



User manual

PV Grid-Connected Inverter

Product Model: SOFAR 1.1K-3KTL (2018.03.16)

Product Name: PV Grid-Connected Inverter
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Shenzhen SOFARSOLAR Co.,Ltd

Notice

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

Save these instructions!

This manual must be considered as an integral part of the equipment, and must be available at all times to everyone who interacts with the equipment. The manual must always accompany the equipment, even when it is transferred to another user or field.

Copyright Declaration

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Preface

Outline

Please read the product manual carefully before installation, operation or maintenance. This manual contains important safety instructions and installation instructions that must be followed during installation and maintenance of the equipment.

• Scope

This product manual describes the assembly, installation, commissioning, and maintenance of Sunny Dog series inverters.

SOFAR 1100TL SOFAR 1600TL SOFAR 2200TL SOFAR 2700TL SOFAR 3000TL

Keep this manual where it will be accessible at all times.

• Target Group

This manual is for qualified person (support person, service person are qualified mentioned in this manual).

• Symbols Used

This manual provides safety operation information and uses the symbol in order to ensure personal and property security and use the inverter efficiently when operating the inverter. You must understand these emphasize information to avoid the personal injury and property loss. Please read the following symbols which used in this manual carefully.







 Danger	Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 Warning	Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 Caution	Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
 Attention	Attention indicated potential risks which, if not avoided, may lead to equipment fault or property damage.
 Note	Note provides tips that are valuable for the optimal operation of the product.

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Basic safety information

 Note	<p>If you have any question or problem when you read the following information, please contact Shenzhen SOFARSOLAR Co., Ltd .</p>
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Outlines of this chapter

Safety instruction

It mainly introduce the safety instruction when install and operate the equipment.

Symbols and signs

It mainly introduce the safety symbols on the inverter.

1.1 Safety instructions

Read and understand the instruction of this manual ,and be familiar with relevant safety symbols in the paragraph, then start to install and debug the equipment.According to the national and state requirements, before connect the grid ,you must get power department permission, and perform the operation only by qualified electrical engineer.Before installing and maintaining the equipment, you should cut off the high voltage application of PV array. You can also open the switch of Solar Array Combiner to cut off the high voltage. Otherwise, serious injury may be caused.

Qualified persons

The customer must make sure the operator has the necessary skill and training to do his/her job. Staff in charge of using and maintaining the equipment must be skilled, aware and mature for the described tasks and must have the reliability to correctly interpret what is described in the manual. For safety reason only a qualified electrician, who has received training and / or has demonstrated skills and knowledge in construction and in operation of this unit, can install this inverter. Shenzhen SOFARSOLAR Co., Ltd does not take any responsibility for the property destruction and personal injury because of any incorrect use.

Assembly situation requirements

Please install and start inverter according to the following sections. Put the inverter in appropriate bearing capacity objects(such as wall and components and so on), to ensure that inverter vertical placed. Choose suitable place for installing electrical equipment. And assure enough fire exit space, convenience for maintenance. Maintain proper ventilation, and ensure that have the enough air cooling cycle.







Transport requirements



If you find packing problems that may cause the damage of the inverter, or find any visible damage, please immediately notice the responsible transportation company. You can ask solar equipment installation contractor or Shenzhen SOFARSOLAR Co.Ltd for help if necessary. Transport of the equipment, especially by road, must be carried out with by suitable ways and means for protecting the components (in particular, the electronic components) from violent shocks, humidity, vibration, etc.

Electric connection



Please comply with all the current electrical regulations about accident prevention in dealing with the current inverter.

 Danger	<p>Before the electrical connection, make sure to use opaque material to cover the PV modules or to disconnect PV array DC switch. Exposure to the sun, PV array will produce a dangerous voltage!</p>
 Warning	<p>All installation accomplished only by professional electrical engineer!</p> <ul style="list-style-type: none"> • must be trained; • Completely read the manual operation and understand relevant matters.
 Attention	<p>Only get permission by the local power department and complete all electrical connection by professional electrical engineer then connect inverter into grid!</p>
 Note	<p>It's forbidden to remove the tamper evident label, and open the inverter. Otherwise Sofarsolar will not provide service and maintenance!</p>

Operation

	<p>Touching the power grid or the terminal of equipment may lead to die of electric shock or fire!</p> <ul style="list-style-type: none"> • Don't touch the terminal or conductor which connect to the power circuit; • Pay attention to anything about grid connection and security document.
Danger	
	<p>Some internal components will be very hot when inverter is working. Please wear protective gloves!</p>
Attention	


Maintenance and repair

	<ul style="list-style-type: none"> • Disconnected with the PV components array and electricity grid before any repair work; • After turn off AC breaker and DC switch for 5 minutes later, the maintenance or repair of the inverter can be carried out!
Danger	
	<ul style="list-style-type: none"> • Inverter should work again after removing any faults. If you need any repair work, please contact with the local authorized service center; • Can't open the internal components of inverter without authorized. Shenzhen SOFARSOLAR Co., Ltd. does not take any responsibility for the losses from that.
Attention	

EMC / noise level of inverter


Electromagnetic compatibility (EMC) refers to that one electrical equipment functions in a given electromagnetic environment without any trouble or error, and impose no unacceptable effect upon the environment. Therefore, EMC represents the quality characters of electrical equipment.



- The inherent noise-immune character: immunity to internal electrical noise.
- External noise immunity: immunity to electromagnetic noise in external system.
- Noise emission level: influence of electromagnetic emission upon environment.

	<p>Electromagnetic radiation from inverter may be harmful to health!</p> <ul style="list-style-type: none"> • Please do not continue to stay away from the inverter in less than 20 cm when inverter is working.
Danger	

1.2 Symbols and signs









Safety symbols

	<p>Caution of burn injuries due to hot enclosure parts!</p> <ul style="list-style-type: none"> • During working only can touch the display and key parts of inverter.
Caution	

	<p>PV array should be connected to the ground in accordance with requirements of local power department!</p> <ul style="list-style-type: none"> • To protect system and the personnel security, we suggest that PV array of border and inverter should be reliable grounding .
Attention	
	<p>Ensure input DC voltage < Max.DC voltage .Over voltage may cause permanent damage to inverter or other losses, which will not be included in warranty!</p>
Warning	

Signs on the inverter

There are some symbols which are related to security on the inverter. Please read and understand the content of the symbols, and then start the installation.

	There is residual voltage in the inverter! Before open the equipment, operator should wait for five minutes to ensure the capacitance discharge completely.
	Caution, risk of electric shock
	Caution, hot surface
	Conformity with European.
	Point of connection for grounding.
	Please read this manul before install Sunny Dog series.
	This indicates the degree of protection of the equipment according to IEC standard 70-1 (EN 60529 June 1997).
	Positive pole and negative pole of the input voltage (DC).

2 Product characteristics

Outlines of this chapter

Product identification

It introduces the field of use, and how to identify different type of Sunny Dog series inverters.

Function description

It introduces how Sunny Dog series inverters work and the function modules inside.

Protection modules

It introduces the protection modules in the inverter.

2.1 Product identification

Field of use

The Sunny Dog series is a PV inverter which converts the DC current of a PV generator into AC current and feeds it into the public grid.

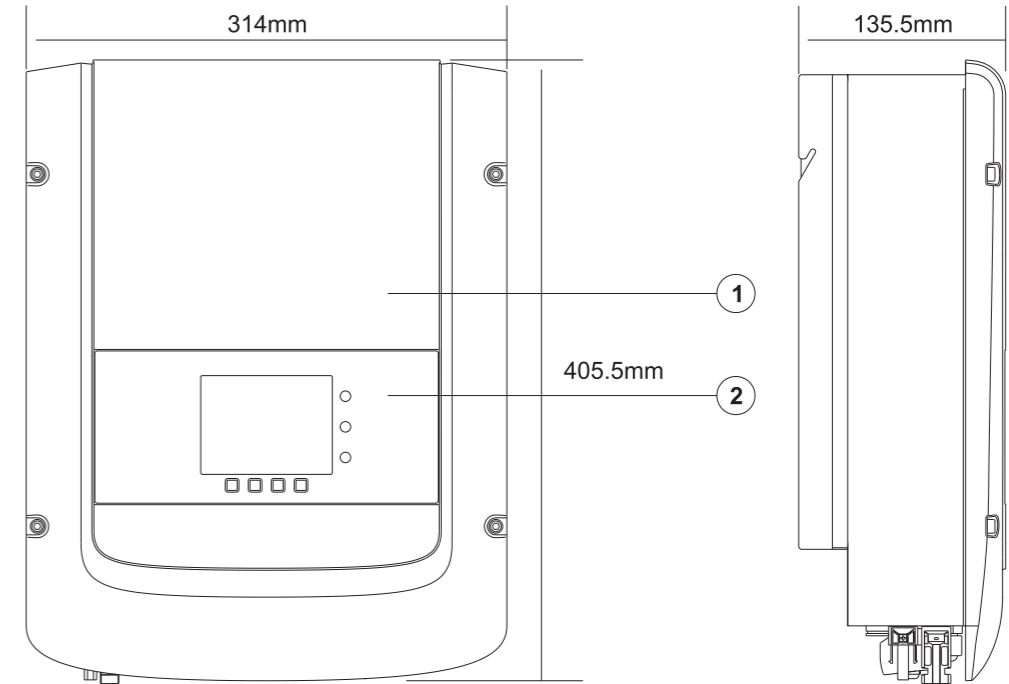
Figure2-1 PV Grid-tied System



Sunny Dog series inverters can be used only with photovoltaic modules that do not require one of the poles to be grounded. The operating current dispersed during normal operation must not exceed the limits specified in the technical specifications. Only one photovoltaic generator can be connected to the input of the inverter (do not connect batteries or other sources of power supply).

