• 15P00EGB500 •

SANTERNO TG TL NA

Utility Interactive Solar Inverter

INSTALLATION AND MAINTENANCE INSTRUCTIONS

English

Issued on September 18, 2013
R.00

- This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
- This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The Manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
- Santerno Inc. is responsible for the device in its original setting.
- Any changes to the structure or operating cycle of the device must be performed or authorized by Santerno's Engineering Department.
- Santerno Inc. shall hold no responsibilities for any consequences caused by use of non-original spare-parts.
- Santerno Inc. reserves the right to make any technical changes to this manual and to the device without prior notice. If printing errors or similar are detected, the corrections will be included in the new releases of the manual.
- The information contained herein is the property of Santerno Inc. and cannot be reproduced. Santerno Inc. enforces its rights on the drawings and catalogues according to the law.

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1. GENERAL

1.1. Manufacturer

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1.2. Scope and Intended Audience of this Manual

This manual covers the **Installation and Maintenance Instructions** for SANTERNO TG TL NA, intended for **Installers, Maintenance Technicians and Plant Managers**. They include, in particular, detailed instructions and prescriptions for the following activities:

- Unpacking
- Assembly
- Positioning
- Cable Connection
- Routine maintenance

This manual only contains instructions for installation and routine maintenance.

Should clarifications or further information be required, or should problems arise which are not exhaustively covered in this manual, please contact Santerno Inc. prior to operate.

	Elettronica Santerno is committed to update its User Manuals available for download from santerno.com with the latest version officially released. Please check from santerno.com for updates.

	The operator shall carefully read this manual in order to: • Operate the equipment in compliance with the intended use specified by the manufacturer • Be aware of all the risks related to improper as well as correct use of the equipment • Be aware of behaviors and restrictions to respect and procedures to implement when using the equipment

The instructions provided herein are organized in chapters, paragraphs and sub-paragraphs. Within each chapter, paragraphs and sub-paragraphs are numbered following a hierarchical order. Tables and Figures are numbered following a progressive order. A table of contents and the figures index and tables index are provided for practical purposes. The pages are numbered in a progressive order. Next to each page number, the total number of pages is also indicated.

In case the equipment is transferred to others, under any form (sale, loan, etc.), it must always be accompanied by the complete documentation bundle.

1.3. Updating Procedure

The instructions provided herein are univocally referred to by means of the code specified in the cover. They are revised and updated, if necessary, each time the equipment undergoes modifications. The codes provided in the cover allow tracking the manual version:

Date of updating	Updated on DD.MM.YY
Revision index	R. XX
Software version	SW Version X.XX

Any modification to the equipment authorized by the Manufacturer entails changes to this documentation as well. Therefore, a new manual version will be provided to the user.

1.4. Document Preservation

All the documents related to the Santerno TG TL NA inverter shall be preserved for the entire service life of the product, along with the PV plant documentation, and shall always be easily accessible for the Operator.

The equipment documentation shall not be stored inside the equipment.

In case of partial or complete destruction of the documentation, contact Santerno Inc. to receive a new copy by indicating the technical name of the equipment. It is also possible to download the manuals from the Manufacturer's website.

1.5. Documents Provided

The following documents are always provided with the Santerno TG TL NA inverter:

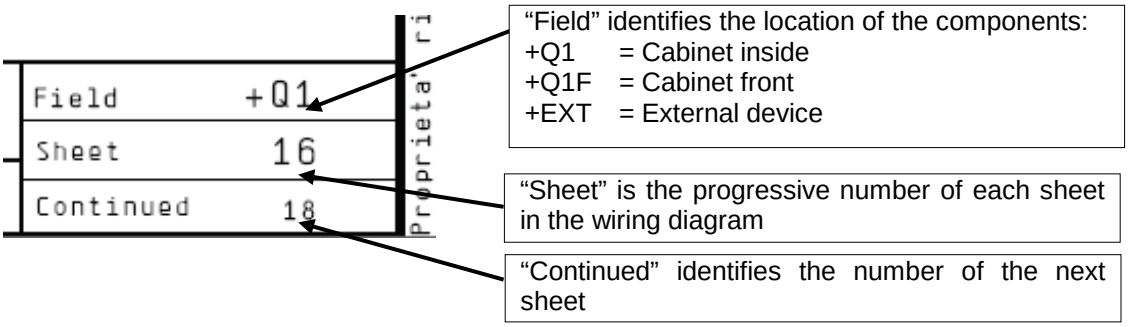
Document Name	Scope
Operating Instructions	This document contains all the information on the functions of the equipment. It also provides instructions for measure readout and parameter programming.
Installation and Maintenance Instructions	This document contains all the information related to the transport, assembly, installation and maintenance of the product.
Electrical and Mechanical Diagram	This document contains detailed information related to the internal layout and the electrical diagram of the cabinet.
Final Test Certificate	This document contains information on the execution and the results of the Production Test.

1.6. Electrical and Mechanical Diagram

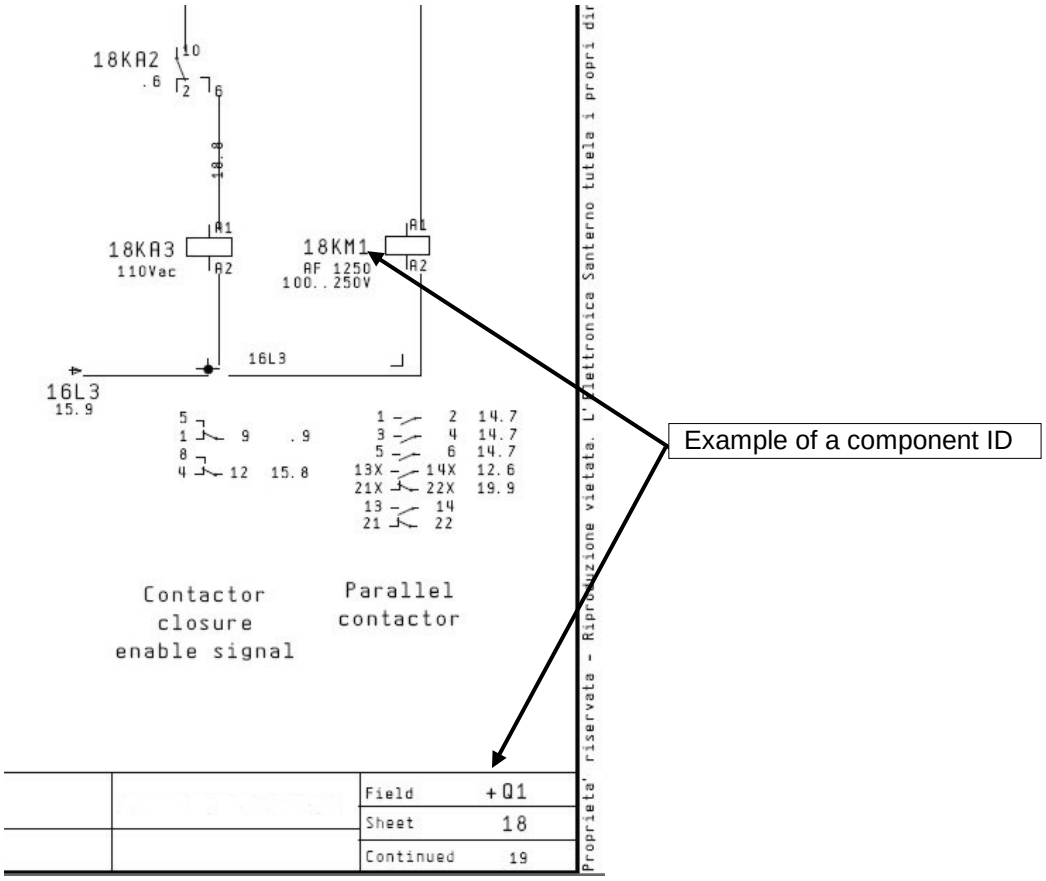
Installation and Maintenance Instructions are typically provided with Electrical and Mechanical Diagram.

The diagram editing technique is described hereafter. This section covers how to read the Wiring and Mechanical Diagram of the Santerno TG TL NA inverters.

Three ID numbers are given in each sheet:

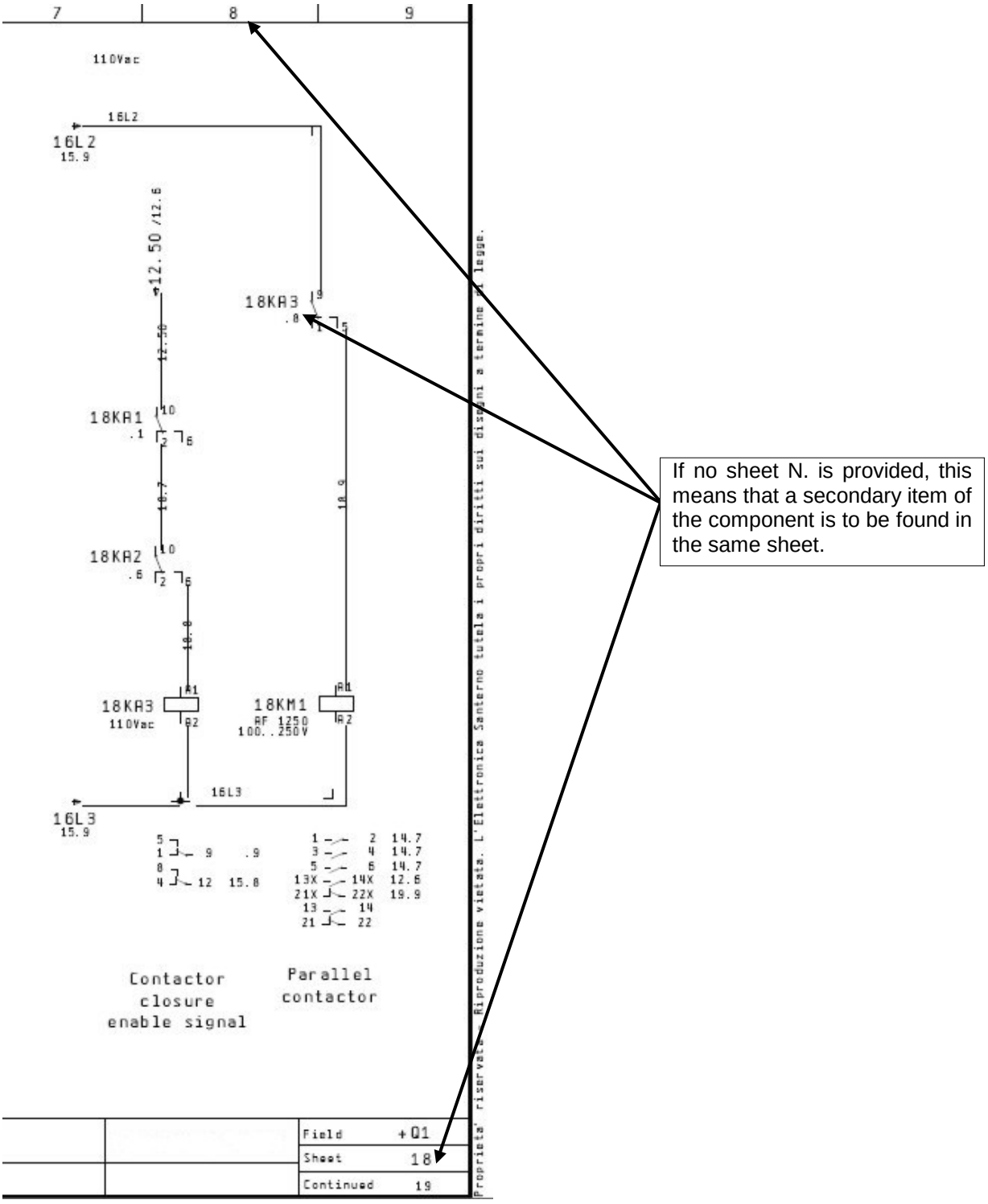


The ID number for each component and each conductor relates to the sheet where the component or the conductor is first used, usually based on the energy flowing direction, followed by a progressive number.



The electrical diagram also provides cross-references for conductors and components described on different pages. The format of a cross-reference is as follows: Sheet.Column.

The sheet number is not indicated in the cross-reference if the reference of the component appears in the same sheet. Only the column number is therefore indicated.



1.7. Final Test Certificate

The Final Test Certificate is issued by the Manufacturer upon testing the equipment. It contains complete information on the execution and the results of the Production Tests and Functional Test as prescribed by CSA107.1-01 and UL1741 standard.
The Final Test Certificate may be issued on the customer's request. Please contact Santerno Inc. if required.

1.8. Warnings

The following symbols and conventions have been adopted for easier and immediate understanding of the topics covered in this manual.

Moreover, any hazards the operator may be exposed to when working on the equipment are signaled by special warning labels applied on the equipment, as given below:

	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
	This symbol indicates important information on the use of the equipment.

Table 1: Warnings

1.9. Definitions

Installer (Qualified personnel)

The Installer is a technician responsible for the placement, installation, PV/Grid connection and commissioning of the equipment, according to the plant diagram and in compliance with state-of-the-art practices and local regulations and standards for installation, such as the National Electrical Code ANSI/NFPA70. The Installer must be recognized as a 'Qualified Person'.

Qualified Person

One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved.

Service Personnel

Trained persons having familiarity with the construction and operation of the equipment and the risks involved.

Operator

A worker having suitable technical knowledge and having acquired familiarity with the equipment by reading and fully understanding the instructions given.

Equipment

The Santerno TG TL NA cabinet, complete and ready for connection to the photovoltaic plant and grid with the purpose of producing electric power. The equipment contains all the maneuvering and control devices, the inverter and any other component required for operation.

Photovoltaic Plant

An electrical installation consisting of a linked system of photovoltaic modules equipped with disconnecting and monitoring devices and connected to the Santerno TG cabinet.

Bipolar Photovoltaic Array

A photovoltaic array that has two outputs, each having opposite polarity to a common reference point or center tap.

Interactive System

A solar photovoltaic system that operates in parallel with and may deliver power to an electrical production and distribution network. For the purpose of this definition, an energy storage subsystem of a solar photovoltaic system, such as a battery, is not another electrical production source.

Grid

An AC electrical installation or system connected to the output of the Santerno TG TL NA cabinet.

Field Voltage

Rated voltage of the photovoltaic field.

Array

A mechanically integrated assembly of modules or panels with a support structure and foundation, tracker, and other components, as required, to form a DC power-producing unit.

Inverter

Equipment capable of changing voltage level or waveform, or both, of electric energy.

Utility-Interactive Inverter

An inverter intended for use in parallel with an electric utility to supply common loads and sometimes deliver power to the utility.

Special Purpose Utility-Interactive Inverter

An inverter that is functionally similar to a Utility Interactive inverter except that it is evaluated for specific applications different from those where Utility Interactive inverters are generally used. These units may have specific utility interconnection protection settings that allow them to provide grid support and operate during abnormal grid events such as low voltage ride through (LVRT).

Please refer to the “Operating Instructions” manual for parameter settings relative to the additional interconnection functions.

Module

A complete, environmentally protected unit consisting of solar cells, optics, and other components, exclusive of tracker, designed to generate DC power when exposed to sunlight.

Panel

A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit.

Solar Cell

The basic photovoltaic device that generates electricity when exposed to light.

Solar Photovoltaic System

The total components and subsystems that, in combination, convert solar energy into electric energy suitable for connection to utilization load.

2. GENERAL

2.1. Product Identification

The product ID is given in the nameplate located on the inverter.

	The nameplate is the only means acknowledged by the Manufacturer to identify the product. It is therefore recommended not to alter or erase the data items stated on the nameplate, since they are essential in order to identify the product and receive precise and immediate technical support.

2.1.1. Part Number

The part number univocally identifies the equipment.

The product name is composed of multiple fields, as described below:

SANTERNO TG760	**WWWWW**	TL NA -	**XXX**	**YY**	**ZZ**

WWWWW: 600V or 1000V - max PV field open-circuit voltage (Voc)

XXX: if present, 320, 340, 360, or 380 - rated AC output voltage for 1000V versions

YY: if present, ID = Indoor version

ZZ: if present, SP = Special Purpose Utility-Interactive Inverter version

2.1.2. Nameplate

The technical and identification data items specified on the nameplate are described below:

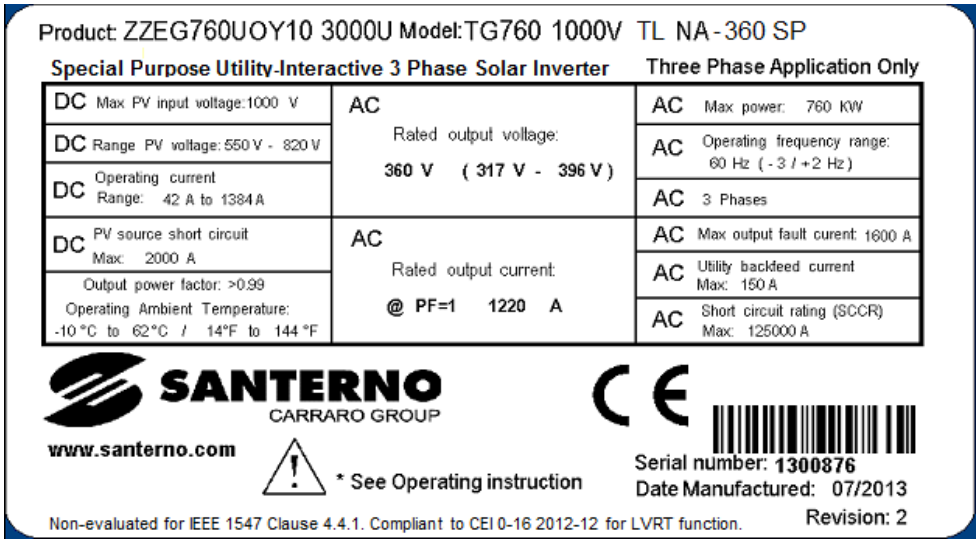


Figure 1: Example of equipment nameplate

1. Inverter type
2. Part Number assigned by Santerno Inc. to the equipment (ZZEGxxxUabyy)
3. Ratings (rated input/output current and voltage, rated power, etc.)
4. Serial Number
5. For Special-Purpose SP Inverters Only: unevaluated portions of IEEE1547 standard and compliance to different standards for additional utility interconnection functions. Please refer to the “Operating Instructions” manual for parameter settings relative to the additional interconnection functions.

The nameplate is located on the outside of the equipment on the right-most door.

