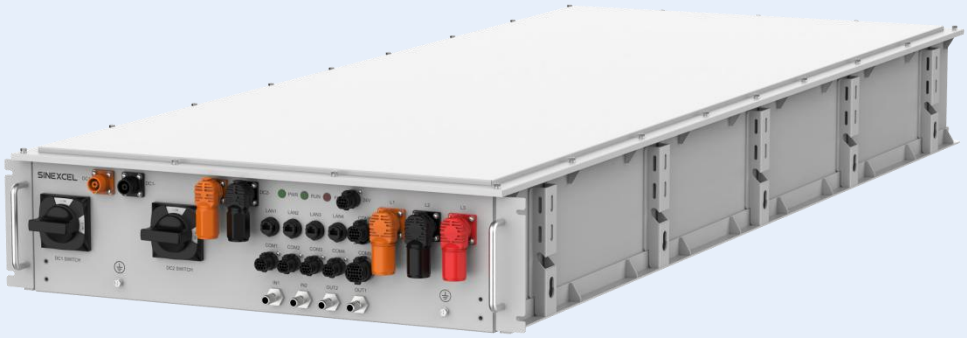
PWS1-450M-H-L-EX
Bi-directional Storage Inverter



User manual

Energy Freedom
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Sinexcel

PWS1-450M-H-L-EX Bi-directional Storage Inverter

User Manual

Version 1.1

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Contents

1 Overview

1.1 Applicable Models

This document applies to the following product codes：

•PWS1-450M-H-L-EX

Model Definitions

This section introduces the product model definitions used in this manual, as shown in Figure 1.1：

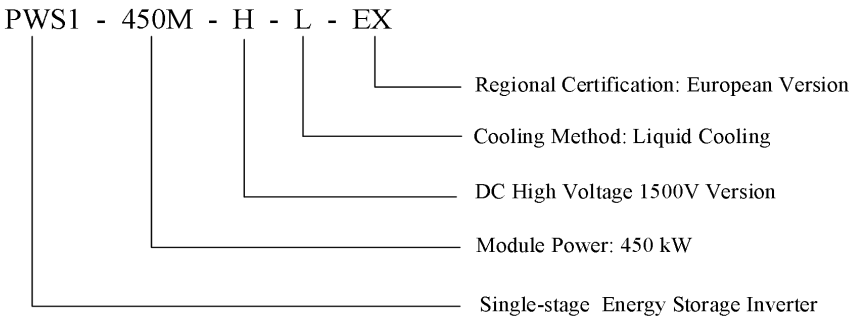


Figure 1.1 Product Model Definition

For example:

PWS1-450M-H-L-EX: Indicates a bi-directional energy storage inverter module with a rated capacity of 450kW, DC high voltage of 1500V, with liquid cooling heat dissipation, and indicates European version.

Check the nameplate on the PCS to determine the model.

The illustrations in this document are for schematic purposes only. Please refer to the actual products for details.

1.2 Target User

The contents described in this document can only be operated by professionals.

Professionals are required to have the following skills:

1) Understand how the product works and how to operate it
2) Learn how batteries work and how to operate them
3) Train and understand how to deal with hazards and risks that arise when installing and using electrical equipment
4) Understand the installation and commissioning of electrical equipment and devices
5) Understand all applicable standard operating instructions
6) Understand and follow this manual and all safety information

1.3 Terminology

Name	Definition
STS	Static Transfer Switch
AC	Alternating current
DC	Direct Current
BESS	Battery Energy Storage System
ESS	Energy Storage System
EMS	Energy Storage System
BMS	Battery Management System
PCS	Power Conversion System
SLD	Single Line Diagram
SOH	State of Battery Health, expressed as a percentage
SCR	Silicon Controlled Rectifier
DOD	Depth of Discharge, expressed as a percentage
EOD	End of Discharge Cut-Off
SOC	State of Charge,or Remaining Power, expressed as a percentage
UI	User Interface
EPO	Emergency Power Off
SPD	Surge Protective Devices

2 Safety Information

2.1 Signs

Signs	Explanation
 **Danger**	Indicates a dangerous situation which, if not avoided, will result in serious injury or death.
 **Warning**	Indicates a potential risk which, if not avoided, will result in personal injury or death
 **Caution**	Indicates a dangerous situation which, if not avoided, may result in minor or moderate injury.
 **Attention**	Indicates that property damage will occur if not avoided.
 **Instruction**	Please note important information, best practice and advice are detailed in the user manual. Note the information used to resolve issues not related to personal injury, equipment damage and environmental degradation.

2.2 Important Safety Instructions

This user manual for the installation and operation of the PWS1- 450M series liquid cooling bi-directional storage inverter from Sinexcel.

Please read this user manual carefully before installation.

The bi-directional energy storage inverter must be commissioned and maintained by an engineer appointed by the manufacturer or an authorized service partner. Failure to do so may endanger personal safety and lead to equipment failure. Damage to the equipment caused as a result is not covered by the warranty.

Bi-directional energy storage inverters should not be used in any environment or application associated with life support equipment.

This manual contains important instructions for the PWS1 series models and these instructions should be followed when installing and maintaining the bi-directional energy storage inverter.

 **Danger**

Any touching of the copper strip, contacts and terminals inside the appliance that are connected to the grid circuit may cause a fatal burn or electric shock!

Do not touch any terminals and wires connected to the grid circuit.

Take note of any instructions and safety documents regarding grid connection.

Warning

Contact with the interior of the appliance may present a risk of electric shock!
Any operation in connection with this appliance must be carried out by qualified personnel.
Please note the safety precautions listed in the safety instructions and installation documentation.
Please take note of the safety precautions listed in the operating and installation manuals and other documentation.

Warning

Before connecting the input power, ensure that the earth is securely grounded.
The appliance must be earthed in accordance with local electrical codes.

Warning

When the battery is connected to a bi-directional energy storage inverter, DC voltage may be present at the input port. Please take care during operation or check the battery system user manual.

Warning

Do not touch live parts within 5 minutes of power failure!
Dangerous energy is stored in the internal capacitors, so do not touch the terminals, contacts, copper strip, etc. for 5 minutes after disconnecting the appliance from all power sources.

NOTICE

All internal maintenance and servicing of the equipment should be carried out by trained personnel. Internal components that require the use of tools to open cannot be maintained by the user.
Please read this user manual before operation

2.3 Additional Information

For further detailed information, please click: www.sinexcel.com.

3 Product Introduction

3.1 System Introduction

Bi-directional energy storage inverter is a conversion device between the grid and the battery, which can charge and discharge the battery. It can invert the DC power from the battery into AC power that can be connected to the grid and rectify the AC power from the grid into DC power that can be charged into the battery. Bidirectional energy storage converters can be used in grid-connected mode or off-grid mode.

The PWS1 series adopts a two-stage interleaved topology. When the AC voltage is 690V, the DC input voltage range is 1000~1500V. Among this range, if the voltage is lower than 1070V, the operation will be derated to 90%.

3.2 System Schematic Diagram

The internal architecture of the PWS1-450M-H-L-EX bi-directional storage inverter is a DC/AC three-level topology. Figure 3.1 shows the topology of the system

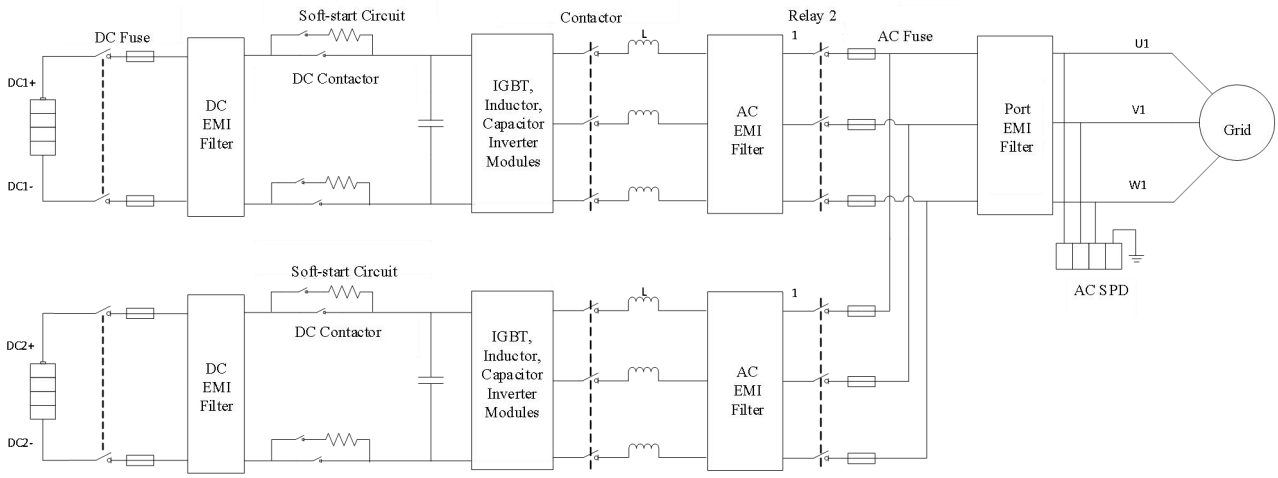
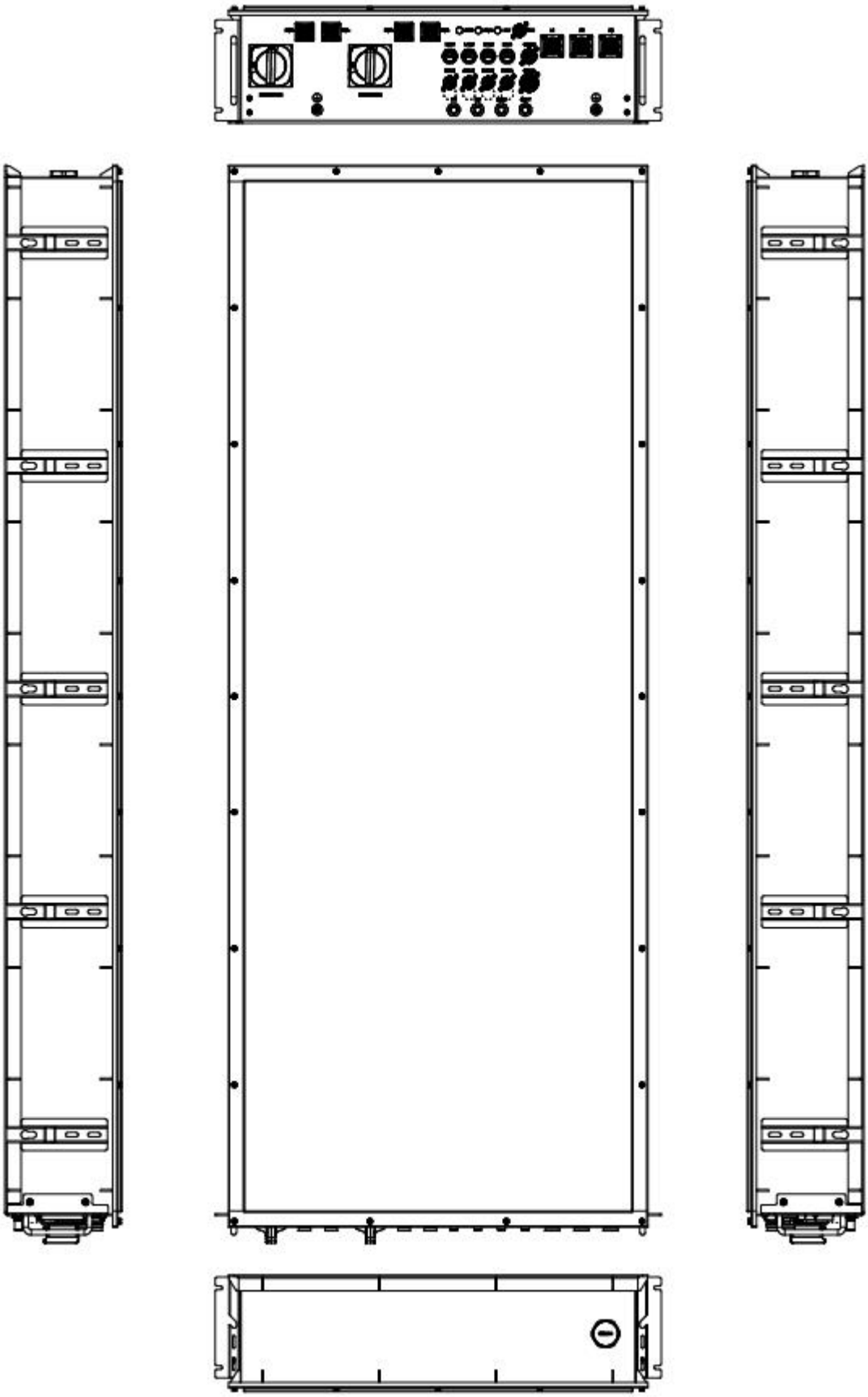


