# PWS2-(29P,30P)-EX

## Energy Storage Converter

# User's Manual

Shenzhen Sinexcel Electric Co., Ltd.

User's Manual

# Sinexcel PWS2-30P-EX / PWS2-29P-EX Energy Storage Converter

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Applicable to: PWS2-29P-EX、PWS2-30P-EX

Shenzhen Sinexcel Electric Co., Ltd. ("Sinexcel") provides its customers with all-around technical support. Users can contact local Sinexcel office or customer service center or directly contact Sinexcel Headquarters.



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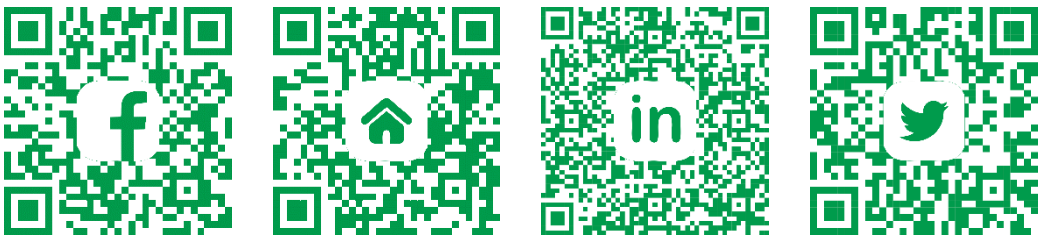


# *CONTENT*

# Chapter 1 Overview

## 1.1 Model definition

Model definition:

The model definition of PWS2-30P-EX / PWS2-29P-EX energy storage converter is shown in Fig. 1-1:

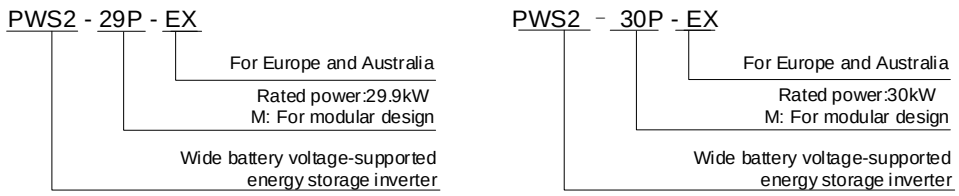



Fig. 1-1 Product model definition

## 1.1 Icon interpretation

This user's manual is about installation and use of Sinexcel PWS2-30P-EX / PWS2-29P-EX energy storage converter.

To ensure personal and property safety or use this product efficiently, please read this user's manual carefully before installation and use.

### 1.1.1 Icons in the manual

The following are the examples for icons in this user's manual. Please read and understand the definition of each icon.

| | |
|---|---|
|  DANGER | The DANGER icon indicates that there is a safety risk during operation. If this kind of warning information is not followed, it will directly result in a serious human casualty accident. |
|  WARNING | The WARNING icon indicates that there is a potential risk during operation. If this kind of warning information is not followed, it might result in a serious human casualty accident. |
|  CAUTION | The CAUTION icon indicates that there is a potential risk during operation. If this kind of warning information is not followed, it might result in device damage. |

| | |
|---|---|
|  | The NOTE icon indicates the additional information in the manual and a highlight and supplement for the content. It provides skills and tips of product usage and can help you efficiently solve some problems in application. |

### 1.1.2 Converter prompt icons

The following are the examples for icons on the converter. Please read and understand the definition of each icon.

| | |
|---|---|
|  | This icon indicates that internal conductive device can be touched by waiting for 10 minutes after converter and power grid are disconnected from storage battery. |
|  | This icon indicates that the converter surface is hot during operation. Keep cautious. Don't touch the converter surface. |
|  | This icon indicates that before any operation of the converter, please read this product manual carefully. |
|  | The ELECTRICAL DANGER icon indicates that only professional and qualified personnel can carry out equipment installation and electric operation. |

## 1.2 Safety instructions

PWS2-30P-EX / PWS2-29P-EX energy storage converter is designed and tested in strict accordance with relevant international safety standards. Its installation, trial operation, operation and maintenance should comply with safe operation specifications of electrical and electronic equipment. Incorrect use or wrong operation might endanger operator or a third party and destroy the converter or other properties. To prevent the above circumstances from happening, the following precautions should be strictly abided by in the process of operation and maintenance. The detailed description will be provided in relevant chapter.

| | |
|---|---|
|  <br>WARNING | All installation, debugging and maintenance should be completed by professionals. Professionals should:<br>▪ be approved engineer by the factory or its agent;<br>▪ be professionally trained;<br>▪ fully read this manual and learn about safe operation matters for |

| | |
|---|---|
| | electrical and electronic equipment;<br>▪ be familiar with relevant safety specification of electric system. |

Professionals who meet the above conditions can:

(1) Install the converter;

(2) Setup energy storage system as per customer's requirement;

(3) Conduct trial operation of energy storage system;

(4) Operate, debug and maintain energy storage system.

| | |
|---|---|
|  <br>CAUTION | Equipment wrong operation might cause injury!<br>▪ Removal and placement of the converter should abide by the description in this manual.<br>▪ Improper equipment operation might cause electric shock, burn or contusion.<br>▪ Any system (equipment) damage caused by modification and disassembly without permission does not fall into the warranty scope. |

### 1.2.1 Safety instructions for mechanical installation

| | |
|---|---|
|  <br>DANGER | Before converter installation, ensure that the converter does not have any electric connection. |
|  <br>CAUTION | Poor ventilation for installation will weaken the system performance!<br>During equipment operation, the ventilation should be good. The equipment should be upright, and there should be no strong air current to prevent airflow so as to ensure that the device is cooled well. |

### 1.2.2 Safety instructions for electrical connection

| | |
|---|---|
|  <br>DANGER | Be careful in electric connection. There is dangerous voltage between the two poles of storage battery. Don't touch the metal terminal when there is no sufficient protection. |
|  | The cables used in energy storage system must be connected firmly and with good insulation and proper specification. |

| | |
|---|---|
| CAUTION | |
|  <br>CAUTION | All electrical installations should meet national/regional electrical standards;<br>Grid-tied operation can be conducted after permission is obtained from local national/regional electric power department.<br>Before power-on, please ensure that it is reliably grounded and the grounding meets local electrical standards. |

### 1.2.3 Safety instructions for converter operation

| | |
|---|---|
|  <br>DANGER | Any contact with copper bar, uncovered contact spot or terminal inside the device that is connected to the loop of power grid might result in burning or fatal electric shock.<br>▪Don't touch any terminal and conductor connected with the power grid.<br>▪Pay attention to any instruction and safety documents about grid connection. |
|  <br>WARNING | There might be an electric shock risk inside the device! When the converter operates or is electrified, don't open the enclosure of the converter.<br>▪ Only intact and closed cabinet can protect operator's personal and property safety.<br>▪ Any operation related to this device will be conducted by professionals.<br>▪Pay attention to the safety precautions listed in this manual and other documents.<br>When AC of the converter is loaded, DC disconnection is not allowed. If disconnection is required, shutdown operation should be conducted first. After the AC load isolation switch of the converter is disconnected and it is confirmed that there is no voltage at the AC terminal of the converter, DC connection can be turned off. |
|  <br>CAUTION | During converter operation, the ventilation duct must not be blocked. |

### 1.2.4 Safety instructions for maintenance and replacement

| | |
|---|---|
|  <br>DANGER | Improper equipment maintenance and operation might cause personal injury or equipment damage. Before any operation, users should strictly abide by the following steps:<br>▪ Disconnect the AC isolation switch between the power grid and the converter, and then turn off DC breaker of the battery box.<br>▪ Wait for at least 10 minutes until internal energy storage elements are discharged off. During this period, don't touch equipment terminal, contact spot, copper bar and other electric parts with body or conductor.<br>▪ Use detecting device to check and ensure that there are no voltage and current on the device. |
|  <br>CAUTION | Stop irrelevant personnel from entering the maintenance site!<br>During electrical connection and maintenance, temporary warning signs should be pasted and barriers should be set up to prevent irrelevant personnel entering electrical connection or maintenance area. |
|  <br>CAUTION | The converter can be restarted only after its malfunction affecting safety performance is removed.<br>Power can be supplied again after the converter is fully disconnected for 1 minute.<br>There are no serviceable parts in the converter. If any maintenance is required, please contact our after-sales personnel. |
|  <br>CAUTION | Don't replace the internal elements at will. Otherwise, our company will not undertake any quality guarantee and joint liability for any losses caused thereby. |
|  <br>CAUTION | Components might be caused by any contact with PCBs or other electrostatic sensitive components or improper operation.<br>Don't touch the circuit boards.<br>Abide by electrostatic protection specifications and wear anti-static wrist strap. |

### 1.2.5 Others

| | |
|---|---|
|  WARNING | Safety signs, warning label and nameplate on the converter:<br>▪ Must be clearly visible;<br>▪ Should not be removed or covered. |

## 1.3 Precautions

### 1.3.1 Personnel requirements

Energy storage converter must be debugged and maintained by the engineers designated by the manufacturer or its agent. Otherwise, it might endanger personal safety and result in device fault. Any damage against the device caused thereby will not fall into the warranty scope.

### 1.3.2 Purposes of usage

Energy storage converter is only used for commercial/industrial purposes, and it cannot be used as an energy saving device related to life support device.

### 1.3.3 Label on enclosure

The label on enclosure contains important information for safe operation to the converter. Don’t tear or damage it.

The label on enclosure should be clear and readable. If it is damaged or becomes vague, please replace it.

### 1.3.4 Notes

To help users read this manual more conveniently, a lot of pictures are provided in this manual. Such pictures are only used for description and indication. For detailed information, please refer to the product itself.

# Chapter 2 Introduction to photovoltaic energy storage system

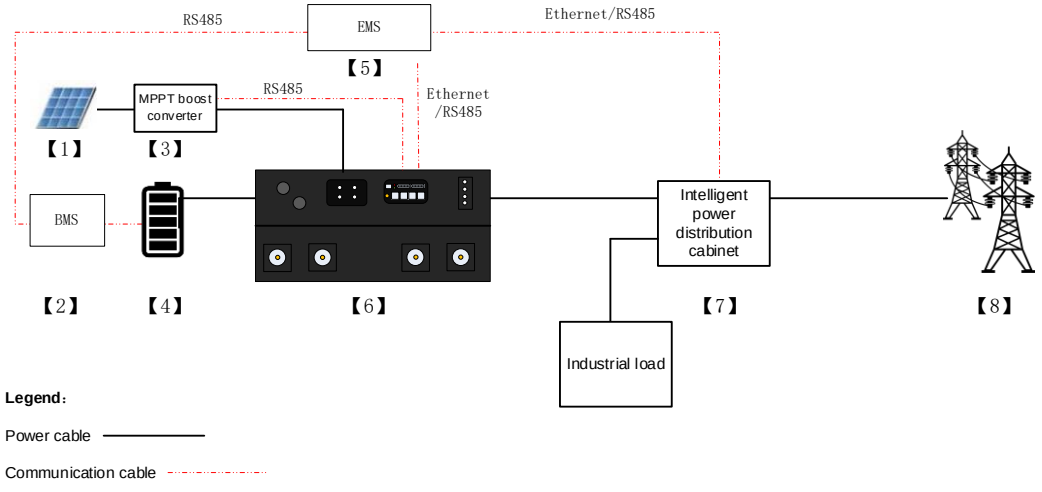
## 2.1 System application

As shown in Figure 2-1, the photovoltaic energy storage system built by PWS2-30P-EX is composed of batteries (groups), converters, smart power distribution units, EMS and BMS, MPPT boost converters, photovoltaic modules, etc. The battery pack is connected to the energy storage device, and the energy storage device is connected to the load and grid-connected through the intelligent power distribution unit. The energy storage device communicates with the EMS through the Ethernet interface (or RS485 interface) to indirectly realize the charge and discharge control of the battery pack. The photovoltaic power generation control is carried out through RS485 communication with the MPPT boost converter, and the EMS communicates with the energy storage device, BMS and smart meter through RS485/Ethernet to realize the energy dispatch of the photovoltaic energy storage system.