2.2. Technical Data

General Data	Santerno TG TL NA	Santerno TG TL NA - SP	Santerno TG TL NA - ID	Santerno TG TL NA - ID SP
Maximum altitude a.s.l.	4000 m / 13120 ft - 1000 m / 3281 ft. without derating	4000 m / 13120 ft - 1000 m / 3281 ft. without derating	4000 m / 13120 ft - 1000 m / 3281 ft. without derating	4000 m / 13120 ft - 1000 m / 3281 ft. without derating
Operating ambient temperature range	-25°C to +62°C -13°F to +143.6°	-25°C to +62°C -13°F to +143.6°	-25°C to +62°C -13°F to +143.6°	-25°C to +62°C -13°F to +143.6°
Storage temperature range	-40°C to +70°C -40°F to 158°F	-40°C to +70°C -40°F to 158°F	-40°C to +70°C -40°F to 158°F	-40°C to +70°C -40°F to 158°F
Cooling system	Forced air	Forced air	Forced air	Forced air
Enclosure rating	NEMA 3R	NEMA 3R	NEMA 1	NEMA 1
Enclosure finish	RAL-7035	RAL-7035	RAL-7035	RAL-7035
Dimensions	H 2.30 m (90.5”) W 2.77 m (108.7”) D 1.01 m (39.5”)	H 2.30 m (90.5”) W 2.77 m (108.7”) D 1.01 m (39.5”)	H 2.10 m (82.7”) W 2.61 m (102.8”) D 0.81 m (31.9”)	H 2.10 m (82.7”) W 2.61 m (102.8”) D 0.81 m (31.9”)
Weight	2150 kg (4740 lbs.)	2150 kg (4740 lbs.)	2050 kg (4520 lbs.)	2050 kg (4520 lbs.)
Testing and certification	UL1741 ongoing IEEE 1547	UL1741 ongoing IEEE 1547 except for Clause 4.4.1 Anti-Islanding CEI 0-16 2012-12 compliance for LVRT function	UL1741 ongoing IEEE 1547	UL1741 ongoing IEEE 1547 except for Clause 4.4.1 Anti-Islanding CEI 0-16 2012-12 compliance for LVRT function
Intelligent monitoring	- SunwayPortal - RemoteSunway - Third-Party compatibility	- SunwayPortal - RemoteSunway - Third-Party compatibility	- SunwayPortal - RemoteSunway - Third-Party compatibility	- SunwayPortal - RemoteSunway - Third-Party compatibility
Number of inputs and fuse rating	See Table 26	See Table 26	See Table 26	See Table 26

Table 2: General technical data

Electrical Data		Unit of Measure	TG760 600V TL NA	TG760 1000V TL NA - 320	TG760 1000V TL NA - 340	TG760 1000V TL NA - 360	TG760 1000V TL NA - 380
Input	Max input voltage	Vdc	600	1000			
	Range of input operating voltage (Vmax MPPT)	Vdc	330 - 600	495 - 900 (820)	525 - 900 (820)	550 - 900 (820)	580 - 900 (820)
	Maximum input current	A	1571				
	Maximum input short circuit current	A	2000				
Output	Nominal output voltage	V	215	320	340	360	380
	Operating voltage range AC		-12% +10%				
	Output power factor rating		1				
	Max output power	kVA	500	711	756	800	844
	Max output current	A	1343	1283			
	Maximum full power operating ambient temp.	°C/°F	+45 °C/ +113 °F	+50 °C/ +122°F			
	Normal output frequency	Hz	60				
	Operating frequency range	Hz	59.3 – 60.5				
	Maximum output fault current and duration (1)	A / ms	2014 / 8	1924 / 8	1924 / 8	1924 / 8	1924 / 8
	Maximum output overcurrent protection	A	1600				
	Utility interconnection voltage and frequency trip limits and trip times		According to IEEE 1547. Special Purpose SP versions do not provide the anti-islanding function (IEEE 1547 Clause 4.4.1) and are compliant to CEI 0-16 2012-12 for LVRT function.				
	Trip limit and trip time accuracy		5%				
	Harmonic distortion		<3%				
Efficiency (2)	Maximum efficiency		98.2 %	98.6 %	98.6 %	98.6 %	98.6 %
	EU-Weighted efficiency		97.5 %	98.3 %	98.3 %	98.3 %	98.4 %
	CEC-Weighted efficiency		97.5 %	98.0 %	98.0 %	98.0 %	98.0 %
	Tare losses	W	45				

Table 3: Electrical data

(1) Short circuit transformer impedance 6%
(2) Efficiency does not include auxiliary consumptions.

2.3. Layout

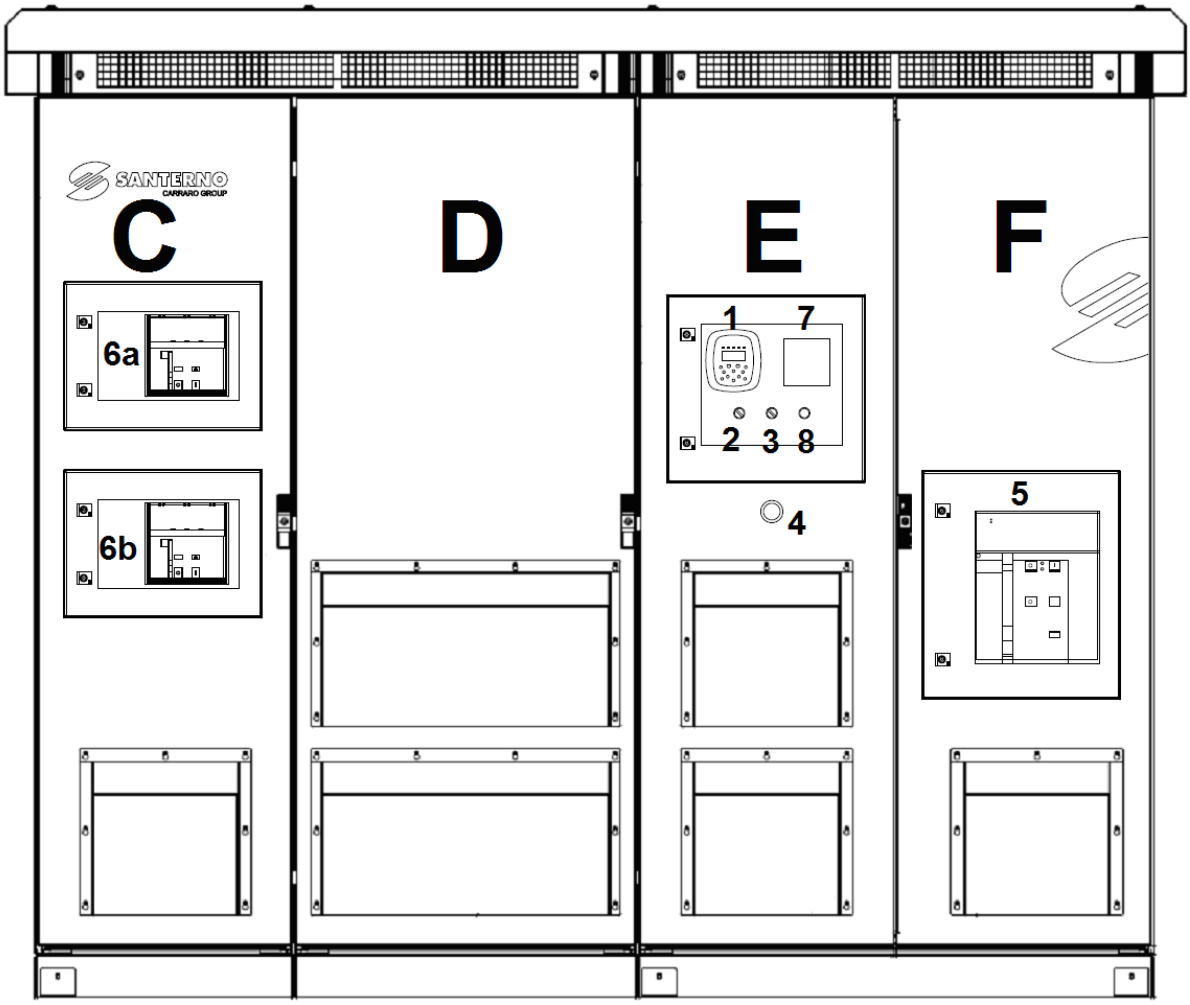


Figure 2: Layout of the Santerno TG TL NA

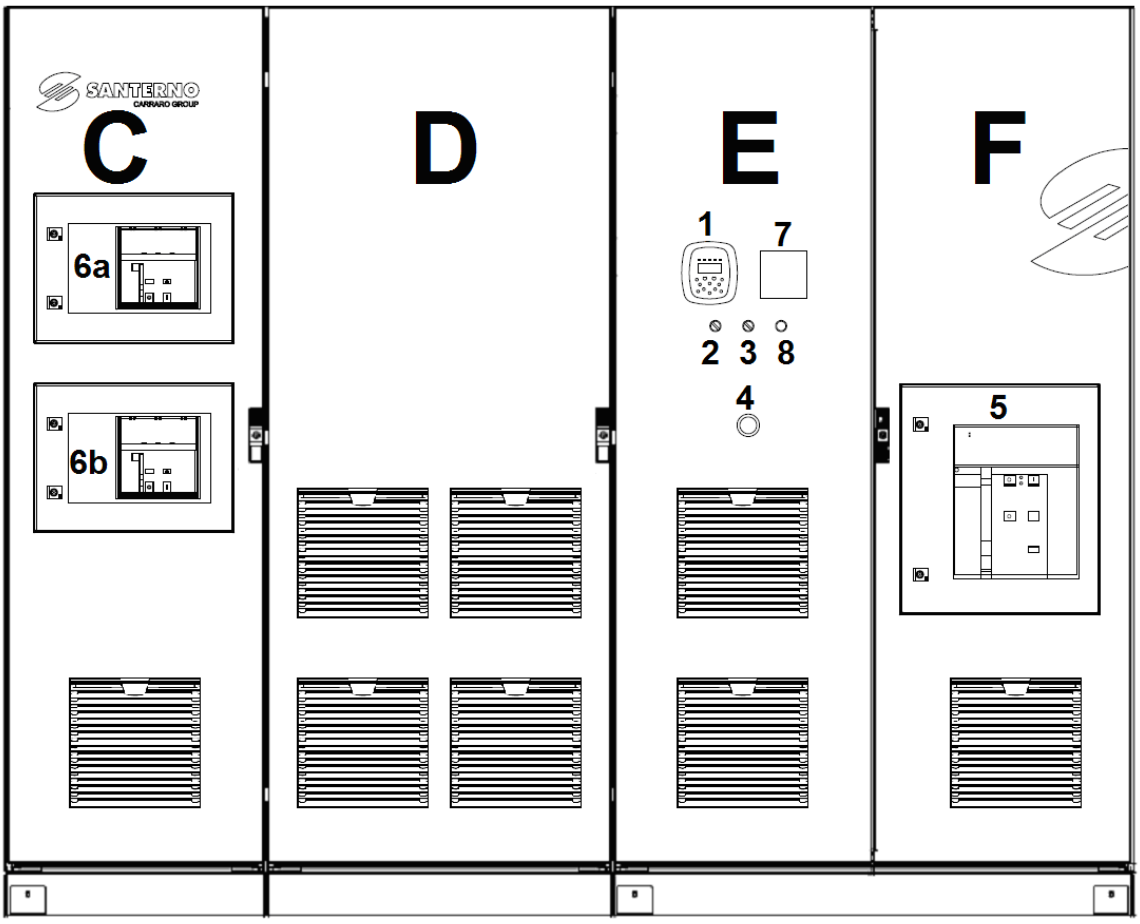


Figure 3: Layout of the Santerno TG TL NA - ID

1- Keypad
2- On-off selector key
3- Maintenance key (by-pass interlock doors)
4- Emergency push-button
5- AC disconnect switch
6a DC disconnect switch (PV subfield 1)
6b DC disconnect switch (PV subfield 2)
7- AC power meter (option)
8- GFDI alarm lamp
C – D – E – F- Hinged doors

3. INFORMATION ON TECHNICAL SUPPORT

3.1. Request for Technical Support

Only technicians authorized by Santerno Inc. are allowed to carry out any kind of technical interventions on the equipment.

To submit a support request, always provide the following information:

1. Inverter type
2. Part Number
3. Serial Number
4. ID(s) of the alarm(s) displayed

4. SAFETY STATEMENTS

WARNING	This section covers safety statements. The non-observance of the safety instructions below may cause serious injury or death and equipment failure. Carefully read the instructions below before installing, starting and operating the inverter. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.

4.1. General Warnings

WARNING	All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. The Santerno TG inverters do not contain user-serviceable parts. For repair and maintenance always contact Santerno Inc. or its authorized service. Before installing or using the Santerno TG inverter, read all of the instructions, cautions, and warnings on the Santerno TG given in these Installation and Maintenance Instructions. Before connecting the Santerno TG inverter to the electrical utility grid, contact the local utility company. This connection must be made only by qualified personnel. PV arrays produce electrical energy when exposed to light and hence can lead to electric shock hazard. Wiring of the PV-arrays should be performed by qualified personnel only.

4.2. Intended Use

The equipment has been designed and constructed exclusively for the purpose of converting DC power produced by solar panels into AC power to be delivered to the distribution grid.

The equipment must be used in compliance with the environmental restrictions and the installation requirements specified by the Manufacturer in this Installation and Maintenance Instructions Manual.

4.3. Improper Use

Any other use different from the one specified by the Manufacturer is to be considered as improper.

In particular, it is forbidden to:

- Connect the equipment to energy sources different from PV panels
- Alter and tamper with the equipment
- Install components not explicitly authorized by Santerno Inc.

4.4. Safety Instructions

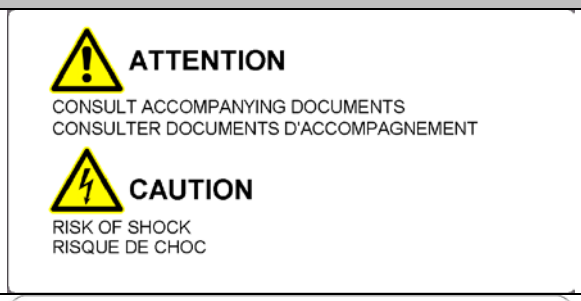
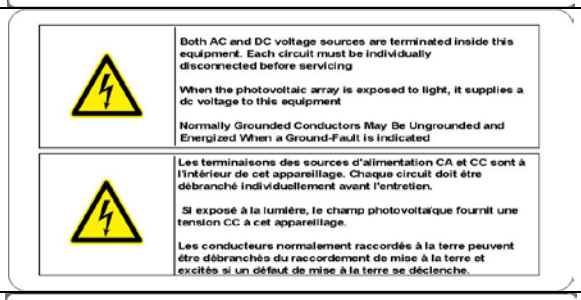
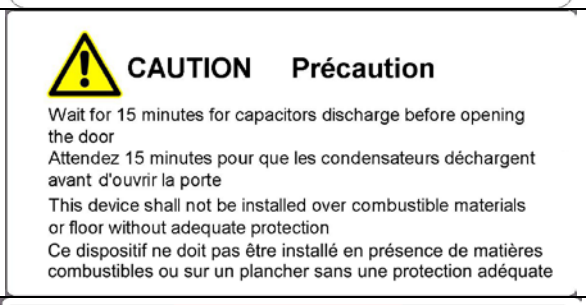
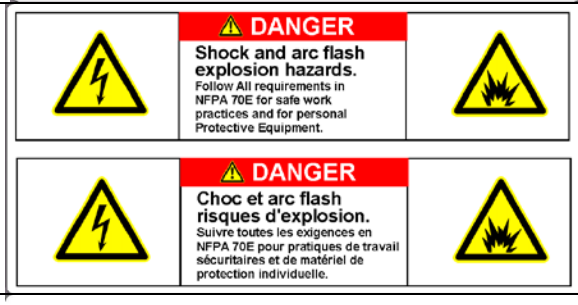
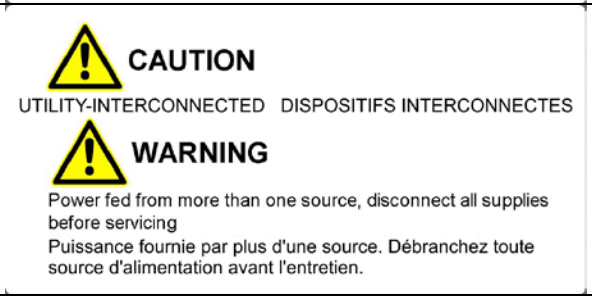
A list of risks is given for each operation:

- Unpacking
- Assembly
- Positioning
- Wiring
- Routine maintenance

	Danger: Hazardous voltage Do not remove any component from the equipment Danger: Hazardous voltage All doors must be closed Danger: Hazardous voltage Do not touch live parts All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	The non-observance of the prescriptions and instructions contained in this Manual may cause serious injuries to people. • Any intervention on the Santerno TG TL NA cabinet must be carried out in compliance with the Instructions provided • Always operate in compliance with the prescriptions provided by the safety warning labels • Never operate the Santerno TG TL NA cabinet in case of visible damages • Contact Santerno Inc. in case of one or more active alarms • Contact Santerno Inc. if any problems arise • Do not attempt to operate the Santerno TG TL NA if some problems still remain unsolved
	Do not store this Instructions Manual inside the equipment.

Table 4: Safety instructions

4.5. List and Location of the Safety Pictograms

Pictogram	Location
	On door E
	On door E, just beside the previous label
	On all the doors
	On doors C and F, just above the disconnect switch
	On doors C and F, just above the disconnect switch

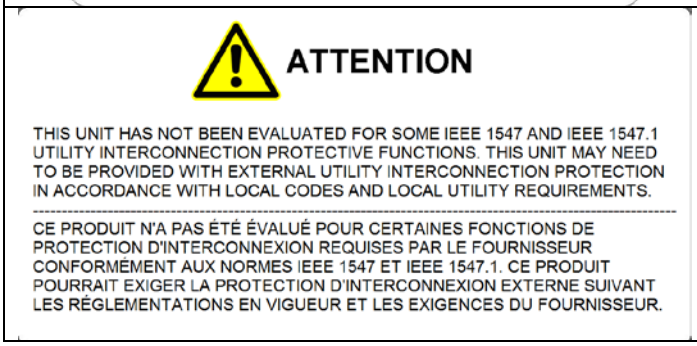
	On door C, just above the DC switches
	On door F, just above the AC circuit breaker
	On door F, just under the equipment nameplate. For Special Purpose SP Inverters only.

