Optim US-A200-Omni

Lithium Iron Phosphate

Battery Energy Storage System

User Manual

Information Version: 1.0

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.

Contents

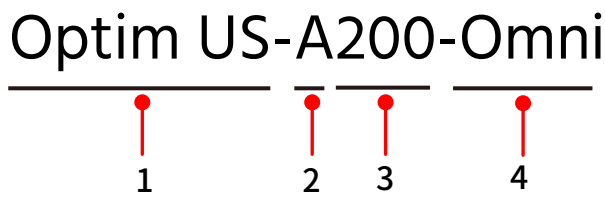
1 Information about this manual

1.1 Purpose

This manual describes the Optim US-A200-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).

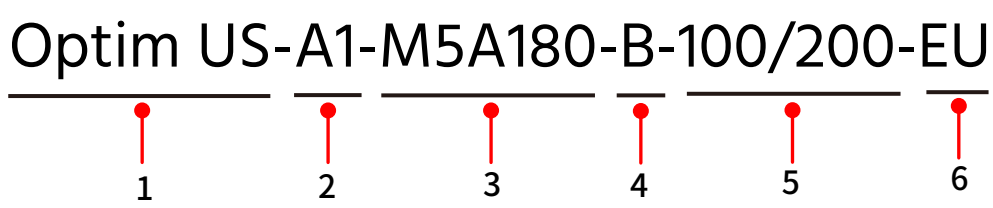
1.2 Product Name Description



No.	Designation	Description
1	Product Series	Optim US Series
2	Cooling type of the system	Air Cooling
3	The rated energy (in kWh) of the system	The rated energy of this system is about 200 kWh*.
4	Type of the cabinet	“Omni” represents all in one cabinet (including the PCS).”

* The actual rated energy of the cabinet system 203.84 kWh.

1.3 Product Model Description



No.	Designation	Description
1	Product Series	Optim US Series
2	"A" represents the type of cabinet system. "1" represents the serial number.	"A" represents "all in one cabinet (including the PCS)." The serial number is "1".
3	Battery model used in the product	The product uses M5 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 100 kW. The rated energy of this system is approx. 200 kWh.
6	Sales territory	The product is intended for European market.

1.4 Explanation of Symbols

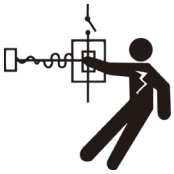
Symbol	Description
DANGER	**Danger**: Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	**Warning**: Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	**Caution:** Indicates 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.

1.5 Abbreviations in this Manual

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
PSW	Perfect Sine Wave
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

2 Safety

2.1 Symbols

	Read the manual before installing and operating the battery system.
	Must wear an ear protector.
	General warning label indicating potential hazards.
	Warning: electric shock.
	Warning: arc flash hazard.
	Warning: flammable materials.
	Do not connect the positive and negative reversely.
	Keep away from flame or ignition sources.
	Keep away from children.
	Grounding
	Recycle label.
	Separate Collection Symbol for regulation concerning batteries and waste batteries (2023/1542/EU)
	The certificate label for CE.

2.2 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 the local regulations and directives.

2.3 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℃~ 55℃ and the optimum temperature is: 10℃~ 40℃. 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.

2.4 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.

2.5 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.

2.6 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.

2.7 Electrostatic Protection

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

2.8 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.

3 System Introduction

3.1 System Overview

The Optim US-A1-M5A180-B-100/200-EU 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.

3.2 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, off-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.

3.3 System Specifications

Specifications	Model Name	Optim US-A1-M5A180-B-100/200-EU
Auxiliary Power Parameters	Auxiliary Voltage (VAC)	220
	Auxiliary Maximum Current (A)	10
	Rated Frequency (Hz)	50
AC side Parameters	AC Rated Voltage (VAC)	400
	AC Maximum Current (A)	160
	Rated Frequency (Hz)	50
	Wiring Method	Three-phase four wire +PE
DC side Parameters	Battery String Qty. (=Battery Control Module Qty.)	1
	Battery Module Qty.	13
	Rated Capacity (Ah)	245
	Rated Energy (kWh)	203.84
	Rated Voltage of Battery String (V)	832
	Maximum DC current (A)	180
	Rated DC current (A)	122.5
System Parameters	External Dimensions (mm)	1310 ± 5 (W) x 2212 ± 5 (H) x 1518 ± 5 (D)
	IP Rating of the outdoor cabinet	IP55
	Weight (kg)	2550
	Working Temperature range (℃) *	-25~ 55
	Relative Humidity	0-95% RH, non-condensing
	Noise (dB)	65 @ 1 meter
	Altitude (m)	3000 (>2000m derating)
	Fire Fighting Method	Aerosol
	Color	Outdoor Orange Texture RAL9003
	Plate Material	SPCC (with heat preservation and fire prevention function)
	Anti-Corrosion Grade	C3 for standard configuration cabinet C4/C5 Optional
	External Communication Protocol	LAN (MODBUS TCP)/RS485(MODBUS RTU)/CAN
	Wire feeding in and out method	Bottom in and bottom out

* In high (>40℃) or low temperature (<10℃) environment, the charging and discharging power of the battery system will be limited according to BMS operation logic.

3.4 Reference standards

3.4.1 System Related Standards

No.	Description	Code
1	CE LVD Directive 2014/35/EU	EN 62477-1
2	CE EMC Directive 2014/30/EU	EN IEC 61000-6-2 EN IEC 61000-6-4

3.4.2 Battery Related Standards

No.	Description	Code
1	Safety Standard for Secondary Lithium Batteries	IEC 62619 IEC 63056 IEC 62040-1
2	Safety Standard for Lithium-ion Battery (UL)	ANSI/CAN/UL 1973
3	Safety Standard for Lithium Battery (Germany)	VDE-AR-E 2510-50
4	CE LVD Directive 2014/35/EU	EN 62477-1
5	CE EMC Directive 2014/30/EU	EN IEC 61000-6-2 EN IEC 61000-6-4
6	UCKA Standard	EN 62477-1 BS EN IEC 61000-6-2 BS EN IEC 61000-6-4
7	Battery Cell Safety Standard	ANSI/CAN/UL 1973
8	Battery Cell Safety Standard	JIS C 8715-2
9	Battery Thermal Runaway Safety Standard	UL 9540A
10	UN38.3 Safe Transport Standard	UN 38.3

3.5 System Components

The external and internal layouts of the cabinet are shown as following:

- **External Layout**

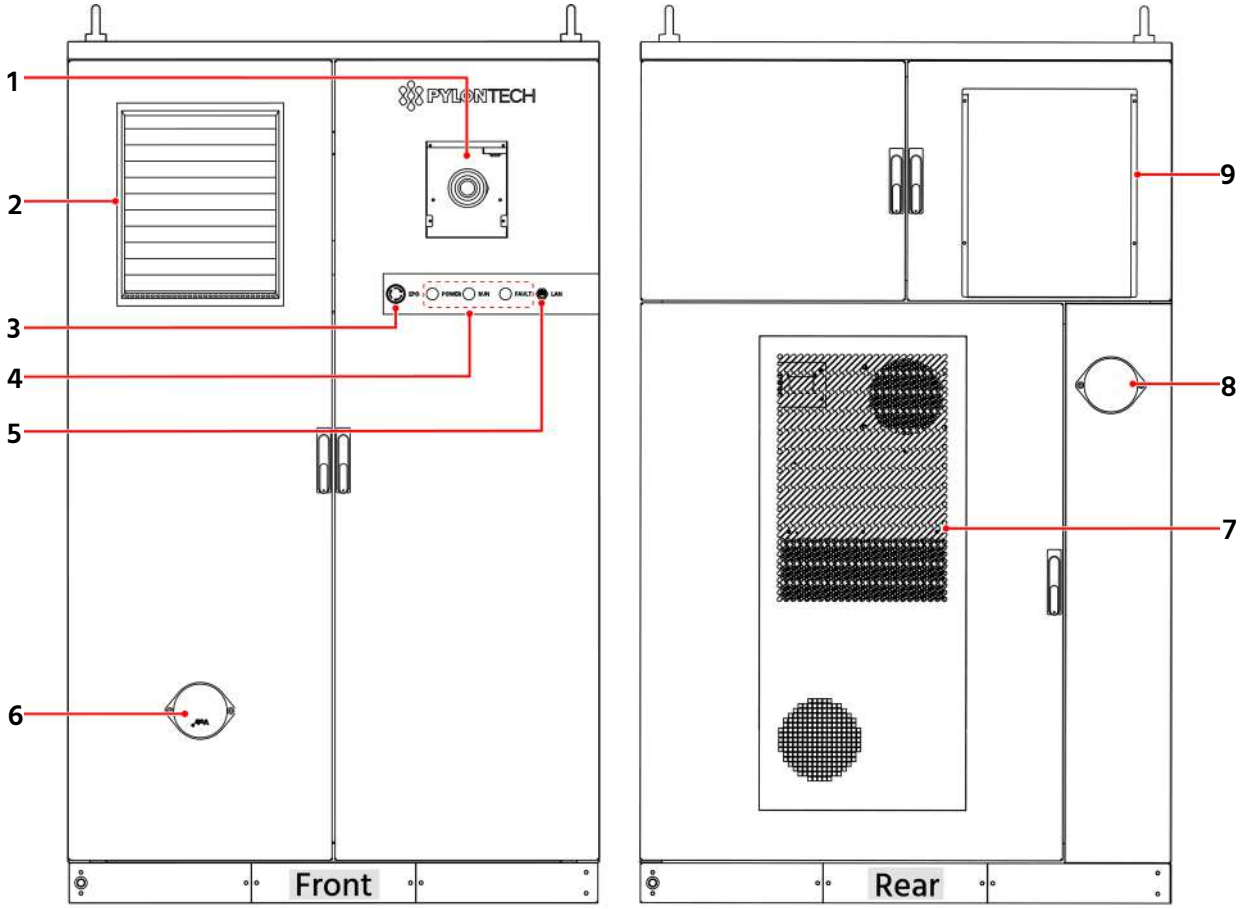


Fig.	Description	Fig.	Description
1	Sounder/Beacon Alarm	6	Explosion-proof valve (air inlet)
2	Air Inlet Ventilation Window	7	Air Conditioner
3	EPO (Emergency Power OFF Switch)	8	Explosion-proof valve (air outlet)
4	Status Indicator	9	Air Outlet Ventilation window (under the water-proof cover)
5	LAN port (for debug)		

- **Internal Layout-Front view**

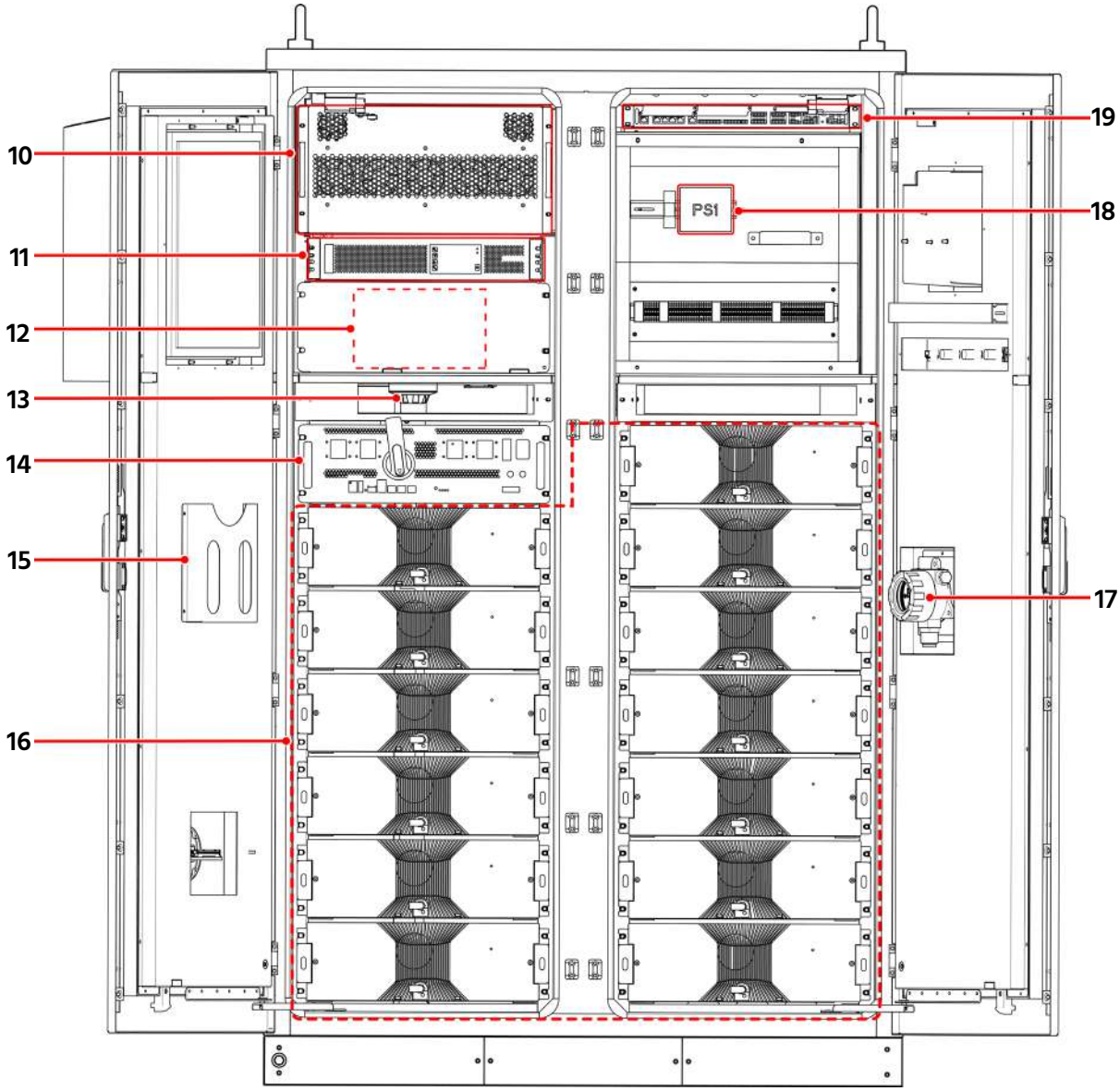


Fig.	Description	Fig.	Description
10	PCS (air intake panel)	15	File Folder
11	UPS (Front Panel)	16	Battery Modules (13 pcs)
12	PSW Filter (under the plate)	17	Gas Detector (H^2)
13	Smoke Detector	18	Switching Mode Power Supply
14	Battery Control Module (BMS)	19	LEMS

- **Internal Layout-Rear view**

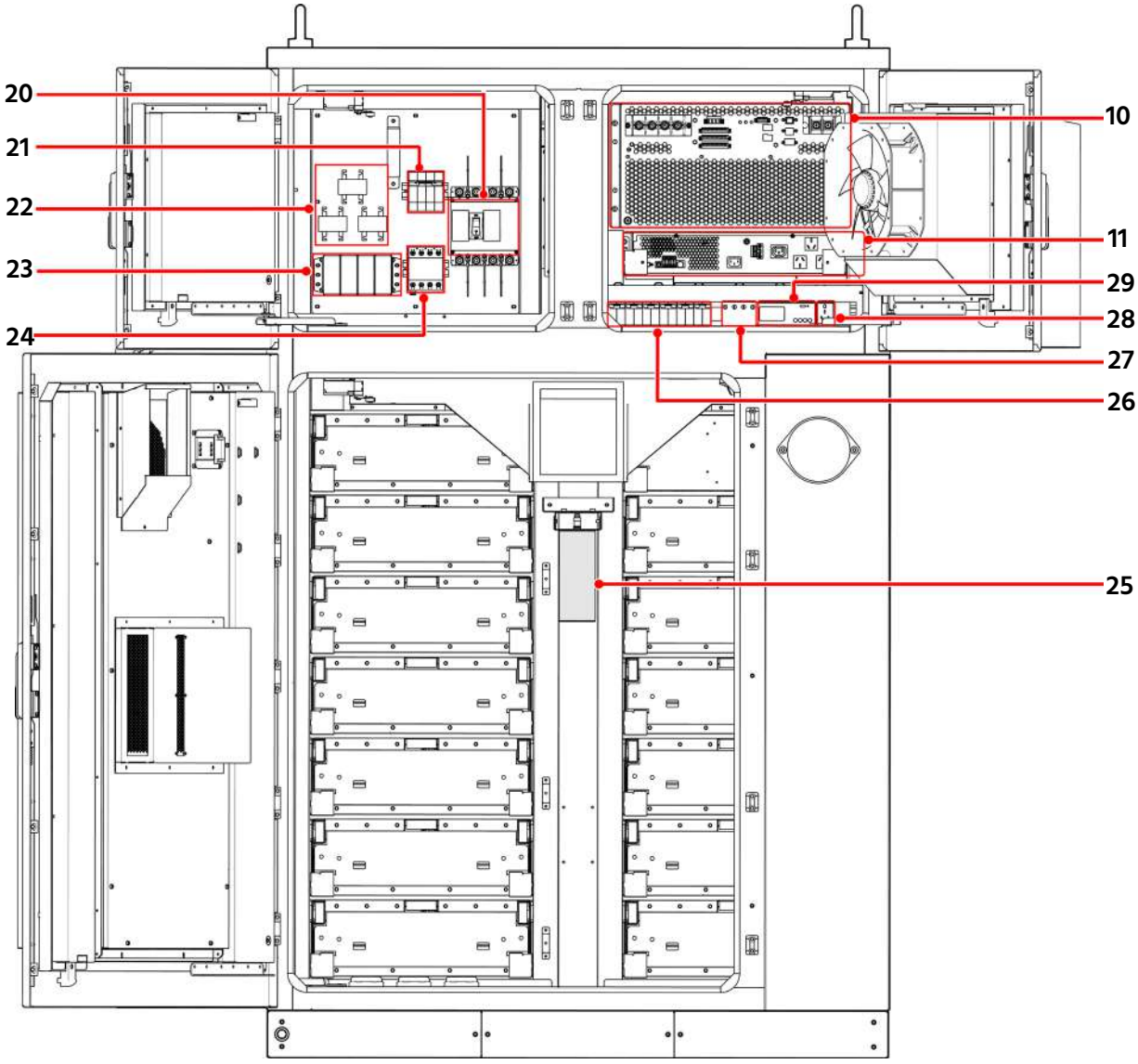
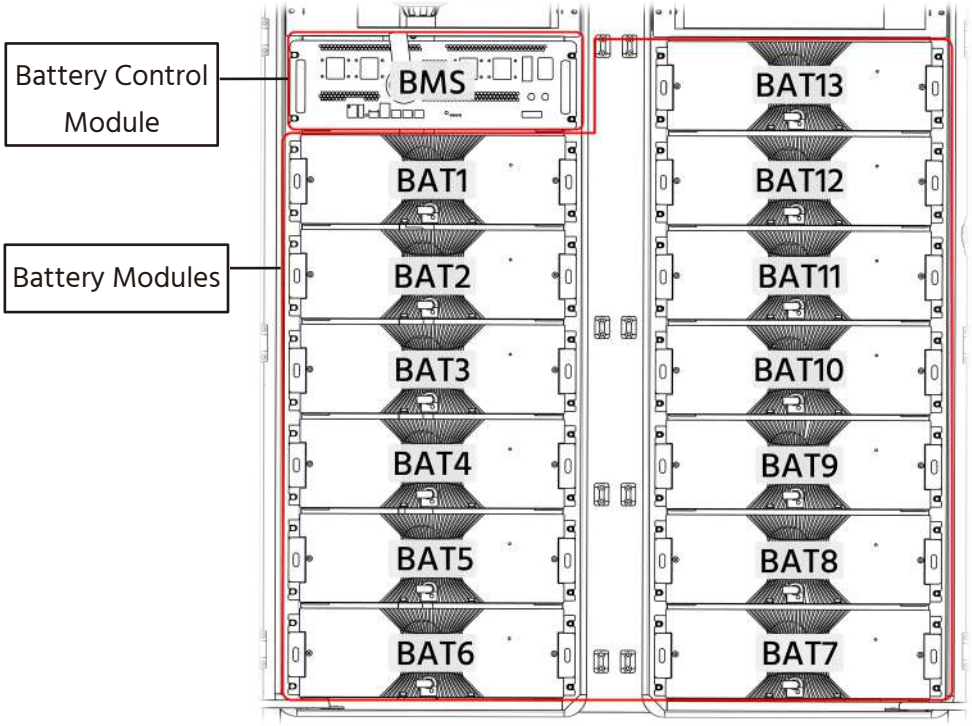