Figure 3.1 Topology Diagram of PWS1-450M-H-L-EX Bi-directional Energy Storage Inverter

NOTICE

The PWS1-450M-H-L-EX module is not equipped with circuit breakers on the AC side, while internally there are AC relays, AC contactors, DC contactors, AC/DC fuses, and isolating switches. External protection and disconnection devices must be configured; refer to Section 6.6.7 for selection guidance.

3.3 PCS Module Appearance



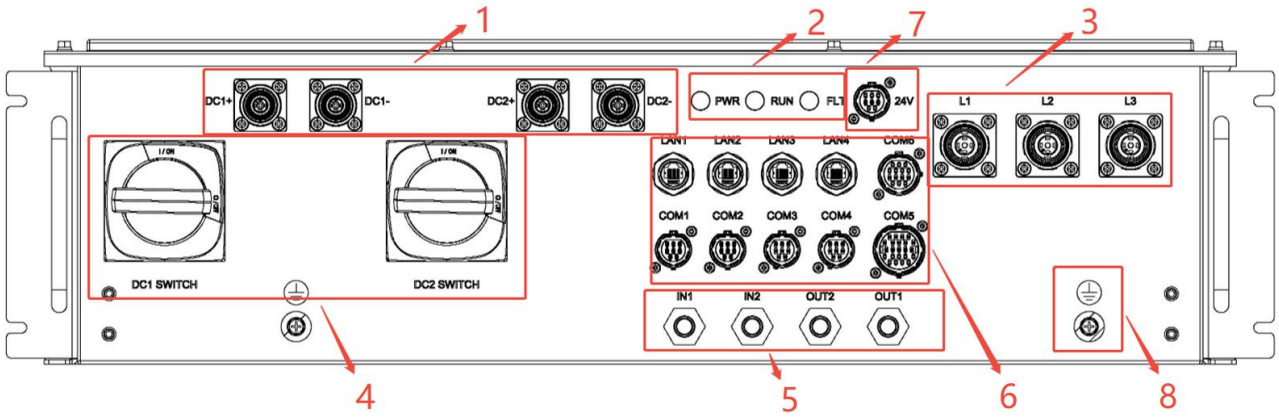


Figure 3.2 Appearance of the PCS Module

Table 3.1 Panel Description

Serial Number	Name	Description
1	Power Terminal	DC positive/negative
2	LED Display	Operating status display
3	Power Terminal	Communication L1/L2/L3
4	DC-side Switch	DC-side manual switch operation
5	Inlet and Outlet Port	Coolant inlet and outlet
6	Communication Terminal Block	CAN/485/Dry Contact/Ethernet (Specific definitions are shown in Table 6.5)
7	External Auxiliary Power Interface	External 24V input for debugging purposes only; do not connect during normal operation.
8	Grounding screw	Module Enclosure Grounding

4 Technical Specification

Table 4-1 PWS1-450M-H-L-EX Technical Specifications

Model	PWS1-450M-H-L-EX
AC Parameters	
Rated AC Power	450kVA (50°C ambient temperature, 55°C inlet temperature)
AC Connection	3P3W
AC Overload Capacity	495 kVA (40°C ambient temperature, 45°C inlet temperature, 1.1 times long-term overload)
Grid-connected Parameters	
Allowable Grid Voltage	690（-15%~10%）Vac
Allowable Grid Frequency	50（-5~5）Hz
DC Voltage Range	1000~1500 Vdc (≤1070 Vdc derated to 90%)
AC current	377A
DC current	210A*2（1070Vdc）
THDi	≤2%
Voltage Ripple Coefficient	≤1%
PF	-1~1
Off-grid Parameters	
AC Voltage Range	690（-15%~10%）Vac
DC Voltage Range	1000–1500 Vdc (≤1070 Vdc dcerated to 90%)
Number of DC Branches	2
AC Current	377A
DC Current	210A*2（1070Vdc）
PF	-1~1
System Parameters	
Maximum Conversion Efficiency	98.5%
Dimensions (W×H×D)	790 × 215 × 2000 mm (excluding handles and terminals)
Weight	≤270kg
Noise	＜65dB
Protection Rating	IP66　C3
Ambient Temperature	-25 to 60°C (＞50°C power derating)
Cooling method	Liquid cooling
Relative Humidity	0–95% (non-condensing)
Altitude	3000m (＞3000m derating)
Display and Communication	
Display	LED、Host computer
Communication Interface	RS 485，Ethernet，CAN
Communication Protocol	Modbus-RTU / Modbus-TCP / IEC61850 /CAN2.0B
BMS	Support

Application Environment Restrictions:

Works in stand-alone mode (off-grid mode), there are some restrictions on the application environment.

• The parallel connection of multiple bi-directional energy storage converter is a customized function. When users need to connect the AC outputs in parallel in off-grid mode, please contact the manufacturer.

• Black start requires a soft start to build voltage, not a step build voltage.

• When DC-side voltage ranges from 1000V to 1500V:

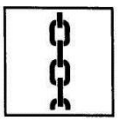
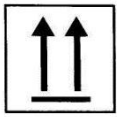
The load can operate with 100% imbalance (when DC voltage is below 1070V, operating power is derated to 90%).

5 Storage, Handling and Transportation

5.1 Transportation and Storage

In order to ensure that the energy storage inverter is in a high protection state during transport, please choose to transport with packaging as far as possible, and according to the indication of the markings on the packaging, the illustration of the packaging markings is shown in Table 5-1:

Table 5-1 Explanation of Packaging Markings

Icon	Description
	Center of gravity mark, indicating the center of gravity of the bi-directional storage inverter.
	Lifting mark, indicating the position of the chain or rope when lifting the bi-directional storage inverter
	The upward mark indicates the placement method when carrying and placing the bi-directional storage inverter. It is strictly forbidden to put it upside down, horizontally or tilted.
	Handle the logo with care, and avoid violent friction or collision during transportation and placement.
	During transportation and storage, the bi-directional storage inverter should be protected from rain or moisture.

 **NOTICE**

The inverter is heavy and requires at least six people for handling, and must pay attention to maintain balance and avoid physical impact on the equipment, such as sudden dropping or lifting.

 **NOTICE**

Please avoid transporting the bi-directional storage inverter under rain or bad weather conditions. If it is unavoidable, please take necessary protective measures.

If on-site installation is not performed immediately after delivery acceptance, the energy storage inverter with its outer packaging must be stored in a well-ventilated, dry, and clean indoor environment. Additionally, the following aspects shall also be noted:

- Restore the packaging to its original condition upon receipt; desiccants inside the packaging must be retained.

- Ensure ventilation and moisture prevention during storage. Water accumulation in the storage environment is strictly prohibited.
- Never stack more than two units during storage! Inverting the inverters during storage is strictly prohibited!
- The storage environment temperature shall be -40℃~+70℃, and the relative humidity of the storage environment shall be 0 ~ 95% without condensation.
- Pay attention to dealing with harsh surrounding environments, such as sudden cold, sudden heat, collision, etc., to avoid damage to the equipment.
- Conduct regular inspections at least once a week. Verify packaging integrity to prevent insect or rodent damage, and replace damaged outer packaging immediately.
- If storage exceeds half a year, open the packaging for inspection, replace desiccant, and then repackage it.

5.2 Unpacking Inspection

Each module has undergone strict factory inspection and testing. To prevent damage during transportation, unpacking inspection is required before the energy storage device is ready for installation. The main inspection contents are as follows:

- Check whether the quantity of each item on the packing list is consistent with the actual item;
- Check whether the nameplate data of the product is consistent with the order contract, such as product model, rated capacity, voltage level, etc.;
- Check whether the factory documents and accessories are complete;
- Check whether the appearance of the bi-directional storage inverter is consistent with the description in this manual;
- Check the bi-directional storage inverter for deformation, peeling paint and loose parts.

