SC1000TL
Power Conversion System (PCS)
Installation Manual
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1 About this Manual

1.1 Forward

Thank you for purchasing the SC1000TL device from Sungrow Power Supply Co., Ltd. We hope that the device will meet with your satisfaction when you use it. Your commands and feedbacks on the performance and function of the device are very important for our further improvement.

1.2 Validity

This Installation Manual is valid for the following device types:

- SC1000TL

The SC1000TL device is referred to as “PCS” hereinafter unless otherwise specified.

1.3 Content

This manual contains the following information:

- Safety Instructions
  Safety instructions for installation of the PCS.
- Delivery and product introduction
  Introduce the delivery and check after receiving the PCS. The appearance and functions of the PCS are also described.
- Installation guide
  Introduce the PCS mechanical installation, electrical installation, communication connection and installation check methods. The suggestions for installation space and cable connection are also mentioned.
- Commissioning
  The safety instructions of commissioning and commissioning processes are introduced.
- Others
  Technical data of the PCS, exclusion of liability and the way to contact Sungrow.

1.4 Target Group

This manual is aimed at technical personnel who are responsible and qualified for the PCS installation and commissioning. Readers should be familiar with the electrical and mechanical diagrams and characteristics of the electrical components.
1.5 How to Use This Manual

Read this manual and other related documents carefully before any work on the PCS. Documents must be stored carefully and available at all times. Additional documents are also available to the users:

• Operation Manual (in the scope of delivery)
• Connection Requirements for Medium-voltage Transformers

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1.6 Symbols Explanation

This manual contains important safety and operational instructions that must be accurately understood and followed during the installation and maintenance of the equipment.

To ensure optimum use of this manual, note the following explanations of symbols used.

⚠️ DANGER

DANGER indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

⚠️ WARNING

WARNING indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

⚠️ CAUTION

CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE indicates a situation which, if not avoided, could result in equipment or property damage.

ℹ️ NOTE

NOTE indicates additional information, emphasized contents or tips to help you solve problems or save time.
The symbols below may be pasted on the electrical parts of the PCS. Make sure to read the following symbols and fully understand them before installing the equipment.

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Symbol 1]</td>
<td>Risk of electric shock!</td>
</tr>
<tr>
<td>![Symbol 2]</td>
<td>Hot surface!</td>
</tr>
</tbody>
</table>
| ![Symbol 3] | Connection point for earth conductor  
Protective conductor terminal |


2 Safety Instructions

2.1 Intended Usage

The PCS developed and manufactured by Sungrow are designed without transformers. It provides an interface between the grid and batteries to realize the charging and discharging of the battery ESS. The PCS is connected to the grid after the voltage at the AC side is increased through the external step-up transformer. The PCS is IP21 protected and is applicable for indoor use only.

Connect the PCS to the grid after AC output voltage is converted into grid-compatible voltage through the external transformer. For technical requirements for the transformer please refer to the Connection Requirements for Medium-voltage Transformer or contact our technical support engineers.

The charging and discharging system with the PCS is as shown below.

![Energy storage system diagram](image)

**Fig. 2-1** Energy storage system

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Energy storage batteries (lead-acid battery, lithium battery and etc.)</td>
</tr>
<tr>
<td>B</td>
<td>SC1000TL PCS</td>
</tr>
<tr>
<td>C</td>
<td>Transformer</td>
</tr>
<tr>
<td>D</td>
<td>Utility grid</td>
</tr>
<tr>
<td>E</td>
<td>Loads</td>
</tr>
</tbody>
</table>

⚠️ WARNING ⚠️

- Installation described in this section must be strictly observed. Any other or additional installation other than the described installation is not permitted.
- Installation and connections other than the contents described in this section may lead to device damages and void warranty claims from Sungrow.
2.2 Important Safety Instructions

This section introduces the safety instructions during installing or commissioning of the PCS. Read the safety instructions in this section before installing. Please also respect all warnings, instructions, and cautions in respective chapters before installation and commissioning.

⚠️ DANGER

Shock Hazard!
Death resulting from burns and electric shock upon touching the PCS live components.
• Do not touch the live components of the PCS or the utility grid.
• Observe all safety regulations.

⚠️ DANGER

Shock hazard inside the product!
• Note and respect the warning labels in the product.
• Respect all safety instructions in this manual and other related documents.

⚠️ DANGER

Electric shock or fire due to device damage or system fault!
• Visual check if there is device damage or other potential dangers before operation.
• Check if other external devices or circuit connections are safe.
• Operate the device only when it is safe to do so.

2.2.1 Manuals

Very important information about transportation and installation of the PCS are included in this manual. All the descriptions in this manual, especially those safety-related items, must be complied with.

• Please read all the instructions thoroughly prior to any transportation or installation work on the PCS. Device damage, personal injury and property loss may follow if otherwise.
• This manual and relevant documents should be available for relevant persons at all times. Do not leave any paper or manuals inside the PCS cabinet after the installation.

2.2.2 Personnel

• Only qualified electricians or personnel with professional knowledge can transport or install the device.
• Operators must be familiar with the whole power generation system and its working principle.
• Operators must be familiar with the Installation Manual and Operation Manual.
• Operators must be familiar with country-specific standards and regulations.
2.2.3 Markings on the PCS

- The PCS enclosure and interior contains important warning and safety information. Do not tear or damage it.
- Nameplates located in the back panel and inside the front door contain very important parameter information. Do not tear or damage them.

**NOTICE**

- All safety instructions, warning labels and nameplate on the PCS body must be clearly visible;
- Replace the markings once they damaged or unclear.

2.2.4 Safety Warning Signs

Please respect the followings during installation, daily maintenance or troubleshooting of the PCS:

- An obvious marking should be placed in the PCS upstream and downstream to keep the switch from accidental reconnection;
- A temporary warning sign or barrier must be posted around the installation area;
- Remove the door keys and keep them appropriately after installation or maintenance work is finished.

2.2.5 Emergency Escape Route

The emergency escape route is critical during an emergency situation.

- Keep the escape route clear and unblocked at all times.
- Never block or lock the emergency escape route.

2.2.6 Storage Battery Protection

High Voltages exist between the positive and negative polarities of the storage batteries for large-scale PV plant. Electrical shock or life risk may occur by accidental touch.

**DANGER**

High voltages exist between the positive and negative polarities of the storage batteries!

- Ensure the PCS and storage batteries are completely disconnected during device maintenance.
- Place warning labels in the disconnection place to avoid accidental reconnection.

2.2.7 Device Installation

Install the PCS by strictly following the description in this chapter.

Install the PCS in electrical control room to avoid the noise produced during PCS operation and safety accidents.

- The control room should be far from residential areas. Sound insulation measures should be taken if necessary.
- Never place any flammable substance inside or around the control room.
• Unobstructed air flow. Escape route meets the requirements.

**NOTICE**

*Smog warning device is recommended to install inside the control room for quick response of plant staff to the potential fire.*

### 2.2.8 Electrical Connection

Electrical connection must be in accordance with the circuit diagram and the description in this chapter.

**WARNING**

- Configuration of the storage batteries, related current, voltage and power must conform to technical data of the PCS.
- Connection to the utility grid must be done after receiving approval from the local utility grid and done by qualified personnel only.
- All the electrical connections must comply with country-specific standards and regulations.

**WARNING**

*Follow strictly the internal connection marks to connect cables.*

### 2.2.9 Measuring Instrument

To ensure that each electrical parameter meets requirement during electrical connection and commissioning, please use related electrical measurement instruments.

**WARNING**

- Instrument for measurement of the electrical parameters should be high quality instrument with sufficient measuring range
- Make sure the connection and use of the instrument are correct to avoid arc and other dangerous situations
- Personal Protective Equipment (for example, insulation gloves and etc.).

### 2.2.10 Volt-free Operations

Perform operations to the PCS only when it is completely voltage-free and current-free.

- Avoid any accidental re-connections of the PCS.
- Verify that no voltage or current is present inside the PCS with appropriate testing devices.
- Ground and short-circuit whenever necessary.
- Cover possible live parts with insulation cloth to avoid accidental contact.
- Ensure sufficient escape room.
- Wait at least 5 minutes until the inner capacitors discharge completely.
2.2.11 ESD Protection

**NOTICE**

The PCS may be damaged irreversibly by electrostatic discharge (ESD) at its components.

