

Installation and user manual

ON GRID SOLAR PV INVERTER

SIRIO-ES 50/60



INTRODUCTION

Thank you so much for choosing SIRIO-ES 50 / SIRIO-ES 60 the latest generation of hybrid PV string inverters (hereinafter referred to as “inverter”) designed and developed by Riello Solartech.
Our company is specialised in the development and production of photovoltaic inverters. The solar inverters in this series are high-quality products, carefully designed and constructed with the aim of ensuring high performance.

This equipment can be used by any person, provided they **READ THIS MANUAL CAREFULLY AND THOROUGHLY**.

This user manual introduces the inverter in terms of its installation, electrical connections, operation, commissioning, maintenance, and troubleshooting.

For information regarding use and to obtain maximum performance from your equipment, this manual should be stored carefully near the inverter and CONSULTED BEFORE OPERATION.

NOTE: some images contained in this document are for information purposes only and may not faithfully reproduce the parts of the product represented.

Application Model

Inverter PV on-grid:

- **SIRIO-ES 50**
- **SIRIO-ES 60**

Intended Recipients

This user manual is intended for photovoltaic (PV) inverter operating personnel and qualified electrical technicians.

Note:

this user manual is subject to change without prior notice. The latest version of the user manual and additional information on the product are available on <http://www.riello-solartech.com>, and/or by consulting your dealer.

Symbol Conventions

The safety symbols used in this manual, which highlight potential safety risks and important safety information, are listed below:

Symbol	Description
 DANGER	Indicates an imminently hazardous situation which, if not correctly followed, will result in serious injury or death.
 WARNING	Indicates a potentially hazardous situation which, if not correctly followed, could result in serious injury or death.
 CAUTION	Indicates a potentially hazardous situation which, if not correctly followed, could result in moderate or minor injury.
 NOTICE	Indicates a potentially hazardous situation which, if not correctly followed, could result in equipment failure or property damage.
 NOTE	Calls attention to important information, best practices and tips: supplements the safety instructions to optimise your use of the PV inverter and reduce wastage of resources.
	Refer to documentation (Remind operators to refer to the documentation shipped with the inverter).

SAFETY PRECAUTIONS

Before using the product, please read these safety precautions in the User Manual carefully.

Personnel Safety

- The PV inverter must be installed, electrically connected, operated and maintained by a specially trained technician.
- The qualified technician must be familiar with the safety regulations concerning the electrical system, the working process of the PV power generation system and the standards of the local power grid.
- The technician must read through this User Manual carefully and master it before any operation.

PV Inverter Protection

	NOTICE	Upon receiving the PV inverter, please check whether it was damaged during transport. If it was, please contact your dealer immediately.
---	---------------	--

- Do not tamper with any warning signs on the inverter's enclosure, because these signs contain important information on safe operation.
- Do not remove or damage the nameplate on the inverter's enclosure, because it contains important product information.

Installation Safety

	NOTICE	Please read the User Manual carefully before installing the PV inverter; warranty or liability will be voided if damage is caused by installation faults.
---	---------------	---

- Ensure that there are no electrical connections around the PV inverter ports prior to installation.
- Adequate ventilation must be provided in the inverter's installation location. Mount the inverter in the vertical direction and ensure that no object is placed on the heat sink, as this may affect the cooling efficiency (for details, refer to the Installation chapter).

Electrical Connections

	DANGER	Before installing the inverter, check all electrical ports to ensure that there are no damages or short-circuits. Otherwise, personal injury and/or fire will occur.
---	---------------	--

- Input terminals of the PV inverter apply only to input terminals of the PV string; do not connect any other DC source to the input terminals.
- Before connecting PV modules, ensure that their voltage is within the safe range; when exposed to any sunlight, PV modules can generate high voltage.
- All electrical connections must meet the electrical standards of the relevant country or region.
- Cables used for electrical connections must be properly secured, well-insulated and made to the appropriate specification.

Operation and Commissioning

	DANGER	While the inverter operates, high voltage can lead to an electrical shock hazard and even cause personal injury. Therefore, operate the PV inverter strictly according to the safety precautions in this User Manual.
---	---------------	---

- Unless permission has been obtained from the power company of the country/region, the grid-tied PV inverter cannot start generating power.
- Follow the procedures for commissioning described in the User Manual when commissioning the PV inverter.
- When the PV inverter is operating, do not touch the surface of any other parts except for the DC switch; its constituent parts will be extremely hot and can cause burns.

Maintenance

	DANGER	Power OFF all electrical terminals before performing inverter maintenance; strictly comply with the safety precautions stated in this document when operating the inverter.
---	---------------	---

- For personal safety, maintenance personnel must wear appropriate personal protective equipment (such as insulation gloves and protective shoes) for inverter maintenance operations.
- Place temporary warning signs or erect fences to prevent unauthorised access to the maintenance site.
- Strictly follow the maintenance procedures specified in the User Manual.
- Check the relevant safety and performance of the inverter; rectify any faults which may compromise the safe operation of the inverter before restarting it.

Additional Information

	NOTICE	To avoid any other unforeseeable risk, contact the dealer immediately if any safety issue emerges during operation.
---	---------------	---

PROTECTING THE ENVIRONMENT

Our company has devoted extensive resources to the analysis of environmental aspects in the development of our products. All our products pursue the objectives set out in the environmental management system policy, developed by our company in accordance with current legislation.

This product does not contain hazardous materials such as CFCs, HCFCs or asbestos.

Product packaging is made from RECYCLED MATERIALS. The disposal of individual components must be performed in accordance with current legislation in the country where the product is used. Refer to the following table for material identification:

DESCRIPTION	MATERIAL	
Packing box	Corrugated cardboard (PAP)	
Protective bag	High-density polyethylene (HDPE)	
Foam	Low-density polyethylene (LDPE)	

LIMITED GUARANTEE

The equipment you have purchased has been constructed according to the most modern techniques and was rigorously tested before leaving the factory.

During the guarantee period, the manufacturer shall repair or replace parts that prove defective, provided that such defects have not been caused by incompetence or negligence of the buyer, fortuitous events or force majeure (lightning, fire, flood, etc.), incorrect or inadequate installation other than as stated in the manual, unsuitable transport or delivery, opening of the unit by unqualified personnel or breaking of the closure seal, modification, testing or unauthorised repair, use or application beyond the limits defined by the manual, or application beyond those defined by safety standards (VDE, UL, etc.).

It is the responsibility of the person applying for technical assistance from Customer Service to provide detailed information about the detected failure or malfunction.

The repair and/or replacement of parts or the device shall be implemented at the discretion of the supplier.

Any repair under guarantee will be performed by the manufacturer or an authorised service centre. Equipment must arrive at the risk and expense of the customer in its original packaging so as not to cause further damage.

If repairs must be performed directly at the customer's premises, the customer shall be charged for expenses and hours of travel, while the costs for labour and parts shall be borne by the manufacturer. This guarantee does not in any case cover the replacement of equipment or compensation for any direct or indirect costs or claims for damage caused by device malfunction.

CONTENTS

PRESENTATION	7
Product Presentation	7
INSTALLATION	10
Preliminary Checks	10
Electrical Connections	16
USE	29
System operation	29
Maintenance	33
Troubleshooting	34
Storage	36
Deposing of the inverter	37
APPENDIX	38
Technical Specification	38

PRESENTATION

PRODUCT PRESENTATION

This chapter introduces the inverter and describes its functional model, network application, appearance, dimensions and working process, etc.

Functional Model

Function

This series consists of a three-phase grid-tied PV string inverter (transformer less) which converts the DC power generated by PV strings into AC power and feeds the power into the power grid.

 WARNING	The inverter is transformer less: if the positive/negative terminal of PV strings has to be connected to ground (i.e., thin-film module), it is mandatory to install an external isolation transformer to ensure proper operation.
 WARNING	Do not connect PV modules in parallel to several PV inverters for operation.

Model Description

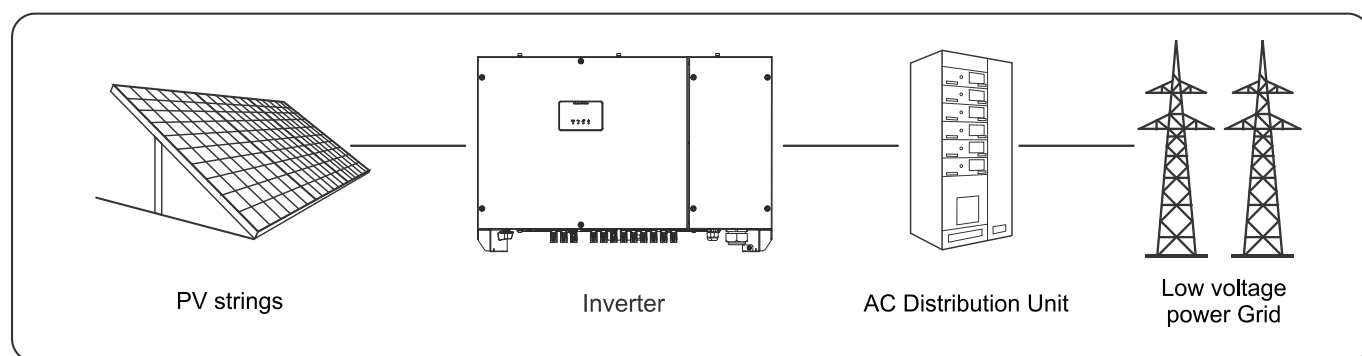
The number in the model's name indicates the power class of the inverter, for example:

SIRIO-ES 50 _____ Power class 50kW

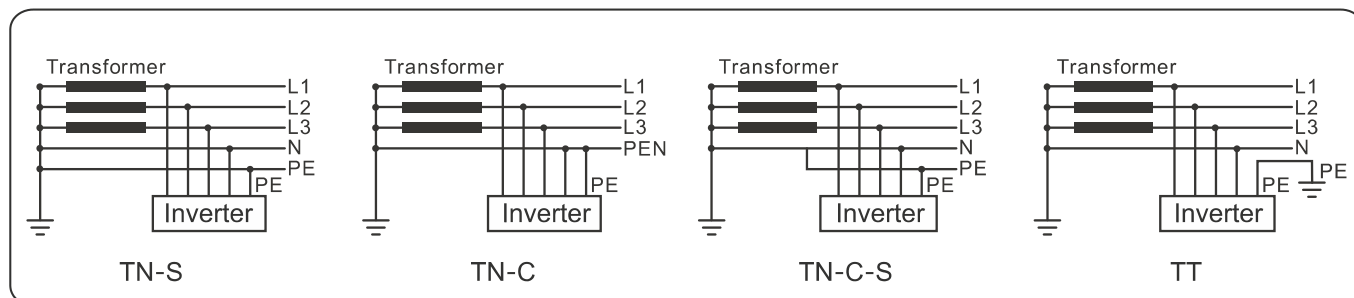
Network Application

Grid-tied PV Power Systems

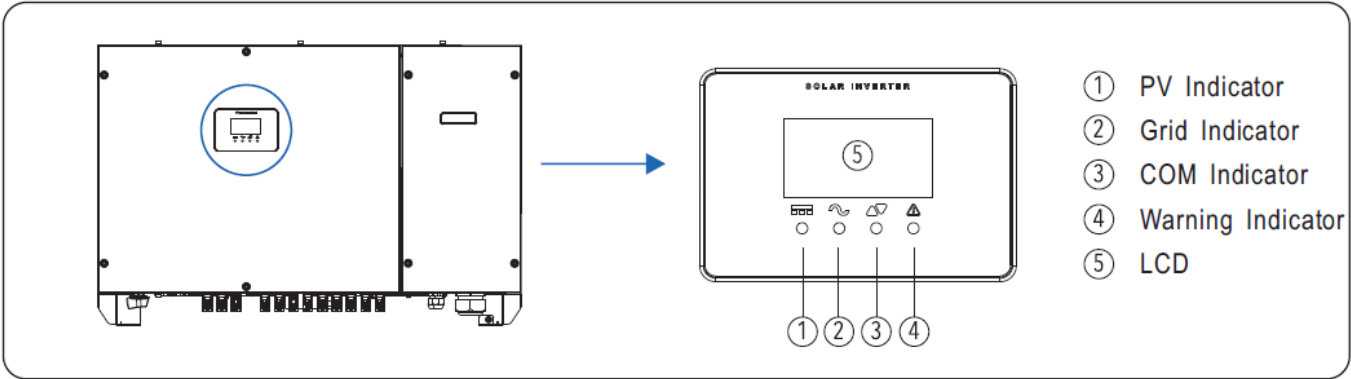
The series include grid-tied PV power systems for industrial/commercial rooftops, light complementary power generation systems, and large ground-based power stations. Typically, a grid-tied PV power system consists of PV modules, grid-tied inverters, AC distribution units and a low-voltage power grid, as shown in the figure below:



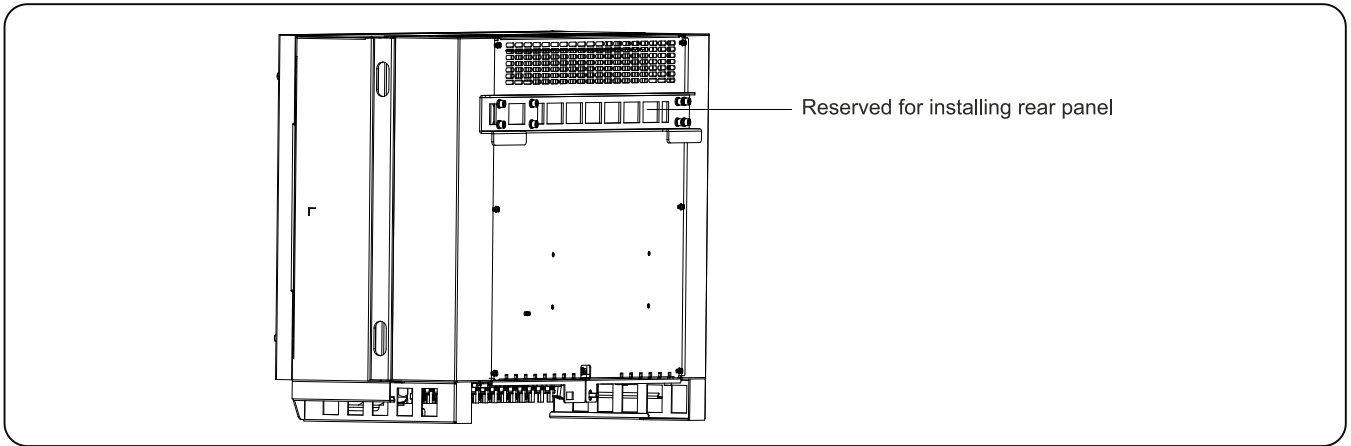
These series inverters support TN-S, TN-C, TN-C-S, and TT power grids as shown in the figure below:



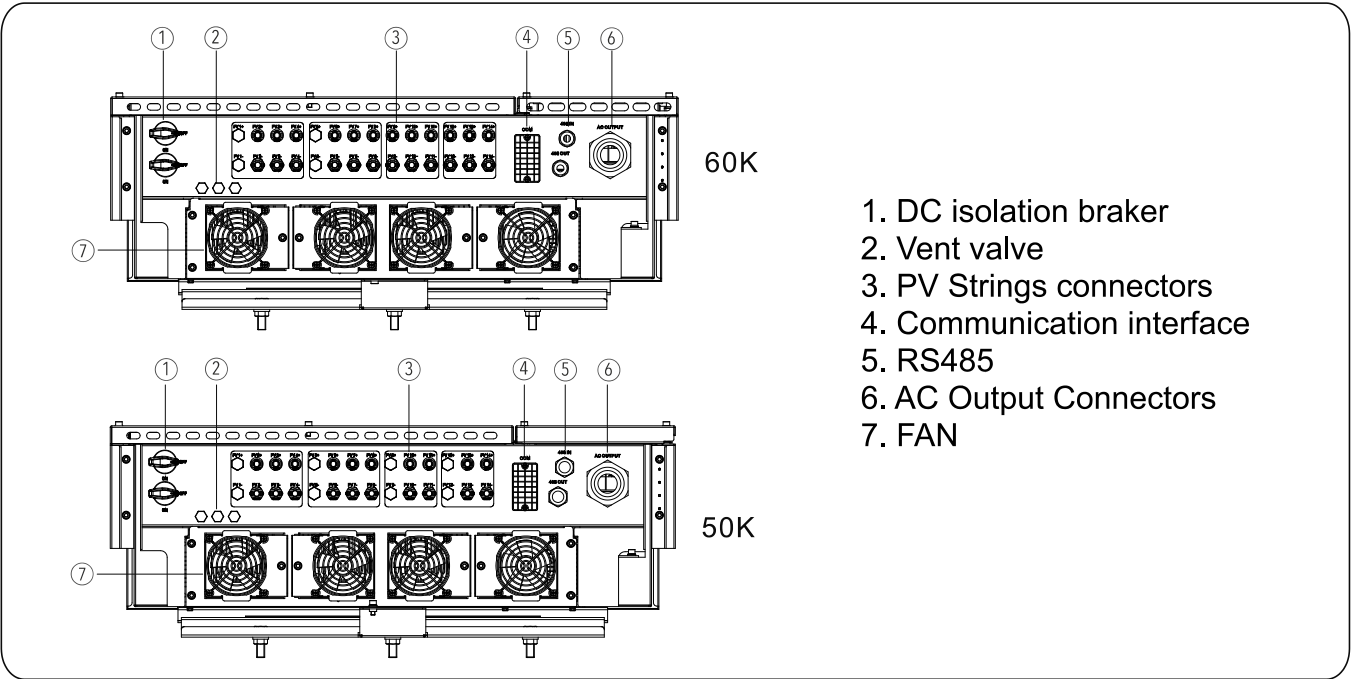
Outline and dimensions



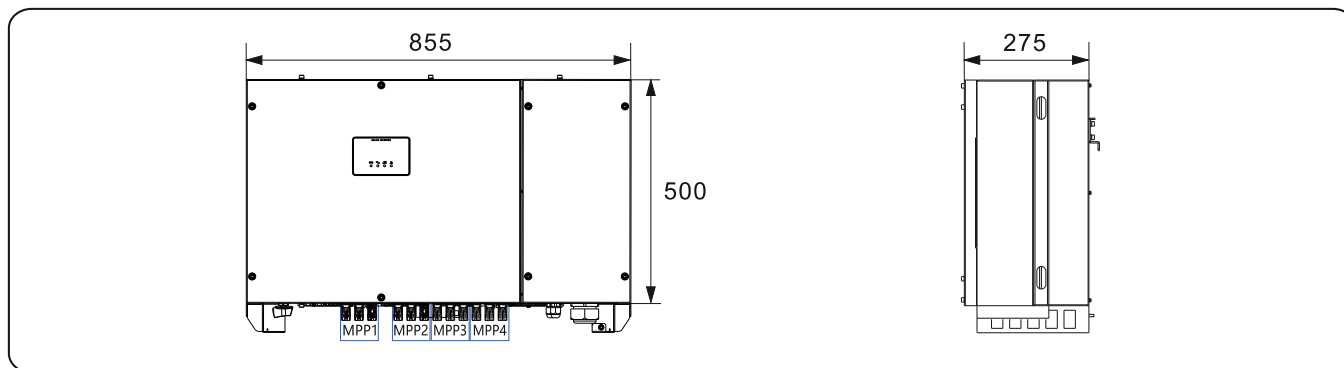
Front view and LED panel indicators detail



Rear quarter view of this series inverter



Bottom view of this series of inverter



Dimensions of this series (unit: mm)

Working Modes

The operating modes of the inverter are described below: stand-by, operation, and shutdown.

The table below shows the conditions for the inverter to switch between operating modes.

Modes	Description
Stand-by	The PV inverter enters the standby mode when - the input voltage of PV Strings can enable auxiliary power supply to run but cannot meet the inverter operation requirements. - the input voltage of PV Strings can meet the inverter to-start requirements but cannot meet its minimum power requirements. - No grid connection standard has been selected.
Operating	When the PV inverter is grid-tied and generates electricity, it - tracks the maximum power point to maximize the PV String output. - converts DC power from PV strings into AC power and feeds the power to the power grid. The PV inverter will enter to the shutdown mode if detecting a fault or a shutdown command.
Shutdown	The PV inverter switches from standby or operating mode to shutdown mode if detecting a fault or a shutdown command. The inverter switches from shutdown mode to standby mode if receiving a Start-up command or detecting that a fault is rectified.

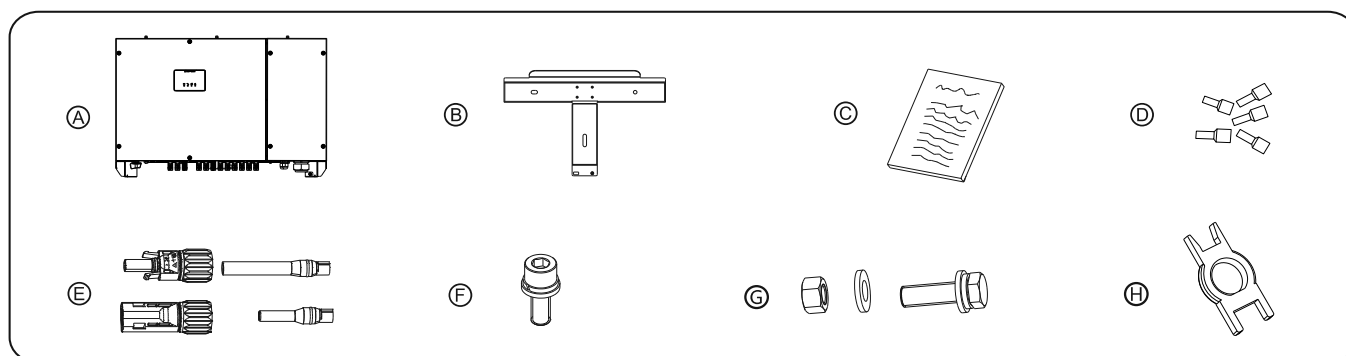
INSTALLATION

PRELIMINARY CHECKS

 DANGER	Do not install the inverter on flammable building materials or in an area that stores flammable or explosive materials.
 CAUTION	Do not install the inverter in a place where personnel are likely to come into contact with its enclosure and heat sinks to avoid electrical shock/burn.

Checking the Outer Packing

- When receiving the inverter, check that the packing materials are intact.
- After unpacking, check that the deliverables are complete, intact, and consistent with your order list.
- Examine the PV inverter and its fittings for damage such as scraps and cracks.

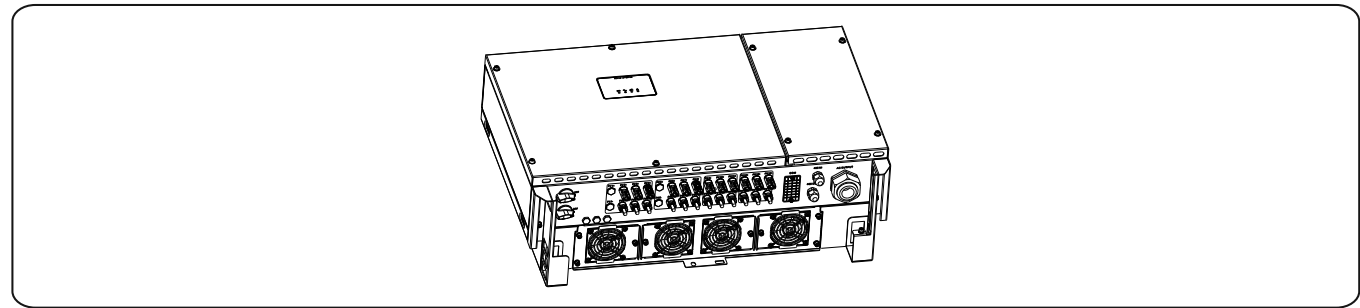


ITEMS	Deliverables
A	PV Inverter
B	Rear panel
C	File package
D	Insulated end sleeve terminal
E	DC terminal connector group
F	M6 screw
G	Bolt group for tightening to the rear panel (including screw, nut) *3
H	Removal tool for DC connector

 AVVISO	If you find any missing or damaged parts, contact your dealer immediately.
--	--

Moving the inverter

After checking the outer packing, move the PV inverter to the designated installation position horizontally. Hold the handles on both sides of the inverter, as show below:



Moving the inverter

	CAUTION	The inverter is relatively heavy! To prevent device damage and personal injury, three people or assistance is required to lift and/or move the inverter. Handle with care.
	CAUTION	Do not place the PV inverter with its wiring terminals contacting the floor because the power ports and signal ports at the bottom of the device are not designed to support the weight of the inverter. When placing the inverter on the floor horizontally, put foam or paper under to protect its enclosure.

Identify the PV Inverter

Nameplate

After moving the PV inverter from packing box, identify it by reading its nameplate labelled on the side of the inverter. The nameplate contains important product information: the model information, communications/technical specification and compliance symbols.

	Risk of electric shock The device contains high voltages, both alternating and direct current, and high leakage currents may be generated during operation. To avoid the risk of electric shock during maintenance or installation, make sure that all DC and AC connection terminals are disconnected. First connect the grounding wire to ground and disconnect it last during maintenance. Check for the proper phases and neutral connection. If the unit is used without following the specifications of the manufacturer, the protection provided by the equipment may be impaired. Disconnect the inverter from the grid, the batteries and from the photovoltaic generator before cleaning the photovoltaic modules: an unexpected capacitive current from the surface of the modules may surprise operators, causing them to fall off the roof.
 	Handling the photovoltaic inverter The photovoltaic inverter must only be handled by qualified service personnel. When the photovoltaic generator is exposed to sufficiently intense light, it generates DC voltage, and when connected to the device, it charges the bulk capacitor. This also applies to batteries if present. After having disconnected the photovoltaic inverter from the grid, batteries and the photovoltaic generator, an electric charge may remain in the bulk capacitor. Please wait at least 10 minutes after disconnecting the device from the grid before handling it.
	Exclusively for the grid The PV inverter is designed for the sole purpose of converting energy from PV modules and injecting it into the grid. This inverter is not designed to be powered by sources of primary energy other than PV modules or to be connected to different loads other than the public grid.
	Hot surfaces Although it has been designed in accordance with international safety standards, the photovoltaic inverter may become hot during operation.
	Disposal If the inverter service life has expired, dispose it in accordance with local rules for disposal of electrical equipment waste. Do not dispose the PV inverter with household garbage.
	TÜV Certification The PV inverter is compliant with TUV.