Note: Subject to actual product packing list

Table 5.2 Standard Configuration

Serial Number	Name	Specification Description	Quantity
1	Energy Storage Module Finished Product	Energy Storage Module - 450kW AC Module	1
2	Power Connection - Black	Power Connector - Single-Core - Male - Black	2
3	Power Connection - Red	Power Connector - Single-Core - Male - Red	4
4	Cable Connector	Cable Connector - Plug - Blue	1
5	Cable Connector	Cable Connector - Plug - Black	1
6	Cable Connector	Cable Connector - Plug - 4-PIN - Black	1
7	Certificate of Conformity	Certificate of Conformity	1
8	Desiccant	Desiccant—10g Montmorillonite Moisture-Absorbing Desiccant	5
9	Test Report - Chinese Standard	A4 paper printing	1
10	Shipment Inspection Report	A4 paper printing	1

NOTICE

Only the energy storage inverter which has been inspected correctly and is complete without any damage or injury can be installed and debugged. During the inspection process, please contact the transporter or Sinexcel as soon as any problem is found.

6 Installation Design

6.1 Installation Process

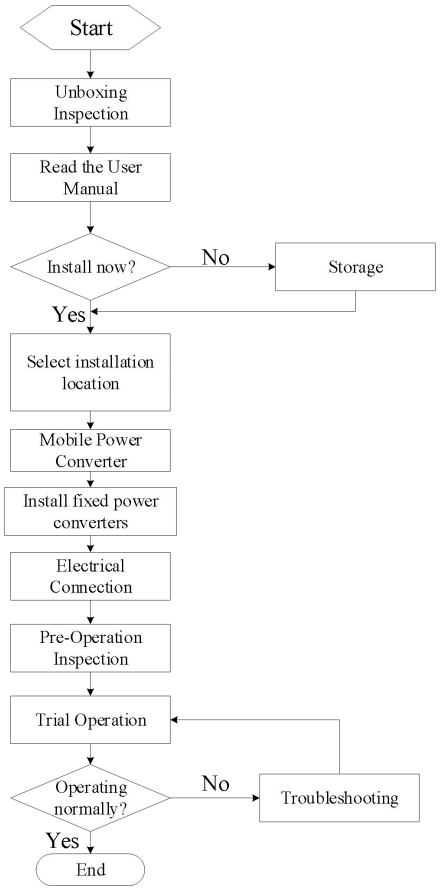


Figure 6.1 Installation Process

Table 6-1 Installation Process Overview

Process	Chapter	Illustrate
Transport Preparation	5	Storage, Handling and Transportation
Equipment Installation	6	Equipment Installation
Electrical Installation	6	Electrical Connection
After-installation Inspection	6	Installation Checklist
Debug Startup and Operation	9	Start up and Running

6.2 Installation Notes

Danger

The live parts of the equipment are high voltage and touching them may result in death or serious injury from electric shock.
Please wear appropriate personal protective equipment for work.
Do not touch any live parts.
Observe all warnings that appear on the equipment and in the documentation.
Follow all safety information provided by the battery manufacturer.

Danger

Touching the DC cables may cause a risk of electric shock.
The DC cable connected to the battery is live. Contact with live cables may result in death by electric shock or serious injury. Before connecting the DC cable, make sure that there is no voltage on the DC cable.
Please wear appropriate personal protective equipment for work.

Warning

Entering the storage system creates a risk of electric shock.
Insulation damage in the storage system can cause fatal ground currents that can result in electric shock. Ensure that the insulation resistance of the storage system exceeds the minimum value. Insulation resistance minimum:1MΩ.
The bi-directional storage converter must be installed in a closed electrical operating area.

Warning

Failure to adhere to torque specifications when bolting can cause fires.
Failure to comply with the specified torque will reduce the load-bearing capacity of the bolted connection and thus increase the contact resistance value.
May cause local overheating and fire.
Make sure to always tighten the bolted connections using the torque specified in this document.
When working on equipment, use only the correct tools.
Avoid repeatedly tightening the bolts as this may result in unacceptably high torques.

6.3 Installation Methods

The correct installation method for the PCS module is as follows: It must be installed horizontally only. Any inverted or tilted installation is strictly prohibited.

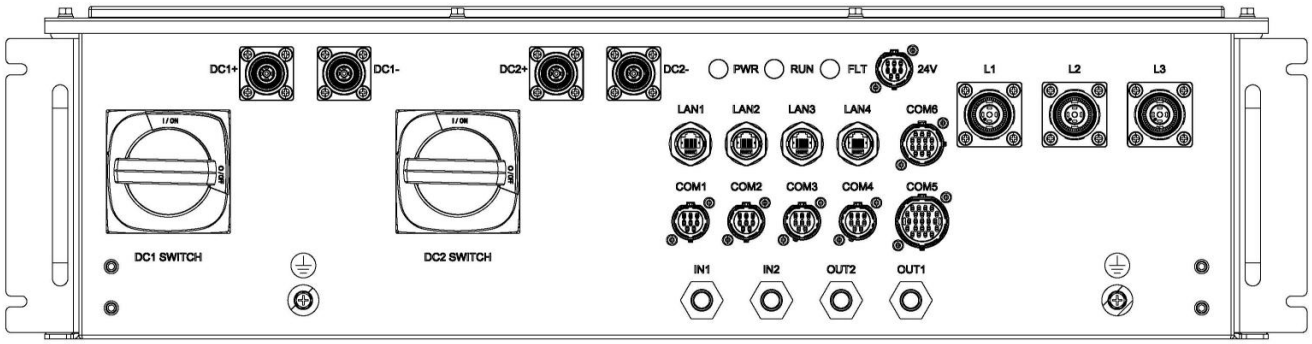


Figure 6.2 Correct Installation Method for PCS Module

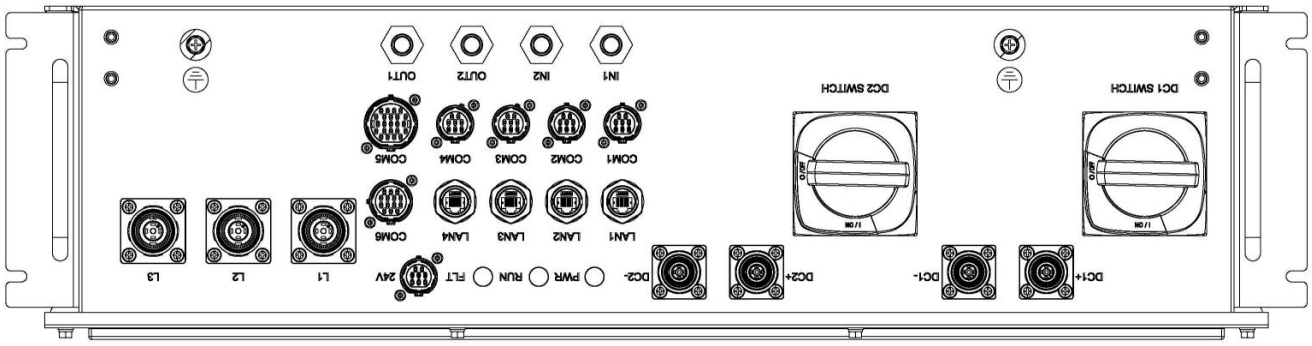


Figure 6.3 Incorrect Installation Method for PCS Module

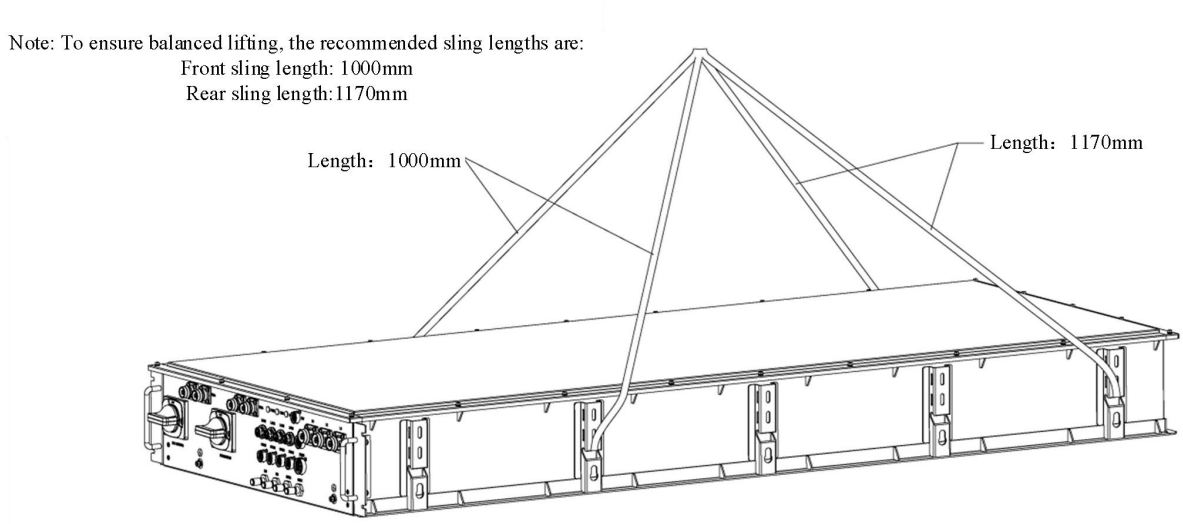


Figure 6.4 PCS Module Lifting Method

6.4 Installation Requirements

6.4.1 Environmental Requirements

- IP66 protection level, suitable for both outdoor and indoor installation;
- The needs to be shielded from direct sunlight when installed outdoors above the inverter;
- Install it in an environment with good ventilation to ensure good heat dissipation;
- Avoid blocking the air inlet and outlet to ensure smooth air ducts;
- The ambient temperature should be maintained between -25°C and 60°C to ensure the optimal operating condition of the inverter. Temperatures that are too high or too low will shorten its lifespan;
- Optimal inlet water temperature should be maintained between 35°C and 40°C with a coolant flow rate of 12 L/min. The PWS1-450M-H-L-EX module requires 10 kW of cooling capacity to ensure efficient inverter heat dissipation. Liquid cooling pipe interface diameter use CQC14 quick plug.

