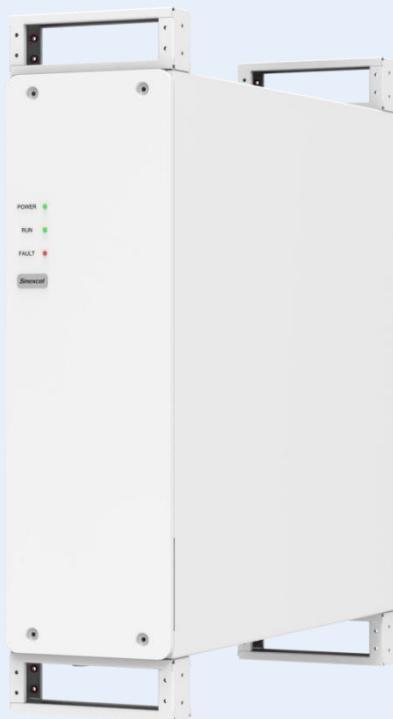


PWS1-160M-H-EX/NA

Bi-directional Storage Inverter



User
manual

Energy Freedom
Driven By **Sinexcel®**

Sinexcel

PWS1-160M-H-EX/NA Bi-directional Storage Inverter

User Manual

Version 1.3

Shenzhen Sinexcel Electric Co.

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Website: www.sinexcel.us

Address: Block 6, Block 2, Baiwangxin Hi-Tech Industrial Park, No.1002 Songbai Road, Nanshan District, Shenzhen, China

Postcode: 518055

Contact: 0755-8651-1588

Fax: 0755-8651-3100

E-mail: service@sinexcel.com

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1 Overview

1.1 Model Definition

This document involves the following product model:

- PWS1-160M-H-EX/NA

Model Definition

This section introduces the product model definitions in this user manual, as shown in Figure 1-1:

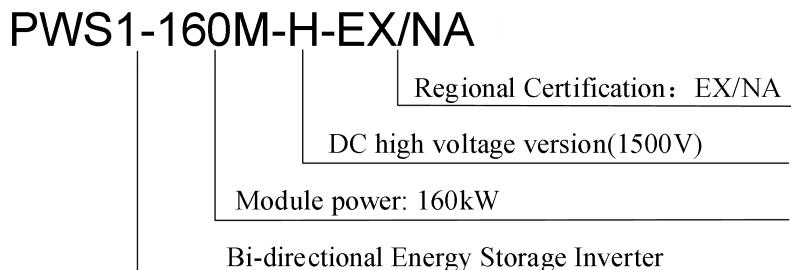


Figure 1.1 Product model definition

For example:

PWS1-160M-H-EX/NA: 160kW bi-directional storage inverter, DC high voltage up to 1500V with EX/NA version.

Check the nameplate on the PCS to identify the model.

The illustrations in this file are only schematic diagram, please refer to the actual product.

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 Management System
BMS	Battery Management System
PCS	Power Conversion System/Bi-directional Storage Inverter
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 Warning Signs

Logo	Explanation
	Danger Indicates a hazardous with a high level of risk which, if not avoided, will result in serious damage to products or properties, bodily injury or death.
	Warning Indicates a hazardous with a medium level of risk which, if not avoided, could result in death or serious injury.
	Caution Indicates a hazardous with a low level of risk which, if not avoided, could result in minor or moderate injury.
	Attention Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results.

2.2 Important Safety Instructions

This user manual is about installation and operation of Sinexcel PWS1-160M-H-EX/NA bi-directional storage inverter.

Please read this user manual carefully before installation.

The bi-directional storage inverter must be commissioned and maintained by an engineer designated by the manufacturer or an authorized service partner. Otherwise, personal safety may be endangered and lead to equipment failure. The equipment damage caused by this is not covered by the warranty.

The bi-directional storage inverter should not be used in any environment or application associated with life support equipment.

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



Danger

Touching any copper bus, contacts, or terminals inside the device that are connected to the power grid circuit may result in burns or fatal electric shock!

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

Pay attention to any instructions and safety documents regarding grid connection.



Warning

There is a risk of electric shock inside the device!

Any operation related to this equipment must be performed by professionals.

Please observe the safety precautions listed in the safety instructions and installation documentation.

Observe the safety precautions listed in the operating and installation manuals and other documentation.



Warning

Before connecting the input power, ensure that the grounding is reliable. The equipment must be grounded in accordance with local electrical codes.



Warning

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



Warning

Do not touch live parts within 5 minutes after power failure!

The internal capacitors store dangerous energy. It is strictly forbidden to touch the terminals, contacts, copper bars and other live parts of the equipment within 5 minutes after disconnecting all power supplies to the equipment.



Attention

All maintenance and servicing of the equipment should be performed by trained personnel. Internal components that require tools to open cannot be maintained by the user.

Please read this user manual before operation.

2.3 Additional Information

For more detailed information, please click: www.sinexcel.us.

3 Product Description

3.1 System Introduction

The bi-directional storage inverter is an energy 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 it can also rectify the AC power of the grid into DC power that can be charged into the battery. The bi-directional storage inverter can be used in grid-connected mode or off-grid mode. If grid-connected and off-grid switching is required, an external N-PE contactor can be configured.

PWS1 series adopts single-stage topology:

AC voltage: 400V; DC voltage input range: 720~1500V; when exceeding 1200V, derate to 90% for operation.

AC voltage: 480V; DC voltage input range: 850~1500V; when exceeding 1200V, derate to 90% for operation

3.2 System Schematic Diagram

The internal architecture of the PWS1-160M-H-EX/NA bi-directional storage inverter is a DC/AC three-level topology. Figure 3.1 shows the topology of the system.

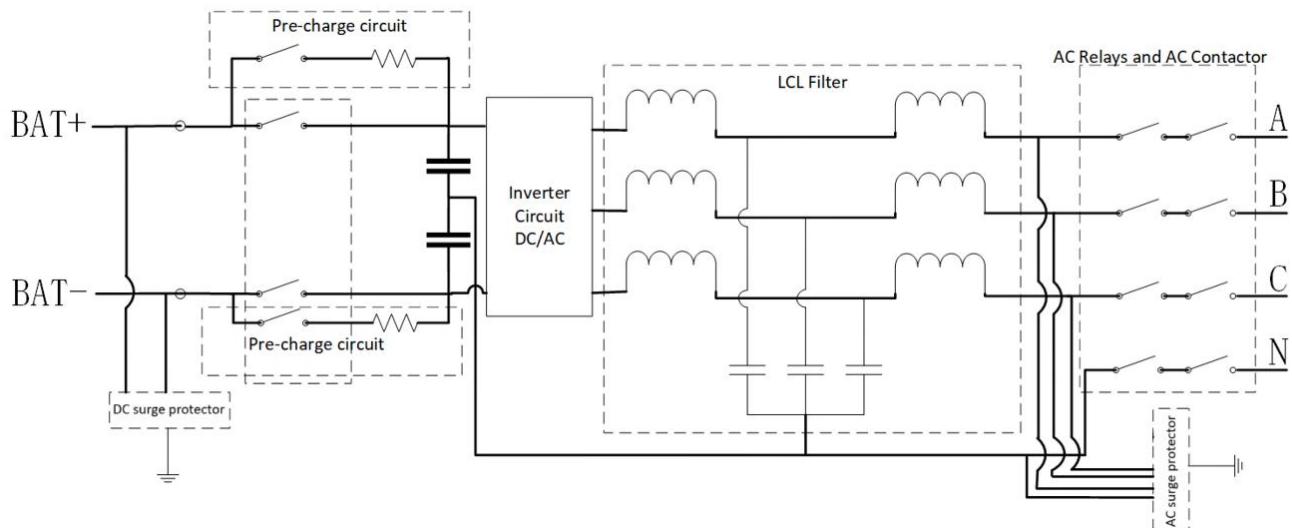


Figure 3.1 PWS1-160M-H-EX/NA bi-directional storage inverter topology diagram



Attention

PWS1-160M-H-EX/NA module has no circuit breakers or fuses on the AC and DC sides, and has AC relays and DC contactors inside the module. External protection and disconnection devices are required. If grid-connected and off-grid switching is required, an external N-PE contactor can be configured. Please refer to section 6.6.7 for selection.