Fig.	Description	Fig.	Description
20	MCCB (Moulded Case Circuit Breaker) (QF1)	26	Circuit Breaker (QF2~QF7)
21	Circuit Breaker (QF8)	27	Fuse
22	Current Reverser (TA1~3)	28	Overhaul Socket
23	TC Wiring Terminal (X1)	29	Energy Meter
24	SPD (Surge Protection Device)	11	UPS (Rear Panel)
25	Aerosol	10	PCS (Interface Panel)

3.5.1 Battery String

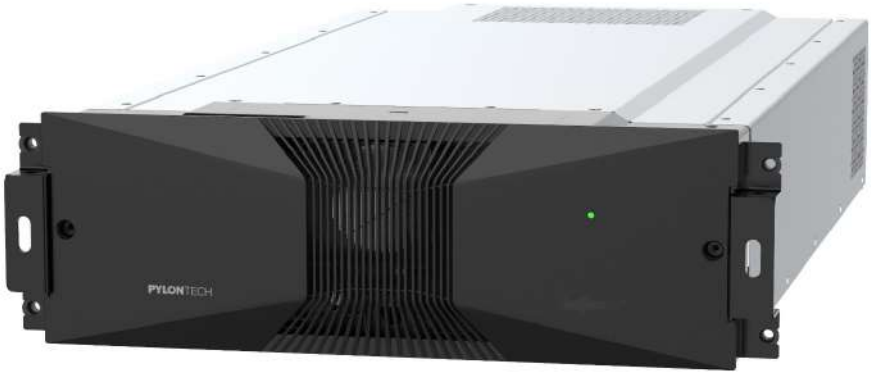
The system has one battery string that includes 1 battery control module (BMS) and 13 battery modules.



3.5.1.1 Specifications of the Battery String

Battery String	PowerCube-M5
Battery Module Model	HM5A180F
Control Module (BMS) Model	S1500M5A180E
Over Current/Duration (Amps/ millisecond)	12000 A /5 millisecond
Humidity (%)	5 ~ 95 (without condensing)
Round-trip efficiency (%, @0.5 C)	95%
Depth of Discharge (DOD) (%)	95%
Rated Current (Amps)	⩽122.5 (@0.5C)
Peak Current (Amps)	＜210A for 5 minutes ＜500A for 30 seconds
System Rated Capacity (Ah)	245
System Configuration Battery Module Quantity (pcs)	13
Maximum Continuous Current (Amps)	180
Total Storage Energy (kWh)	203.84
System Rated Voltage (VDC)	832
Upper limit Charge Voltage (VDC)	936
Lower limit Discharge Voltage (VDC)	702

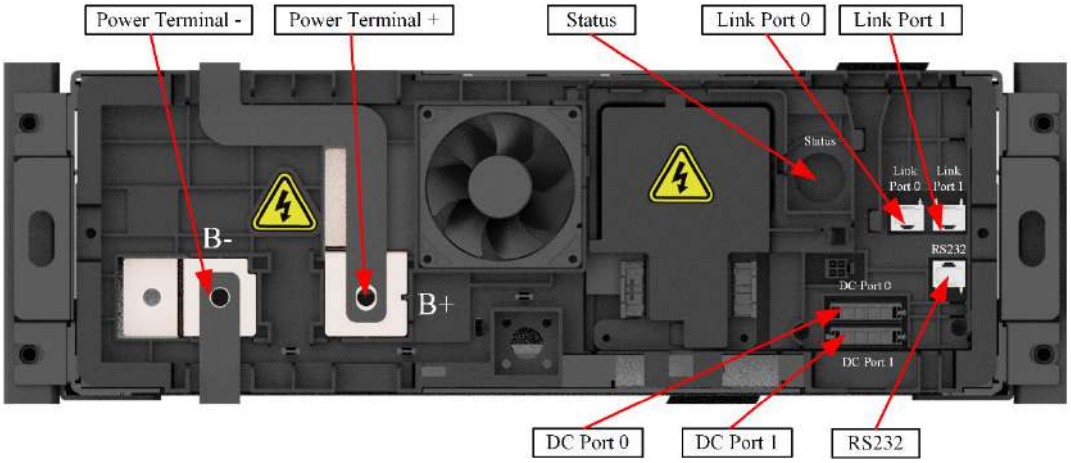
3.5.1.2 Battery Module



Battery Module Specifications

Product Type	**HM5A180F**
Cell Technology	$LiFePO_4$ (LFP)
Battery Module Energy (kWh)	15.68
Battery Module Voltage (VDC)	64
Battery Module Capacity (Ah)	245
Power of BMU (Battery Management Unit) (W)	3
Power of Battery Module Fan (W)	15.6
Dimensions (W x D x H, mm)	515(W) × 935 (D) × 160.5(H)
Weight (kg)	115
Design Life (year)	15+
Transportation Certificate	UN38.3

Battery Module Interface



Power Terminals B+/B-

Connects battery in serial at power side.

Status Light

Shows the status of battery module (Normal●, Abnormal●).

Link Port 0/1

Communication Terminal: (RJ45 port), CAN communication, between multiple serial battery modules and control module.

DC Port 0/1

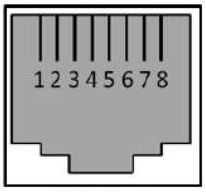
DC Port 0, 1 Terminals: the terminal is 4 pin of DC supply, which consists of 2 pins of 12V for BMU power supply, and 2 pins of 24V for fan power supply. DC Port 0 for DC power input, DC Port 1 for DC power output.

RS232 Terminal

Console Communication Terminal: (RJ45 port) follows RS232 protocol, for manufacturer or professional engineer to debug or service.

Definitions of RJ45

No.	Link Port 0/1	RS232
1	---	---
2	GND	---
3	---	TX
4	CANH	---
5	CANL	---
6	---	RX
7	---	---
8	---	GND



RJ45 Port

RJ45 Plug

3.5.1.3 Control Module

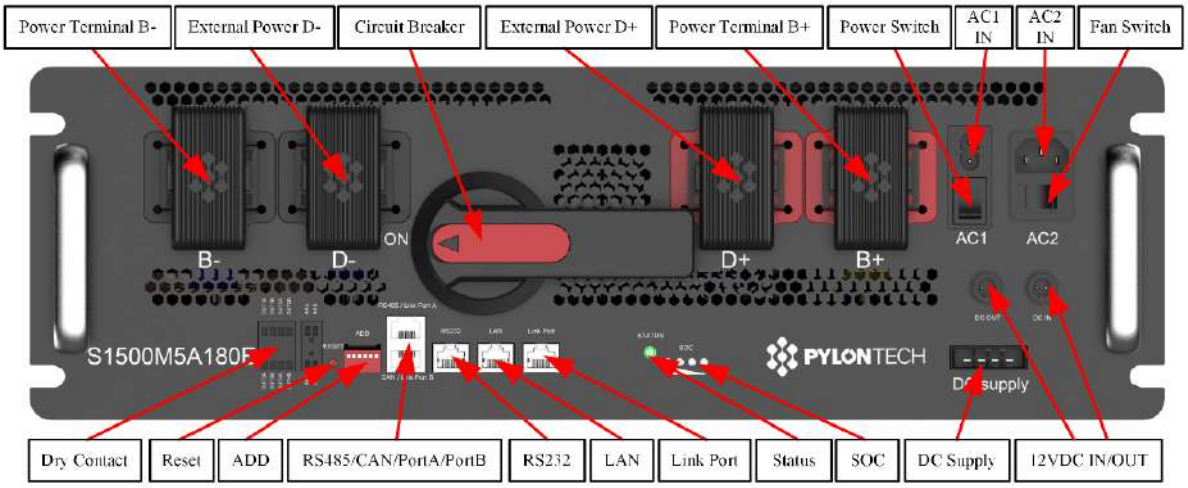
The appearance and the specifications of the control module are shown as follows.

Product Type	S1500M5A180E
Related Product	M5A-180
AC Supply for BMS*	100~305 VAC/50/60Hz
Fan Power Consumption (W) **	15.6
Operation Current (Maximum) (A)	180
Self-consumption Power-Relay On (W)	16.5
Instantaneous power of relay engagement(W)**	65.4
Dimensions (W × D × H, mm)	460(W) × 858(D) × 160(H)
Weight(kg)	28
Communication Protocol	RS485(MODBUS RTU) \CAN\LAN
Operation Life (year)	15

*AC power @100~305 VAC/50/60Hz supply to BMS & air fan separately.

** Instantaneous power consumption of each relay is 56.4W, happens when relay acting.

Control Module Front Interface



Power Terminal B+/B-

Connects battery modules in series.

Power Terminal D+/D-

External Power terminal: Connects battery system to the PCS.

Circuit Breaker

Controls the circuit breaker ON/OFF, and carries out shunt tripping function when system is overcurrent or short circuit.

Power Switch

Controls the BMS power supply ON/OFF.

AC1 Input for BMS power supply

AC Socket and Control Module Power Switch: External power supply for Control Module. Power Switch to control ON/OFF. Applied with UPS system.

AC2 Input for BMS power supply

AC Socket and FAN Power Switch: AC power input sockets for external power supply. Fan power Switch to control ON/OFF.

12VDC Input

IN: Back-up 12 VDC power supply port for BMS.

12VDC Out

OUT: Power supply for MBMS-LC, to connect with MBMS-LC' 12VDC IN.

DC Supply

Integrated with 12 VDC for BMU and 24 VDC for fans power supply, connects to battery module.

SOC (LED)

Battery Capacity Indicator: 4 green lights and each light represents 25% capacity.

Refer to ***Table of LED Indicators Instructions*** in *section 6.1.1* for details.

STATUS (LED)

Shows the status of battery module (Normal🟢, Abnormal🔴).

Refer to ***Table of LED Indicators Instructions*** in *section 6.3.1* for details.

Link Port (RJ45 port)

For communication between multiple serial battery modules and control module.

LAN

Console Communication Terminal: (RJ45 port) follows Modbus protocol, used for communication between MBMS-LC, switch or upper controller.

RS232

Console Communication Terminal: (RJ45 port) follows RS232 protocol, for manufacturer or professional engineer to debug or service.

RS485/ Link Port A (RJ45 port)

RS485 (for external communication) follows Modbus RTU protocol, for communication between the battery system and the PCS.

Link Port A (for internal communication): used for cascade communication between the BMSs; when the system is configured less than 6 battery strings, it is used for communication between the first battery string's BMS and the MBMS-LC.

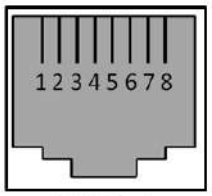
CAN / Link Port B (RJ45 port)

CAN (for external communication) follows CAN protocol, for communication between the battery system and the PCS.

Link Port B (for internal communication): used for cascade communication between the BMSs.

Definitions of RJ45 Port Pin

No.	CAN	RS485	RS232
1	---	---	---
2	GND	---	---
3	---	---	TX
4	CANH	---	---
5	CANL	---	---
6	---	GND	RX
7	---	RS485A	---
8	---	RS485B	GND



RJ45 Port

RJ45 Plug

ADD

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.

Reset

Reset Button: Long press this button to restart the battery system.

Dry Contact

(Dry Contact Terminals): provide 2 input and 4 output dry contact signals.

Dry Contact Terminal

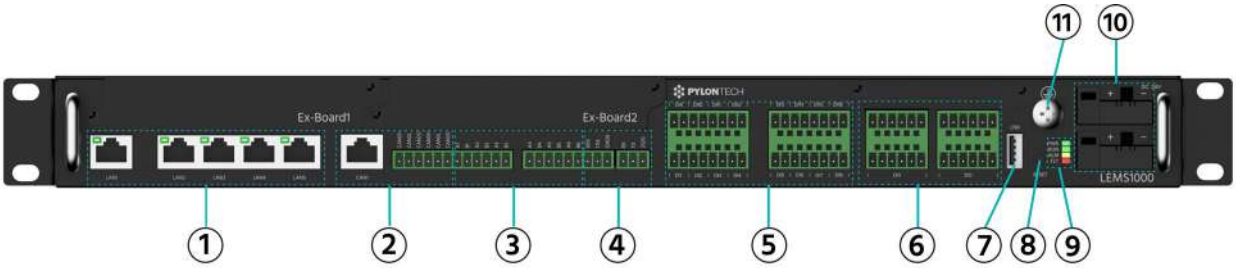
In/Out	Function	Open and close state
In1	Reserved	Normal close.
In2	Emergency Power off	Normal close, power relay open when signal received.
Out1	Stop charging	Normal close, when suggested charge current is “0”, it shall open.
Out2	Stop discharging	Normal close, when suggested discharge current is “0”, it shall open.
Out3	Error	Normal close, when system error activated, it shall open.
Out4	Current limit	Normal close, when current limit ≤5A activated, it shall open.