6.4.2 Carrier Requirements

- The inverter installation carrier must have fire-proof properties.
- Do not install the inverter on flammable building materials.
- Please ensure that the mounting surface is solid and meets the load-bearing requirements for installing the converter.

Attention

The modules are integrated within a sealed container, which must be equipped with heat dissipation equipment such as dry coolers to ensure the heat generated by the bi-directional energy storage inverter can be smoothly exhausted out.

6.5 Installation Tools

Table 6.1 Tools

Serial Number	Name	Remarks
1	Torque wrench	
2	Phillips screwdriver	M5、M6
3	Wire stripper	
4	Utility knife	
5	Crimping pliers	
6	Hot air gun	
7	Heat shrink tubing	
8	Multimeter	Range greater than 1500V
9	Diagonal pliers	
10	Socket	

6.6 Electrical Installation and Connection

6.6.1 Input Requirements

The battery clusters DC voltage of bi-directional storage inverter must be within PCS required input range, otherwise the bi-directional storage inverter will not work. When configuring the number of batteries in series, the user must fully consider the maximum charging voltage and the minimum discharging voltage. For details, please consult Sinexcel technical service personnel.

The bi-directional energy storage inverter has a combination of DC isolating switches and fuses on the DC side, and the AC side should be equipped with circuit breakers external to the energy storage inverter. For safer and more regulated use of this inverter, the recommended configuration of the energy storage system is shown below:

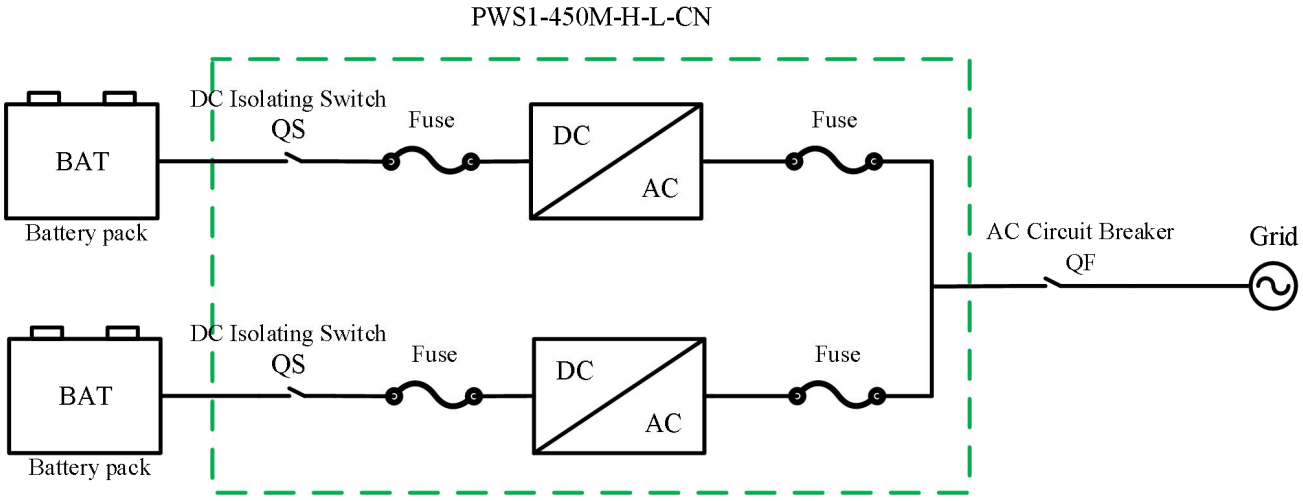


Figure 6.5 Recommended Configuration

Attention

Each DC input branch of multiple bi-directional storage inverter modules operates independently. If standard equipment requires parallel operation of the DC sides of multiple devices, it is necessary to connect a single cluster of batteries to a separate branch DC port.

6.6.2 Output Requirements

The PWS1-450M-H-L-EX series bi-directional energy storage inverter, with three-phase three-wire, output at 690V AC. The output side connects to the medium-voltage grid via a step-up transformer. The output side must be equipped with an AC circuit breaker or a combination of an AC isolating switch and a fuse,and external protection should be configured according to technical specifications.

6.6.3 Wiring Method

The bi-directional energy storage inverter adopts a front-to-front wiring method, with AC and DC power cables directly connected to the inverter via quick-plug method. Communication ports COM1, COM2, COM3, COM4, COM5, and COM6 utilize waterproof plugs.

(Note: After debugging and connecting, COM1 and COM2 are inter-PCS communication ports, not customer application ports, please do not touch them.)

Table 6.2 PWS1-450M-H-L-EX Cable Recommended Usage Instructions

Cable	Cable cross-sectional area（mm²）	Terminal Specifications	Remarks
AC Cable	=150	Quickly plug	L1, L2, L3, withstand voltage greater than 1000Vac
DC Cable	=70	Quickly plug	DC+ and DC- withstand voltage greater than 1500 Vdc
Grounding Wire	≥75	M6	1/2 AC phase line cross-sectional area
Communication line	0.5-1	Quickly plug	8PIN、14PIN、23PIN
24V External Auxiliary Power Cable	0.5-1	Quickly plug	8PIN

Cables shall be crimped and installed using the factory-supplied quick plug terminals provided with the product.

Figure 6.6 PWS1-450M-H-L-EX Module Terminal Diagram

Table 6.3 PWS1-450M-H-L-EX Terminal Descriptions

Location	Name	Description
DC1+	Battery 1 Positive Terminal+	Battery positive input terminal
DC1-	Battery 1 Negative Terminal-	Battery negative terminal input
DC2+	Battery 2 Positive Terminal+	Battery positive input terminal
DC2-	Battery 2 Negative Terminal-	Battery negative terminal input

L1	Phase A	Phase A of the AC
L2	Phase B	Phase B of the AC
L3	Phase C	Phase C of the AC
PE	Grounding	Protective grounding
LAN1 LAN2 LAN3 LAN4	Ethernet Communication	LAN1, LAN2 PCS networks port communication LAN3,LAN4 Secondary BMS networks port Communication
COM1 COM2 COM3 COM4 COM5 COM6	Communication and Control Ports	RS485, CAN communication, input/output dry contacts, control circuit
24V	External Auxiliary Power Interface	24V+ Input

6.6.4 System Grounding

Warning

Modules and racks require reliable grounding! Grounding resistance must be less than 4Ω, otherwise, it may cause personal injury.

The bi-directional energy storage inverter module is equipped with a grounding terminal, which should be grounded. When wiring, please refer to the cable diameter specified in the table below, and ensure that the grounding resistance is less than 4Ω.

Table 6.4 Grounding PE Cable Specifications

Rated Power	Recommended Value for PE Copper Wire (mm²)
450kW	≥ Phase conductor cross-sectional area/2, recommended value: 70 mm², temperature resistance not less than 105°C

6.6.5 AC/DC Side Power Connections

Warning

Quick plug terminals must be fully inserted; otherwise, excessive contact resistance may occur, posing a fire hazard.

Danger

When unplugging the quick plug terminals of the inverter, make sure that the AC and DC circuit breakers or fuses are disconnected to ensure that there is no dangerous voltage.

Cable Category	Recommended Copper Wire Value (mm²)
AC side	150mm² single outdoor copper core cable (core diameter: 16±0.5mm), one 150mm² (single-core) cable per phase insulation sheath temperature resistance not less than 105°C
DC side	70mm² single outdoor copper core cable, one positive and one negative conductor each at 70mm² (single-core) Insulation sheath temperature resistance not less than 105°C

6.6.6 Application Example of Power Quick Plug Terminal

Step 1: Prepare materials (contain cables, quick plug terminals)

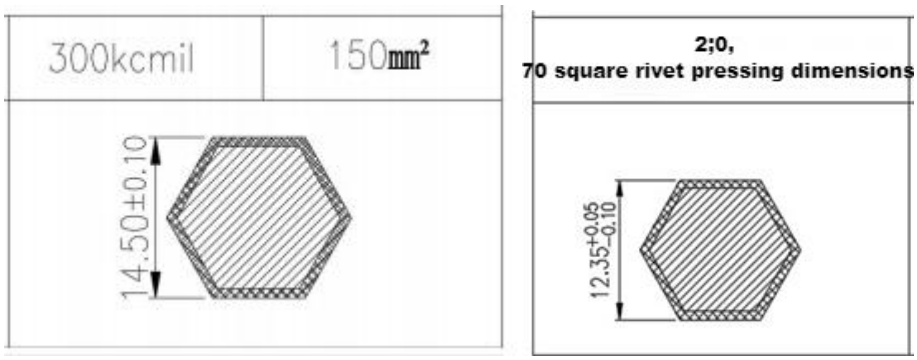
Step 2: Remove the plug nut rear cover while threading the cable through the nut rear cover assembly.

Step 3: Strip the cable insulation to a length of 15 ± 0.5 mm.

Step 4: Crimp the terminals. Refer to the terminal crimping requirements below for crimping dimensions. Maintain pressure for 2 seconds during crimping.

Step 5: Install the nut rear cover into the plug body (rear cover installation torque: 1.0–1.2 N·M).

Recommended Terminal Crimping Dimensions:



The dimensions above are for reference only and must meet the following retention force requirements:

Retention force after crimping: ≥2700 Nmin;

If retention force is insufficient or terminals are excessively elongated, adjust the crimping dimensions accordingly.