Table 5: List of the external safety pictograms

Pictogram	Location
	Adjacent to fuse holders
	Adjacent to input/output terminals, metal screen

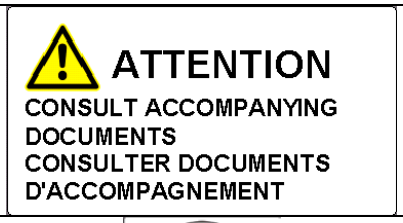
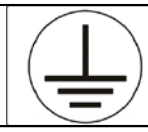
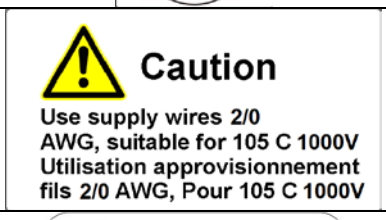
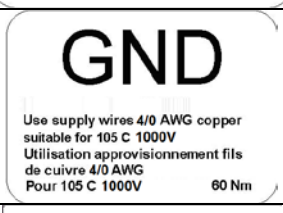
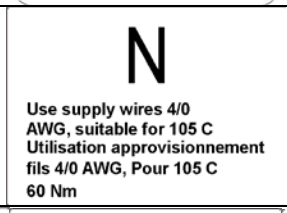
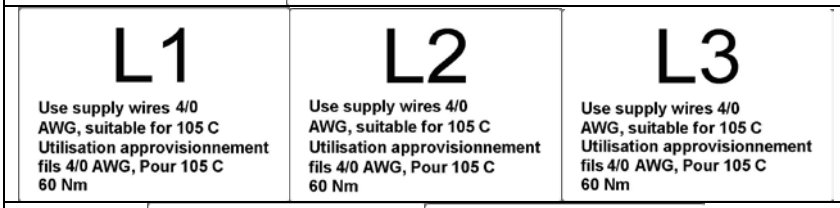
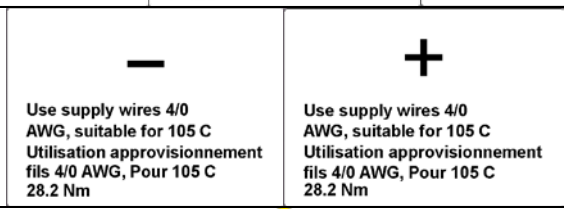
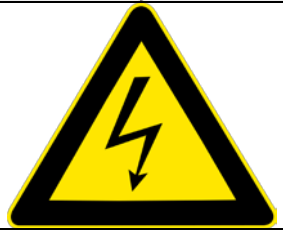
	Adjacent to field wiring terminal
	Adjacent to the main protective ground terminal
	Adjacent to the field wiring terminal Ratings and data in the labels placed on the equipment may vary from the ones given in this manual
	Adjacent to the wiring terminal
	Adjacent to the main protective ground terminal Ratings and data in the labels placed on the equipment may vary from the ones given in this manual
	Adjacent to the neutral terminal, if present Ratings and data in the labels placed on the equipment may vary from the ones given in this manual
	Adjacent to the utility connection terminals Ratings and data in the labels placed on the equipment may vary from the ones given in this manual
	Adjacent to the field wiring terminals Ratings and data in the labels placed on the equipment may vary from the ones given in this manual
	On some internal components of the equipment

Table 6: List of the internal pictograms

5. PACKING

Unless prior agreements between the parties exist, the equipment is packed by Santerno Inc. on wooden pallets. The roof and rain hoods for outdoor versions are shipped in a separate crate annexed to the inverter.

Mechanical protection from shock and environmental protection is ensured by bumpers on the corners and overseas packaging bag.

	Santerno TG TL NA - ID	Additional crate for outdoor parts
Packaged dimensions WxHxD	2.84x2.3x1.09m. (111.8”x98.4”x70.8”)	3.01x1.33x0.5m. (118.5”x52.4”x19.7”)
Packaged weight	2360 kg (5200 lbs.)	310 kg (683 lbs.)

Table 7: Size and weight of the packed equipment

On the packaging, the following information is provided by pictograms or text:

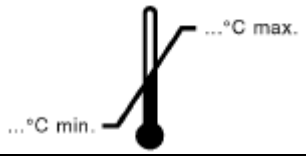
CG position	
High	
Max. and Min. allowed temperature	
Do not turn upside down	
Read the instructions	
Weight	--
Size	--

Table 8: Pictograms and information on the packaging

6. STORAGE AND HANDLING

⚠ WARNING	Prior to storing the packaged equipment in areas exposed to rain, extreme humidity conditions or direct sunlight, the following recommendations must be observed: • The overseas packaging bag must not be damaged • The internal temperature of the cabinet shall not exceed 158°F (70°C).

The equipment packaged, as described in section 5, shall be stored in environments with the characteristics described in Table 2.

The packed equipment may be exposed to rain and, in case of exposure to humidity, the following condition must be observed:
5% to 95% from 1g/ m^3 to 25g/ m^3 non-condensing and non-freezing.

It is preferable not to expose the packaged equipment to direct sunlight.

⚠ CAUTION	All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed. Observe the safety instructions on the packaging. Consider the CG position when handling the equipment. Choose a lift truck with adequate capacity. Avoid sudden movements or tearing during handling as the load may overturn.

The inverter is originally shipped on a wooden pallet and it can be handled with a forklift truck.

Hold the pallet in order to maintain the center of gravity between the forks of the lift truck: for safety reasons and to ensure correct operation, avoid swaying and tilting up the inverter.

To remove the equipment from the pallet and place it on its final location, remove the roof from the outdoor version or remove the M12 bolts on top of the cabinet on indoor versions, place lifting angle bars on top and hook the cabinet by suitable ropes or chains from top.
It is mandatory to use a couple of proper lifting angles bar (Figure 6) to perform this operation. Please contact Santerno Inc. if lifting angles are to be supplied.

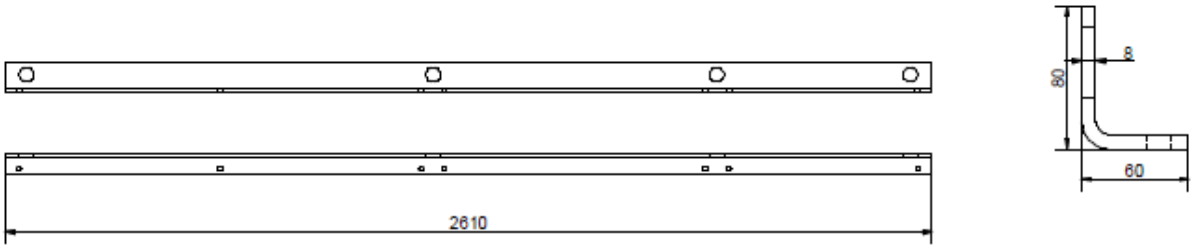


Figure 4: Lifting angles

Lifting the equipment by using eyebolts is forbidden as it may cause serious injury or death and equipment failure.

Make sure that the length of the hoisting ropes is such to form an angle which does not exceed 60 °.
The following figures show the correct way of hoisting inverters of this size.

Figure 5: Correct hoisting of inverters

6.1. Handling the Santerno TG TL NA Cabinet

	It is forbidden to access, remove the roof and lift up the product under inclement weather conditions, such as snow, rain, fog and wind. Always make sure that no water or condensation is to be found inside the equipment.

To handle the Santerno TG TL NA inverter, follow the procedure below:

- Remove the roof (outdoor versions only)

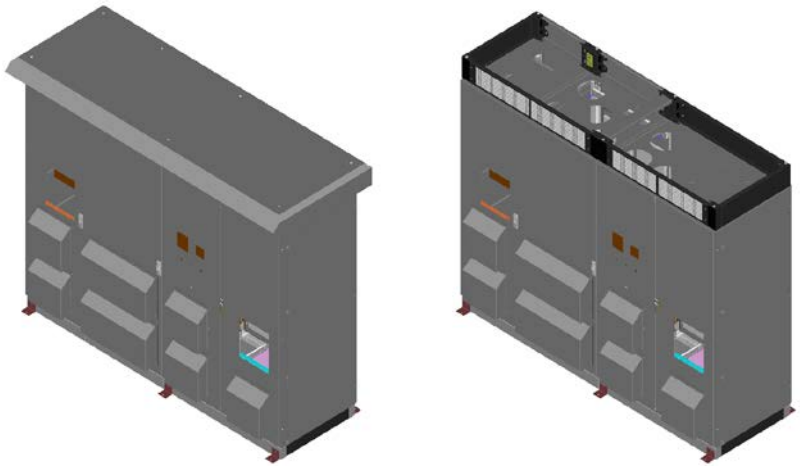


Figure 6: Roof removal

- Unscrew the M12 bolts on top of the cabinet
- Remove the columns and walls of the plinth (outdoor versions only)

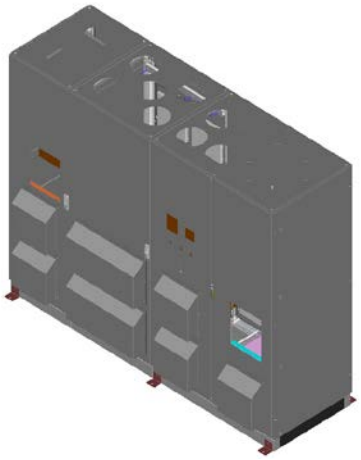


Figure 7: Plinth removal

- Mount the lifting angle bars on top of the cabinet, using the M12 bolts previously removed from the top of the cabinet
- Hook the lifting bars in all the holes with the ropes and lift up the cabinet
- Settle the equipment on its final location
- Remove the lifting bars from the top of the cabinet
- Screw the M12 bolts in their previous positions (tightening torque: 10 Nm to 35 Nm), fixing the plinth columns at the top of the cabinet (outdoor versions only)

- Insert the cage nuts to the holes in the high part of the plinth columns and only in correspondence of the fixing holes in the roof (outdoor versions only)
- The correct position of the columns and cage nuts is shown in the picture below (outdoor versions only)

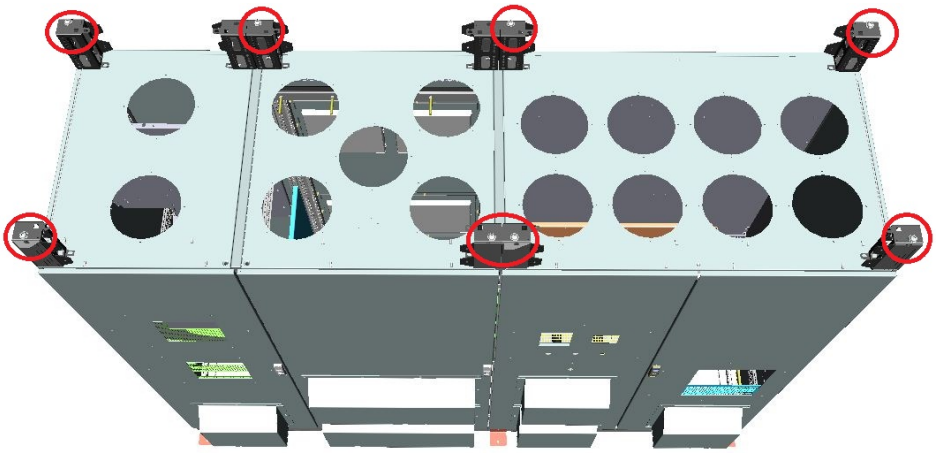


Figure 8: Plinth columns and cage nuts

- Fix the back panels with black countersunk screws (tightening torque: 5 Nm) (outdoor versions only)

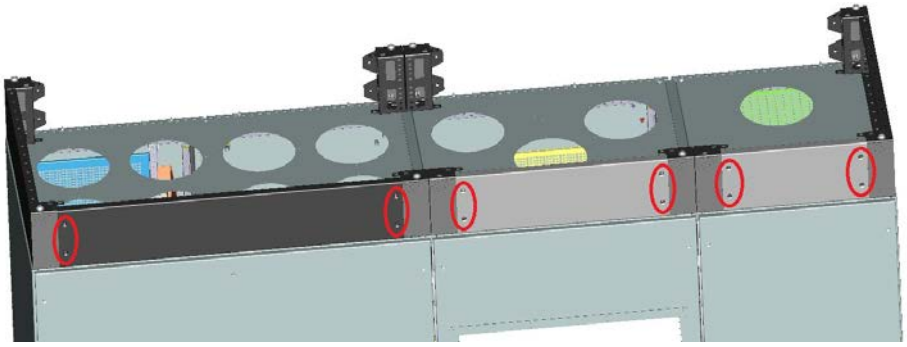


Figure 7: Plinth back panels

- Fix the side panels and highlighted structural parts with two screws and locks on each side (tightening torque 12 Nm) (outdoor versions only)

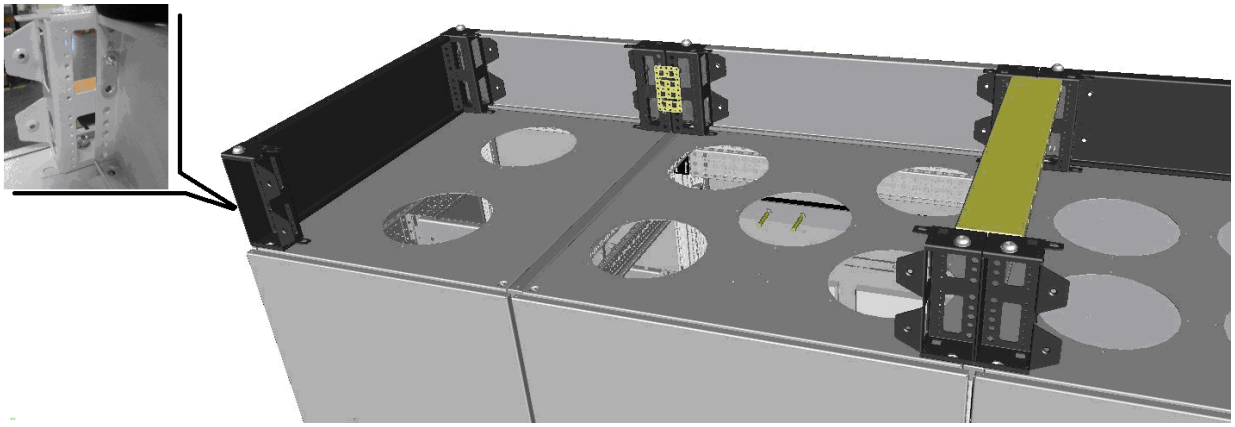


Figure 9: Plinth side panels and structural parts

- Raise the roof with the forklift truck and put it in position on the cabinet (outdoor versions only)

Figure 10: Raising the roof

- Hold the roof in position and pull out the forks. Fix the roof by using M12 screws with rubber gaskets (Tightening torque: 10 Nm) (outdoor versions only)
- Assemble the filter grilles as shown below (no screws are required) (outdoor versions only)

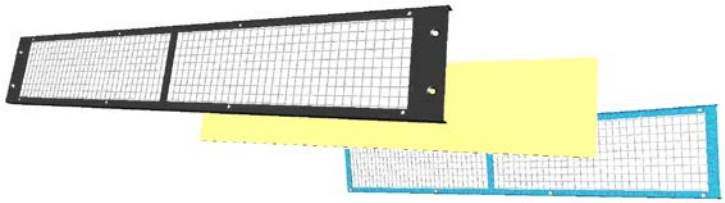


Figure 11: Filter grilles

- Fix the grilles with black countersunk screws (tightening torque: 5 Nm) (outdoor versions only)
- Insert plastic covers on the support angles (outdoor versions only)
- Clean any dirty part and repair any scratch by applying the recommended touch-up paint.

7. UNPACKING AND DELIVERY CHECK

Inspect the product upon receipt, before unpacking the equipment. If visible damages are found, please contact Santerno Inc. immediately.

	Read this Instruction Manual before unpacking the equipment.

Avoid using cutters, as they could scratch the equipment and remove the protective paint.

The packing material should be taken to a waste collection center in accordance with the local regulations in force.

8. INSTALLATION

8.1. Characteristics of the Installation Site

The equipment can be installed indoor or outdoor depending on the inverter versions. Please refer to the inverter nameplate. If installed indoor, special requirements must be met to ensure proper ventilation.
The equipment must be installed on flat surfaces, with adequate capacity, under no potentially hazardous conditions.

	It is forbidden to install and maintain the product under inclement weather conditions, such as snow, rain, fog and wind. Always make sure that no water or condensation is to be found inside the equipment.

8.2. Properties of the Installation Site

8.2.1. Installation Requirements

The installation site must meet the environmental requirements specified in 2.2 Technical Data.
Furthermore, the following environmental requirements must be met.

Installation site	Pollution degree 2 or better
Ventilation air flow for indoor installation	Min. 12000 m^3/h
Cooling power for indoor installation	Min. 22.8 kW for TG760 TL NA

Table 9: Environmental conditions

CAUTION	Do not install in places exposed to conductive dust, corrosive gas, vibrations, water sprinkling or dripping; do not install in salty environments.

8.2.2. Installation Surface and Plate Preparation for Cable Entry

The installation surface must:

1. Be able to support the weight of the equipment
2. Be flat
3. Not be made of conductive or flammable material.

Before placing the equipment, all conduits should be arranged for the cables run from the PV field array and from the power grid (Figure 12).

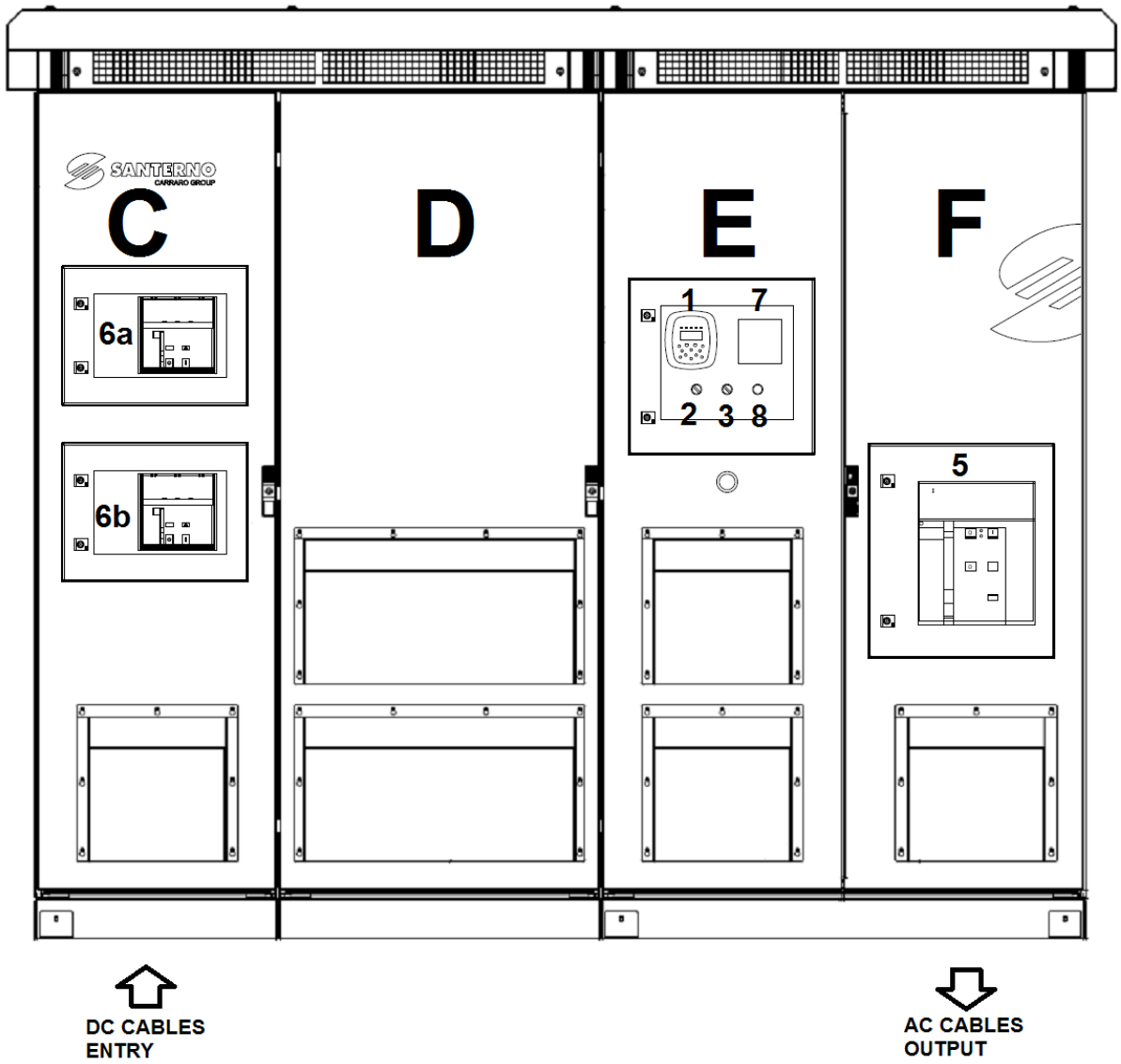


Figure 12: Cable entries

The DC- and AC-side cable entry plates are completely closed when supplied. The entry plate shall be drilled in order to house the exact number and size of conduits or fittings. Please refer to the Electrical and Mechanical Diagram for the dimensions and drawings of the entry plates.