- During the operation of the PCS, please observe all the ESD-related safety regulations for example wear antistatic wrist strap.
- Avoid unnecessary touch of the printed circuit board or other sensitive components.

2.2.12 Moisture protection

**NOTICE**

Penetrating moisture may damage the PCS! For normal operation of the PCS, please respect the followings:

- Do not open PCS doors when relative humidity is above 95%.
- Do not install the PCS in rainy days.

2.2.13 Disposal of Waste

When the PCS is end of life, it cannot be disposed of together with household wastes. Please contact the local authorized collection point.

2.2.14 Other Protection

Use suitable protective equipment (for example safety goggles, earplugs, dielectric gloves, insulating shoes) when transporting or installing the device.

Emergency aid should be prepared beforehand since the PCS is always installed far away from the downtown area.

Every possible auxiliary method should be taken to ensure the safety of personnel and device.

- All the pictures and descriptions in this manual apply to the PCS with standard configuration. The actual product you receive may differ. Should you have any specific requirements, please inform us.
- This manual may not cover all possible situations. Should a specific problem occur that is not explained in this manual, please contact Sungrow.
3 Delivery

Materials described in this section should be included in the crate (pictures are indicative only. The actual materials you receive may differ).

![Diagram of delivery items]

**Fig. 3-1** Scope of Delivery

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
<th>Quantity</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>PCS</td>
<td>1</td>
<td>Including keys and other accessories</td>
</tr>
<tr>
<td>B</td>
<td>Installation Manual</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>Operation Manual</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>Warranty Card</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>E</td>
<td>Product Test Report</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>F</td>
<td>Quality Certificate</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

3.2 Identifying PCS

3.2.1 Appearance

The front view and the main external components of the PCS are shown below.
### 3.2.2 Nameplate

Identify the PCS from its nameplate. Two identical nameplates are located separately as shown by Item A in the figure below. They provide information on the type of PCS, the most important specifications, marks of certification institutions, website and serial number which are available and identified by Sungrow.

---

**WARNING**

AC switch is inside the door. It can only be used to start/stop the PCS. Damage to the switch due to improper operation is not within the scope of warranty.

---

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>LED Indicators</td>
<td>3 indicators: Power, Operation and Fault</td>
</tr>
<tr>
<td>B</td>
<td>LCD touch Panel</td>
<td>Display data and perform control functions</td>
</tr>
<tr>
<td>C</td>
<td>Emergency Stop Button</td>
<td>Press down the button in emergency occasions, the PCS will stop immediately</td>
</tr>
<tr>
<td>D</td>
<td>Start/Stop Switch</td>
<td>Start/Stop the PCS</td>
</tr>
<tr>
<td>E</td>
<td>Door Lock</td>
<td>Two door locks, to lock/unlock the front doors</td>
</tr>
</tbody>
</table>
3.3 Checking for Transport Damage

The PCS has been strictly inspected and tested before delivery. Despite robust packaging, the machine may be damaged during transport. Therefore, once you receive the PCS, a detailed inspection is necessary.

3.3.1 Checking the Package

Check the outer package at first. Check whether the package is damaged during transport.

- Then, check whether the shockwatch label and tiltwatch label on the package have turned to red.
- If the shockwatch label has turned to red, it means that collision may be happened during transportation.
- If the tiltwatch label has turned to red, it means that the tilt angle may be out of range during transportation.

Once any of the two labels have been found to be red, the inside device may be damaged. Please make a record on the bill of lading, and give the PCS a thorough test.

3.3.2 Checking the PCS

After unpacking, check the following items for any possible damages:

- Check to see if the delivery contents are complete as per section 3.1.
- Check to ensure that the PCS type is correct.
- Check the PCS outside and inside components to see if any damage has occurred during transportation.

If any damage is detected, contact the shipping company or Sungrow immediately. A relevant photo is preferred. We will provide you with the fast and best service.

3.4 Storage

If it is not to be installed or commissioned immediately upon reception, the PCS should be stored appropriately.

- The unit must be stored in original packaging with the desiccant inside.
- The PCS must be stored on an even foundation, which must be solid enough to support the PCS.
- The unit must be stored in a clean and dry place to prevent dust and moisture.
• The storage temperature should be always between -40°C and +70°C. The storage relative humidity should be always between 0 and 95% without condensation.
• It is very important to keep the PCS away from harsh environment, for example shock cold, shock hot or crash.
• During the storage time, check periodically (at least once a week) for visible damages by rodents. Replace the packaging if necessary.
• Unpacking check if the storage is longer than half a year. Replace the desiccant bag and pack the PCS.

⚠️ WARNING

• The PCS must be packed!
• No stacking on top of the crate!
• No tilting of the device.

ℹ️ After long-term storage, a thorough and professional test is necessary before installation.
4 Product Description

4.1 Design of the PCS

4.1.1 Mechanical Data

Dimensions

![Dimensions of the PCS](image)

**Fig. 4-1 Dimensions of the PCS**

<table>
<thead>
<tr>
<th><strong>Width</strong></th>
<th><strong>Height</strong></th>
<th><strong>Depth</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1605mm</td>
<td>2065mm</td>
<td>935mm</td>
</tr>
</tbody>
</table>

Weight

Net weight of the PCS: approx. 1400kg. For the real weight of the product you receive, please refer to the nameplate.
4.1.2 Cabinet Composition

![Fig. 4-2 Cabinet Composition of the PCS](image)

<table>
<thead>
<tr>
<th>Label</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DC Cabinet</td>
<td>DC cable connection terminals are located in the cabinet base.</td>
</tr>
<tr>
<td>B</td>
<td>AC Cabinet</td>
<td>Including LED indicators, LCD display, Start/Stop switch, emergency stop button and etc. AC cable connection terminals are located in the cabinet base.</td>
</tr>
</tbody>
</table>

**WARNING**

Disassembly of the PCS in any form is strictly forbidden!

4.1.3 Ventilation Design

Cooling air is fed in via the shutters (Item A in Fig.4-3) in the PCS front and rear panels.

Each shutter is equipped with one filter screen, which is convenient for removal and replacement.

Clean the filter screens periodically.
Fig. 4-3 Cooling Air inlets of the PCS

The exhaust air outlets are on the top of the PCS. The air ventilation is shown in the following figure. 3710m³/h exhaust air rate is needed for the DC cabinet on the left, 1600m³/h for right fans. To ensure the normal operation of a single PCS, at least 5300m³/h cooling air is needed per hour.

Linking holes are specially designed in the PCS top, which can be connected with ventilation ducts in the electrical control room.

Fig. 4-4 Ventilation Illustration of the PCS

4.1.4 Drop-proof Top Cover Design

To prevent the water leakage on top of the electrical control room, the IP21 protection degree can be adopted. Based on the original configuration, there is drop-proof top cover installed on
hot air outlet of the PCS. The position of the top cover is marked by A in the figure below.

Fig. 4-5 Position of the drop-proof top cover

Please specify in your order if you need the drop-proof top cover.

4.1.5 Cable Inlet/Outlet Design

For a PCS of standard configuration, all the electrical cables come into or outside of the cabinet through the bottom of the PCS. Positioning and size of the cable inlet/outlet holes are described below (figures in mm).

Fig. 4-6 Cable Inlet/Outlet Holes on the bottom of the PCS

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DC cable entry</td>
</tr>
<tr>
<td>B</td>
<td>AC cable entry</td>
</tr>
</tbody>
</table>

4.2 Circuit Diagram

Through the 3-phase full bridge device, the PCS can realize current conversion and inversion. The converted output then feed into the battery after filtered by the filter. The inverted output will be turned into sine-wave voltage through the LC filter and then feed the grid through 3-phase isolated transformer.

The circuit diagram is shown below.
Fig. 4-7 Circuit diagram
5 Installation Design

5.1 The Solution with Optional Devices from SUNGROW

The configuration of the energy storage system is shown in Fig. 5-1.