6.6.7 Selection of AC Circuit Breakers

AC Circuit Breaker:

The rated voltage **Ue** is recommended to be 690V;

The rated current **In** is recommended to be 500A;

Remarks: When the altitude is higher than 2000m or the temperature is higher than 70℃, it will be considered with the actual working condition and circuit breaker brand for derating;

The rated ultimate short-circuit sectionalization capacity **Icu** is based on the AC side transformer parameters after calculation;

The rated operating short-circuit sectionalization capacity **Ics** is calculated from the AC side transformer parameters;

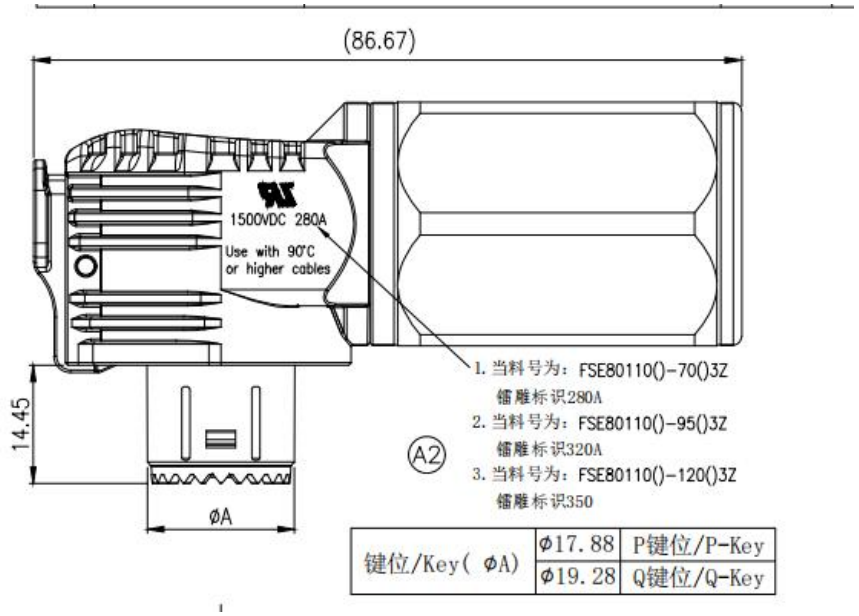
6.6.8 Model Numbers of Matching Terminals and Related Model Diagrams

Power Terminal Model:

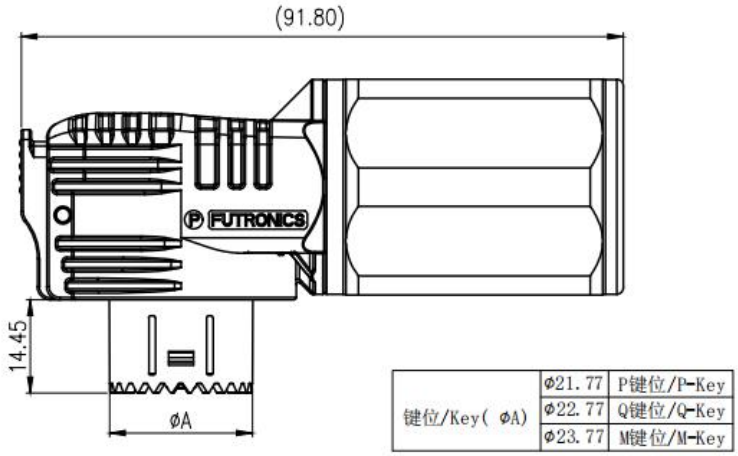
		Male Connector Model	Female Connector Model	Male Terminal Crimping Cable Requirements
DC	Positive (Orange)	FSE80110P-70A3Z	FSE2A110P-M8AZ	2/0AWG 70mm2
	Negative (Black)	FSE80110Q-70B3Z	FSE2A110Q-M8BZ	2/0AWG 70mm2
AC	L1（Orange）	FSE80113P-150A3Z	FSE2A113P-M10AZ	300kcmil 150mm2
	L2（Black）	FSE80113Q-150B3Z	FSE2A113Q-M10BZ	300kcmil 150mm2
	L3（Red）	FSE80113M-150R3Z	FSE2A113M-M10RZ	300kcmil 150mm2

Power Terminal Model Diagram:

DC Terminal:



AC Terminal:



Note: For the AC male connector's crimping cable, the inner diameter of the copper tube is 16.51mm. When crimping 300kcmil, please check whether the stranded diameter of the cable meets the requirements.

6.6.9 Communication, Control, and 24V Auxiliary Power Cables

The PWS1-450M-H-L-EX module provides Ethernet, CAN, 485, dry contact, emergency stop EPO, parallel synchronization control signals,and so on. The four Ethernet ports are designated as LAN1, LAN2, LAN3, and LAN4. Other signals including CAN, 485, dry contacts, EPO, and parallel synchronization are located on shared communication ports (COM1, COM2, COM3, COM4, COM5, COM6). External debugging is accessible via the auxiliary 24V port.

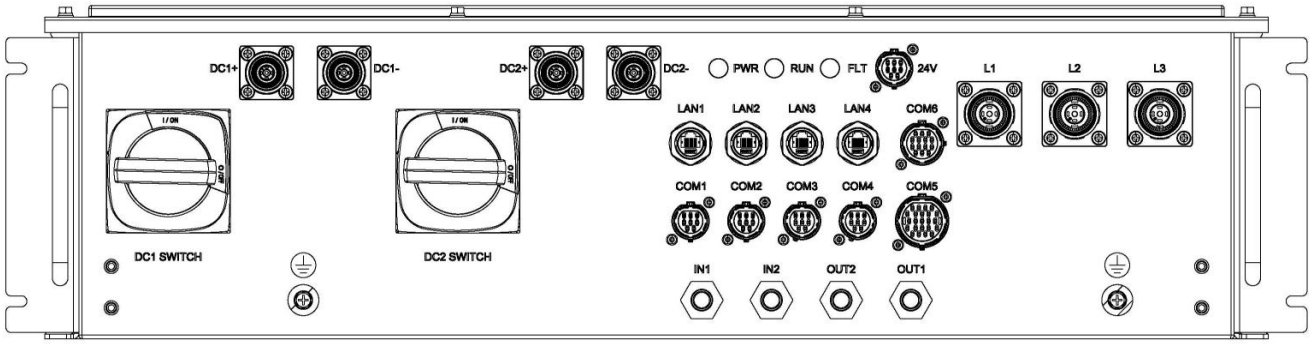
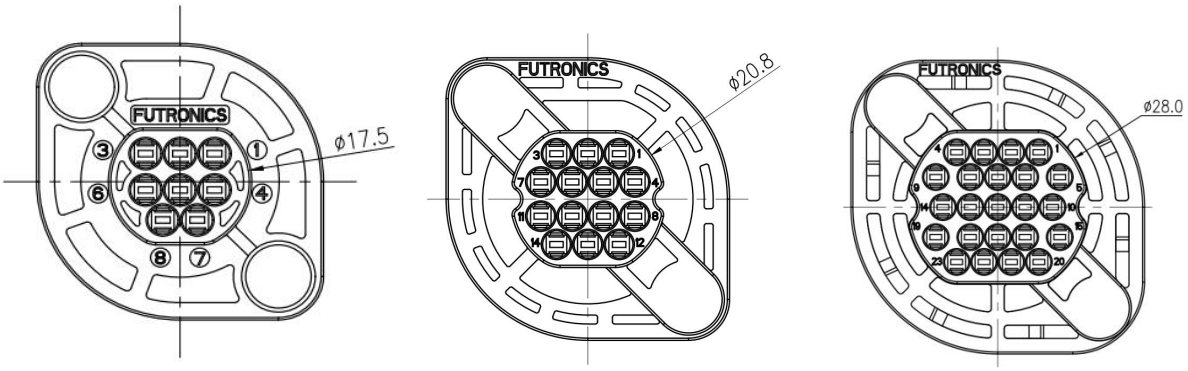


Figure 6.7 Location of Communication Control Interface

The female connector serial numbers for shared communication ports (COM1, COM2, COM3, COM4, COM5, COM6) are as shown in the example below:



The male connector serial numbers are as shown in the example below:

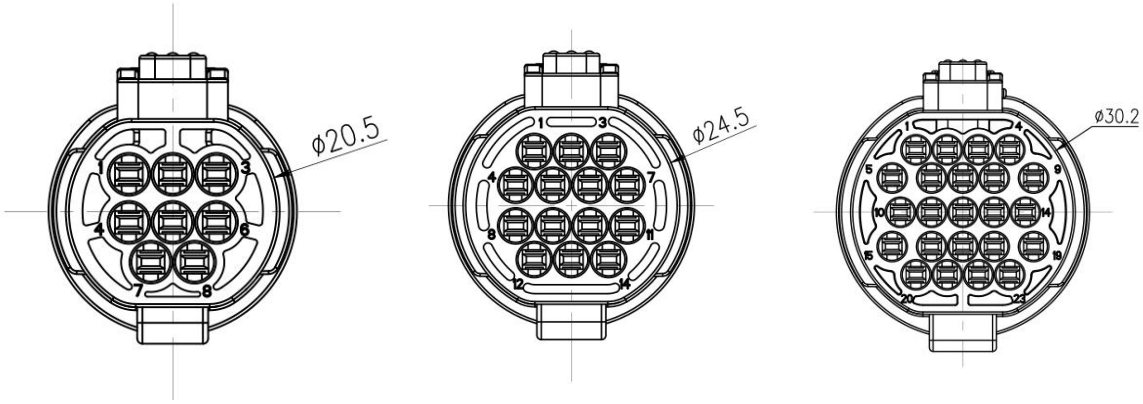
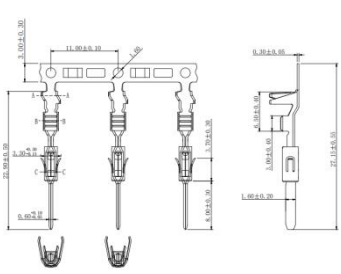
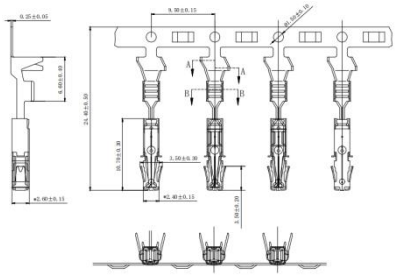


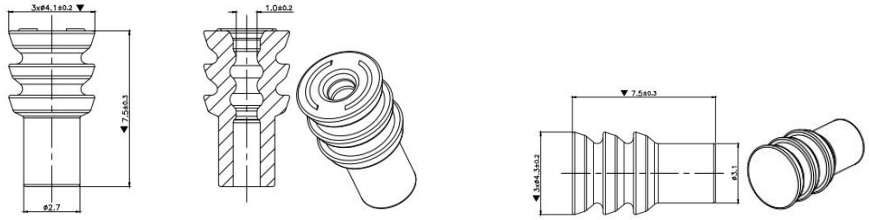
Diagram of matching terminal pins, waterproof rings, and plugs:



Male connector pin



Female connector pin



Waterproof ring Plug

Note: (The usage ratio of pins to waterproof rings is 1:1. To ensure airtightness, unused pin ports must be sealed with plugs. The waterproof rings and plugs have the same model for both male and female connectors.)