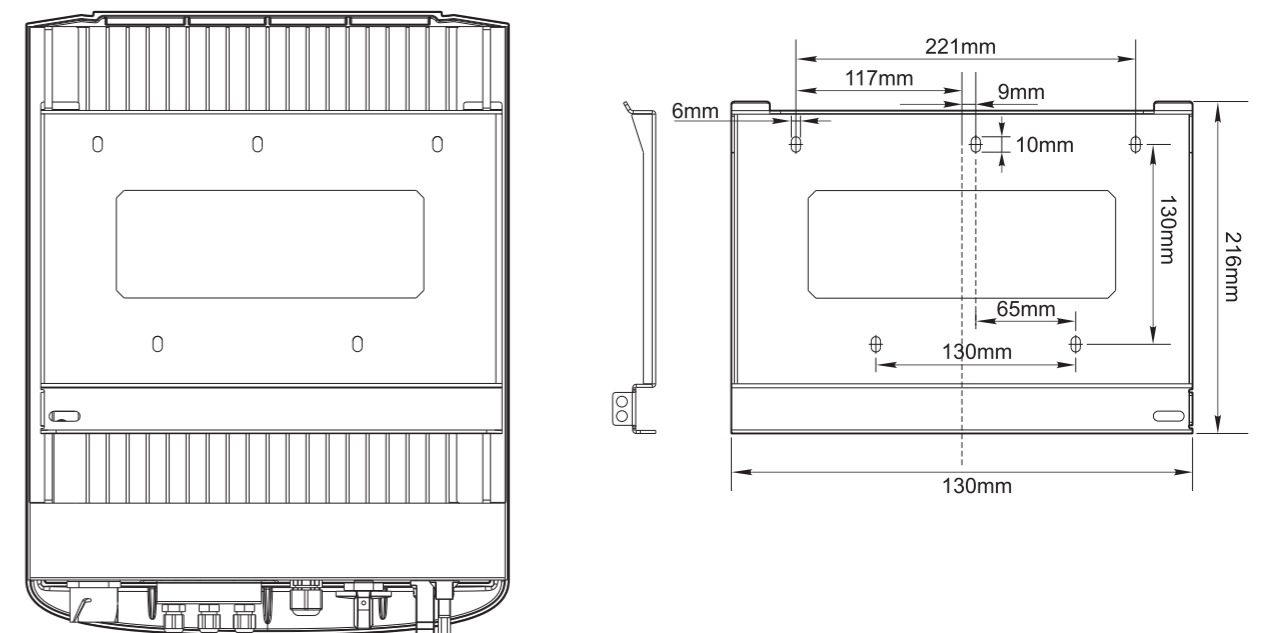
- The choice of model of inverter must be made by a qualified technician who knows about the installation conditions, the devices that will be installed outside the inverter and possible integration with an existing system.
- Overall dimensions: L×W×H=405.5mm×314mm×135.5mm.

Figure2-2 Front view and left view dimensions

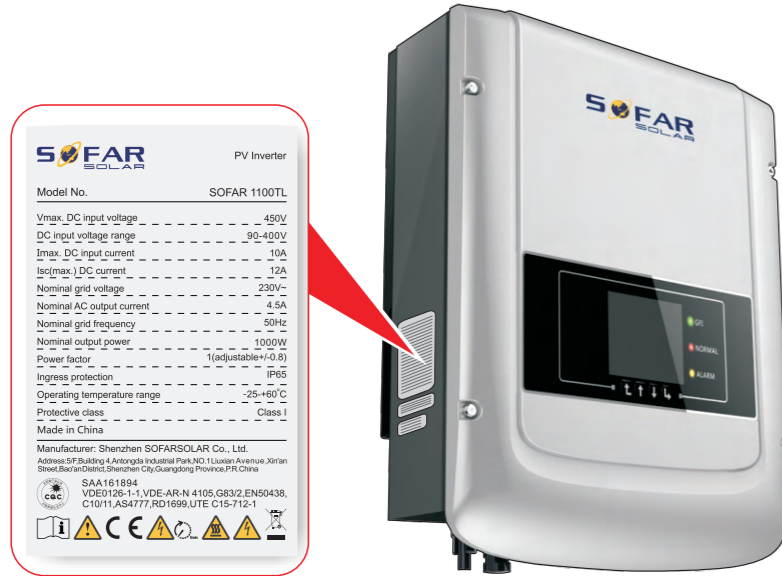


1. Cabinet 2. Human Interface board

Figure2-3 Back view and Bracket dimensions



• Identification labels of the equipment :



The labels must NOT be hidden with objects and extraneous parts (rags, boxes, equipment, etc.); they must be cleaned regularly and kept visible at all times.

2.2 Function description

DC power generated by PV array is filtered through Input Board before entering into Power Board. Input Board also offer functions such as insulation impedance detection and input DC voltage / current detection. DC power is converted to AC power by Power Board. AC power is filtered through Output Board then AC power is fed into the grid. Output Board also offer functions such as grid voltage / output current detection, GFCI and output isolation relay. Control Board provides the auxiliary power, controls the operation state of inverter and shows the operation status by Display Board. Display Board displays fault code when inverter is in abnormal operation conditions. At the same time, Control Board can trigger the relay so as to protect the internal components.

• Function module

A. Energy management unit

This control can be used to switch the inverter on/off through an external (remote) control.

B. Feeding reactive power into the grid

The inverter is able to produce reactive power and can therefore feed it into the grid through the setting of the phase shift factor. Feed-in management can be controlled directly by the grid company through a dedicated RS485 serial interface.

C. Limiting the active power fed into the grid

The inverter, if enabled can limit the amount of active power fed into the grid by the inverter to the desired value (Expressed as a percentage).

D. Self power reduction when grid over frequency

When the grid frequency is over limited value, inverter will reduce output power which does well to the grid stability.

E. Data transmission

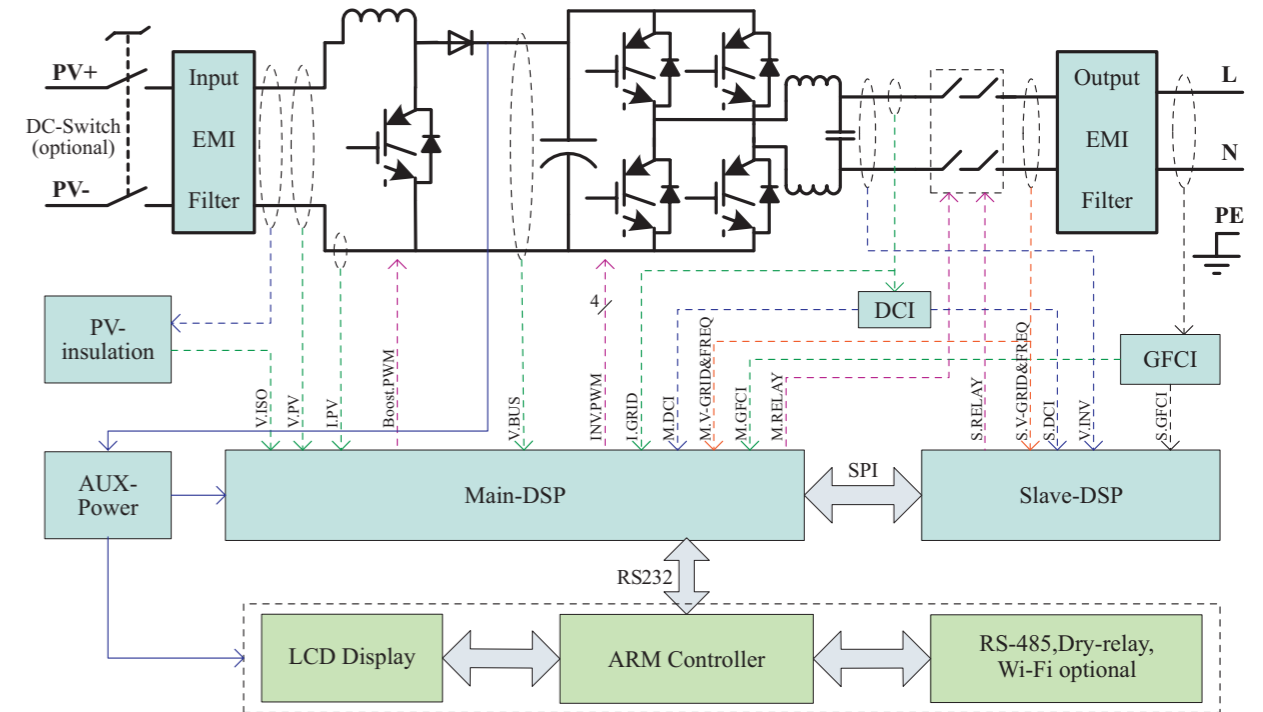
The inverter or a grid of inverters may be monitored remotely through an advanced communications system based on an RS-485 serial interface, or remotely via the WIFI.