Installing Requirements

According to installation position, two kinds of physical installation are described below in detail: Support-mounting & wall-mounting.

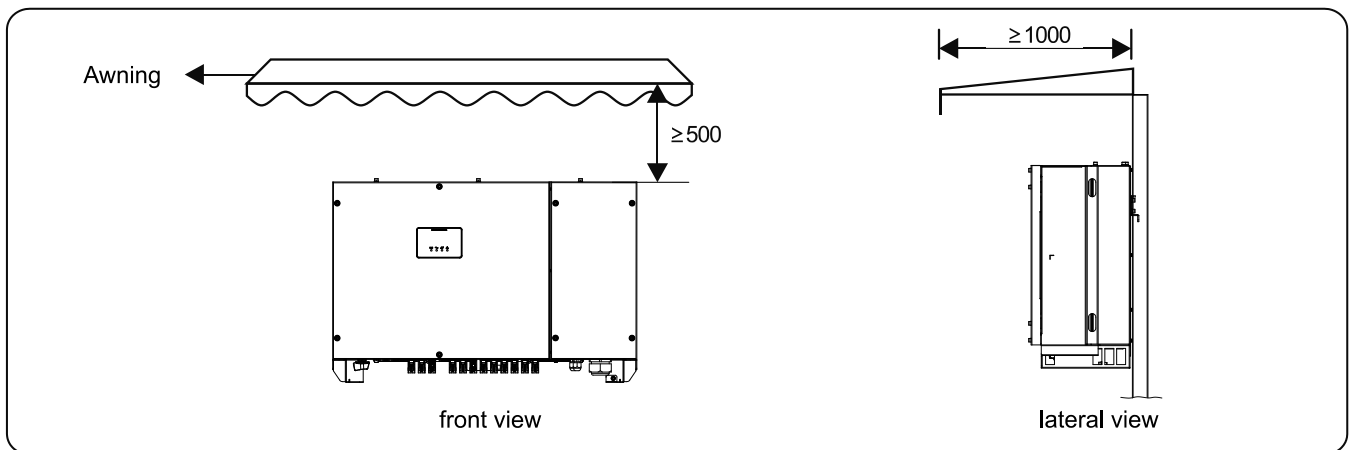
Determining the Installation Position

Basic requirements

- The inverter is protected to IP65 and can be installed indoors or outdoors.
- The installation method and position must be appropriate for the weight and dimensions of the inverter.
- Do not install the inverter in a place where personnel are likely to come into contact with its enclosure and heat sinks because these parts are extremely hot during operation.
- Do not install the inverter in an area that stores flammable or explosive materials.

Installation Environment Requirements

- The ambient temperature must be below 50℃ which ensures the inverter's optimal
- The inverter must be installed in a well-ventilated environment to ensure good heat dissipation.
- To avoid shortening the device's lifespan, the inverter must be installed away from direct sunlight, rain, and snow. If no shelter is available, build an awning, as shown in Figure



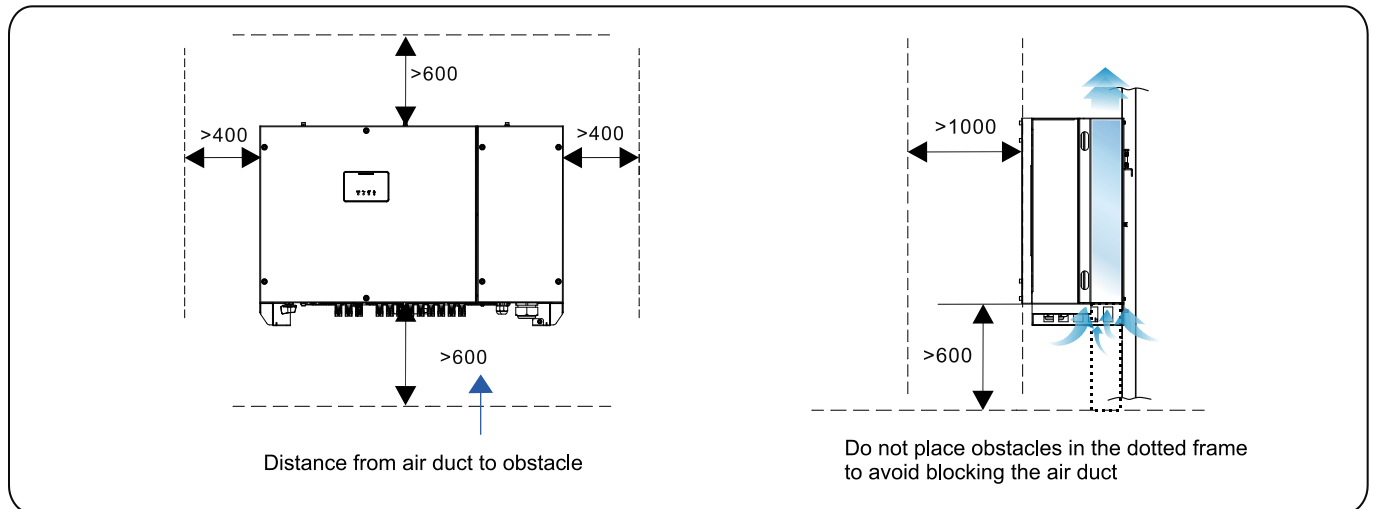
Installation environment with (unit: mm)

Carrier Requirements

- The carrier where the inverter is installed must be fire-proof. Do not install the inverter on flammable building materials.
- The wall must be solid enough to bear the weight of the inverter.
- Do not install the inverter on a wall made of gypsum boards or similar materials with weak sound insulation to avoid noise disturbance in a residential area.

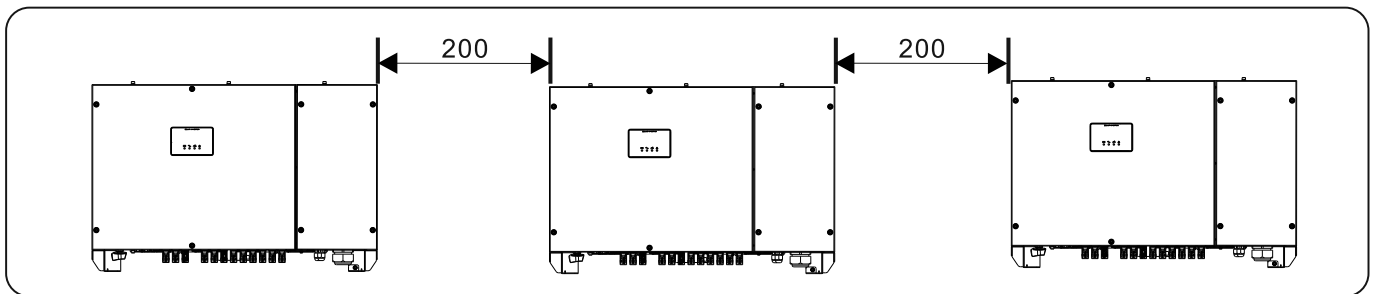
Installation Space Requirements

- It is recommended that the inverter be installed at eye level to facilitate operation and maintenance.
- Reserve enough clearance around the inverter to ensure sufficient space for installation and heat dissipation, as shown below.

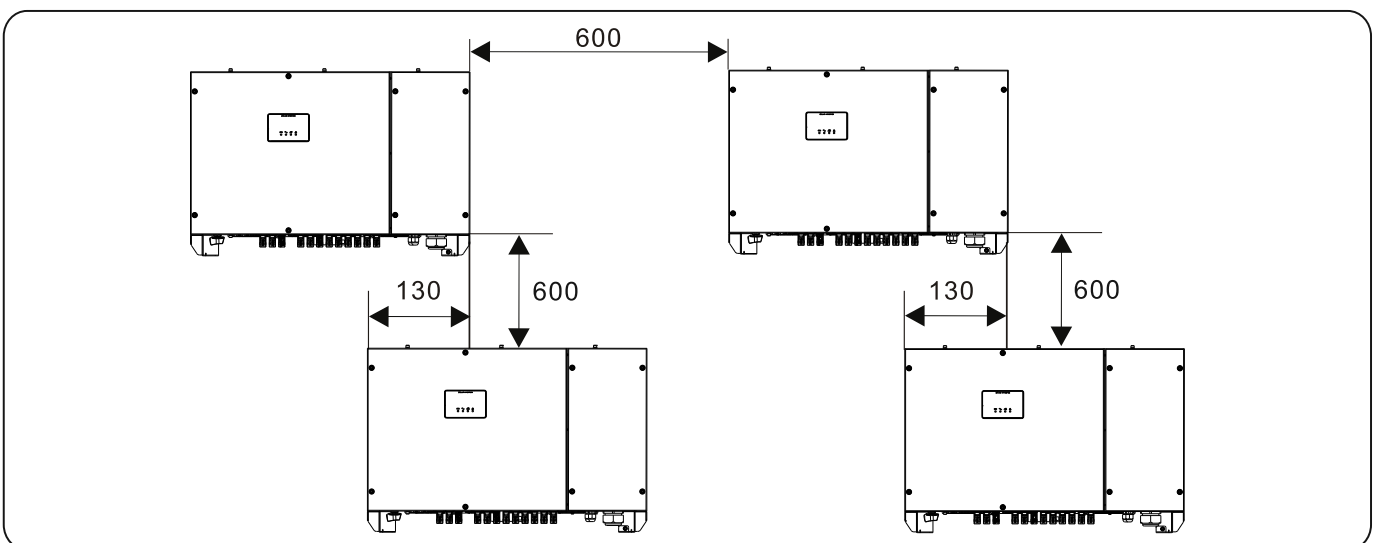


Installation Space Requirements (unit: mm)

When installing multiple inverters, install them along the same line if sufficient space is available, and install them in triangle mode or in stacked mode if no sufficient space is available. The installation modes ensure sufficient space for installation and heat dissipation.



Installation along the same line (unit: mm)



Installation in stacked mode



NOTICE

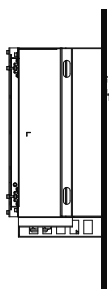
The clearance between multiple inverters must be increased to ensure proper heat dissipation when they are installed in a hot area.

Installation Mode Requirement

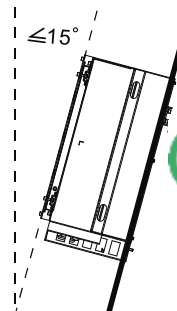
Install the inverter upright or at a maximum back tilt of 15 degrees to facilitate heat dissipation.
Below are some correct / wrong installation modes.



The correct installation mode



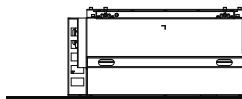
Upright



Back tilt



The wrong installation mode



Horizontally



Upside-down



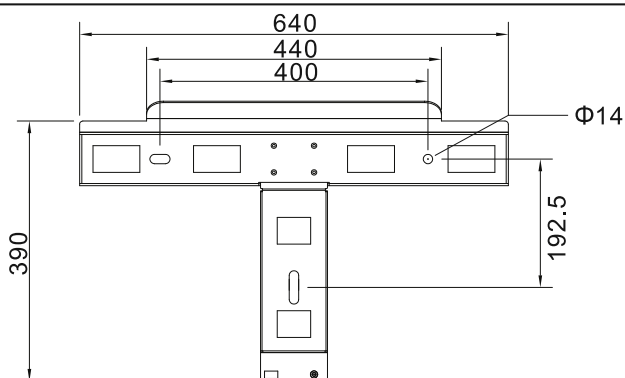
NOTICE

The wrong installation will lead to failure of the inverter operation.

Support-mounting of the inverter

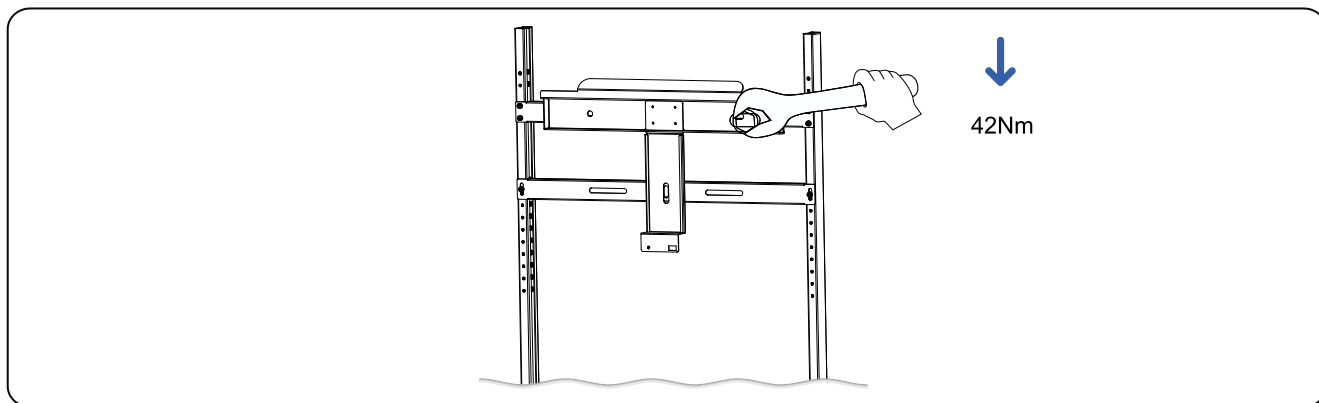
Installing the inverter on a supporting structure is recommended. Before installing the inverter, attach the supplied mounting bracket to the dedicated support.