---

Fig. 5-1 Configuration of energy storage system

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Batteries</td>
<td>Used to store energy</td>
</tr>
<tr>
<td>B</td>
<td>SC-serial PCS</td>
<td>Interface between the grid and battery. Charge or discharge to the battery. Monitoring and dispatch functions</td>
</tr>
<tr>
<td>C</td>
<td>Transformer</td>
<td>Increase the PCS AC output voltage</td>
</tr>
<tr>
<td>D</td>
<td>Utility grid</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>SolarInfo Hybrid monitoring software</td>
<td>Record and analyze the whole system and parameter of each PCS; user friendly interface; powerful analysis function; perfect fault warn function</td>
</tr>
</tbody>
</table>

5.2 Basic Requirements

With IP21 protection degree, it is suitable to install the PCS in clean and dry indoor plant environment. According to EMC requirements and its noise level, the PCS can be installed in industrial environment.

The following requirements should be met in order to ensure the normal operation of the PCS.

- The PCS must be installed in a specially designed electrical control room.
- Both cooling air inlet and exhaust air outlet of the electrical control room should be protected from dust, sand and rain.
- The installation ground should be dry and stable; prevent water logging; make sure the ground is not shaking and solid enough to support the weight of the PCS.
- Ambient temperature range: -30°C ... +50°C; Relevant humidity: 0- 95% (non-condensing).
- Maintain spaces around the PCS for proper ventilation, installation operation and passage (escape route).
• Ground resistance of the PCS should be less than 4Ω.
• Install the PCS in a place where you can see the LED indicators and LCD display conveniently and clearly.
• Never place any flammable substance inside or around the installation place.
• Clean installation environment.

5.3 Installation Environment Design

The PCS should be installed in electrical control room. The floor, clearances, ventilation equipment and precaution devices should be designed by professional personnel and satisfy the following requirements.

5.3.1 Floor

PCS should be installed on cement foundation with flame resistance material or steel channel support. The foundation must be solid and safe enough to position the PCS. It must be able to provide the load-carrying capacity necessary to cope with the weight of the PCS.

Any existing uneveness, depressions or slope must be corrected prior to installation.

During foundation construction, lay cable trench according to the whole situation of the plant and the cable routing method on the PCS bottom.

Drill holes on the ground. The positions of the holes should be exactly the same with the holes on the PCS base to connect the PCS firmly to the foundation.

Bottom view of the PCS is shown below (figures in mm). Six positioning holes with size of 16x25mm are designed in the PCS base. It is advisable to fix the PCS base to the ground by M12 bolts.

![Diagram of PCS base with positioning holes](image)

**Fig. 5-2** Position of the positioning holes on the PCS base

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6 Positioning holes</td>
</tr>
<tr>
<td>B</td>
<td>Cable inlet/outlet</td>
</tr>
</tbody>
</table>

5.3.2 Clearance Space

The minimum clearance space around the PCS shown below should be maintained for service operation, ventilation and escape route.

The space illustrated in this section is the minimum values. More space is recommended for better ventilation and higher conversion efficiency of the PCS.
Fig. 5-3 Clearance Space around the PCS

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1250mm</td>
<td>500mm</td>
<td>500mm</td>
<td>600mm</td>
<td>600mm</td>
</tr>
</tbody>
</table>

* The distance is from the top of the PCS enclosure to the installation site ceiling. If exhaust air ducts are installed, the distance must be designed appropriately by professional personnel.

**NOTICE**

- The PCS can be installed side-by-side with other PCSs. The D and E distance should be kept between the leftmost or the rightmost PCS and the wall.
- Please refer to country-specific codes for escape route requirements.

### 5.3.3 Ventilation Requirements

The heat generated (hot air exhausted) by the PCS must be dissipated out of the electrical control room as soon as possible, in order to guarantee safe operation and high feed-in power.

**WARNING**

If the electrical control room is comparatively airtight (for example, no ventilation window or wall with air screen), the ventilation ducts must be designed to ensure the normal operation of the device.

**NOTICE**

High temperature inside the electrical room can lead to active power limitations of the PCS!

Please observe the following items:

- Clean filter screens of air inlet/outlet windows periodically.
- Periodically check whether the ventilation fans inside the PCS are working normally.
- If the ventilation ducts are installed on the PCS top, install individual air duct for each cabinet to prevent thermal short-circuit inside the PCS.
It is recommended to install the ventilation ducts in the electrical room to ensure that the PCS is in good-working conditions.

For well-ventilation, the PCS installation environment should meet the following requirements:

- Plenty of pure and dust-free air should be available.
- Do not install the PCS in places with bad ventilation or low air flow; install fans to increase the ventilation rate;
- Dust-proof and rain-proof measures, for example filter must be taken to maintain the air quality.
- Ventilation system inside the PCS must be independent from other ventilation system in the electrical control room.

### 5.3.4 Ventilation Ducts

Ventilation ducts are advisable for well ventilation and reliable operation of the PCS.

**Dimensions of the ventilation ducts must be designed by professional personnel.**

![Fig. 5-4 Ventilation Ducts Design (for reference)](image)

There should be sufficient fresh air supply to the PCS air inlet to ensure the balance of pressure. You may install extra fans in the air duct with the direction in accordance with the local wind condition. Moreover, pay attention to the anti-sand, anti-wind and waterproof design of the air inlets and outlets.

### 5.3.5 Cable Trench

The external cables can route into or out of the cabinet through the bottom of the PCS. Cable trenches or steel supports above the floor are recommended (Refer to relevant design guides or standards). If cable trenches are designed, fix the PCS with foot screw or steel channel; if steel supports are designed, fix the PCS directly to the steel support.

Cable trenches should be dimensioned and designed by construction party and take the device weight and dimensions into consideration.
Good electrical connection is preferred among the cable trenches and between cable trenches and grounding electrodes.

Cable trenches are shown as below. Cable support arms can be used to support cables. Signal cables should be separated from power cables and DC loop should be separated from the AC loop for enough distance to avoid interference.

<table>
<thead>
<tr>
<th>Item</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cable trench</td>
</tr>
<tr>
<td>B</td>
<td>Cable Support Arms</td>
</tr>
</tbody>
</table>

**5.3.6 Other Requirements**

**Room temperature**

Too high or too low temperature may affect the PCS normal operation! Take proper methods to make the PCS meet its operation requirements (temperature, humidity and etc.).

- High ambient temperature may affect the PCS output. Please properly design the ventilation method.
- Too low ambient temperature will also affect PCS normal operation. Heater equipment is needed when the ambient temperature is lower than -25°C.

**Firefighting requirements**

- Design of the electrical control room must be in accordance with firefighting requirements.
- Place no flammable or blast materials within 5m of the electrical control room.

**Surge protection and others**

- Surge protection measures should be taken into account when designing the electrical control room.
- Ensure the roof rain-proof of the control room and check the roof periodically.

**5.4 Wiring Specification**

Cables in the PCS can be classified into power cables, control cables and data cables.

It is recommended that the power cables and data cables be installed on separate cable support arms for at least 200mm. Avoid long parallel runs of the two kinds of cables in order to decrease electromagnetic interference.

Where data cables must cross power cables make sure they are arranged at an angle as near to 90° as possible. Do not run extra cables through the PCS.
The following table shows the recommended minimum distances between different parallel lengths of shielded data cables and power cables.

<table>
<thead>
<tr>
<th>Parallel length (m)</th>
<th>Min. Distance (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>0.3</td>
</tr>
<tr>
<td>300</td>
<td>0.5</td>
</tr>
<tr>
<td>500</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Data cable must be routed as near to the ground or supports (i.e. support beam, steel channel or metal rail, etc.) as possible.

### 5.5 Tightening Torques and Cable Protection

#### 5.5.1 Cable Fixing

Tighten the cable with proper torque shown below to prevent the poor contact, high contact resistance, or fire caused by the looseness of cable lugs.

<table>
<thead>
<tr>
<th>Screw size Torque (N·m)</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M8</th>
<th>M10</th>
<th>M12</th>
<th>M16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque</td>
<td>0.7 - 1</td>
<td>1.8 - 2.4</td>
<td>4 - 4.8</td>
<td>7 - 8</td>
<td>17 - 20</td>
<td>34 - 40</td>
<td>60 - 70</td>
<td>119 - 140</td>
</tr>
</tbody>
</table>

Secure the cable at proper place to reduce the stress of the cable lug.