### 2.1.1 System structure diagram

The structure diagram of photovoltaic energy storage system is shown below. PWS2-30P-EX / PWS2-29P-EX energy storage converter pushes the data to EMS & MPPT boost converters or other host systems in real time.

The Intelligent power distribution unite is a remote controllable disconnector. A manual switch can also work. This component is used to isolate the grid when the system needs to run in off-grid mode.




（1）Photovoltaic module　（2）BMS　（3）MPPT boost converter　（4）Battery

（5）EMS　（6）PWS2-30P-EX　（7）Intelligent power distribution cabinet　（8）Grid

Fig. 2-1 Structure of energy storage system

## 2.2 Overall dimension

Overall dimension of PWS2-30P-EX / PWS2-29P-EX is shown in Fig.2-2.

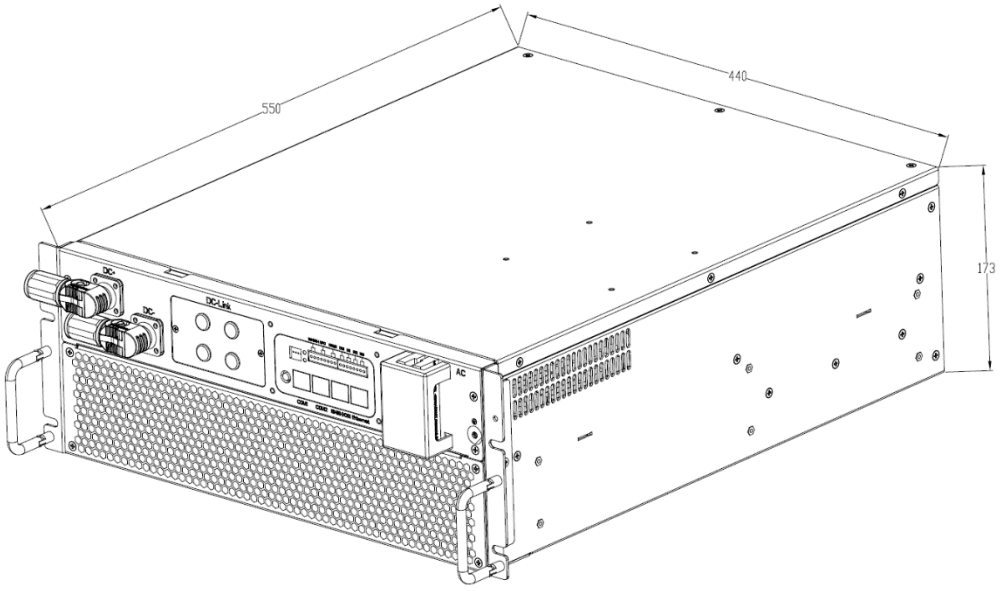



Fig. 2-2 Dimensions of PWS2-30P-EX modular machine model (unit: mm)

## 2.3 Appearance

The appearance of PWS2-30P-EX / PWS2-29P-EX is shown in Fig.2-3.

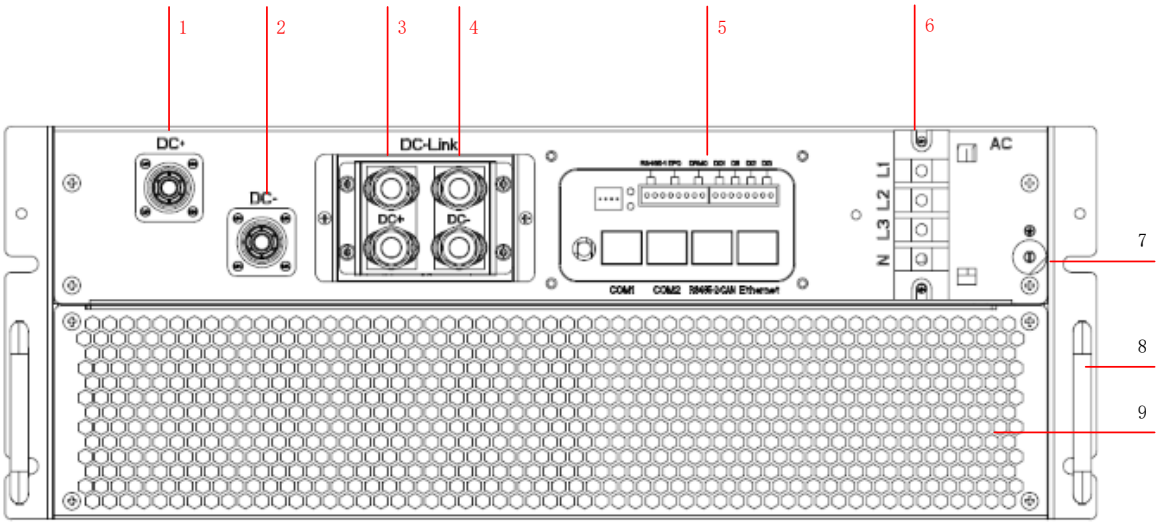



Fig. 2-3 Appearance of front side of PWS2-30P-EX / PWS2-29P-EX

| SN | Name | Description |
|---|---|---|
| 1 | Positive DC port | To connect positive power cables to the battery cabinet |
| 2 | Negative DC port | To connect negative power cables to the battery cabinet |
| 3 | DC bus positive | MC4 terminal*2 |
| 4 | DC bus negative | MC4 terminal*2 |
| 5 | Signal interface area | External communication interface |
| 6 | AC terminal | AC wiring |
| 7 | Ground terminal | Grounding protection wire fixed point |
| 8 | handle | Extraction module, not for load-bearing |
| 9 | Vent | Fan cover and air duct vents |

## 2.4 Technical parameters

Technical parameters of PWS2-30P-EX / PWS2-29P-EX energy storage converter:

Table 2-1 Technical parameters

| | |
|---|---|
| **DC PORT - BATTERY** | |
| Rated allowable power | 30kW |
| Battery charge/discharge voltage range | 150V-750V (350 ~ 750V full load) |
| Maximum charge/discharge current of battery | 90A |
| **DC bus** | |
| Rated allowable power | 45kW |
| Input voltage range | 700 ~ 830V |
| Maximum input current | 65A |
| **AC GRID-TIE PARAMETER** | |
| Rated output power | 30kW |
| Maximum apparent power | 33kVA |
| Maximum active power | 33kW |
| Rated grid voltage | 3/N/PE, 400VAC; 3/PE 480VAC |
| Total current harmonic distortion rate | <3% |
| Power factor | Listed: 0.8 ~ 1 leading or lagging |
| | Actual: 0.1 ~ 1 leading or lagging |
| **AC OFF-GRID PARAMETER** | |

| | |
|---|---|
| Rated output power | 30kW |
| Maximum apparent power | 33kVA |
| Maximum active power | 33kW |
| Rated grid voltage | 3/N/PE, 400VAC; 3/PE 480VAC |
| Rated grid frequency | 50/60 Hz |
| Power factor | Listed: 0.8 ~ 1 leading or lagging |
| | Actual: 0.1 ~ 1 leading or lagging |
| Overload capacity | 110% ~ 120% for 10min; |
| | 120% ~ 150% 200ms |
| **SYSTEM BASIC PARAMETERS** | |
| Module size | 440*173*596mm |
| Net weight | 33kg |
| Topology | Non-isolation |
| Heat dissipation mode | Air cooling |
| Altitude | 4000m (derating greater than 2000m) |
| Pollution level of working environment | ≤2 |
| Operating temperature/humidity | -20 ℃-60 ℃ (45 ℃ derating)/0-95% |
| Noise | ≤ 65dB |
| Protection level | IP20 |
| **Display/communication** | |
| Display | LED |
| Communication | CAN/RS485/Network Port/WIFI |
| **Efficiency** | |
| Peak efficiency | 97.30% |
| CEC efficiency | 96.50% |
| **Protection** | |
| Temperature protection, grid monitoring (OVP/UVP, OFP/UFP), EPO, grid reverse sequence, island protection, fan/relay fault, overload protection, AC short circuit protection, leakage current protection | |
| **Certification** | |
| Grid-connected standard | EN50549, AS4777.2, VDE4105, G99, IEEE1547, NB/T 32004 |
| Safety certification | IEC 62109, NB/T 32004, UL 1741 |
| EMC | EN61000 Series |

## 2.5 Technical specification

### 2.5.1 Principle description

There are four working modes: grid-connected discharge, grid-connected charging, off-grid discharge, photovoltaic power generation scheduling.

When the battery voltage connected to PWS2-30P-EX / PWS2-29P-EX is within the preset normal voltage range, the converter can work in four working modes: grid-tied discharge, grid-tied charging and off-grid discharge, and photovoltaic power generation. If the converter is in discharging state, the DC power supply of the battery can be inverted into

3-phase AC power supply. If the converter is in charging state, the 3-phase AC power energy of the power grid can be stored into battery (pack). The converter can realize photovoltaic access by connecting to the MPPT boost converter on the DC bus side, which can transfer photovoltaic power to the battery for charging, or send photovoltaic power to the grid.

The protection circuit of the converter is used to ensure safe operation of the converter and operators' safety.

| | |
|---|---|
|  CAUTION | Energy storage converter without built-in isolation transformer.<br>If the capacity of the energy storage device does not meet the demand, multiple parallel connections can be made. Each converter is equipped with a suitable battery capacity on the DC side and the AC side is connected to the grid in parallel. |

### 2.5.2 Function description

The functions of PWS2-30P-EX / PWS2-29P-EX are as follows:

Grid-tied discharging: The converter is in inverting state, converts DC into AC that meets the requirement of power grid department in installation region, and feeds the energy back to the power grid.

Grid-tied charging: The converter is in rectification state and transmits 3-phase AC to charge the battery (pack) by the set charging mode.