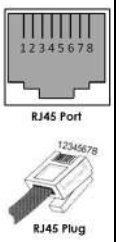
3.5.2 LEMS

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, sensors, 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
Protection degree	IP20
Weight (kg)	4.0
Working temperature (℃)	-40~85
Storage temperature (℃)	-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

3.5.2.1 Interface Panel of the MBMS



No.	Port	Silk-screen	Description and Function	
1	LAN	LAN1	An Ethernet Port (100Mbps) with default IP:192.168.10.100	Used for SCADA, EMS, Cloud Platform etc. They are backup for each other, and support IEC61850, IEC60870-5-104, and Modbus/TCP protocols.
		LAN2	An Ethernet Port (1Gbps) with default IP:192.168.11.100	
		LAN3	LAN3 and all batteries' main control boards (CMUs) are connected to the ethernet switch so they can communicate with each other by Pylon IBC Protocol.	LAN3/4/5 are switched from the chip's original 1Gbps LAN port with default IP:162.172.1.100, 192.168.3.100, and 192.168.0.100.
		LAN4	Used to connect to PCS through Modbus/TCP protocol, and the slave LEMS1000s.	
		LAN5	Used to connect to the touch screen or PCs with BatteryView Pro installed.	
2	CAN	CAN1	a RJ45 Port, pin2 is CAN1G, pin4 is CAN1H, pin5 is CAN1L. 	All these three CAN ports can be connected through CAN ports to devices e.g. PCSs.
		CAN2H/ CAN2L/ CAN2G (CAN2)	CAN Port	
		CAN3H/ CAN3L/ CAN3G (CAN3)	CAN Port	

No.	Port	Silk-screen	Description and Function
3	RS485	A1B2~A6B6	All these six RS485 ports can be connected through RS485 ports to devices, e.g. air-conditions, energy meters, humidity-temperature sensors, liquid chiller, H2/CO concentration sensors, PCSs, dehumidifiers, etc.
4	RS232	RX6/TX6/GND6 RX/TX/232G	Two debug ports.
5	DI	DI1~16	Dry Contact, 16 Digital Inputs. Passive signal or active signal not higher than 5V. They can be used to monitor the signals such as fire-alarm, door open, UPS fault, PCS fault and etc. And every signal can be configured to any DI arbitrarily from DI1 to DI16. The default state can be configured also. Use the signals according to the specific system, referring to *section 2.2* for details of the DI signals.
6	DO	DO1~8	Dry Contact, 8 Isolated passive Digital Outputs, specification is DC 30V/2A, AC 240V/0.25A. They can be used to control the signals such as main shunt trip, LEDs, load relay, on-off grid relay and etc. And every signal can be configured to any DO arbitrarily from DO1 to DO8. Each DO port has three pins for NC, COM, NO, and can be used flexibly. Use the signals according to the specific system, referring to *section 2.3* for details of the DO signals.
7	USB	USB	USB2.0 port for device upgrade or data download using a U-disk.
8	Reset Switch Button	RESET	Press this button restart the system.
9	LED Indicators	PWR/RUN/ALM /FLT	See *Section 6.3.2* for detailed instructions.
10	9~36VDC input	DC 24V + -	Power supply for the device, external power supply of 9~36VDC. There are two power ports for backup.
11	Grounding Bolt		Grounding Protection

3.5.3 PCS

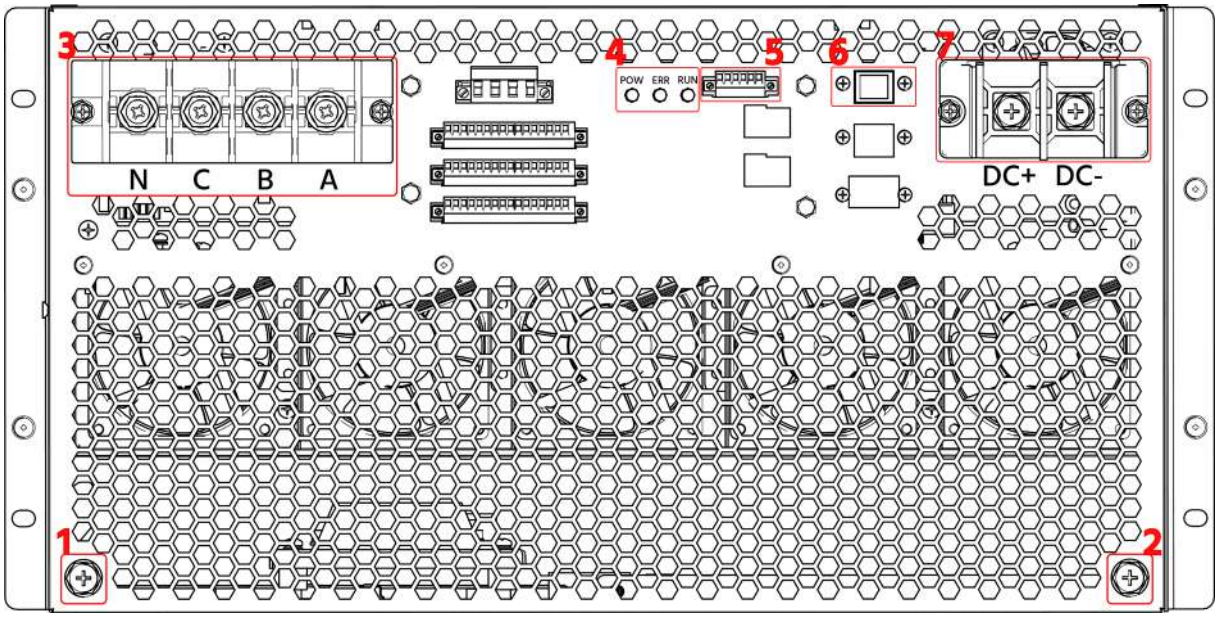
The directional PCS realizes the charge and discharge control of the energy storage battery. It is an important part of the smart grid, which can regulate power resources and ensure the normal operation of the grid. On one hand, the PCS can invert the direct current of the energy storage battery into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

3.5.3.1 Specifications of the PCS

Model	**INPPCS-100/0.4-W-24-C1-OS**
DC Side Parameters	
DC voltage range	DC630V~900V (full load)
Rated DC current	159A
Maximum DC current	190A
Rated DC power	100kW
Voltage Regulation Accuracy	⩽ ±2%
Current Regulation Accuracy	⩽ ±5%
AC Grid-connected Parameters	
Rated AC power	100kW
Overload capacity	1.1 times for long-term, 1.2 times for 1 minute. (Ambient temperature ≤ 35°C)
Rated voltage	AC400V
Rated AC current	145A
AC access method	Three-phase four-wire
Grid voltage range	340V~460V
Grid frequency range	50Hz/60Hz±2.5Hz
Total harmonic distortion rate of current	≤ 3% (full load)

Power factor	-0.99～+0.99
Current DC component	≤0.5%
Charge and discharge conversion time	＜100 milliseconds
AC Grid-disconnected Parameters	
AC grid-disconnected voltage	AC400V
AC voltage range	AC400V±3%
AC grid-disconnected frequency	50Hz/60Hz
Grid-disconnected output THDU	≤ 3% (linear load)
Unbalanced load capacity	100%
Other Parameters	
Maximum conversion efficiency	≥98%
Allowable ambient temperature	-25℃~60℃ (⩾45°C for limited load)
Allowable relative humidity	≤95% (No condensation)
Noise	≤75dB
Protection grade	IP20
Altitude	3000 m (⩾2000m for limited load)
Size	W480mm×H260mm×D659mm
Weight	70KG
Cooling method	Forced air cooling
Multiple modules networking mode	Disconnected on DC side; Parallel on AC side
Airflow direction	Airflow enters from the front and exits from the rear
BMS communicationinterface	CAN
EMS communicationinterface	Network interface or 485

3.5.3.2 Interface Panel of the PCS

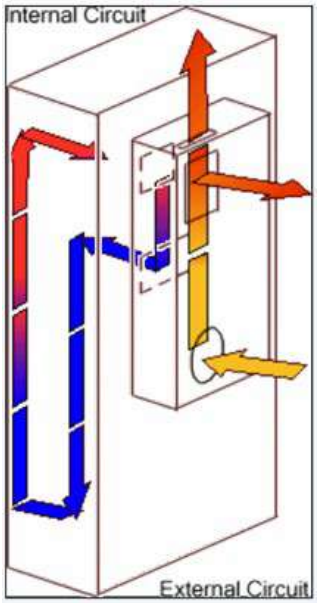


No.	Item	Description
1/2	Grounding points	Choose one of the points for grounding connection.
3	AC wiring port	Connect the cables from AC side to the A, B, C, N phases of the PCS, ensuring correct phase sequence.
4	Indicator Light	**POW** Indicator: In normal operation, the indicator light is always on, and in standbystatus, the indicator light flashes
		ERR Indicator: The indicator light is always on during failure.
		RUN indicator: The indicator light is always on when DC is connected.
5	CAN, 485-1/2	(communication Port): used for communication connection with BMS. Please refer to ***<Annex 3: System Communication Wiring Diagram>*** for details.
6	COM1	(communication Port): used for communication connection with LEMS. Please refer to ***<Annex 3: System Communication Wiring Diagram>*** for details.
7	DC wiring port	Connect the DC cables from Battery String [D+] to PCS [DC+], Battery String [D-] to PCS [DC-].

3.5.4 Air Conditioner

The outdoor cabinet is equipped with an air conditioner to control the temperature and of the battery compartment.

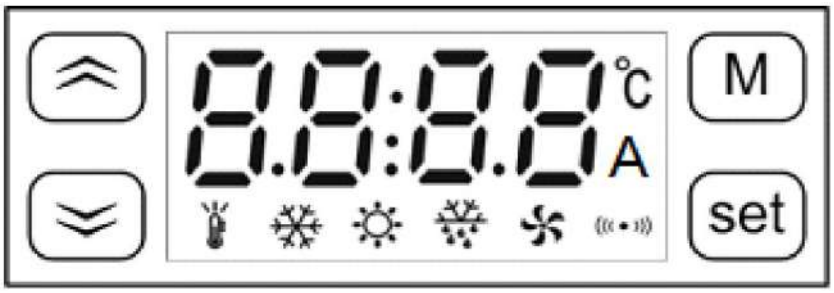
The energy storage battery system inside the cabinet is the main heat source. And the air conditioner's parameters are selected based on the battery system's total heat generation to meet the requirements in the target environment.



Product Specifications

Product Model	SAD130-3
Cooling Capacity (W)	3000
Rated Voltage (V)	220V
Rated Frequency (Hz)	50/60
Rated Power (W)	1100
Rated Current (A)	5.0
Heating Capacity (W)	1000
External circulation air volume (m^3/h)	1380
Internal circulation air volume (m^3/h)	720
Refrigerant	R513a
Volume of the refrigerant	1300
Working Temperature Range (^oC)	-40~55
Corrosion-proof Grade	C4
IP Protection Level (for outdoor side)	IP55

3.5.4.1 Display panel introduction



LED display panel is used to display running status and setting parameters. During normal operation, the LED panel will display internal temperature.

Indicator light

The function of lights was defined as the table below:

Symbol	Description	On	Flash
	Temperature	Setting mode	Self-check mode
	Cooling	Open air conditioner	---
	Heating	Open heater	---
	Dehumidification	Dehumidification state	---
	External fan	External fan running	---
	Alarm	Alarm	---

Item	Action
Panel Operation	When the air conditioner runs normally, the LED display panel shows internal temperature.
Switch to external temperature	At normal status, press ▲ button, then display panel shows external temperature with unit light(℃) flash. After that, press "M" button, return to the main menu and display internal temperature.
Switch to voltage	At normal status, press "S" button, then display panel shows AC supply power voltage. After that, press "M" button, return to the main menu and display internal temperature.
Switch to compressor speed	At normal status, press "M" button, then display panel shows inverter compressor speed. After that, press "M" button, return to the main menu and display internal temperature.
Switch to current	Press ▲ and ▼ at the same time, display panel shows compressor and heater current. After that, press "M" button, return to the main menu and display internal temperature.

NOTE: Before delivery, the parameters settings have been completed and no extra settings are required on site. For more details of the air conditioner, please refer to its product manual.

3.5.5 UPS

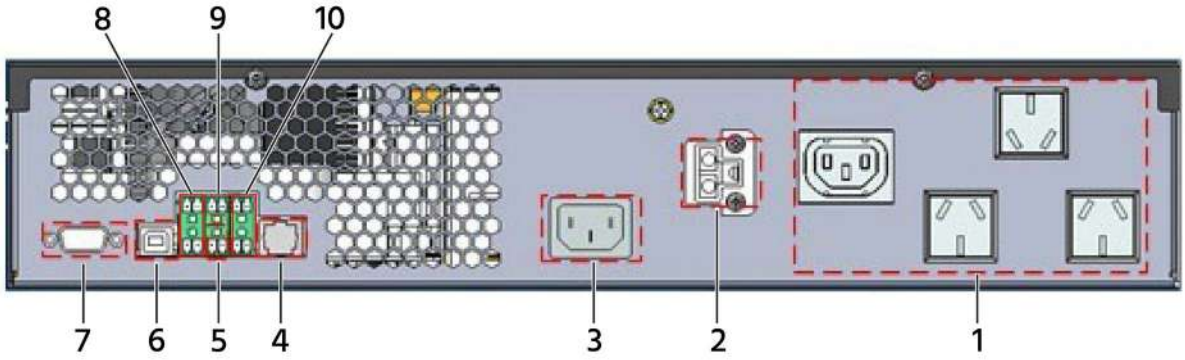
The cabinet is equipped with a set of UPS (ITA-01K00AS1102C00) to provide power for devices in the cabinet, such as BMS, LEMS, combustible gas detector, temperature sensor, smoke detector, etc.

3.5.5.1 Front Panel of the UPS

As shown in the following figure, the UPS front panel provides ventilation holes, operation and display panel, LED indicators and functional keys.

NO.	Description
1	Ventilation holes
2	Functional keys
3	Operation and display panel
4	LED indicators

3.5.5.2 Rear Panel of the UPS



NO.	Description	NO.	Description
1	Output outlet	6	USB port
2	Battery module port	7	Intellislot port (DB9)
3	Input outlet	8	Output dry contact port
4	Ethernet port	9	REPO (Remote Emergency Power Off) Port
5	Battery module number detection port	10	Input dry contact port

3.5.5.3 Introduction of the Operation and Display Panel

The Operation and Display panel is located on the front of the UPS. The display panel allows the user to operate and monitor the UPS, and to view the UPS parameters, UPS and battery status information and any alarm messages.

As shown below, the display panel includes LCD screen, menu keys, LED indicators (Run indicator and Alarm indicator).

Item	Description
1	Menu keys
2	LCD
3	Run Indicator
4	Alarm Indicator
5	Power Button

LED Indicators

The LED indicators consist of the run indicator and alarm indicator. See the following table for description of these indicators.

Indicator	Color	State	Meaning
Run indicator	Green	On	UPS has output.
		Blinking	PCS is starting.
		Off	UPS has no output, PCS is starting.
Alarm indicator	Yellow	On	Alarm occurs.
	Red	On	Fault occurs.
	/	Off	No alarm, no fault.

Audible Alarm (Buzzer)

The UPS operation is accompanied by the following two different kinds of audible alarms.

Sound	Meaning
Continuous beep	Sound is generated when the UPS fault appears, such as fuse or hardware failure.
One beep every 0.5 seconds	Sound is generated when the UPS critical alarm appears, such as PCS overload.
One beep every second	Sound is generated when the UPS critical alarm appears, such as battery low voltage.
One beep every 3.3 seconds	Sound is generated when the UPS general alarm appears.

LCD and Functional Keys

The operation and display panel includes five functional keys, and the respective functions are described in the table below.

Functional key	Silk print	Description
Confirm		Used to confirm or enter.
Up		Used to page up, turn left or add value, etc.
Down		Used to page down, turn right or reduce value, etc.
Escape		Used to return, escape, cancel or forbid operation.
Power		Used to power on, power off or transfer to Bypass mode.

Prompt Window

A prompt window is displayed during the operation of the system to alert you to certain conditions and/or to require your confirmation of a command or other operation. The following table lists the prompts and meanings.

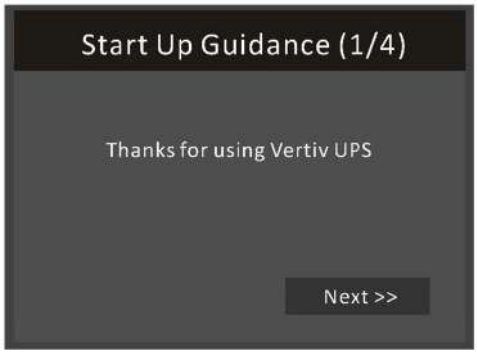
Prompt	Meaning
Cannot set this online, please shut down output.	If the user wants to change some important settings under condition of output (output voltage, output frequency, output phase No.), the prompt will appear.
Incorrect password, please input again.	The prompt will appear when the user incorrectly input the Settings password.
Operation failed; condition is not met.	The prompt will appear when the user wants to execute a certain operation but the condition is not met.
Password changed OK.	The prompt will appear when the user successfully changes the Settings password.
Fail to change password, please try again.	The prompt will appear when the user tries to change the Settings password but input two different new passwords.
The time cannot be earlier than system time.	The prompt will appear when the user set the time of 'Turn on delay' or 'Turn off delay ‘is earlier than the current system time.
Turn on failed, condition is not met.	When users press the power button (or execute the command of 'Turn on/Turn off/to Bypass' under 'Control' page), the prompt will appear.

3.5.5.4 Initial Start-up Guidance

1. Welcome Page

When the UPS is the initial start-up, the interface shown below will appear to guide the user to set basic parameters of the UPS.

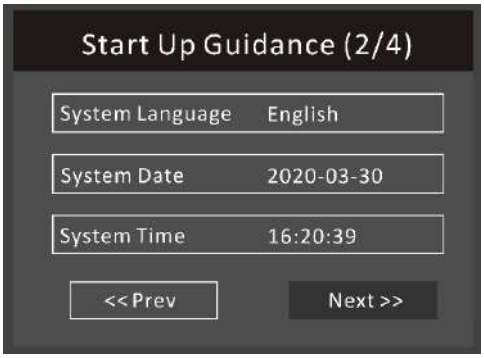
Please refer to s*ection 3.5.5.3* for instructions on the use of UPS keys, and operate the system according to the function of each key.



Initial Start Up Guidance (1/4) Page

2. Language, Date and Time settings

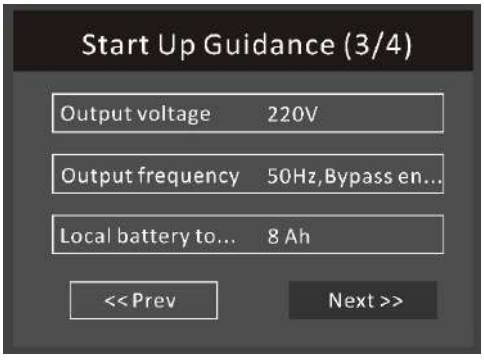
On this page, you can set the language, date and time you need. Click “Next “to start the guidance.



Initial Start Up Guidance (2/4) Page

3. Output and Battery Parameters Page

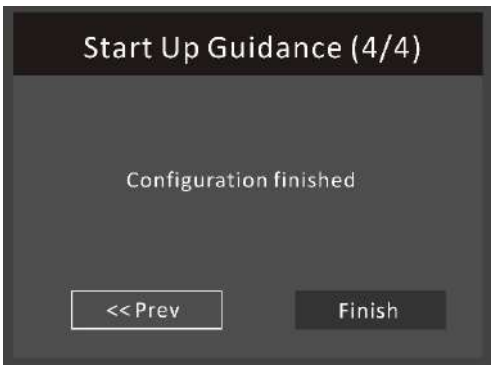
At this page, you can set the output voltage, output frequency and total Ah (According to the number of batteries connected, the settings can be changed, seeing the figure below.



Initial Start Up Guidance (3/4) Page

4. Finish Page

The interface shown in the following figure will appear. Click “Finish” to enter the Flow page, then the user can operate the UPS normally.



Initial Start-up guidance (4/4)

NOTE:

- The UPS battery was fully charged before delivery. However, some loss of capacity is inevitable during transportation and storage. Therefore, it is important to charge the battery for eight hours before the UPS is first put into operation to ensure it can provide adequate backup time.
- For more detailed information of the UPS, please refer to the separate UPS manual.