#### 5.5.2 Cable Protections

Cable protections include the communication cable protection and power cable protection.

- Protection of communication cables
  Communication cables are thin and easily to be broken. Lay power cables first and then communication cables.
  Communication cables should be laid in cable trenches or cable support arms and tightened up by cable ties.
  Avoid heating elements and the strong electric fields.

- Protection of power cables
  Strong electric currents are present in the power cables. Protect the insulating layer from scratches and damages.
  Fix the power cable properly.
6 Mechanical Installation

6.1 Transport and Shipping

6.1.1 Attentions

**WARNING**

- The PCS should be transported and installed as an integrated unit. Disassembly without the permission of SUNGROW will void any or all warranty right.
- Transport the PCS by strictly following the description in this chapter.

**WARNING**

- Always keep in mind the non-central center of gravity of the PCS and gravity mark on the PCS.
- Please take the heavy weight of the PCS into consideration during shipping and moving.

**WARNING**

- Always keep the PCS upright!
- Inclination angle <5°. If the inclination angle is more than 5°, PCS may tip over. Since the device is heavy and big, there may be personal injury or device damage.
- Avoid sudden force when moving or transporting the device.

**WARNING**

Do not transport the PCS in raining or other harsh environment.
Take proper protection methods if the PCS must be transported in harsh days.

**WARNING**

Only qualified personnel with professional authorization can transport and move the PCS.

**NOTICE**

Please take necessary auxiliary methods to transport the PCS to the final installation place safely.

6.1.2 Moving the Packed PCS

Please transport the PCS with package for better protection. Pay attention to the symbols, marks and data on the package.
<table>
<thead>
<tr>
<th>Symbol or Data Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Center of Balance" /></td>
<td>CENTER OF BALANCE</td>
</tr>
<tr>
<td><img src="image" alt="Heave Here" /></td>
<td>HEAVE HERE</td>
</tr>
</tbody>
</table>
| ![This End Up Keep Upright](image) | THIS END UP  
KEEP UPRIGHT               |
| ![Fragile](image) | FRAGILE                                   |
| ![Keep Dry Caution Against Wet](image) | KEEP DRY  
CAUTION AGAINST WET      |

<table>
<thead>
<tr>
<th>MODEL NO.:</th>
<th>Type of the PCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE:</td>
<td>Package Dimensions</td>
</tr>
<tr>
<td>N. W.:</td>
<td>Net Weight</td>
</tr>
<tr>
<td>G. W.:</td>
<td>Gross Weight</td>
</tr>
</tbody>
</table>

The moving of the packed PCS must be carried out with the aid of specific equipment, such as forklift, pallet truck or crane. Always keep in mind the heavy weight and the uneven distribution of the weight of the PCS during moving.

- **Forklift**

The standard way to transport the PCS is using a forklift. The central of gravity of the crate should be placed between the two prongs. A trial transport is recommended. The length of prongs should be at least 1.2m, see item A in the following figure.

The transport, move and put down of the PCS must be slow and stable. Place the PCS only where is solid and smooth.
Fig. 6-1 Move the Packed PCS via a Forklift

Safety Operation Rules of Forklift should be observed at all times. The big size of the PCS may block the driver's view, please transport the device with the help of other persons.

- Pallet Truck

Fig. 6-2 Move the Packed PCS via a Pallet Truck

If the transportation route is stable on site, a pallet truck can be used. The central of gravity of the crate should be placed between the two prongs. A trial transport is recommended. The length of prongs should be at least 1.2m.

The transport, move and put down of the PCS must be slow and stable. Place the PCS only where is solid and smooth.

Safety Operation Rules of Pallet Truck should be observed at all times. The big size of the PCS may block the driver's view, please transport the device with the help of other persons.

- Crane

The crane can be used to move the PCS. Tie two flexible straps to the external crate through the crane marks. The lifting hook should be vertical to the central of gravity of the device. Tilting transport is strictly forbidden.

The transport, move and put down of the PCS must be slow and stable. Place the PCS only where is solid and smooth.

Safety Operation Rules of Crane should be observed at all times. Avoid moving PCS with crane in raining, heavy fog, or strong wind conditions.
6.1.3 Moving the Unpacked PCS

Lay the DC and AC cables before moving the PCS to the final installation place. Since those cables are thick, once the PCS is installed, those cables are hard to operate and easily broken.

Unpack the PCS only just before it is to be installed. Forklift, rail steels or crane can be employed to move the PCS after unpacking.

- Forklift

Safety Operation Rules of Forklift should be observed at all times.

The transport, move and put down of the PCS must be slow and stable. Place the PCS only where is solid and smooth.

- If the unpacked PCS is far from the final position, it can be moved together with the wooden baseboard by a forklift. Place the gravity of the PCS between the two prongs of the forklift.
Fig. 6-4 Move the PCS with the Wooden Baseboard by forklift

- If the wooden baseboard is removed, move the PCS with forklift directly. Place the central of gravity between the two prongs.

For convenient transport, the fork pocket has been designed beforehand. Remove the cover plate on the bottom and then move the device.

Fig. 6-5 The bottom structure of the PCS and the position of the fork pocket

- Pallet Truck
Pallet truck can be used to move the unpacked PCS. A trial transport is recommended. The central of gravity of the crate should be placed between the two prongs.

The transport, move and put down of the PCS must be slow and stable. Place the PCS only where is solid and smooth.

Safety Operation Rules of Pallet Truck should be observed at all times.

- Crane
PCS is designed with two lifting beams for easy crane transport.

During moving, the center of the hook should be vertically through the PCS center. A trial lifting is necessary.

Safety Operation Rules of Pallet Truck should be observed at all times.

The transport, move and put down of the PCS must be slow and stable. Place the PCS only where is solid and smooth.
Fig. 6-6 Transport the PCS by crane

- Rail Steels
  If the door of the electrical control room is too narrow to use forklift or crane, the rail steels can then be used to move the PCS to its final installation place. Crowbar and jack need also be used.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take the dimensions of the PCS and other devices into account when designing the door of the control room for convenient transport of the PCS.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubricant can be used on the surface of the rail steels.</td>
</tr>
</tbody>
</table>

Fig. 6-7 Transport the PCS by rail steels
NOTICE

No matter which transport method is adopted, please make sure:
• Keep the center of gravity in mind at all time;
• Keep the heavy weight of PCS in mind at all time;
• Take proper auxiliary methods to ensure the safety of transport personnel;

6.2 Field Installation

NOTICE

• Do not perform any mechanical operation other than the installation described in this chapter inside or on top of the PCS.
• Make sure the PCS internal and surrounding environment is clean during installation.

6.2.1 Unpacking the PCS

NOTICE

Since the PCS package panels are heavy, please make sure at least two persons are operating together during PCS unpacking.

Proceed as follows to unpack the PCS from the shipping crate.

Step 1 Remove the crate’s wooden top panel.
Step 2 Remove the crate’s wooden side panel.
Step 3 Remove the barrier bag material from the crate.
Step 4 Remove the PCS’s anchor hardware that bolts the PCS to the pallet.

PCS is removed from the wooden baseboard.

Fig. 6-8 PCS is fixed to the wooden baseboard

⚠️ WARNING

Once the PCS is removed from the wooden baseboard, do not transport the PCS by the baseboard. Meanwhile, take possible measures to prevent the PCS from rolling over.
6.2.2 Checking before Fixing

It is advisable to fix the PCS to the steel channel. Before fixing the PCS, please make sure:

- The built of cable trench meets the requirements of the PCS installation;
- The installation and holes of the steel channel meets the requirements of the PCS installation.

PCS can also be fixed to the ground by foot screws. Drill holes on the ground and make sure the dimensions of the holes exactly match the holes of the PCS.

6.3 Fixing the PCS

Place the AC side of the PCS near to the downstream transformer to shorten the cable length from PCS AC side to the downstream 3-phase.

Proceed as follows to fix the PCS:

**Step 1** Move the PCS to its final installation place using proper tools;

**Step 2** Fix the PCS to the steel channel or ground by M12 bolts;

**Step 3** Install the front and rear panel of PCS base to finish the PCS fixing.

**Fig. 6-9** Fix the PCS

Connection sequence between PCS base and channel steels is described below.
6.4 Installation of Ventilation Ducts

⚠️ WARNING
High internal temperature will affect the PCS electrical performance, or even damage the device!

