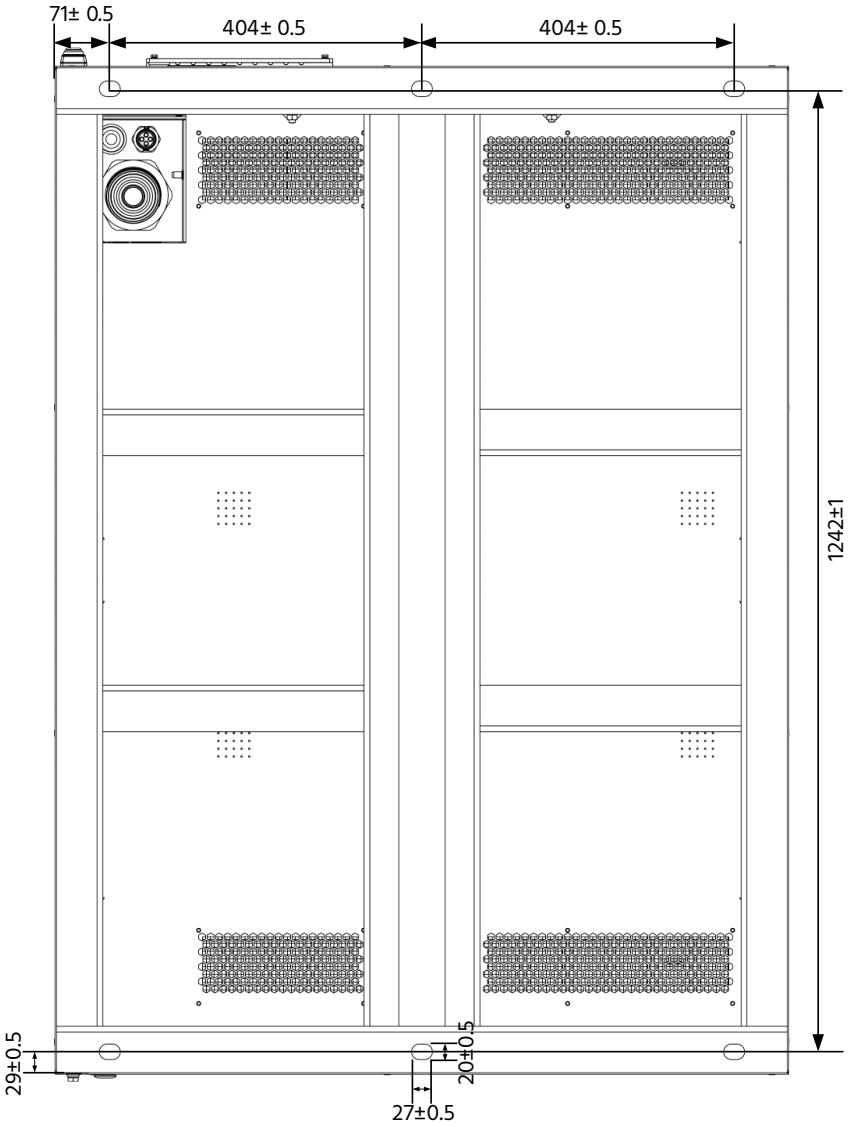
NOTE: During the transportation by forklift, the radial acceleration of the forklift cannot exceed 2.35m/s^2. The lifting acceleration should be less than 1.4G and the duration should be less than 1.2G.

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 6 mounting holes.



Positioning holes in the mounting foundation (Unit: mm)

3. Use expansion bolts to secure the cabinet to the foundation.

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 Cable Requirements and Bolt Torque

- **Cable Requirements**

The wire diameter of the cables used in the outdoor cabinet must be selected in accordance with the maximum current of the AC side and DC side, and there must be a residual reservation. Please follow the cable specifications below.

Cable	Diameter Requirements	Terminal Model
AC side Phase A/B/C/N	70 mm^2	SC70-8
Ground PE-Cable	35 mm^2	SC35-8
External Ethernet communication cable	Ultra Category 6 shielded cable	RJ45
External RS485 cable	Twisted shielded cable ≥ 1,5 mm^2	E1510

- **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:

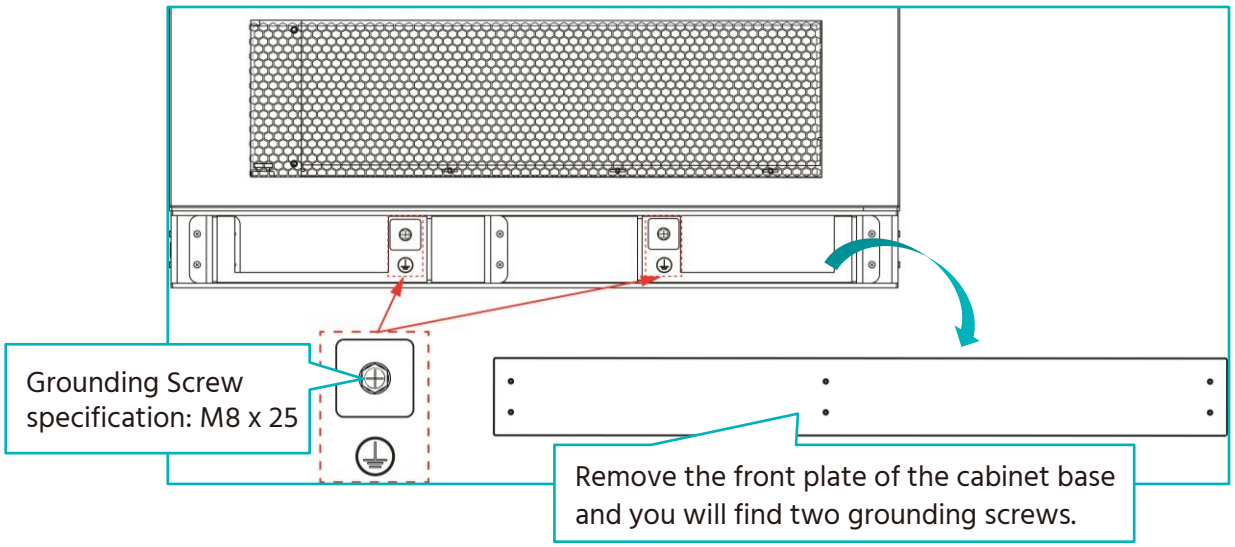
Screw Size	M3	M4	M5	M6	M8	M10	M12	M16
Torque (N•m)	0.5~0.8	1.2~1.5	3~4	5~6	8.8~10.8	17.7~22.6	31.4~39.2	78.5~98.1