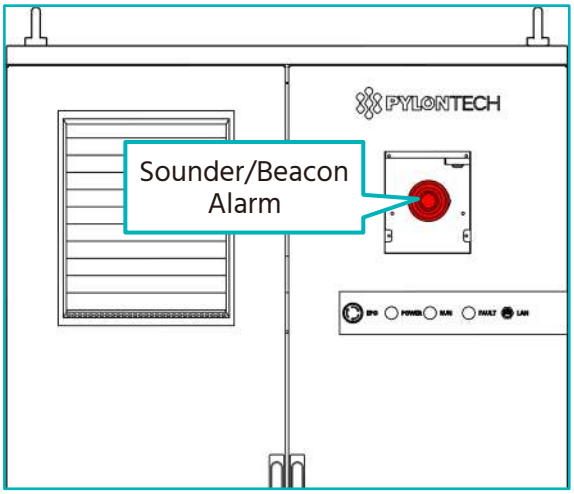
3.5.6 Safety Features

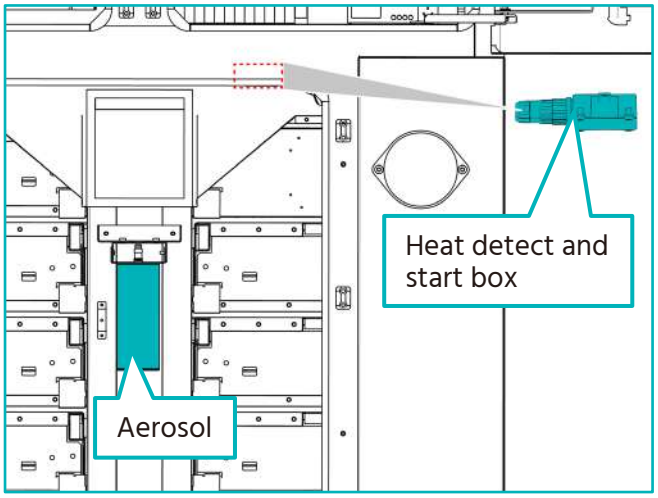
This system is equipped with safety features that include a fire protection system as well as an explosion proof and vent system.

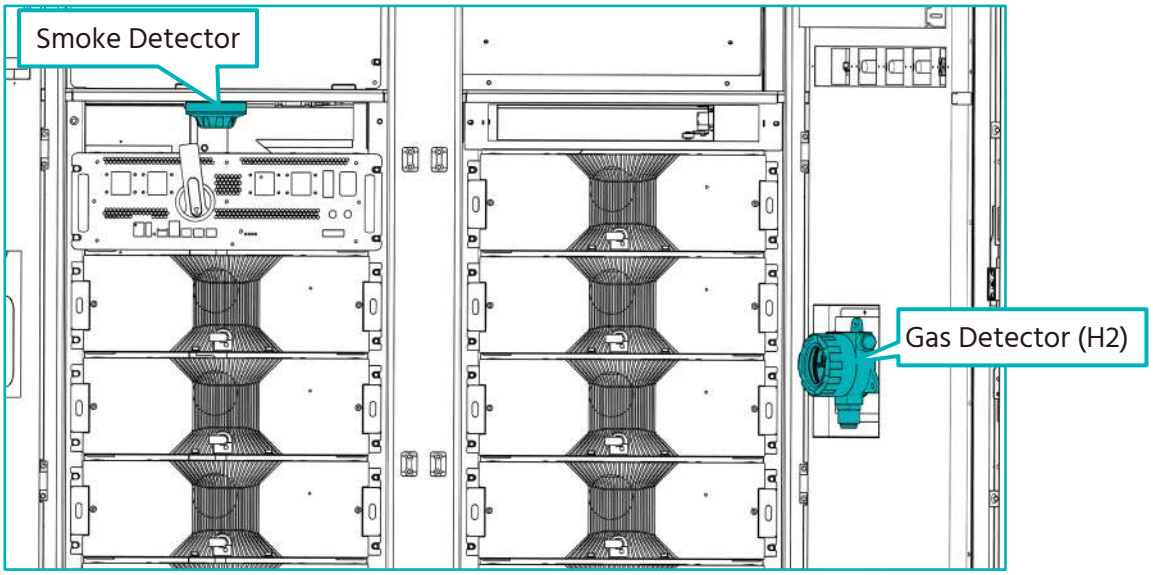
3.5.6.1 Fire Protection System

The fire protection system is mainly composed of fire alarm system and fire suppression system. The former consists of detectors and a 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, the heat detect and start box detects high temperature, and it will automatically switch on and output electrical signals to the fire extinguishing device. Thus, aerosol will be released to suppress the fire. At the same time, the fire alarm will sound until the system is powered off.

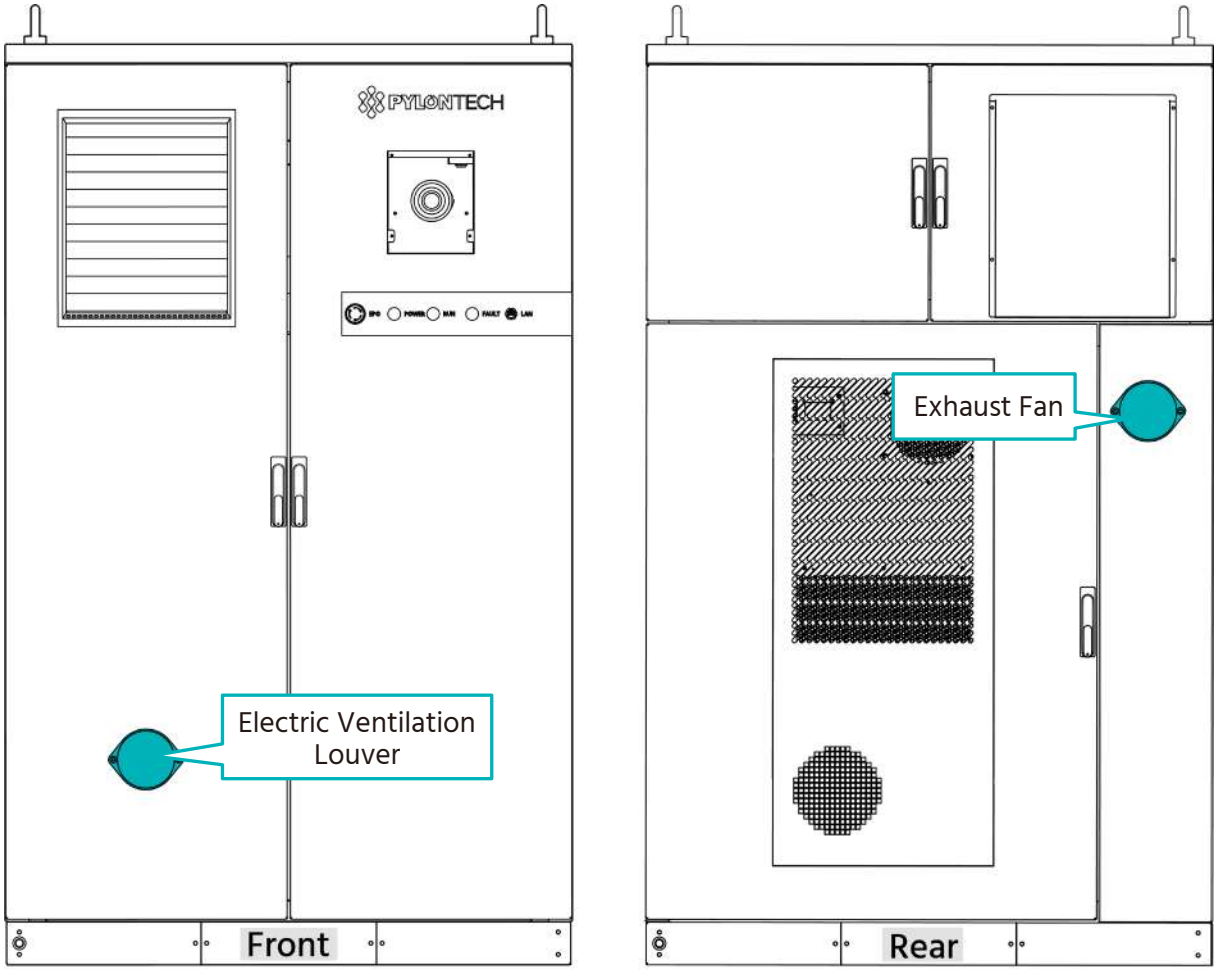






3.5.6.3 Explosion proof and vent System

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.



4 Mechanical Installation

4.1 Checking Before the Installation

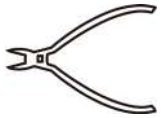
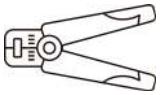
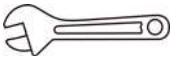
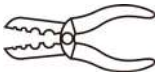
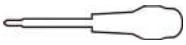
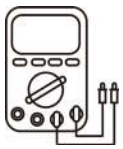
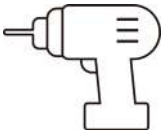
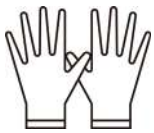
Checking the Outer Packing

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

<table>
<tr><th colspan="6">Tools</th></tr>
<tr><td> 
Wire Cutter</td><td> 
Crimping Modular Plier</td><td> 
Adjustable Wrench</td><td> 
Wire Stripper</td><td> 
Torque Wrench</td><td> 
Screwdriver</td></tr>
<tr><td> 
Cable Tie</td><td colspan="2"> 
Socket Wrench set</td><td> 
Electric Drill</td><td> 
1000VDC Multimeter</td><td> 
Electric Screwdriver</td></tr>
<tr><th colspan="6">PPE (Personal protective equipment)</th></tr>
<tr><td> 
Insulating Gloves</td><td colspan="2"> 
Safety Shoes</td><td> 
Ear Protector</td><td> 
Safety Goggles</td><td> 
Anti-static Bracelets</td></tr>
</table>

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

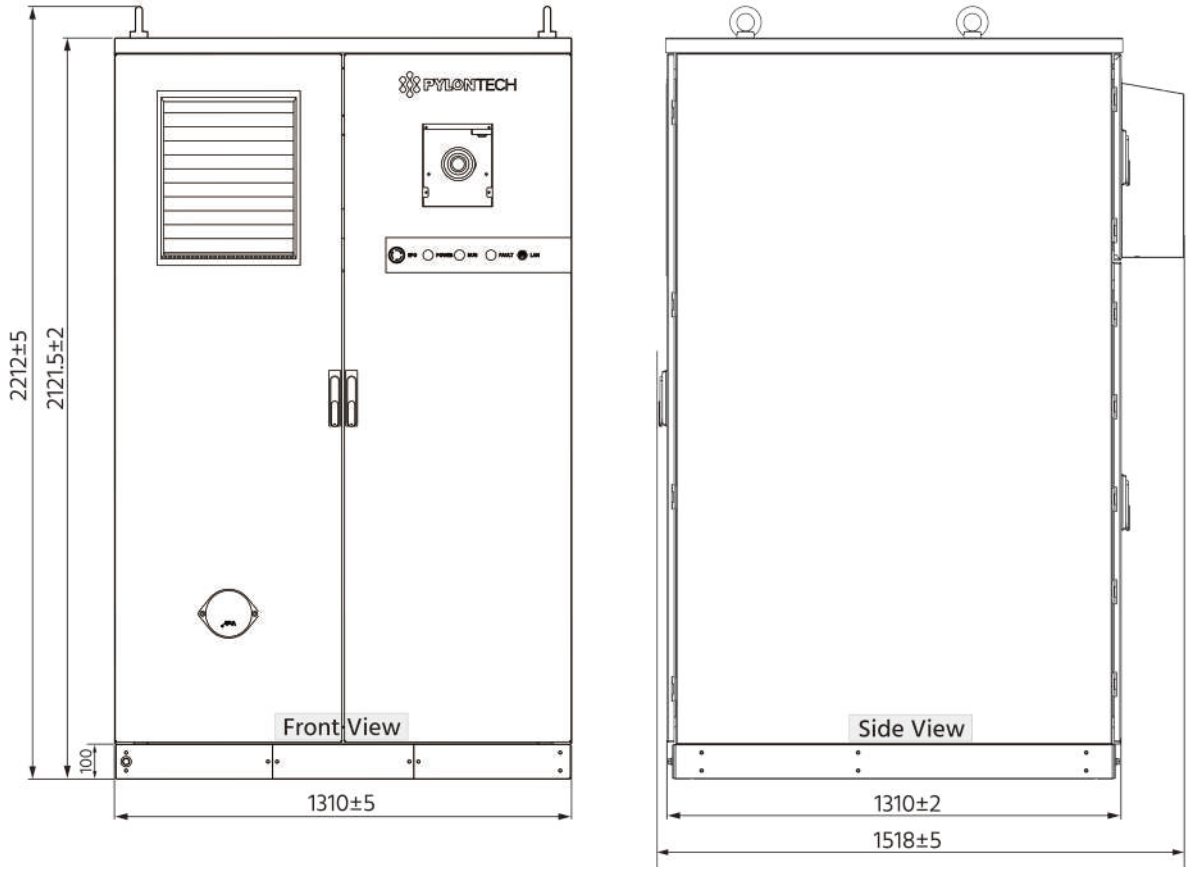
4.3.1 Working Environment Requirements

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℃ to ensure that the outdoor integrated cabinet can operate normally.

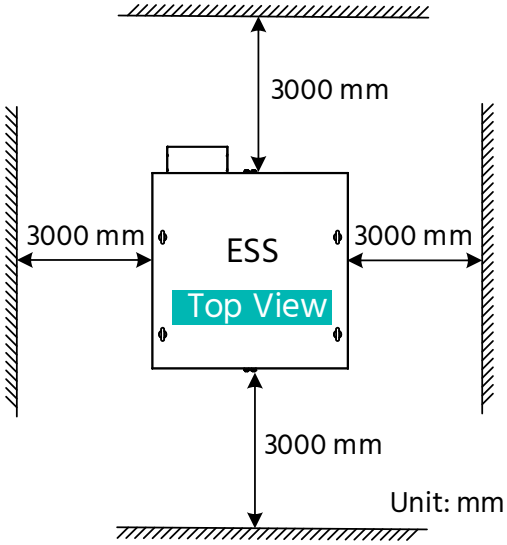
4.3.2 Installation Space Requirements

- The external dimensions of the storage system are 1310±5 mm (W) x 2212±5mm (H) x 1518 ±5mm (D). And the installation site must have enough space to place the equipment.



(unit: mm)

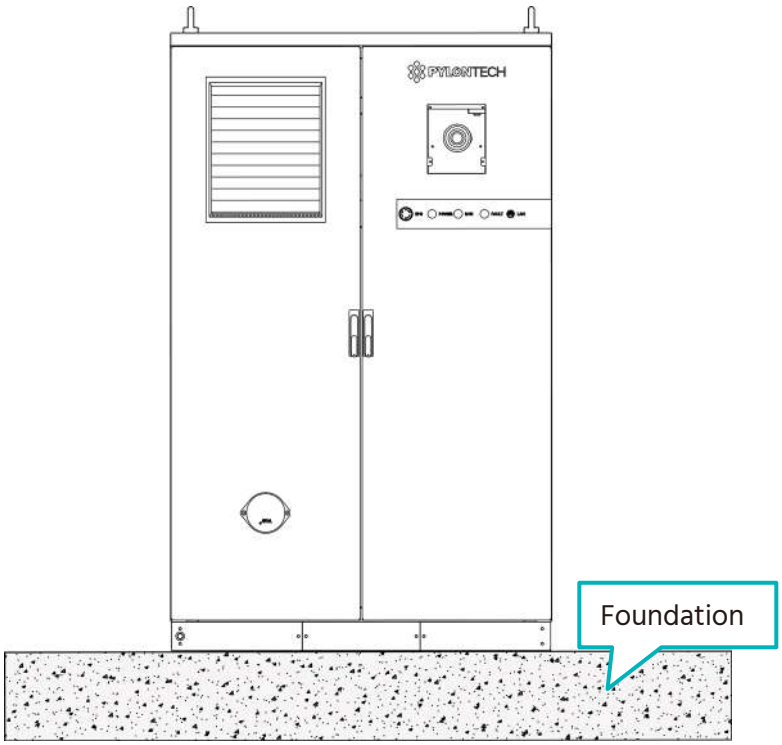
- Suggestions for fire safety distance around the system (unit: mm).