⚠️ WARNING
• The ventilation ducts must be designed by professional personnel. The flow backward among each cabinet of the PCS must be prevented during ventilation design.
• During installation, do not remove the filter screens. Protection measures should be taken to prevent nuts, washers and etc. from falling inside the PCS.

⚠️ WARNING
• Seal the joint points of ventilation ducts. Sealing material of at least 70°C can be used.
• After installation, check the PCS inside and clean it if necessary.

⚠️ WARNING
Design and installation of the ventilation ducts must meet the PCS ventilation requirements for high efficient operation.
• Clean the filter screens of air inlet/outlet windows periodically.
• Check whether the exhaust air fans are in normal working conditions periodically.

Installation holes are designed in the PCS top. Ventilation ducts can be connected to these holes directly.
Two connections methods are provided, either of which can be chosen according to on-site conditions.
6.4.1 Connection Solution

The DC cabinet and AC cabinet are heat-dissipated via one ventilation duct. Please refer to the figure below for detailed information (figures in mm).

![Connection Solution Diagram](image)

**Fig. 6-10 Connection solution**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Hole numbers</th>
<th>Set-screw Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Connection holes</td>
<td>10</td>
<td>M5</td>
</tr>
</tbody>
</table>
7 Electrical Connection

7.1 Safety Instructions

The safety instructions in this chapter and country/regional-specific safety instructions must be respected for safe electrical connection.

⚠️ DANGER

High voltage! Electrical hazards!
• Do not touch the live components of the device.
• Make sure the AC and DC sides are voltage-free before installation.
• Never put flammable or explosive materials in the vicinity of the PCS.

⚠️ WARNING

• Observe all the country/regional-specific standards and regulations for electrical connection.
• Connect the PCS to public grid only after receiving authorization from the local network operator and only by professional technicians.

⚠️ WARNING

• Only professional electricians can perform the operations described in this chapter
• Strictly follow all the device internal cable connection instructions.

Five Safety Rules

Throughout electrical connections and other work on the PCS, observe the following Five Safety Rules:

• Disconnect all the external connections and disconnect the PCS internal power supply.
• Avoid any accidental re-connections of the PCS.
• Verify that no voltage or current is present inside the PCS with appropriate testing devices.
• Ground and short-circuit whenever necessary.
• Cover possible live parts with insulation materials to avoid accidental contact.

7.2 Installation Tools

Prepare the following tools before installation:

• Torque wrench
• Screwdrivers
• Wire stripper
• Terminal crimping device
• Alcohol blast burner or hot air blower
• Allen wrench
• Meg-ohmmeter or multimeter
• Other auxiliary tools or spare parts

7.3 Parts for Cabling

WARNING
• Incorrect connection of power cables will cause fires. Follow the sequence when connecting the power cables.
• Ensure the fastness of the connection parts. Poor contact or oxidation of the contact surface may cause fire.

Clean the connection terminals before wire connection. Do not touch the terminal after cleaning.

Spare parts required for power cables connection like the screws are within the scope of delivery. Please follow strictly the description in this chapter.

7.3.1 Copper Wire Connection

If copper wires are used, connect the spare parts as described below.

![Copper Wire Connection Diagram]

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper Bar</td>
<td>Copper terminal</td>
<td>Bolt</td>
<td>Spring washer</td>
<td>Flat washer</td>
<td>Nut</td>
</tr>
</tbody>
</table>

7.3.2 Aluminum Wire Connection

When the aluminum wire is selected, an albronze filter is needed as shown below.
Beware the direction of the albronze filter, i.e. the copper side must be closely attached to the copper bar and the aluminum side must be closely attached to the aluminum connection terminal.

When the busbar has several connection terminals, an intact albronze filter is required as shown in the following figure.

**7.4 Preparation before Electrical Connections**

**7.4.1 Opening the Front Door**

Open the front door before cable connection. Proceed as follows to open the front door.
Remove the key and store it properly after installation.

7.4.2 Removal of the Protection Cover

The PCS is equipped with transparent protection grid inside to maintain safe operation and reduce noise level. Remove the grid prior before electrical connections.

**NOTICE**

All external cables connect to the connection terminal through the cable entries on the bottom of the PCS.

1. Open the cabinet door and find the transparent protection grid.
2. Unscrew the bolts on the bottom of the transparent protection grid and remove the protection grid.

7.4.3 Opening the Cable Entries

Cable entries are reserved on the bottom of the PCS DC and AC cabinets. Lead the external cables to the PCS through the bottom of the PCS. Proceed as follows to open the cable entries.

1. Turn the two nuts (marked by A in the following figure) on back of the cover plate counterclockwise until the cover plates can move forward and backward.
2. Turn the cover plate backward to open the cable entry.

**NOTICE**

Protective sponges are used to prevent the cover plate and baseplate from scratches. Do not remove them.
7.4.4 Checking the Cables

**WARNING**

Check to ensure the intactness and insulation of all cables before electrical connection. Poor insulation or damages of cables may cause potential hazards. Replace them immediately.

7.4.5 During Cable Connection

**WARNING**

- Make sure the DC cables and AC cables are correctly routed before connection.
- Do not pull the cables hard during connection.
- Make sure there is enough wire bending space for all cables.
- Take proper methods to reduce the stress of cables.
- Check carefully to ensure the correctness and fastness of the connections.

7.5 Overview of the Connection Area

All input and output terminals of the PCS are located on the bottom of the cabinet with distinct marks for each terminal. Please connect cables by strictly following the marks.

![Diagram of connection area]

**Fig. 7-7** Overview of the connection area

Description of the terminals is shown in the following table:
### 7.6 Cable Requirements

Choose cables according to the requirements below:

- All cables must have sufficient ampacity. The ampacity of the conductor can at least be influenced by environmental conditions, conductor insulation materials, laying, wire materials and cross-sectional areas and etc.
- All the cables must be chosen according to the maximum current of the PCS.
- Cables for one side should be of the same type and specification.
- Flame retardant and fire resistant cables are recommended.

Recommended cable specifications are listed below.

<table>
<thead>
<tr>
<th>Cable</th>
<th>Min. Requirements</th>
<th>Installation hole specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC+</td>
<td>At least 6×10 mm², copper, 90°C, or total cross-section no less than 700 mm²</td>
<td>Φ17</td>
</tr>
<tr>
<td>DC-</td>
<td>At least 6×10 mm², copper, 90°C, or total cross-section no less than 700 mm²</td>
<td>Φ17</td>
</tr>
<tr>
<td>Grid phase L1</td>
<td>4×185 mm² for each phase, copper, 90°C, or total cross-section for each phase no less than 550 mm²</td>
<td>Φ17</td>
</tr>
<tr>
<td>Grid phase L2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid phase L3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grounding</td>
<td>1×50 mm², copper, 90°C</td>
<td></td>
</tr>
<tr>
<td>External control</td>
<td>4×4 mm² cable</td>
<td></td>
</tr>
<tr>
<td>power supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS485 communication</td>
<td>2×0.75 mm², shielded cables are recommended</td>
<td></td>
</tr>
<tr>
<td>Ethernet communication</td>
<td>Standard network cable</td>
<td></td>
</tr>
</tbody>
</table>

⚠️ **WARNING**

**Overloading operation of cables is strictly forbidden.**
7.7 DC Connection

7.7.1 Checking before Connection

Check the following items before DC cable connection:

- Measure the open-circuit voltage of the storage batteries and make sure the open-circuit voltage does not exceed the max. DC voltage;
- Confirm the positive and negative polarity and make marks.

**WARNING**

*Open-circuit voltage of the storage batteries cannot exceed the PCS max. DC input voltage. Too high open-circuit voltage may damage the PCS.*

**WARNING**

*Connect the cables by strictly following the marks inside the device.*

Connect the DC cables only after all checking and measurement meet the requirements.

7.7.2 Cable Connection

**Step 1** Make sure the storage batteries of the PCS upstream are all disconnected.

**Step 2** Strip off the insulation cover of the cable end with a stripped length of 5mm longer than the depth of the cable lug.

**Step 3** Based on the cable specification, it is recommended to use DTxxxx-17 cable lug (xxx is the cross-section of the cable selected).