3.3 PCS Module Appearance

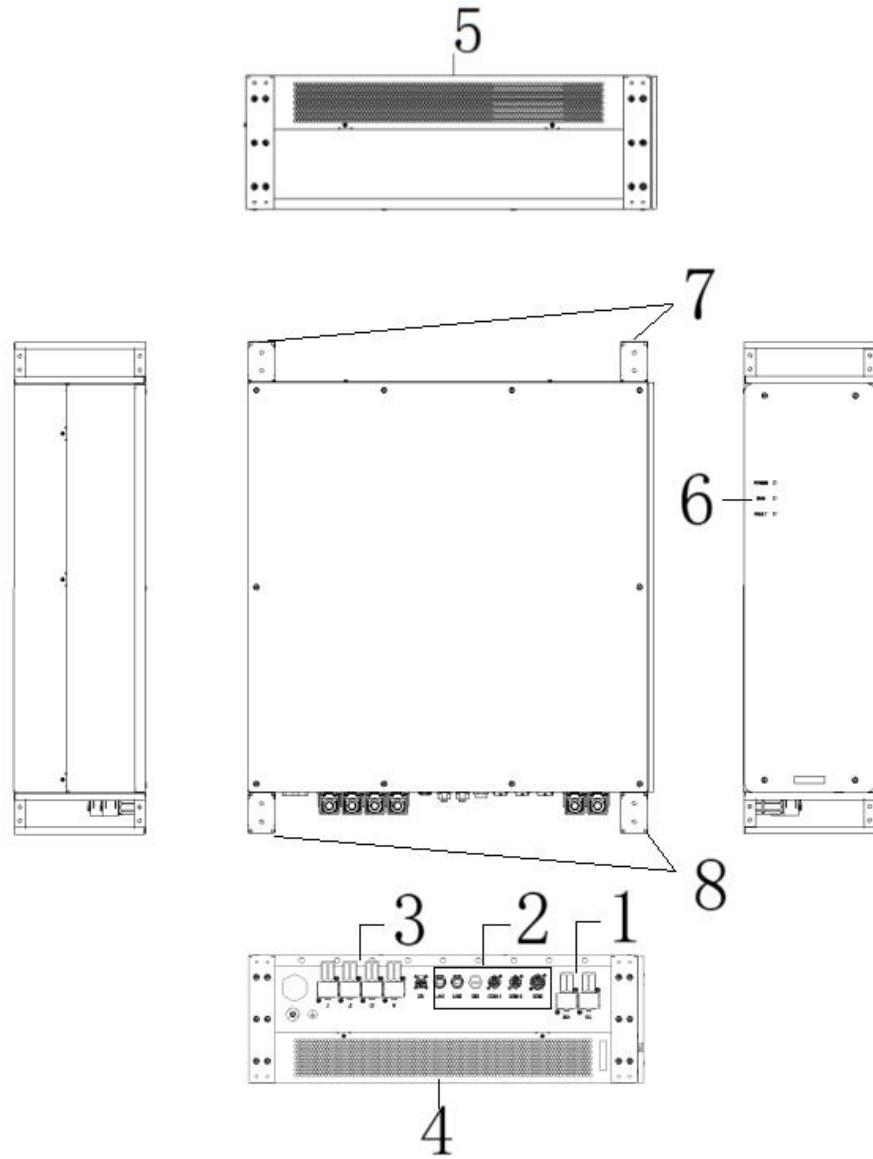


Figure 3.2 Appearance of PCS module (Refer to the drawing for details)

Serial Number	Name	Description
1	DC terminal	DC positive/negative
2	Communication terminal	CAN/485/Dry Contact/Ethernet
3	AC Terminal	AC L1/L2/L3/N
4	Bottom Air Inlet	
5	Top Air Outlet	
6	LED Display	Running status display
7	Handle	At the top
8	Handle	At the bottom

4 Technical Specifications

Table 4-1 PWS1-160M-H-EX Technical Parameters

Model	PWS1-160M-H-EX
Utility-interactive Mode	
Nominal Power	160kVA
AC Voltage	400 (-15%~15%) Vac
DC Voltage Range	720~1500V, >1200V derating to 90%
AC Current	231A
DC Current	230A
AC Connection	3P4W/3P3W
AC Frequency	50(-2.5~2.5) Hz
THDI	≤3%
Voltage Ripple Coefficient	≤1%
AC PF	-1~1
AC Overload Capacity	176 kVA (1.1 times long-term)
Stand-alone Mode	
Nominal Power	160kVA
AC Voltage	400 (-10%~15%) Vac
DC Voltage Range	720~1500Vdc, >1200V derating to 90%
AC Current	231A
DC Current	230A
AC Connection	3P4W
AC Frequency	50 (-2.5~2.5) Hz
AC PF	-1~1
AC Overload Capacity	176 kVA (1.1 times long-term/ 1.5 times for 10s overload)
System Parameters	
Maximum Efficiency	98.5% (External auxiliary source)
Dimensions (width x height x depth)	893*290*1080mm 893mm*290mm*900mm (Excluding handles and terminals)
Weight	136kg
Noise	<75dB @1m Vertical installation
Enclosure	IP66
Operation Temperature	-25 °C~60 °C(>50 °C derating)
Cooling	Forced air cooling
Operation Humidity	0~100% (no condensation)
Operation Altitude	3000m (>3000m derating)
Installation Method	Flat/Vertical/Wall-mounted installation
Communication	
Communication	RS 485, Ethernet, CAN
Communication Protocol	Modbus TCP/RTU, CAN2.0

Table 4-2 PWS1-160M-H-NA Technical Parameters

Model	PWS1-160M-H-NA
Utility-interactive Mode	
Nominal Power	160kVA
AC Voltage	480 (-15%~15%) Vac
DC Voltage Range	850~1500V, >1200V derating to 90%
AC Current	193A
DC Current	195A
AC Connection	3P4W/3P3W
AC Frequency	60 (-2.5~2.5) Hz
THDI	≤3%
Voltage Ripple Coefficient	≤1%
AC PF	-1~1
AC Overload Capacity	176 kVA (1.1 times long-term)
Stand-alone Mode	
Nominal Power	160kVA
AC Voltage	480 (-10%~15%) Vac
DC Voltage Range	850~1500Vdc, >1200V derating to 90%
AC Current	193A
DC Current	195A
AC Connection	3P4W
AC Frequency	60 (-2.5~2.5) Hz
AC PF	-1~1
AC Overload Capacity	176 kVA (1.1 times long-term/ 1.5 times for 10s overload)
System Parameters	
Maximum Efficiency	98.5% (External auxiliary source)
Dimensions (width x height x depth)	893*290*1080mm 893mm*290mm*900mm (Excluding handles and terminals)
Weight	≤136kg
Noise	<75dB @1m Vertical installation
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Cooling	Forced air cooling
Operation Humidity	0~100% (no condensation)
Operation Altitude	3000m (>3000m derating)
Installation Method	Flat/Vertical/Wall-mounted installation
Communication	
Communication	RS 485, Ethernet, CAN
Communication Protocol	Modbus TCP/RTU, CAN2.0

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 storage inverters 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 soft start to build up the voltage, and cannot build up the voltage in steps.
- DC side voltage range is [800V~1300V @400Va.c](#) :
- DC side voltage range is [850V~1300V @480Va.c](#) :

The load can operate with 100% unbalance (when the DC voltage is greater than 1200V, the operating power is reduced to 90%).