Step 1 Move out the rear panel from the packing case, and determinate the position for the inverter and the support.

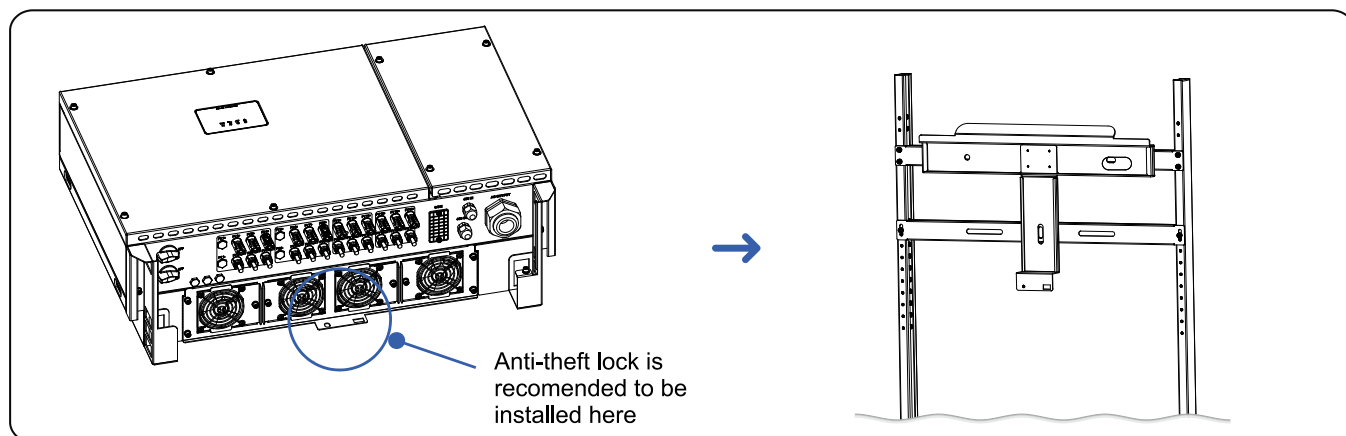


The rear panel (unit: mm)

Step 2 Tighten the rear panel with the support using M12 bolt to a torque of 42Nm.



Step 3 Mount the inverter on the support and tighten the inverter with the rear panel using screws.



Installation Self-check

- Ensure that the three supporting points (on the rear side of the inverter) align with the three holes of the support.
- Ensure that the inverter is well fixed.
- Ensure that the inverter is locked on the support and an anti-theft is installed.

ELECTRICAL CONNECTIONS

Preliminary operations

- It is advisable to install a circuit breaker on the AC side with rated current higher than 250A.
- Turn the DC switch off.
- Open the AC switch downstream of the inverter.

 DANGER	Before performing any electrical connections, ensure that both DC and AC switches are OFF. Otherwise, fatal injury can occur due to the high voltage generated from AC and DC cables.
 CAUTION	If grounding of the PV strings is required, an isolation transformer must be installed on the AC side of the inverter, observing the following requirements: • Ensure that the neutral wire of the isolation transformer is disconnected from the PGND cable. • Install one isolation transformer for every PV inverter, do not install a single isolation transformer for multiple inverters. Otherwise, it will lead to operation failure.

Connecting Protection Ground (PGND) Cables

Preparation

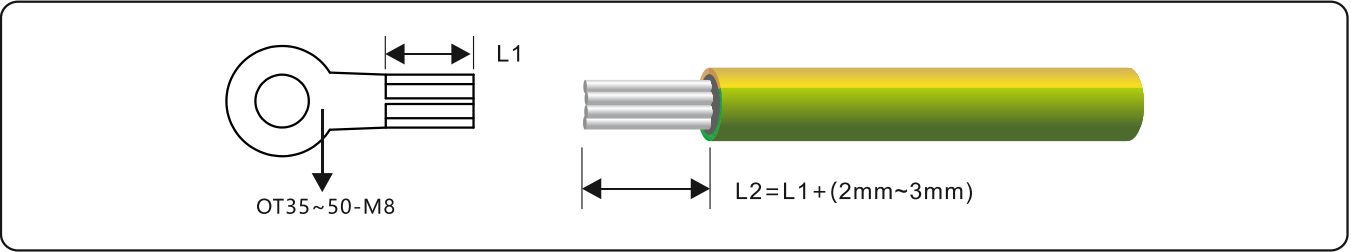
The ground cable and OT terminals have been prepared with below requirements.

- The ground cable and OT terminals have been prepared with below requirements with copper cable with cross section of 30~50 mm².
- OT terminal: OT terminals for M8 screws and cable with cross section of 30~50 mm².

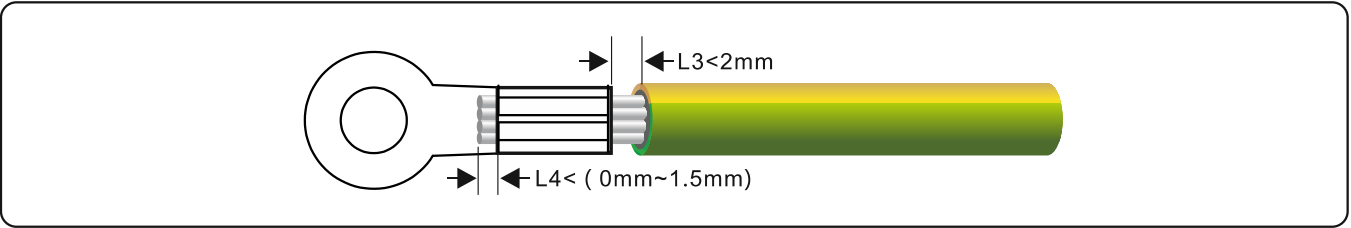
	NOTICE	Connecting an external PGND cable is not intended to replace the PE cable of the AC wiring. Make sure both are connected and properly grounded. Otherwise, the warranty will be invalidated if faults occur due to inadequate electrical connections.
	NOTE	Good grounding for the inverter helps resist the impact of surge voltage and improve the EMI performance. Connect the PGND cable before connecting the AC power cables, DC power cables, and communication cables.
	NOTE	It is recommended that the ground cable be connected to a nearby ground position. For a system with multiple inverters connected in parallel, connect the ground points of all inverters to ensure equipotential connections.

Wiring Procedures

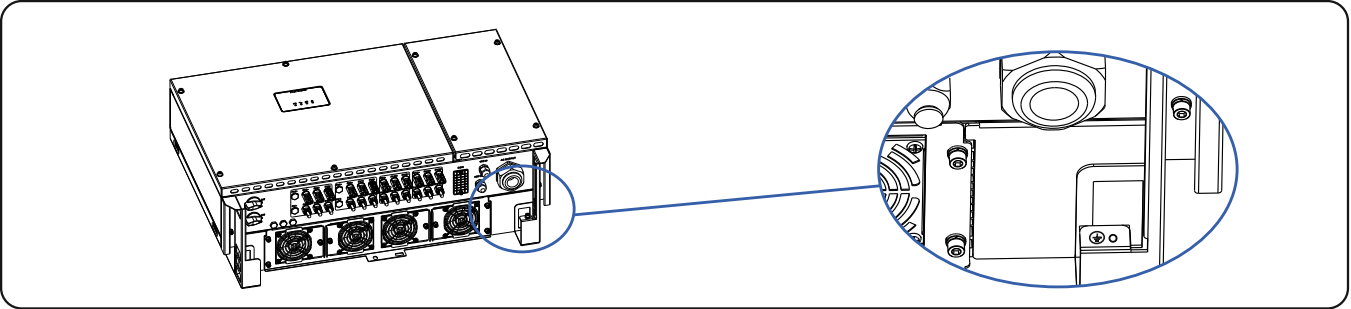
Step 1 Remove an appropriate length of the insulation layer from the PGND cable using a wire Stripper; the length is a little bit longer than that of OT terminal's crimping end by 2mm~3mm, as shown in Figure.



Step 2 Insert the exposed core wires into the crimping areas of the OT terminal and crimp them using a crimping plier.



Step 3 Remove the ground screws from the ground points, secure the PGND cable (done by step 1 & 2) using the ground bolts, and tighten the bolts to a torque of 3 Nm using a socket wrench. PE wire must be well grounded to ensure that impedance between Neutral wire and Earth wire be less than 10#.



Securing the PGND cable

Connecting AC Output Cables

Preparation

The AC power cable and AC terminals have been prepared with below requirements.

AC power cable: Outdoor multi cooper-cores cables are recommended, as shown below.

	Cable type	Conductor section (mm ²)	Recommended OT terminals	NOTES
AC terminal	Outdoor multi cooper-cores cable	30~50	OT 35~50 M8	The distances between AC terminal and grid connection is no more than 200m.
Protection Ground (PGND) Cables	Outdoor multi cooper-cores cable	30~50	OT 35~50 M8	Terminal connection

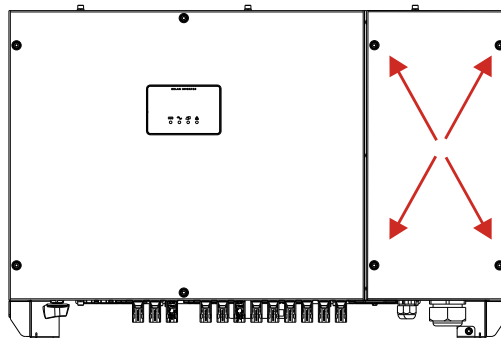
Note: The inverter requires the connection of M8 OT terminals (not supplied) and a cable with a maximum cross-section of 50mm².

If it is necessary to install a residual current device, install a type B circuit breaker with a tripping current of at least 600mA. Do not share neutral wire when leakage current protection switch is stalled, otherwise the protection trip may occur.

 WARNING	An independent three-phase circuit breaker must be installed on the AC side of each inverter; Do not install one circuit breaker for multiple inverters.
 WARNING	Do not connect loads between the AC output terminals of the inverter and the circuit breaker.

Procedure of Connecting AC Cables

AC wiring chamber on the right side of the inverter, and before AC wiring, remove these four retaining screws, uninstall Earth wire, and remove the cover of AC wiring chamber. Please follow below steps to ensure equipment and personal safety.



Removing the cover of AC wiring chamber

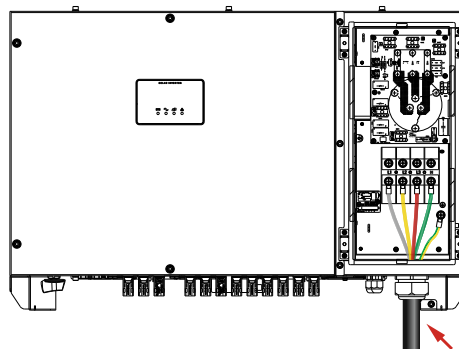
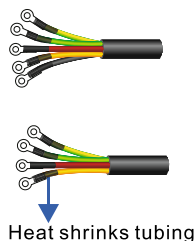
Step 1 Remove an appropriate length of the jacket and insulation layer from the AC output cable. Insert the exposed core wires into the crimp area of the OT terminal, wrap the wire crimp area with heat shrink tubing or insulation tape, and crimp them using hydraulic pliers.

Step 2 Loosen the locking cap from the AC OUTPUT waterproof cable connector at the bottom of the inverter and remove the plug from the locking cap.

Step 3 Route the AC output power cable into the locking cap and the AC OUTPUT connector at the inverter bottom, and connect the AC cable to L1, L2, L3, N, and PE, tighten them using screwdriver and the required torque is 12 N.m.

Step 4 Tighten the locking cap on the AC OUTPUT waterproof cable connector to a torque of 12 N.m.

Step 5 Tighten the four screws on the cover to a torque of 3 N.m.



Connecting AC cables

Connecting the PV Strings

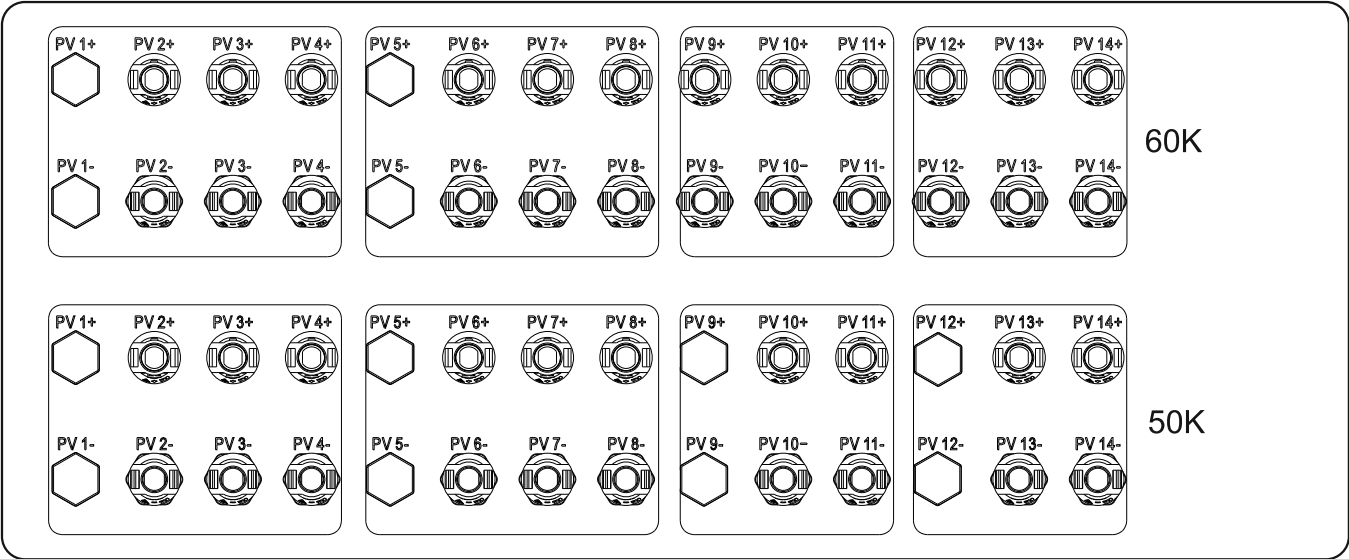
 DANGER	PV Strings connection needs below prerequisites; otherwise, an electrical shock can occur.
 DANGER	PV modules generate electric energy when exposed to sunlight and can create an electrical shock hazard. Therefore, when connecting the PV modules, shield them with opaque cloth.
 DANGER	Before connecting DC input power cables, ensure that the voltage on the DC side is within the safe range and that the DC SWITCH on the inverter is OFF. Otherwise, high voltage may result in electric shock.
 DANGER	When the inverter is grid-tied, it is not allowed to maintain DC input power cables, such as connect or disconnect a string or a module in a string. Only after the inverter enters in shutdown mode, it is allowable for preceding DC input power cables maintenance.