⚠ WARNING	Cable entry accessories must be chosen by the installer so as to restore the original NEMA type of the equipment. Only one cable per AC phase shall be inserted into each AC entry hole. Avoid inserting the cables from the 3 phases into different holes. Failure to do so may lead to parasitic currents causing the entry plate to melt.
	It is forbidden to install, access and maintain the product under inclement weather conditions, such as snow, rain, fog and wind. Always make sure that no water or condensation is to be found inside the equipment.

Use appropriate tools for drilling holes in galvanized sheet metal of 2 mm (0.08") thickness. A punching press is recommended.

⚠ CAUTION	Remove any metal burrs that may have formed during the drilling of the cable entry panels.

Proceed as follows:

1. Open the door of the Santerno TG TL NA where the plate is located
2. Remove the internal protective grilles using a 5mm hex key
3. Unscrew the entry plates from the bottom of the cabinet
4. Unscrew the connecting pin of the equipotential circuit
5. Remove the panel
6. Drill holes in the panel and install the fittings for cable entry on the panel. Then re-place the panel inside the equipment
7. Connect the cable of the pin equipotential circuit
8. Fix the panel using the screws previously removed
9. Place the protective grilles in their previous position using the same 5mm hex key and screws
10. Close the door

8.3. Minimum Clearance

The equipment must be installed leaving minimum allowable clearance from walls or obstacles in order to ensure:

- Ventilation as needed
- Space for opening doors
- Space for maintenance operations

For indoor versions only, additional 2ft (61cm) minimum clearance from the ceiling shall be left for ventilation purposes and for lifting the inverter from top.

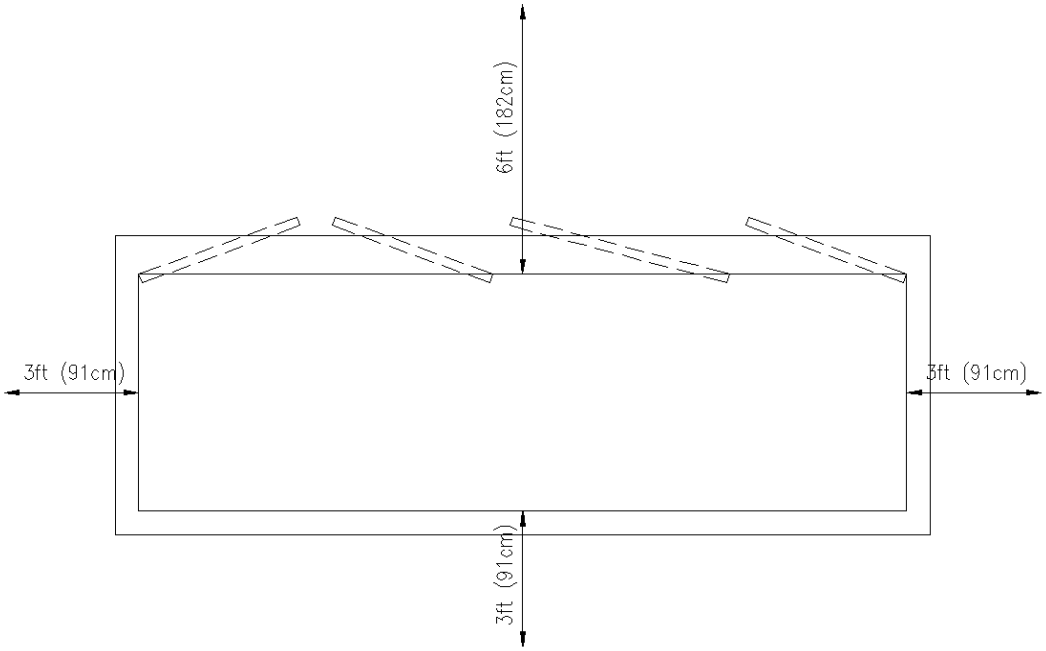


Figure 13: Minimum clearance for outdoor version

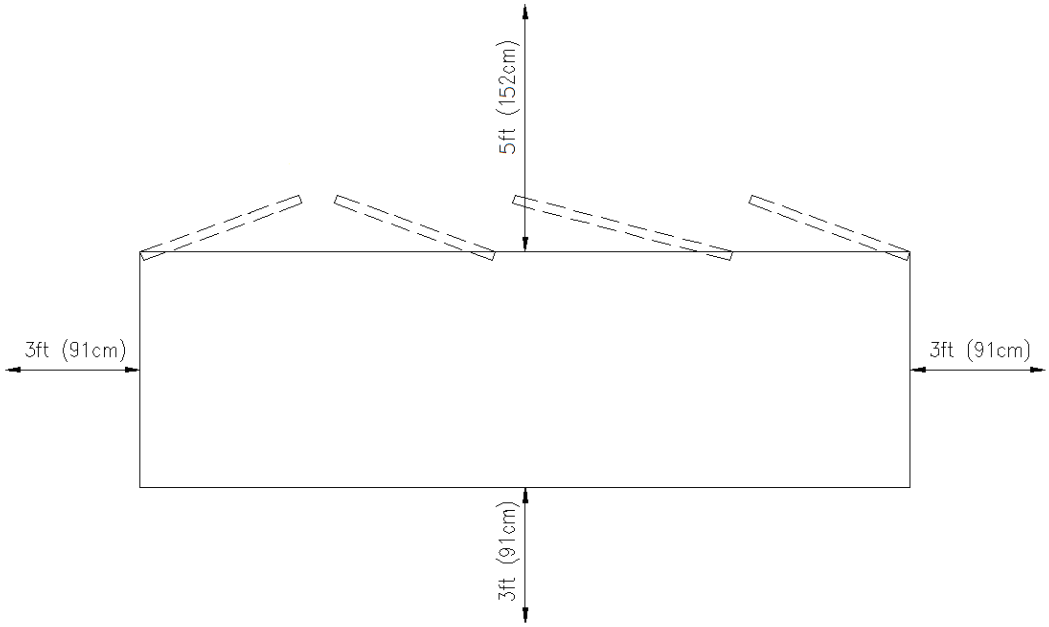


Figure 14: Minimum clearance for indoor version

8.4. Accessing the Cabinet

DANGER	Danger of electrocution. Danger of death. Only Qualified Persons can access the internal parts of the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
WARNING	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.
	It is forbidden to install, access and maintain the product under inclement weather conditions, such as snow, rain, fog and wind. Always make sure that no water or condensation is to be found inside the equipment.

The equipment is designed in order to safely access the internal maneuver components. Line entries are located behind hinged doors C and F, where voltage is always applied unless the equipment is externally isolated.

The equipment can be accessed through hinged doors that can be opened with special keys. Each door is interlocked with a position switch that, in case of door opening with voltage on, controls the opening of the DC- and AC-side disconnect switches.
All the areas behind hinged doors where accessible live parts are present have been secured with protective metal grilles fixed with screws. A tool such as a screwdriver, hex wrench or similar is required to remove them.

Figure 15: Cabinet door key

Figure 16: Internal protective grilles

The equipment can be accessed when it is:

1. Isolated
2. Live

8.4.1. Accessing the Isolated Equipment

DANGER	Danger of electrocution. Danger of death. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make operation safe. Only Qualified Persons can access the internal parts of the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
WARNING	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

How to access the isolated equipment:

1. Stop the inverter by pressing the STOP button from the display/keypad
2. Press the AC circuit breaker “O Push OFF” red button and pad-lock the buttons
3. Press the “O Push OFF” red button on both DC disconnect switches and pad-lock the buttons
4. Disconnect the PV field and the AC grid by operating on the relative external disconnect switches
5. In case an external power supply source is used to power the ventilation system or the equipment is power supplied via UPS, isolate these sources using appropriate external disconnect switches
6. Wait 15 minutes for capacitors discharge before opening the doors
7. Open the door using the key provided
8. Use a 5mm hex-key to remove the protective grilles to reach the parts protected by the grilles

Figure 17: Pad-locking system on OFF isolator with DC or AC disconnect switch lock

	Danger of electrocution. Danger of death. After removing the protective grilles, reassemble them using all the screws supplied. Connect the cable of the equipotential circuit. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.

8.4.2. Accessing the Live Equipment

	Danger of electrocution. Danger of death. Use personal protection equipment appropriate for the task to be performed. Use appropriate warning signs to make the operation safe. Only Qualified Persons can access the internal parts of the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

How to access the live equipment:

1. Control the door by-pass by setting key-operated selector switch 50S2 to ON
2. Open the door concerned
3. If you need to reach internal components protected by the protective grilles, remove the protective grilles using a 5mm hex key.
4. Reassemble the protective grilles, close the door, set key-operated selector switch 50S2 to ON, and remove it.

	Danger of electrocution. Danger of death. After removing the protective grilles, reassemble them using all the screws supplied. Connect the cable of the equipotential circuit. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.

8.5. Electrical Connection of the Equipment

The electrical connection of the equipment shall be carried out when the equipment is isolated, i.e. when it is not powered from the PV field, the grid and the auxiliary power supply. The connection must be performed according to the sequence in Table 10, according to the following requirements.

	The equipment is supplied with all the fuses in their fuse holders and all the switches and disconnect switches in Open position (OFF).

DANGER	Danger of electrocution. Danger of death. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make operation safe. Only Qualified Persons can access the internal parts of the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
WARNING	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

All cable connections must be performed on different terminal strips based on the type of circuit to be connected.

Terminal board	Description	Location
X1	Grid terminals	Behind door F
X2	PV field terminals	Behind door C
X3	Ambient signals and PV field I/Os terminal strip	Behind door F
X4	RS485 terminal strip	Behind door F
X7	External Power Supply/UPS terminal strip	Behind door F

Table 10: Terminal board list

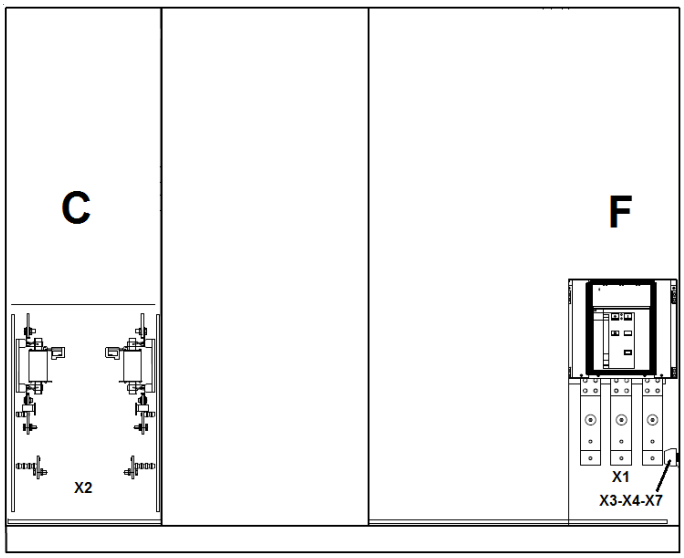


Figure 18: Location of the terminal boards

DANGER	Do the following before connecting the equipment: 1. Make sure that both the DC switches are isolated (OFF) 2. Remove the fuses from the DC line input (X2) 3. Check if the AC switch is disconnected (OFF) 4. Check if the following switches are isolated (OFF): a. 14Q1 – 25Q1 - 27Q1 5. Check if the following fuse holders are isolated and their fuses removed: a. 25F1 – 25F2 – 25F3 - 27F1 – 27F4 – 27F5 – 28F1

8.5.1. Connecting the Control Circuit Cables to Terminal Board X3

The cables of the control circuits must be connected to terminal board X3, located in compartment B.
All the terminals are spring terminals. The connection procedure is as follows:

1. Strip the cable for about 10 mm (0.4 in.)
2. Open the terminal spring clamp by inserting a flat screwdriver (max. 4 mm) (0.16 in.)
3. Insert the conductor and remove the screwdriver
4. Check tightness by slightly pulling the cable.

Max. AWG14 Min. AWG26
Cu Only
75°C cable

Table 11: Terminal board X3 electrical ratings

Please refer to the Electrical and Mechanical Diagrams for the list of available I/Os and terminals available in terminal board X3 and their allocated functions.

8.5.1.1. Connecting the Ambient Sensors and the PV Field I/Os

Six inputs acquiring ambient measures are available on the Santerno TG TL NA.
They are located on ES847 Expansion Board for Environmental Sensors and PV Field I/Os. ES847 board is covered in section 15.2 ES847 Board.

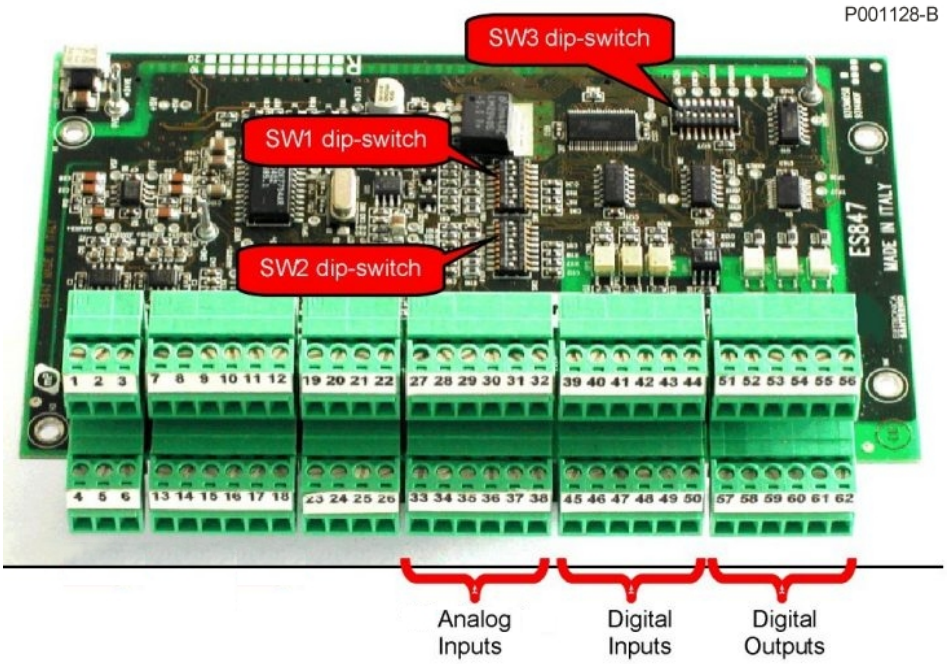


Figure 19: Environmental Sensors and I/Os Expansion Board

Environmental Measure	Factory-set Sensor	Factory Setting	Terminal
Ambient Measure 1	Module radiation	0-100mV	X3, contacts 5-6
Ambient Measure 2	Horizontal radiation	0-100mV	X3, contacts 7-8
Ambient Measure 3	Integrated PT100	PT100	--
Ambient Measure 4	Module temperature	PT100	X3, contacts 3-4
Ambient Measure 5	Aux 1 signal	(0-10)V	X3, contacts 9-10
Ambient Measure 6	Aux 2 signal	(0-10)V	X3, contacts 11-12

Table 12: List of environmental sensor terminals

8.5.1.2. ES847 Board Configuration DIP-switches

ES847 board is provided with three configuration DIP-switches allowing setting the operating mode as described in Table 13.

DIP-switch	Operating Mode
SW1	Sets the operating mode of environmental analog inputs 1 and 2
SW2	Sets the operating mode of environmental analog inputs 3 and 4
SW3	Factory-setting: SW3.2=ON, SW3.5=ON, all the other DIP-switches OFF (DO NOT MODIFY)

Table 13: Functionality of the 3 DIP-switches in control board ES847

The possible configurations of DIP-switch SW1 and SW2 based on the setting of the environmental channels are shown in the tables below:

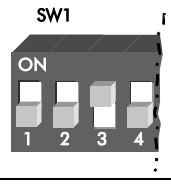
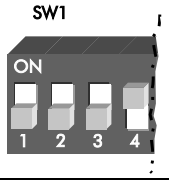
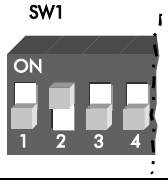
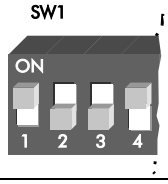
Configuration of environmental analog channel 1			
0-10V f.s. mode	0-100mV f.s. mode	0-20mA f.s. mode	Temperature reading with PT100 thermostat
			

Table 14: Environmental analog channel 1 DIP-switch

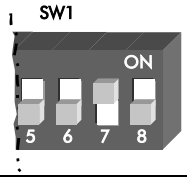
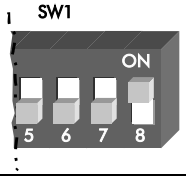
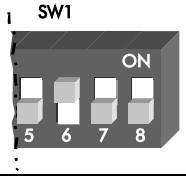
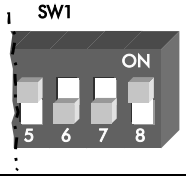
Configuration of environmental analog channel 2			
0-10V f.s. mode	0-100mV f.s. mode	0-20mA f.s. mode	Temperature reading with PT100 thermostat
			

Table 15: Environmental analog channel 2 DIP-switch

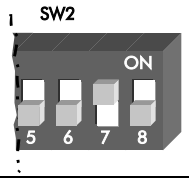
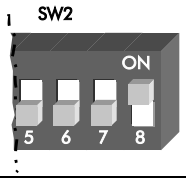
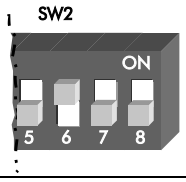
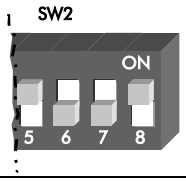
Configuration of environmental analog channel 4			
0-10V f.s. mode	**0-100mV f.s. mode**	**0-20mA f.s. mode**	**Temperature reading with PT100 thermostat**
			

Table 16: Environmental analog channel 4 DIP-switch

The DIP-switches are factory set as follows:

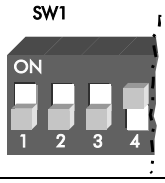
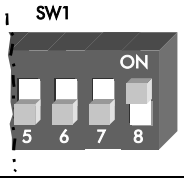
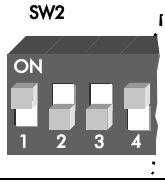
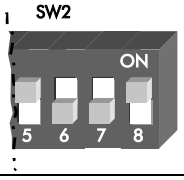
Environmental analog channel 1	
0-100mV f.s. Mode	
Environmental analog channel 2	
0-100mV f.s. Mode	
Environmental analog channel 3	
Temperature reading with PT100 thermostat	
Environmental analog channel 4	
Temperature reading with PT100 thermostat	

Table 17: Factory setting of the configuration DIP-switches in ES847 board

	The software parameter setting must be consistent with the DIP-switch setting. Otherwise, no predictable result is given for acquired values.
	Any voltage or current value exceeding full-scale values or dropping below min. values will generate an acquired value limited to the max. measure or the min. measure respectively.
⚠ WARNING	Voltage inputs have high input impedance and must always be closed when active. Isolating a conductor connected to an analog input set as a voltage input will not ensure that its channel readout will be equal to zero. Zero is detected only if the input is short-circuited or wired to a low impedance signal source. Relay contact should not be series-connected to the inputs to reset the detected value.