- DC side voltage range is 1300V~1500V [@400Va.c](#) :
- DC side voltage range is 1300V~1500V [@480Va.c](#) :

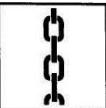
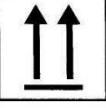
Except for single-phase and dual-phase inductive loads and single-phase and dual-phase RCD (resistance capacitor diode) loads, which cannot operate with 100% unbalance, other types of loads can operate with 100% unbalance and power reduction to 90%.

5 Storage, Handling and Transportation

5.1 Transportation and Storage

In order to ensure that the energy storage inverter is in a better protection state during transportation, please choose to transport it with packaging as much as possible, and transport it according to the instructions of various labels on the packaging. The illustrations of packaging labels are shown in Table 5-1:

Table 5-1 Packaging label instructions

Icon	Illustration
	The center of gravity mark indicates the location of the center of gravity of the energy storage inverter.
	Lifting mark, indicating the position of the chain or rope when lifting the energy storage inverter.
	The upward mark indicates the placement method when transporting and placing the energy storage inverter. It is strictly forbidden to place it upside down, horizontally or tilted.
	Handle the label with care and avoid severe friction or collision during transportation and placement.
	Moisture-averse label: The energy storage inverter should be protected from rain or moisture during transportation and storage.
	Attention
	The inverter is heavy and should be carried by at least four persons. Attention should be paid to maintaining balance and avoiding physical shocks to the equipment, such as sudden lowering or lifting.
	Attention
	Avoid transporting the energy storage inverter in rainy or bad weather conditions. If it cannot be avoided, please take necessary protective measures.

Not carried out immediately after delivery and acceptance, the energy storage inverter with outer packaging should be stored in a ventilated, dry and clean indoor environment. At the same time, the following aspects should also be noted:

- Restore the packaging to the state it was in when it was received. The desiccant inside the packaging must be retained.
- When storing the equipment, attention should be paid to ventilation and moisture-proofing. Water accumulation in the storage environment is strictly prohibited.

- It is strictly forbidden to stack more than 2 units during storage! It is strictly forbidden to store the inverter upside down!
- The storage environment temperature must be between -40°C and +60°C, and the relative humidity must be between 0 and 100%, with no condensation.
- Pay attention to the harsh environment around you, such as sudden cold, sudden heat, collision, etc., to avoid damage to the equipment.
- Regular inspections should be conducted at least once a week. Check whether the packaging is intact to prevent insects and rodents from biting it. If the outer packaging is damaged, it should be replaced immediately.
- If the storage time exceeds half a year, the package should be opened for inspection, and the desiccant should be replaced and repackaged.

5.2 Unpacking Inspection

Before leaving the factory, the energy storage inverter has been checked by the staff of Sinexcel and packed firmly. Nonetheless, the following items need to be checked after the energy storage inverter shipping packaging has been removed:

- 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 the energy storage inverter for deformation, peeling paint and loose parts.

Note: The actual configuration shall prevail according to the delivered product.

The packing list of the PCS is shown in Table 5-2.

Table 5-2 Packing list

Serial Number	Name	Specification Description	Quantity
1	Bi-directional Storage Inverter	Energy Storage Module - 160kW AC Module	1
2	Power Connection - Black	Power Connector - Single Core - Male - Black	2
3	Power Connection - Orange	Power Connector - Single Core - Male - Orange	4
4	Cable Connector	Cable Connector-14PIN Plug-Black	2
5	Cable Connector	Cable Connector-23PIN Plug-Black	1
6	Cable Connector	Cable Connector-4PIN Plug-Black	1
7	Sealing Rings	Cable connector-Sealing rings	60
8	Plugs	Cable Connectors-Plugs	60
9	Pins	Cable Connectors-Pins	60
10	Pins	Cable connector-24V external interface pin	2
11	Plugs	Cable Connector-RJ45 Waterproof Plugs	2
12	Limit Shield	Power Terminal Limit Cover	6
13	Certificate of Conformity	Certificate of Conformity	1
14	Test Report - English Standard	A4 Paper	1
15	FAT Report	A4 Paper	1



Attention

Only energy storage inverters that have been inspected correctly and are intact and undamaged can be installed and debugged. If any problems are found during the inspection, please contact the transporter or Sinexcel in a timely manner.

6 Equipment Installation

6.1 Installation Process

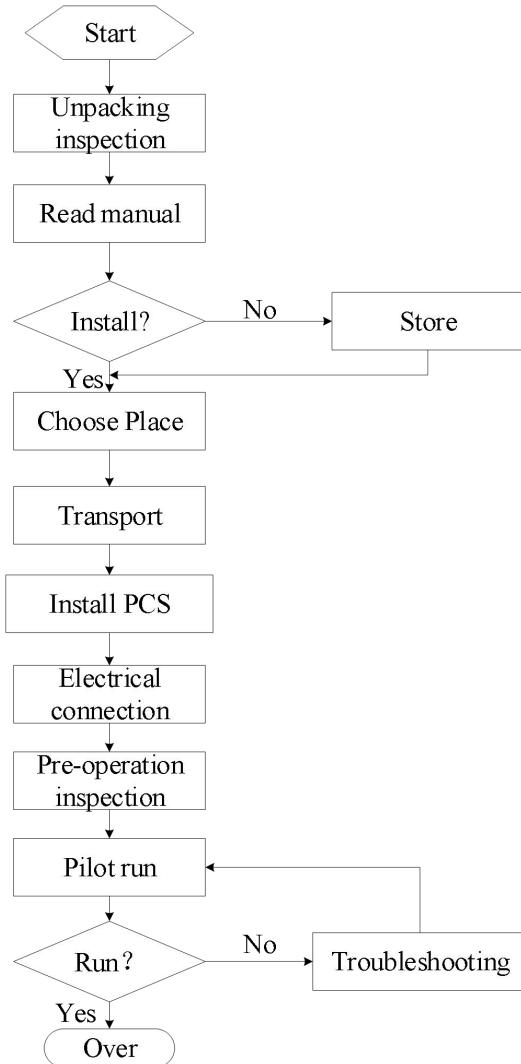


Figure 6.1 Installation process

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: 50 kΩ

The bi-directional storage inverter 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 Method

Correct installation methods for the bi-directional storage inverter are as follows, including horizontal and vertical installation. Any other inverted or tilted installation is prohibited:

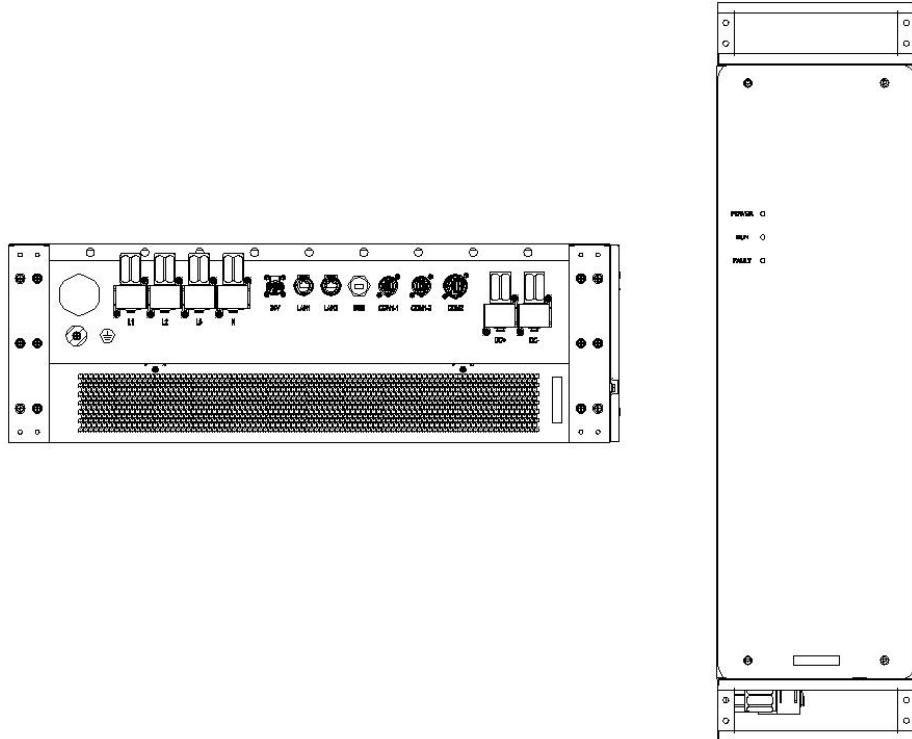


Figure 6.2 Installation method of bi-directional storage inverter

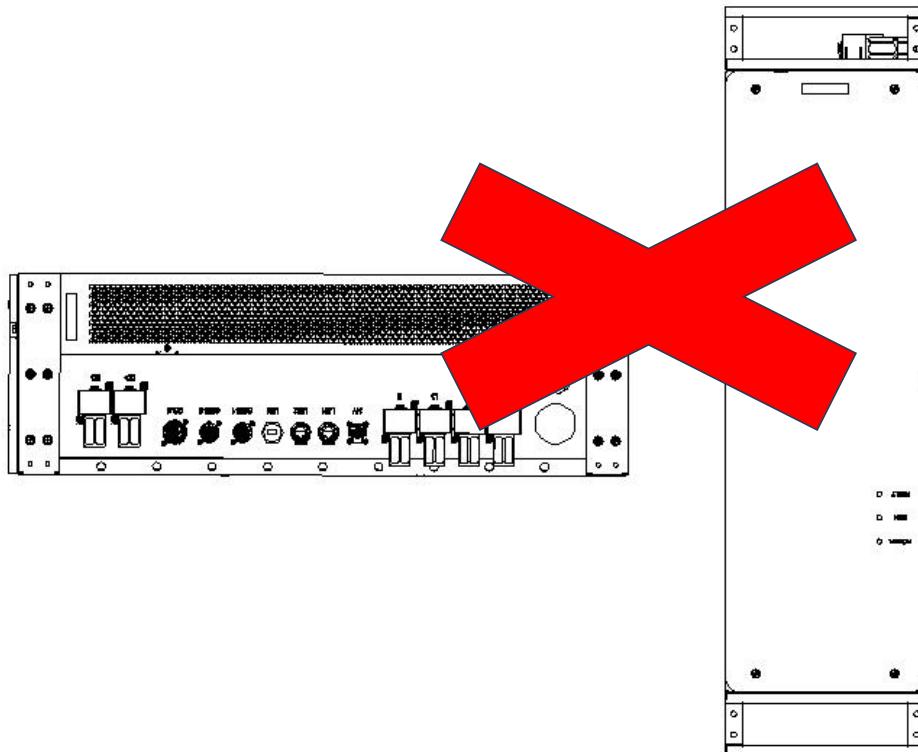


Figure 6.3 Incorrect installation method of bi-directional storage inverter

PWS1-160M-H-EX/NA module:

Exclude handles and terminals: Depth: 900mm; Height: 290mm; Width: 893mm.

With handle: Depth: 1080mm; Height: 290mm; Width: 893mm.

The handle is detachable as shown.

6.4 Installation Requirements

6.4.1 Environmental Requirements

- The protection grade is IP 66 and can be installed outdoor or indoor.
- When installed outdoors, there needs to be a shield above the inverter to avoid direct sunlight;
- Install PCS in a well-ventilated environment to ensure good heat dissipation;
- Avoid blocking the air inlet and outlet to ensure smooth air flow;
- The ambient temperature should be maintained between -25°C and 60°C to ensure the best operation of the PCS. Too high or too low a temperature will shorten PCS life.

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 inverter.
- Ensure installation on a stable surface. Vehicle-mounted use and long-term mobile use are prohibited.

For non-standard environmental applications, please contact Sinexcel.

6.4.3 Ventilation Requirements

The cooling method of the bi-directional storage inverter adopts forced air cooling. The module has an independent heat dissipation air duct, with the module's heat dissipation mode being front -inlet and rear-outlet. The required cold air is suctioned through the mesh holes of the front door of the cabinet, and the hot air after absorbing heat is exhausted through the mesh holes of the rear door of the cabinet.

When installing the module in the cabinet, the air intake should be ensured, and appropriate space should be left for air inlet and outlet. It is required that the air outlet of the cabinet meets the system air-volume demand in Table 6-1 to ensure that the heat dissipated by the bi-directional storage inverter is exhausted out of the machine room.

Table 6-1 Air volume required for heat dissipation of PWS1-160M

Model	System Air volume Demand	Number of Module Fans	Inlet Area	Outlet Area
PWS1-160M	650CFM	6	35000 mm ²	35000 mm ²



Attention

When the module is integrated in the cabinet, the module's inlet and outlet need to meet 1.2 times the system air volume demand, and the internal air ducts of the cabinet should not cross. If there is a sealed baffle in front of the module's inlet and outlet, the distance between the module's inlet and outlet and the baffle should be $\geq 250\text{mm}$ to ensure that the heat dissipated by the bi-directional storage inverter can be smoothly exhausted out of the cabinet.

6.5 Installation Tools

Table 6-2 Tools

Serial Number	Tool Name	Remark
1	Torque Wrench	
2	Phillips Screwdriver	M5, M6
3	Wire Strippers	
4	Utility Knife	
5	Crimping Pliers	
6	Heat Gun	
7	Heat Shrink Tubing	
8	Multimeter	Range greater than 1 500V
9	Diagonal Pliers	
10	Sleeve	

6.6 Electrical Installation and Connection

6.6.1 Input Requirements

The battery voltage 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 our technical service personnel.