 WARNING	If grounding of the PV strings is required, an isolation transformer must be installed on the AC side of the inverter, observing the following requirements: • Ensure that the neutral wire of the isolation transformer is disconnected from the PGND cable. • Install one isolation transformer for every PV inverter, do not install a single isolation transformer for multiple inverters. Otherwise, it will lead to operation failure.
 WARNING	PV modules connected in series in each PV string must be of the same specifications.
 WARNING	The maximum open-circuit voltage of each PV string must be always lower than or equal to its permitted range.
 WARNING	The maximum short circuit current of each PV string must be always lower than or equal to its permitted range.
 WARNING	The positive and negative terminals of PV modules must be connected to the positive and negative DC input terminals of the inverter respectively.
 WARNING	During the installation of PV strings and the inverter, the positive or negative terminals of PV strings cannot be connected with short circuit.

Preparation

PV Strings DC input cable and connectors have been prepared; refer to No. of DC input terminals at the bottom of inverter shown in below figure: 50K with 10 routes and 60K with 12 routes, if quantity of PV strings is less than number of input on inverter, you can refer to below

Table for the installation of PV strings and the inverter.

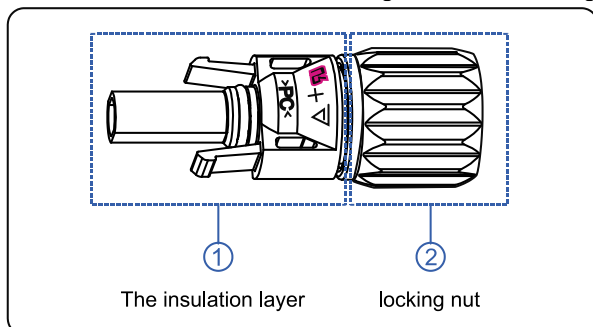


Input Route	Number of Input Route	Inverter Model
1	Connected to any route	50K / 60K
2	Connected to routes 2 & 6	
3	Connected to routes 2, 6 & 10	
4	Connected to routes 2, 6, 10 & 13	
5	Connected to routes 2, 3, 6, 10 & 13	
6	Connected to routes 2, 3, 6, 7, 10 & 13	
7	Connected to routes 2, 3, 6, 7, 10, 11 & 13	
8	Connected to routes 2, 3, 6, 7, 10, 11, 13 & 14	
9	Connected to routes 2, 3, 4, 6, 7, 10, 11, 13 & 14	
10	Connected to routes 2, 3, 4, 6, 7, 8, 10, 11, 13 & 14	
11	Connected to routes 2, 3, 4, 6, 7, 8, 9, 10, 11, 13 & 14	Only 60K
12	Connected to routes 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13 & 14	

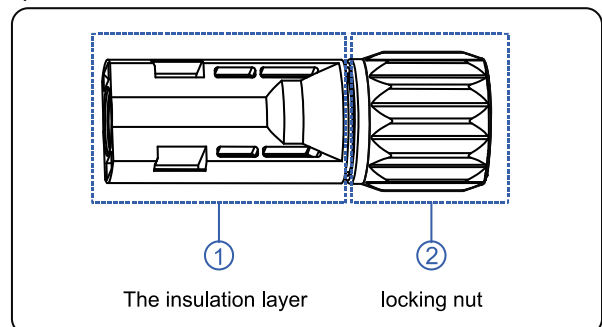
It is necessary to prepare DC power connector and PV string connector; the table below shows recommended specification.

Inverter Model	Cable type	Section (mm ²)		External cable diameter (mm)
		Range	Recommended value	Range
50K 60K	PV standard application cables (model: PV1-F)	4–6	4	5-8

Connectors of PV Strings: Positive and negative DC input connectors are used, as shown below:



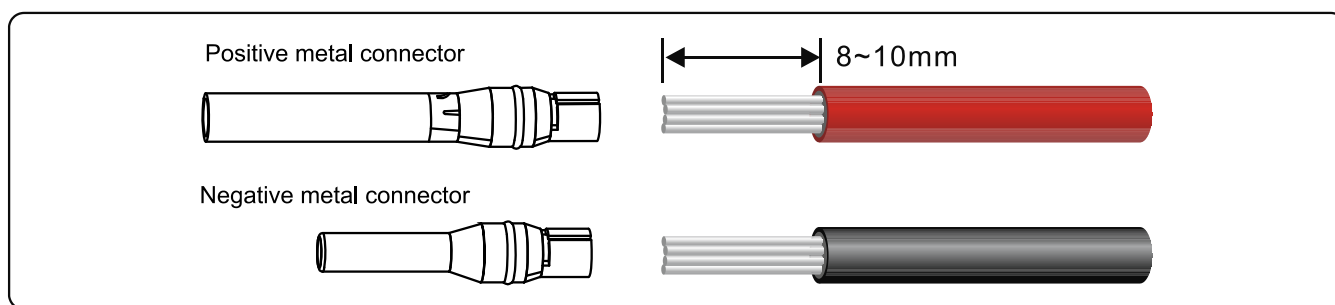
Positive connector composition



Negative connector composition

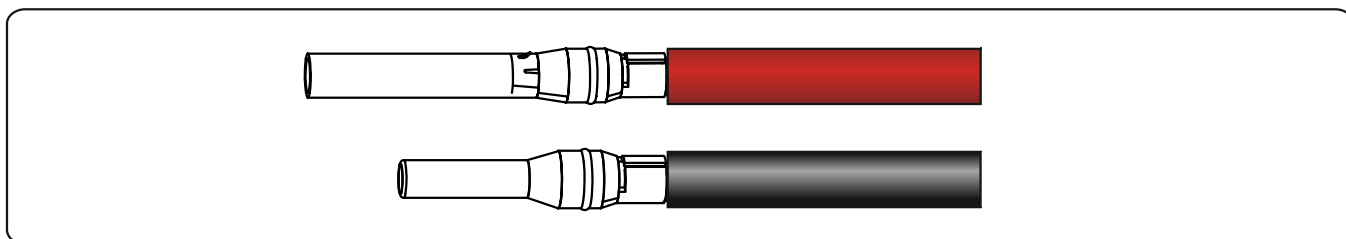
Procedures of connecting the PV Strings

Step 1 Remove an appropriate length of the insulation layer from the positive and negative power cables using a wire stripper, as shown in below Figure.



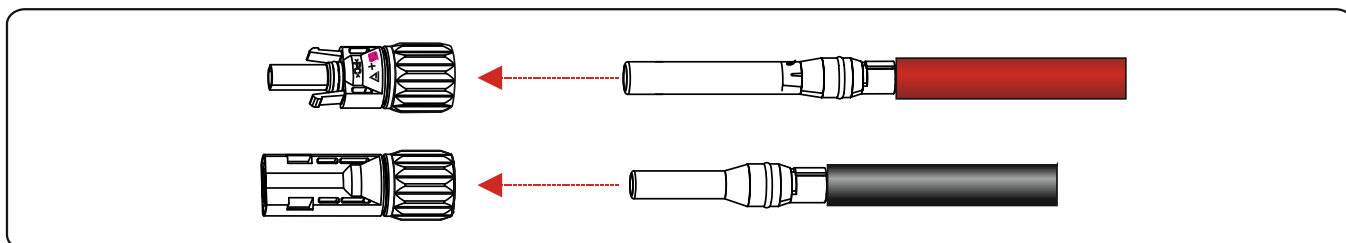
Removing insulation layer for DC cable (unit: mm)

Step 2 Insert the exposed areas of the positive and negative power cables into the metal terminals of the positive and negative connectors respectively and crimp them using a crimping tool, as shown in Figure.



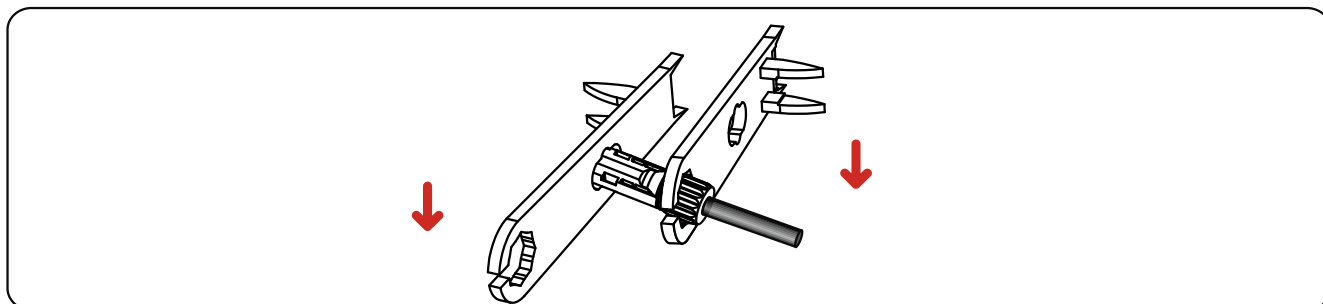
Crimping a metal connector

Step 3 Insert the crimped positive and negative power cables into the corresponding positive and negative connectors until a "click" sound is heard, as shown in Figure.



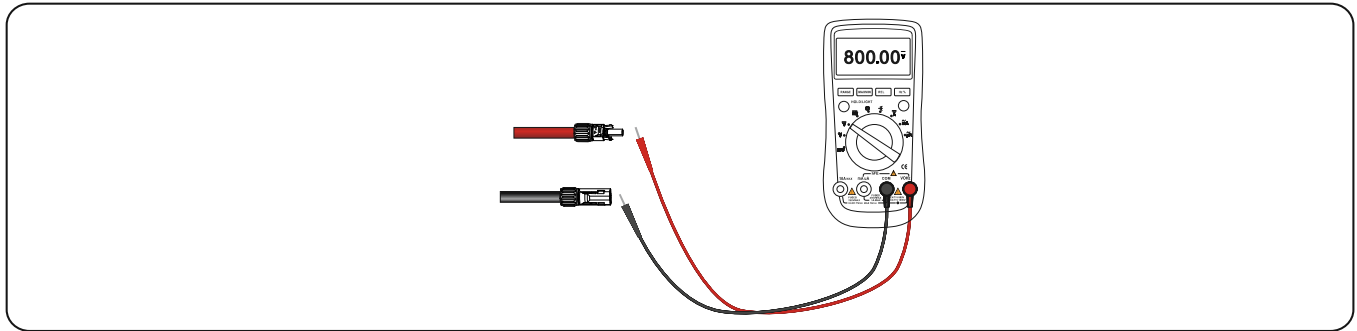
Connecting positive and negative connectors

Step 4 Tighten the locking nuts on the positive and negative connectors using a removal wrench, as shown in Figure.



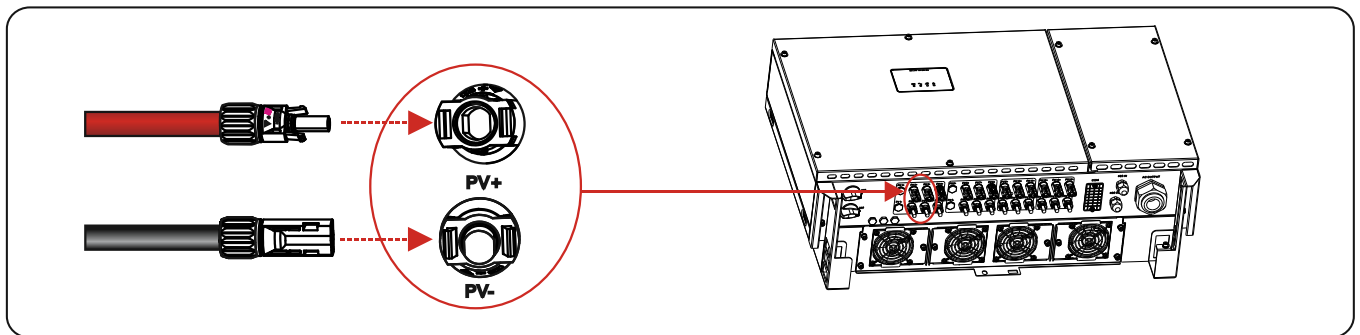
Locking connectors

Step 5 Measure the voltage of every route Strings using a multimeter. Ensure that the polarities of the DC input power cables are correct, as shown in Figure.