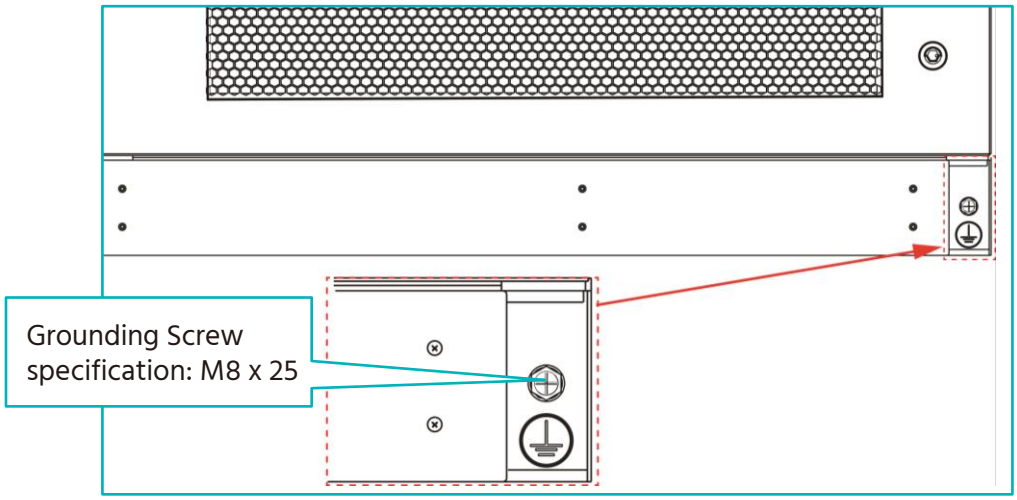
5.2 Grounding

DANGER

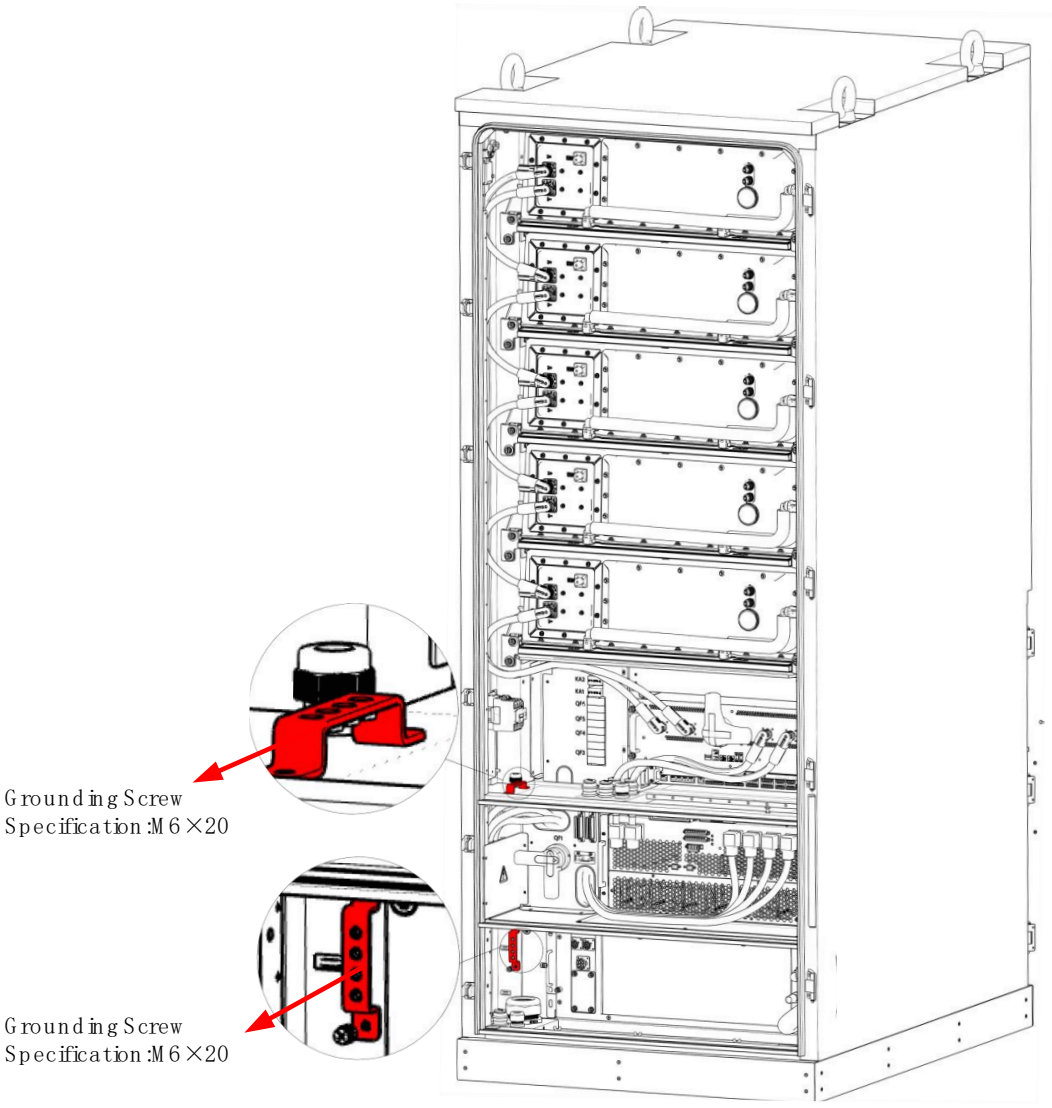
Life-threatening electric shock may occur if the grounding is insufficient or absent. Before installation, make sure that the grounding points of the battery energy storage system are stable and reliable.