Figure 6.8 Schematic Diagram of Shared Communication Interface

Table 6.5 Shared Communication Interface Description

Female Terminal Model	Male Terminal Model	Communication port	Number	Function		Remarks
8-Pin Huzheng Model FLP2508W-01Z W-Keyed Socket	8-Pin Huzheng Model FLP6008W-01Z W-Keyed Plug	COM1	1	50Hz_Sync_BUS_ISO	Power Frequency Synchronization Signal	
			2	GND_ISO		
			3	Carrier_Sync_BUS_ISO	Carrier Synchronization Signal	
			4	Grid-connected/Off-grid Switching Dry Contact Function	Reserved Dry Contact for Grid-connected/off-Grid Switching or Precise Cutting	
			5	CANA_H	Communication between Modules and between Modules and the U2 Board	
			6	CANA_L		
			7	CANB_H	Communication between Modules	
			8	CANB_L		
8-Pin Huzheng Model FLP2508W-01Z W-Keyed Socket	8-Pin Huzheng Model FLP6008W-01Z W-Keyed Plug	COM2	1	50Hz_Sync_BUS_ISO	Power Frequency Synchronization Signal	
			2	GND_ISO		
			3	Carrier_Sync_BUS_ISO	Carrier Synchronization Signal	

			4	Grid-connected/Off-grid Switching Dry Contact Function	Grid-connected/off-grid Switching or Precision Switching with Dry Contact terminals reserved	
			5	CANA_H	Communication between Modules and between Modules and the U2 Board	
			6	CANA_L		
			7	CANB_H	Communication between Modules	
			8	CANB_L		
8-Pin Huzheng Model FLP2508X-01Z X-Keyed Socket	8-Pin Huzheng Model FLP6008X-01Z X-Keyed Plug	COM3	1	BMS-CAN2H-IN	BMS Master Control Communication - CANH	
			2	BMS-CAN2L-IN	BMS master Control Communication - CANL	
			3	BMS-TX+ IN	BMS mAster Control address Configuration Input	
			4	BMS-TX- IN		
			5	Monitoring Dry Contact D1 Board	EPO	Normally closed is normal; short-circuit when not in use.
			6	GND		
			7	485-A-IN	Reserve 485-4 (EMS)	
			8	485-B-IN		
8-Pin Huzheng Model FLP2508X-01Z X-Keyed Socket	8-Pin Huzheng Part Number FLP6008X-01Z X-Keyed Plug	COM4	1	BMS-CAN2H-IN	BMS master control communication - CANH	
			2	BMS-CAN2L-IN	BMS Master Control Communication - CANL	

			3	BMS-TX+ OUT	BMS master controller address configuration output	
			4	BMS-TX- OUT		
			5	Monitoring Dry Contact D1 Board	EPO	Normally closed is normal; short-circuit when not in use.
			6	GND		
			7	485-A-IN	Reserve 485-4 (EMS)	
			8	485-B-IN		
23-Pin Huzheng Model FLP2523W-01ZW-Keyed Socket	23-Pin Huzheng Model FLP6023W-01ZW-Keyed Plug	COM5	1	BMS1-CAN0H	BMS1 Slave Control CANH	
			2	BMS1-CAN0L	BMS1 Slave Control CANL	
			3	BMS1-IP1	BMS1 Slave Control Daisy Chain IP1	
			4	BMS1-IM1	BMS1 Slave Control Daisy Chain IM1	
			5	BMS1-IP2	BMS1 Slave Control Daisy Chain IP2	
			6	BMS1-IM2	BMS1 Slave Control Daisy Chain IM2	
			7	BMS1-MSD-NO	Battery Cluster 1, MSD Contact Dry Contact NO	Normally closed is normal; short-circuit when not in use.
			8	BMS1-MSD-COM	Battery Cluster 1, MSD Contact Dry Contact COM	
			9	BMS1 Addressing +5V	Battery Cluster 1, Pack Slave Control Addressing	
			10	BMS1 Power Supply 24V	24V Power Supply, Battery	

			11	BMS1 Power Supply GND	Cluster 1, Pack Slave Control BMS Power Supply	
			12	BMS2-CAN0H	BMS2 Slave Control CANH	
			13	BMS2-CAN0L	BMS2 Slave Control CANL	
			14	BMS2-IP1	BMS2 Slave Control Daisy Chain IP1	
			15	BMS2-IM1	BMS2 Slave Control Daisy Chain IM1	
			16	BMS2-IP2	BMS2 Slave Control Daisy Chain IP2	
			17	BMS2-IM2	BMS2 Slave Control Daisy Chain IM2	
			18	BMS2-MSD-NO	Battery Cluster 2, MSD Contact Dry Contact NO	Normally closed is normal; short-circuit when not in use.
			19	BMS2-MSD-COM	Battery Cluster 2, MSD Contact Dry Contact COM	
			20	BMS2 Addressing +5V	Battery Cluster 2, Pack Slave Control Addressing	
			21	BMS2 Power Supply 24V	24V Power Supply, Battery Cluster 2, Pack Slave Control BMS Power Supply	
			22	BMS2 Power Supply GND		
			23	/		
14-Pin Huzheng Model FLP2514Z-01Z Z-Keyed Socket	14-Pin Huzheng Model FLP6014Z-01Z Z-Keyed Plug	COM6	1	BMS-CAN1H-Debug	BMS and PCS Communication CAN1H Debug Port	
			2	BMS-CAN1L-Debug	BMS and PCS Communication CAN1L Debug Port	

			3	BMS-CAN2H-R	BMS Master Control CAN2 connected to 120Ω Terminating Resistor	
			4	BMS-CAN2L-R		
			5	EMS485-A-IN-R	Communication 485-4 Matching Resistor	
			6	EMS485-B-IN-R		
			7	RefGen(DRM0)	DRM0	
			8	COM(DRM0)		
			9	ISO_24V	DRMS (D1 Board Isolated 24V Power Extraction)	
			10	ISO_GND		
			11	485-A-IN	485-5（DRM）	
			12	485-B-IN		
			13	DRY-out1	Dry Contact Output Function	
			14	DRY-out1-GND		
8-Pin Huzheng Model FLP2508W-01Z W-Keyed Socket	8-Pin Huzheng Model FLP6008W-01Z W-Keyed Plug	24V	1	N	DC bus Neutral Point N (Caution: high-power electricity)	
			2	/		
			3	/		
			4	/		
			5	/		
			6	EXT_24V	External 24V Input For Debugging Only. Do not connect under normal conditions.	
			7	/		
			8	GND	External Input 24V-GND	

Note: Terminal resistors for COM1 and COM3 ports should be configured as needed. For COM1-5/6 and 7/8, add 120Ω resistors and short-circuit them. For COM3-1/2 and 7/8, add 120Ω resistors and short-circuit them.

Table 6.6 Communication Interfaces with Other Devices

Equipment	Wiring Method
EMS	Ethernet (The protocol is based on MODBUS TCP/IP and is compatible with MODBUS RTU)
BMS	CAN CAN 2.0 Protocol Specification
Other PCS	CAN

6.6.10 Connecting EMS via Ethernet

When an Ethernet communication solution is selected for a single energy storage inverter module, it is only necessary to connect the Ethernet interface (LAN1 or LAN2) of the energy storage inverter to the EMS (Energy Management System) using a network cable (EIA/TIA 568B).

Figure 6.9 Schematic Diagram of Ethernet Communication Solution for a Single Energy Storage Inverter

For the communication connection of multiple energy storage inverter modules, an Ethernet switch needs to be configured. First, connect the communication network cables (LAN1 or LAN2) of the multiple units to the same switch, and then connect the switch to the EMS.

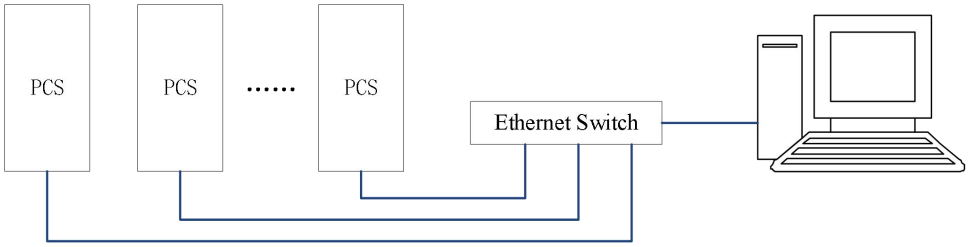


Figure 6.10 Schematic Diagram of the Ethernet Communication Scheme for Multiple Energy Storage Power Inversion Systems

6.6.11 Built-in Secondary-Level BMS Communicates with the Tertiary-Level Master Control

It supports CAN communication, available on COM3 and COM4. It can also connect to the tertiary-level BMS via network ports LAN3/LAN4 through a switch.

6.6.12 Communicate with the Battery Pack Slave Control

Terminal COM5 can be connected to the CAN or daisy chain of the battery pack's slave control, with the slave control powered by 24V.

6.7 Installation Inspection Checklist

After the installation of the bidirectional energy storage power converter, inspections shall be conducted as follows:

The equipment shall be properly positioned and installed, meeting the safety distance requirements.

1） The wiring shall be correct. The grounding wire shall be well-connected to the grounding grid. Technicians are required to check the grounding resistance.