F. Software update

SD card is used for updating the firmware.

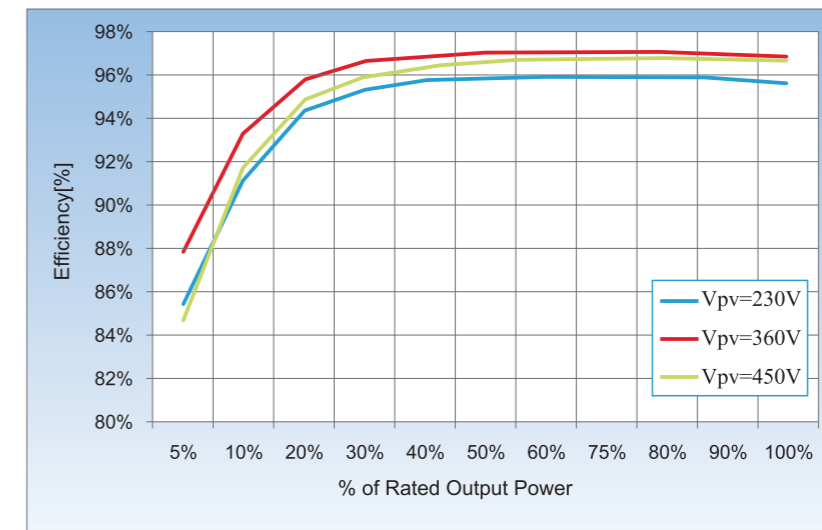
• Electrical block diagram

Figure2-4 Electrical block diagram



2.3 Efficiency curve

Efficiency curve of the SOFAR 3000TL






3 Installation

Outlines of this chapter

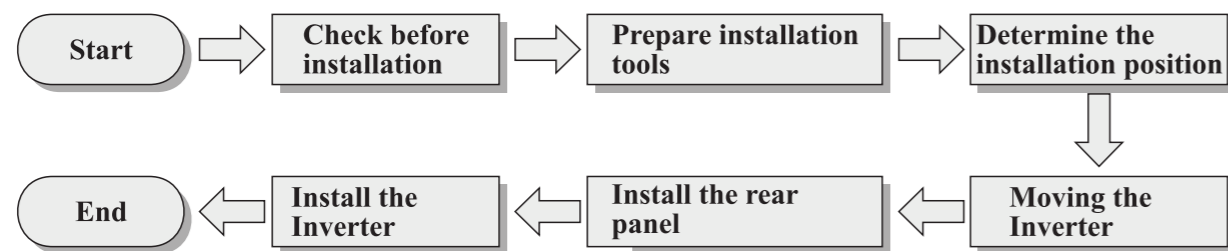
This topic describes how to install the Sunny Dog series inverter.

Installation notes

 Danger	<ul style="list-style-type: none"> Do not install the Sunny Dog series on flammable building materials. Do not store the Sunny Dog series in areas with flammable or explosive materials.
 Caution	Do not install the Sunny Dog series in places prone to body contact because the Sunny Dog series shelf and heat sinks become hot during the inverter operating.
 Attention	<ul style="list-style-type: none"> Take the Sunny Dog series weight into consideration when transporting and moving the Sunny Dog series. Install the Sunny Dog series in an appropriate position and surface.

3.1 Installation Process

Figure3-1 Installation flowchart



3.2 Checking Before Installation


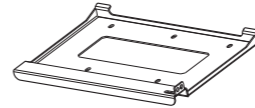
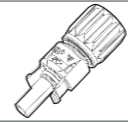

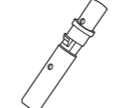
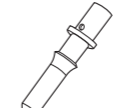
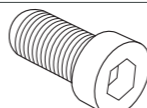
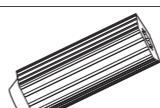
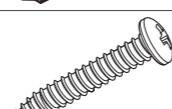



Checking Outer Packing Materials

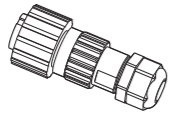
Packing materials and components may be damaged during transportation. Therefore, check the outer packing materials before installing the inverter. Check the outer packing materials for damage, such as holes and cracks. If any damage is found, do not unpack the Sunny Dog series and contact the dealer as soon as possible. You are advised to remove the packing materials within 24 hours before installing the Sunny Dog series inverter.

Checking Deliverables

After unpacking the inverter, check whether deliverables are intact and complete. If any damage is found or any component is missing, contact the dealer.

Table3-1 shows the components and mechanical parts that should be delivered

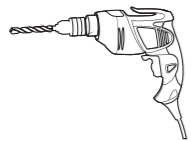
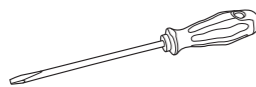
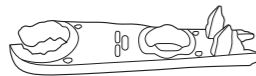
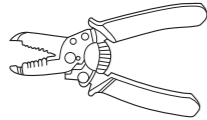
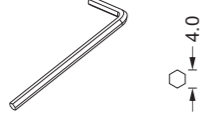
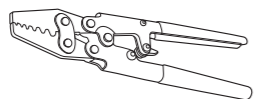
No.	Pictures	Description	Quantity
1		Sunny Dog Series	1 pcs
2		Rear panel	1 pcs
3		PV+ input terminal	1 pcs
4		PV-input terminal	1 pcs
5		Metal terminals secured to PV+ input power cables	1 pcs
6		Metal terminals secured to PV- input power cables	1 pcs
7		M5 Hexagon screws	2 pcs
8		Expansion bolts	7 pcs(spare 2pcs)
9		Self-tapping screw	5 pcs
10		Manual	1 pcs
11		The warranty card	1 pcs
12		Certificate	1 pcs

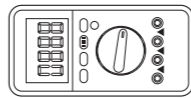

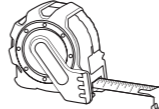
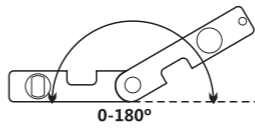
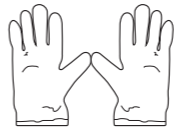


No.	Pictures	Description	Quantity
13		AC output terminal	1PCS

3.3 Tools

Prepare tools required for installation and electrical connections.