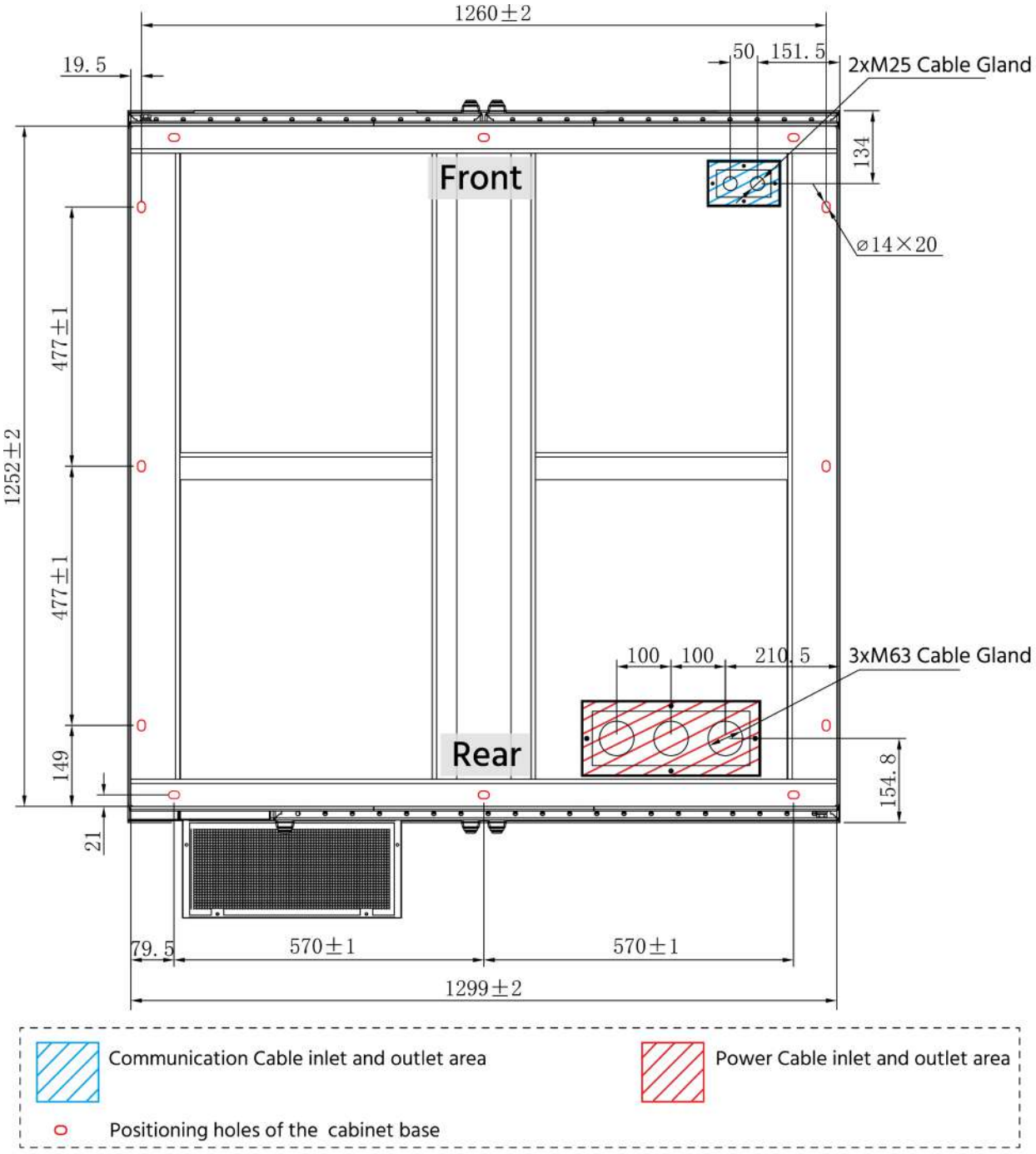
4.3.3 Installation Foundation Requirements

The installation site needs to meet the following requirements:

- The installation foundation should be able to bear the total weight of the whole outdoor cabinet system (about 2550kg).
- 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



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



⚠ 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.

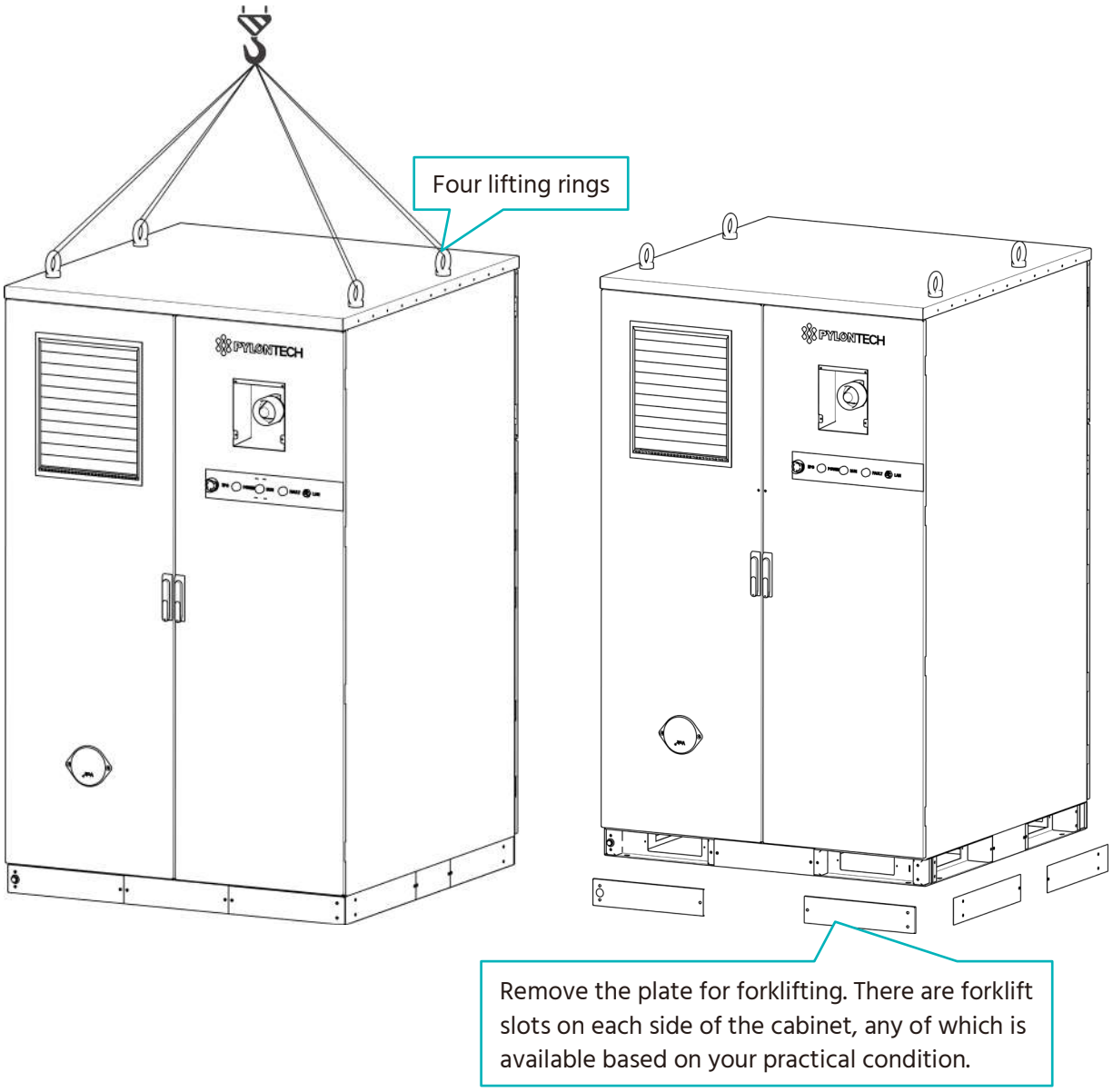
DANGER

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

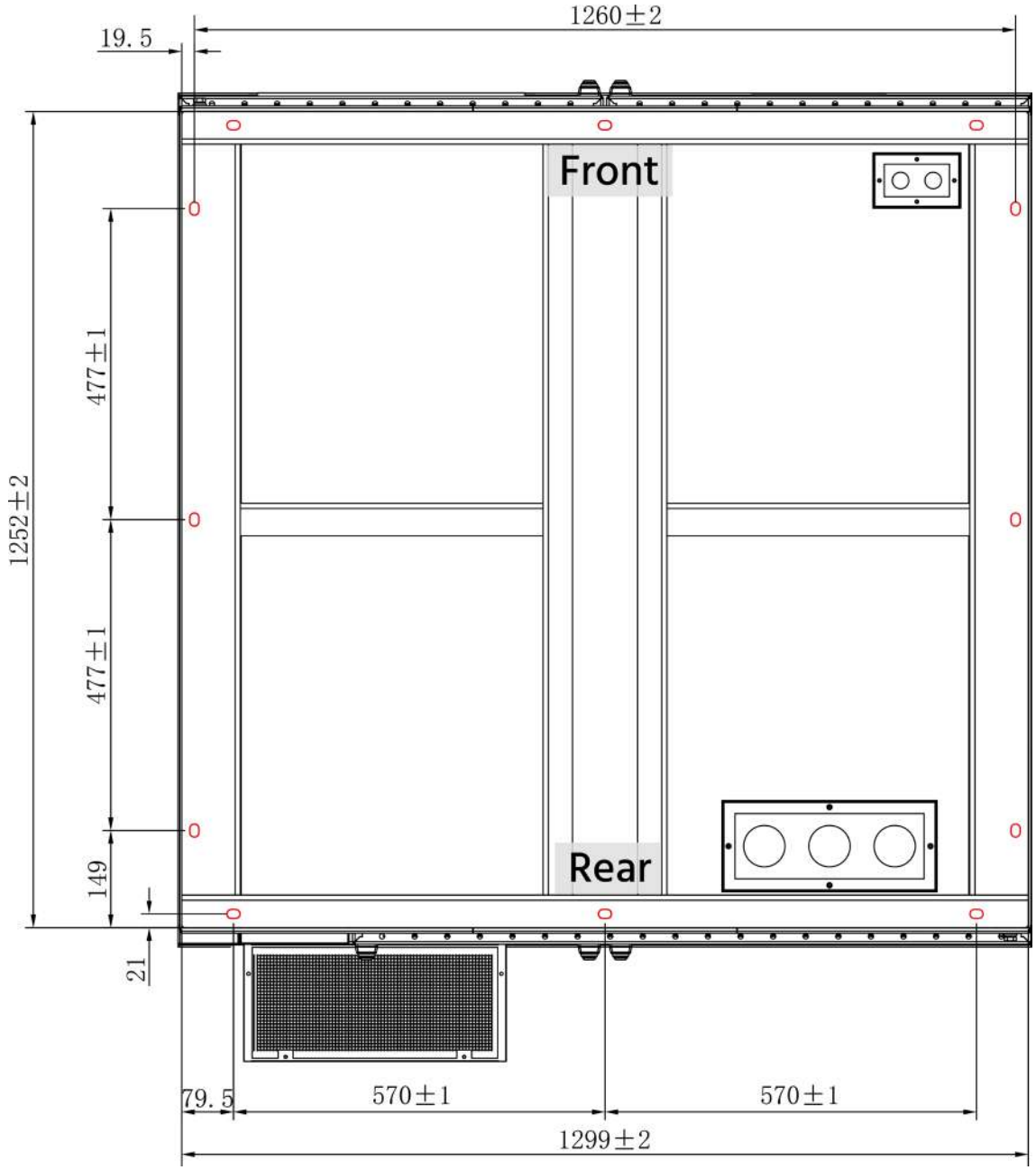
Pay attention to the center of gravity when lifting or forking the cabinet and keep the moving process slow, smooth and balanced.
During the moving process, the equipment should not be tilted at an angle of more than 5° and should not be suddenly lowered or lifted.

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 12 mounting holes (marked in red).



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.

NOTE: For detailed system diagram of the cabinets, please refer to the ***<Annex 1: System Electrical Diagram-Main circuit>*** *and* ***<Annex 2: System Electrical Diagram-Secondary circuit>.***

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	⩾ 50 mm^2	SC50-10
Ground PE-Cable	⩾ 25 mm^2	SC25-8
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:

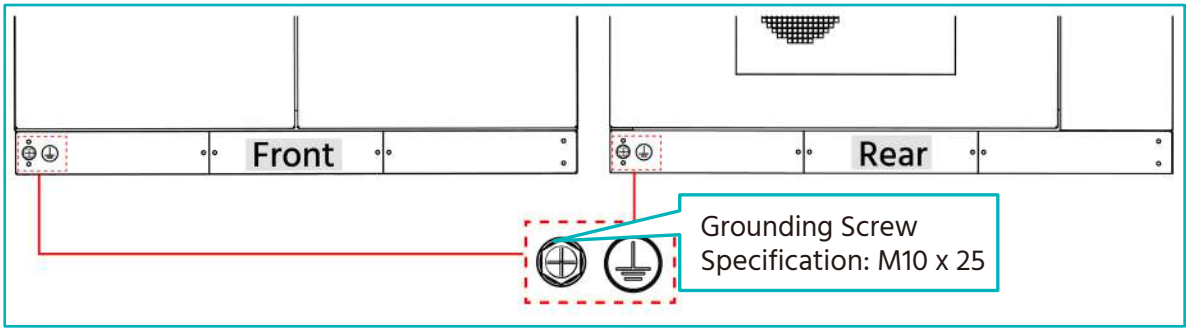
Screw Size	M3	M4	M5	M6	M8	M10	M12	M16
Torque (N•m)	0.5~0.8	1.2~1.5	3~4	5~6	8.8~10.8	17.7~22.6	31.4~39.2	78.5~98.1

5.2 Grounding

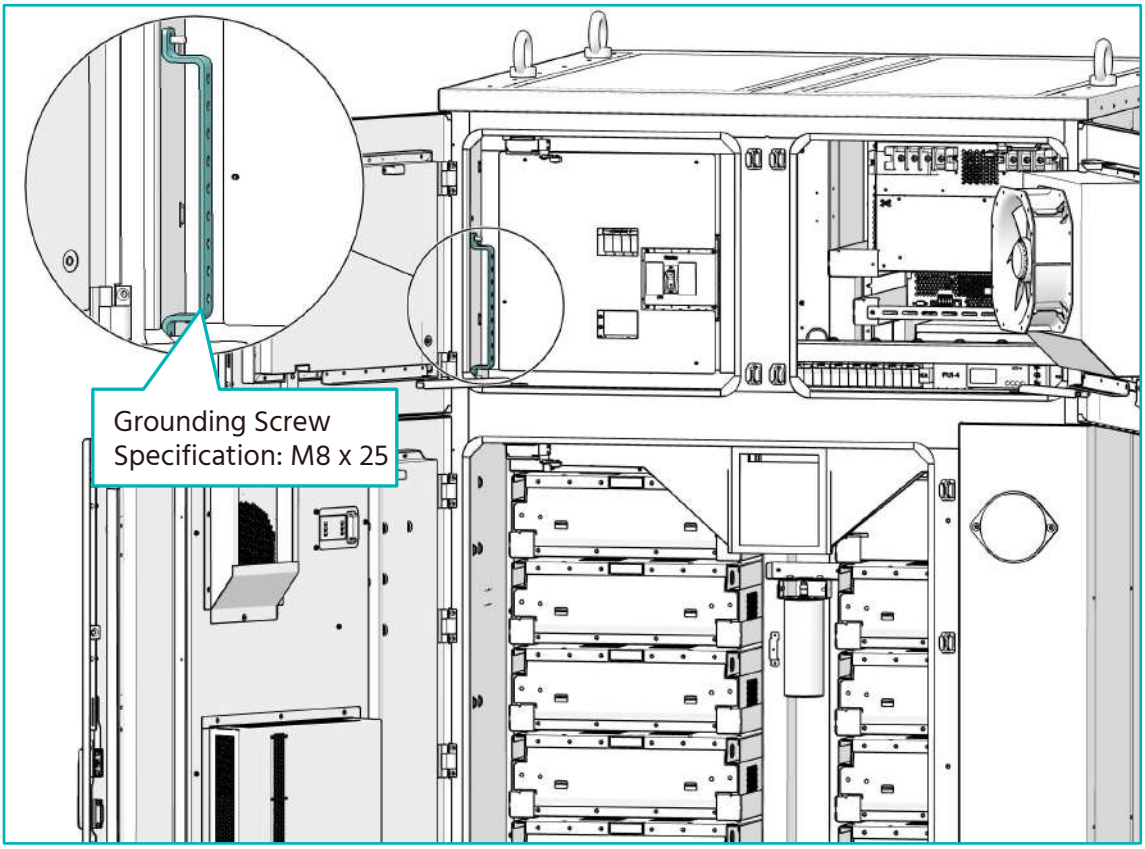
DANGER

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 two grounding points for cabinet grounding on the base, one on the front and the other on the rear.



- Grounding copper bars: There is one grounding copper bar inside the rear of the cabinet, used for connecting grounding cables of the electrical device in the cabinet.



5.3 Battery Energy Storage System Connection

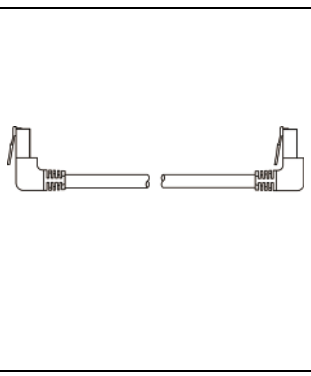
DANGER

Do not reverse the positive and negative connection.

5.3.1 Cable Kit of Battery String

The battery string cable kit includes cables and screws, see details below.