2）Compare the factory-provided original main wiring diagram with the on-site wiring diagram. Check for any discrepancies and assess whether they will affect the safe operation of the energy storage system. After the installation is completed, check the following list:

Equipment Installation	√
There is enough free space in front and behind the Bi-directional storage inverter to meet maintenance requirements.	□
The environmental operating conditions are within the specifications.	□
The Bi-directional storage inverter is correctly installed and fixed.	□
Make sure nothing blocks the heat dissipation duct of the dry cooler in the storage inverter cooling system to ensure air circulation and meet the heat dissipation requirements.	□
Electrical Installation	√
The bi-directional storage inverter (including cables) is grounded correctly.	□
The AC line voltage matches the rated output voltage of the Bi-directional storage inverter.	□
The parameters of the external medium-voltage or low-voltage AC transformer match those of the Bi-directional storage inverter.	□
Ensure that the insulation of the cables is good and meets the specifications.	□
The terminals of the AC power supply A, B,C, and N are connected with the travel in place and the cable fastened.	□
The DC power supply cables are connected to the terminals of DC+ and DC- with the travel in place and the cables fastened.	□
Auxiliary cables and control cables must be routed separately from power cables.	□
The external control cable is correctly connected to the port of the bi-directional storage inverter.	□
The cable connections and tightening torque on the junction box are appropriate.	□
External cable insulation withstand voltage test.	□
The grounding resistance should be less than 4Ω.	□

7 Operation and Commissioning

7.1 Control Mode

7.1.1 Ethernet Connection

Use an Ethernet connection. First, open a browser on the computer desktop, then enter the device’s default IP address (LAN1: 192.168.1.10, LAN2: 172.16.1.10) in the browser’ s address bar. The login interface shown in Figure 7.1 will appear.

Enter "admin" in the Name input box.

Enter the initial password "123456" in the Password input box.

Click "Log in" to access the background operation interface of the PWS1-450M-H-L-EX, as shown in Figure 7.2.

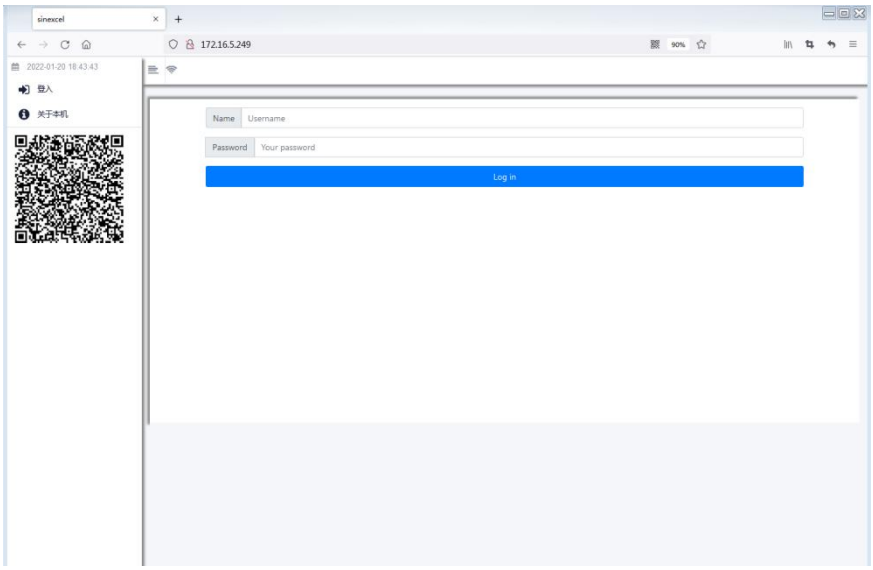


Figure 7.1 Login Interface

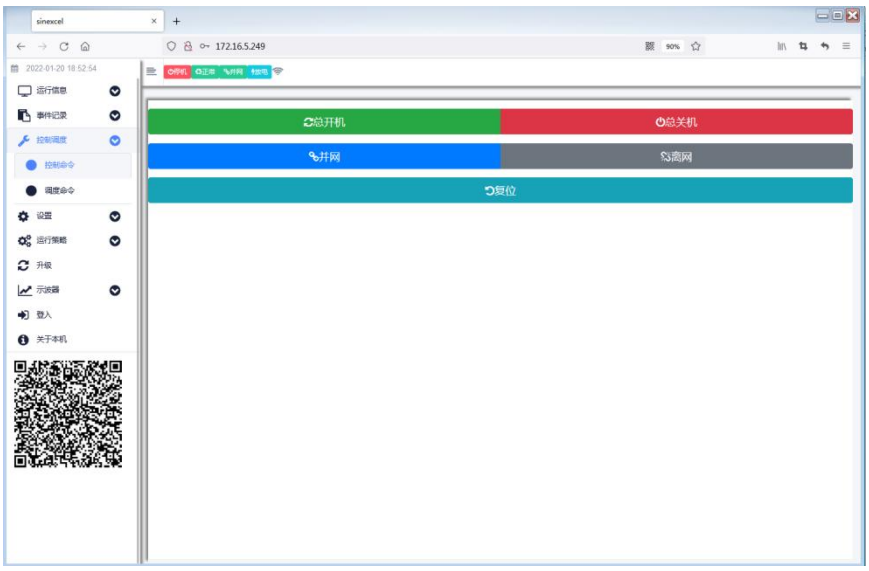


Figure 7.2 Example of the Web Background Operation Interface

7.1.2 RS485 Connection

Use an RS485 connection (for communication between the PCS and the BMS). Before using the RS485 connection, please follow the previous two methods on the computer, mobile phone or other devices;

Logging in to the device, select RS485 in " Monitoring Settings" in the " Settings " tab to connect to the BMS, as shown in the figure below.

Connection to BMS requires only setting the baud rate. It is recommended that the BMS timeout be set to 5 seconds. Other settings are generally unnecessary.

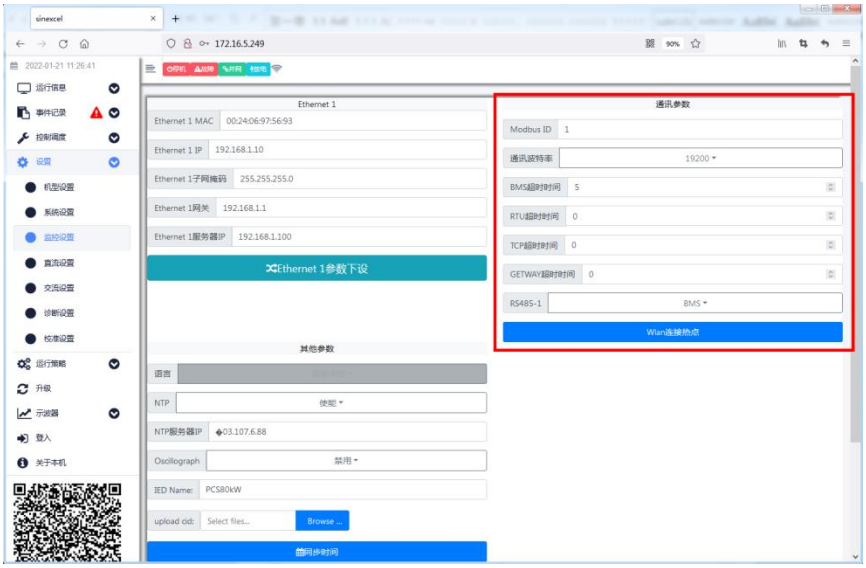


Figure 7.3 RS485 Connection Settings

7.2 Power On/Off

The energy storage system must be fully installed, commissioned by an engineer, and have the external power switch closed before performing the startup procedure.

7.2.1 Pre-Startup Inspection

Before starting up, check the equipment according to the following steps:

1) Visually check that there is no sign of damage on the outside of the module, and confirm that the external DC circuit breaker and AC circuit breaker are both in the "OFF" state;

2) According to the inspection items after installation in Chapter 6.7. Verify that the DC input wiring, AC output wiring, and grounding are all correct and in good condition.

3) Check whether the battery voltage is normal;

4) Check whether the phase voltage and line voltage on the grid side are within the normal range, and record the voltage values.

7.2.2 Startup Procedure

1) Close the battery cabinet output circuit breaker and power on the equipment from the DC terminals. Then power indicator light will illuminate.

2) First, open the browser on the computer desktop (Google Chrome is recommended), then enter the machine 's default IP (LAN1: 192.168.1.10, LAN2: 172.16.1.10) in the browser 's URL bar, and the login interface shown in Figure 7.1 will appear.

Enter“admin” in the Name input box.

Enter the initial password "123456" in the P as sword input box.

Click “Log in” to enter the background operation interface of PWS1-450M-H-L-EX, as shown in Figure 7.1.

At this time, the "Current Alarm " in the " Event Record " will display information such as "AC #01 AC bus undervoltage", "AC #01 AC bus underfrequency ", "AC #02 AC bus undervoltage", "AC #02 AC bus underfrequency"etc.

When the device is started for the first time, it is necessary to set the battery DC protection parameters and communication configuration.

3) The converter works in grid-connected mode by default. Close the external AC circuit breaker and power on the AC port of the machine. At this time, the information such as "AC #01 AC bus undervoltage" and "AC #01 AC bus underfrequency " "AC #02 AC bus undervoltage", "AC #02 AC bus underfrequency."displayed in "Current Alarm " will be automatically eliminated.

4) Click the "Control Scheduling " tab on the left side of the webpage, and set the start-up command in the "Control Command" so that the converter starts to connect to the grid.

7.2.3 Shutdown Procedure

1) Click the "Control Scheduling " tab on the left side of the webpage, and set the shutdown command under "Control Command";

2) Check whether the inverter is in shutdown state;

3) Disconnect the AC circuit breaker;

4) Disconnect the DC circuit breaker of battery.

8 Troubleshooting

Warning

Only qualified technicians can perform the operations described in this chapter.

"Meets the requirements" means that the operator has previously participated in professional training on various equipment troubleshooting operations.

Perform only the troubleshooting procedures described in this manual.

When operating, please follow all safe operating procedures.

If you still cannot solve the problem with the help of this manual or still have questions, please contact Sinexcel Electric. In order to provide you with better and faster service, we usually need the following information:

- Energy storage converter model
- Energy storage converter serial number
- The manufacturer and model of the relevant components connected to the energy storage inverter, as well as the energy storage battery configuration and other information
- Communication connection scheme for energy storage inverter
- Fault information and brief description
- Photos of the fault site (if conditions permit)

8.1 Preliminary Investigation

When the energy storage converter does not work as expected or the charge and discharge capacity changes abnormally, please check the following items before consulting our maintenance personnel:

- Does the open circuit voltage of the energy storage battery meet the requirements of the energy storage converter?
- Is the grid and DC side connected correctly and powered on?
- Is the communication cable loose?