Table3-2 shows the components and mechanical parts that should be delivered

No.	Tool	Model	Function
1		Hammer drill Recommend drill dia. 6mm	Used to drill holes on the wall
2		Screwdriver	wiring
3		Removal tool	Remove PV terminal
4		Wire stripper	Strip wire
5		M4 Hexagon socket	Turn the screw to connect rear panel with inverter
6		Crimping tools	Used to crimp power cables

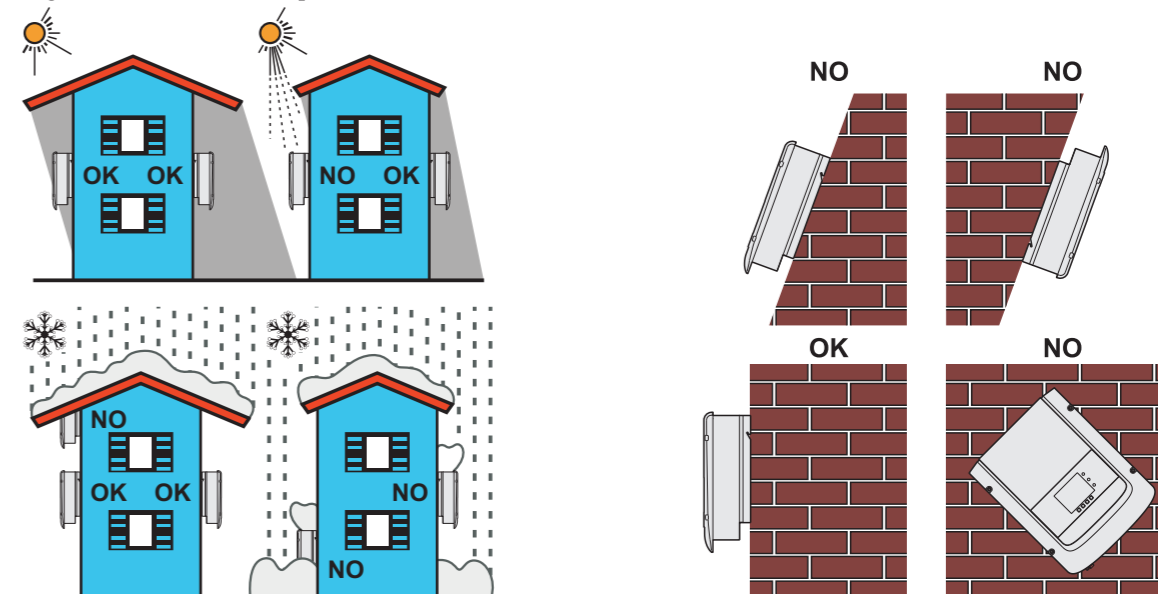
No.	Tool	Model	Function
7		Multi-meter	Used to check grounding
8		Marker	Used to mark signs
9		Measuring tape	Used to measure distances
10		Level	Used to ensure that the rear panel is properly installed
11		ESD gloves	Operators wear
12		Safety goggles	Operators wear
13		Anti-dust respirator	Operators wear

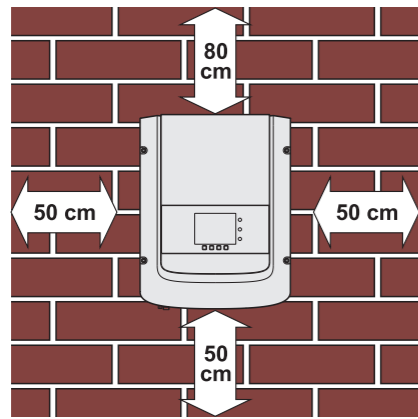
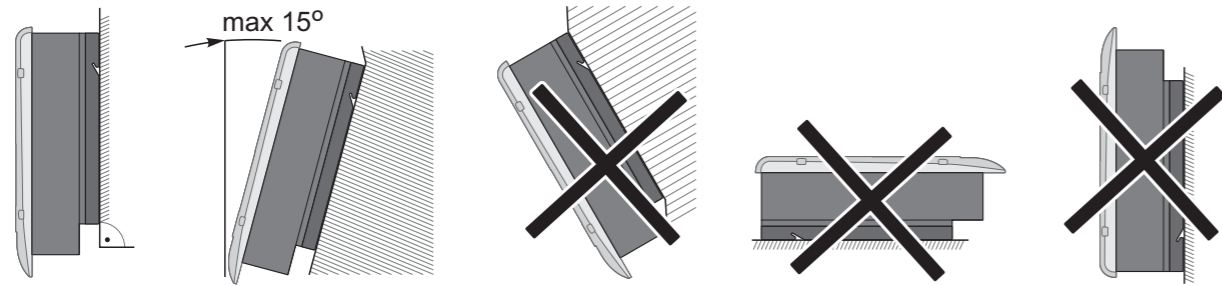
3.4 Determining the Installation Position

Determine an appropriate position for installing the Sunny Dog series inverter.

Comply with the following requirements when determining the installation position:

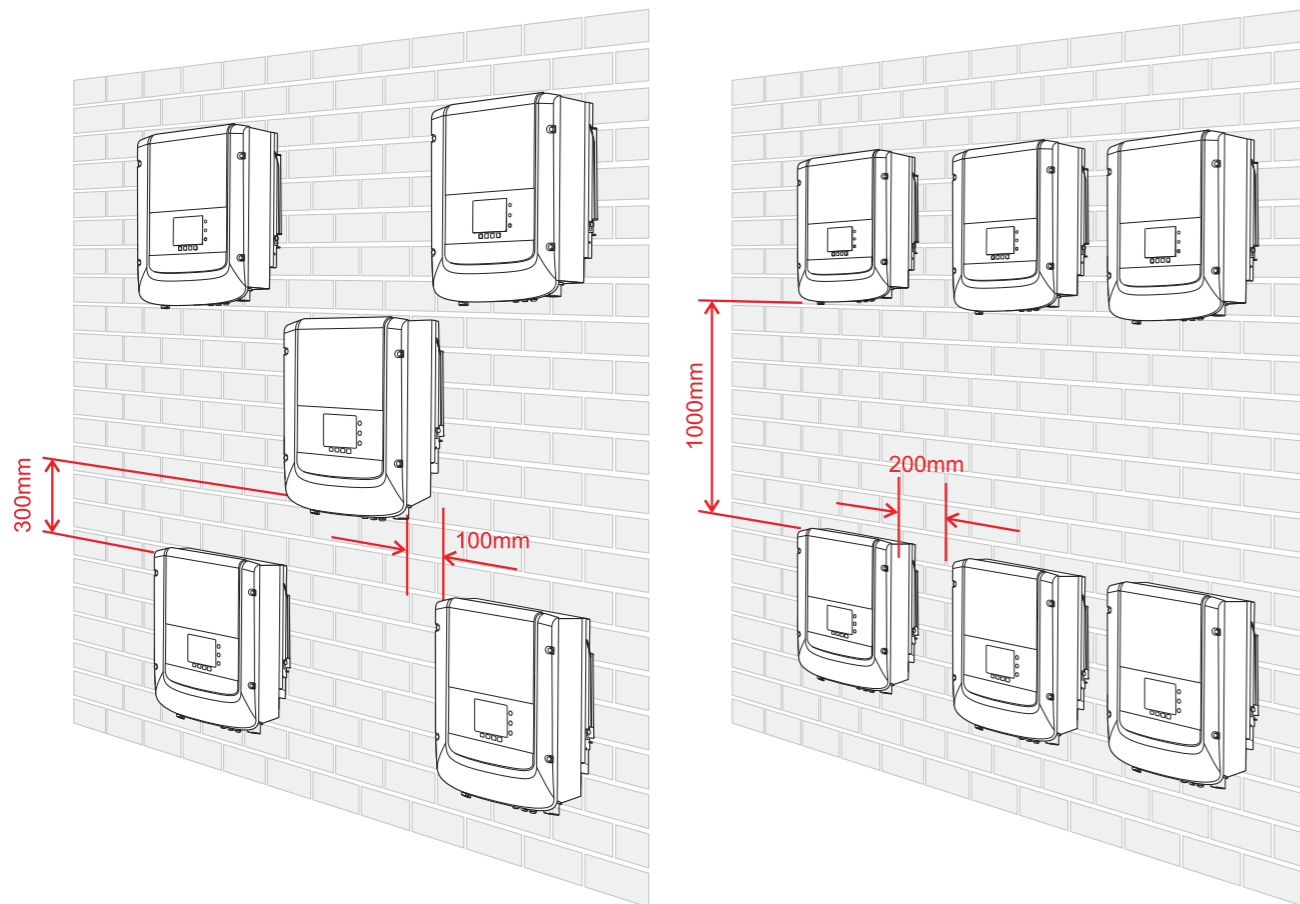
Figure3-2 Installation Requirements





Minimum installation distance for single Sunny Dog series

Many single Sunny Dog series installation



3.5 Moving the Sunny Dog series inverter

This topic describes how to move the Sunny Dog series to the installation position horizontally

Step 1 Opening the packing, insert hands into the slots on both sides of the Sunny Dog series and hold the handles, as shown in Figure 3-3 and Figure 3-4.

Figure 3-3 Moving the Sunny Dog series (1)

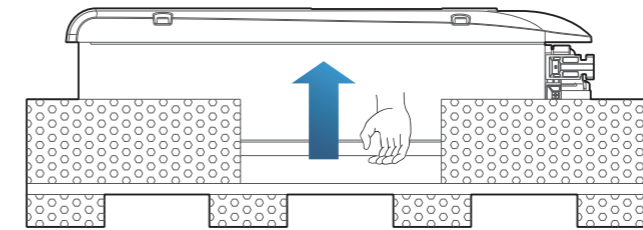
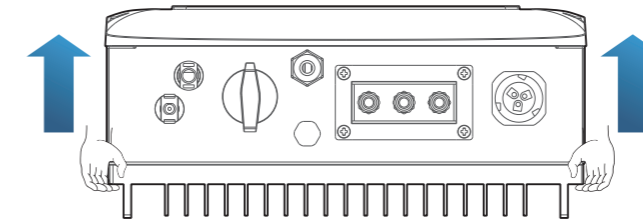


Figure 3-4 Moving the Sunny Dog series (2)



Step 2 Lift the Sunny Dog series from the packing case and move it to the installation position.