The battery system with the bi-directional storage inverter should be equipped with a DC circuit breaker or a combination of a DC isolating switch and a fuse. In order to use this inverter more safely and in a standardized manner, the recommended energy storage system configuration is as follows:

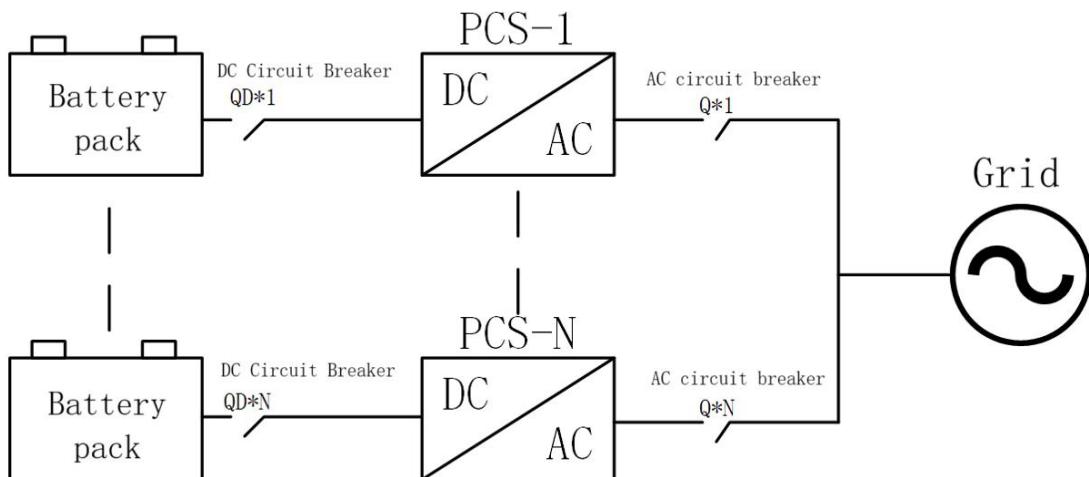


Figure 6.4 Recommended configuration

Note: This product does not have internal fuses/circuit breakers, and users are required to configure external protection according to technical specifications.



Attention

Each DC input branch of multiple bi-directional storage inverter modules operates independently. Standard equipment does not support the DC side parallel connection of multiple devices, and it is necessary to connect a single battery cluster to a separate branch DC port respectively.

6.6.2 Output Requirements

PWS1-160M-H-EX/NA series bi-directional storage inverter can select output as three-phase four-wire/ three-phase three-wire, and can select output side as AC 400V/ 480V. It is connected to the medium voltage grid through a transformer. The output side should 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 storage inverter adopts the front-to-front wiring method, and the AC and DC power cables are directly connected to the inverter by plug. The communication COM1 and COM2 use waterproof plugs.

Table 6-3 PWS1-160M-H-EX/NA Cable recommended instructions

Cables	Cable Cross-sectional Area (mm ²)	Terminal Specifications	Remark
AC cable	=70/95 (Optional)	Quick-plug	L1, L2, L3, Rated voltage:1000Vac
DC Cable	=70/95 (Optional)	Quick-plug	DC+, DC-, Rated voltage greater than 1500Vdc
Ground wire	≥35/50	M6	1/2 AC phase line cross-sectional area
Communication line	=1	Quick-plug	16pin, COM1, COM2

Cables are crimped using the product's factory-supplied quick-plug terminals. The default configuration of terminal lug is 70mm². If 95mm² terminal lug is required, please contact Sinexcel in advance.



Figure 6.5 PWS1-160M-H-EX/NA module terminal diagram

Table 6-4 PWS1-160M-H-EX/NA terminal description

Location	Name	Description
DC+	Battery negative terminal +	Battery positive input terminal
DC-	Battery positive terminal -	Battery negative input terminal
L1	Phase A	AC phase A
L2	Phase B	AC phase B
L3	Phase C	AC phase C
N	N-phase	AC phase N
PE	Grounding	Protective grounding
LAN1 LAN2	Ethernet communication	Receive EMS communication

COM1 COM2	Communication and control ports	RS485, CAN communication, input and output dry contacts, control circuit
DREM	DREM	Australian grid standard control directive
USB	USB Port	For software upgrade or external communication module (4G)
24V	External auxiliary source interface	24V+input (AC/DC switching power supply > 60W)

6.6.4 System Grounding



Warning

The module and rack need to be grounded reliably! The grounding resistance should be less than 4Ω , otherwise it may cause personal injury.

The bi-directional storage inverter module has a grounding terminal. When wiring, refer to the cable diameter in the following table to ground from this terminal. The grounding resistance is required to be less than 4Ω .

Table 6-5 Grounding PE cable description

Rated Power	PE Copper Wire Recommended Value (mm ²)
160 kW	\geq Phase line cross-sectional area/2, 35/50mm ² is recommended, rated temperature is not less than 105°C.

6.6.5 AC and DC Power Connections



Warning

Quick-plug terminals must be properly plugged in, otherwise the contact impedance will be too large, posing a fire hazard.



Danger

Maintaining the inverter by pulling out the quick-plug terminals, ensure that the AC and DC upper circuit breakers or fuses are disconnected to ensure that there is no dangerous voltage.

Cable Category	Recommended Copper Wiring Value (mm ²)
AC side	70/95mm ² single outdoor copper core cable, 1 for each of the three phases and N, 70/95mm ² (single core) or larger cable cross-sectional area The insulation skin rated temperature is not less than 105°C.
DC side	70/95mm ² single outdoor copper core cable, 1 positive and 1 negative cable, 70/95mm ² (single core) or larger cable cross-sectional area The insulation skin temperature resistance is not less than 105°C.

To meet the electromagnetic compatibility (EMC) requirements of the module, ferrite cores shall be installed at the following positions:

Ferrite cores shall be added respectively to the cable sections close to the AC power terminals (L1, L2, L3 and N) and close to the DC power terminals (DC+, DC-) of the module, **as follows**:

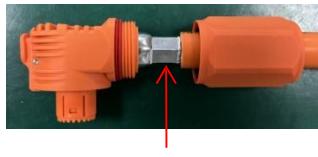
1. Install one nanocrystalline ferrite core and wind the cable around it for 3 turns if conditions permit.

2. Install one nickel-zinc ferrite core with no need for cable winding.

6.6.6 Use of Matching Power Quick-plug Terminals

Step1: Installation instructions

1. Installation instructions for plugs

Serial NO.	Picture	Description	Notes
1		1. Prepare materials as shown	Use tin-plated cables
2		2. Remove plug nut back cover as shown	
3		3. Thread the cable through the nut back cover assembly as shown	
4		4. The insulation layer of the cable was peeled off $15.0 + 0.5/-0$ mm	
5		As shown 1. Crimped terminals. The dimensions of the crimping refer to the requirements of this document. The crimping should be held for 2 seconds Flatten the tail	

6		Insert the nut back cover into the plug body, as shown, and the Assembly completed (.1.0~ 1.2 N. M)	
---	---	---	--

Step2: Instructions for matching plugs and sockets

2.1 The plug is aligned with the socket outlet

2.2 To insert, hear a click to indicate that the assembly in place



Step 3 Disconnecting

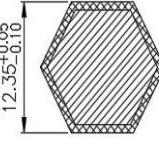
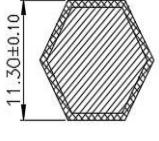
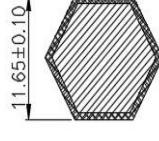
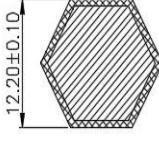
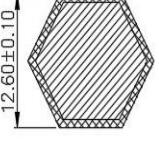
3.1 Press the button down



3.2 Pull Up, you can pull out the plug



Step4: Recommended terminal riveting dimensions

Dimension of terminal riveting				
2/0 AWG; 70mm ²	3/0 AWG	95mm ²	4/0 AWG	120mm ²
				

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

Wire harness retention force after riveting: $\geq 2700N$;

If the holding force is insufficient or the terminal is over-extended, please adjust the riveting size appropriately.