**Step 4** Crimp the cable lug.

1. Put the stripped cable inside the cable lug;
2. Tighten the cable lug with relevant tools. The crimping number should be more than two.

**Step 5** Insert the heat-shrinkable tubing:

1. A tubing with a length of 2cm longer than the cable lug is recommended;
2. Insert the heat-shrinkable tubing into the cable lug;
3. Shrink the tubing with hot air blower.

**i** Cable protectors are advisable in the cable crosses if the multi-core cables are used.

**Step 6** Connect the cable.

1. Select bolt matching with the cable lug.
2. Attach the cable lug to the DC connection copper bar following the sequence in the following figure.

3. Tighten the bolts with screwdriver or wrench with torque of 60N·m.

Fig. 7-8 Connection sequence

⚠️ WARNING

- Respect all the safety instructions listed by the device manufacturer. Incorrect connection sequence may cause fire. Please pay maximum attention to the connection sequence.
- Ensure the firmness of the cable connection. Poor connection or oxidation of the surface may cause over-heating or fire.

NOTICE

- Long bolts may affect the insulation and may cause short circuit.
- Remove the heat-shrinkable tubing between the cable lug and the copper bar if necessary. Poor contact or over-heating may follow if otherwise.

Step 7 Make sure the cable connection is secure.

7.8 AC Connection

7.8.1 Safety Instructions

⚠️ WARNING

Incorrect AC connection may affect the normal operation of or cause damages to the PCS.

⚠️ WARNING

Electric shock hazards upon touching the live components!
- Disconnect the AC switches and make sure the contact terminals are voltage-free.
- The connection to the distribution grid must be carried out only after receiving approval from the distribution utility as required by national and state interconnection regulations.
7.8.2 Cable Layout

Follow the descriptions in this section to route the cables from the PCS AC output side to the three phase of the transformer low voltage winding side inside the cable trench.

As shown in the following figure, AC cables should be placed in groups in order not to cause current unbalance. One group should contain three cables and each of them is from one of the three phases. Distances between different groups should be at least twice of the cable cross-sectional areas.

![AC cable layout inside the cable trench](image)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cable cross-section</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Distance between cable group</td>
<td>B ≥ 2A</td>
</tr>
</tbody>
</table>

7.8.3 AC Cable Connection

AC side connection terminals of the PCS are shown in the following figure:
PCS AC output feeds to the grid via the medium-voltage transformer. Proceed as follows to connect the AC cables.

**Step 1** Make sure the switches of the PCS downstream are all disconnected.

**Step 2** Confirm the sequence of the AC connection cable.

**Step 3** Strip off the insulation cover of the cable end with a stripped length of 5mm longer than the depth of the cable lug. It is advisable to use DT×××-17 (xxx is the cross-sectional area of the cable selected) copper lug according to the cable specification.

**Step 4** Crimp the cable lug.
   1. Put the stripped cables inside the cable lug.
   2. Tighten the cable lug with proper tool. The crimping number should be more than two.

**Step 5** Install the heat-shrinkable tubing.
   1. A tubing with a length of 2cm longer than the cable lug is recommended.
   2. Insert the heat-shrinkable tubing into the cable lug;
   3. Shrink the tubing with hot air blower.

   **Tip** Cable protectors are advisable in the cable crosses if the multi-core cables are used.

**Step 6** Connect cable L1 to the L1, namely phase A(U) in the transformer low voltage side.
   1. Select proper bolt to connect the cable lug to the copper bar (if it is the standard PCS, the M12 bolt is within the scope of delivery).
   2. Crimp the cable lug into the AC copper bar. Install as per sequence shown below.
   3. Fasten the bolt with screwdriver or wrench with torque of 60 Nm.
The specification and numbers of the AC cables should be selected properly according to the on-site situation. At most 6 cables can be connected. If the cables connected are more than 3, please follow the following sequence to connect them.

**Fig. 7-12 Connection sequence when two cable lugs are used**

**WARNING**

- Incorrect AC connection sequence may cause fire. Please notice the cable connection sequence.
- Ensure the fastness of the connection parts. Poor contact or oxidation of the contact surface may cause fire.

**NOTICE**

- Long bolts may affect the insulation and may cause short circuit.
- Remove the heat-shrinkable tubing between the cable lug and the copper bar if necessary. Poor contact or device damage may follow if otherwise.

**Step 7** Follow the same procedure in Step 6 to connect cable L2 to the L2, i.e. phase B(V) in the transformer low voltage side; connect cable L3 to the L3, i.e. phase C(W) in the transformer low voltage side; leave cable N unconnected.
Heat-shrinkable tubing of yellow, green and red is applied to three phases of the AC output: L1, L2 and L3 respectively to distinguish them from each other.

**Step 8** Check to make sure the connection is secure.

### 7.9 Ground Connection

**WARNING**

Ground cable should be grounded properly. Otherwise,
- Electrical hazards may follow if a fault occurs.
- Device may be damaged during lightning.
- Device may not operate normally.

**NOTICE**

- Observe country-specific codes and regulations to perform ground connections.
- The connection of the grounding devices and grounding polarities must be secure.
- Measure to ensure the ground resistance is no more than 4Ω.

**WARNING**

Respect all internal connection marks and instructions.

#### 7.9.1 Connection of Ground terminal

It is crucial to ground all PCS via PEN conductor.

The PCS enclosure and internal components (for example, SPD) that needed to be grounded have been firmly connected to the PE copper bars on the bottom of the PCS cabinet. Connect the PE copper bar to the equipotential bonding equipment in the installation field or electrical control room using ground cable with cable cross-sectional area of at least 50mm². The ground resistance must not exceed 4Ω.

#### 7.9.2 Equipotential Connection of Multiple Devices

There are also initial charge cabinet and other electrical devices inside the electrical control room. During ground connection, perform equipotential connection to all electrical devices to avoid current appearing in the shielded layer of the communication cable (caused by the different level of different devices).

If different cabinets do not connected by bolts, adopt either of the following two methods to ensure different devices are equipotential.

- Use cable connection plate and bolt to connect the single-core yellow-green cable of at least 25mm² to the frame of the PCS enclosure. Or
- Connect each device to the equipotential copper bar inside the electrical control room

#### 7.9.3 Ground of the Shielded Layer of Communication Cable

Communication method for standard configured PCS is RS485 communication. Shielded
twisted-pair cables are adopted. Ground the shielded layer to reduce the communication interference.

If RS485 communication cable is selected, the shielded layer must be connected securely and single grounded. The grounded place is usually outside the DC power distribution cabinet or the PCS.

7.10 Communication Connection

**WARNING**

Strictly follow all the device internal cable connection instructions.

7.10.1 Communication Terminals

There are several communication ports reserved for external connection: 1 internet communication port for PC; 1 RS485 communication port for mutual exclusion use of PC and BMS; 1 CAN communication port for BMS and dry contact input port. The following figure shows the communication ports.

*Picture above for reference only, please consult with the real products.

7.10.2 RS485 Communication Solution

The communication solution of PCS is shown in Fig. 7-14: connect the communication port A0 and B0 of the RS485 to a RS485/RS232 convertor and then connect to monitor PC.
Connection step

**Step 1** Strip off the insulation layer of the two cables that connected to one connection terminal.

**Step 2** Insert the bare copper cable to the cold-pressed terminal and connect them tightly with crimping pliers.

**Step 3** Connect the cold-pressed terminal to the communication terminal.

**Step 4** Twist the shielded layer of the two cables into one and then cover it with thermal shrinkable sleeve. Connect the cable after inserting cold-pressed terminal.

NOTICE

The RS232 communication distance should be within 15 meters and the RS485 communication distance should be within 1200 meters. If the distance is exceeded, the LAN communication method should be used. The electric/optical adapter and the optical fiber part should be designed separately according to the actual situations. Sungrow can provide professional technical solutions.

- RS485 cable should be shielded twisted-pair for good communication (RVVSP-2×1.0 shielded twisted-pair cable is recommended).
- Shielding layer of shielded cable should be single-point grounded in the site of monitoring terminal.