	<ul style="list-style-type: none"> To prevent device damage and personal injury, keep balance when moving the Sunny Dog series because the Sunny Dog series is heavy. Do not put the Sunny Dog series with its wiring terminals contacting the floor because the power ports and signal ports are not designed to support the weight of the Sunny Dog series. Place the Sunny Dog series horizontally. When placing the Sunny Dog series on the floor, put foam or paper under the Sunny Dog series to protect its shell.
--	--

Attention

--- End

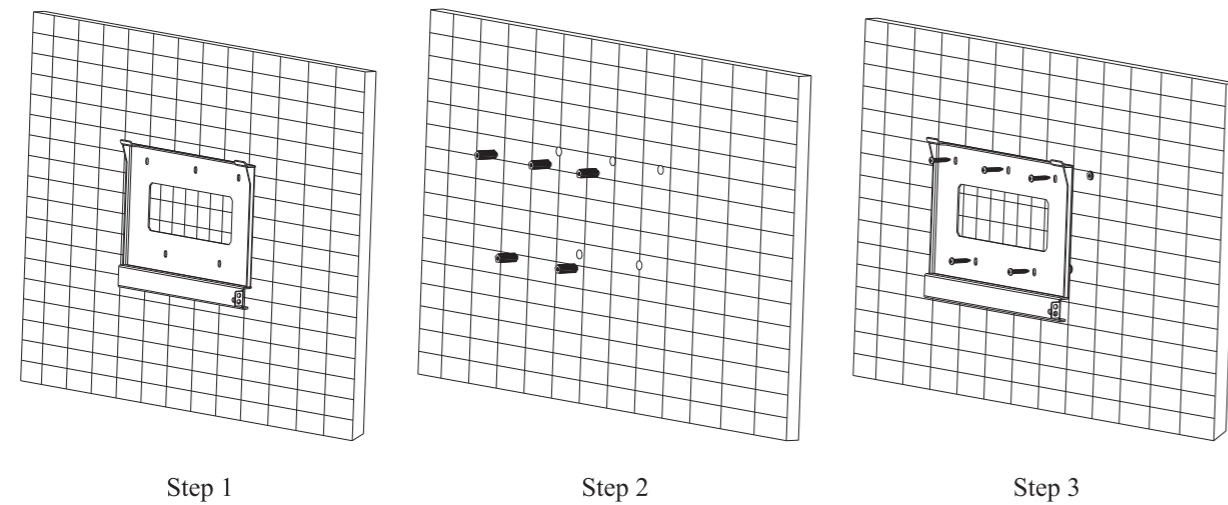
3.6 Installing Sunny Dog series inverter

Step 1 To determine the position for drilling holes, level hole positions, and then mark the hole position by using a marker, use the hammer drill to drill hole on the wall. Keeping the hammer perpendicular to the wall, do not shake when drilling, so as not to damage the walls. If the aperture errors, need to reposition.

Step 2 The expansion screw is vertically inserted into the hole, pay attention to expanding screw insertion depth (not too shallow).

Step 3 putting the rear panel on the wall, the rear panel is fixed by the nuts.

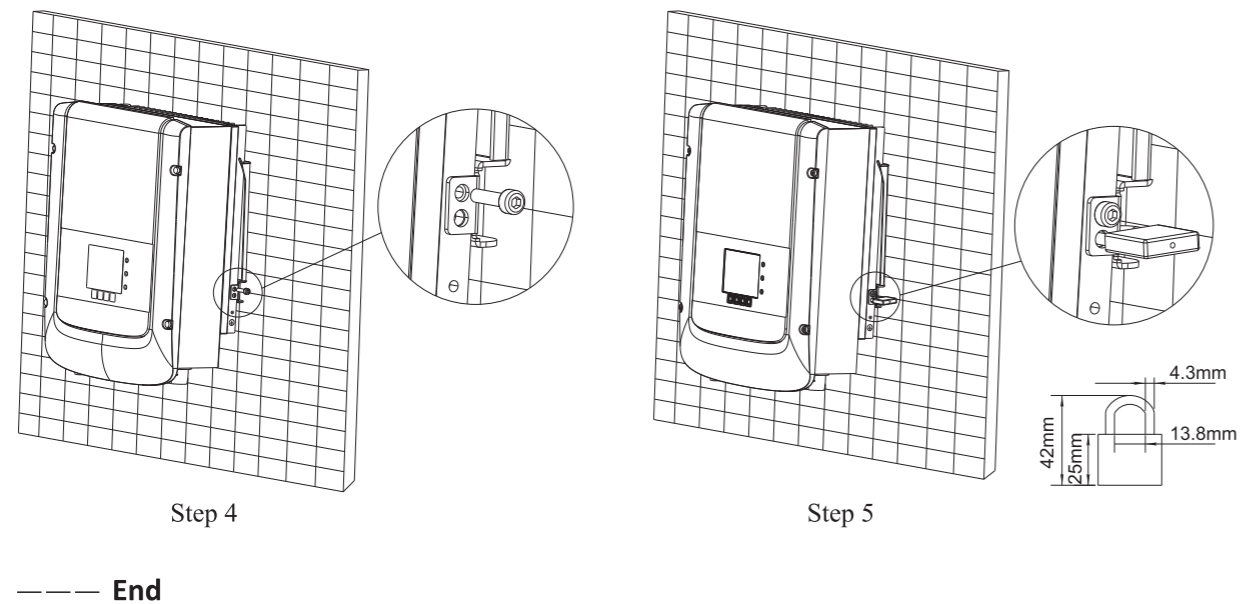
Figure 3-5



Step 4 putting the inverter hook on the rear panel. Using an M5 screw back and inverter bottom fastening, to ensure safety.

Step 5 Putting the rear panel and inverter to lock together, In order to ensure the safety (the user can select lock according to the actual situation).

Figure 3-6



--- End

4 Electrical Connections

Outlines of this chapter

This topic describes the Sunny Dog series inverter electrical connections. Read this part carefully before connecting cables.

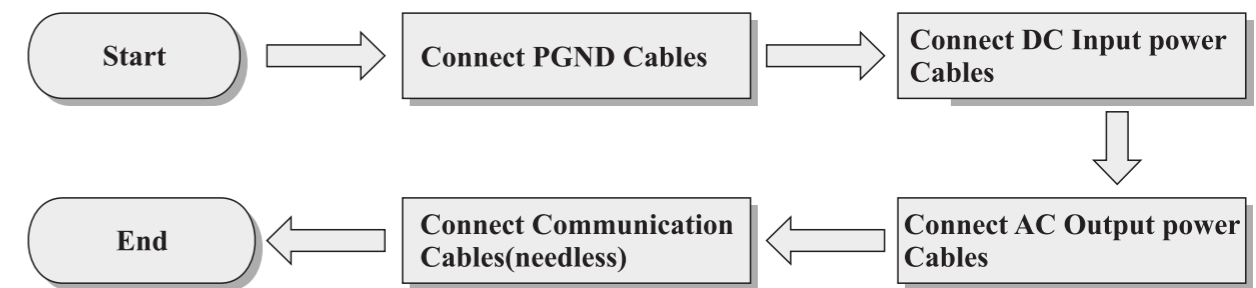
NOTE:

Before performing electrical connections, ensure that the DC switch is OFF. Since the stored electrical charge remains in a capacitor long after the DC switch is turned OFF. So it's necessary to wait for at least 5 minutes for the capacitor to be electrically discharged.

	Installation and maintenance of inverter, must be operated by professional electrical engineer.
Attention	
	PV modules generate electric energy when exposed to sunlight and can create an electrical shock hazard. Therefore, before connecting DC input power cable, cover PV modules using opaque cloth.
Danger	
	<ul style="list-style-type: none"> • Open-circuit voltage of module arrays connected in series must be $\leq 500V$. • The power of PV grid-tied system which contain by several the Sunny Dog Series inverters must be $< 3.68kw$ in Germany.
Note	

4.1 Electrical connection

Figure4-1 Shows the flowchart for connecting cables to the Sunny Dog series



4.2 Connecting PGND Cables

Connect the Sunny Dog series to the grounding electrode using protection ground (PGND) cables for grounding purposes.