8.5.1.3. Connecting Analog Inputs to Sensors Provided with Voltage Outputs

Use a screened pair data cable and connect its braiding to the side of ES847 board.

Although “slow” acquisition analog channels have a cut-off frequency slightly exceeding 10Hz, and the mains frequency, which is the main disturbance source, is weakened, make sure that wiring is correct, particularly if the full-scale value is 100mV and if wires are longer than 10 m. Figure 20 and Figure 21 show a wiring example for the acquisition of a voltage source.

Properly set the DIP-switches for the configuration of the analog channel being used: set the full-scale value to 10V or 100mV. The setting of the programming parameter must be consistent with the hardware setting.

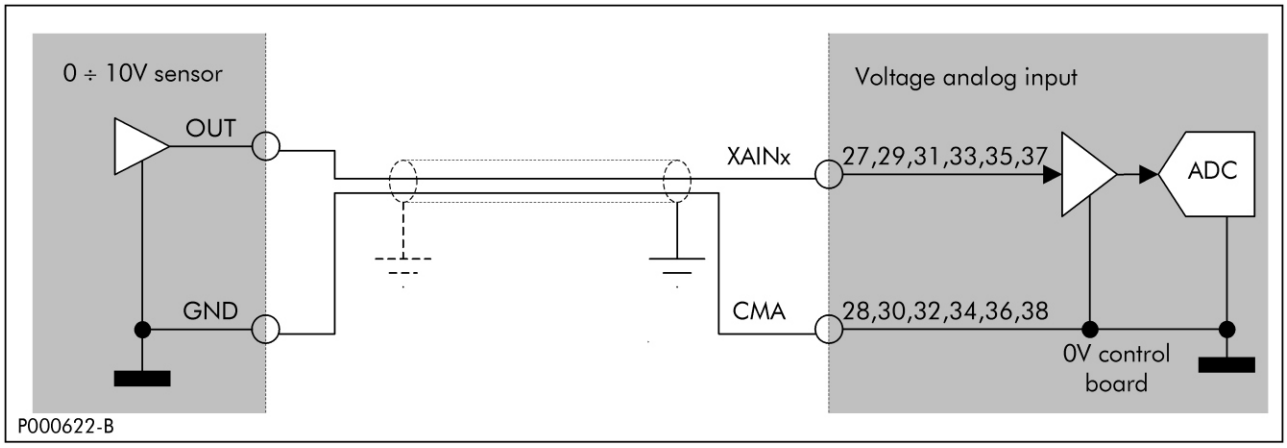


Figure 20: Connection of voltage output to 0 ÷ 10V analog input

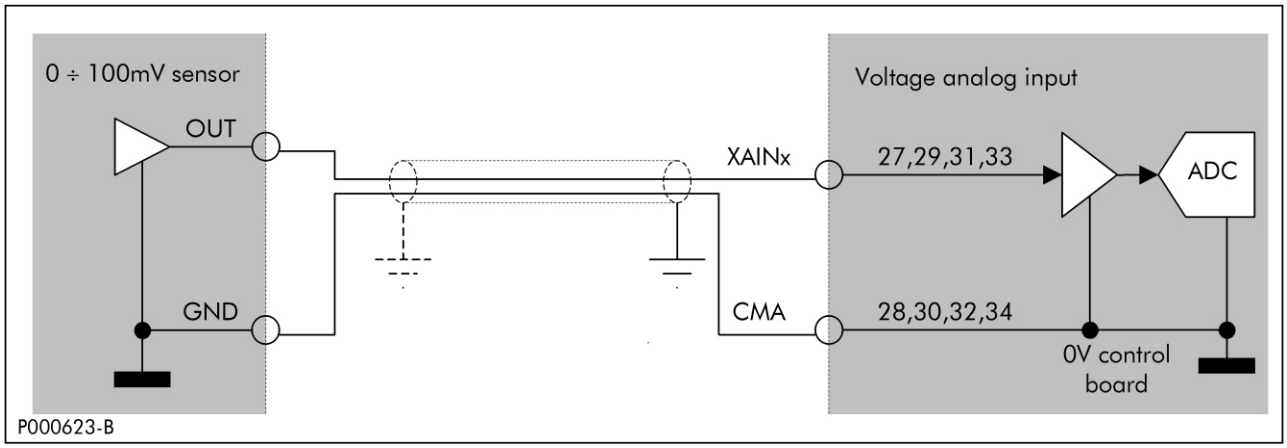


Figure 21: Connection of voltage output to 0 ÷ 100mV analog input

8.5.1.4. Connecting Analog Inputs to Sensors Provided with a Current Output

Figure 22 shows how to connect slow analog inputs to current sources. Channels XAIN8, XAIN9, XAIN10, XAIN11—corresponding to terminals 27, 29, 31, and 33—are capable of acquiring current signals with a full-scale value of 20mA. Properly set the DIP-switches for the configuration of the analog channel being used: set the full-scale value to 20mA and set the relevant programming parameter to 0÷20mA or 4÷20mA.

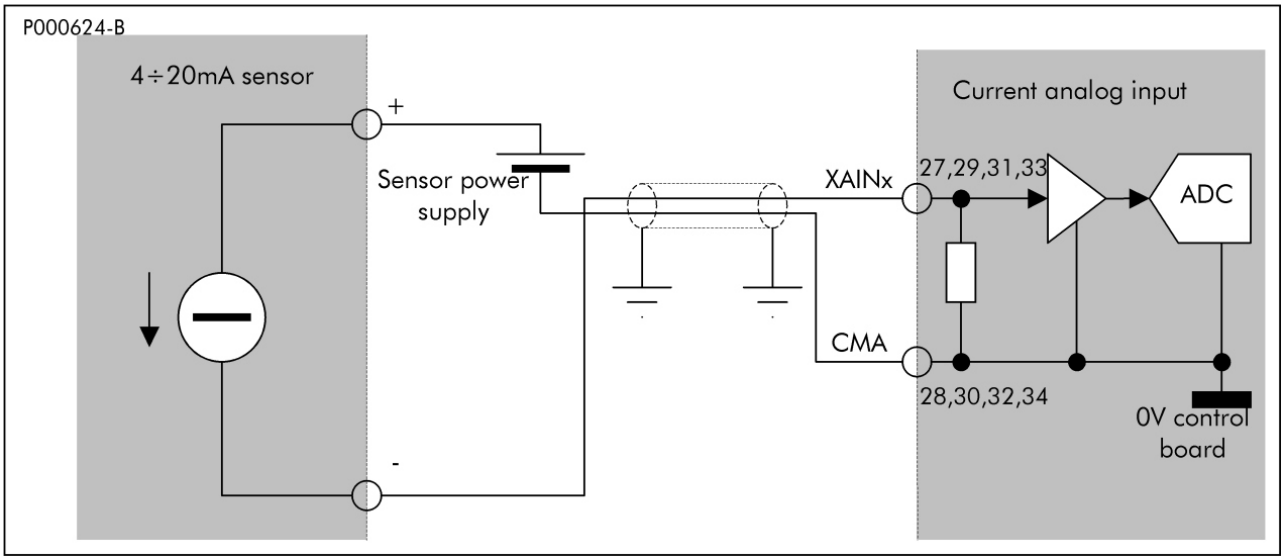


Figure 22: Connecting 0÷20mA (4÷20mA) sensors to current inputs

8.5.1.5. Connecting Analog Inputs to PT100 Thermistor

ES847 board allows reading temperatures directly from the connection of standard PT100 thermistors. Two-wire connection is used for easier wiring. Use relatively short cables and make sure that cables are not exposed to sudden temperature variations when the inverter is running. Proper wiring is shown in Figure 23.

Use a screened cable and connect its braiding to the inverter metal frame through the special conductor terminals.

If a cable longer than approx. 10 meters is used, on-site measure calibration is required. For example, if a 1sqmm (AWG 17) screened pair data cable is used, this results in a reading error of approx. +1°C every 10 meters.

To perform measure calibration, connect a PT100 sensor emulator set to 0°C (or connect a 100Ω 0.1% resistor) to the line terminals, then rectify the resulting offset.

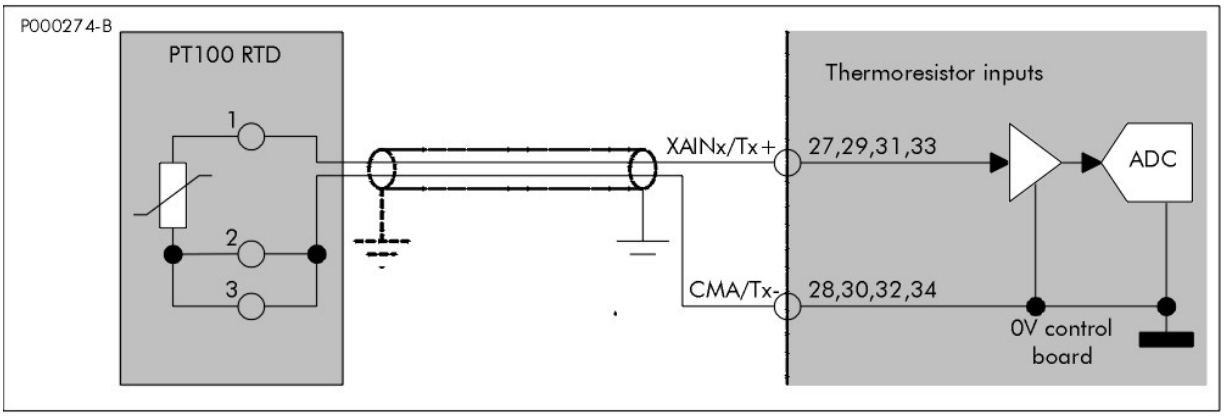


Figure 23: Connecting PT100 thermoresistors to the analog channels

8.5.1.6. Connecting External Pulse Counters for Produced and Absorbed Energy Measurement

The external counters are connected by means of one or two voltage-free contacts, as shown below.

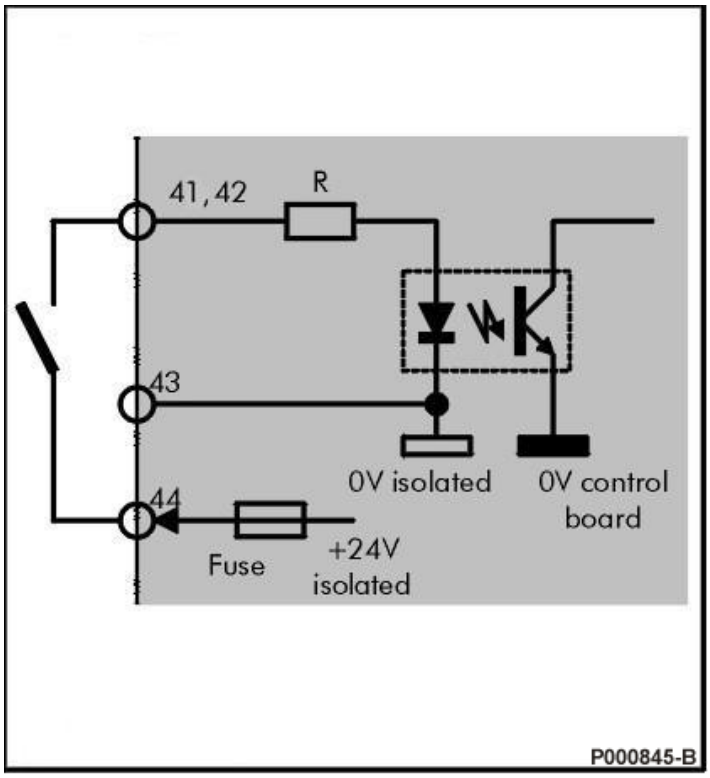
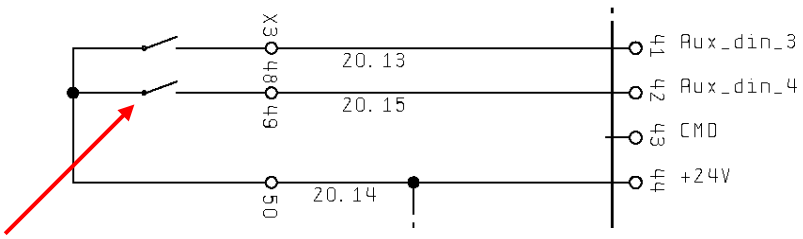


Figure 24: Connection of a voltage-free energy counter

	The voltage levels for the pulse counters are the following: 0V – Low level 24V – High level Otherwise, use a voltage-free contact or a PNP contact and on-board +24V power supply.
	The maximum input frequency for the auxiliary digital inputs is 40Hz.

Wiring is as shown below:

- X3 48-50 External contact for energy produced pulse
- X3 49-50 External contact for energy absorbed pulse



The external contacts shall be potential-free.

To activate this functionality, set the programming parameters accordingly.

8.5.1.7. Connecting the Enable Contact for Enclosure Exhaust Fans

The external exhaust fans (if fitted) in the substation where the inverter is located can be enabled by a voltage-free contact.

Wiring is as shown below:

- X3 78-79 Enable contact for Enclosure Exhaust Fans

8.5.2. Connecting Terminal Board X4 Serial Links

Check tightness by slightly pulling the cable. All the terminals are spring terminals. The connection procedure is as follows:

1. Strip the cable for about 10 mm (0.4 in.)
2. Open the terminal spring clamp by inserting a flat screwdriver (max. 4 mm) (0.16 in.)
3. Insert the conductor and remove the screwdriver
4. Check tightness by slightly pulling the cable.

X4 Electrical Ratings
Max AWG14 Min AWG26
Cu Only
75°C cable

Table 18: Terminal board X4 electrical ratings

The table below lists the terminals available in terminal board X4 and their allocated functions.

Since the terminals configuration is based on the application, please refer to the Electrical and Mechanical Diagrams to check for the available serial links.

Terminal	Function	Notes
1	RS485 link COM0 Channel A	Available in the Basic version Slave Modbus
2	RS485 link COM0 Channel B	
3	RS485 link COM0 0V	
4	RS485 link COM0 SCH	
5	RS485 link COM1 Channel A	Data Logger Optional Master/Slave Modbus
6	RS485 link COM1 Channel B	
7	RS485 link COM1 0V	
8	RS485 link COM1 SCH	
9	RS485 link COM2 Channel A	Data Logger Optional Master/Slave Modbus
10	RS485 link COM2 Channel B	
11	RS485 link COM2 0V	
12	RS485 link COM2 SCH	

Table 19: Terminals in terminal board X4

The MODBUS-IDA (http://www.modbus.org) association defines the type of connection for MODBUS communications over RS485 serial link, which is used by the Santerno TG TL NA inverters, as a “2-wire cable”. Specifications are as follows:

Wiring cable	
Type of cable	Screened cable composed of a balanced pair named D1/D0 + common conductor (‘Common’). Recommended cable: Belden 3106A Paired EIA Industrial RS-485 PLTC/CM.
Min. cross-section for the conductors	AWG23 corresponding to 0.258mm^2. For long paths, cross-sections up to 0.75mm^2 are recommended.
Max. length	500 meters based on the max. distance measured between any two stations.
Characteristic impedance	Greater than 100Ω (recommended): typically 120Ω.

Table 20: Serial connection cable requirements

The wiring procedure is detailed in section 15.3.

	All the devices connected to the communication multidrop network should be earthed to a common conductor to minimize any difference of ground potentials between devices that can adversely affect communications.
	All the devices connected to the communication multidrop network should have their common conductor (0V) connected in common to minimize any difference of ground potentials between devices that can adversely affect communications.
	The common terminal for the supply of the inverter control board is isolated from grounding. If one or multiple inverters are connected to a communication device with a grounded common (typically a computer), a low-impedance path between control boards and grounding is created. High-frequency disturbance could come from the inverter power components and affect the operation of the communication device. If this happens, provide the communication device with a galvanically isolated RS485 communications interface or with a galvanically isolated RS485/USB converter.
	Category 5 cables (two-pair, three-pair or four-pair) cannot be used for obtaining the serial link, even for short cable paths.

8.5.3. Auxiliary Power Supply from UPS and Connection to Terminal Board X7 for Ventilation

The control circuit of the equipment must be powered via UPS.

The ventilation system can be powered via an external source.

Any power supply source must be connected to terminal board X7, which is located in compartment F.

8.5.3.1. Auxiliary Power Supply from UPS

The power supply via UPS must have the following features:

UPS ratings	
Rated voltage	24Vdc
Minimum power	200W
Cable	AWG12/AWG24 Only Cu

Table 21: Electrical characteristics of UPS power supply line

The terminals are spring terminals. The connection procedure is as follows:

1. Remove all external voltages from the equipment and open circuit breakers 20QM1, 20QM2, 30QM1 and fuses 27F5
2. Remove the cable insulation for about 13 mm (0.4 in.)
3. Connect the cables of the UPS-generated power to terminals 9 and 10. To do so, open the terminal spring clamp by inserting a flat screwdriver (max 4 mm, 0.16 in.), then fit in the cable and remove the screwdriver.
4. Check tightness by slightly pulling the cable
5. Before closing fuses 27F5, check that the UPS output voltage is equal to 24Vdc, otherwise stop the connection procedure and check the UPS
6. Close circuit breakers 20QM1, 20QM2, 30QM1 and fuses 27F5.

8.5.3.2. Connection of External Power Supply for the Ventilation System

The power generated externally for the equipment ventilation system must have the following characteristics:

Voltage	220V
Frequency	50/60Hz
Power	2200VA
Cable	AWG8/AWG16 Only Cu

Table 22: Electrical characteristics of external power supply line for the ventilation system

All the terminals are spring terminals. Before connecting the external power supply, check if voltage is applied and is the same as the expected current. If this is not the case, stop wiring and check the external power supply source.

The connection procedure is as follows:

1. Remove all external voltages from the equipment and open circuit breakers 20QM1, 20QM2, 30QM1 and 27F1, 27F4 and fuses 27F5
2. Remove the cable insulation for about 18 mm (0.4 in.)
3. Open the terminal spring clamp by inserting a flat screwdriver of max 4 mm (0.16 in.)
4. Insert the cable and remove the screwdriver
5. Check tightness by slightly pulling the cable
6. Remove bridge between terminals 5-6 and 7-8.
7. Connect the power supply cables to terminals 6 and 8 (Figure 25).

⚠ WARNING	Do not connect power supply to terminal 5 and 7 in terminal board X7.

Close circuit breakers 20QM1, 20QM2, 30QM1 and 27F1, 27F4 and fuses 27F5.

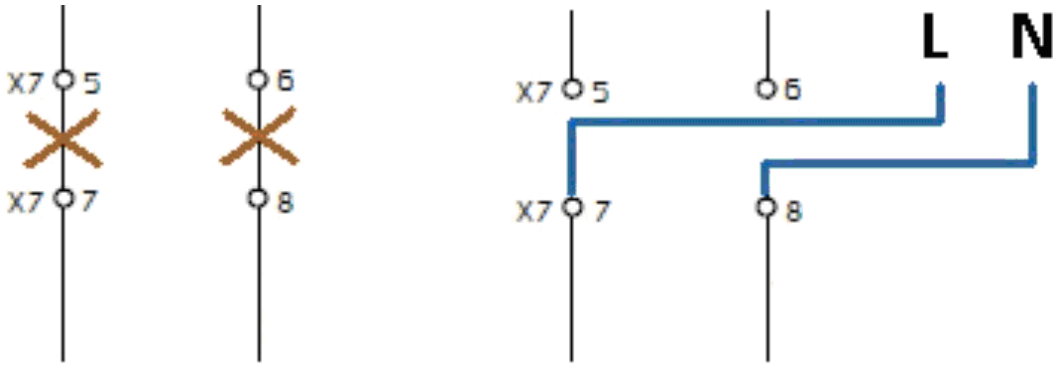


Figure 25: Connecting an external power supply source to terminal board X7

Set parameter C006 relating to auxiliary power supply accordingly.