Off-grid discharging: The converter is in inverting state, converts DC into AC that meets the requirement of power grid department in installation region, and provides power supply for 3-phase load in the micro-grid.

Photovoltaic power generation scheduling: The converter can realize photovoltaic access through the MPPT boost converter connected to the DC bus side, and can transfer the photovoltaic power to the battery for charging, or send the photovoltaic power to the grid.

Data storage and display: Storage and operation information, operation record and failure record are displayed on the LCD screen.

Communication function:

- Standard RS-485 interface can be connected with monitoring device such as EMS, BMS.
- Standard Ethernet interface is used to communicate with upper computer to realize such functions as remote control and remote software upgrading.
- **Reactive power configuration:** Regulate the reactive power of the storage system.

- **FVRT**: frequency/voltage ride-through, this function can be enabled or disabled, for more information, please refer to UL1741 Supplement A or other similar rules about Utility-Interactive Distribute Generators.
- **Soft-Start/Reconnection ramp rate**: This function will apply when system suspend happens caused by utility voltage abnormal, and reconnect after utility restore normal. The default value is 2, twice of rated power per second, which means within 0.5 seconds the system restores to full output.
- **Anti-Islanding**: enable or disable anti-islanding function. For more information, please refer to UL1741 Supplement A or other similar rules about Utility-Interactive Distribute Generators.
- **Volt/Watt:** Available when activated and operating in discharge mode. When the actual voltage is above the point, the active power will be regulated with the ramp rate. The ramp rate is defined as multiple of set active power per 1% of rated voltage that above the Volt/Watt point.
- **Volt/VAR:** Available when activated and operating in discharge mode. In this mode, Reactive power as a function of grid voltage. In Volt/Var mode, the Q configuration is disabled.
- **Freq/Watt:** Available when activated and operating in discharge mode. When the actual frequency is above the point, the active power will be regulated with the ramp rate. The ramp rate is defined as multiple of set active power per hertz that above the above the Freq/Watt point.
- **PF regulate:** Regulate the PF of the entire storage system.

**Protection function:**

- Overcurrent protection
- Overload protection
- Short circuit protection
- Environment over-temperature protection
- Over-temperature protection of power module
- Ground leakage current monitoring
- Grid voltage monitoring
- Grid frequency monitoring
- Anti-islanding protection
- Monitoring of AC output current and DC component
- Battery overcharge protection
- Battery over-discharge protection

- VDE certified redundancy protection

**Grid support function:**

- Grid over/under frequency drop active power function
- Grid over/under voltage drop active power function
- Grid over/under voltage regulation reactive power function
- Active power regulation power factor curve function
- Power ramping after grid fault recovery

### 2.5.3 De-rating

The de-rating of converter is to avoid converter overload or restrain potential faults. The converter might conduct de-rating operation in the following operating conditions:

- Internal over-temperature (including environment temperature and module temperature)
- Grid under-voltage
- Battery under-voltage
- Remote power dispatching

**Over-temperature de-rating**

Over-high environment temperature and ventilation duct blocking will cause de-rating of converter. Over-temperature de-rating regulation is as follows:

- If power device temperature reaches the upper limit, the converter will automatically decrease the input and output power. After the power device temperature is restored to the normal range, the converter will gradually increase the set value.
- When the environment temperature in the converter exceeds the upper limit, the converter will automatically power off so as to protect the converter.

| | |
|---|---|
|  | The lower limit of over-temperature de-rating is about 66% of rated power. If the de-rating reaches the lower limit but the temperature is not improved, the converter will shut down automatically. |

**Grid under-voltage de-rating**

If the grid voltage is too low, the converter will limit the grid current to a specified range through de-rating. The de-rating of grid under-voltage will be activated when 3-phase grid voltage reaches 360V. The curvilinear relationship for grid voltage de-rating is as follows:

$$P_{[V_{\min} 360V]} = P_n \times (V_{grid} / 360V)$$

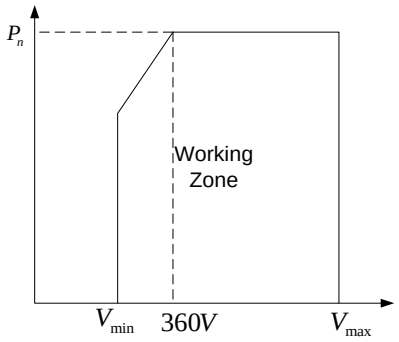



Fig.2-4 Grid under-voltage de-rating

**Battery under-voltage de-rating**

If the battery voltage is too low, the converter will limit the battery discharge current to a specified range through de-rating. The de-rating of battery under-voltage will be activated when the battery voltage reaches 350V. The curvilinear relationship for battery voltage de-rating is as follows:

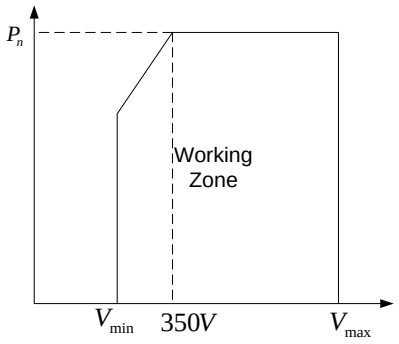



Fig.2-5 Battery under-voltage de-rating

**External command de-rating**

The converter can regulate the de-rating of output active and reactive power by remote grid dispatching command. The operation state of the converter will be displayed on the screen.

# Chapter 3 Equipment transport, storage and installation

## 3.1 Transport and storage

During transport and storage of converter module, pay attention to the packing label on enclosure. Transport and storage should meet the following requirements:

- Don’t dismantle external package of the converter.
- Ensure there is no corrosive gas nearby.
- Storage temperature is maintained between -40℃~65℃, and relative humidity is maintained between 0%RH~95%RH.
- Dusty environment is not allowed.
- 5 layers are stacked at most.
- During storage, regular inspection should be conducted. If the packing material is damaged by worms or rats, it should be replaced in time.
- The storage location complies with firefighting requirement.
- After long-term storage, the converter needs to be checked and tested by professionals before use.

## 3.2 Installation flow

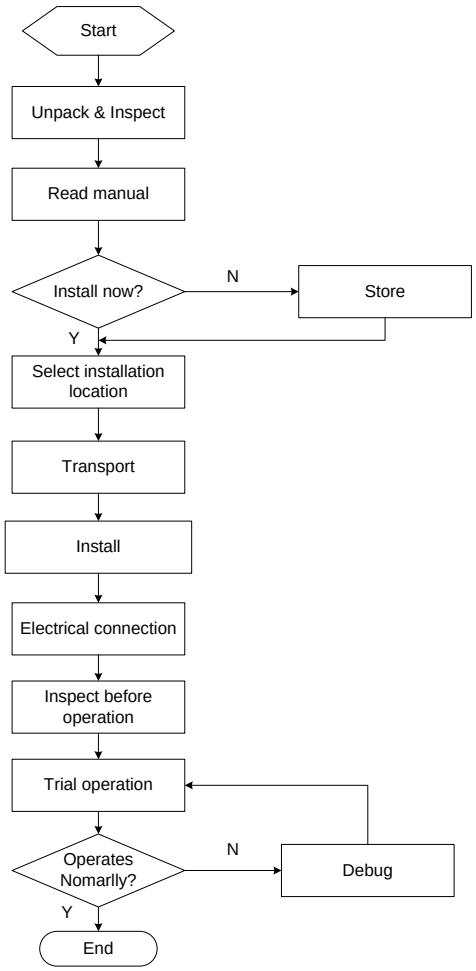



Fig. 3-1 Flow chart for installation

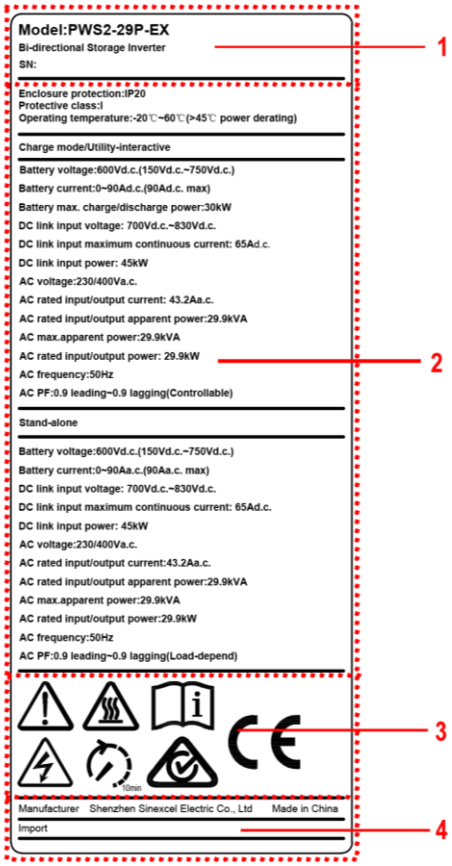
## 3.3 Open-case inspection

Before delivery, each converter is strictly checked and tested. To prevent any damage during transport, the case needs to be opened and checked before installation of energy storage converter. The following should be checked:

- Check whether the items in the packing list are consistent with the real objects.
- Check whether the data (such as product model, rated capacity and voltage) on the product nameplate is consistent with purchase contract.
- Check whether the ex-factory documents and accessories are complete.
- Check whether the energy storage converter is deformed and falls off paint.

## 3.4 Converter check and preparation

Before installation, please check converter parameters. The nameplate in the side of PWS2-30P-EX / PWS2-29P-EX contains converter model, important technical parameters and certification marks, etc. Prepare operation tools (such as percussion drill, marker and cross screwdriver) in advance so that the energy storage converter can be installed and wired smoothly. The nameplate label is shown in



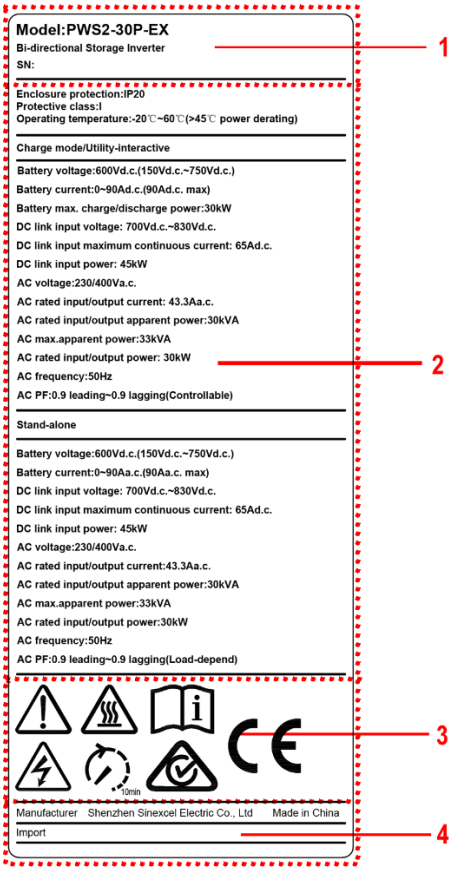

Model:PWS2-30P-EX
Bi-directional Storage Inverter
SN:
Enclosure protection:IP20
Protective class:I
Operating temperature:-20℃~60℃(>45℃ power derating)
Charge mode/Utility-interactive
Battery voltage:600Vd.c.(150Vd.c.~750Vd.c.)
Battery current:0~90Ad.c.(90Ad.c. max)
Battery max. charge/discharge power:30kW
DC link input voltage: 700Vd.c.~830Vd.c.
DC link input maximum continuous current: 65Ad.c.
DC link input power: 45kW
AC voltage:230/400Va.c.
AC rated input/output current: 43.3Aa.c.
AC rated input/output apparent power:30kVA
AC max.apparent power:33kVA
AC rated input/output power: 30kW
AC frequency:50Hz
AC PF:0.9 leading~0.9 lagging(Controllable)
Stand-alone
Battery voltage:600Vd.c.(150Vd.c.~750Vd.c.)
Battery current:0~90Aa.c.(90Aa.c. max)
DC link input voltage: 700Vd.c.~830Vd.c.
DC link input maximum continuous current: 65Ad.c.
DC link input power: 45kW
AC voltage:230/400Va.c.
AC rated input/output current:43.3Aa.c.
AC rated input/output apparent power:30kVA
AC max.apparent power:33kVA
AC rated input/output power:30kW
AC frequency:50Hz
AC PF:0.9 leading~0.9 lagging(Load-depend)
10min
Manufacturer Shenzhen Sinexcel Electric Co., Ltd Made in China
Import
1
2
3
4

Fig. 3-2.