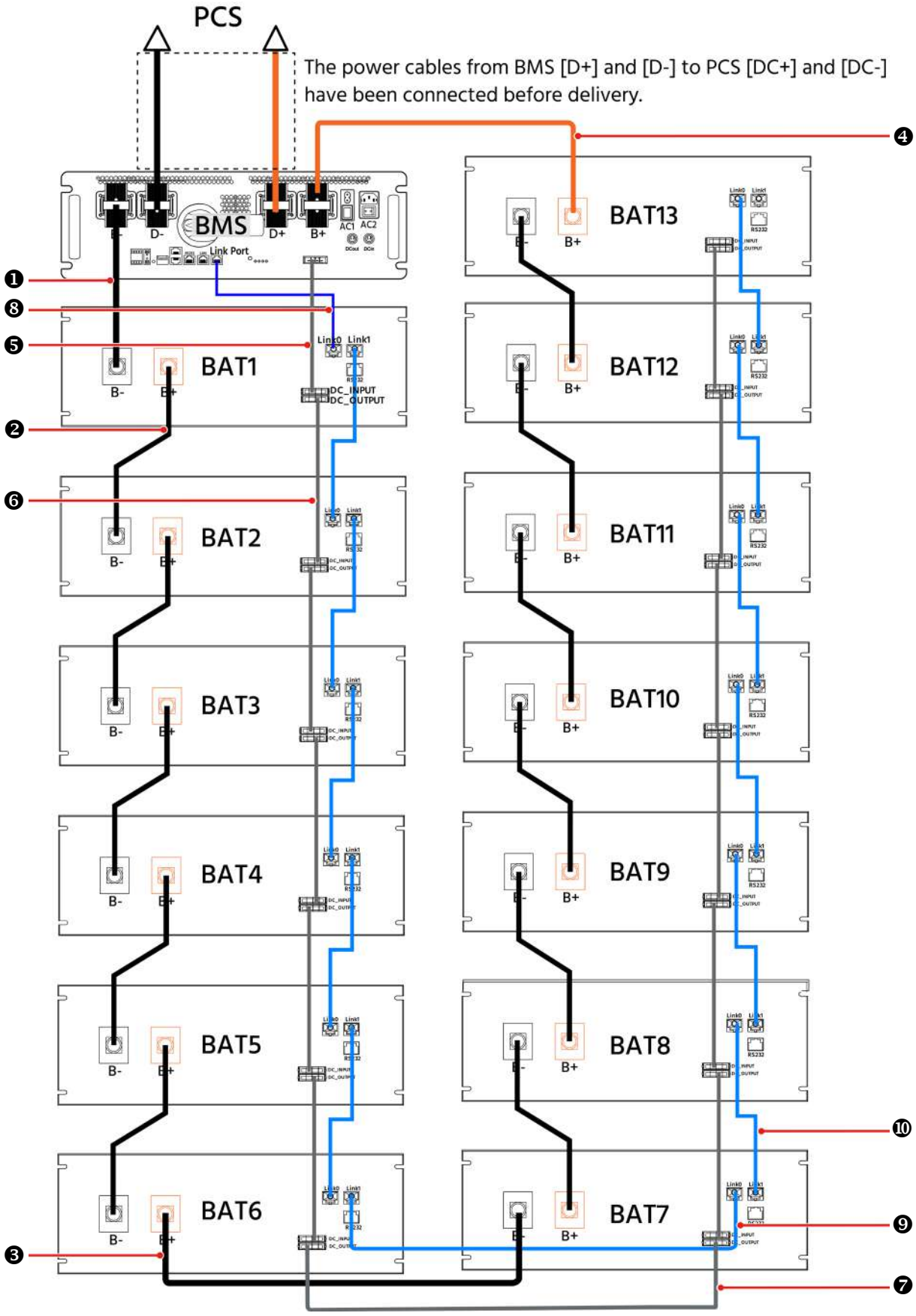
- **Cable List**

NO.	Illustration	Qty.	Material Code	Description
❶		1	5STPT04-00314	Copper Bar-Battery Module [B-] to Battery Control Module [B-]
❷		11	5STPT04-00317	Copper Bar- Battery Modules [B+] to [B-] serial Connection
❸		1	5STPT04-00567	Copper Bar- Battery Module (bottom left) [B+] to Battery Module (bottom right) [B-] serial Connection
❹		1	5STPT04-00566	Copper Bar- Battery Module (upper right [B+] to Battery Control Module [B+]
❺		1	5WRPY02-01573	Power cable (190 mm)- Fan power supply (battery control module to battery module)
❻		11	5WRPY02-01571	Power cable (175 mm)- Fan power supply (connection between battery modules)
❼		1	5WRPY02-20478	Power cable (820 mm)- Fan power supply (bottom left to bottom right battery module connection)
❽		1	5WRPY01-20169	Communication Cable (400 mm)- battery control module to battery module
❾		1	5WRPY01-20168	Communication Cable (880 mm)- bottom left to bottom right battery module connection
❿		11	5WRPY01-00917	Communication Cable (136 mm) - connection between battery modules

- **Screws -**28 pcs M8x20 screws for fixing the copper bars

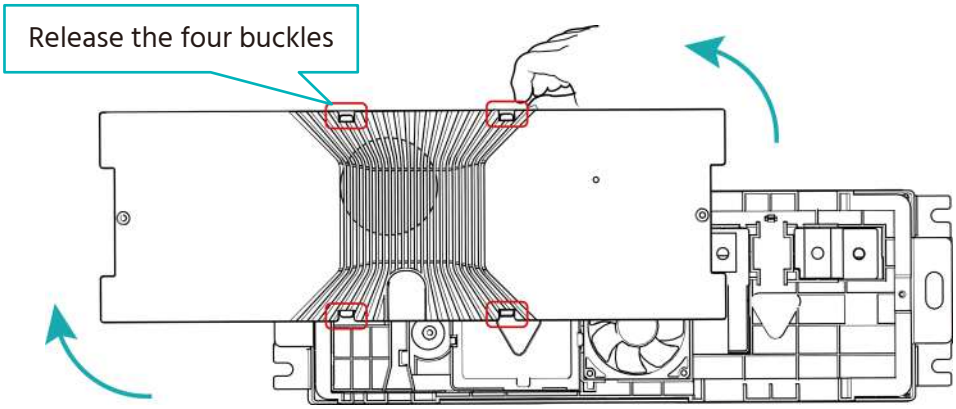
5.3.2 Battery String Wiring Diagram

The wiring diagram of the battery string is as follows. The label numbers correspond to the cable list in *section 5.3.1.*



5.3.3 Battery String Wiring Procedure

1. Remove all front covers from the battery modules.



2. The internal and external communication cables of the battery string have been connected before delivery. Check to make sure the communication connection is made correctly, referring to *section 5.3.2.*

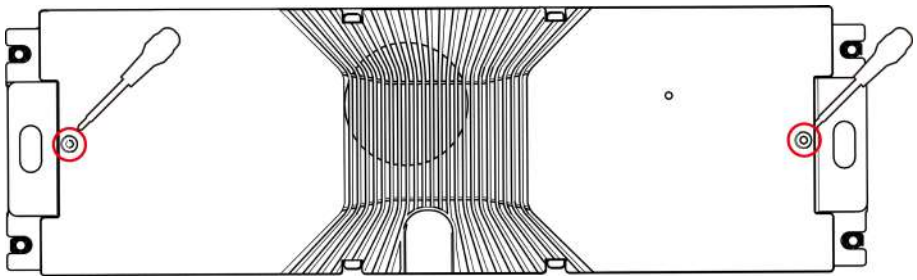
⚠ DANGER

Do not reverse the positive and negative connection.

3. Connect the copper bars and power cables for the battery string according to the wiring diagram in *section 5.3.2.* Be sure to screw the copper bars once they are connected.
4. Whenever a battery module is connected, replace the cover on the battery module and tighten the screws (M4x16). For torque requirements, refer to *section 5.1 Bolt Torque*.

⚠ DANGER

For safety, be sure to replace the cover on the battery module and tighten the screws whenever a battery module is connected.



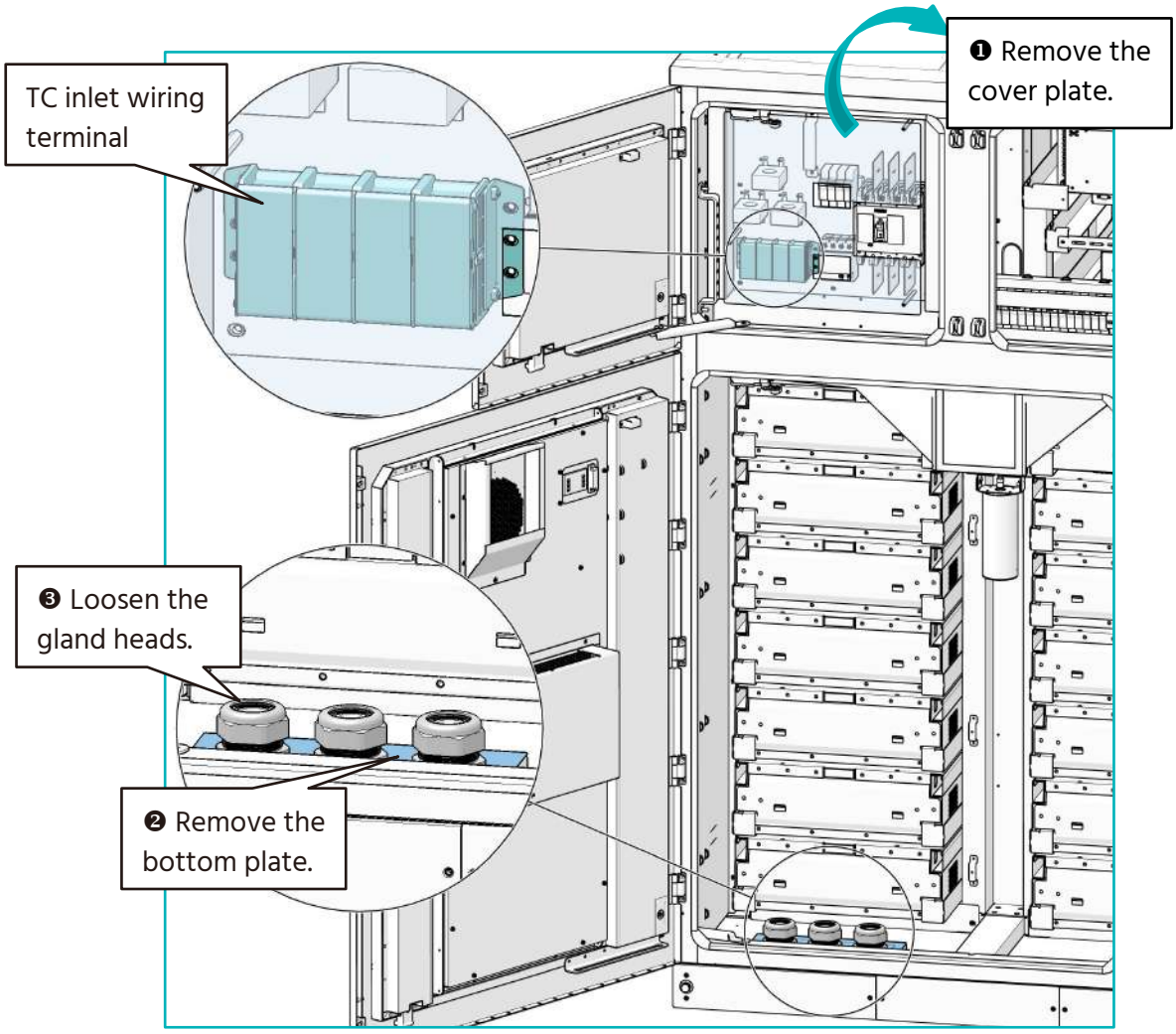
5.4 AC Side Cable Wiring

Preparations before wiring:

1. Unscrew the cover plate over the TC inlet wiring terminal (❶).
2. Unscrew the plate at the bottom of the base and loosen the gland heads (❷❸).

Steps for wiring:

1. Feed the cables from AC Grid through the pre-opened holes at the bottom and connect to the TC inlet wiring terminal. Make sure the cables go through the bottom plate. (Any of the three holes is available for feeding cables due to practical condition of the installation site.)



2. According to the labeling, connect the cables of each phase sequence in turn, three opposite sequences are not allowed.
3. Finish wiring and ensure that all connections are correct, and there is no overlap and no stress between the wires and sheet metal.
4. Install back the gland heads on the unoccupied holes and cover plate over the TC inlet wiring terminal.
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

The communication cables have been connected before delivery.

NOTE: For detailed system diagram of the cabinets, please refer to the ***<Annex 3: System Communication Wiring Diagram>***.

Definitions of LEMS DI & DO Ports

Item	Name	Definition
DI	DI01	Smoke detector feedback
	DI02	Aerosol feedback UPS failure
	DI03	QF1 feedback
	DI04	EPO feedback
	DI05	Limit switch on/off
	DI06~DI16	Reserved
DO	DO01	Run Indicator LED
	DO02	Fault Indicator LED
	DO03	QF1 shunt trip
	DO04	Air Inlet Vent and Explosion Proof Fan (Startup)
	DO05	Sounder/Beacon alarm
	DO06	Air Inlet Vent and Explosion Proof Fan (Shutdown)
	DO07	Reserved
	DO08	Reserved

6 Commissioning

6.1 System Turning On

⚠ WARNING

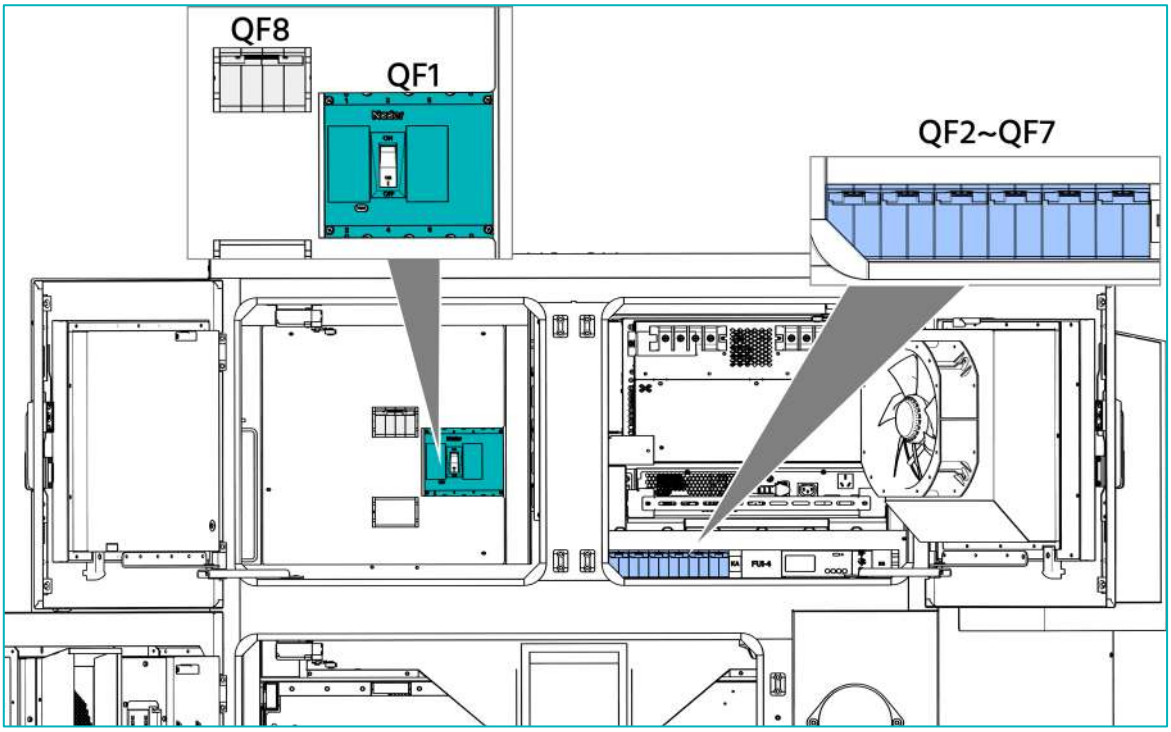
Double check all the power cables and communication cables. Ensure that the voltage of the PCS matches the voltage of the battery system. Check to make sure that all the power switches are OFF.

⚠ 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.

Procedure

1. Switch on the Moulded Case Circuit Breaker QF1.
2. Switch on the Circuit Breaker QF8.
3. Switch on the Circuit Breaker QF2.
4. Switch on Circuit Breakers QF3 and QF4 one after another. The air conditioner will start automatically.
5. Switch on the circuit Breaker QF5 and the battery string will be powered on.
6. Switch on the circuit Breaker QF6 and the UPS will be powered on.



Rear Door Open

7. Switch on the UPS following the steps below.

(1) Hold the power button for 2 seconds until the LCD pops up the confirmation dialog box. (Note: if the battery is not available, no dialog box appears when pressing and holding the power button.)

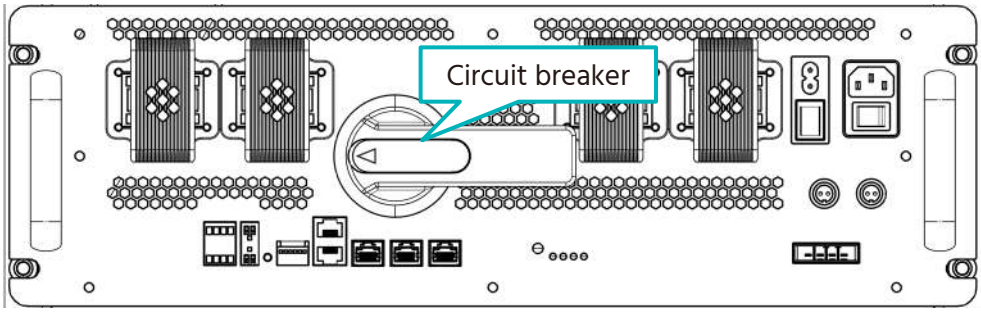
(2) Use  or  move the cursor, press the “Enter”  key to select "Yes", then the running indicator (green) flashes, the inverter is on, and the running indicator is solid on.

(3) Check whether the inverter output voltage is normal and then close the external output circuit breaker.

(4) If the battery is not connected, the alarm indicator will turn yellow. If battery access, alarm indicator will be off.

(5) If this is the first time UPS is started, the start guide is opened to set the basic parameters of UPS, referring to section *3.5.5.4 Initial Start-up Guidance*. For detailed instructions on UPS display functions and settings, refer to *Section 3.5.5.3 Introduction of the Operation and Display Panel.*

8. 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 MBMS 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 LEMS 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:

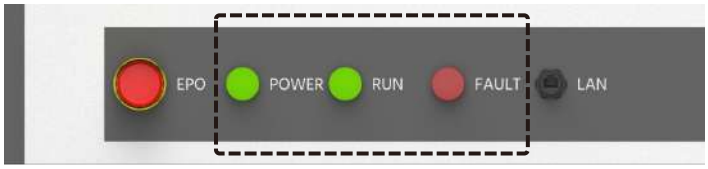
- When starting up for the first time, it is necessary to fully charge the battery for SOC calibration.
- After installing or restarting the system when it is not used for a long time, the entire energy storage system should be firstly fully charged.

6.2 System Debug

Debug Step	Actions
Preparations for debug	Turn on the BESS system, referring to *section 6.1*. Remark: Besides the BESS, if other equipment has its own system starting upsteps, 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.