- PE (to the ground): There are three grounding points for cabinet grounding on the base of the cabinet, two on the front of the base and one on the rear.





- Grounding copper bars: There are two grounding copper bars inside the cabinet, used for connecting grounding cables of the electrical device in the cabinet.



5.3 Battery Energy Storage System Connection

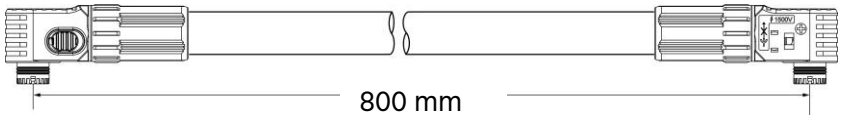
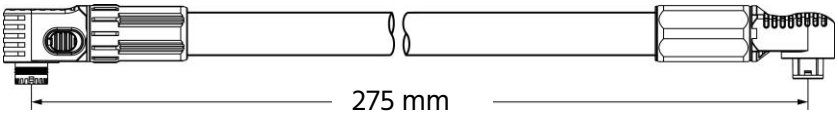
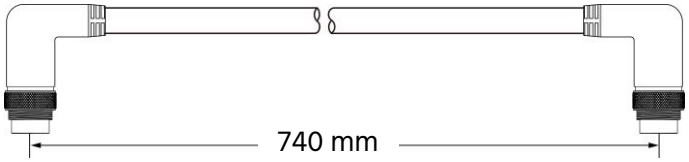
DANGER

Do not connect the positive and negative reversely.

(1) Connect the positive and negative electrodes of the battery modules in series.

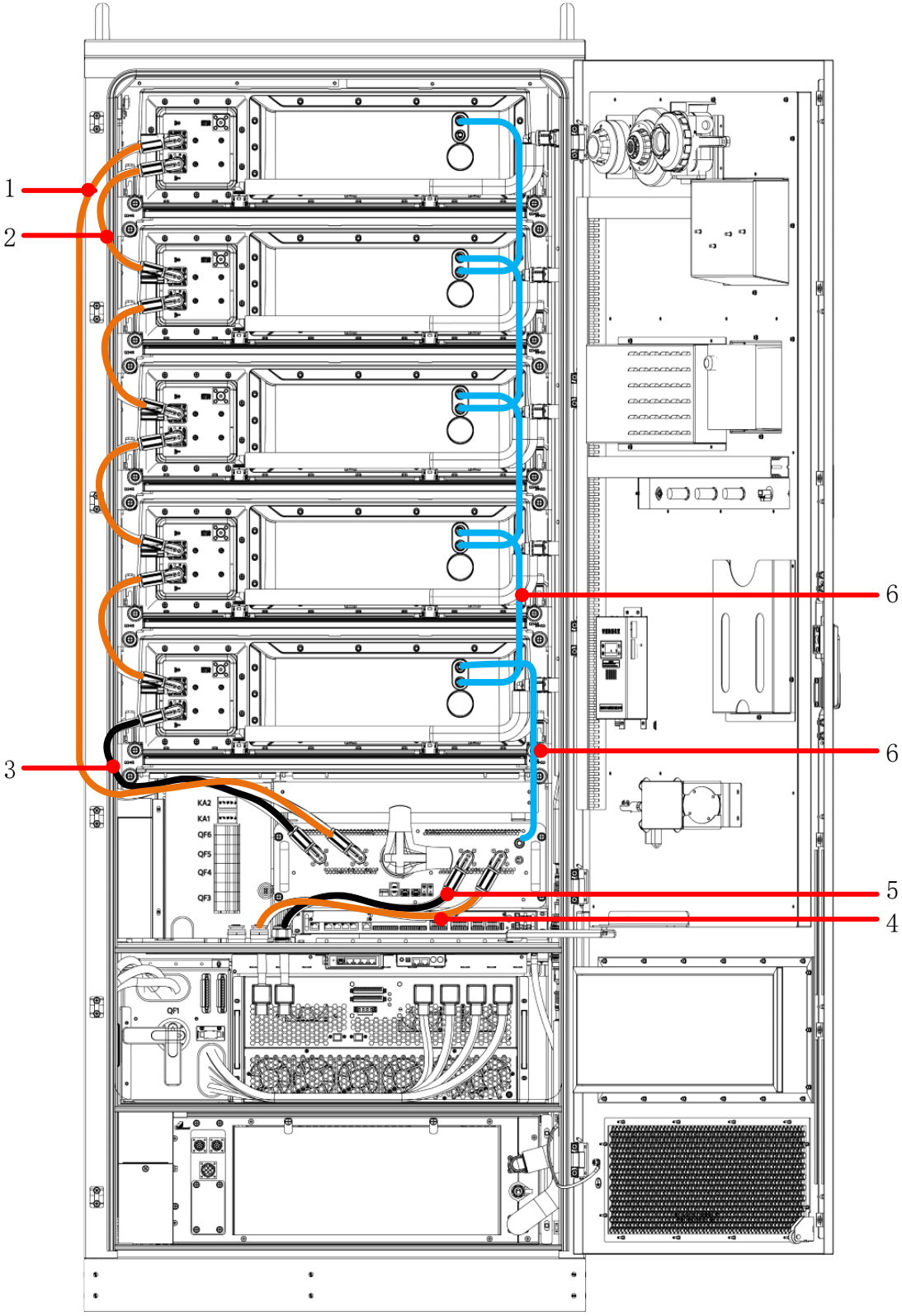
(2) Connect the internal and external communication cables of the battery string