Fig. 3-2 Nameplate

* The above picture is only for reference. Please refer to the real object.

(1) Product model and serial number (2) Technical parameters of converter

(3) Precaution and Certification label (4) Manufacturer

## 3.5 Installation requirements

### 3.5.1 Environment requirements

- The converter is designed for indoor use. Direct sunshine, rain and ponding should be avoided.
- The installation environment is clean. The air should not contain lots of dust.
- The installation should be conducted in a well-ventilated environment so as to ensure good heat dissipation.
- Air inlet and outlet should not be sheltered so as to make ventilation duct unblocked.
- Environment temperature should be -20~45℃ so as to ensure that the converter has the best operation state. Over-high and over-low temperature will shorten the service life of converter.

### 3.5.2 Carrier requirements

- The installation carrier of converter should be fireproof.
- Don’t install the converter on the flammable construction materials.
- Please ensure that the installation surface is firm and meets the load bearing requirements for converter installation.

## 3.6 Electrical connection

PWS2-30P-EX / PWS2-29P-EX electrical wiring should strictly following the following requirements. Please read the following carefully.

| | |
|---|---|
| DANGER | Before electrical connection, please ensure that all switches of energy storage system are in “OFF” state. Otherwise, the high voltage of the converter might cause an electric shock risk. |
| WARNING | Incorrect wiring operation might cause operator casualties or permanent equipment damage.<br>Only qualified professional can conduct wiring work.<br>Before electrical connection, remember that the converter has 2 supplies. Electrical operator should wear protective devices such as helmet, insulated shoes and protective gloves. |
| CAUTION | The cable colors mentioned in all electrical connection diagrams in this chapter are for reference only. Cable selection should comply with local cable standard. (Yellow and green cables can only be used for protective grounding.) |

### 3.6.1 Recommended system configuration

The configuration of energy storage system is recommended as follows:

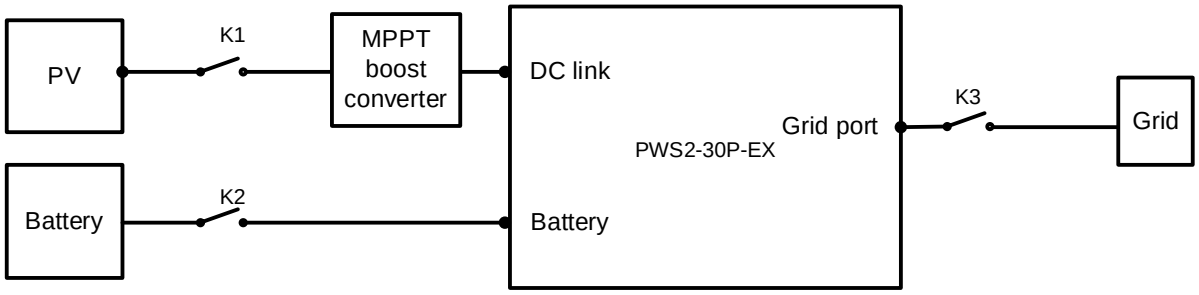



Fig. 3-2 Recommended configuration

| | |
|---|---|
| | The input of DC voltage in the battery side of energy storage inverter should be within the required range. Otherwise, the energy storage inverter will not be able to operate. |

| | |
|---|---|
| WARNING | When configure the quantity of battery series and parallel quantities, the highest charging voltage and the lowest discharging voltage need to be considered. For detailed information, consult qualified technical service personnel.<br>PWS2-30P-EX / PWS2-29P-EX does not include GFDI function, and the system needs to configure BMS and MPPT boost converter containing DC GFDI function.<br>If the MPPT boost converter has no DC switch, isolation switch K1 should be equipped at the input port of the MPPT boost converter.<br>If there is no integrated isolation switch K1 inside the MPPT boost converter, the photovoltaic output port needs to be additionally equipped with an isolation switch K1, and it is recommended to be equipped with an isolation switch with a rated current of 1.25 times or more;<br>Isolation switch K1 should be installed at the battery side of the inverter, and an isolation switch whose current specification is more than 1.25 times of the rated current is recommended.<br>To ensure the safety and reliability of the inverter, a current limiting device and an isolating switch should be installed at the grid side of the inverter. A three-phase circuit breaker K3 whose current is more than 1.25 times of the rated current is recommended, to ensure the safe disconnect between the inverter and the power grid. |
|  <br>WARNING | Only qualified professional can conduct wiring work. |

### 3.6.2 Introduction to port of PCS

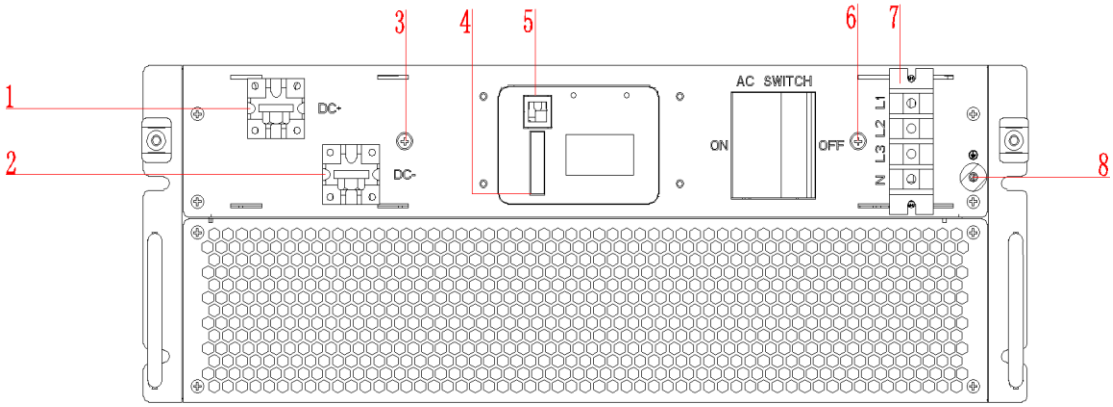



Fig. 3-4 Terminals introduction

| No. | Items | Description |
|---|---|---|

| | | |
|---|---|---|
| 1 | Positive DC terminal | Connect the positive power cable for the battery cabinet. |
| 2 | Negative DC terminal | Connect the negative power cable for the battery cabinet. |
| 3 | Positive pole of DC bus | MC4 terminal * 2 |
| 4 | Negative pole of DC bus | MC4 terminal * 2 |
| 5 | Communication Interface area | External communication interface |
| 6 | AC Terminal | AC wiring |
| 7 | Ground protection block | Ground protection cable fixed point |

Preparation tools:

- Torque wrench
- Screwdriver
- Wire stripper
- Terminal crimping machine
- Multimeter
- Hot air blower
- Heat Shrink Tubing

### 3.6.3 System grounding

Connect the converter to the grounding bar through the protective grounding wire to protect grounding protection.

Specifications of cable and terminal:

- Grounding wire: the recommended cross sectional area≥10mm$^2$（7AWG） outdoor copper core cable
- Ring terminal: M4

| | |
|---|---|
| CAUTION | Good grounding can resist the surge voltage surge and improve EMI performance. Before connection of AC, DC and communication cables, the grounding wire should be connected first.<br>It is recommended that the converter should be grounded locally. For multiple PWS2-30P-EX / PWS2-29P-EX parallel connection system, the grounding points of all converters should be connected with each other so as to ensure equal potential connection of grounding wires. |

Step 1: Use a wire stripper to strip the insulating layer of the grounding wire in a proper length;

Step 2: Penetrate the wire core whose insulating layer is stripped into the conductor crimping area of ring terminal. Press the ring terminal with a hydraulic clamp.

Step 3: Cover the terminal on the grounding bolt and screw up the nut.

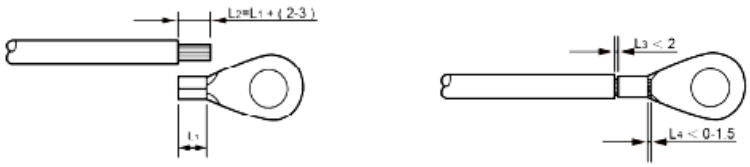



Fig. 3-5 Wiring stripping

### 3.6.4 DC wiring

Specifications of cable and terminal:

- DC wire: the recommended cross sectional area ⩾25mm$^2$（3AWG）outdoor copper core cable
- Ring terminal: Quick plug terminal

Step 1: Use a multi-meter to measure the voltage of battery, and ensure that the voltage is within input voltage range of energy storage inverter.

Step 2: Turn off the DC breaker. Wiring operation can be conducted after using a multi-meter to measure and confirm that there is no voltage between positive and negative poles of DC input.

Step 3: Use a wire stripper to strip the DC cable in a proper length, cover the quick plug terminal and use wire crimpers to compress it. Recommended DC cable ≥25mm$^2$（3AWG）.

Step 4: Connect the positive cable of the battery pack to the “DC+” of the DC terminal block.

Step 5: Connect the negative cable of the battery pack to the “DC-” of the DC terminal block.

| | |
|---|---|
| DANGER | Turn off AC and DC distribution switches and ensure that there is no dangerous voltage in the system during wiring. |
| CAUTION | The positive and negative poles of batteries cannot be connected inversely. Before wiring, a multi-meter needs to be used for measurement. |
| WARNING | Only qualified professional can conduct wiring work. |

### 3.6.5 AC wiring

Step 1: Use a phase-sequence meter for measurement, and ensure that the phase consequence of wires should be correct.

Step 2: Turn off the AC breaker connected to energy storage converter.