6.3 System Status

The battery cabinet system status (Run ● , Alarm ●, Fault ●) can be viewed through the Status LED on the door of the communication and confluence cabinet.



6.3.1 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:

Battery Status	Protection / Alarm / Normal	STATUS (green)	STATUS (red)	Capacity SOC				Descriptions
		●	●	●	●	●	●	
Shut Down		Off	Off	Off	Off	Off	Off	All off
Sleep	Normal	Flash 1	Off	Off	Off	Off	Off	Indicates Sleep Mode, to save the power.
Idle	Normal	Light	Off	Off	Off	Off	Off	Indicates save power mode.
	Alarm	Light	Off	Off	Off	Off	Off	Indicates the battery voltage or temperature is high or low.
	Protection	Off	Light	Off	Off	Off	Off	Indicates the battery voltage or temperature is over or under.
Charge	Normal	Light	Off	The highest capacity indicator LED flashes (Flash 1), others lighting.				The highest capacity indicator LED flashes (flash 2), others lighting, horse race lamp when SOC＞= DODH;
	Alarm	Light	Off					
	Protection	Off	Light	Off	Off	Off	Off	Stop charging, STATUS (red) lighting.
Discharge	Normal	Flash 1	Off	Indicate based on capacity				Indicate based on capacity
	Alarm	Flash 1	Off					
	Protection	Off	Light	Off	Off	Off	Off	Stop discharging, STATUS (red) lighting.
Abnormal	Power On Fault	Off	Flash 2	Off	Off	Off	Off	Stop charging/discharging, STATUS (red) lighting.
	Other Fault	Off	light	Off	Off	Off	Off	
	STL Fault	Off	Flash 1	Flash 1				MCU self-check problem

Flash 1 - 0.5 seconds light / 0.5 seconds off; Flash 2 – 1 second light / 1 second off.

6.3.2 LED Indicators Instructions of the LEMS

The whole BESS's status can be viewed through LEMS's LED Indicators. Please see the instructions as follows.

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	The yellow LED indicator lighting 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	The red LED indicator lighting 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.

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.

⚠ 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.

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

7.1 System 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

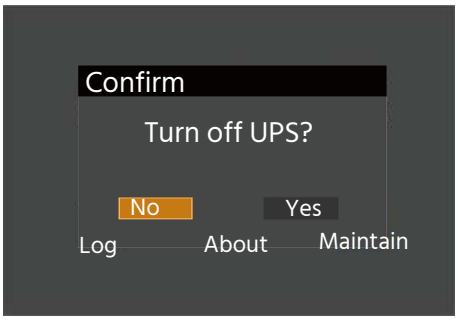
The PCS contains deadly high voltage! Failure to follow the instructions may result in death or severe electric shock injury!

- 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. Shut down the UPS as follows:

(1) Long press the power button ⏻ on the front panel of the UPS.

(2) Click “Yes” to confirm “Turn off UPS” on the display panel. After a while, the UPS shuts down.



3. Disconnect the circuit breaker QF6.
4. Turn off the circuit breaker of the BMS.
5. Disconnect the circuit breakers QF5, QF4 and QF3 one after another.

⚠ 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 QF2, QF8 and QF1 on after another.

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 Interval
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 during 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 heating of the energy storage system cabinet is normal, and use the thermal imager to monitor the heating of the system.	Once 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. (3) Check the humidity and dust in the ambient environment. (4) Check the ventilation of the air inlet and outlet. (5) Check if there is dust, foreign object, or insects blocked in the filter screen of the air inlet window. Replace the filter element when necessary, referring to *section 7.2.1.* (6) Check if there is dust, foreign object, or insects blocked in the filter screen of the air outlet window. Clean the filter screen when necessary, referring to *section 7.2.2*	Every 6 months to 1 year (depending on the dust content of the environment in which it is used). *

	NOTE: Open the door gently to prevent the dust raising from the filter element which may lead to detectors to alarm.	
Power circuit connection check	(1) Check power cable connections for looseness and retighten to the torque specified above. (2) Check power cables and control cables for damage, especially cut marks on the skin in contact with metal surfaces. (3) Check that the insulating wraps of the power cable terminals are not detached.	Officially run for six months, then every six months to one year thereafter.
Terminal and wiring connection check	(1) Check whether the control terminal screws are loose and tighten them with a screwdriver. (2) Check whether there is any color change in the wiring copper or screws. (3) Visually inspect the connections such as equipment terminals and the distribution of wiring. (4) Check the main circuit terminals for poor contact and screw locations for signs of overheating.	Officially run for six months, then every six months to one year thereafter.
Circuit breaker maintenance	(1) Routine inspection of all metal components for corrosion. (2) Annual inspection of contactors (auxiliary switches and micro-switches) to ensure that they are in good mechanical working order. (3) Check the operating parameters (especially voltage and insulation).	Officially run for six months, then every six months to one year thereafter.
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.

* **NOTE**:

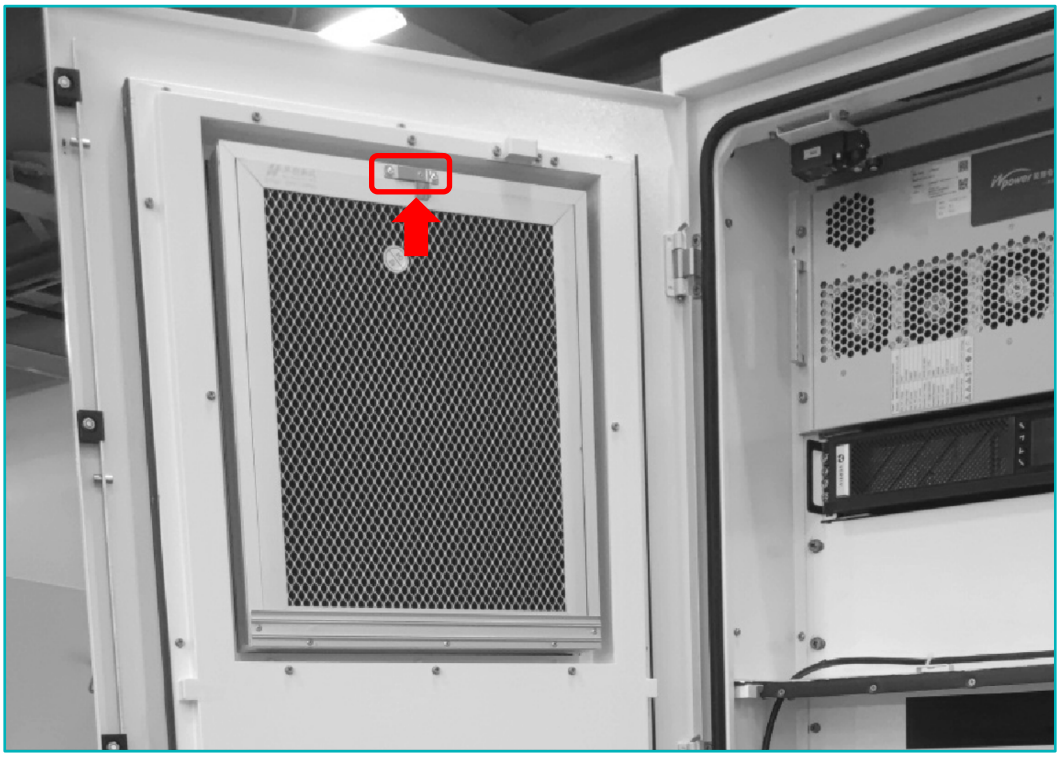
(1) The maintenance intervals listed in the above table are ONLY recommended maintenance intervals. The actual maintenance interval is determined based on the installation environment and location of the product.

(2) If the operating environment is heavily sand-blown or dusty, shorten the maintenance period and increase the frequency of maintenance.

7.2.1 Maintenance of the Air Inlet Ventilation Window

Please follow the steps below to replace the filter element of the air inlet ventilation window.

1. Push the buckle on top of the filter screen and lift up the filter screen slowly.
2. Remove the filter screen from the ventilation window.



3. Gently pull down the filter element from the filter screen.

4. Clean the filter element or replace it with a new one if it is too dirty.
5. Stuff back the filter element into the filter screen.
6. Install back the filter screen into the ventilation window and pull back the buckle to make sure the filter screen is steadily fixed.

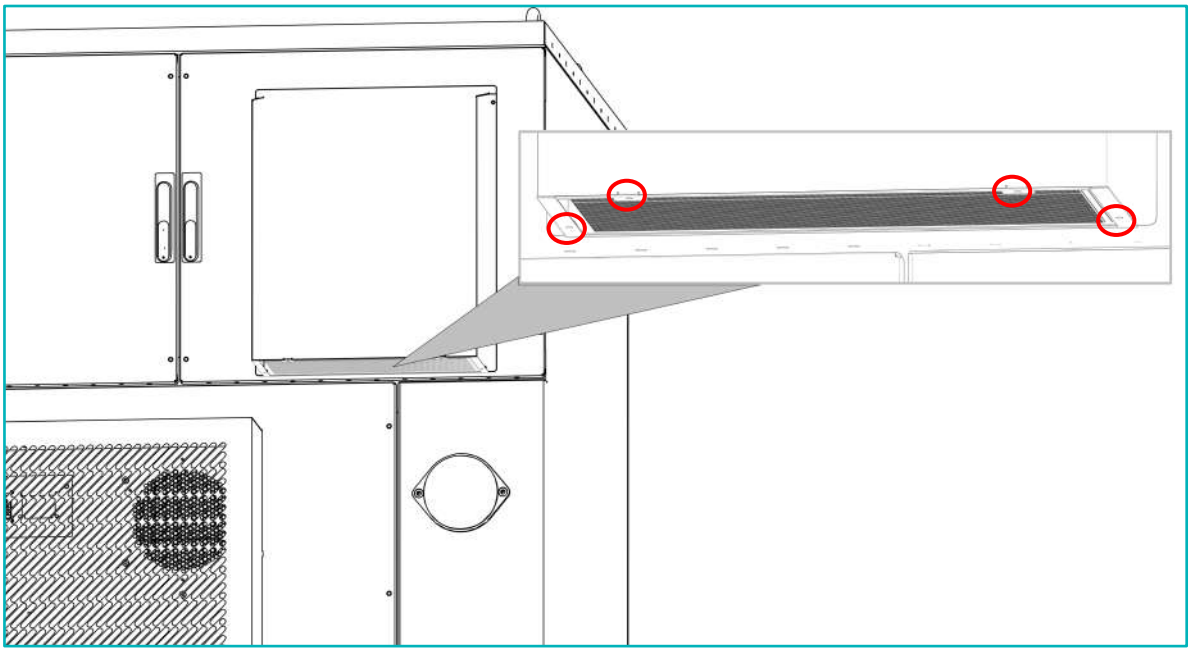
7.2.2 Maintenance of the Air Outlet Ventilation Window

1. Visually inspect to check if there is any dust, foreign object, or insects blocked in the filter screen of the air outlet window.
2. Gently knock the filter screen to let the blockage matters fall down.
3. It the filter screen is too dirty, remove it for cleaning as following (Optional Step):

   (1) Loosen the four screws to take out the filter screen.

   (2) Wash the filter screen and wipe it dry, then install it back to the ventilation window.

   (3) Fasten the screws to make sure the filter screen is steadily fixed in the ventilation window.



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 (charging to full) should be done every 3 months and is usually done automatically by communication between the system and external device.	Once 3 months
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

⚠ DANGER

All maintenance operations must be carried out with all switches on the DC side, AC side, battery modules and AC distribution cabinet of the PCS disconnected. After the PCS AC/DC switch is disconnected, some components on the PCS still have residual voltage. Please wait at least 60 minutes before maintaining the PCS to prevent electric shock!

The PCS must be maintained regularly to ensure its normal operation and service life. The recommended routine maintenance cycle and work contents are shown in the table.

Routine Maintenance Table

Maintenance Item	Interval
Clean the dust at the air inlet of the Power module.	Once a month
Check whether there is dust, moisture or condensed water vapor inside the box.	Once a month
Check whether the cable connection is loose and tighten the screws if necessary.	Once a month
Check warning signs and add or replace them if necessary.	Once a month
Manually check AC and DC breakers.	Once every six months
Check the stop function of LCD.	Once a month
Check whether there is abnormal noise during the operation of the equipment.	Once a month

Waste Disposal

The PCS will not pollute the environment, and the materials and components of the products meet the environmental protection requirements. When the service life of the PCS ends, users shall operate and dispose of it according to the relevant local laws and regulations, and shall not discard it at will.

7.5 Air conditioner Maintenance

⚠ WARNING

All the maintenance work of the air conditioner shall be operated by qualified and authorized person only.

Please disconnect the air conditioner power supply and signal cable in advance, and connect the air conditioner power supply and signal cable after the maintenance work is finished. If cleaning or wiping the external dirt of the cabinet air conditioner, please use neutral detergent, do not use organic solvents.

Maintenance Table

Maintenance Item	Maintenance Action	Interval
Filter Screen	Clean filter screen at the air inlet port with a soft bristle brush.	Three or four times every year
Condenser and Evaporator	Clean the bent plate of the condenser and evaporator with a brush.	Three or four times every year
Check Electric Safety	Check whether the power cable and communication cable of the cabinet air conditioner are normal.	Three or four times every year
	Check whether the air conditioner operates normally.	Three or four times every year
	Check whether the cooling effect of the cabinet air conditioner is normal.	Three or four times every year

7.6 UPS Maintenance

The UPS maintenance includes the fan maintenance, battery maintenance, UPS cleaning, UPS state check, and UPS function check.

> **⚠ CAUTION**
>
> Never attempt to carry out maintenance on the UPS while it is online. Ensure that the UPS has been switched off completely when performing any internal maintenance operations on it.

7.6.1 Fan Maintenance

> **⚠ CAUTION**
>
> In order to avoid injury or damaging the device, wait until the fan is completely stationary before inserting fingers or any tools into it.

The UPS fans are expected to run for 20000 hours ~ 40000 hours continuously. The higher the ambient temperature, the shorter the fan life is.

During the UPS operation, please verify the fan status once every half year by confirming that air blows out from the ventilation holes on the rear panel.

7.6.2 UPS Battery Maintenance

> **⚠ CAUTION**
>
> 1) Never reverse-connect the battery connections, otherwise the fire will occur.
> 2) Never attempt to open batteries since they contain electrolyte which is potentially harmful to personnel. In the event of accidental with electrolyte, wash the affected area with abundant, clean water, and seek medical assistance immediately.

The internal battery of the UPS is sealed, lead-acid, maintenance-free battery. The battery life depends on the ambient temperature, charge and discharge times. High ambient temperature and deep discharge shortens the battery life. To ensure the battery life, it is required to:

- Prevent small current discharge. Continuous battery operation time exceeding 24 hours is strictly prohibited
- Charge the battery for at least 12 hours, if the battery hasn't been charged for three months at specified ambient temperature, or two months at high ambient temperature.

⚠CAUTION

1) Check regularly the screws at the battery connection parts, and fasten the loosen ones immediately.
2) Make sure that the safety equipment is complete and that the function is normal, especially that the settings of the battery management parameters are normal.
3) Measure and record the internal temperature of the battery capsule.
4) Check whether the battery ports are damaged or hot, and whether the chassis and the covers are damaged.

7.6.3 Cleaning UPS

To ensure free airflow inside the UPS, clean the UPS periodically, especially the ventilation holes. If necessary, clean the UPS with a vacuum cleaner. Confirm that the ventilation holes are unobstructed.

7.6.4 Checking UPS State

It is recommended to check the UPS operation status once every half year. Check the following items:

1. Check if the UPS is faulty:
   1) if the alarm indicator is on, or
   2) if there are any active UPS alarms.
2. Check if the UPS is operating in Bypass mode. Under normal conditions, the UPS operates in Normal mode; if you find that it is operating in Bypass mode, determine the reason (operator intervention, overload, internal fault, etc.).
3. Check if the battery is discharging: If the grid power supply is normal, the battery should not discharge; if you find that it is operating in Battery mode, determine the reason (grid outage, battery test, operator intervention, etc.).

7.6.5 Checking UPS Functions

⚠CAUTION

UPS functions checking operation may cause load power supply outage.

We recommend checking the UPS functions once every half year.

Backup the load data before conducting the UPS functions check. Procedures are as follows:

4. Press the power button to check if the buzzer beeps, indicators are ON, and the LCD display is normal.
5. Press the ESC key to check again if the indicators are ON, the LCD display is normal and the UPS has been transferred to the inverter mode.

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:

Error Code checked from BMS (Modbus protocol Appendix IV or CAN ID 0*4250&0*4290):

*The 'Failure Definition' and 'Failure Mode' column is reference from Pylontech Modbus protocol Appendix IV Error code 1 bit to present.

Failure Type	Failure Definition	Possible Reason	Solution
External	Input RV Err (Bit4)	D+ D- reversely connected	Check the external power cables of the polarity and connection.
External	DC OV Err input over voltage error (Bit3)	D+ D- voltage extremely higher than battery system voltage.	Check that if the PCS's voltage matches the battery system.
External	Emergency stop (Bit13)	Command by external device via dry contactor.	Command by external device, not an erroractively reported by battery system.
Current Leakage	Current Leakage Error (Bit21)	Current Leakage >25mA	With insulation gloves, disconnect the battery system and contact Pylontech service engineer.

Self-test	Self-test module Initial Error (Bit16)	Self-test failed.	1. Restart the battery system. 2. If the problem persists, contact Pylontech service engineer.
Self-test	Self-test module coulomb error (Bit15)	Self-test failed.	Contact Pylontech service engineer.
Self-test	Self-test module detecting amount error (Bit14)	Self-test failed.	Contact Pylontech service engineer.
Self-test	Safety check failure (Bit11)	Chip self-test failed.	1. Restart the battery system. 2. If the problem persists, contact Pylontech service engineer.
Self-test	Self-test volt error (Bit10)	Battery cell voltage measurement mismatch with DCBUS voltage measurement.	Restart the battery system. Check the connectivity and reliability of the power and communication cables. Swap the current measurement board or BMS. If the problem persists, contact Pylontech service engineer.
Battery cell	Battery damage error (Bit6)	Battery cell voltage measured at <2.0V.	Restart the battery system. Swap out the RED LED battery module. Use multimeter to measure the battery module power terminal voltage, if is the same as the BMS reading value, then it`s a true cell damage. Otherwise please swapthe BMU of the module.