6.6.7 Selection of Fuses and Switching Devices

AC Circuit Breaker:

It is recommended to select a four-pole plastic-cased AC circuit breaker with synchronized breaking on the N line;

The rated voltage **Ue** is recommended to be 480V;

Note: The rated voltage **Ue** is recommended to be 500V when the grid voltage is unstable;

The rated current **In** is recommended to be 320A;

Remarks: When the altitude is higher than 1000m or the temperature is higher than 40°C, it will be considered with the actual working condition and circuit breaker brand for derating. After derating, the rated current requirement must still be met.

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;

DC Disconnector:

The rated voltage **Ue** is recommended to be 1500V;

The rated current **In** is recommended to be 400A;

Remarks: When the altitude is higher than 1000m or the temperature is higher than 40°C, it will be considered with the actual working condition and the brand of disconnecting switch for derating. After derating, the rated current requirement must still be met.

Withstand capacity **Icw** not less than 8kA/1s (When used in conjunction with DC fuses, the re-selection of models can be conducted by reducing the withstand capacity based on test results);

The matched cable shall be 95mm².

DC fuses:

Type recommended aR;

Rated voltage **Ue** recommended 1500V;

Rated current **In** recommended 350/400A;

Remarks: When the altitude is higher than 1000m or the temperature is higher than 40°C for operation, it will be considered for derating in combination with the actual working condition and the brand of circuit breaker. After derating, the rated current requirement must still be met.

Segmentation capacity is based on the battery side short-circuit current calculation;

DC fuse needs to be used in conjunction with disconnector.

If grid-connected and off-grid switching is required, an N-PE contactor can be externally added to connect the N line (The N-PE contactor opens when grid-connected, and closes when off-grid):

Rated voltage **Ue**: Recommended 1500 VDC or 500 VAC and above

Rated current **In**: Recommended 600 A (For use with four sets of 160M modules or less connected in parallel);

Note: When the altitude is higher than 1000m or the temperature is higher than 40°C, it will be considered with the actual working condition and brand for derating.

The short-time withstand capability shall bear the current energy of 2kA/80ms caused by the single-phase-to-ground short circuit of PCS in off-grid mode (test data of four sets of 160M modules connected in parallel).

6.6.8 Communication and Control Cables

PWS1-160M-H-EX/NA module provides communication interfaces such as Ethernet, CAN, 485, dry contact, USB, and control signals such as emergency stop EPO, parallel synchronization, and Australian DREM. Among them, the two network ports are numbered LAN1 and LAN2, the USB port is numbered USB, and the Australian grid-connected control command is numbered DREM. Other CAN, 485, dry contact, emergency stop EPO, parallel synchronization and other signals are located in the common communication ports (COM1, COM2).

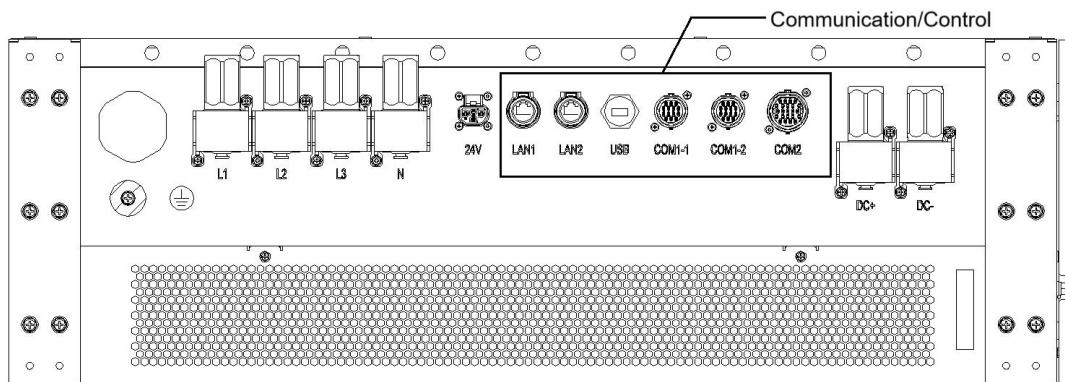


Figure 6.6 Communication control interface location

The shared communication ports (COM1, COM2) are defined as shown below:

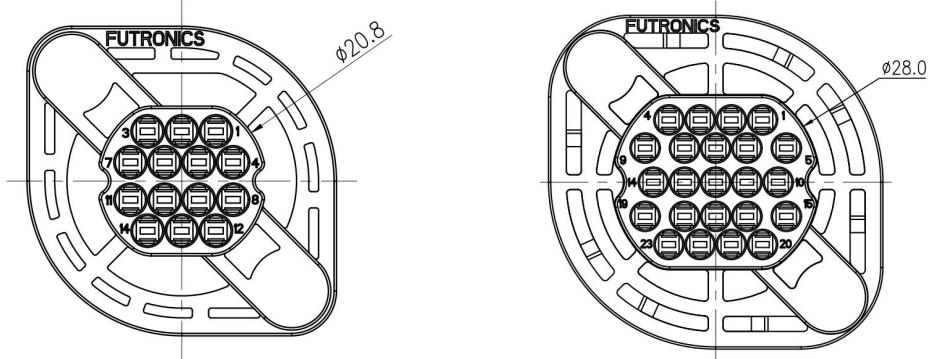


Figure 6.7 Schematic diagram of shared communication ports COM1 and COM2 (female connectors) (pin locations is viewed from inside the chassis outward)

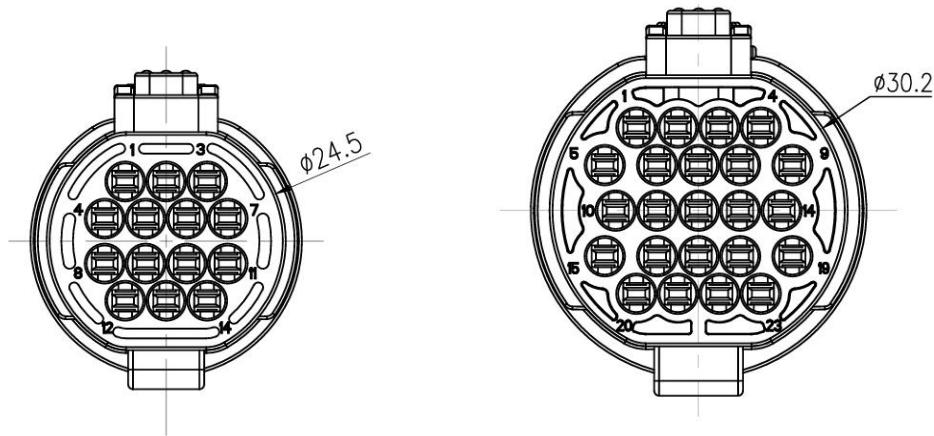


Figure 6.8 Schematic diagram of shared communication ports COM1 and COM2 (male connectors) (pin locations indicate cable insertion points)

Table 6-6 Description of shared communication interfaces

Interface Location	PIN Definition	Description
COM1-1	1: 50Hz_Sync_BUS_SELV 2: GND_SELV 3: Carrier_Sync_BUS_SELV 4: GND_SELV 5: EPO_NO 6: U1_INB 7: CANB_Para_H 8: CANB_Para_L	1/2: Industrial frequency synchronization 3/4: Carrier wave synchronization 5: EPO Short circuit fault 6: Input dry contact B 7/8: Synchronized CANB
COM1-2	1: 50Hz_Sync_BUS_SELV 2: GND_SELV 3: Carrier_Sync_BUS_SELV 4: GND_SELV 5: EPO_NO 6: U1_INB 7: CANB_Para_H 8: CANB_Para_L	1/2: Industrial frequency synchronization 3/4: Carrier wave synchronization 5: EPO short circuit fault 6: Input dry contact B 7/8: Synchronized CANB
COM2	1: Urs485A4 2: Urs485B4 3: UcanL2 4: UcanH2 5: Urs485A5 6: Urs485B5 7: MON_EXT_OUTA 8: GND SELV 9: MON_EXT_OUTB 10: GND SELV 11: BMS_NO 12: GND SELV 13: MON_EXT_INC	1/2: 485_1 3/4: CAN-2 5/6: 485_2 7/8: Output dry contact A 9/10: Output dry contact B 11/12: BMS short circuit failure 13/14: Input dry contact C