	The inverter is transformer-less, Requires The positive pole and the negative pole of the PV array are not grounded, Otherwise it will cause inverter failure, In the PV power generation system, all non current carrying metal parts(such as: Bracket inverter shell) should be connected to earth.
Attention	

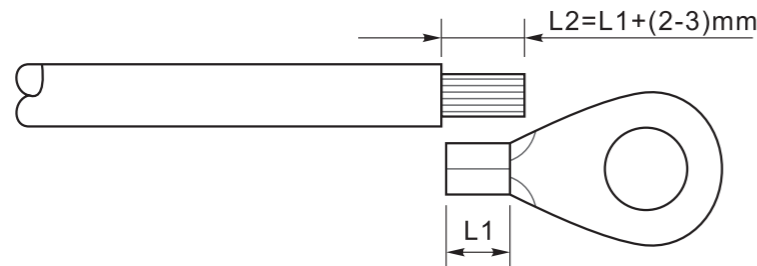
Prerequisites:

The PGND cables are prepared ($\geq 4\text{mm}^2$ outdoor power cables are recommended for grounding purposes),the color of cable should be yellow-green.

Procedure:

Step 1 Remove the insulation layer with an appropriate length using a wire stripper, as shown in Figure 4-2.

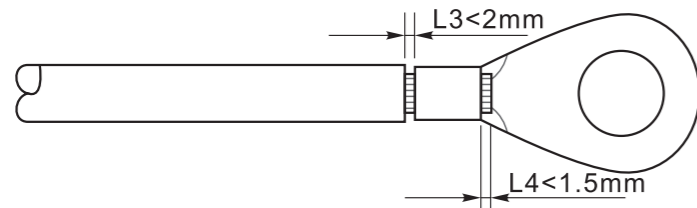
Figure4-2 Preparing a ground cable (1)



Note : L2 is 2 to 3mm longer than L1

Step 2 Insert the exposed core wires into the OT terminal and crimp them by using a crimping tool, as shown in Figure 4-3.

Figure4-3 Preparing a ground cable (2)

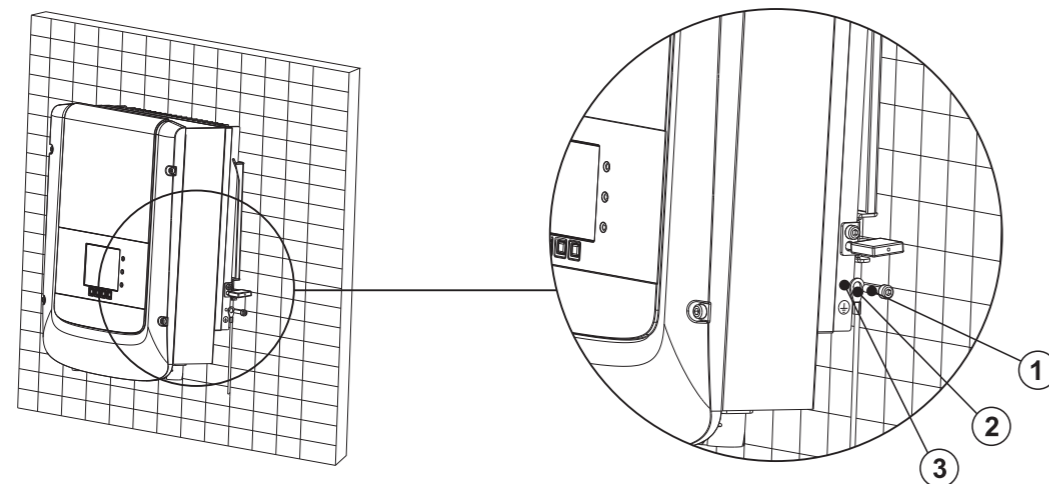


Note 1: L3 is the length between the insulation layer of the ground cable and the crimped part.L4 is the distance between the crimped part and core wires protruding from the crimped part.

Note 2: The cavity formed after crimping the conductor crimp strip shall wrap the core wires completely. The core wires shall contact the terminal closely.

Step 3 Install the crimped OT terminal, flat washer, and spring washer on the M5 welded stud, and tighten the nut to a torque of 3 N.m using a socket wrench.

Figure4-4 Ground terminal composition



1. M5 welded stud 2. OT Terminal 3. M5 Antiskid nut

--- End

4.3 Connecting DC Input Power Cables

Table 4-1 Recommended DC input cable specifications

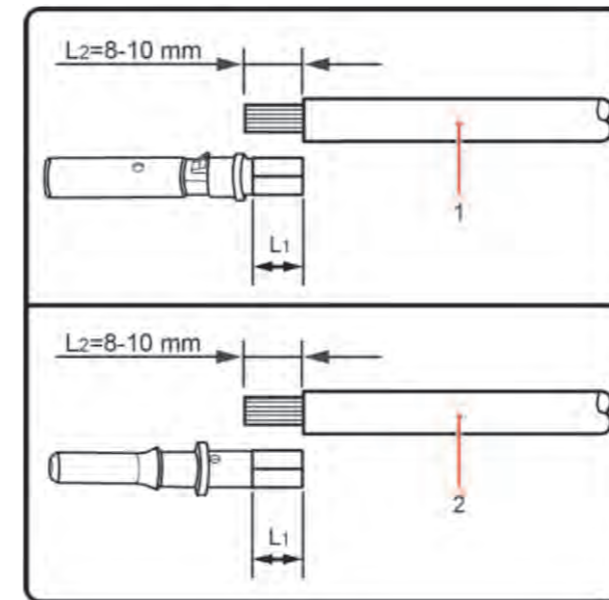
Cross-Sectional Area (mm ²)		External Cable Diameter(mm ²)
Range	Recommended Value	
4.0~6.0	4.0	4.5~7.8

Procedure

Step 1 Remove cable glands from the positive and negative connectors.

Step 2 Remove the insulation layer with an appropriate length from the positive and negative power cables by using a wire stripper as show in Figure 4-5.

Figure 4-5 Connecting DC input power cables



1. Positive power cable 2. Negative power cable



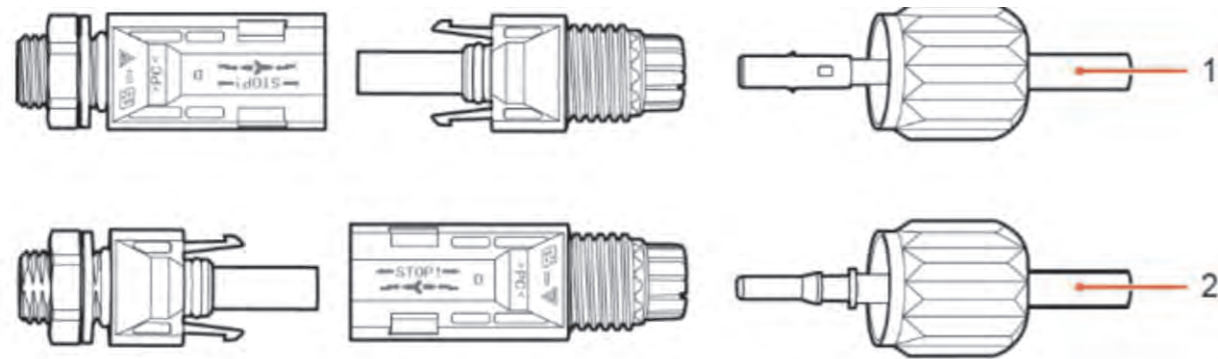
Note

L2 is 2 to 3 mm longer than L1.

Step 3 Insert the positive and negative power cables into corresponding cable glands.

Step 4 Insert the stripped positive and negative power cables into the positive and negative metal terminals respectively and crimp them using a crimping tool. Ensure that the cables are re-crimped until they cannot be pulled out by force less than 400 N, as shown in Figure 4-6.