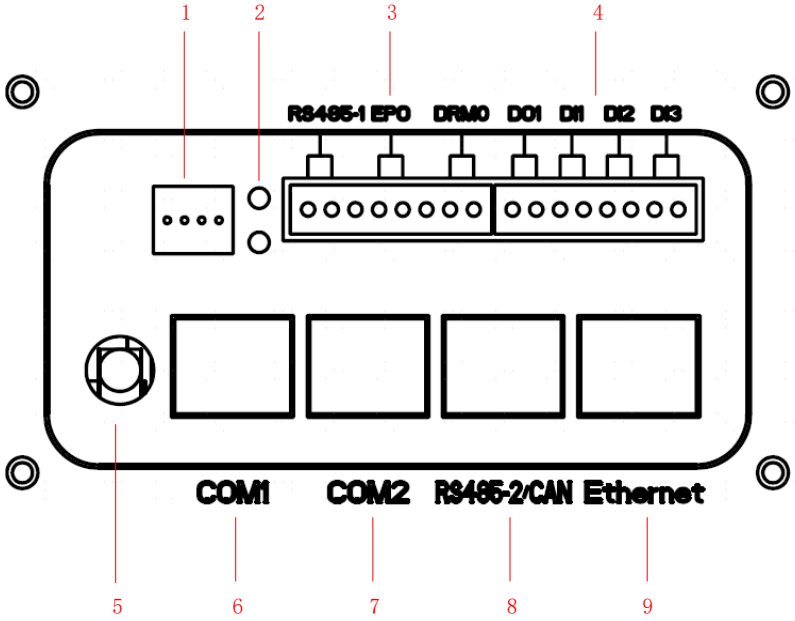
Step 3: Use a multi-meter to measure and confirm that the cables connected to the terminals are electrically neutral.

Step 4: Use a wire stripper to strip the AC cable in a proper length, cover a cord end terminal and use wire crimpers to compress it. Recommended AC cable ≥8mm²（8AWG）.
Step 5: Connect AC cable to “L1”, “L2”, “L3” and “N” of AC wire terminal block;
Step 6: Confirm wiring firmness and lock the waterproof tube of AC cable.

| | |
|---|---|
| WARNING | Ensure that there is no dangerous voltage at connection points during wiring. |
| WARNING | Only qualified professional can conduct wiring work. |

### 3.6.6 Connection of communication cables

The functions of the communication interface area are defined as follows:




| SN | Define PIN | Description |
|---|---|---|
| 1 | 1：/<br>2:R_CAN_syc<br>3:R_485_1<br>4:R_485_2 | Matches the dip switch of the resistance<br>ON: Access 120ohms matching resistor；<br>Off: No access 120ohms matching resistor； |
| 2 | / | Green light: Running<br>Red light: Fault |
| 3 | Terminal Block 1：<br>1: 485A1<br>2: 485B1 | 1/2:RS485_1 differential signal; Connect to MPPT boost converter<br>4/5: EPO dry contact input signal; Connect to EMS or ATS or others |

| | | |
|---|---|---|
| | 3:/<br>4:EPO_IN<br>5:GND<br>6:/<br>7:REFGEN<br>8:GND | 7/8: DRM0 access signal; Connect to ATS or other equipment with DRM signal output |
| 4 | Terminal Block 2：<br>1:DO<br>2:GND<br>3:DI_1<br>4:GND<br>5:DI_2<br>6:GND<br>7:DI_3<br>8:GND | 1/2: DO OC output; (reserve)<br>3/4: DI_1 dry contact input signal 1; (reserve)<br>5/6: DI_2 dry contact input signal 2; (reserve)<br>7/8: DI_3 dry contact input signal 3; (reserve) |
| 5 | / | WIFI antenna interface |
| 6 | COM1<br>1:CANH_Syc<br>2:CANL_Syc<br>3:GND_Syc<br>4:DI_Syc<br>5:GND_Syc<br>6:Bus_Reserve_Syc<br>7:Bus_Syc<br>8:GND_Syc | COM1: Synchronous signal interface (used for inverters running in parallel, also can paralleled with ATS)<br>1/2: synchronization CAN;<br>3/6: Reserved bus;<br>4/5: digital input;<br>7/8: Synchronization bus; |
| 7 | COM2<br>1:CANH_Syc<br>2:CANL_Syc<br>3:GND_Syc<br>4:DI_Syc<br>5:GND_Syc<br>6:Bus_Reserve_Syc<br>7:Bus_Syc<br>8:GND_Syc | COM2: Extended Interface of synchronous signal interface, as an extension of COM1; |
| 8 | 1:CANH<br>2:CANL | Reserved communication interface:<br>1/2: CAN, connect to BMS;<br>4/5:RS485_2, connect to EMS or BMS; |

| | | |
|---|---|---|
| | 4:485A2<br>5:485B2 | |
| 9 | Ethernet port | Ethernet port, connect to EMS or Switch |

**(1) Ethernet cable connection**

PWS2-30P-EX / PWS2-29P-EX can be directly networked through Ethernet and connected to PC for communication. Through networking, users can remote dispatch energy, monitor operation state, and set parameters with background software in PC. The definition of RJ45 connector pin is shown in Fig. 3-6.

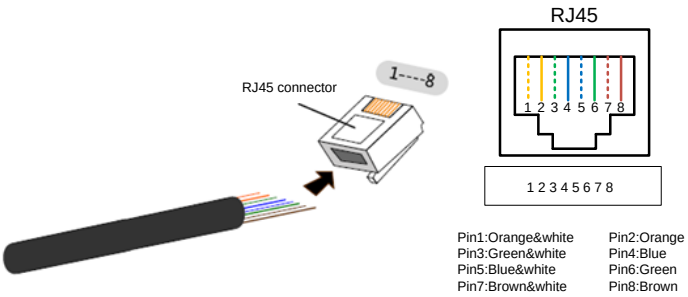



Fig. 3-6 Ethernet interface

Step 1: Penetrate network cable whose insulating layer is stripped into the waterproof cap and insert it into RJ45 connector after being arranged in order;

Step 2: Use wire crimpers to compress the connector;

Step 3: Insert the finished cable into the "Ethernet" port of the converter panel.

**(2) Optional - RS 485_1 cable connects EMS or BMS**

PWS2-30P-EX can be connected to BMS/EMS through RS-485_1 to obtain battery information and energy dispatching command and complete automatic charging and discharging control and protection of energy storage system. This port is RJ45 port.

| | |
|---|---|
| WARNING | Only qualified professional can conduct wiring work. |

(3) Optional - COM1 and COM2 realize multiple inverters communication in parallel;

COM1 and COM2 interfaces can be used in scenarios where multiple inverters communicate in parallel with the form of Daisy chain. When multiple inverters communicate in parallel, 120ohms resistors can be connected in parallel on the communication bus of the first and the last inverters through the DIP switch PIN 2 to ensure the communication quality.

### 3.6.7 Signal connection of terminal block 1

(Optional) RS485_2 cable connection MPPT boost converter; The PWS2-30P-EX device can be connected to the MPPT boost converter through RS485_2 to obtain the PV module information, and schedule or limit the MPPT boost converter energy. The interface is a 3.81MM pitch pluggable terminal block. You can insert the communication cable into the wiring terminal according to the port definition on the operation panel, lock the terminal, and connect it to the communication port.

For EPO function, the EPO_IN (PIN4) and GND (PIN5) can be used as the EPO interface, which is a 3.81MM pitch pluggable terminal block.

The EPO function can be enabled or disabled by setting the contents of the 0x0148 address register to 1 or 0. When the EPO function is enabled, you needs to short the EPO_IN (PIN4) to GND (PIN5) to maintain the normal operation of the PWS2-30P-EX / PWS2-29P-EX. If the EPO_IN (PIN4) and GND (PIN5) are disconnected, the device will trigger an EPO alarm to shut down.

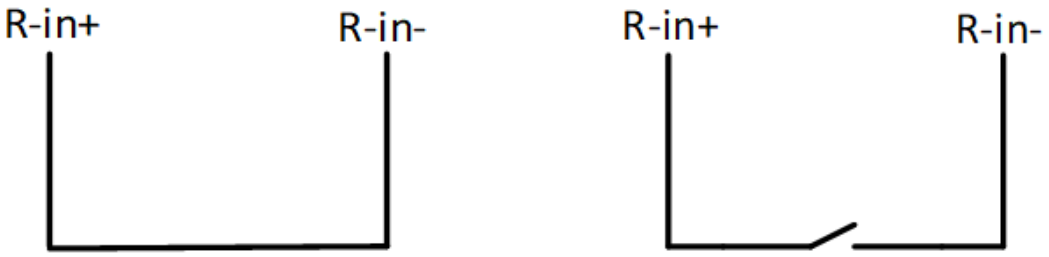



Fig.3-7 Wiring ways

| | |
|---|---|
| WARNING | Only qualified professional can use EPO_IN (PIN4) and GND (PIN5) interface. |

DRM0 function, according to the requirements of the Australian certification for the Inverter d**emand response modes (hereinafter referred to as DRM) function, the grid-connected equipment incorporated into the Australian grid must be equipped with DRM devices. At present, the built-in DRM device of PWS2-(29P, 30P)-EX can only realize DRM0 function, as shown in the following figure.**

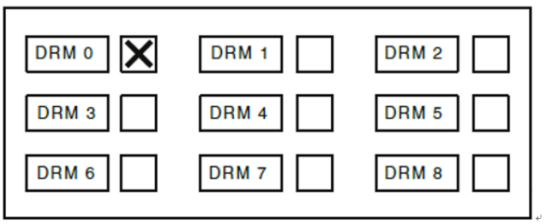



Fig. 3-8 DRM function selection table

When the PWS2-30P-EX / PWS2-29P-EX has a built-in DRM device, the customer can

enable or disable the DRM0 function by setting the contents of the 0x0148 address register to 2 or 0.

If the DRM0 function is enabled, a resistor with a resistance of 15kΩ and power greater than 0.1W must be connected between the REFGEN (PIN7) and the GND (PIN8). If the resistor is short-circuited or open circuited, the PWS2-30P-EX / PWS2-29P-EX device will report a fault within 2 seconds and shut down.

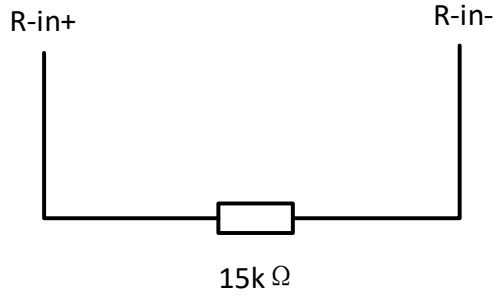



Fig.3-9 DRM0 interface

| | |
|---|---|
| WARNING | Since both the EPO function and the DRM0 function need to use the REFGEN (PIN7) and GND (PIN8), only one of the two functions can be selected. |
| WARNING | Only qualified professional can use REFGEN (PIN7) and GND (PIN8). |

### 3.6.8 DO and DI Interfaces (Output and input dry contacts)

PIN (1/2: DI OC output; (reserve)
3/4: DI_1 dry contact input signal 1; (reserve)
5/6: DI_2 dry contact input signal 2; (reserve)
7/8: DI_3 dry contact input signal 3; (reserve)

## 3.7 Check after installation

### 3.7.1 Cable connection check

After installation of energy storage converter, inspection shall be conducted:

(1) All switches connected to the energy storage device are in the off state

(2) The device should be placed and installed properly and meeting safe distance requirements.