5.3.1 Cable List

Item	Description
❶	Power Cable, Orange, 2/0 AWG (BMS 'B+' to Battery Module 'B+') 
❷	Power Cable, Orange, 2/0 AWG (Battery module series connection, 'B-' to 'B+') 
❸	Power Cable, Black, 2/0 AWG (BMS 'B-' to Battery Module 'B-') 
❹	Power Cable, Black, 2/0 AWG (BMS 'D+' to PCS 'D+') 
❺	Power Cable, Orange, 2/0 AWG (BMS 'D-' to PCS 'D-) 
❻	Communication Cable, Black (BMS to Battery Module/ Battery module cascade communication connection) 

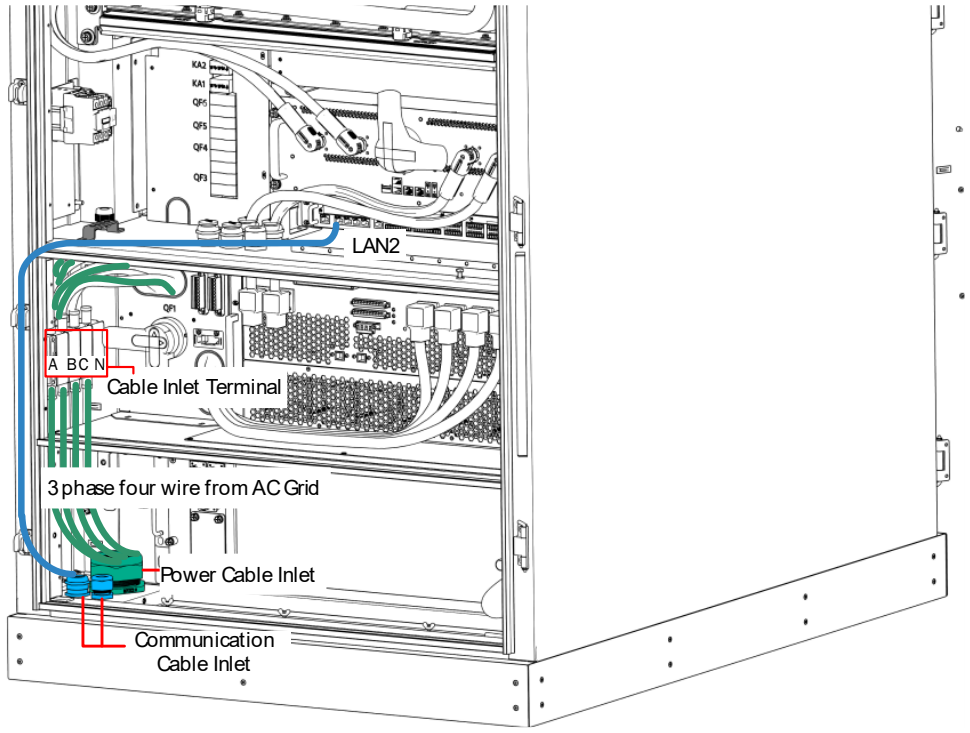
5.3.2 Battery String DC Wiring

For the battery string system, the DC wiring should be done according to the drawing below. The label numbers correspond to the cable list in *section 5.4.1.*



5.4 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.