8.5.4. Connection of AC Side Cables in Terminal Board X1

DANGER	Risk of death from burns and electrocution. Remove all the external voltages from the equipment before operating on the electrical parts. Open the DC disconnect switches and the AC circuit breaker and prevent accidental closing. Before operating on the equipment, make sure that it is isolated. Connect the ground wire to GND terminal as the first cable. The installer is responsible for checking the effectiveness of the grounding system. Only Qualified Personnel may operate the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.

Terminal board X1 is composed of four poles.

Pole	Cable to be connected
X1.1 – X1.2 – X1.3	Grounded or ungrounded three-phase power cables having the same or exceeding voltage rating as the one given in the equipment nameplate.
GND	Ground wire, to be effectively connected to ground by the operator.

Table 23: Terminal board X1

WARNING	Input and output circuits are isolated from the cabinet enclosure. System grounding, when required by the local electric code, is the responsibility of the installer. Only the proper GND terminal shall be used.

WARNING	Electrical Connections Options for REFERENCE ONLY. Please check with the Local Building and Electrical Code for approval prior to start-up the equipment. Consider that voltage may reach 1000V.

The cable connection on the AC side is by copper bar with screw clamping; terminal board X1 is housed in compartment F. Data for proper connection is shown in Table 24.

Product	Pole	N. of cables that can be connected to each screw	Max. cable cross-section	Screw supplied	Tightening torque	Max. lug width
Santerno TG760 TL NA	L1 - L2 - L3	1 Cu only 105°C	646MCM (320mm^2)	M12	62.69 Lb. ft. / 85 Nm	1.18 in. 50mm
	GND	1 Cu only 105°C	AWG4/0 (107mm^2)	M10	36.88Lb. ft. / 50 Nm	1.57 in. 40mm

Table 24: AC cable connection data

8.5.5. Connection of DC-Side Cables in Terminal Board X2

DANGER	Risk of death from electrocution. Dangerous voltage flows when the solar panels are exposed to direct solar radiation. Open the PV field box switches and prevent accidental closing. Before operating on the equipment, make sure that it is isolated. Connect the ground wire to GND terminal as the first cable. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
CAUTION	In grounded systems, if the GFDI indicates ground failure, this means that the cable connected to ground has lost ground reference. Risk of electrocution. Check DC cable voltage before operating on the equipment. Only Qualified Personnel may operate the equipment.

Terminal board X2 comes in different configurations, depending on the number of connectable cables and the PV field configuration:

1. **Configuration 1** Floating PV field, 10 fuses per pole, 1 cable per fuse (Figure 26)
2. **Configuration 2 or 3** PV field with grounded positive or negative pole, 10 fuses on ungrounded pole, 1 cable per fuse (Figure 27 and Figure 28)
3. **Configuration 4 or 5** PV field with grounded positive or negative pole, 20 fuses on ungrounded pole, 1 cable per fuse (Figure 29 and Figure 30)
4. **Configuration 6** Neutral configuration, suitable for connection to external recombiners (Figure 31).

	The configurations described in this manual may be modified at the manufacturer's discretion both from a technical point of view and in appearance, hence the illustrations provided herein are not binding. The proportions between the various measurements are approximate and are not to be considered as absolute values.

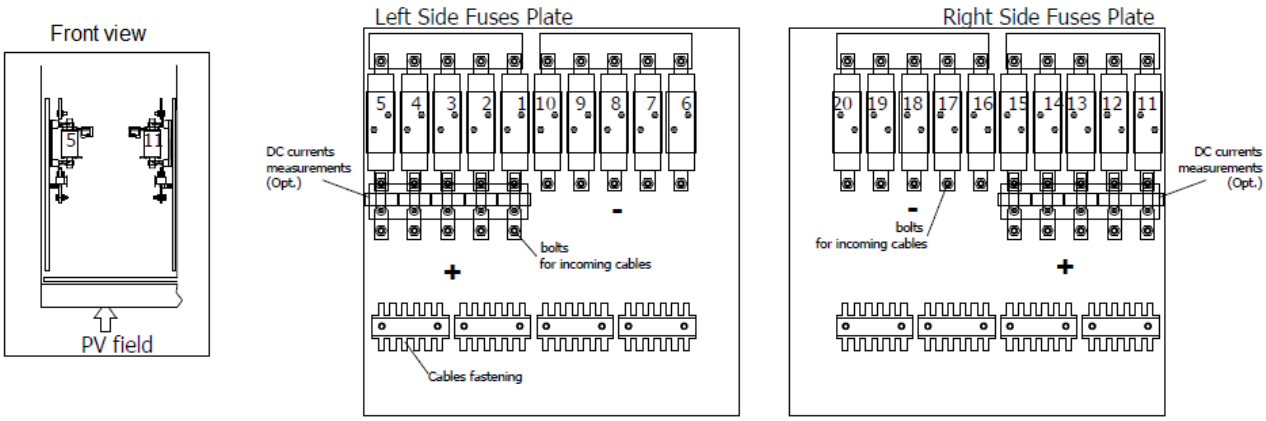


Figure 26: Configuration 1 of terminal board X2, floating PV field, 10 fuses on each pole

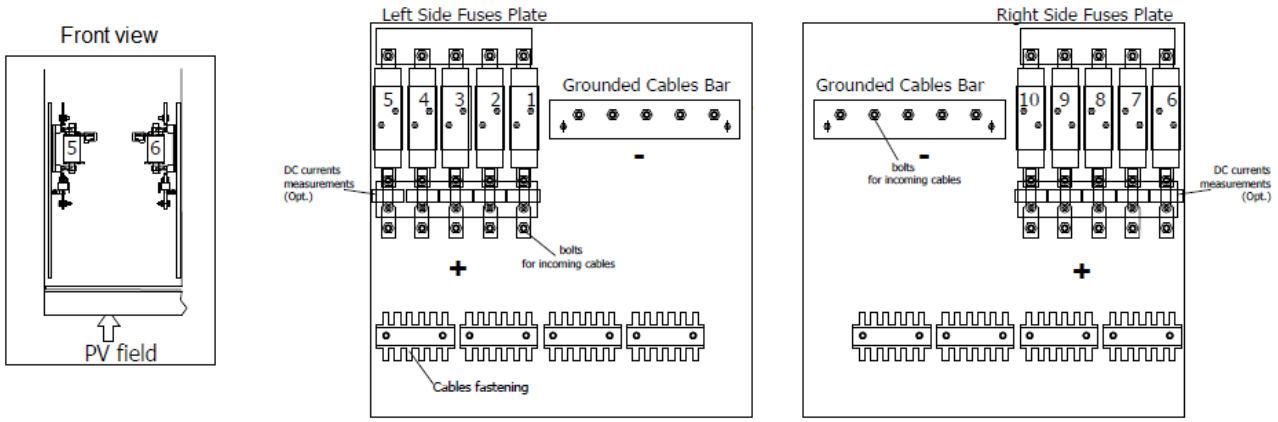


Figure 27: Configuration 2 of terminal board X2, PV field with negative grounded pole, 10 fuses on positive pole

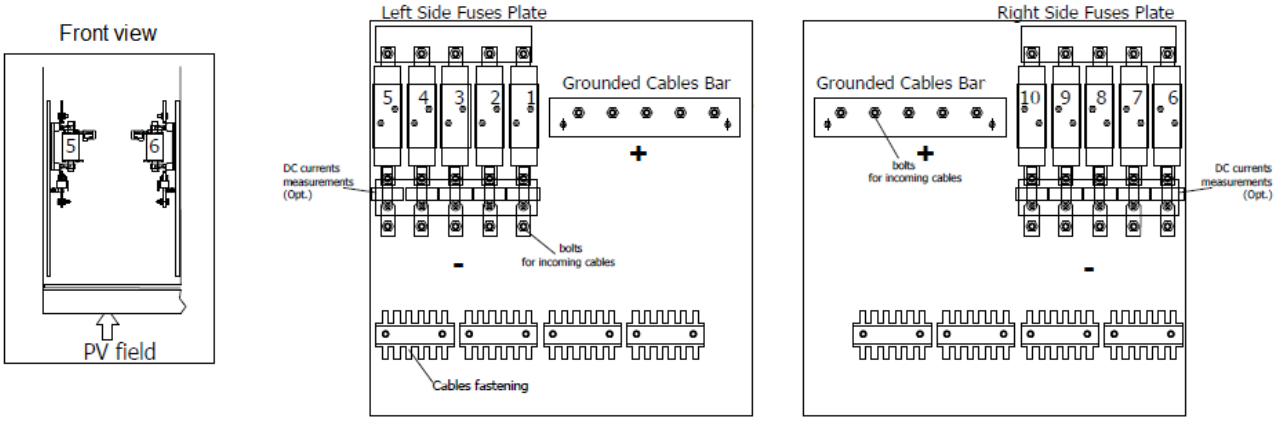


Figure 28: Configuration 3 of terminal board X2, PV field with positive grounded pole, 10 fuses on negative pole

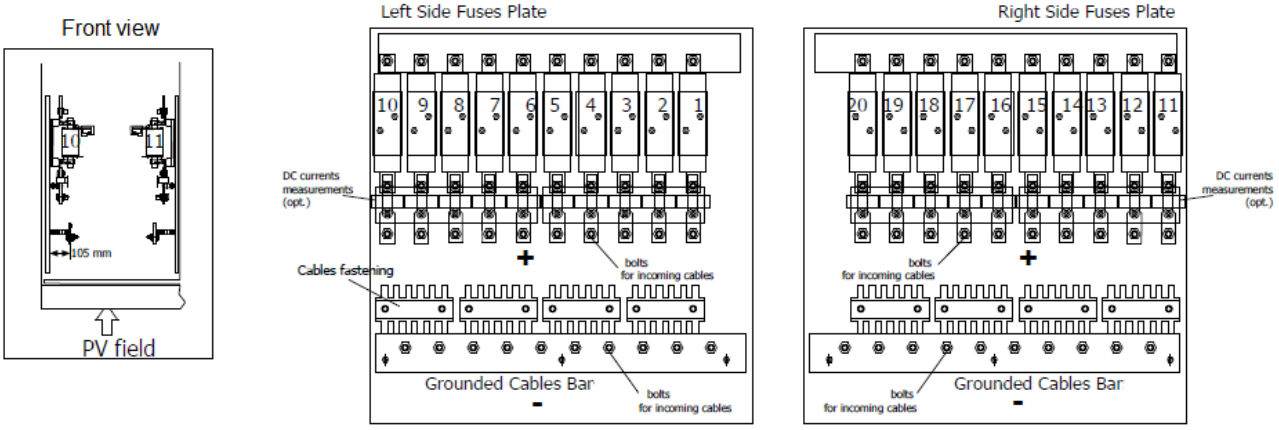


Figure 29: Configuration 4 of terminal board X2, PV field with negative grounded pole, 20 fuses on positive pole

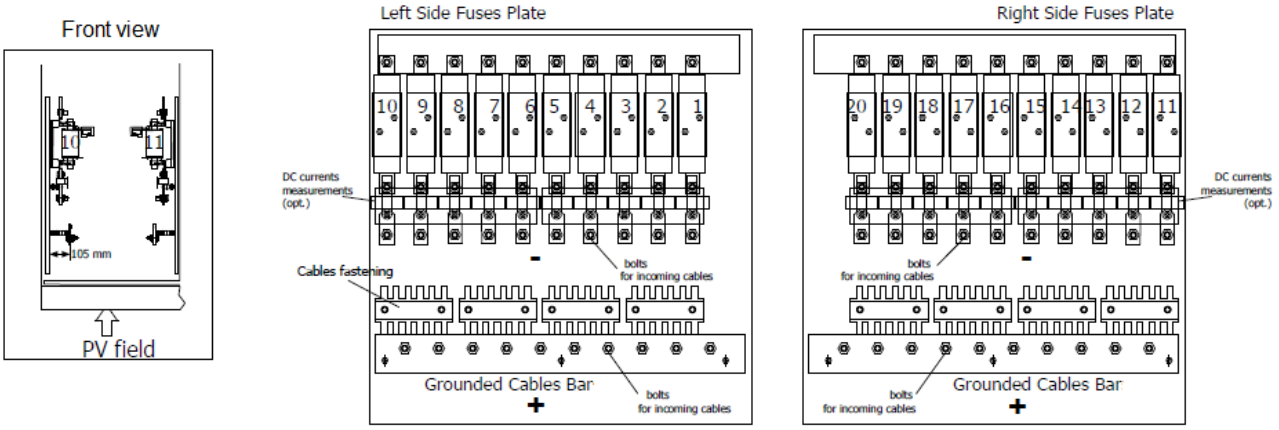


Figure 30: Configuration 5 of terminal board X2, PV field with positive grounded pole, 20 fuses on negative pole

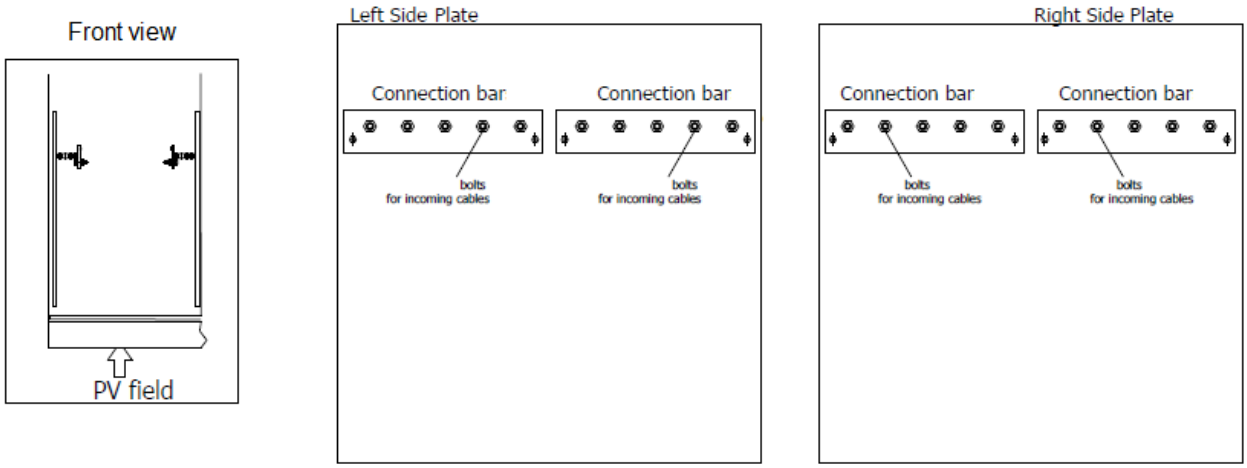


Figure 31: Configuration 6 of terminal board X2, Neutral configuration

Pole	Cable to be connected
+	Cable from PV field, + potential
-	Cable from PV field, - potential

Table 25: Terminal board X2

Product	Pole	N. of cables that can be connected to each screw	Max. cable cross-section	Screw supplied	Tightening torque	Max. lug width
Santerno TG760 TL NA	+ / -	1 Cu only 105°C	600 MCM (300 mm^2)	M10	23.6 Lb. ft. / 32 Nm	1.26 in./ 32mm
				M12	28.02 Lb. ft. / 38 Nm	
		1 Al only 105°C	600 MCM (300 mm^2)	M10	23.6 Lb. ft. / 32 Nm	1.26 in./ 32mm
				M12	28.02 Lb. ft. / 38 Nm	

Table 26: DC cable connection data

8.5.5.1. Input Current Capacity

The DC fuse compartment can be equipped with a set of fuses having different sizes. Each fuse is provided with a fuse blowing microswitch triggering an alarm in the event of fuse blown.
The fuses must be ordered separately.

The rated capacity values usually refer to ambient temperature of 68 °F (30 °C). For applications at higher ambient temperature, a derating coefficient of 15% must be applied.

8.5.6. Electrical Power Connections - X1 - X2

The electrical connections of the power circuits in terminal boards X1 and X2 must be performed according to the following requirements.

DANGER	Danger of electrocution. Danger of death. Before working on the equipment, make sure that the equipment is isolated. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make the operation safe. Only Qualified Persons can access the internal parts of the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	During transport, the contact surfaces of the poles in terminal boards X1 and X2 may become oxidized or dirty. Before connecting the cables, check the condition of the contacts: if dirty or oxidized, clean them using antioxidants or degreasing products. Use lugs suitable for screws and cables size listed in Table 24 and Table 26. Use proper tightening tools as recommended by the lug manufacturer. Be sure to respect the recommended tightening torques.

1. Connect the cables to the equipment as shown in Figure 32
2. Cables coming from the string boxes must be connected directly onto the terminals of the fuse holders.
3. When connected to terminal board X2, positive and negative pole cables coming from each string box shall be connected to the nearest terminals/bolts available (both on the left or both on the right side)
4. Tighten the connections as indicated in Table 24 for connections on X1 (AC connections) and in Table 26 for connections on X2 (DC connections)
5. The type of connection entails that the cables are terminated by ring lugs suitable for connections on copper bars. The diameter of the lug hole must range from 10.5 (0.41”) to 12.5mm (0.503”). Please refer to the electrical and mechanical schematic.
6. Connection of Aluminum cables shall be performed using suitable lugs, listed for Aluminium-Copper connection.

	The installer is responsible for the connection of the PV field and the grid cable. The installer is also responsible for the termination of such cables. Lugs should be crimped with dies and equipment recommended by their manufacturer.

WARNING	Electrical Connections Options for REFERENCE ONLY. Please check with Local Building and Electrical Code for approval prior to start-up the equipment. Consider that voltage may reach 1000V.

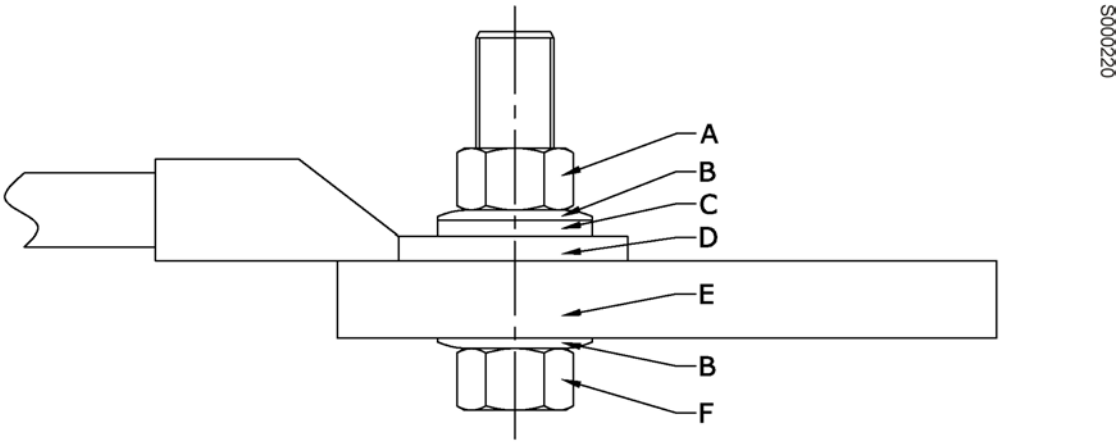


Figure 32: Power circuit (X1-X2), electrical connection of cables

A – Nut
B – Spherical washer
C – Flat washer
D – Lug
E – Terminal board copper bar
F – Screw

All the parts shown in Figure 32 are supplied with the Santerno TG TL NA inverter, except for the lugs.