(3 Power cable is connected correctly. Ground wire and ground grid are in good connection. The constructor is required to inspect the grounding resistance.

(4) Compare main wiring diagram and site wiring. Check whether there is any difference and judge whether such difference will affect the safe operation of energy storage system.
(5) Confirm that the communication cables of Ethernet and RS-485 have been connected correctly without open circuit and short circuit.

| | |
|---|---|
|  CAUTION | The neutral line of the load MUST be connected to the grid's neutral line even if the PWS2-30P-EX / PWS2-29P-EX is implemented as backup power. |

| | |
|---|---|
|  DANGER | Electrical connection inspection needs to be completed by qualified operator.<br>After the switch is closed, the system has been loaded with high voltage, so contact with any bared electrical part in the converter is prohibited. |
|  WARNING | Only qualified professional can operate. |

# Chapter 4 Control Mode and Debugging Operation

## 4.1 Control method

### 4.1.1 Connect with Ethernet.

First, please open a browser on the computer desktop (Google/Firefox browser is recommended), then enter the default IP of the machine in the URL bar of the browser, the login interface shown in Figure 4-1 will appear, and finally, enter the Name Enter "admin" in the box, enter the initial password "20072020" in the "Password" input box, and click ‘Log in’ to enter the background operation interface of PWS2-(29P,30P)-EX, as shown in Figure 4-2.

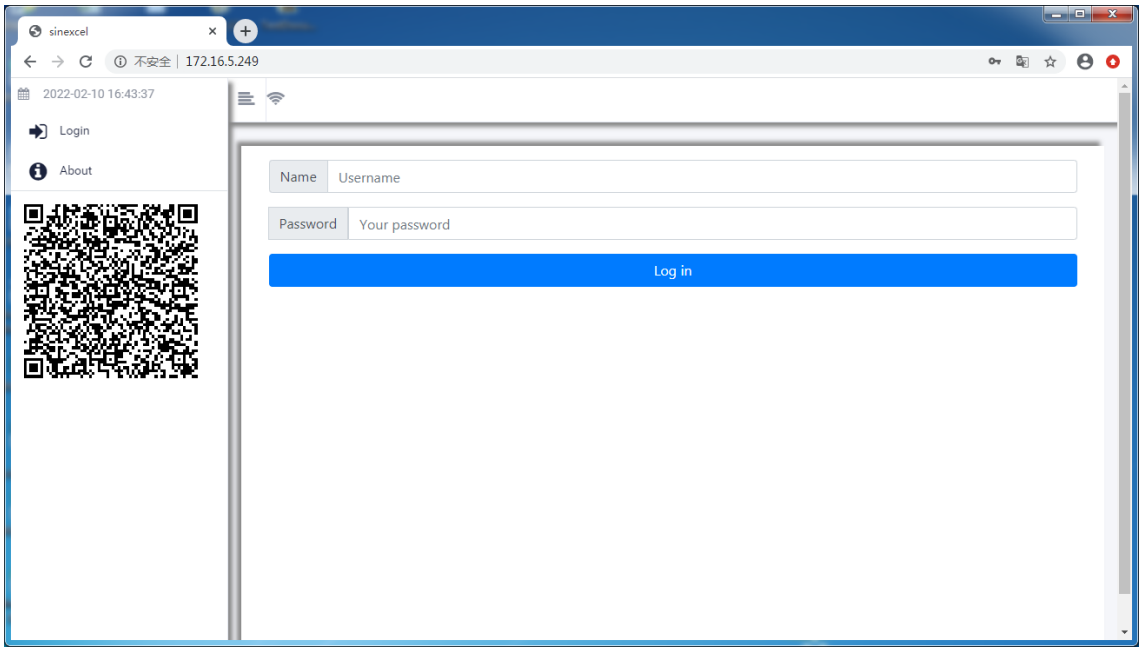



Fig 4-1 Login interface

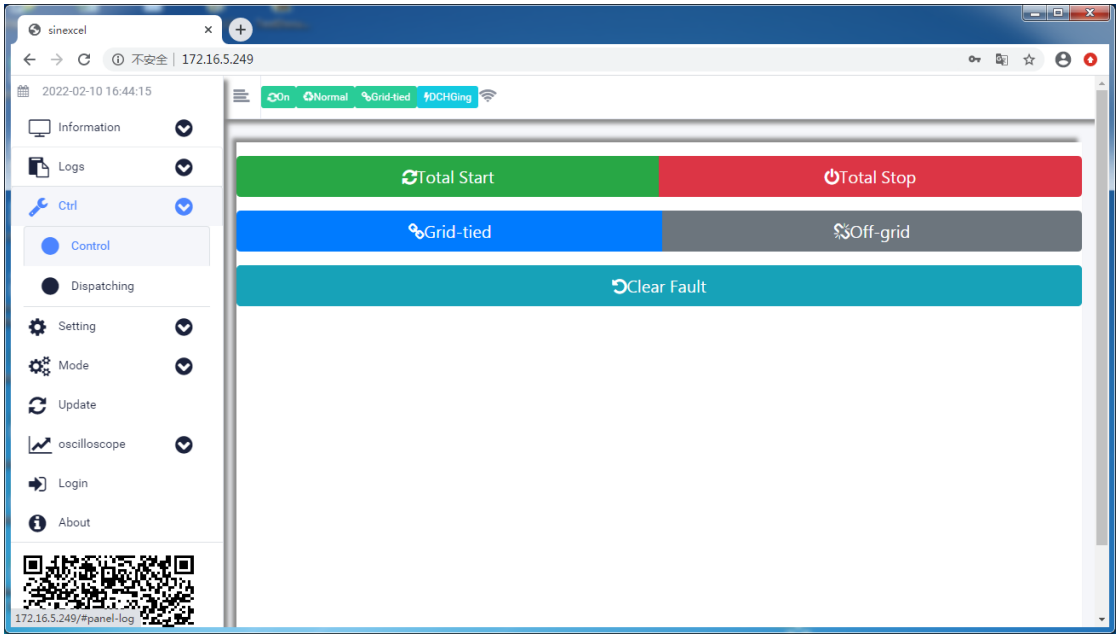



Fig 4-2 Background operation interface

| | |
|---|---|
| **CAUTION** | 1、 The initial password of the admin user login is 20072020;<br>2、 When powering on for the first time, please use the initial password and change the password as soon as possible. After changing the password, please remember the password to ensure account security. Failure to change the password may lead to the leakage of the password, and the loss of the password will prevent the user from accessing the device, and the user shall be responsible for the loss caused thereby. |

### 4.1.2 Connect with WIFI (Take iPhone as an example).

First, please open the wireless LAN on the phone settings, search the network to find the corresponding serial number of the device, enter the initial WIFI password "12345678", and connect to this network, as shown in Figure 4-3. Then open the browser on the mobile phone, enter the default IP of the machine in the URL bar, and the login interface shown in Figure 4-4 will appear. Finally, enter "admin" into the Name input box, and enter the initial password into the "Password" input box. "20072020", click "Log in" to enter the background operation interface of PWS2-(29P,30P)-EX, as shown in Figure 4-5.

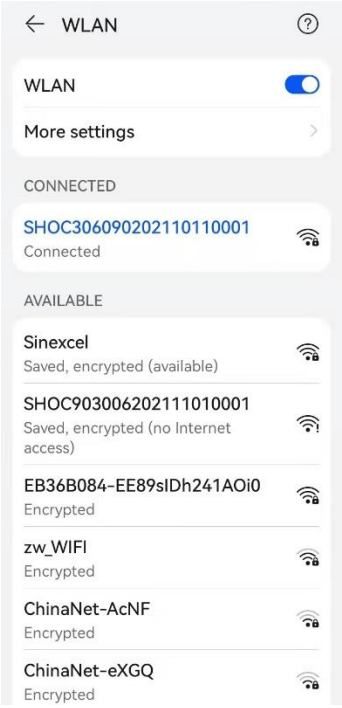



Fig 4-3 WIFI Connect

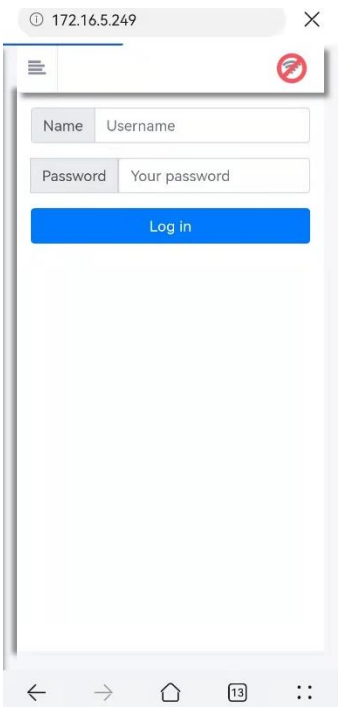



Fig 4-4 Mobile login interface

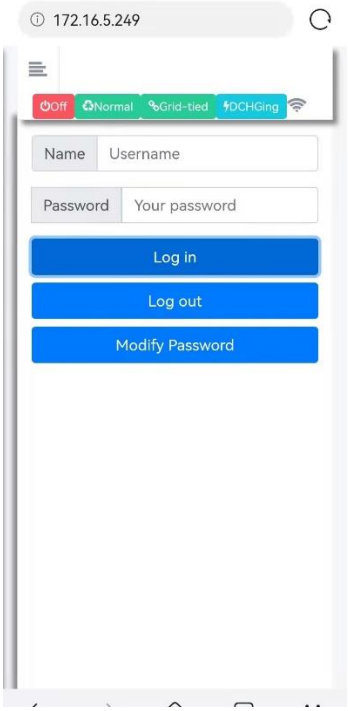



Fig 4-5 Mobile phone interface

| | |
|---|---|
| **CAUTION** | 1、 The initial password of the admin user login is 20072020；<br>2、 When powering on for the first time, please use the initial password and change the password as soon as possible. After changing the password, please remember the password to ensure account security. Failure to change the password may lead to the leakage of the password, and the loss of the password will prevent the user from accessing the device, and the user shall be responsible for the loss caused thereby. |

### 4.1.3 Connect with RS485 (Applied to EMS or BMS)

First of all, before using RS485 connection, please follow the first two methods on the computer, mobile phone or other devices; after logging in to the device, select RS485-1 to connect to EMS or BMS in the "Monitoring Settings" tab of the "Settings" tab. As shown below. If you choose to connect to BMS, you only need to set the baud rate, the BMS timeout is 5, and others do not need to be set; if you choose to connect to EMS, you only need to set the baud rate, and the TCP/RTU timeout is set to 0, and others do not need to be set. set up. Finally, the BMS/EMS can communicate with the converter through RS485.