Checking the voltage of every route Strings

Step 6 Insert the positive and negative connectors into their corresponding terminals of the inverter until a "click" sound is heard, as shown in Figure.



Connecting to the inverter

Step 7 After connecting the PV strings, ensure that all connectors are in position by checking for resistance when a slight pull is applied.

Connecting Communication Cables

Communication Mode Description

You can use the following communications modes to implement communications: Bluetooth, WIFI, GPRS, and RS485, all of which are described as follows.

Bluetooth Module

You can turn on the Bluetooth function of the mobile phone, and set parameters and monitor data of the inverter through the mobile APP. For details about operation, refer to APP User Manual.

Wi-Fi/ETHERNET Modules

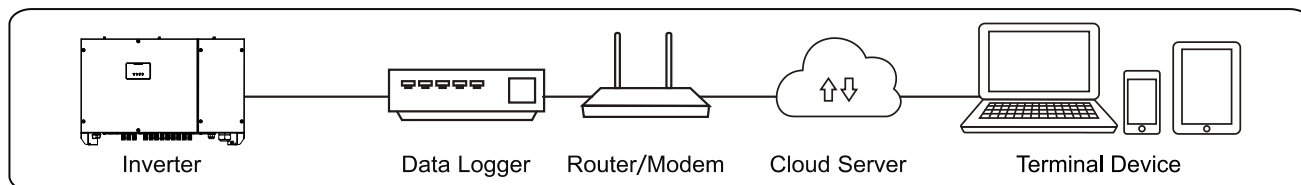
Module	Description
WIFI	WIFI module implements communication with Cloud server through wireless network to monitor PV inverter's data status. For more details, refer to WIFI Product Application Manual.
ETHERNET	ETHERNET module implements communication with Cloud server through LAN to monitor PV inverter's data status. For more details, refer to the related ETHERNET manual.

	NOTE You can choose and buy WIFI/ETHERNET communication modules from our company.
---	--

	WARNING Only permitting to connect inverter's communication interface with the original WIFI/ETHERNET accessory other brand WIFI/ETHERNET accessory could damage inverter and no warranty could be provided.
---	---

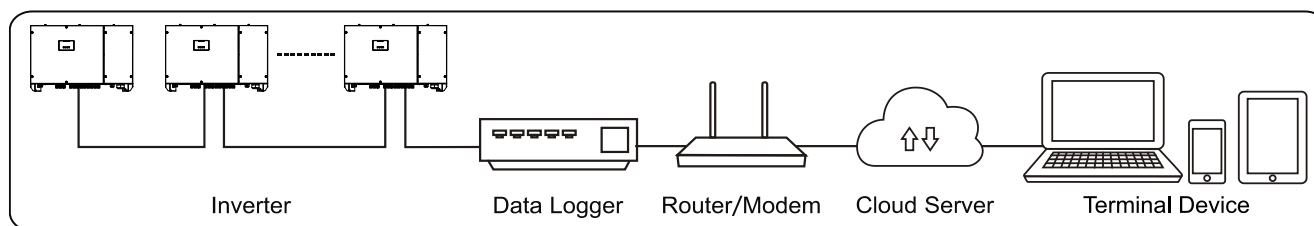
RS485 Communications mode (for single inverter)

Via the RS485 communication port, it is possible to connect an external data logger to a single inverter or to multiple inverters. Figure below demonstrates connection to single inverter to implement RS485 communications.



RS485 communication mode for a single inverter

RS485 communications mode (for multiple inverters)



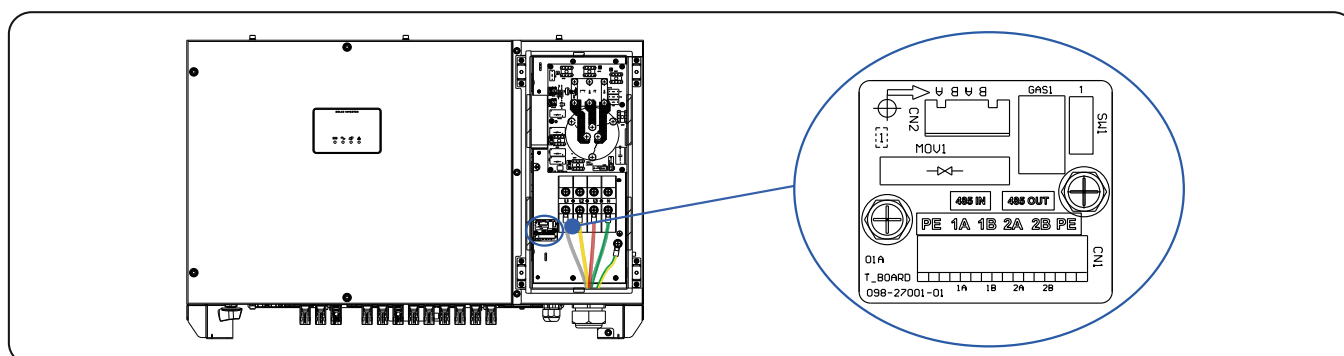
NOTE

If more inverters are connected, keep in mind next points:

1. If more inverters are connected, it's necessary to set the Modbus address manually on each inverter through the Riello PV APP. For more details, refer to APP User Manual.
2. Turn RS485 Resistance to ON from the dial switch of the inverters on the end of the chain.
3. Ensure that the length of communications cable between every two inverters is less than 200m and **communication cable must be separated from other power cables to avoid communication interference.**

Connecting RS485 Communication Cables

The inverter case right side locates the interface of RS485 communication, as shown in Figure.



RS485 communication interface

Step 1 Remove the wiring chamber on the right of inverter and loosen the locking cap on 485 waterproof cable connector from the bottom of inverter.

Step 2 Remove an appropriate length of the insulation layer from the communication cable, loosen screw lock to take out panel, insert the cable to the waterproof cable connector, and tighten the locking cap.

Step 3 Connect RS485 differential positive and negative signal of data logger to terminal 1A and 1B of inverter and connect terminal 2A and 2B of the inverter to terminal 1A and 1B of another inverter.



NOTE

To prevent corrosion, apply silica gel or fireproof mud to the terminal or interface after connecting external PGND cables, AC cables, RS485 port.

Setting the Modbus address

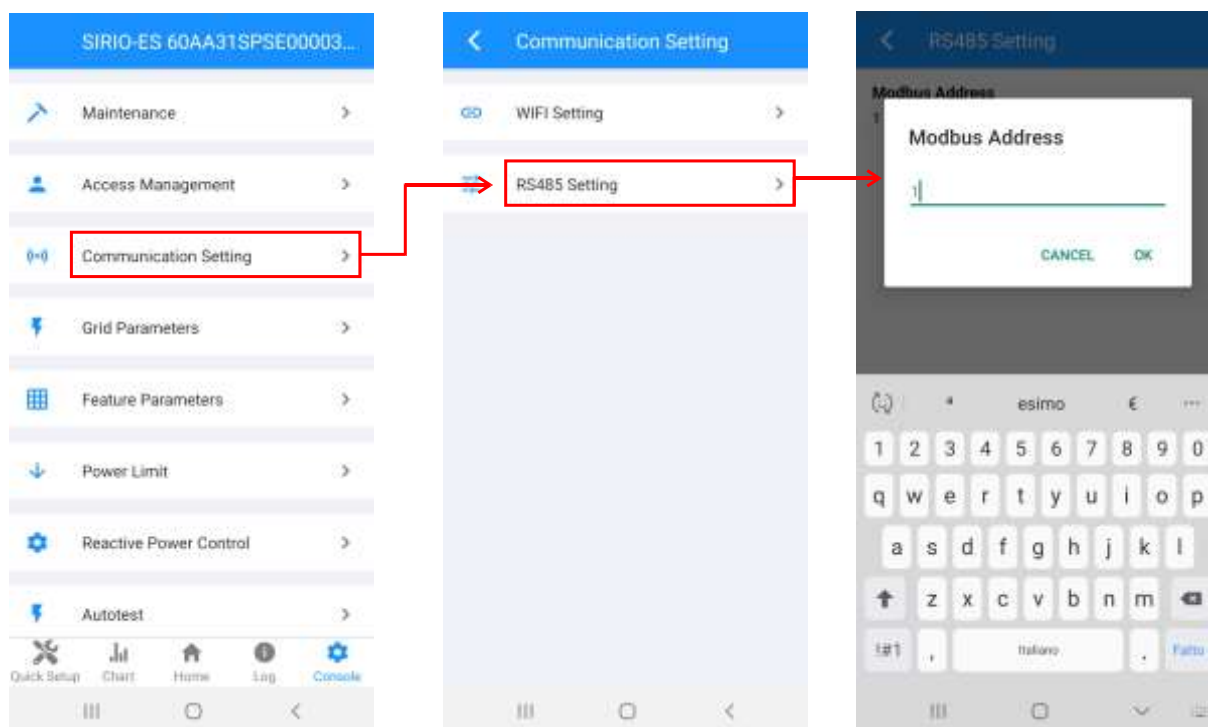
Setting the Modbus address is essential if multiple inverters are connected to the same RS485 line.

Step 1 Scan the QR code to download the app.

You must allow access to all resources requested in the pop-up windows when launching/using the app.

Step 2 Enable Bluetooth on your device, open the app, and connect to the inverter. Refer to the quick start guide for this operation.

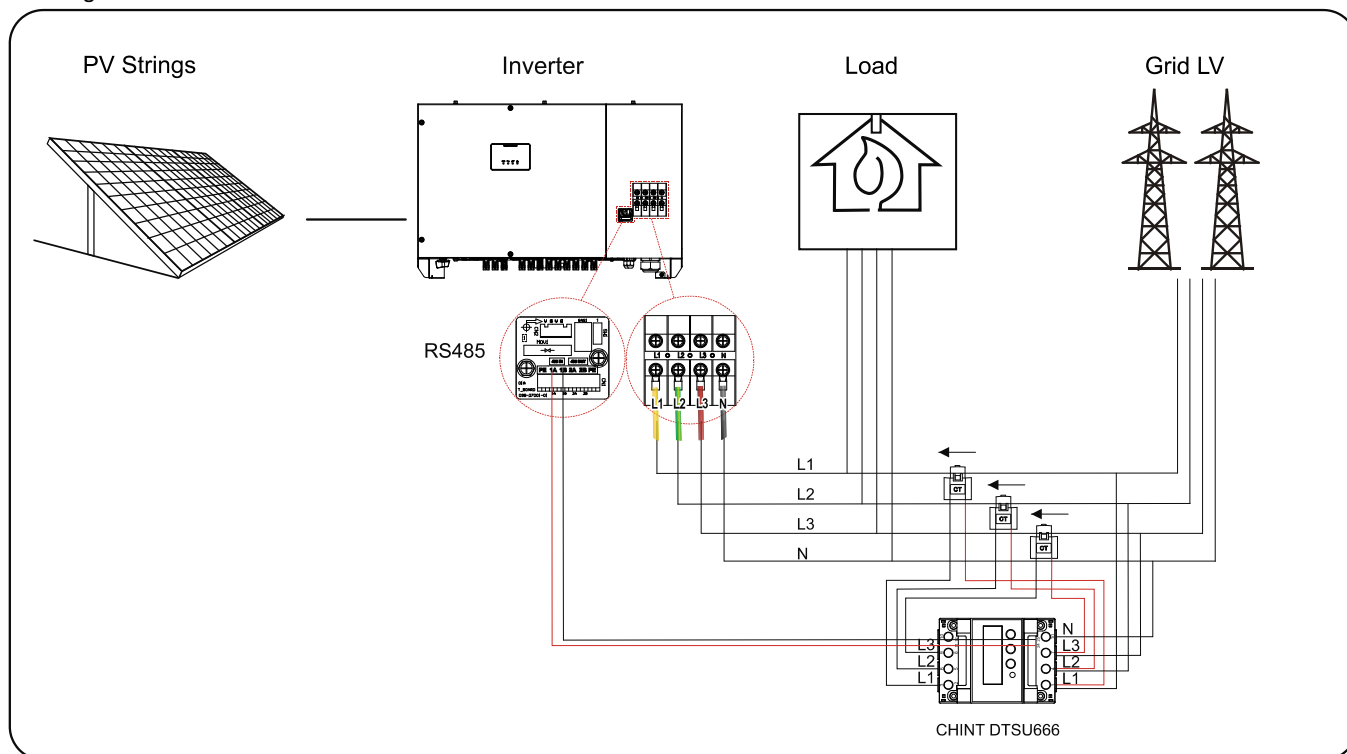
Step 3 Go to the [Service](#) > [Communication Settings](#) > [RS485 Settings](#) page as shown in the image. On this page, you can set or change the ModBus address if necessary (address range 1 to 247). The default ModBus address is 1. The ModBus address cannot be the same between multiple inverters connected to the same RS485 bus.



Power Limit

To the RS485 communication port it is possible to connect a digital energy meter, as an alternative to the data logger, to monitor energy produced, consumed, and fed to the grid during the day, when sunlight is available.

The following diagram shows the connection of the digital meter (example: CHINT DTSU666 and external CTs) for load power monitoring.