8.2 LED Indicator Display and Troubleshooting Methods

Please refer to the device status description in the table below:

Table 8.1 Troubleshooting Methods

LED Status	Handling Methods
The POWER indicator light is off	This indicates that neither the AC nor the DC sides of the energy storage inverter are powered. 1. Check whether the power supply and connection of the grid and battery are normal. 2. Check whether the AC and DC quick plug terminals are firmly plugged in. 3. If the indicator light is still off, please contact our after-sales service personnel.
The RUN indicator light is off	This indicates that the energy storage inverter is not in operating state.

	1. Check whether the AC and DC wiring are correct, use a multimeter to measure the DC input voltage, and ensure that the voltage value exceeds the starting voltage of the energy storage inverter. 2. Ensure that the grid power supply and various parameters meet the operating requirements of the energy storage inverter. 3. If the indicator light is still off, please contact our after-sales service personnel.
The FAULT indicator light is always on	This indicates that the energy storage converter has failed and the failure has not been eliminated. 1. Please check the detailed fault information on the LCD screen or web monitoring and take appropriate troubleshooting measures. 2. If the indicator light stays on, please contact our after-sales service personnel.

8.3 Common Faults and Handling Methods

Fault Type	Possible Causes	Simple Handling	Remarks
DC Input Overvoltage	The DC voltage is higher than the maximum allowable DC voltage	Check the configuration of the battery cluster and reduce the open circuit voltage of the battery cluster	Please contact the energy storage battery supplier
DC Input Undervoltage	The DC voltage is lower than the minimum allowable DC voltage	Check the battery cluster configuration	Please contact the energy storage battery supplier
AC Bus Overvoltage	The grid voltage is higher than the maximum allowable grid voltage	Check the power grid	The grid voltage returns to the permissible range, it can be allowed again
AC Bus Undervoltage	The grid voltage is lower than the minimum allowable grid voltage	Check the power grid	the grid voltage returns to the permissible range, it can be allowed again
AC Bus Overfrequency	The grid frequency is greater than the maximum allowable grid frequency	Check the power grid	the grid frequency returns to the permissible range, it can be allowed again
AC Bus Underfrequency	The grid frequency is less than the minimum allowed grid frequency	Check the power grid	the grid frequency returns to the permissible range, it can be allowed again
Island Protection	The energy storage inverter detects the occurrence of islanding phenomenon	Check the power grid	After the power grid returns to normal, it can be reconnected to the

			grid
AC Bus Short Circuit	There is a short circuit on the AC side of the energy storage inverter or the internal electronic components are damaged.	Check the cable connection of the AC side circuit of the energy storage converter and whether there are any problems with the control circuit board	Please contact our company for details
Module Over-temperature 1	The IGBT module substrate temperature is higher than the allowable value	1.Check whether the "Module Fan Fault 1" alarm has been triggered. 2.Use the fan control command to test the module fan individually and check if it works normally. 3.High altitude or ambient temperature may trigger the alarm.	If the fault occurs more than 10 times per day, please contact our company
Module Over-temperature 2	The temperature of the label on the water port of the liquid-cooled plate inside the energy storage inverter is higher than the allowable value.	1.Check whether "Module Fan Fault 1" or "Module Fan Fault 2" alarms have been triggered. 2.Use the fan control command to test the module fan individually and check if it works normally. 3.High altitude or ambient temperature may trigger the alarm.	If the fault occurs more than 10 times per day, please contact our company
Module Over-temperature 3	Module balancing circuit temperature is too high	1.Check whether "Module Fan Fault 1" or "Module Fan Fault 2" alarms have been triggered. 2.Use the fan control command to test the module fan individually and check if it works normally. 3.High altitude or ambient temperature may trigger the alarm.	If the fault occurs more than 10 times per day, please contact our company
DC Input Soft-Start Fault	The soft start relay connecting the inverter to the battery is faulty	After the power inside the device is completely cut off, inspect the circuit board.	If the fault occurs more than 5 times a day, please contact our company

AC Surge Protection Fault	AC side surge protector fault	After the power is completely cut off inside the device, check the internal circuit board or determine whether the terminal is loose.	Please contact our company for details
Built-in Fan Fault	Internal fan fault	After the power is completely cut off inside the device, check whether the internal fan terminal is loose.	Please contact our company for details

Attention

Alarm Classification:

Fault - shutdown fault.

Alarm - Shutdown alarm.

Warning - Alarm without but not shutdown

Alarm Clearing Method:

Auto - The alarm is automatically cleared after the alarm cause disappears.

Manual - After the alarm cause disappears, the alarm is cleared by sending a reset command;

PowerOff - After the alarm cause disappears, the alarm is cleared by powering off and restarting

The Following Simplifies to:

Fault shutdown + Automatic FA

Fault shutdown + Manual FM

Fault shutdown + Power off FP

Warning shutdown + Automatic WA

Warning + Automatic WA

Warning + Manual WM

8.4 Other Faults

- The machine is too noisy

Possible causes: abnormal operation of the energy storage inverter, abnormal operation of the inductor, or failure of the cooling fan.

Solution: Check whether the power is within the normal range, and measure whether the grid-connected current and voltage waveforms are normal. Abnormal waveforms will generate a lot of noise and the inductor will heat up. Repair or replace the cooling fan.

- Failure to Communicate with the Upper Computer
- Host computer communication failed

Ethernet communication:

1. Check whether the IP address, subnet mask and gateway are set correctly.
2. Check whether the communication cable is a straight-through cable and whether it is well connected.

9 Maintenance

9.1 Safety during maintenance

Danger

High voltage exists in the live parts of the product. Touching live parts may cause death or serious electric shock damage.
When performing maintenance, wear appropriate personal protective equipment.
Do not touch any live parts.
Review all warning messages in the product and documentation.
Please follow all safety information provided by the battery manufacturer.
Before performing any work, be sure to disconnect the external power supply from the Bi-directional storage inverter:

- Grid voltage for grid feed
- Internal power supply
- DC voltage of the battery
- Additional external voltage, e.g. control signals from the control room

Make sure that disconnected devices cannot automatically reconnect.
After switching off the device, wait at least 5 minutes before switching it on again to allow the capacitors to discharge completely.
Before operation, make sure that all components are completely free of voltage.
Cover or insulate any adjacent live components.

Attention

Prevent product damage caused by dust intrusion and moisture penetration
The ingress of dust or moisture can damage the product and impair its functionality.
Only perform maintenance work in a dry and dust-free environment.
Product maintenance is only allowed when the product is turned off.
Reconnect external power after installing the product.
If the installation or commissioning process is interrupted, install all bezels. Close and lock the chassis.
Store the product in a dry area.

9.2 Maintenance Plan and Spare Parts

9.2.1 Operating Environment Requirements

The environment in which the equipment is installed must meet the operating environment requirements of the equipment:

Allowable ambient temperature: -25~60℃

Allowable relative humidity:： 0~95％(no condensation)

Maximum permitted altitude:3,000m

Note: When the maximum height is exceeded, the PCS will have its output derated.

For specific derating factors, please consult our technical staff.

9.2.2 Electrical and Fixed Connection Inspection

After putting into operation, conduct regular inspections on the connections of the electrical and fixed components of the equipment. It is recommended to check once every three months. The following items should be checked each time:

- Ground connection;
- Electrical connections for DC input;
- Electrical connections for AC input;
- Connection of communication and control cables
- Module Fan;
- Access the fault information recorded by the monitoring system.

9.2.3 Clearing and Cleaning

Before the equipment is put into operation, its radiator, terminals and mesh should be cleaned of dust and debris.

After the equipment is put into operation, the dust in the machine room should be cleaned regularly. Check whether the ventilation and exhaust facilities in the equipment room are normal. It is recommended to clean it every three months.

9.3 Maintenance Work

- In severe environmental conditions the maintenance intervals should be shortened.
- Site location and environmental conditions will affect maintenance intervals. Pay attention to cleaning and corrosion prevention.
- More frequent maintenance may be required, depending on site conditions.
- If the DC distribution components are subject to harsh environmental conditions, shorter maintenance intervals are recommended.
- We recommend regular visual inspections to determine if maintenance is required.

Consumables and maintenance materials

Consumables and maintenance materials are not usually included in the standard equipment list;
Only professionals or electrically qualified personnel can perform the operation;

Live maintenance work;

View history;
Read error messages and warnings;
Check the fan;

Maintenance without power supply;

View history;
Conduct a visual inspection;
Clean the ventilation dampers;
cleaning of air ducts and ventilation ducts;
Check the interior;
Check the bolt connections of the power cables;
Check the label;
Check door locks, door stops and hinges;

10 Appendix

10.1 Quality Assurance

If a product fails during the warranty period, Shenzhen Sinexcel Electric Co., Ltd. (hereinafter referred to as the Company) will repair or replace it with a new product free of charge.

- **Evidence**

During the warranty period, our company requires customers to present the invoice and date of purchase of the product. At the same time, the trademark on the product should be clearly visible, otherwise we have the right to not provide quality assurance.

- **Condition**

The replaced defective products will be handled by our company.
Customers should allow the Company reasonable time to repair faulty products.

- **Waiver of liability**

In the following circumstances, our company has the right not to provide quality assurance:

1. The whole machine and its components have exceeded the free warranty period.
2. Shipping damage.
3. Improper installation, modification or use.
4. Operation in very severe environments beyond those specified in this manual.
5. Equipment failure or damage caused by installation, repair, modification or disassembly by anyone other than our company’s service personnel.
6. Equipment failure or damage caused by the use of non-standard or non-Sinexcel parts or software.
7. Any installation and use beyond the scope specified in the relevant international standards.
8. Damage caused by abnormal natural environment.

If the product fails due to the above situation and the customer requires repair service, the paid repair service may be discontinued after the judgment of our service department.

In order to continuously improve customer satisfaction, our company's products and user manuals are in continuous improvement and upgrading. If there is a discrepancy between the user manual in your hand and the product, it may be due to version reasons. Please refer to the specific product. If you still have questions, please contact our company.

11 Contact

If you have any technical questions about our products, please call our service hotline. Please provide the following information so that we can provide you with the necessary assistance.

- Model of the device
- Device serial number
- Battery Specifications
- Current alarm information of the device
- Current AC and DC information of the device
- The software version of the device

Shenzhen Sinexcel Electric Co., Ltd.

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Installation Record