	14: GND SELV 15: U1 INA 16: GND SELV 17: VDD7_MAIN SELV 18: GND SELV 19: REFGEN 20: COM 21: 120Ω Matching Resistance 22: 120Ω Matching Resistance	15/16: Input dry contact A 17/18: 24V Power Supply 19/20: DRM0 21/22: CANB Matching Resistance
--	---	---

Table 6-7 Summary of input and output dry contact information

Dry Contact Name	U1_INA	U1_INB	MON_EXT_INC	EPO_NO	MON_EXT_OUTA	MON_EXT_OUTB	BMS_NO	DRM
Dry Contact Function	Input Dry Contact A	Input Dry Contact B	Input Dry Contact C	Fixed EPO	Output Dry Contact A	Output Dry Contact B	Fixed BMS Fault Signal	DRM Enable
BMS Redundant Fault Dry Contact	External Switching Device Signal	EPO Redundant Fault	Fixed EPO	Run Indicator Light	1. PCS Fault Indicator Light 2. Electrical Room Fan Control	Fixed BMS Fault Signal	DREM 0	
Default Disabled	YES	YES	YES	NO	YES	YES	NO	YES
Optional Function 1	BMS Open Circuit Fault	Grid-Connected/Off-Grid Switching	EPO Open Circuit Fault	EPO Short Circuit Fault	PCS Start/Stop	PCS Fault/Normal	BMS Short Circuit Fault	DREM 0 Enable
Optional Function 2	BMS Short Circuit Fault	/	EPO Short Circuit Fault	/	PCS Off-grid / Grid-connected	Electrical Fan Start/Stop	/	/

Table 6-8 Communication interface with other devices

Equipment	Wiring method
EMS	Ethernet (Protocol based on MODBUS TCP/IP, compatible with MODBUS RTU)
BMS	RS485 (Protocol based on MODBUS RTU) or CAN (CAN2.0 protocol specification)
Other PCS	CAN

6.6.9 Connecting to EMS via Ethernet

When a single energy storage inverter module uses the Ethernet communication solution, you only need to use a network cable (EIA/TIA568B) to connect the Ethernet interface (LAN1 or LAN2) of the energy storage inverter to the EMS system.



Figure 6.9 Schematic diagram of Ethernet communication solution for a single PCS

The communication connection of multiple energy storage inverters requires the configuration of an Ethernet switch. The communication cables (LAN 1 or LAN2) of multiple machines are connected to the same switch and then connected to the EMS system.

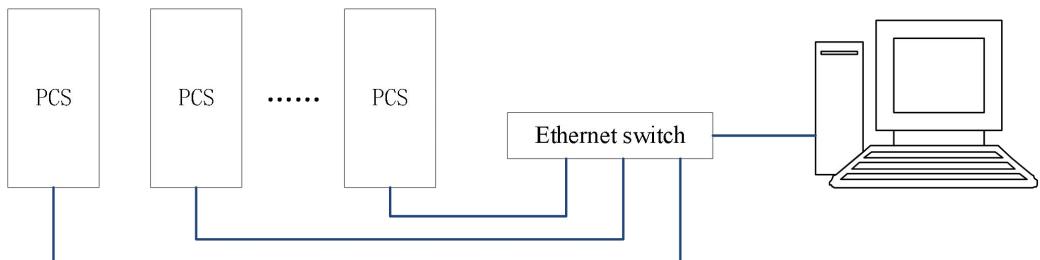


Figure 6.10 Schematic diagram of Ethernet communication solution for multiple PCS

6.6.10 Connect to BMS via RS485 or CAN

When the bi-directional energy storage inverter communicates with the BMS system, RS485 or CAN communication can be selected, which is located in COM2.

6.6.11 Fault Dry Contact with BMS

The bi-directional storage inverter communicates with the fault dry contact of the BMS system. The COM2 terminal can be connected to the BMS fault dry contact. The BMS input fault dry contact is normally closed. When the BMS fails, a disconnect signal is given to the PCS, and the PCS will report a fault and shut down.

6.7 Installation Checklist

After the bi-directional storage inverter is installed, it needs to be checked:

- 1) The equipment should be placed and installed reasonably to meet the safety distance requirements.
- 2) The wiring is correct. The ground wire is well connected to the ground grid. Ask the technician to check the ground resistance.
- 3) Compare the factory main wiring diagram with the on-site wiring diagram. Check if there are any differences and determine whether they will affect the safe operation of the energy storage system. After installation, check the following list:

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

7 Operation and Debugging

7.1 Control Method

7.1.1 Ethernet Connection

Use Ethernet connection. First, open the browser on the computer desktop, then enter the default IP of the machine (192.168.1.10) in the URL bar of the browser, 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 Password input box.

Click “Log in” to enter the background operation interface of PWS1-160M-H-EX/NA, as shown in Figure 7.2.