7.10.3 Ethernet Communication Solution

The position of the Ethernet port is shown in the figure below. Remove the protection cover of the Ethernet port before cable connection.
Solution for a single PCS

For the Ethernet communication of a single PCS, connect the Ethernet port of the PCS to the PC by network cable EIA/TIA568B.

Solution for Several PCSs

For the Ethernet communication of several PCSs, an Ethernet switch is required. The following monitoring solution can be adopted.

Fig. 7-17 Communication solution for several PCSs
7.11 Power Supply Mode Setting

**WARNING**
Respect all internal connection marks and instructions.

PCS has two kinds of control power supply modes: internal power supply mode (default mode) and external power supply mode.

![Power supply mode setting terminals](image)

**Fig. 7-18 Power supply mode setting terminals**

<table>
<thead>
<tr>
<th>Circuit breaker</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Control the internal power supply mode</td>
</tr>
<tr>
<td>Q2</td>
<td>Control the external power supply mode</td>
</tr>
</tbody>
</table>

Identify the circuit breakers that control the external power supply and internal power supply by the marks on the device.

Proceed as follows to select the power supply mode.

7.11.2 Internal Power Supply Mode (Default Mode)

**NOTICE**
The internal power supply mode is set before delivery. User can use this mode without any configuration.

Proceed as follows to set the internal power supply mode.

**Step 1** Disconnect the Q2 switch.

**Step 2** Connect the Q1 switch.
7.11.3 External Power Supply Mode (Optional Mode)

**WARNING**

- Shock hazard!
- Disconnect the device completely before connecting to the external power supply or setting the power supply mode.

External power supply should be 400V three-phase AC power. The cross-sectional area of the cable connected to the external power supply should be more than 2.5mm².

Proceed as follows to set the external power supply mode.

**Step 1** Disconnect the Q1 switch.

**Step 2** Connect the AC 400V cables to the Q2 switch.

**Step 3** Connect the Q2 switch.

7.12 Closing the Cable Entries

Conduct a thorough inspection after all electrical connection.

Pull the cover plate of the cable entries toward the PCS front door until the cover plate is back to its original place. Turn the nut clockwise. Do not remove the protective sponge. Seal the gaps with fireproofing mud to prevent rodents entering.
### 7.13 Installation Checklist

Check the mechanical and electrical installation of the PCS after above-mentioned operation. Go through the checklist below with the aid of another person.

Make record during checking. Make improvement once any unconformity is found.

<table>
<thead>
<tr>
<th>Mechanical Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ PCS is intact without distortion or damage</td>
</tr>
<tr>
<td>☐ PCS bottom is reliably fixed and supported</td>
</tr>
<tr>
<td>☐ The clearance spaces around the PCS are sufficient</td>
</tr>
<tr>
<td>☐ The PCS ambient temperature, humidity and ventilation meet the requirements</td>
</tr>
<tr>
<td>☐ Cooling air circulates smoothly</td>
</tr>
<tr>
<td>☐ Cabinets are integrated and reliably sealed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ PCS is grounded properly and reliably</td>
</tr>
<tr>
<td>☐ The grid voltage matches the nominal output voltage of the PCS</td>
</tr>
<tr>
<td>☐ Grid side connection sequence is correct and the torque meets requirements</td>
</tr>
<tr>
<td>☐ Polarities of the DC input connection are correct and the torque meets requirement</td>
</tr>
<tr>
<td>☐ Communication cables are connected correctly and far away from other cables</td>
</tr>
<tr>
<td>☐ Marks on the cables are correct, clear and distinguishable</td>
</tr>
<tr>
<td>☐ Insulation protection cover is reliable and intact; warning labels are clear and distinguishable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Insulation belts tighten all unused cables</td>
</tr>
<tr>
<td>☐ No tools, spare parts, dusts or other foreign objects falls inside the PCS</td>
</tr>
<tr>
<td>☐ No condensing or ice inside the cabinet</td>
</tr>
</tbody>
</table>
## Commissioning

### 8.1 Commissioning Requirements

Before starting PCS for the first time, all installation performed on the device should be checked thoroughly.

- Make sure all cables are connected correctly and all bolts are screwed securely.
- Make sure DC side voltage meets PCS requirement and the polarities are correct.
- Make sure AC side voltage meets the PCS requirement.
- Make sure all system connections meet the requirements of related standards and regulations.
- Make sure system is properly grounded. Ground resistance decides the safety of the whole system. Make sure the ground resistance meets the requirement (ground resistance should be no more than 4Ω).

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All operation during commissioning must be performed by qualified personnel only. Unauthorized persons are not permitted to operate.</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Disconnect all external AC and DC switches before commissioning.</strong></td>
</tr>
</tbody>
</table>

### 8.2 Checking before Commissioning

#### 8.2.1 Checking Cable Connection

- Check cable connection for any possible damages or cracks;
- Check again to make sure all cables are connected correctly according to the system circuit diagram. Adjust the cable connection if necessary.
- Make sure all cables are connected securely. Fasten corresponding installation screws if necessary.
- Check the PE equipotential connection. Ensure the PCS AC side PE ground terminal has connected to the equipotential connection point in the electrical room and properly grounded. The ground resistance should be no more than 4Ω.

#### 8.2.2 Checking the PCS

Check the PCS before PCS power on:

- Ensure the switches are disconnected.
- Ensure the START/STOP switch is at the START position and can work normally.
- Ensure the emergency stop button is released and can work normally.
- Check and ensure the PCS and switches and buttons upstream and downstream operate flexibly and meet the requirement.

### 8.2.3 Checking Batteries

⚠️ **WARNING**

Make sure the measuring devices are connected and used correctly. There will be electric arc if otherwise.

⚠️ **WARNING**

DC side voltage should not exceed the PCS maximum allowable DC input voltage. Too high DC voltage may damage the PCS even cause safety incident.

Check the storage battery before starting the device to make sure the open-circuit voltage of the battery meet the requirement:

- Record field measured data accurately;
- Make sure the positive and negative polarities are correct. Incorrect polarity may damage the module seriously.
- Measure the resistance of cables (between the terminal box and the PCS) by ohmmeter. Accurately record all measured data.

### 8.2.4 Checking Grid Voltage

- Measure accurately the grid side 3-phase line voltage: L1-L2, L1-L3, and L2-L3. The measured data should not exceed PCS AC side permissible voltage and the three phases are balance.

**i** Adjust the transfer ratio of the transformer by qualified personnel if the grid voltage deviation is serious.

- Measure accurately the AC grid side frequency. The measured data should not exceed the grid permissible frequency range of the PCS.
- Measure the voltage THD of each phase if necessary. PCS may not operate if the THD is serious.
- Record accurately all measured data.

### 8.3 Preparation before Starting

Prepare to start the PCS when the abovementioned items are checked and meet requirements:

- Place the disassembled protection grids to their original places and make sure the connection is secure.
- Close and lock the cabinet front door. Store the key by appointed person.
- Clean the device site. Make sure the site is clean without any flammable or explosive materials.
- Make sure the ventilation of the device installation place is normal.
• Check again and ensure the PCS and switches and buttons operate flexibly and meet the requirement.

### 8.4 Starting the PCS

If all tests and measurements have been performed, and all measured data lie within the permissible range, the device can be switched on for the first time. Proceed as follows to start the PCS:

**Step 1** Connect the batteries correctly.

**Step 2** Turn the PCS AC side switch to the ON position.

**Step 3** It takes approximately 5-10 minute for the automatic initialization of the power inversion circuit and LCD control panel. The POWER LED of the PCS will be on.

**Step 4** Work state displayed on the LCD is **Stop** when the DC&AC sides meet requirement.

**Step 5** PCS will turn to **Run** state according to directions if all conditions meet requirement. The OPERATION LED is on and PCS begins normal operation.

### 8.5 LCD Parameter Setting

When the LCD is on, set the LCD display language, data and time, communication parameters, and active power limitation etc. according to the Operation Manual. You can also view the PCS running information and perform pertinent operation through LCD display.

### 8.6 Completing Commissioning

Perform the following tests when the PCS is successfully connected to the grid:

• Check whether there are anomalies of the PCS: abnormal noise, overheating, smoking or unusual odor.

• Measure the PCS's grid-connected voltage, current and THD for unstableness.

• Check if the PCS enclosure is correctly grounded.

• Check if the LCD display is operated normally and correctly.