8.6. Preliminary Checks

DANGER	Danger of electrocution. Danger of death. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make operation safe. Only Qualified Personnel may operate on the equipment when doors are open and voltage is applied. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
WARNING	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

Before starting the equipment, check its status as described in the sequence below.

1. AC Circuit Breaker and DC switches in open position (OFF) and pad-locked
2. DC line input fuses (X2) removed
3. Equipment not running (stopped)
4. PV field and grid cables connected (X1, X2)
5. Signal cables connected (X3, X4, X7)
6. Disconnect switches of the upstream PV field in open position (OFF) and pad-locked
7. Maintenance key 3 in Figure 2 in “disable” position

Proceed as follow:

1. Open door C and remove the protective grilles
2. Insert fuses in terminal board X2
3. Install the fuse blowing microswitch on each individual fuse
4. Close the AC Circuit Breaker
5. Close the disconnect switches of the upstream PV field
6. Check polarity of the DC field. Proceed if correct, otherwise re-open the disconnect switches of the upstream PV field, reverse polarity of the DC cables from the combiner boxes and repeat this part of the procedure.
7. Re-open and pad-lock the disconnect switches of the upstream PV field
8. Open and pad-lock the AC Circuit Breaker
9. Open door E and door F
10. Insert all internal fuses in the fuse holders (refer to the Electrical and Mechanical Diagram)
11. Close all internal MCCBs (ON) (refer to the Electrical and Mechanical Diagram)

12. Install the internal grilles previously removed
13. Close all the doors
14. Close the disconnect switches of the upstream PV field
15. Close the AC Circuit Breaker
16. Close the DC disconnect switches

8.6.1. Voltage Check

Please refer to the Electrical and Mechanical diagram for the voltage check.

1. Check if 24V DC auxiliary voltage is applied to the upper and lower poles of fuses 27F5 while fuses are removed; check the aux voltage value
2. Check if 220V AC auxiliary voltage is applied to the poles of fuses 27F4; check the aux voltage value

In case of negative results, please contact Santerno Inc. Customer Service.

8.6.2. Ventilation Check

Turn on the equipment as described below:

1 Close the AC circuit breaker by pressing the “I Push ON” green button
2 Make sure that no alarm tripped (no alarm messages displayed and indicator LEDS for “GFDI” off, if present).
3 Close both the DC disconnect switches by pressing the “I Push ON” green button
4 Press the START button from the display/keypad.

Visually check if all the fans are on. Refer to the electrical and mechanical diagram to identify how many fans the equipment is supplied with.
The air flow should be bottom-up.

9. RESETTING THE PROTECTIVE DEVICES

9.1. AC Circuit Breaker 30QM1

This is a pushbutton spring operated MCCB accessible from the front door.

The ON, OFF positions are clearly visible, as shown in Figure 33.

Figure 33: AC circuit breaker

Before closing the circuit breaker, springs are to be charged by pulling the special lever. Keep the lever pulled until the “spring charged” message appears.

Once the springs are charged, it is possible to close the circuit breaker by pressing the “I Push ON” green button.

To open the circuit breaker, the “O Push OFF” red button shall be pressed; pulling the lever is not required for the opening maneuver.

The circuit breaker can be pad-locked to OFF position.

9.1.1. DC Disconnect switches 11QM1 and 11QM2

The DC switches are push-button spring operated Disconnect Switches accessible from the front door.

The ON, OFF positions are clearly visible as shown in Figure 34.

Figure 34: DC disconnect switches

Before closing the circuit breaker, springs are to be charged by pulling the special lever. Keep the lever pulled until the “spring charged” message appears.

Once the springs are charged, it is possible to close the switches by pressing the “I Push ON” green button.

To open the switches, the “O Push OFF” red button shall be pressed; pulling the lever is not required for the opening maneuver.

The switches can be pad-locked to OFF position.

9.1.2. GFDI

This is a protective device tripping when the PV field is not properly grounded due to a fault.

This protective device cuts off the fault current and triggers a failure indication.

On grounded PV field configurations, it is implemented through 11F2 and 11F4 fuses and indicator lamp 8 in Figure 2 ON.

	The photovoltaic field is grounded internally to the inverter. Do not carry out any external ground bonding for the photovoltaic field.

When the protective device trips, remove the cause responsible for the protection activation and reset the protective device by replacing the fuse as described in the wiring diagrams.

	Danger of electrocution. Danger of death. Insert the fuse with the striker upward. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make operation safe. Only Qualified Personnel may operate on the equipment when doors are open and voltage is applied. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

Figure 35: Correct positioning of GFDI fuses

9.1.3. Protective Device against PV Field Polarity Mismatch 11F1 and 11F3

This is a fuse protective device tripping when the poles of the PV field are mismatched.
This protective device disconnects the inverter from the PV field if a suitable 24Vdc auxiliary power supply is applied.

When the protective device trips, remove the cause responsible for the protection activation and reset the protective device by replacing the fuse as described in the wiring diagrams.

⚠ DANGER	Danger of electrocution. Danger of death. Insert the fuse with the striker upward. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make the operation safe. Only Qualified Personnel may operate on the equipment when doors are open and voltage is applied. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
⚠ WARNING	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

Figure 36: Correct positioning of GFDI fuse

9.1.4. PV Field Cable Safety Device 10F1…10F20

This is a fuse safety device for the protection of the PV field cables.

When the protective device trips, remove the cause responsible for the protection activation and reset the protective device by replacing the fuse as described in the wiring diagrams.

	Danger of electrocution. Danger of death. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make the operation safe. Only Qualified Personnel may operate on the equipment when doors are open and voltage is applied. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

9.1.4.1. Replacing a DC Fuse in the DC Compartment

To replace a DC fuse, proceed as follows:

- Make sure that all the disconnect switches for the upstream strings are open and pad-locked: this is an essential condition for ensuring that the fuses are free from voltage. Please remember that all fuses are parallel-connected downstream, hence if just one string is powered the same voltage is present in all the fuses.
- Make sure that the inverter connected to the DC-Parallel is NOT running (STOPPED).
- Open the switches on the DC side of the inverter
- Open door C and remove the grilles protecting the DC fuse compartment
- Remove the auxiliary contact switch from the damaged fuse
- Remove the faulty fuse using the special insulated handle provided
- Install a new fuse using the special insulated handle provided
- Connect the auxiliary contact switch to the new fuse
- Replace the grilles protecting the DC fuses compartment

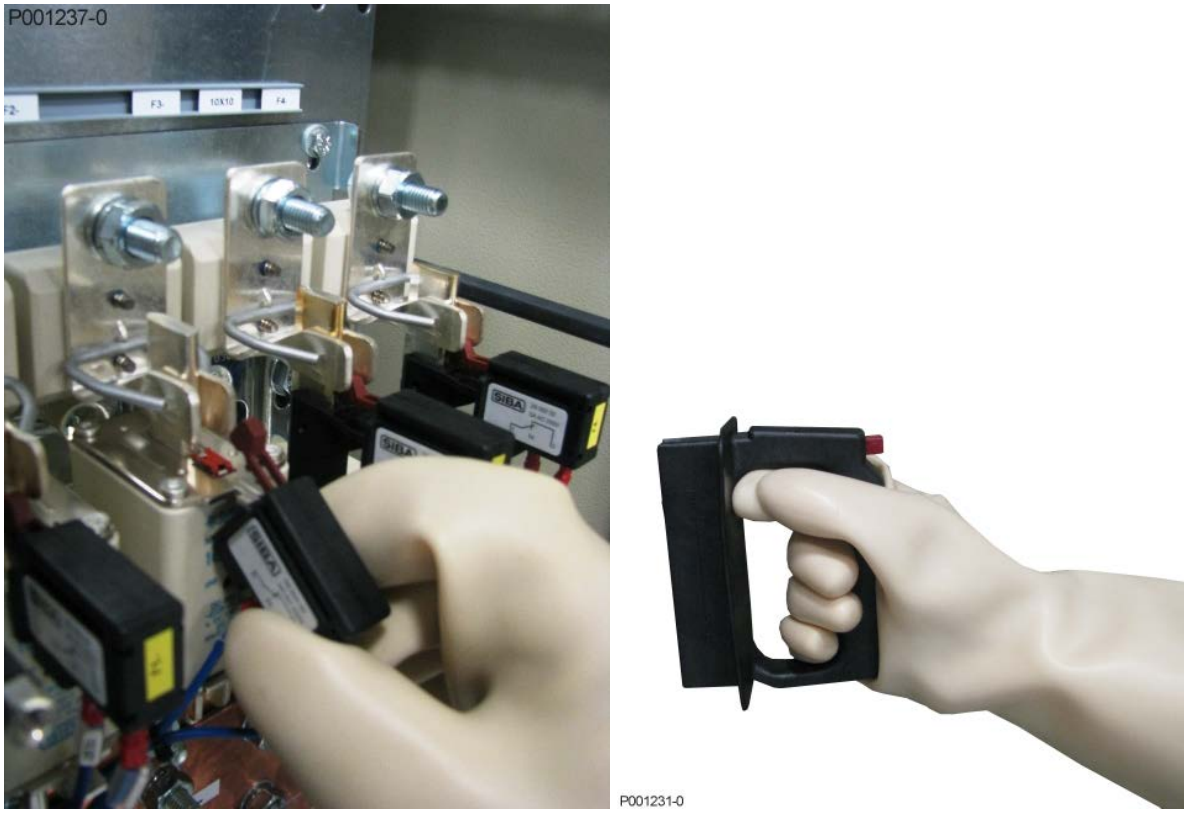


Figure 37: Extracting the fuse: microswitch disconnection and handle for removing the fuse

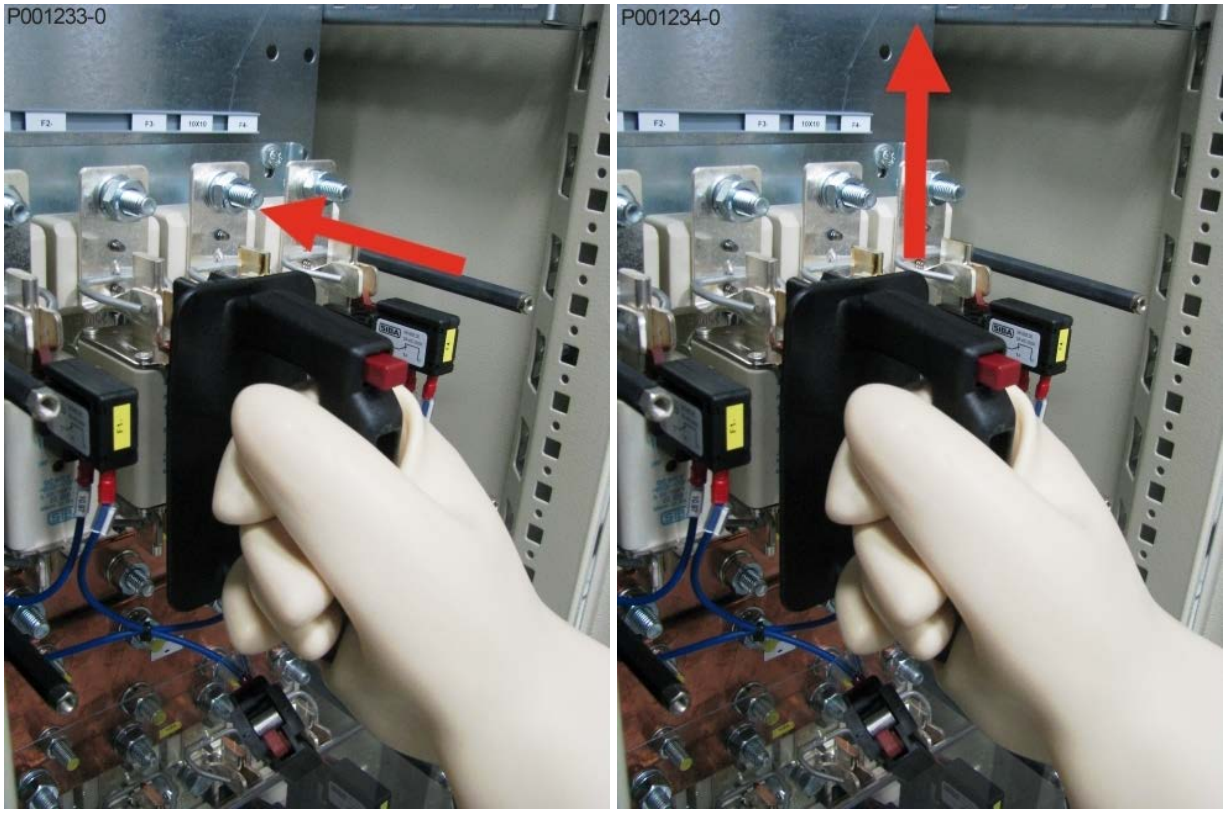


Figure 38: Extracting the fuse: using the insulated handle for removing the fuse

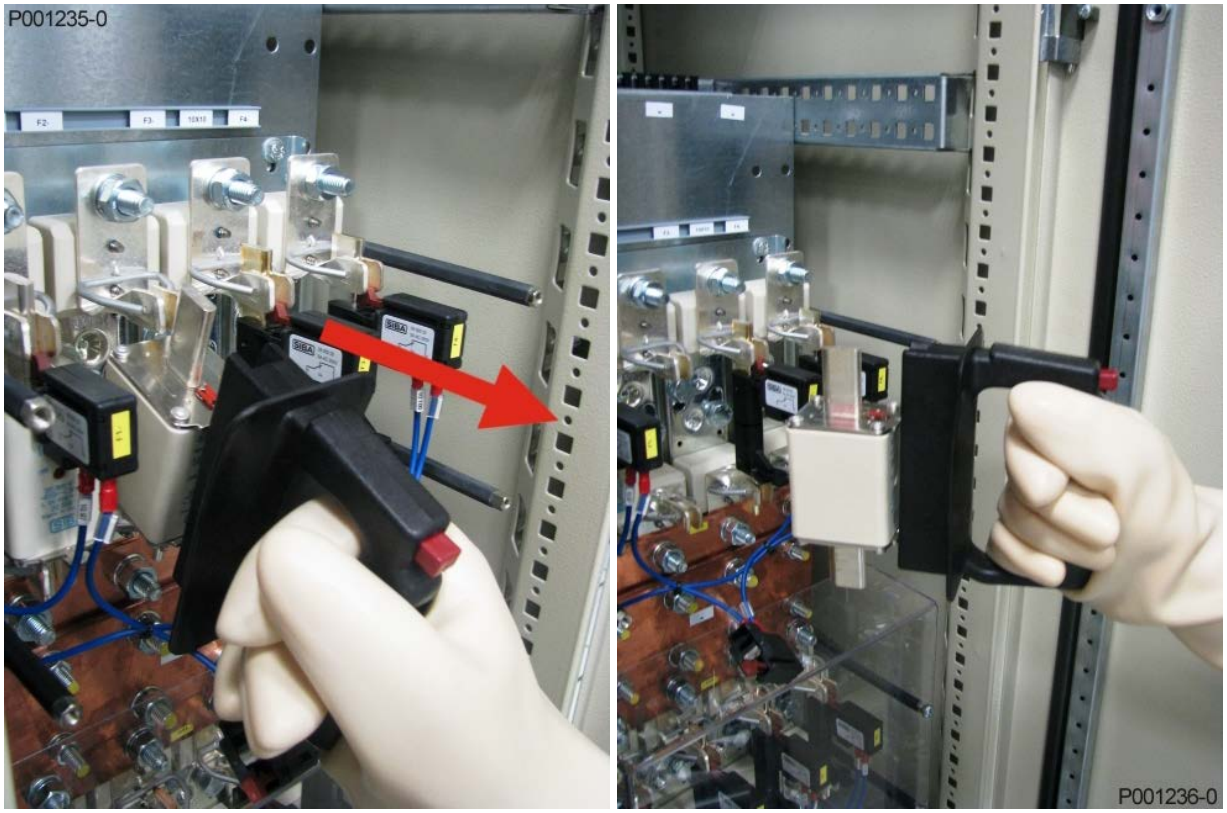


Figure 39: Extracting the fuse: using the insulated handle to remove the fuse

Once the fuse has been replaced, restore all the conditions for the inverter normal operation.

9.1.5. Control Circuit and Service Protections

DANGER	Danger of electrocution. Danger of death. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make the operation safe. Only Qualified Personnel may operate on the equipment when doors are open and voltage is applied. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
WARNING	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

When a fuse blows, it must be replaced with an identical one (please refer to the wiring diagrams).

Identify

In both cases, identify the cause responsible for the safety protection activation and fix the problem before restoring the safety devices.

10. SPARE PARTS

The list of the spare parts is given on the last pages of the Electrical and Mechanical Drawing of the inverter.

	Danger of electrocution. Danger of death. Only Qualified Persons can access the internal parts of the equipment. NEVER work on the equipment unless it is switched off and disconnected from the power supply sources. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

11. DISMANTLING

At the end of its useful lifetime, the inverter must be dismantled in compliance with all the applicable regulations, regional and local requirements to avoid leakage of harmful materials.

DANGER	Electrocution hazard. Make sure that voltage has been removed from the grid and the PV field before operating on the equipment. Open the grid circuit breaker and the DC circuit breaker and take any safety measure to avoid accidental closure of both circuit breakers. Service personnel only are authorized to operate on the equipment. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.

It is mandatory to proceed as follows:

- Disconnect all the power supply sources of the equipment by opening and pad-locking all disconnect switches of the combiner boxes in the PV field, of the external auxiliary power supply (if provided) and of the MV AC switch of the relative step-up transformer
- Disconnect all the incoming cables and outgoing cables to and from the inverter
- Remove all the conduits from the cable entry plates
- Remove all the cables and the copper bars from the internal raceways
- Separately collect the capacitors and batteries (if any). Dispose of them separately in accordance with all the applicable regulations
- Remove the inverter from its installation place by removing its fastening bolts from the floor
- Separately collect the copper parts from the steel parts for recycling
- Dispose of the remaining parts in accordance with all the applicable regulations

12. HOW TO CONTACT THE CUSTOMER SERVICE

The following information is required when contacting Santerno Inc.'s Customer Service:

- Product model
- Serial Number
- Date of Commissioning
- ID of the Confirmation of Order, if available

If the product is an inverter, the data below shall be retrieved from its memory:

- Hours running
- Fault List

You can retrieve these data from the display/keypad or via the RemoteSunway in local/remote mode.
Please contact Santerno Inc. for repairing or returning the equipment.

12.1. Warranty

The warranty terms and conditions are indicated in the Confirmation of Order.

13. ROUTINE MAINTENANCE

The routine maintenance is defined in Table 27.

The Operator is only allowed to carry out cleaning operations of the outside of the equipment.

The external cleaning must be carried out once a year, or more often, depending on the conditions of the installation site.

Use a cloth moistened with water.