Figure 4-6 Connecting DC input power cables



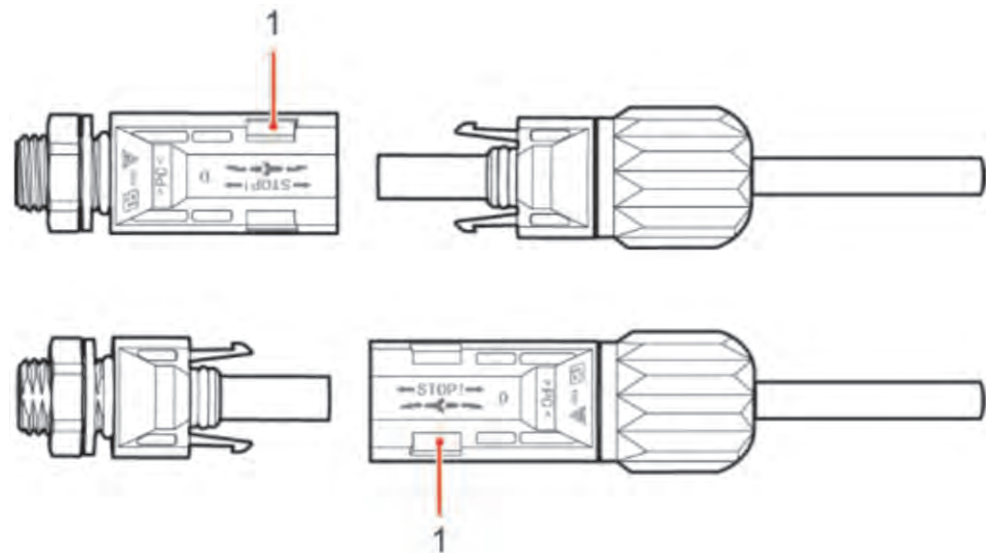
1. Positive power cable 2. Negative power cable

Step 5 Insert crimped power cables into corresponding housings until you hear a "click" sound. The power cables snap into place.

Step 6 Reinstall cable glands on positive and negative connectors and rotate them against the insulation covers.

Step 7 Insert the positive and negative connectors into corresponding DC input terminals of the Sunny Dog Series until you hear a "click" sound, as shown in Figure 4-7.

Figure 4-7 Connecting DC input power cables



1. Bayonet

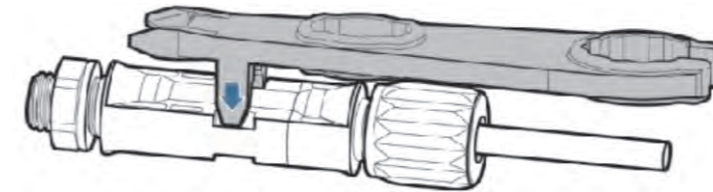
— — — End

Follow-up Procedure

To remove the positive and negative connectors from the Sunny Dog Series, insert a removal wrench into the bayonet and press the wrench with an appropriate strength, as shown in Figure 4-8.

	<p>Before removing the positive and negative connectors, ensure that the DC SWITCH is OFF.</p>
<p>Caution</p>	

Figure 4-8 Removing a DC input connector



4.4 Connecting AC Output Power Cables

Connect the Sunny Dog Series to the AC power distribution frame (PDF) or power grid over AC input power cables.

	<ul style="list-style-type: none"> • It is not allowed for several inverters to use the same circuit breaker. • It is not allowed to connect loads between inverter and circuit breaker. • AC breaker used as disconnect device, and the disconnect device shall remain readily operable.
<p>Caution</p>	

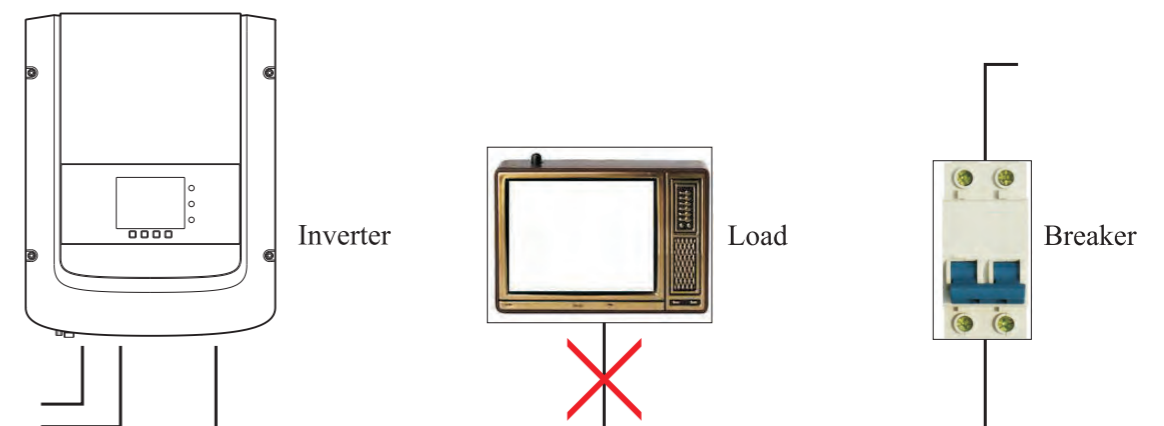
Context

All the AC output cables used for the inverters are outdoor three-core cables. To facilitate the installation, use flexible cables. Table 4-2 lists the recommended specifications for the cables.

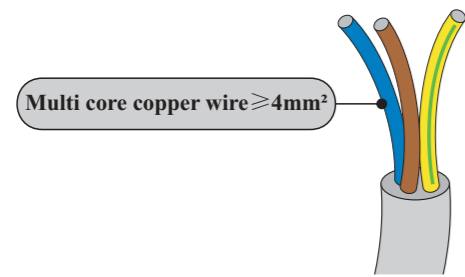
Table 4-2 Recommended AC output cable specifications

Type	Sofar 1100TL	Sofar 1600TL	Sofar 2200TL	Sofar 2700TL	Sofar 3000TL
Cable(Copper)	≥ 4mm ²	≥ 4mm ²	≥ 4mm ²	≥ 4mm ²	≥ 4mm ²
Breaker	16A/400V	16A/400V	25A/400V	25A/400V	25A/400V

Figure 4-9 NOT allowed: connect loads between inverter and circuit breaker

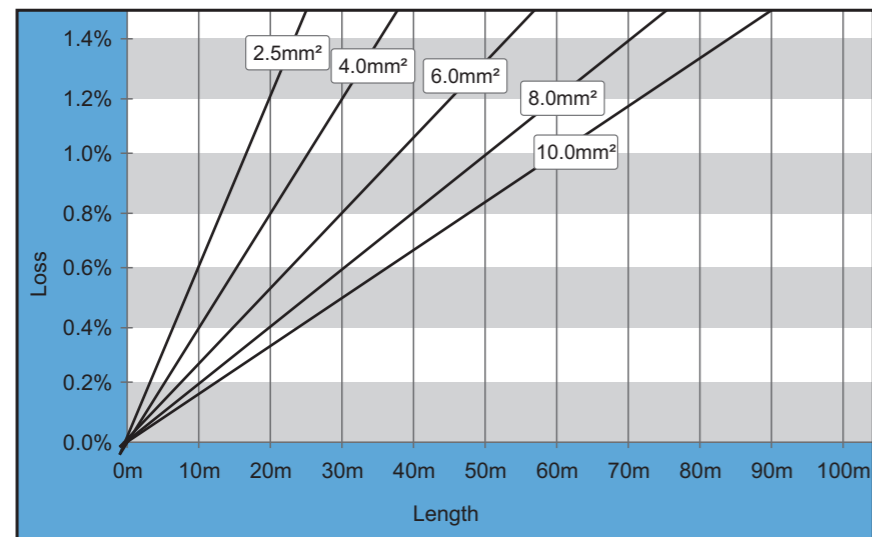


Multi core copper wire



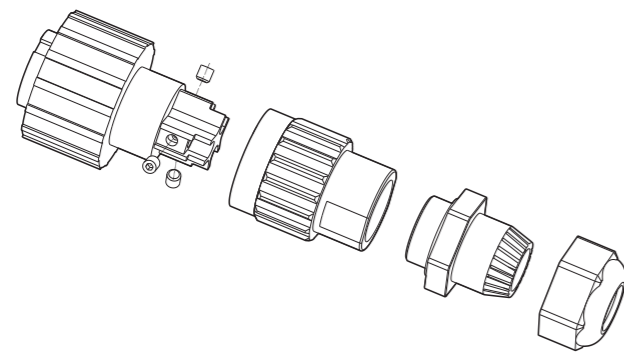
Impedance of inverter and grid contact must be less than 2Ω , In order to ensure the reliability of anti islanding function, should choose the PV cable and ensure line loss less than power 1%, From the inverter to the grid, the cable length should not exceed 150m. Below chart is cable .