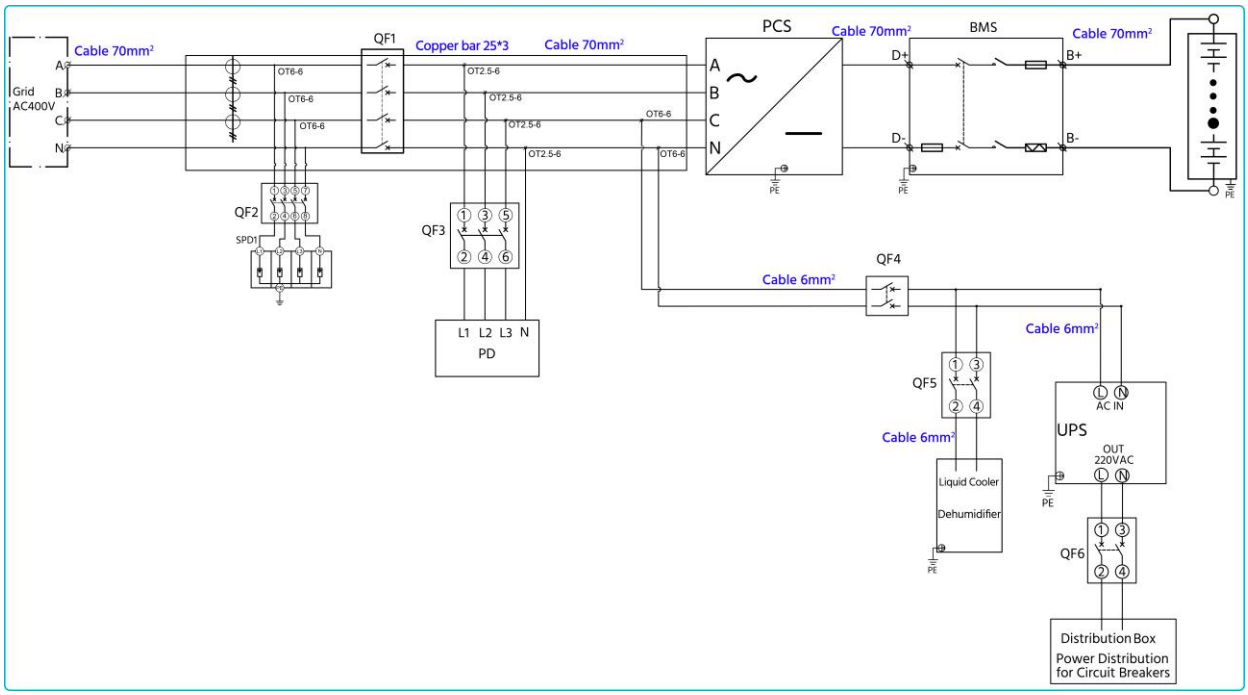


Front View

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 finish wiring, make sure that all the cable inlets and outlets are sealed with suitable material to insure fireproof, waterproof and insect-proof.

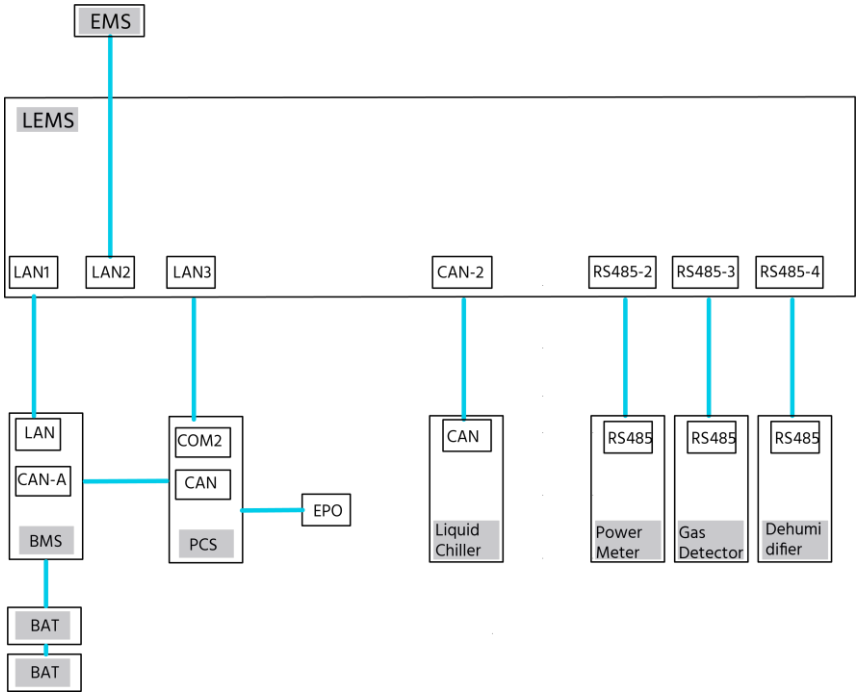
5.5 Communication Wiring Diagram

5.5.1 System Electrical Diagram



5.5.2 Wiring Diagram

The communication cables have been connected before delivery.



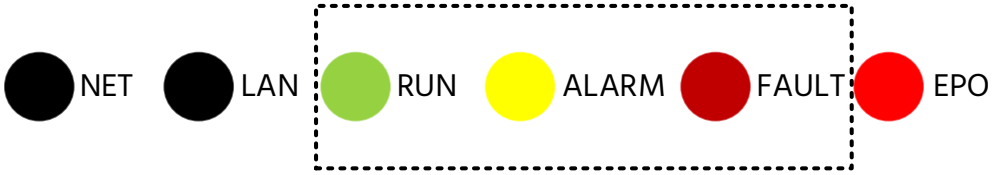
5.5.3 Definitions of LEMS Ports

Port	Silk-screen	Definition
LAN	LAN1	Battery Control Module(BMS)
	LAN2	External EMS
	LAN3	PCS
	LAN4	Parallel Cabinet 1(single cabinet not applicated)
	LAN5	Parallel Cabinet 2(single cabinet not applicated)
RS485	RS485-2	Power Meter
	RS485-3	Gas Detector
	RS485-4	Dehumidifier
	RS485-1, RS485-5, RS485-6	Reserved
RS232	RS232-1/RS232-2	Reserved
CAN	CAN-2	Liquid Chiller
	CAN-1, CAN-3	Reserved
DI	DI-01	Aerosol Signal Feedback
	DI-02	Reserved
	DI-03	Smoke Detector Signal Feedback
	DI-04	Temperature Detector Signal Feedback
	DI-05	EPO Signal Feedback
	DI-09	Grid-Connected Circuit Breaker(QF1)
	DI-11	Travel Switch
	DI-06~DI-8, DI-10, DI-12~DI-16	Reserved
DO	DO-01	Alarm Indicator
	DO-02	Running Indicator
	DO-03	Fault Indicator
	DO-04	Grid-Connected Circuit Breaker(Q F1) Shunt Trip
	DO-05	PCS Fan Control
	DO-06	Exhaust Fan
	DO-07	PCS Dry Contact
	DO-08	Reserved

6 Commissioning

6.1 System Status

The battery cabinet system status can be viewed through the Status LED(As shown in the dashed frame.) on the door of the communication and confluence cabinet.