8.2 PCS Trouble Shooting

Contact Customer Service for assistance with PSC troubleshooting.

8.3 Air Conditioner Trouble Shooting

Failure	Possible Reason
E01: The return-air temperature sensor is faulty.	The sensor is damaged or loose.
E04: The humidity and temperature sensor is faulty.	The humidity and temperature sensor is damaged or loose.
E13: High temperature alarm in the cabinet.	The temperature is higher than the setting alarm temperature.
E14: Low temperature alarm in the cabinet.	The temperature is lower than the setting alarm temperature.
E21: High humidity alarm in the cabinet.	The humidity is higher than the setting alarm humidity.
E24: High voltage alarm.	The high voltage switch is damaged or disconnected.
After power-on, the temperature in the cabinet is higher than the setting temperature. And the device do not work.	(1) Check the power supply and electric circuit. (2) Contact with professional maintenance personnel.
The device works properly but the cooling effect is not good.	(1) Re-select the device model or add extra device. (2) Make sure that the working temperature of the device is within normal operating range. (3) Contact with professional maintenance personnel.
During normal operation, the device stops cooling and the electric control system is normal.	(1) Normal phenomenon. (2) Contact with professional maintenance personnel.
During normal operation, the device stops working and the electric control system is normal.	(1) Check if the electric circuit is normal. (2) Contact with professional maintenance personnel.

NOTE: Please contact Customer Service for more problems.

8.4 UPS Trouble Shooting

List of UPS Alarm and Fault Message

Alarm message	Description
Input abnormal	The rectifier and charger are off due to the mains voltage and frequency exceeding normal range. Check that the rectifier input phase voltage and frequency exceed the normal range or that the mains has powered off.
Rectifier overload	The output power is larger than the rectifier overload point. Check that the input voltage meets the output load, mains input 176V ~ 100V, the load 100% ~ 50% linear derating.
Inverter on failed	Check the input voltage, frequency and system settings.
Rectifier fault	The rectifier is faulty and off.
Charger fault	The charger output voltage is abnormal, and the charger is off.
DC/DC fault	The discharger is faulty, because the bus voltage exceeds the setting range when discharger starts or soft starts.
System over temperature	The internal heat sink temperature is too high, and the inverter is off. Only each module heat sink temperature decreased to the setting value can you silence the alarm. The system can automatically start after the overtemperature fault is solved. If over temperature occurs, please check: 1) Ambient temperature too high or not. 2) Dust is blocked or not. Fan fault or not.
Inverter overload	Inverter load capacity is larger than the rated value, overload delay time is up, inverter shuts down. If bypass is available, the system will transfer to the bypass mode, otherwise the output is failure. Check that the actual inverter load capacity, if overloaded, just reduce the load capacity, and the system will transfer to the inverter mode after five minutes with alarm cleared.
Inverter fault	The inverter is off when the inverter output voltage and current exceed the setting range. If bypass is available, the UPS will transfer to bypass mode, otherwise the system will power off.
Output pending	Remote shutdown is enabled, and the system will be off.
Output disabled	The system is in standby state, and the dry contact shutdown is enabled. Check whether the shutdown dry contact is enabled or not.
Battery module connection abnormal	If the number of battery cabinets detected exceeds 6, report abnormal connection of battery modules.
DC bus abnormal	The inverter is off when DC bus voltage is faulty. The load will transfer to bypass if the bypass is available.

Alarm message	Description
Bypass overcurrent	The bypass current exceeds the rated value. Overload delay time is up, inverter shuts down.
Bypass abnormal	Maybe caused by bypass voltage and frequency outside of range, bypass power-off and incorrect bypass cables connection. 1) Check that the bypass voltage and frequency are within the setting range. 2) Check the bypass cables connection.
Bypass abnormal in ECO mode	The ECO mode is available, and the bypass voltage and frequency are outside of the setting range. Check that the bypass input voltage and frequency are within the setting range.
Battery reversed	The battery positive and negative are reversed. Please reconnect the battery and check the battery.
Battery low pre-warning	This alarm occurs when the battery reaches the EOD. After the pre-warning, the battery capacity allows two minutes discharge at full load. The user can set the time ranging from 2～30mininutes, (2 minutes by default). Please shut down the load timely.
Battery voltage abnormal	When the battery is connected, the system checks that the battery voltage exceeds the normal setting range. Check that the battery terminal voltage exceeds the normal range.
No battery	Check the battery and battery cables connection.
Battery test fail	The battery low voltage is detected when the battery has manual or periodical self-test. Battery replacement is recommended.
Battery over temperature	Battery ambient temperature too high. Check that the battery ambient temperature is higher than setting value 40 ~ 60℃ (default: 50℃).
Battery mode	The UPS is on battery, and the inverter starts.
REPO	Shutdown caused by the REPO terminal Normally Closed contact open.
Output off, voltage is not zero	When there is no output, the system detects that the output has a voltage.
Output short	Check that the output cables are not shorted.
System fault	The alarm occurs when model identification is incorrect. Solution: Contact service manager.
Operating on inverter	The UPS output state is on inverter.
Bypass mode	The UPS is on bypass.
No output	The UPS has no output.
Internal communication fails	Check the communication cables are normal.

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.

NOTE:

1) Before shipment, a single module is pre-charged to about 55% SOC, or according to customer requirements. After delivered on-site, the remaining battery capacity is determined by the storage time and condition.

2) The battery module complies with the UN38.3 certification standard. In particular, special rules for the carriage of goods on the road and the current dangerous goods law should be observed.

9.2 Storage

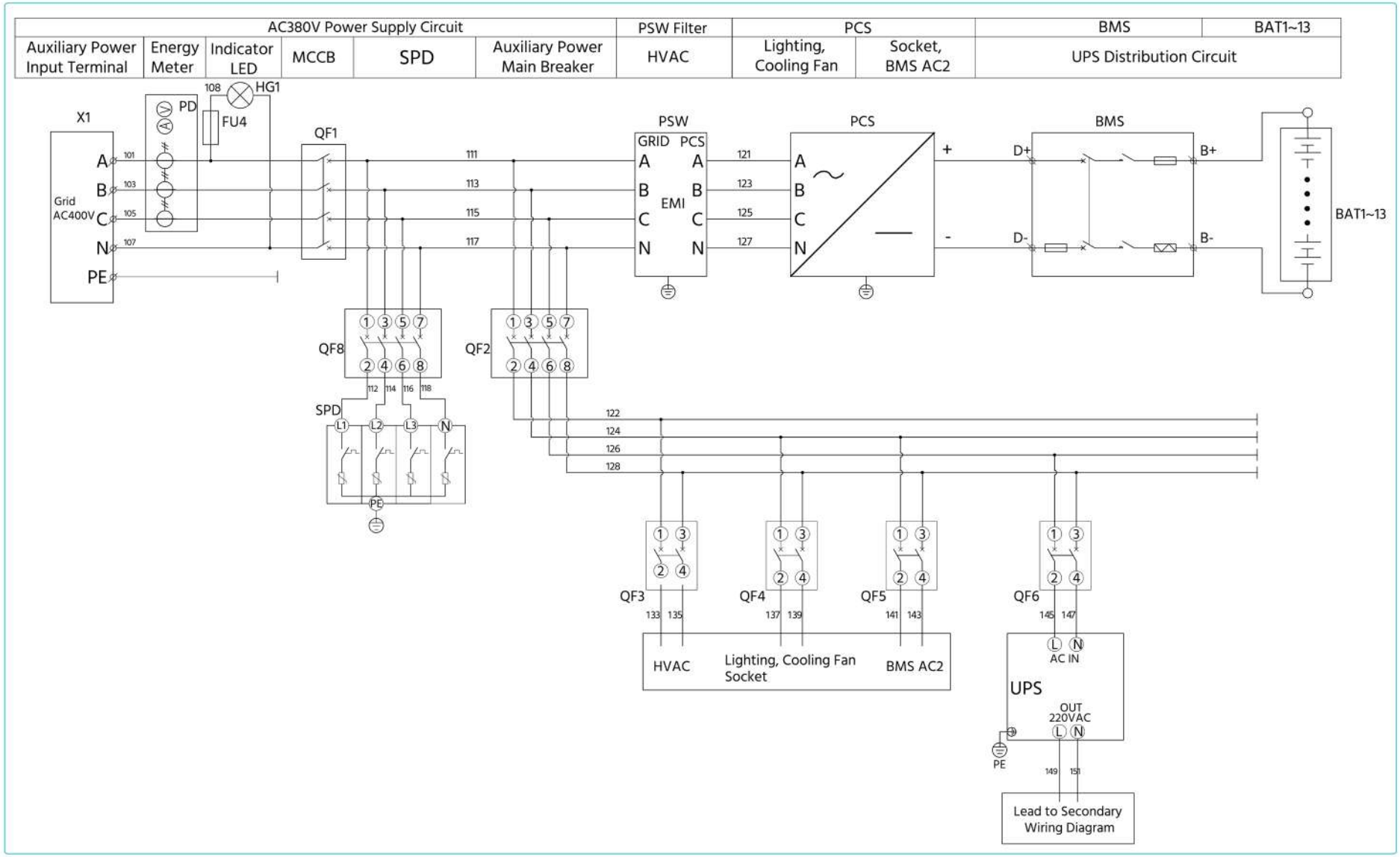
> ⚠ **CAUTION**
>
> Be sure to follow the instructions below for long-term storage. Otherwise, the battery's cycle life will decrease.

Before storage, the battery should be charged to 50~55% SOC.

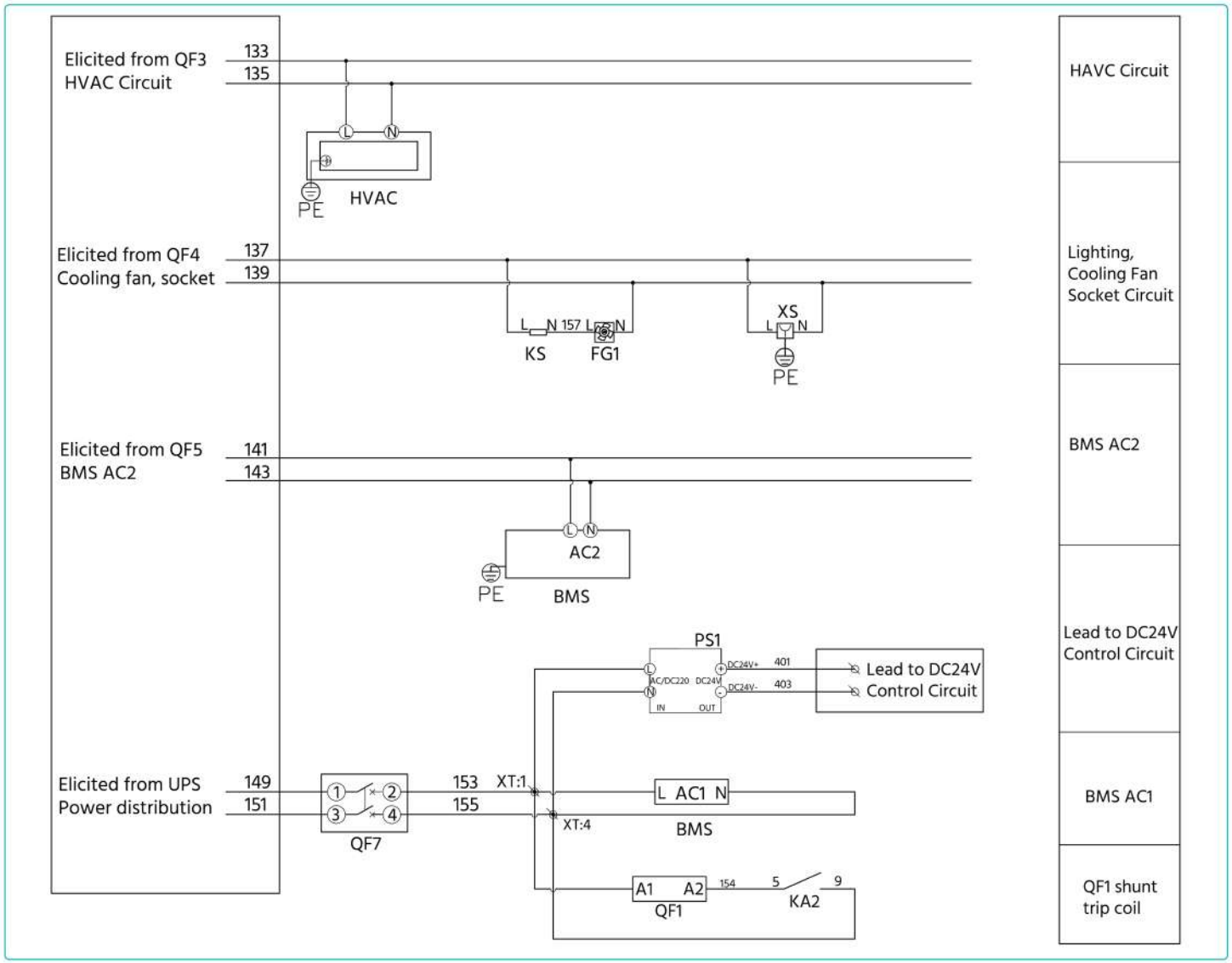
For long-term storage, e.g. if it needs to be stored for a long time (more than 3 months), the battery should be stored in the temperature range for 5~45°C, relative humidity <65% clean, well-ventilated, and corrosive-gas-freed environment.

It is recommended to discharge and charge the battery every 3 months, and the longest discharge and charge interval shall not exceed 6 months.

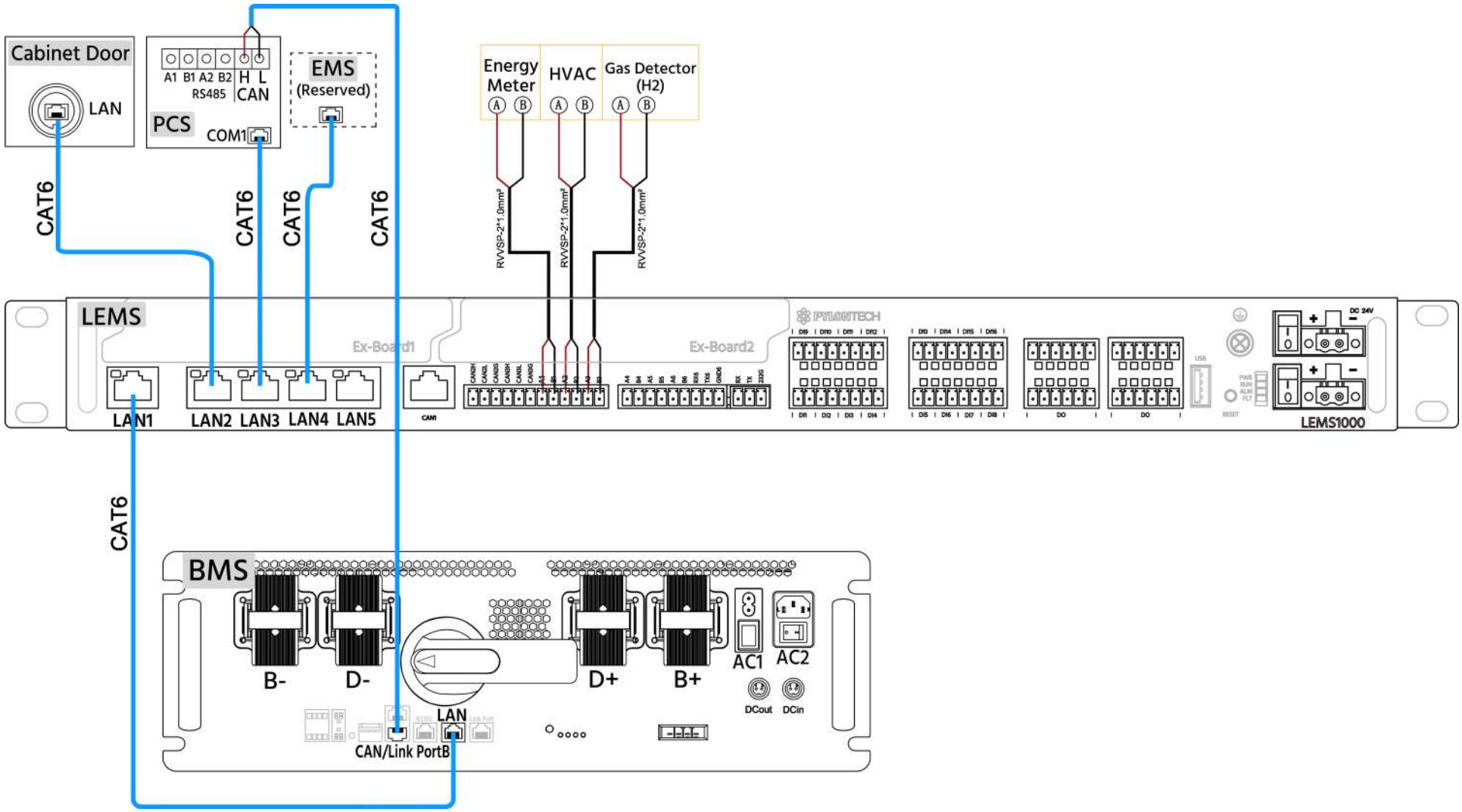
Annex 1: System Electrical Diagram- Main Circuit



Annex 2: System Electrical Diagram- Secondary Circuit



Annex 3: System Communication Wiring Diagram



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