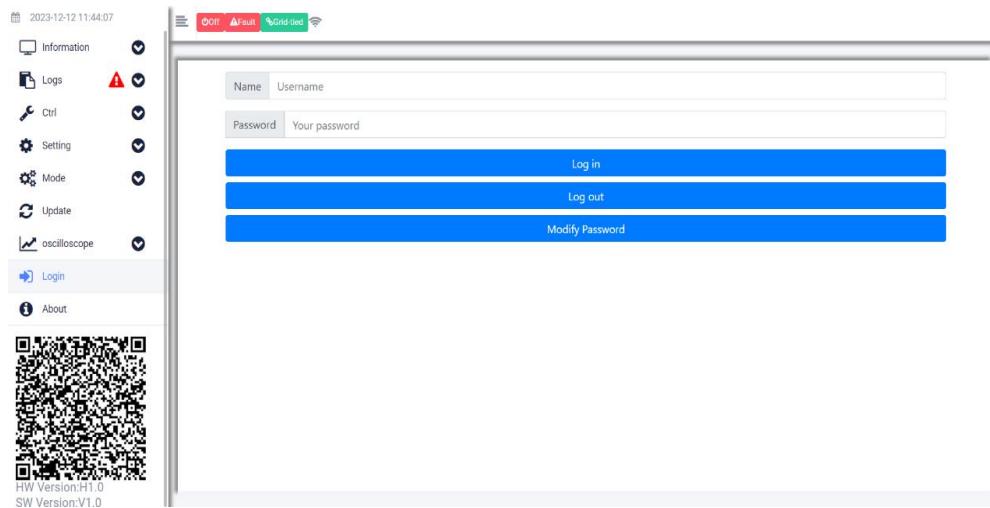


Figure 7.1 Login interface

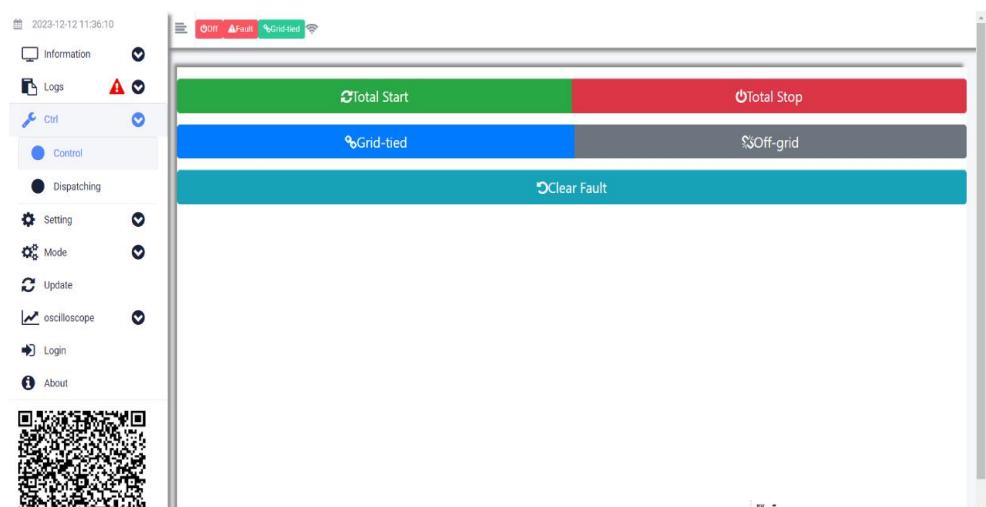


Figure 7.2 Example of web backend operation interface

7.1.2 RS485 Connection

Use RS485 connection (inverter and BMS communication). Before using 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.

If you choose to connect to BMS, you only need to set the baud rate. It is recommended to set the BMS timeout to 5 seconds. Other settings are usually not required.

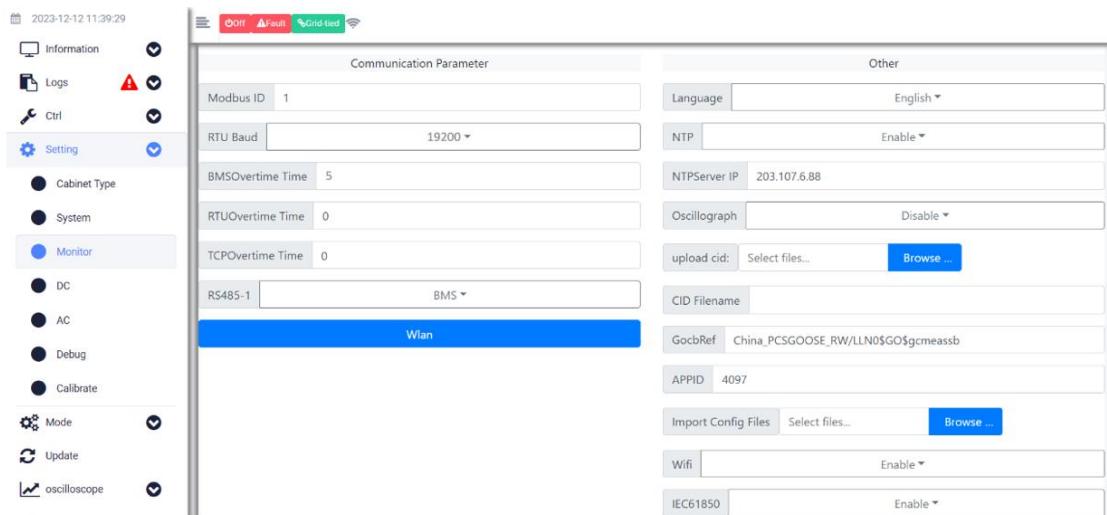


Figure 7.3 RS485 connection settings

7.2 Power-on and Power-off

After the energy storage device has been installed and debugged normally by engineers and the external power switch has been closed.

7.2.1 Check before Power-on

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, check whether the DC input wiring and AC output wiring of the energy storage device are normal and whether the grounding is good;
- 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 Power-on Steps

- 1) Close the output circuit breaker of the battery cabinet and power on the DC port of the device. At this time, you will see the power indicator light up.
- 2) First, open the browser on the computer desktop (Google Chrome is recommended), then enter the machine's default IP (192.168.1.10) 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 PWS1-160M-H-EX/NA, 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", etc.

The first time you start the device, you need to set the battery DC protection parameters and communication configuration.

3) The inverter 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" 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 inverter starts to connect to the grid.

7.2.3 Power-off Steps

- 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 inverter model
- Energy storage inverter 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 Troubleshooting

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

- Whether the open circuit voltage of the energy storage battery meets the requirements of the energy storage inverter;
- Whether the power grid and DC side are correctly connected and powered on;
- Whether the communication cables are loose.

8.2 LED Indicator Display and Troubleshooting Methods

Please refer to the following table for device status description:

Table 8-1 Troubleshooting methods

LED Status	Treatment
The POWER indicator light is off	<p>This indicates that neither the AC nor the DC sides of the energy storage inverter are powered.</p> <ol style="list-style-type: none">1. Check whether the power supply and connection of the grid and battery are normal.2. Check whether the AC and DC quick-connect 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	<p>Indicates that the energy storage inverter is not in operation.</p> <ol style="list-style-type: none"> 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	<p>This indicates that the energy storage inverter has failed and the failure has not been eliminated.</p> <ol style="list-style-type: none"> 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 Solutions

Fault type	Possible causes	Simple processing	Remark
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 manually reconnected to the grid
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 manually reconnected to the grid

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 inverter and whether there are any problems with the control circuit board.	Please contact our company for details
Internal environment over temperature fault	The internal temperature of the energy storage inverter is higher than the allowable value	After the power is completely cut off inside the device, inspect the fan.	If the fault occurs more than 10 times a day, please contact our company
Module over-temperature fault x (x=1~2)	The IGBT module substrate temperature is higher than the allowable value	After the power is completely cut off inside the device, inspect the fan.	If the fault occurs more than 10 times a day, please contact our company
DC input soft start failure	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
DC lightning protection fault	The DC side lightning arrester fails	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
AC lightning protection fault	The AC side lightning arrester fails	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
Internal fan failure	Internal fan abnormality	After the power is completely cut off inside the device, check whether the internal fan terminal is loose.	Please contact our company for details
External fan failure	External fan abnormality	After the power is completely cut off inside the device, check whether the external fan terminal is loose.	Please contact our company for details



Attention

Alarm classification:

Fault : Hardware Shutdown Fault;

Alarm: Shutdown Alarm;

Warning :Warning 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;

Power off : After the alarm cause disappears, the alarm is cleared by powering off and restarting

The following is simplified as:

Fault Shutdown+ automatic F.A

Fault Shutdown+ manual F.M

Fault Shutdown+ power off F.P

Alarm Shutdown+ Automatic A.A

Warning + Automatic W.A

Warning + Manual W.M

8.4 Other Faults

- High operating noise of the machine

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

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 loud noise and cause excessive heating of the inductor. Repair or replace the cooling fan.

- 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°C

Allowable relative humidity: 0~ 100 % (no condensation)

Maximum permitted altitude: 3,000 m

Note: When the maximum height is exceeded, the energy storage inverter will have its output derated.

For specific derating factors, please consult our technical staff.

9.2.2 Electrical and Fixed Connection Inspection

After the equipment is put into operation, the electrical and fixed component connections of the equipment should be checked regularly. It is recommended to check once every three months. The following items should be checked each time:

- Grounding 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 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
- Photovoltaic module information
- 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.

Website: www.sinexcel.us

Building 6, Zone 2, Baiwangxin High-tech Industrial Park , No. 1002, Songbai Road, Nanshan District, Shenzhen

Postal Code:518055

Hotline:+86 0755-8651-1588

Installation Record