6.1.1 Battery String Status

The battery string status can be viewed through the "STATUS "LED on the BMS of the battery string. Following are the details:

Table of LED Indicators Instructions

Battery Status	Normal/ Fault	STATUS (green)	STATUS (red)	Descriptions
		●	●	
Shut Down	/	Off	Off	Indicates the battery modules in the battery system are shutdown. And the BMS is still power on.
Initialization	Normal	Blink 2* (slow flashing)	Off	Indicates the battery system is initializing.
Sleep	Normal	Off	Blink 1* (slow flashing)	Indicates Sleep Mode, to save battery power.
Idle	Normal	Light	Off	Indicates Idle Mode, to save battery power.
Standby	Normal	Light	Off	Indicates Standby Mode.
Charge	Normal	Light	Off	Indicates the battery system is charging.
Discharge	Normal	Blink 2* (slow flashing)	Off	Indicates the battery system is discharging.
Fault	Fault	Off	Blink 3* (fast flashing)	Device initialization faults (the number of batteries is inconsistent, module capacity is inconsistent, battery manufacturers are inconsistent, module configuration information is inconsistent, BMU address assignment is incorrect.)

			Blink 2* (fast flashing)	Self-check of the safety function of the CMU chip or BMU chip is faulty.
			ON	Other faults.
Black Start	Black Start Succeeds	Blink 5* (fast flashing)	Off	The emergency power-on command succeeds.
	Black Start Fails	Off	Blink 5* (fast flashing)	The emergency power-on command fails.

* The LED Blink instructions:

Blink 1 - 0.3 seconds light / 3.7 seconds off.

Blink 2 - 0.5 seconds light / 0.5 seconds off.

Blink 3 - 1 second light / 1 second off.

Blink 4 - 4 seconds light / 1 second off. (**not in use for this system**)

Blink 5 – 0.1 seconds light / 0.1 seconds off.

6.2 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

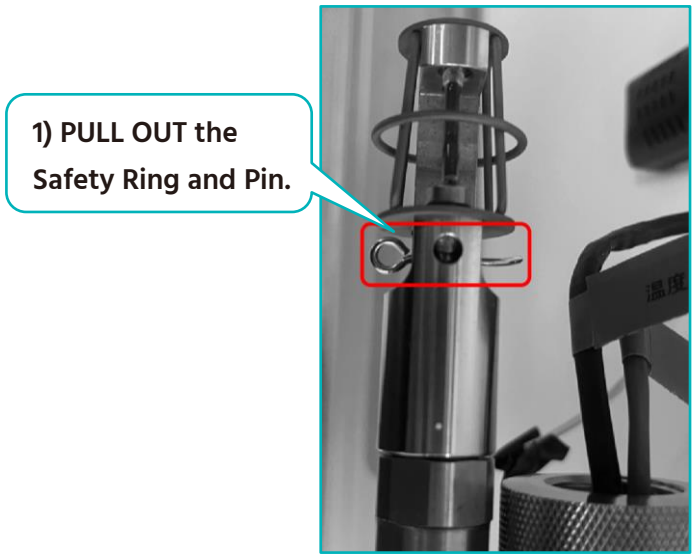
The switches or breakers between PCS and battery string must be off before the battery system power on. Make sure that all micro circuit breakers in the cabinet are off.

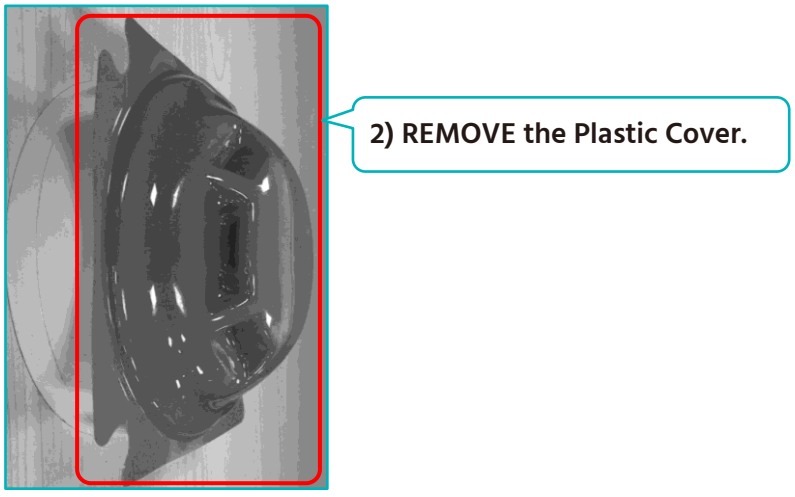
Fire Protection System Prerequisites

⚠ 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.





Turning-On Procedure

1. Switch on the Moulded Case Circuit Breaker QF1.
2. Switch on the Circuit Breaker QF2.
3. Switch on the Circuit Breaker QF3.
4. Switch on the Circuit Breaker QF4 and the UPS is powered on.
5. Switch Circuit Breaker QF5. And the liquid chiller, dehumidifier and the cooling fans for the PCS will start automatically.
6. Switch on the UPS following the steps below.

   (1) Once the UPS is powered on, The UPS front panel display illuminates and shows EATON logo.

   (2) Verify that the UPS status screen shows ⏻.

   (3) Press the ⏻ button on the UPS front panel for at least 2 seconds. The UPS front panel display changes status to "UPS starting...".

   (4) Check the UPS front panel display for active alarms or notices. Resolve any active alarms before continuing. See *section 8.2 UPS Trouble Shooting.*

NOTE:

- If the ⚠ indicator is on, do not proceed until all alarms are clear. Check the UPS status from the front panel to view the active alarms. Correct the alarms and restart if necessary.
- To ensure the UPS can provide adequate backup time, charge the UPS battery for eight hours before it is put into operation.