Figure 4-10 length, section area and wire loss



SOFAR inverter is equipped with IP66 AC output connector dedicated for PV inverter, customer need to make AC output cable connections by himself, and the appearance of the AC connector is shown below:

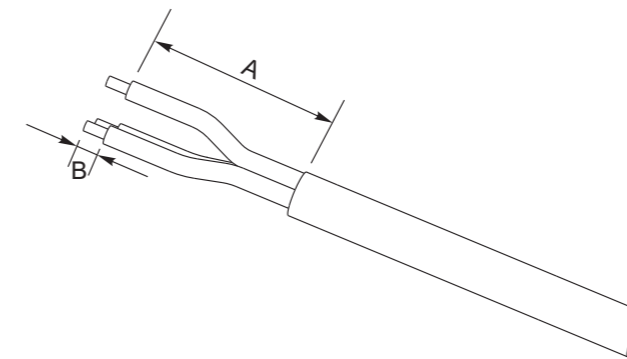
Figure 4-11 AC output connector



AC wire connections procedure:

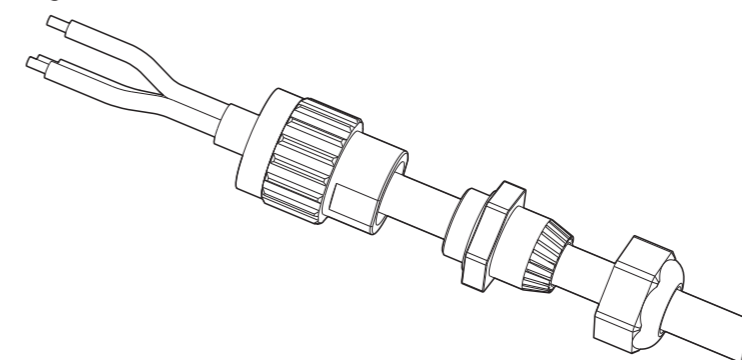
Step 1 Select appropriate cables according to Table 4-2, Remove the insulation layer of the AC output cable using a wire stripper according to the figure shown below: A: 30~50mm B: 6~8mm;

Figure 4-12



Step 2 Disassemble the AC connector according to the figure shown below: insert the AC output cable (with its insulation layer stripped according to step 1) through the waterproof locking cable gland;

Figure 4-13

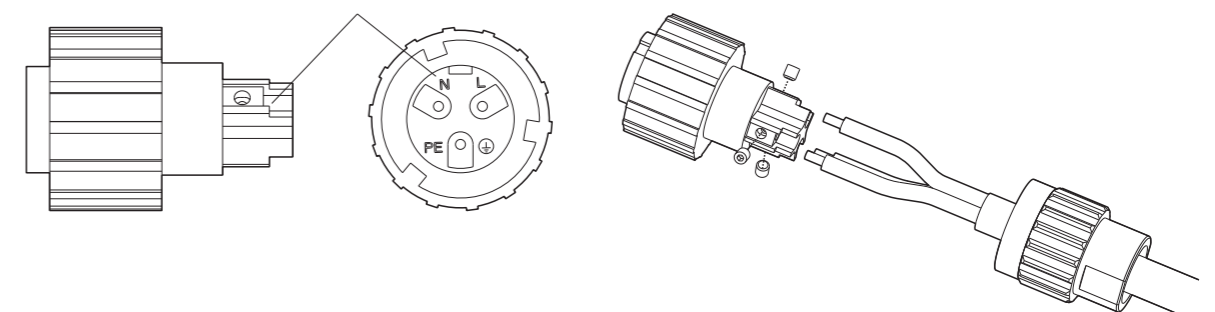


Step 3 Connect AC output cable as per the following requirements:

- Connect the yellow-green wire to the hole labeled 'PE', fasten the wire using an Allen wrench;
- Connect the brown wire to the hole labeled 'L', fasten the wire using an Allen wrench;
- Connect the blue wire to the hole labeled 'N', fasten the wire using an Allen wrench;

Figure 4-14

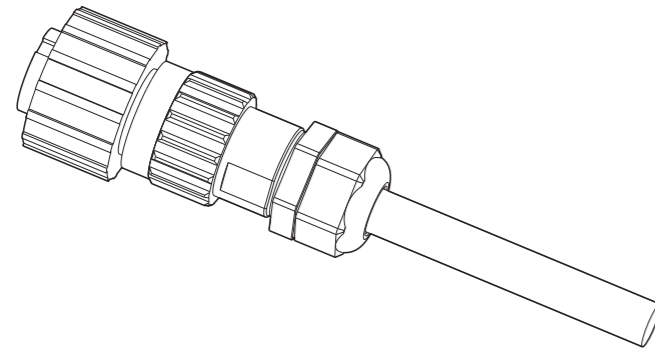
L--brown, N--blue, PE--yellow/green



Step 4 Secure the locking cable gland clockwise, shown as below: make sure that all the wires are securely connected;

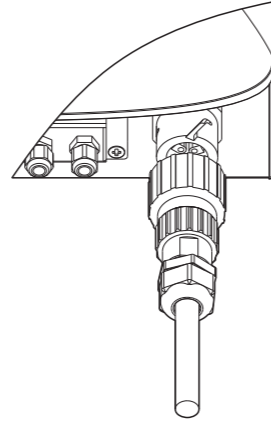
Step 5 Connect the AC output connector to the output wiring terminal of SOFAR inverter, rotate the AC connector clockwise until the fastener reaches its designated position, as shown below:

Figure 4-15



Step 4

Figure 4-16



Step 5

4.5 Connecting Communications Cables

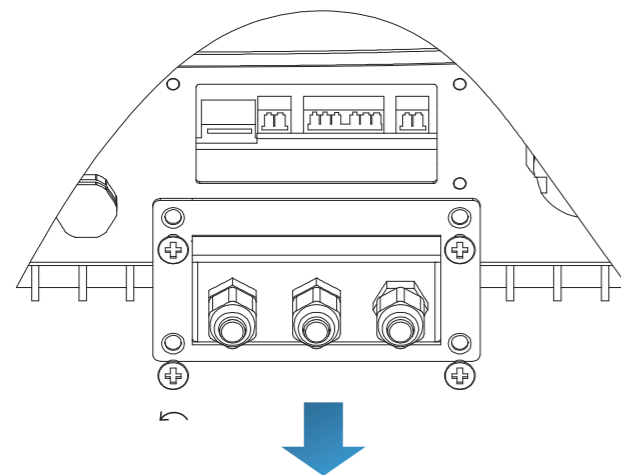
The wiring methods are the same for RS485, I/O and CT, this part describes their wiring methods all together:

Table4-3 Recommended communication cable sizes are shown below

Communication function	RS485	I/O	CT
Cable size	0.5~1.5mm ²	0.5~1.5mm ²	0.5~1.5mm ²
Outside diameter	2.5~6mm	2.5~6mm	2.5~6mm

Step 1 Remove the communication waterproof cover using a screwdriver;

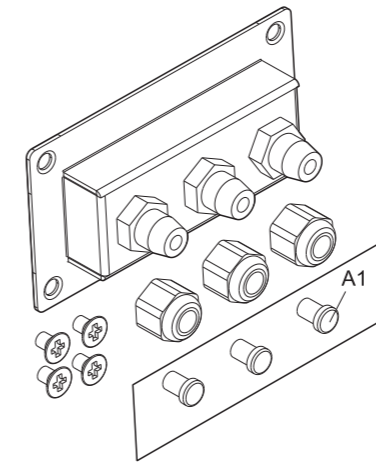
Figure 4-17



Step 2 Unlock the waterproof cable gland, remove the stopper in the waterproof connector;

Figure 4-18

A1 : Waterproof stopper

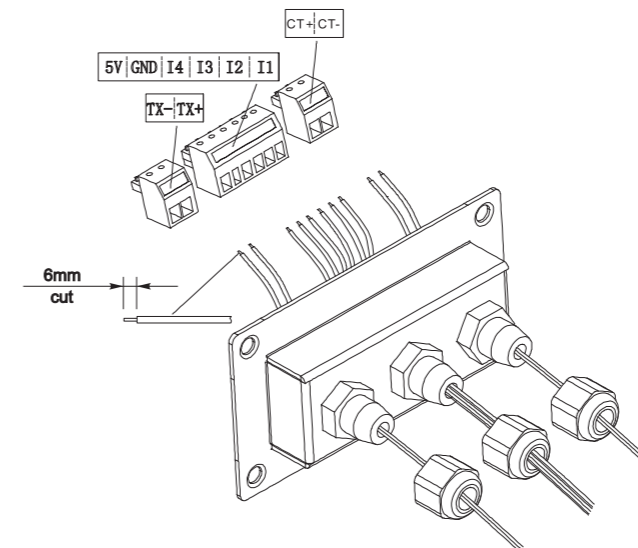


Note:

The waterproof connectors correspond to: I/O, dry contact, RS485 from left to right. Unlock the waterproof connectors according to the communication functions you are using. Do NOT unlock the unused connectors.

Step 3 Select appropriate cable according to Table 4-2, remove the insulation layer using a wire stripper, the length of the wire core is about 6mm, insert the cable through the cable gland and waterproof cover, as shown in the figure below:

Figure 4-19



Step 4 Choose the terminal according to Table 4-4, connect the wires as per the labels, and secure the wires using a slotted screwdriver.



Note:

keep the unused terminals for future use.