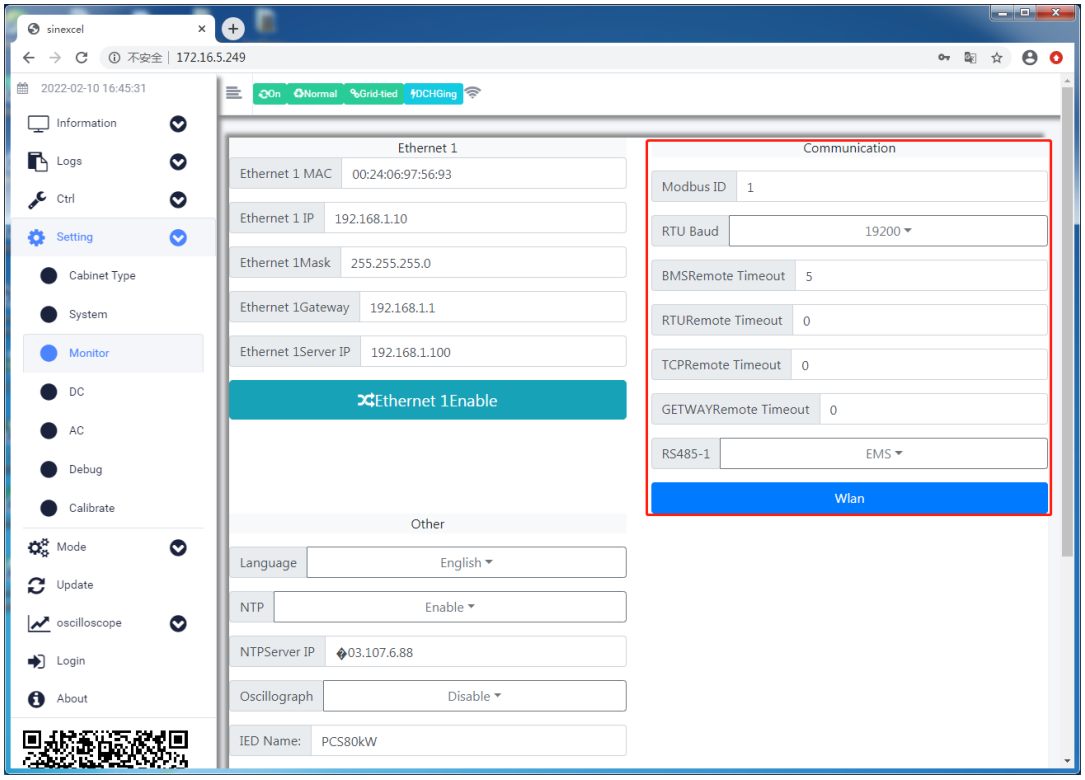



Fig 4-6 RS485 Connection

## 4.2 Startup and shutdown

The energy storage device must be installed, debugged normally by the engineer, and the external power switch has been closed before the start-up steps can be performed.

### 4.2.1 Check before startup

Before startup, check the device according to the following steps:

(1) Visually inspect and ensure that there is no damage outside the module, and DC breaker D1 and AC breakers S2 and D3 are in “OFF” state.

(2) According to the inspection items in the third chapter after installation, check the DC input wiring of the energy storage device, whether the AC output wiring is normal and the grounding is good.

(3) Check whether battery voltage is within normal voltage range.

(4) Check whether the phase voltage and line voltage of the grid side are within the normal range and record the voltage value.

### 4.2.2 Startup steps

These startup steps are applicable to the circumstance that the energy storage converter system is in outage state and can be started. Operation steps are as follows:

(1) Close DC breaker D1 of battery cabinet, the converter will be powered-on. And the LCD is on and initializing. After about 10s, LCD will indicate such warning information as

“Alarm: 0103”. (It represents AC undervoltage and AC underfrequency.)

(2) The converter is defaulted to operate in grid-tied mode. Close AC breaker D3.

(3) In the case of the first startup, the converter should first perform important parameter settings and confirmation. After completion, if the inverter is powered on again, this step can be skipped. First, click the "Settings" tab on the left side of the webpage, open the "Model Settings" to display the interface shown in Figure 4-7, and then confirm the rated voltage level and frequency level of the AC side and the incoming line of the AC side according to the actual situation of the local power grid. Then select the corresponding battery type in "branch 1 DC connection type" according to the battery type actually connected to the DC side of the machine; after the model parameters are set, click "restart the whole machine", the machine re-enters the initialization, and then waits for After the webpage is refreshed, the important model parameter settings are completed.

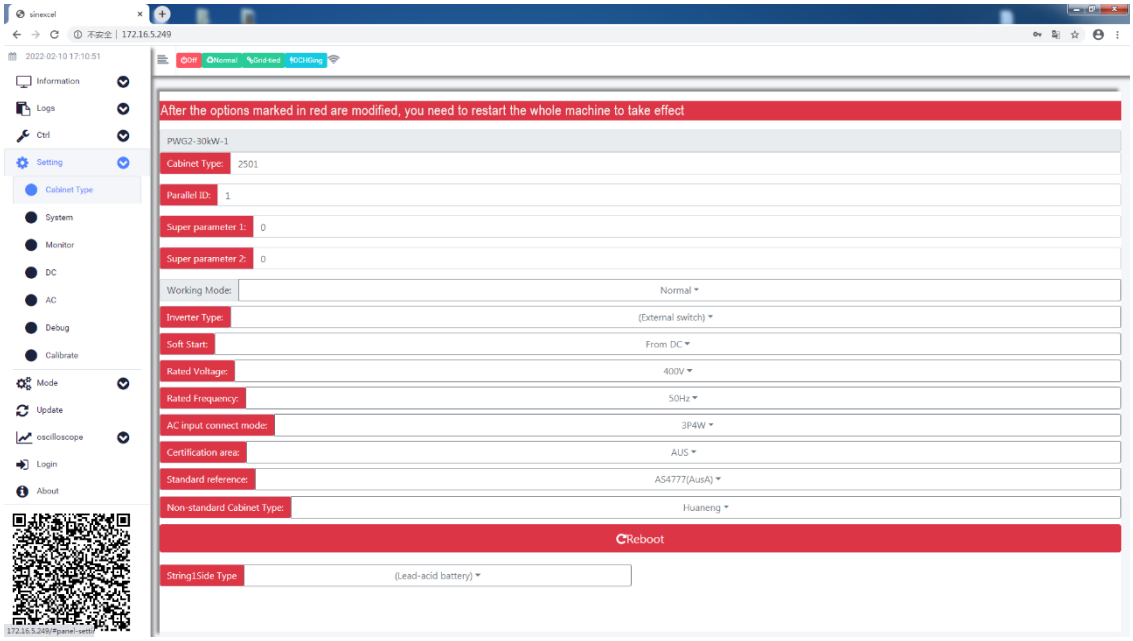



Fig 4-7 Model settings

(4) Close AC isolator S2 in the converter. After about 5s, such warning information as“Alarm:0103” will be cleared automatically.

(5) Set up the system startup and on-grid operation mode.

(6) If the converter is required to operate in off-grid mode, set monitoring parameter to control the operation mode after Step (1). If it is set as off-grid mode, such information as “Alarm:0103” will be cleared automatically.

(7)After the AC voltage on LCD screen of the converter is 400V, close AC isolator S2 of the converter to power a load.

| | |
|---|---|
| **CAUTION** | 1. The initial password of the admin user login is 20072020；<br>2. When powering on for the first time, please use the initial password and change the password as soon as possible. After changing the password, please remember the password to ensure account security. Failure to change the password may |

| | |
|---|---|
| | lead to the leakage of the password, and the loss of the password will prevent the user from accessing the device, and the user shall be responsible for the loss caused thereby. |
|  **CAUTION** | If you want to run the converter in off-grid load mode, please make sure that the circuit breaker of the intelligent power distribution unit has been disconnected, otherwise the converter will be damaged. |

### 4.2.3 Shutdown steps

During normal operation of energy storage converter, the following steps shall be conducted if shutdown is required:

(1) To find the location of the shutdown register in the accessory protocol table protocol, then send shutdown instructions to converter.

(2) To confirm whether the converter is in standby state.

(3) Turn off AC isolator S2 and AC breaker D3.

(4) Turn off DC breaker D1 of battery pack.

| | |
|---|---|
|  **WARNING** | After the electric circuits connected with the converter are turned off, the upper cover plate cannot be opened before DC capacitor in the module fully discharged after 10 minutes.<br>To prevent personal injury, please use a multi-meter to measure the voltage at wiring terminal if case maintenance or opening is conducted. Only after ensuring that all the parts in the converter is not electrified, relevant operation can be conducted! |

# Chapter 5 Communication mode

## 5.1 EMS communication

PWS2-30P-EX / PWS2-29P-EX supports Modbus protocol, adopts RS485-2 and Ethernet communication interface and facilitates users to conduct background monitoring for energy storage converter and realize remote signaling, remote metering and remote regulating of energy storage converter.

### 5.1.1 RS-485 interface

RS485_2 interface is reserved at the bottom of PWS2-30P-EX / PWS2-29P-EX and used to communicate with EMS. As an energy dispatching unit for energy storage system, EMS accepts remote dispatching, receives BMS information and realizes control and protection of automatic charging and discharging of energy storage system.

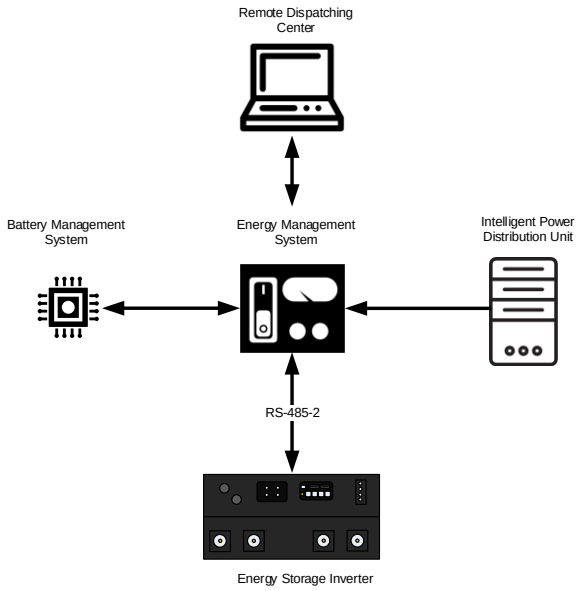



Fig. 5-1 Converter connecting with EMS through RS485-2

### 5.1.2 Ethernet interface

PWS2-30P-EX / PWS2-29P-EX supports Modbus TCP/IP protocol and has its own IP address. It can connect the Ethernet ports of multiple energy storage converters to the switch, and the switch is connected to remote control computer or EMS. Thus, the state of energy storage converter can be monitored and controlled in real time.