   (5) Verify that the ∿ indicator illuminates solid, indicating that the UPS is operating normally and any loads are powered and protected.

7. Turn on the BMS (battery control module) by switching on the circuit breaker of the control module.

Instructions of the battery system self-check process:

The battery string's system will enter self-check mode once the system is powered on.

- The status LEDs on the BMS and battery modules show green: if the BMS and all battery modules are working properly and the self-check is completed within 30 seconds, each status LED shows green, indicating that the self-check is finished.
- The status LED on the BMS turns red after 30 seconds: the BMS cannot receive signals from

the upper-level device (LEMS) because of the communication outage. Then the status LED will turn red after 30 seconds. This does not mean that there is a failure, it is that the BMS is not communicating with the LEMS or PCS.

- The status LED on the BMS or battery module shows red from the beginning: if the status LED shows red from the beginning, it indicates that there is a failure of the battery. In this case, inspection of the battery module must be performed first.

> **⚠ WARNING**
>
> If there is any failure during the self-check, be sure to debug the failure prior to the next step.

8. After the above procedures are completed, the EMS will issue startup command to the PCS. Wait for about 2 minutes for the PCS to complete the startup process. During this time, there will be a sound of contactors closing. After the PCS is running (the running indicator light is on), check for any abnormalities. If there is abnormal noise, unusual smells, or smoke, shut down the equipment immediately for inspection. To shut down the PCS, log onto the interface of the LEMS upper computer to perform.

NOTE:

- When starting up for the first time, it is necessary to fully charge the battery for SOC calibration.
- After installing or restarting the system when it is not used for a long time, the entire energy storage system should be firstly fully charged.

6.3 System Debug

Debug Step	Actions
Preparations for debug	Turn on the BESS system, referring to *section 6.2 System Turning On*. Remark: Besides the BESS, if other equipment has its own system starting up steps, be sure to follow its own system operation manual.
System function test	(1) Check to make sure the power supply from the UPS is working normally. (2) Communication Test: Check that if the communication between the BESS system and communicated devices are normal.
Trial operation test.	After the system is powered on, run the system a period as a test to check it works properly.

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.

7.1 System Turning Off

Turning-off Procedure

1. Log onto the interface of the LEMS upper computer to shut down the PCS, and the PCS will enter the automatic shutdown process. The PCS will automatically disconnect the contactor on the AC/DC side. At this time, there will be a sound of contactor disconnection. After about 10 seconds, the normal shutdown will be completed.

DANGER

The PCS contains deadly high voltage! Failure to follow the instructions may result in death or severe electric shock injury!

- The PCS contains capacitor. After disconnecting the PCS from power, wait for at least 10 minutes before performing any subsequent operations.
- Ensure that the power supply on both the AC and DC sides of the PCS is fully disconnected before performing maintenance.

2. Disconnect the circuit breakers “QF5” and “QF4” in the cabinet.
3. To shut down the UPS, press the ⏻ button on the front panel for three seconds.
   - A confirmation message will appear.
   - When confirmed, the UPS starts to beep and shows a status of "UPS shutting OFF...". The UPS then transfers to Standby mode, and the ∿ indicator turns off.
4. Turn off the circuit breaker of the BMS.

CAUTION

Before changing the battery module for service, be sure to charge/discharge the replaced battery at the same open circuit voltage as the other ones in the battery module system. Otherwise, the system needs a long time to do balance for this new battery module.

⚠ WARNING

Do not turn off the circuit breaker during normal running status (unless emergency). Otherwise, it will cause current surge to the rest battery strings. Be sure to turn off the PCS first prior to turning off the circuit breaker in normal running condition.

5. Disconnect the circuit breakers “QF3”, “QF2” and “QF1” in the cabinet.

7.2 Routine Maintenance

Due to the influence of ambient temperature, humidity, dust, vibration, etc., the internal components of the system or equipment will be aged or worn, which will lead to the potential failure of the system or equipment. Therefore, it is necessary to carry out routine maintenance on the system to ensure its normal operation and service life.

After the system is out of operation, you must wait at least 10 minutes before carrying out maintenance or overhaul operations on the system.

After the system is shut down, pay attention to:

- Ensure that the system is not accidentally re-powered on.
- Use a multi-meter to check that the system is completely shut down.
- The possible live parts adjacent to the operating part shall be covered with insulating cloth.
- During the whole process of maintenance, it is necessary to ensure that the escape routes are completely unblocked.

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 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.	Every 6 months.
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.	Officially run for six months, then every six months to one year thereafter.

	(3) Check that the insulating wraps of the power cable terminals are not detached.	
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. (2) It is recommended that the battery be fully charged and equalized on a regular basis.	Every 6 months to 1 year
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.

7.3 Battery Maintenance

⚠ DANGER

The power must be turned off prior to any maintenance of the battery.

Battery Maintenance Table

Item	Description	Interval
Voltage Inspection	Check the voltage of battery system through the monitor system. Check if the system has abnormal voltage. For example: Single cell's voltage is abnormally high or low.	Once half a year
SOC Inspection	Check the SOC of the battery system through the monitor system. Check if the battery string has abnormal SOC.	Once half a year
Cable Inspection	Visually inspect all the cables of the battery system. Check if the cables are broken, aging, or getting loose.	Once half a year
Balancing	The battery strings will become unbalanced if not fully charged for a long time. The balancing maintenance (charge to full) should be done every 3 months and is usually done automatically by communication between the system and external device.	Once half a year
Output Relay Inspection	Under low load condition (low current), switch the output relay to OFF and ON to hear the clicking sound, which means this relay can be turned off and on normally.	Once half a year
History Inspection	Analyze the historical records to check if there is an accident (alarm and protection) and analyze the reasons.	Once half a year
Environment Inspection	Check the installation environment such as dust, water, insect etc. And clean them when necessary.	Once half a year

7.4 PCS Maintenance

Environmental factors such as temperature, humidity, dust, and vibration can lead to aging of the components inside the PCS, potentially causing failures or reducing the PCS's lifespan. Therefore, it is necessary to implement regular maintenance of the converter.