If several PCSs are commissioning at the same time, operate them as the same principle of the single PCS operation. During commissioning, record accurately the running data of each PCS. PCS can operate normally after completing.

#### NOTICE

**PCS needs no manual control in daily operation. Open the cabinet door only for maintenance or troubleshooting and by qualified personnel only.**

**Keep the door closed and locked and store the keys of the door by appointed personnel during normal operation.**
9 Appendix

9.1 Technical Data

9.1.1 Electrical Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Specification</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DC side parameter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal DC power</td>
<td>kW</td>
<td>1000kW</td>
<td></td>
</tr>
<tr>
<td>Max. DC voltage</td>
<td>V</td>
<td>1200V</td>
<td></td>
</tr>
<tr>
<td>Working voltage range</td>
<td>V</td>
<td>810V - 1200V</td>
<td>-</td>
</tr>
<tr>
<td>Min. DC voltage</td>
<td>V</td>
<td>810V</td>
<td></td>
</tr>
<tr>
<td>Max. DC current</td>
<td>A</td>
<td>1358A</td>
<td></td>
</tr>
<tr>
<td><strong>AC side parameter</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working mode</td>
<td>-</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td>Nominal Output Power</td>
<td>kW</td>
<td>1000kW</td>
<td></td>
</tr>
<tr>
<td>Output overload capacity</td>
<td>KVA</td>
<td>1100 KVA</td>
<td>110% overload, longtime operation</td>
</tr>
<tr>
<td>Max. AC current</td>
<td>A</td>
<td>1176A</td>
<td></td>
</tr>
<tr>
<td>Max. THD</td>
<td>%</td>
<td>&lt;3% at nominal power</td>
<td></td>
</tr>
<tr>
<td>Nominal grid voltage</td>
<td>V</td>
<td>540V</td>
<td></td>
</tr>
<tr>
<td>Grid voltage range</td>
<td>V</td>
<td>432V - 621V</td>
<td></td>
</tr>
<tr>
<td>Nominal grid frequency</td>
<td>Hz</td>
<td>50/60Hz</td>
<td></td>
</tr>
<tr>
<td>Grid frequency range</td>
<td>Hz</td>
<td>45 - 55Hz/55 - 65Hz</td>
<td></td>
</tr>
<tr>
<td>Power factor at nominal power</td>
<td>-</td>
<td>&gt; 0.99</td>
<td></td>
</tr>
<tr>
<td>Isolated transformer</td>
<td>-</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>DC current injection range</td>
<td>-</td>
<td>&lt;0.5% at nominal output current</td>
<td></td>
</tr>
<tr>
<td>Grid-connected power factor range</td>
<td></td>
<td>0.8 (lagging) - 0.8 (leading)</td>
<td></td>
</tr>
</tbody>
</table>

9.1.2 Mechanical Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (W×H×D)</td>
<td>1605mm×2065mm×935mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1400kg</td>
</tr>
</tbody>
</table>

9.1.3 System Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. efficiency</td>
<td>98.4% (without transformer)</td>
</tr>
<tr>
<td>Euro efficiency</td>
<td>98.0% (without transformer)</td>
</tr>
<tr>
<td>Protection Degree</td>
<td>IP21 (indoor)</td>
</tr>
<tr>
<td>Stop Power Consumption</td>
<td>&lt;127W</td>
</tr>
<tr>
<td>Noise level</td>
<td>&lt;70dB</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-30°C...+50°C</td>
</tr>
<tr>
<td>Cooling Method</td>
<td>Temperature-controlled forced air cooling</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>0 - 95% (Non-condensing)</td>
</tr>
<tr>
<td>Max. Working Altitude</td>
<td>6000 m (operation with derating above 4000m)</td>
</tr>
</tbody>
</table>
9.1.4 Display and Communication

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Specification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>Touch screen</td>
</tr>
<tr>
<td>Standard communication</td>
<td>RS485, Ethernet</td>
</tr>
<tr>
<td>Communication with BMS</td>
<td>CAN, RS485</td>
</tr>
<tr>
<td>Communication protocol</td>
<td>IEC 104/Modbus TCP/Modbus RTU</td>
</tr>
</tbody>
</table>

9.1.5 Other Data

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Specification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC side disconnection device</td>
<td>Contactor + fuse</td>
</tr>
<tr>
<td>AC side disconnection device</td>
<td>Switch</td>
</tr>
<tr>
<td>DC over-voltage protection</td>
<td>Yes</td>
</tr>
<tr>
<td>AC over-voltage protection</td>
<td>Yes</td>
</tr>
<tr>
<td>Reverse polarity protection</td>
<td>Yes</td>
</tr>
<tr>
<td>Module protection temperature</td>
<td>Yes</td>
</tr>
</tbody>
</table>

9.2 Cable Specifications

<table>
<thead>
<tr>
<th><strong>Cable</strong></th>
<th><strong>Min. Requirements</strong></th>
<th><strong>Installation hole specification</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC+</td>
<td>At least 6x120mm², copper, 90°C, or total cross-section no less than 700mm²</td>
<td>Φ17</td>
</tr>
<tr>
<td>DC-</td>
<td>At least 6x120mm², copper, 90°C, or total cross-section no less than 700mm²</td>
<td>Φ17</td>
</tr>
<tr>
<td>Grid phase L1</td>
<td>4 x 185mm² for each phase, copper, 90°C, or total cross-section for each phase no less than 550mm²</td>
<td>Φ17</td>
</tr>
<tr>
<td>Grid phase L2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid phase L3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grounding</td>
<td>1x50 mm², copper, 90°C</td>
<td>-</td>
</tr>
<tr>
<td>External control power supply</td>
<td>4x 4mm² cable</td>
<td>-</td>
</tr>
<tr>
<td>RS485 communication</td>
<td>2 x 0.75mm², shielded cables are recommended</td>
<td>-</td>
</tr>
<tr>
<td>Ethernet communication</td>
<td>Standard network cable</td>
<td>-</td>
</tr>
</tbody>
</table>

9.3 Exclusion of Liability

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Guarantee or liability claims for damages of any kind are excluded if they are caused

- Improper or inappropriate use or install of the product
- Install or operate the product in unintended environment
• Install or operate the product without observing relevant safety regulations in the deployment location
• Ignore the safety warnings or instructions contained in all documents relevant to the product
• Install or operate the product under incorrect safety or protection conditions
• Alter the product or supplied software without authority
• Product malfunctions due to operation attached or neighboring devices running out of the allowed limit values
• Unforeseen calamity or force majeure

The use of supplied software produced by Sungrow Power Supply Co., Ltd. is subject to the following conditions:

• Sungrow Power Supply Co., Ltd. assumes no liability for direct or indirect damages arising from the use of SolarInfo software. This also applies to the provision or non-provision of support activities.
• SolarInfo software used for commercial purposes is prohibited.
• Decompiling, decoding or destroying the original program, including SolarInfo software and the embedded software, is prohibited.

9.4 About Us

Sungrow power supply is a Chinese leading manufacturer of various power electronics products for renewable energy generation systems. Our products include PCSs, inverters, battery chargers and other power supplies for distributable generation systems in both grid-connected and stand-alone applications. The power rating of SUNGROW products covers a range from several hundred watts to large mega-watt systems.

The pursuit of SUNGROW is to help our customers acquire stable and clean power with minimum cost, maximum reliability and enhanced safety.

9.5 Contact Information

Should you have any questions or queries about this product, please contact us through the following information. We will be more than happy to assist you!

<table>
<thead>
<tr>
<th>Company</th>
<th>Sungrow Power Supply Co., Ltd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Website</td>
<td><a href="http://www.sungrowpower.com">www.sungrowpower.com</a></td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:info@sungrowpower.com">info@sungrowpower.com</a></td>
</tr>
<tr>
<td>Address</td>
<td>No.1699 Xiyou Rd., New &amp; High Technology Industrial Development Zone, Hefei, P. R. China.</td>
</tr>
<tr>
<td>Zip</td>
<td>230088</td>
</tr>
<tr>
<td>Telephone</td>
<td>+86 551 6532 7834, +86 5516532 7845</td>
</tr>
<tr>
<td>Fax</td>
<td>+86 551 6532 7856</td>
</tr>
</tbody>
</table>