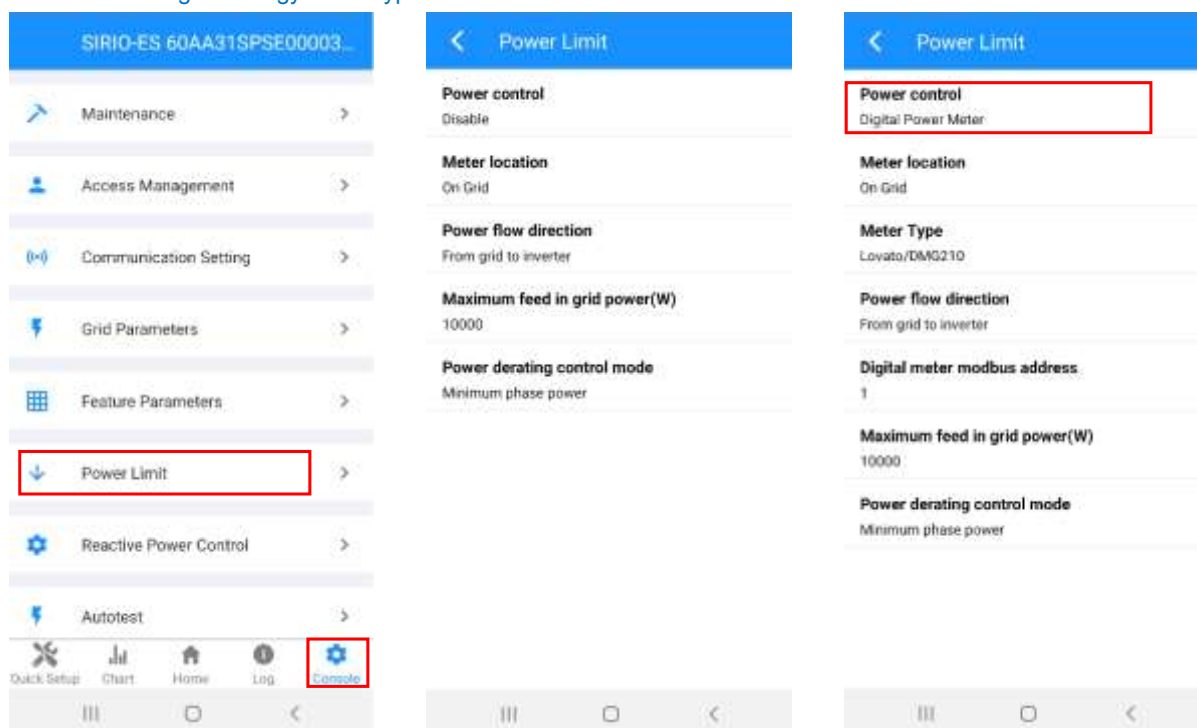


App Settings

Power limitation settings must be configured via the Riello PV app to allow the inverter to communicate correctly with the installed meter.

The following procedure shows the settings:

- 1- Open the Riello PV app and click on [Service > Power limitation](#).
- 2- Click on [Power limitation function](#) and select [Digital energy meter](#).
- 3- Then click on [Digital energy meter type](#) and select the meter model used.



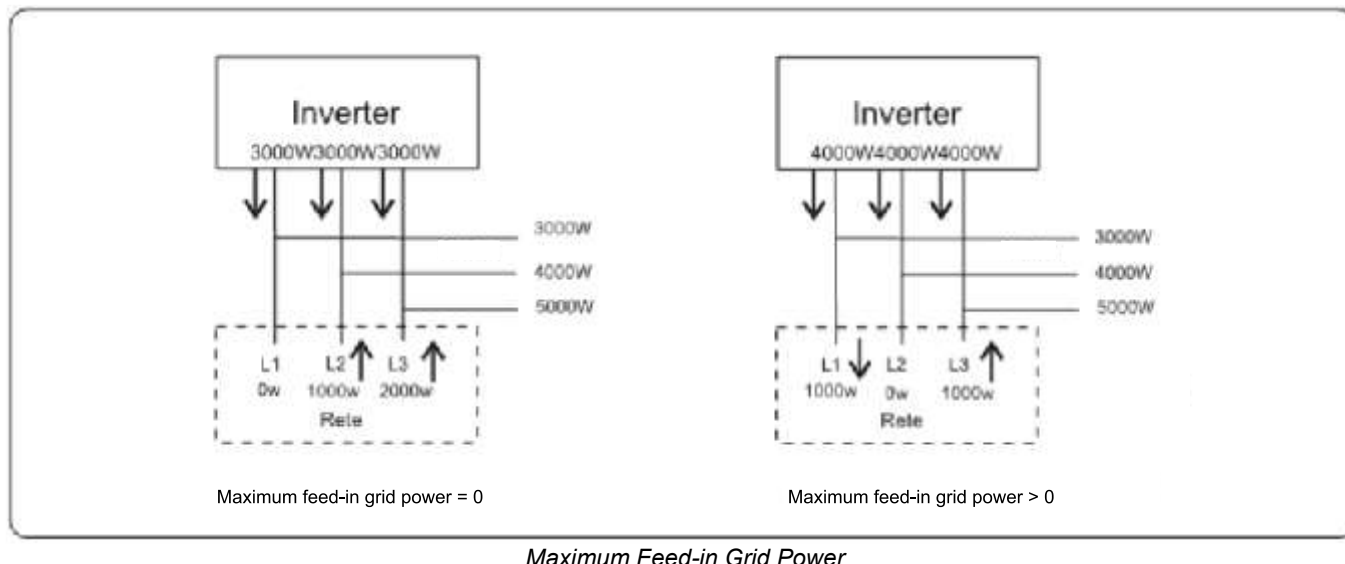
When Power Limit function is set on “Digital Power Meter”, the RS485 Inverter port will change working mode on “Host” which will communicate through Modbus-RTU with Digital Meter.

Check that the device is set as follows:

- Protocol: Modbus-RTU
- Baud Rate: 9600
- Data bit: 8
- Parity: None
- Stop bit: 1
- Address: 1

For the digital meter setting operation, please refer to the meter user manual.

Inverter’s power management



If the maximum Feed-in grid power is set to 0, the inverter will produce on each phase, the power corresponding to the phase in which the load absorbs the least. In the image on the left, you can see that the load has the phase with the least power at 3kW; consequently, the inverter produces 3kW on each phase.

If the maximum Feed-in grid power is set to a value greater than zero (e.g., 10W), the inverter will produce power equal to the average of the load's power requirements. In the image on the right, you can see the load absorbing 5kW, 4kW, and 3kW, respectively, which add up to 12kW. If you take this value and divide it by the three phases output of the inverter, you get that the inverter produces 4kW for each phase.

 NOTE	The values shown in the image are for illustrative purposes only.
--	---

Installation Verification

Check the following items after the inverter is installed.

1. The PV inverter is installed correctly and securely.
2. There is enough space for ventilation.
3. No other objects put on the PV inverter.
4. All screws, especially the screws used for electrical connections, are tightened.
5. Ground, AC, DC, and Communications cables are connected tightly/correctly and securely.
6. Check there is no open circuit or short-circuits at AC and DC terminals using multimeter.
7. Waterproof connectors at AC terminals and RS485 ports are plugged with waterproof plugs tightly.
8. Covers at AC terminals are tightened.
9. Idle terminals are sealed.
10. All safety warning symbols are intact and complete on the inverter.

SYSTEM OPERATION

First Powering ON

Step 1: Set the DC SWITCH upstream of the inverter to ON.

Step 2: Set the AC SWITCH downstream of the inverter to ON.

Step 3: Set the DC SWITCH of the inverter to ON.

Step 4: Connect the inverter through Riello PV APP and set local grid parameters. For more details, refer to User manual on APP. This setting is necessary for

	NOTE This setting is required for inverter operation, if it isn't set the inverter doesn't connect to the grid and it will not generate power, even if there is sufficient solar irradiation.
--	--

Step 5: Observe statuses of LED indicator lights on the inverter (see User Interface chapter).

Powering ON the Inverter

Step 1: Switch ON the AC SWITCH downstream of the inverter.

Step 2: Set the DC SWITCH of the inverter to ON.

Step 3: Observe statuses of LED indicator lights on the inverter (see User Interface chapter).

	NOTE When LED status lights display the inverter has entered grid-connecting, it means the inverter is operating well. Any query during operating the PV inverter, call your dealer.
--	---

Powering OFF the Inverter

Step 1: Switch off using the App.

Step 2: Switch off the circuit AC breaker downstream of the inverter.

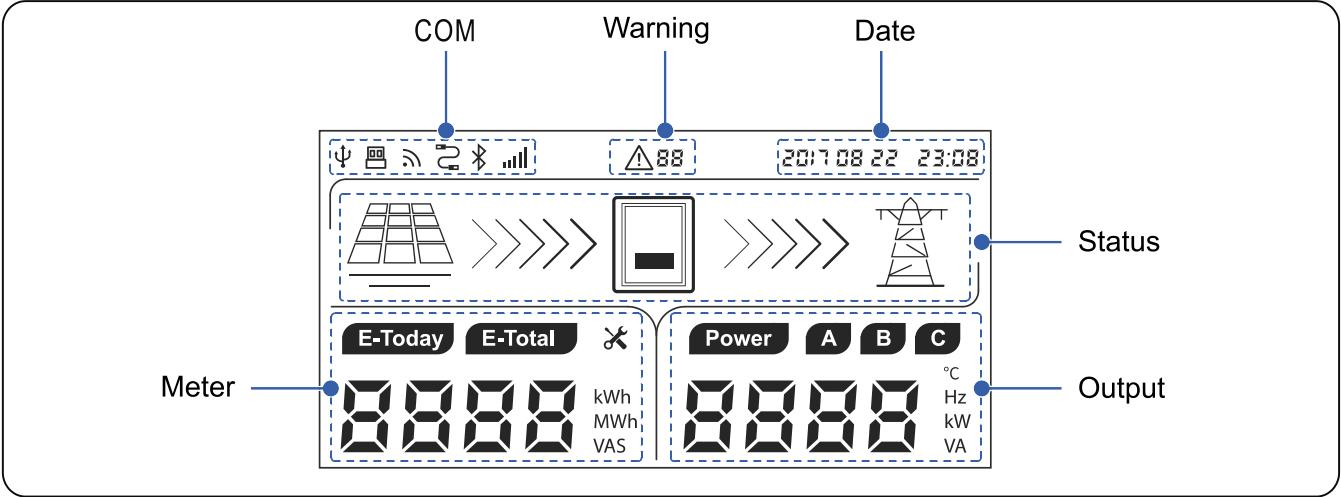
Step 3: Set the DC SWITCH to OFF.

	WARNING After the inverter switches off, the remaining electricity and heat may still cause electrical shock and burns. Wait ten minutes after the power-off before servicing the inverter.
--	--

LED Status

LED Indicator	Status	Description
PV Indicator	ON	Voltage of PV strings meet the conditions for feed-in operation.
	Blink	Voltage of PV strings does not meet the conditions for feed-in operation.
Grid Indicator	Blink	Power grid abnormal. The conditions for feed-in operation are not yet met.
	ON	Feed-in operation. The blink times (every cycle lasts 30s) of the grid indicator present power size, and after that the indicator keeps ON. When less than 20% rated power, blink one time 20%~40% rated power, blink twice 40%~60% rated power, blink three times 60%~80% rated power, blink four times 80%~100% rated power, blink five times.
COM Indicator	Blink	Communication data transmission is underway.
	OFF	No external communication is connected or no communication data
Warning Indicator	ON/Blink	Refer LED status in warning table.
	OFF	No warning.

LCD Screen



1) COM

When WIFI/ETHERNET/Bluetooth is transferring data, icon will be ON, while no data transmission, the icon will be off after 10s. When RS485 is transferring data, icon will be ON, while no data transmission, the icon will be off after 10s.

2) Warning

When warning is triggered, icon will be illuminated: from left to right the first bit could be (A)/ (B)/ (C), it stands for warning type, and the second bit is warning code, please refer to warning code in next chapter.

3) Date

When external communications is normal and time zone is set correctly, the built-in clock of inverter will be synchronized with server's time.

4) Status

Icon stands for PV strings; when inverter is standby status, MPPT voltage of the PV string will be displayed in Meter zone.

Icon stands for grid; when voltage and frequency of power grid is in normal range, the icon keeps on, or else, it blinks; when there is no voltage, the icon will be off.

Icon stands for energy flow; when inverter is in normal status, the icon will be on, or else it will be off.

5) Meter

Normal status: today and total energy, MPPT voltage and current are showed in turn.	
Standby status: counter down value before inverter starts up.	
Any status: setting parameters via APP, the screen keeps for 5 seconds.	

6) Output

Normal status: output power, grid voltage and current are showed in turn.	
---	--

View Inverter Status

The inverter operation status can be obtained from observing LED indicator status. For more details, see next table.

View and Set Inverter running data

The inverter operation data can be obtained from APP, mobile phone APP downloaded through Bluetooth communication. For more details, refer to APP User Manual.