Regular Maintenance

Maintenance Item	Maintenance Action	Maintenance Interval
Dust removal	Remove the dust at the air intake of power module.	Once a month
	Check whether there is dust, moisture or condensate vapor inside the cabinet.	Once a month
Warning labels	Check warning signs and add or replace them if necessary.	Once a month
Equipment	Check for abnormal noises during operation.	Once a month
Power cable connection	Check for loose cable connections; tighten screws if necessary.	Once every three months
	Check the cables for any signs of insulation aging or damage. If such issues are found, apply additional insulation measures or replace the cables.	Once every six months
Main switch	Conduct a routine inspection for corrosion on all metal parts of the AC/DC main switch.	Once every six months

Waste Disposal

The PCS will not cause any environmental pollution, all of its materials and components meet the environmental protection requirements. When the service life of PCS expires, users should operate and deal with it according to the corresponding local laws and regulations.

7.5 Liquid Chiller Maintenance

Please refer to the separate *Liquid Chiller product manual* for maintenance information.

7.6 UPS Maintenance

Please refer to the separate *UPS product manual* for maintenance information.

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

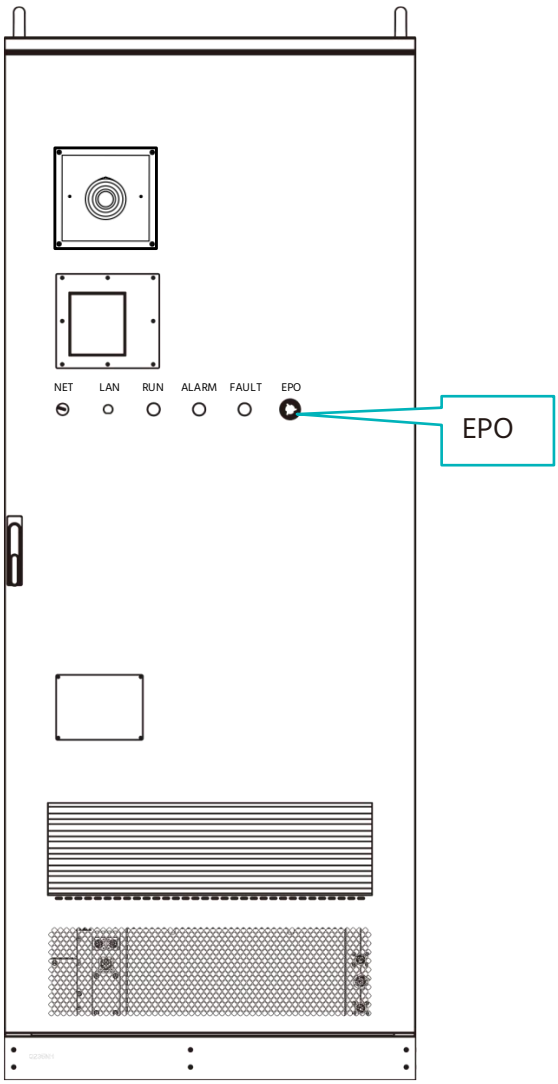
Contact Customer Service for assistance with PSC troubleshooting. system installation details and the model and serial number of the product.

8.4 Liquid Chiller Trouble Shooting

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.

NOTE:

1) 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.

2) 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 °C	/	Not allowed
-40 °C≤T < -30 °C	20%~ 40%	≤ 7 days
-30 °C≤T < -20 °C	20%~ 40%	≤ 30 days
-20 °C≤T < 35 °C	20%~ 40%	≤ 180 days (After 180 days of storage, a full charge and discharge is required.)
35 °C≤T < 50 °C	20%~ 40%	≤ 30 days
50 °C≤T < 60 °C	20%~ 40%	≤ 7 days
T≥ 60 °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 bmuinfo to view the information of BMU.
1	INIT_COUL	Power-On Self-Test: Module Capacity Mismatch	Use 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 bmuinfo to view the information of BMU.
2	INIT_BMUCFG	Power-On Self-Test: Module Configuration Mismatch	Use 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 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.

	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 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 inspect whether the sampling lines for cell voltage and temperature are functioning properly.
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)

			• 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 the Cluster	It can be restored once the rated value is reached.

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) • Bit 10: AFE overlap test fault (1: Abnormal, 0: Normal)
23	BT_INV_P		

			• 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 "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.
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 Voltage	It can be restored once the rated value is reached.
45	MSDT_INV	Invalid Temperature of Pack MSD	1. Check if there are MSD 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 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 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 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. 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 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. You can check the bmuinfo. Command to use: Use 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 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. 2. If the MSD is configured, check whether it is properly closed and not loose. Command to use: Use 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 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.)
73	CIR_SHORT	Main Circuit Adhesion	1. Check if there is any abnormality in the

		Fault	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_INV	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_SELFDSGDIFF	Excessive Difference in Self-Discharge of the Battery Cells	NULL
82	BAT_SOLDER_E	Battery Virtual	NULL

	RR	Soldering Fault	
83	COMM_BMUSMOKE	Communication Loss of the Smoke Sensor in BMU to Pack	Check if the power supply of the smoke sensor is normal, the wiring is loose, and the device operates properly.
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. • 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	CONFIGDATALOAD	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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