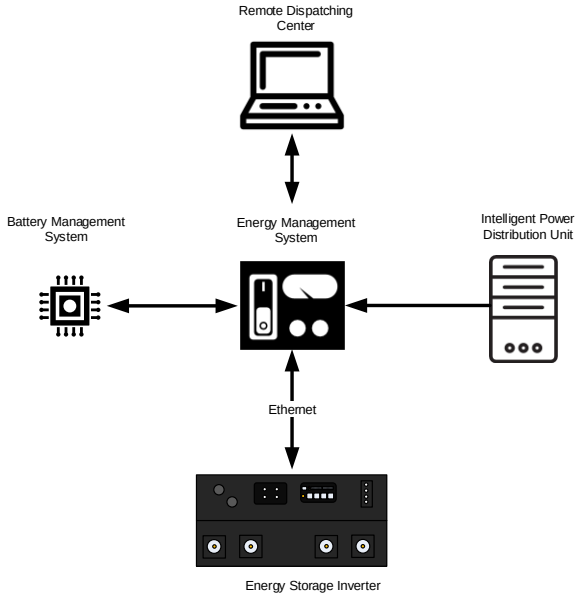



Fig. 5-2 Converter connecting with EMS through Ethernet

## 5.2 BMS communication

PWS2-30P-EX / PWS2-29P-EX supports communication with BMS. It can obtain and detect basic state and protection information from BMS, close the energy storage converter according to the protection state of storage battery fault and improve the safety of battery pack. RS-485 is adopted for communication between energy storage converter and BMS, as shown in the following diagram.

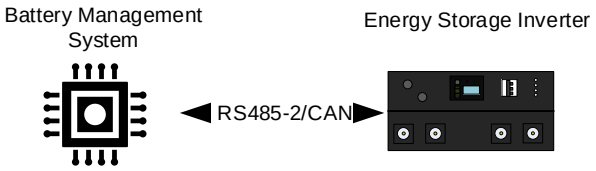



Fig. 5-3 Communication between PWS2-30P-EX / PWS2-29P-EX and BMS

| | |
|---|---|
| | Energy storage converter communicates with BMS through RS-485. If the converter communicates with BMS directly, the communication interface of converter and EMS can only be configured as Ethernet. |

## 5.3 Communicate with MPPT boost converter

PWS2-(29P, 30P)-EX can communicate with the MPPT boost converter through the RS485-1 port, can obtain and detect the status of the MPPT boost converter, and remotely control the power generation status of the MPPT boost converter, as shown in the figure

below shown.


Fig 5-4 Communication between PWS2-(29P, 30P)-EX and MPPT boost converter

| | |
|---|---|
| | Please contact customer service for the selection of MPPT boost converter |

## 5.4 Multiple PWS2-(29P, 30P)-EX Cluster Networking

Multiple PWS2-(29P, 30P)-EX can communicate with each other through COM1 and COM2 ports to realize cluster data collection and monitoring. The communication lines of COM1 and COM2 are connected in a daisy-chain form; in order to ensure the quality of the communication signal, it is necessary to turn the DIP switch 2 of the machine matching resistance at both ends of the daisy-chain to the closed state;

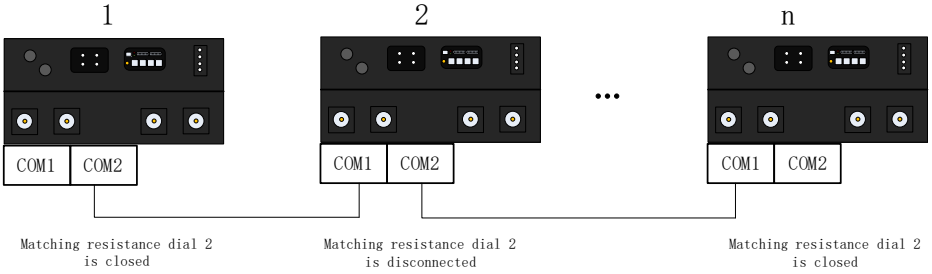



Fig 5-5 Multiple PWS2-(29P, 30P)-EX cluster networking communication

You can also choose to connect COM1 or COM2 to the smart power distribution unit at the beginning or end of the network to realize grid monitoring, fast response, fast scheduling or protection functions. The smart power distribution unit has built-in matching resistors. The other end of the PWS2-(29P, 30P)-EX matching resistor 2 can be turned to the closed state. As shown below:

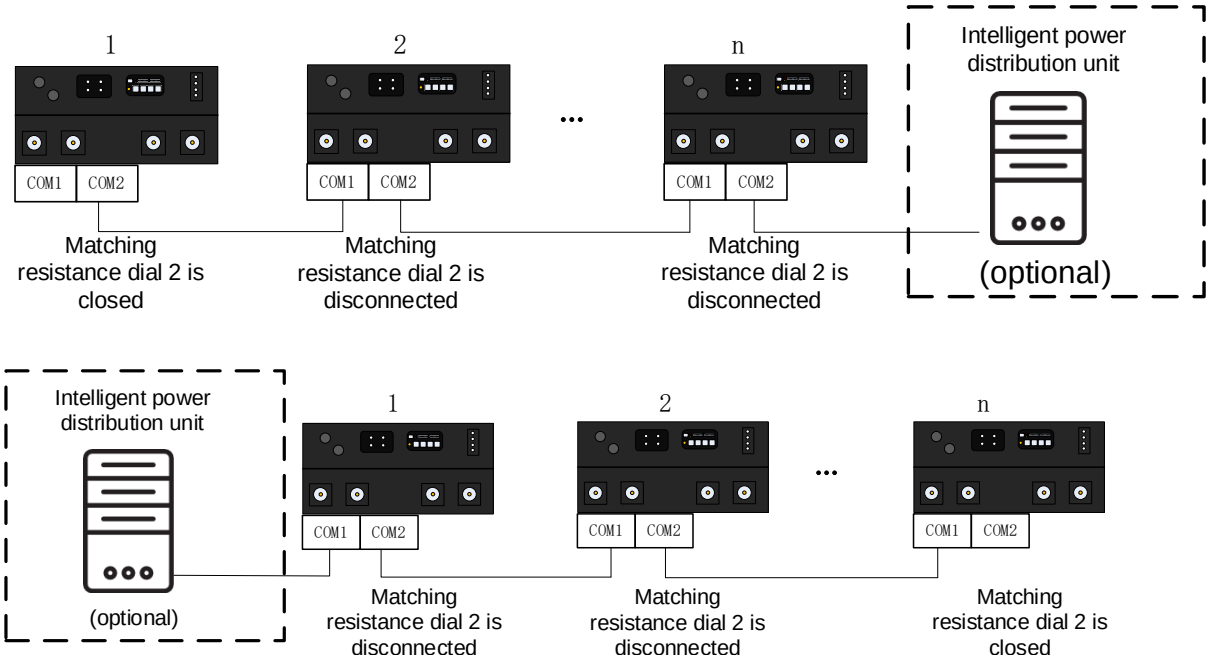



Fig 5-5 Cluster network communication of multiple PWS2-(29P, 30P)-EX connected to an intelligent power distribution unit

| | |
|---|---|
| | 1、The selection of intelligent power distribution unit can contact customer service personnel;<br>2、In order to ensure the communication quality, the length of the communication line is recommended to be less than 10m. If you have special requirements, please contact the customer service staff;<br>3、The number of converters in the cluster network should not exceed; |

## 5.5 Multiple PCS connected to the same network

Multiple PWS2-(29P,30P)-EX can be connected to a network, and the background monitoring and dispatching system can be connected to realize the operation and control of the energy storage device, which provides great convenience for detecting and controlling the operation of the energy storage device. , the overall structure of the system network is shown in Figure 5-6.

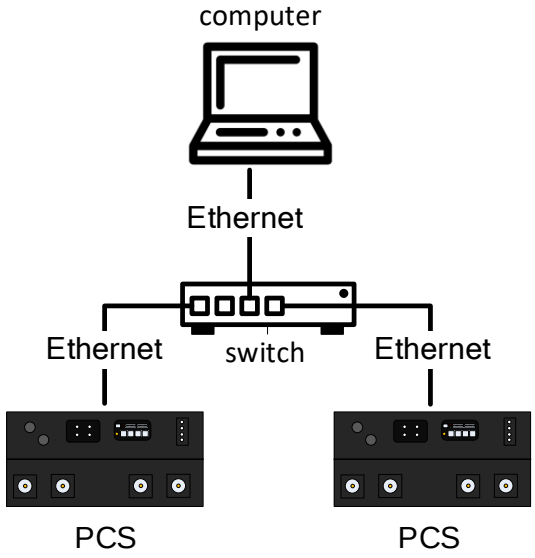



Fig 5-6 Background monitoring system structure diagram

# Chapter 6 Maintenance

## 6.1 Operation environment requirements

- Temperature: -20~60℃
- Humidity: 0~95% (non-condensing)
- Max. elevation: 4,000m

| | |
|---|---|
|  | It is recommended that the operating temperature should be maintained between -20~45℃ so as to ensure the best performance of the convert. If the temperature is too high or low, it will shorten the service life of converter.<br>If the altitude exceeds 2,000 meters, the energy storage converter will de-rate. |

## 6.2 Electrical and fixed connection inspection

After installation and commissioning, routine inspection on follow items is recommended every three months. Record for each inspection should be made.

- All-in-one grounding connection;
- Electrical connection for DC input;
- Electrical connection for AC input;
- Connection for communication cables;
- AC/DC switches and fans;
- Read monitoring fault information.

## 6.3 Clearing and cleaning

Before installation and commissioning, regularly clean the dust and sundries in the terminals and mesh openings of the converter.

After installation and commissioning, regularly clean the dust in machine room, check ventilation and air exhaust facilities. Cleaning once every three months is recommended.

After installation and commissioning, regularly clean dust in converter fan and insect prevention mask. Cleaning once every three months is recommended.

| | |
|---|---|
|  <br>CAUTION | The dust on the fan can block the ventilation duct, and the converter shuts down due to over-temperature, which will severely affect the normal operation of the converter. |

# Appendixes

**Appendix I: Quality assurance and after-sales service**

(1) Quality assurance

Within warranty period, SINEXCEL will provide free maintenance or replacement for products without.

(2) Disposal of claim products

The replaced nonconforming products will be disposed by Sinexcel. Users should properly store the claim products. As for the products requiring repair, users should give reasonable and sufficient time. We apologize for any inconvenience caused to you.

(3) In case of any of the following circumstances, Sinexcel will not offer any quality assurance:

- Transport damage;
- The device is operated under the environment conditions beyond this user's manual or in severe condition;
- The device is incorrectly installed, refitted or used;
- Users dismantle or assemble the device or system parts at will;
- It is beyond the warranty period;
- Product damage is caused by emergencies or natural disasters.

If customers require maintenance for the product faults above, our company will offer paid maintenance services after being judged by customer service department.

## Installation records

## Feedback