LED Status and Warning Code Table

	Warning code	PV Indicator	Grid Indicator	COM Indicator	Warning Indicator
Normal Status		●	● / ★	◎	○
Starting up (inverter tries to connect to grid)		●	○	◎	○
WLAN/WIFI/RS485 Communication		◎	◎	★	○
PV normal		●	◎	◎	○
Grid over voltage	A0	◎	★	◎	○
Grid under voltage	A1				
Grid absent	A2				
Grid over frequency	A3				
Grid under frequency	A4				
Grid unbalanced	A6				
Grid over mean voltage	A7				
PV over voltage	B0	★	◎	◎	○
PV under voltage	B4				
PV irradiation weak	B5				
PV string abnormal	B3	◎	◎	◎	★
Inverter over temperature	C5				
Fan abnormal	C8				
PV insulation abnormal	B1	●	○	○	●
Leakage current abnormal	B2	○	●	○	●
String reverse	B7	○	○	●	●
Internal power supply abnormal	C0	○	★	○	●
Inverter over dc-bias current	C2	★	●	★	●
Inverter relay abnormal	C3	○	●	●	●
GFCI abnormal	C6	●	●	○	●
System type error	C7	★	★	★	●
Unbalanced DC-Link voltage	C9	●	○	●	●
DC-Link over voltage	CA	○	●	★	●
Internal communication error	CB	○	○	★	●
Software incompatibility	CC	★	●	○	●
Internal storage error	CD	★	○	●	●
Data inconsistency	CE	★	●	●	●
Inverter abnormal	CF	●	●	●	●
BOOST abnormal	CG	★	○	○	●
Datalogger lost	CH	○	○	◎	★
Meter lost	CJ	○	○	◎	★
Remote OFF	CN	●	○	◎	○

Note:

●
Light fixed on

○
Light off

★
Light blinking

◎
Keep original status

MAINTENANCE



WARNING

Before commissioning or performing maintenance on the inverter and its peripheral distribution unit, switch off all the switches and wait at least 10 minutes after the inverter is powered off.

Routine maintenance

Check item	Check content	Maintain content	Maintenance interval
Inverter output status	Statistically maintain the electrical yield status and remotely monitor its abnormal status.	N/A	Weekly
PV inverter cleaning	Periodically check that the heat sink is free from dust and clogging.	Clean the heatsink periodically.	Yearly
PV inverter running status	Check that the inverter is not damaged or deformed. Check for normal sound emissions during inverter operation. Check and ensure that all inverter communications are running well.	If there is any abnormal situation, contact the customer service centre.	Monthly
PV inverter electrical connections	Check that the AC, DC and communication cables are securely connected; check that the PGND cables are securely connected; check that the cables are intact and have no signs of ageing.	If there is any abnormal situation, replace the cable or re-connect it.	Half-yearly
FAN cleaning	Check periodically heat sink and the inlet/outlet of fans, clean them, and ensure that they are free from dust and blockage. If there is any abnormality with any of the fans, contact the dealer to request a replacement.	Switch off the inverter and check fans, if they are dusty use air compressor to clean them.	Half-yearly

TROUBLESHOOTING

The following table shows inverter's basic common warning and fault handling methods.

Alarm code	Alarm definition	Cause	Possible solutions
A0	Grid over voltage	The grid voltage exceeds its allowable range.	1. If the alarm occurs occasionally, it means that the grid is operating abnormally; the inverter can automatically restore its normal operating status after the grid returns normal. 2. If the alarm occurs repeatedly and it can automatically recover, contact the local power company to obtain permission to modify the inverter grid protection parameters with the app. If the alarm occurs repeatedly for a long time, check whether: a) The output breaker is closed b) The output terminal is OK c) The output cable conforms to the instructions of the User Manual
A1	Grid under voltage	The grid voltage exceeds its allowable range.	
A2	Grid absent	The grid voltage is absent.	
A3	Grid over frequency	The grid frequency exceeds its allowable range.	
A4	Grid under frequency	The grid frequency exceeds its allowable range.	
B0	PV over voltage	The PV module input voltage is higher than the allowed range.	Please measure the PV input voltage with a multimeter and compare it with the "Max input voltage" shown on the inverter label. If the PV input voltage is higher than the "Max input voltage", reduce the quantity of PV modules.
B4	PV under voltage	The PV module input voltage is below the inverter's default protection value.	1. If the alarm occurs during weak sunlight conditions (in the morning or at dawn, during rain, etc.), this is normal and no action is needed. 2. If not, check if there is a PV module connection short-circuit.
B1	PV insulation abnormal	The insulation resistance against the ground is low before inverter start-up.	1. If the alarm occurs occasionally, it may be caused by an external circuit; the inverter can automatically recover its normal operating status once the fault is solved. 2. If the alarm occurs repeatedly or lasts a long time, take the following steps: a) Check if the output cable is stable. b) 2) Plug the PV strings one by one to find the abnormal PV string. Check if the insulation resistance against the ground of the PV strings is too low, or if the cable is broken or connected incorrectly.
B2	Abnormal leakage current	The insulation resistance against the ground at the input side decreases during inverter operation.	1. If the alarm occurs occasionally, it may be caused by an external circuit; the inverter can automatically recover its normal operating status once the fault is solved. 2. If the alarm occurs repeatedly or lasts a long time, take the following steps: a) Check if the output cable is stable. b) Plug the PV strings one by one to find the abnormal PV string. Check if the insulation resistance against the ground of the PV strings is too low, or if the cable is broken or connected incorrectly.
B3	PV string abnormal	PV strings have been shielded for a long time. PV strings are deteriorating.	1. Check whether the PV string is shielded. 2. If the PV string is clean and not shielded, check whether the PV modules are aging or deteriorated.
B7	PV string reverse	The cables of PV strings are connected reversely during the inverter installation.	Remove all strings and connect them once at the time to find the problematic one. Modify the wrong cable.
C9	Unbalance DC-link voltage	Internal warning	1.If the alarm occurs occasionally, the inverter can automatically recover. No action is needed.
CA	DC-link over voltage	Internal warning	2. If the alarm occurs repeatedly, contact the customer service centre.
CF	Inverter abnormal	Internal warning	1.If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, contact the customer service centre.

E6	BOOST abnormal	Internal warning	1.If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, contact the customer service centre.
E0	Internal storage error	Internal warning	1.If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, contact the customer service centre.
E0	Internal power supply abnormal	Inverter internal power source abnormal	1.If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, contact the customer service centre.
B5	Weak irradiation	The PV module power is less than the minimum inverter operating power.	This indicates that the PV modules are not getting enough sunlight. No action is needed.
E2	Inverter over dc-bias current	The DC component current in the grid exceeds the allowed range	1.If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, contact the customer service centre.
E3	Inverter relay abnormal	The output relay cannot be closed.	1. If the alarm occurs occasionally, this could be a grid anomaly. The inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, ensure that the voltage between live and ground/earth are as expected. If no problem can be detected, contact the customer service centre.
E5	Inverter over temperature	Inverter internal temperature high.	1. If the alarm occurs occasionally, the inverter can automatically recover. No action is needed. 2. If the alarm occurs repeatedly, check whether: a) The inverter is not under direct sunlight. b) The heat sink is not blocked. c) All fans are working. d) Environment temperature is under 45° C If no problem can be detected, contact the customer service centre.
E6	GFCI abnormal	Residual current test failed during inverter start-up.	1. If the alarm occurs occasionally and the inverter keeps generating power, it can be caused by an external circuit. The inverter can automatically recover its normal operating status once the fault is solved. 2. If the alarm occurs repeatedly or for a long period of time, contact the customer service centre.
E7	System type error	Internal warning	Contact customer service centre.
E8	Fan abnormal	One or more inverter fan is not working properly.	1.If the alarm occurs occasionally, try to restart the inverter. 2. If the alarm occurs repeatedly, one or more fans could be blocked from dust or occlusions. Clean all the fans. 3. If a fan is not spinning at all and is free from blockage, contact the customer service centre to request a substitution. If no problem can be detected, contact the customer service centre.
E8	Internal communication error	Internal warning	Contact the customer service centre.
E0	Software incompatibility	Internal warning	Contact the customer service centre.
E0	Data inconsistency	Internal warning	Contact the customer service centre.
E8	Data logger lost	RS485 lost communication with data logger	Check the correct connection between RS485 bus and Modbus settings.
EJ	Meter lost	The communication between the inverter and the energy meter is not working	Check the correct connection between RS485 bus and Modbus settings.

**NOTE**

If you cannot clear the preceding alarm according to the recommended measures, contact your dealer promptly.

Removing the inverter

To remove the inverter. Follow the steps below.

Step 1: Turn off the inverter (see dedicated chapter).

Step 2: Switch off all breakers upstream the inverter (DC breaker on the inverter and AC breaker upstream the inverter).

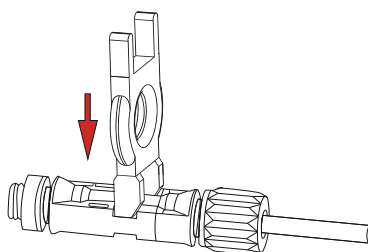
Step 3: Remove all cables from the inverter, including any communication cables, DC input, AC output power cables and PGND cables, as shown in the following figure.

**WARNING**

Before removing the DC input connector, double-check that the DC input switch is turned OFF to avoid inverter damage and personal injury.

**NOTE**

When removing DC input connectors, insert the removal spanner into the bayonet, press the spanner down and take out the connector carefully.



Step 4: unscrew the fixing screws that fasten the inverter to the rear panel.

Step 5: remove the inverter from the rear panel.

Step 6: remove the rear panel.

STORAGE

This chapter describes the storage requirements for the inverter.

The following storage instructions apply if the PV inverter will not be deployed immediately:

- Do not unpack the inverter (add desiccant in the original box if the PV inverter is unpacked).
- Store the PV inverter within a temperature range of -40°C to $+70^{\circ}\text{C}$ and with relative humidity between 0 and 100% (no condensing).
- The PV inverter should be stored in a clean and dry place, protected from dust and water vapour corrosion.
- A maximum of six layers of inverters can be stacked.
- Do not position the inverter tilting frontwards, tilting excessively backwards, tilting sideways or upside-down.
- Conduct periodic inspections during storage.
- Replace the packaging materials immediately if any rodent bites are found.
- Ensure that qualified personnel inspect and test the inverter before use if it has been stored for a long time.

DEPOSING OF THE INVERTER

Users take the responsibility for the disposal of the inverter.

 WARNING	Dispose the inverter in accordance with relevant local regulations and standards to avoid property losses or casualties.
 NOTICE	Some parts of the inverter may cause environmental pollution. Please dispose of them in accordance with the disposal regulations for electronic waste applicable at the installation site.

APPENDIX

TECHNICAL SPECIFICATION

Model	SIRIO-ES 50		SIRIO-ES 60	
Efficiency				
Maximum Efficiency	98.3%		98.3%	
European Efficiency	98.0%		98.0%	
Input (PV)				
Maximum input voltage	1100V			
Maximum PV configuration	150%			
Nominal input voltage	620V			
Maximum input current	130A (39A/39A/26A/26A)		156A (39A/39A/39A/39A)	
Maximum short-circuit current	140A (42A/42A/28A/28A)		168A (42A/42A/42A/42A)	
Start input voltage	250V			
MPPT operating voltage range	200V – 1000V			
Maximum number of PV strings	10(3/3/2/2)		12(3/3/3/3)	
MPPT inputs	4			
Output (Grid)				
Rated output power	50,000W		60,000W	
Maximum AC apparent power	55,000VA		66,000VA	
Maximum AC output power (PF=1)	55,000W		66,000W	
Rated output current	3x83A		3x92A	
Maximum AC short-circuit current	160A		180A	
Nominal AC voltage	380V/400V,3W+N+PE			
AC voltage range	277V – 520V (adjustable)			
Nominal Grid frequency	50Hz / 60Hz			
Grid frequency range	45Hz – 55Hz / 55Hz – 65Hz (adjustable)			
THDI	<3% (nominal power)			
DC current injection	<0,5% In			
Adjustable power factor range	> 0,99 nominal power (adjustable from 0,8 on advance to 0,8 on delay)			
Advised breaker	100A (Z or B curve)		125A (Z or B curve)	
Protections				
DC breaker	Supported			
Anti-islanding protection.	Supported			
AC over current protection	Supported			
AC short-circuit protection	Supported			
Reverse DC connection	Supported			
Over voltage protection	DC type II / AC type II			
Insulation detection	Supported			
Leakage current protection	Supported			
General				
Topology	Transformer-less			
IP class	IP65			
Power consumption at night	< 1W			
Cooling type	Air cooling (fans)			
Operating temperature range	From –25°C to +60°C			
Operating humidity range	0–100%			
Operating maximum altitude	4000m			
Noise	< 62dB (measured at 1m)			
Dimensions (W*H*D)	855x500x275 mm			
Weight	73kg		74kg	

HMI e COM	
Interface	Wireless with APP + LED
Communications	Wi-Fi (optional), RS485 (integrated), GPRS 4G/ETHERNET (optional)
Certifications	
Secure standards	IEC62109-1, IEC62109-2
EMC	EN 61000-6-2/4
Approval and national standard	CEI 0-16, CEI 0-21, UNE 206006/206007-1, UNE 217001
Warranty	5 years

Technical specifications are subject to change without notice.



RIELLO SOLARTECH

RPS S.p.A. - Viale Europa, 7 - 37045 Legnago (VR) Italy

divisione Riello Solartech
Via Somalia, 20 - 20032 Cormano (MI)
Tel. 800 48 48 40
e-mail: info@riello-solartech.com

www.riello-solartech.com