	Do not use solvents. It is forbidden to install and maintain the product under inclement weather conditions, such as snow, rain, fog and wind. Always make sure that no water or condensation is to be found inside the equipment.

	Danger of electrocution. Danger of death. All electrical installations must be done in accordance with the local and National Electrical Code ANSI/NFPA 70 or Canadian Electrical Code, Part I, considering that voltages may reach 1000V. Before working on the equipment, make sure that no voltage is applied. Use appropriate tools and wear appropriate protective equipment. Prevent voltage from being unexpectedly applied to the equipment after locking the disconnect switches. Use appropriate warning signs to make the operation safe. Only Qualified Personnel may operate on the equipment when doors are open and voltage is applied. All applicable safety procedures such as OSHA requirements, regional and local safety requirements, safe working practices and good judgment must be observed.
	WARNING: THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT SPECIFIED IN THIS INSTRUCTION MANUAL UNLESS YOU ARE QUALIFIED TO DO SO.

Code of the maintenance activity	Maintenance tasks	Maintenance interval (recommended)
OM1	Read the stored data and Fault List	Every month
OM2	Check the external/internal conditions of the electrical cabinet	Every 6 months
OM3	Maintain the air filter	Every 6 months[1]
OM4	Check the emergency stop	Every 12 months
OM5	Check the door microswitches	Every 12 months
OM6	Check the gaskets, locks and hinges	Every 12 months
OM7	Check the fans	Every 6 months
OM8	Check control and auxiliary voltages (220 V and 24 V)	Every 6 months
OM9	Check fuses, relays, circuit breaker and disconnect switch	Every 6 months
OM10	Check the cables and bars tightening	Every 12 months
OM11	Check the SPDs	Every 6 months
OM12	Check the anticondensation heater (if installed)	Every 6 months
OM13	Check the microswitches on the DC input fuses	Every 12 months
OM14	Calibrate the environmental sensors	Every 12 months
OM15	Check conditions of nameplate and warning signs	Every 24 months
OM16	Check internal and external connection tightening	Every 24 months

Table 27: Routine maintenance tasks

13.1. Reading the Stored Data and Fault List

To guarantee correct operation of the system, all its components must be correctly matched up. Incorrect operation leads to lower efficiency with a subsequent reduction in system profitability.

The inverter includes functions to warn the user of failures or faults affecting the system. Periodical checks of system operation are in any case still necessary for the detection of minor operating faults which are not associated with an alarm. The inverter's alarm memory and the data stored in the Data Logger (if installed) must be analyzed at least once a month.

[1] More often if required.

13.2. Checking the External/Internal Conditions of the Electrical Cabinet

To check the external/internal conditions of the electrical cabinet, proceed as follows:

OVERALL CONDITION OF THE CABINET

Check the external condition of the cabinet.

Check the state of the insulating sheaths on the conductors.

Check that there are no signs of overheating on the power conductors (especially near the connection points on the equipment).

Check that there are no signs of cable gnawing caused by rodents.

Check the state of all the signs/nameplates affixed to the equipment. Signs must always be in good condition and legible.

GENERAL CABINET CLEANING

Check the interior of the cabinet for the build-up of dust, dirt, humidity and infiltration of water from the outside.

Should it be necessary to clean the cabinet, always adopt adequate measures. The electronic section in the Santerno TG inverter series is well protected and hence does not require any maintenance.

Carry out a visual inspection only and clean the printed circuit board with a soft brush or a vacuum cleaner fitted with a soft cleaning tool. The cleaning accessories used must be antistatic tools in compliance with ESD specifications.

Do not use heavy brushes or brushes with coarse bristles.

NEVER use compressed air for cleaning operations.

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! NEVER work on the equipment unless it is switched off and disconnected from the power supply.
DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! Do not touch any components other than those specifically indicated in this Instruction Manual.

13.3. Air Filter Maintenance

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! NEVER work on the equipment unless it is switched off and disconnected from the power supply.

To clean or replace the filters in the air suction system, remove the relative hood and grilles.

	In the event of any fault, please contact Santerno Inc. CUSTOMER SERVICE for instructions on the necessary corrective action to be taken.

13.4. Checking the Emergency Stop

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! Do not touch any components other than those specifically indicated in this Instruction Manual.

To check correct operation of the emergency stop switch, proceed as follows:

- STOP the inverter
- Make sure that the inverter is connected to both supply voltages (DC and AC) and that it is powered
- Check that the external emergency stop button has not been activated
- Press the emergency stop button
- Check that the AC and DC switches on the inverter are correctly opened
- Release the emergency stop button
- Close the AC and DC switches on the inverter
- Start the inverter by pressing the RUN button

13.5. Checking the Door Microswitches

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! Do not touch any components other than those specifically indicated in this Instruction Manual.

To check correct operation of the door opening safety microswitches, proceed as follows:

- STOP the inverter
- Make sure that the inverter is connected to both supply voltages (DC and AC) and that it is powered
- Turn key-operated selector switch 41SA1 to DISABLED
- Open the cabinet doors
- Check that the AC and DC switches on the inverter are correctly opened
- Close the cabinet doors
- Close the AC and DC switches on the inverter
- Turn key-operated selector switch 41SA1 to ENABLED
- Start the inverter by pressing the RUN button

13.6. Checking the Seals, Locks and Hinges

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! NEVER work on the equipment unless it is switched off and disconnected from the power supply.

To check the cabinet door seals, locks and hinges, proceed as follows:

- Visually inspect the cabinet seals for any signs of cracking or damage. Any seals showing signs of damage in the areas of door contact must be completely replaced.
- It is suggested that talc be used to prevent seals from sticking to the sheet metal of the cabinet over time
- Check the correct operation of the inverter cabinet and compartment locks by locking and unlocking the doors
- Check if the door hinges operate smoothly
- Spray all movable parts and parts subject to wear with a water-free lubricant

13.7. Checking the Fans

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! Do not touch any components other than those specifically indicated in this Instruction Manual.

Check operation and noisiness of all the fans. If it is necessary to open the doors to carry out this inspection, proceed as follows:

- STOP the inverter.
- Make sure that the inverter is connected to both supply voltages (DC and AC) and that it is powered.
- Make sure that key-operated selector switch 41SA1 is turned to DISABLED.
- Open the doors.

13.7.1. Checking Control and Auxiliary Voltages (220 V and 24 V)

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! Do not touch any components other than those specifically indicated in this Instruction Manual.

Please refer to the Electrical and Mechanical Diagram to check the correct position of the control voltage points.

Do the following to check the 24 Vdc power supply:

STOP the inverter.

Make sure that the inverter is connected to both supply voltages (DC and AC) and that it is powered.

Make sure that key-operated selector switch 41SA1 is turned to DISABLED.

Open the doors.

Check the presence of 24 Vdc control voltage on the terminals referring to fuses 27F5 (see Figure 40).

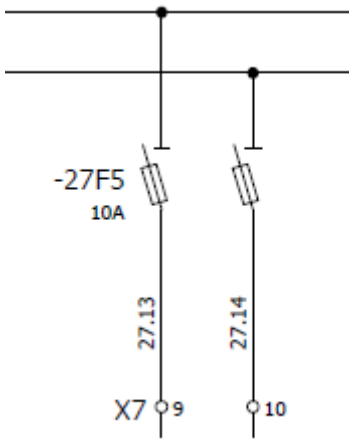


Figure 40: Checking the 24 Vdc control power supply

- STOP the inverter.
- Make sure that key-operated selector switch 41SA1 is turned to DISABLED
- Open the doors
- Check the presence of 24 Vdc control voltage on the wires 27.13 and 27.14.
- Open the 27F5 fuseholder
- Check the presence of 24 Vdc control voltage on the wires 27.13 and 27.14.
- Close the 27F5 fuseholder
- Close the door
- Turn key-operated selector switch 41SA1 to ENABLED.
- Start the inverter by pressing RUN.

To check the 220 Vac power supply, proceed as follows:

- STOP the inverter
- Make sure that the inverter is connected to the AC supply voltage and that it is powered
- Make sure that key-operated selector switch 41SA1 is turned to DISABLED
- Open the doors
- Check the presence of 220Vac supply voltage on the terminals referring to fuseholder 27F4
- Close the door
- Turn key-operated selector switch 41SA1 to ENABLED
- Start the inverter by pressing the RUN button

13.8. Checking the Relays, Fuses, Circuit breaker and Disconnect switch

DANGER	Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death! NEVER work on the equipment unless it is switched off and disconnected from the power supply.

This section refers to relays, fuses and fuse holders/disconnect switches located inside the cabinet.

Visually inspect the installed fuses and the fixing springs on the fuse holders.

If necessary, grease the contact points on the holders.

Visually inspect the installed relays, checking that they fit well into their holders.

13.9. Checking the cables and bars tightening

The Santerno TG TL NA cabinets have special Belleville springs in all the internal tightening points for the copper bars and power cables. Usually, no maintenance is required.
However, for safety reasons, periodical check is recommended.

Check the tightness of all internal cables and copper bars and tighten if necessary.
Pay particular attention to any color variations or anomalies concerning the insulation and the terminals.

DANGER	Risk of death from electrocution. Dangerous voltage flows when the solar panels are exposed to direct solar radiation. Open the PV field box switches and prevent accidental closing. Before operating on the equipment, make sure that it is isolated. Connect the ground wire to the GND terminal as the first cable.

	The maintenance operations must be recorded in the Maintenance Record Tables provided as Annex 4.

13.10. Checking the SPDs

A visual inspection of the SPD on AC side (if present) shall be performed to ensure they are properly protecting the equipment.

- STOP the inverter
- Make sure that the inverter is connected to the AC supply voltage and that it is powered
- Make sure that key-operated selector switch 41SA1 is turned to DISABLED
- Open the doors
- Check the presence of the blue light on SPD 30A1
- Close the door
- Turn key-operated selector switch 41SA1 to ENABLED
- Start the inverter by pressing the RUN button

13.11. Checking the Anticondensation Heater (if present)

Check the operation of the anticondensation heater (if present). Toggle relay 52KA7 to OFF. Make sure that the fan in heater 36R1 is on and that the heater is hot. The heating process may take a few minutes.

13.12. Checking the Microswitches on the DC Input Fuses

Check if the microswitches on the DC input fuses (11F1..11F20) switch correctly. When the toggle lever is pushed upward, the switch clicks (this indicates that switching is successful).

13.13. Checking Conditions of Nameplate and Warning Signs

A visual inspection of the nameplate and warning sign is required.

	The maintenance operations must be recorded in the Maintenance Record Tables provided as Annex 4.

13.14. Checking the Cables and Bars Tightening

The Santerno TG TL NA cabinets have special Belleville springs in all the internal tightening points for the copper bars and power cables. Usually no maintenance on these points is required.
However, for all tightening works carried out on site, periodical check of the tightening torques is required over the equipment's life cycle to guarantee correct tightness of the electrical contacts.

Check the tightness of all the terminal clamps for power wiring and tighten, if necessary.
Pay particular attention to any color variations or anomalies concerning the insulation and the terminals.

	Risk of death from electrocution. Dangerous voltage flows when the solar panels are exposed to direct solar radiation. Open the PV field box switches and prevent accidental closing. Before operating on the equipment, make sure that it is isolated. Connect the ground wire to the GND terminal as the first cable.

	The maintenance operations must be recorded in the Maintenance Record Tables provided as Annex 4.

14. ANNEX

14.1. Annex 1 – Maximum Voltage Derating

When the equipment is to be installed at high altitudes, the maximum allowable DC voltage, such as the maximum allowable Voc, applicable to the inverter is to be derated as per Table 28:

Altitude [m]	Maximum DC/Voc voltage
0-2000	Based on Table 3
2001-3000	846 V

Table 28: Maximum correction factor based on altitude

For installations above 3000m, please contact Santerno Inc.

14.2. Annex 2 – Rated Power Derating

If the ambient temperature exceeds 50°C (122°F), the inverter limits its output power to prevent overtemperature from damaging the internal components. Figure 41 shows the curve of the maximum power delivered based on the ambient temperature. This applies to installations at sea level.

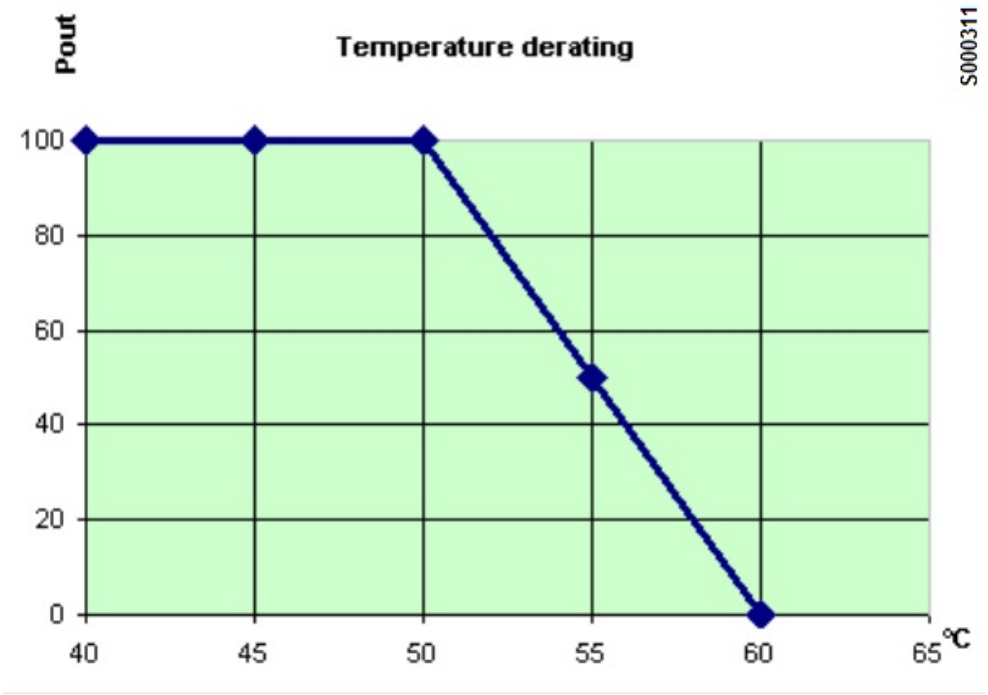


Figure 41: Temperature derating (at sea level)

Both temperature and altitude affect the continuous power output of the inverter.
The **'Kt'** coefficient is assigned to ambient temperature, whereas the **'Ka'** coefficient is assigned to altitude. See Figure 42.

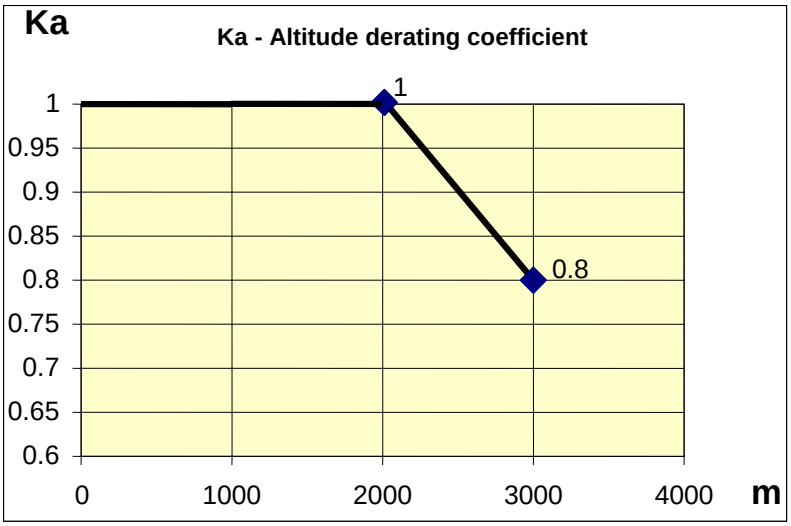


Figure 42: Ka coefficient for altitude derating

14.3. Annex 3 – Operating Intervals

The Santerno TG TL NA inverters are designed to operate in accordance with IEEE 1547 and CSA 107.1. The voltage ranges are given in Figure 43. The disconnecting intervals in accordance with the regulations in force are given in Table 29. Since most of these data are adjustable by changing internal parameters, it is possible to fit these limits to all the future revisions of International and Local Standards and Regulations.

The Special Purpose SP versions of the SANTERNO TG TL NA inverters may have specific utility interconnection protection settings that allow them to provide grid support and operate during abnormal grid events such as low voltage ride through (LVRT).

Please refer to the "Operating Instructions" manual for parameter settings relative to the additional interconnection functions.

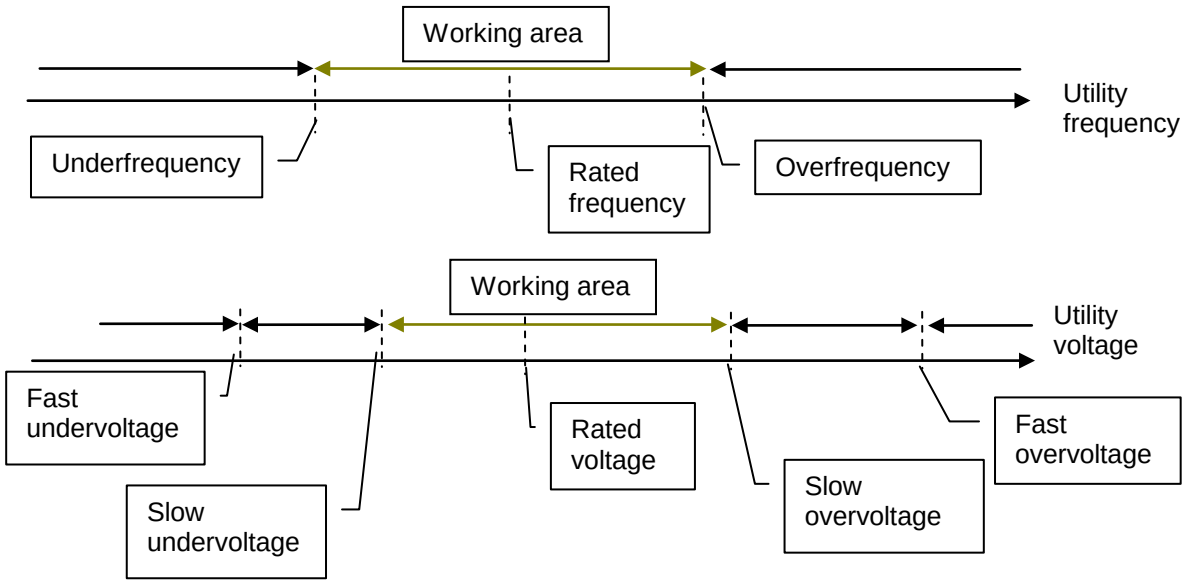


Figure 43: Voltage and frequency limits

Condition	CSA 107.1			IEEE 1547		
	Voltage (Nominal output rating)	Frequency (Hz)	Max N. of cycles before disconnection	Voltage (Nominal output rating)	Frequency (Hz)	Max N. of cycles before disconnection
Fast undervoltage	V<50%	rated	6	V<50%	rated	10
Slow undervoltage	50%<V<88%	rated	120	50%<V<88%	rated	120
Slow overvoltage	110%<V<137%	rated	120	110%<V<120%	rated	60
Fast overvoltage	V>137%	rated	2	V>120%	rated	10
Underfrequency	rated	f<rated – 0.5Hz	6	rated	<57.0	10
				rated	Adjustable 57.0-59.8	Adjustable 10-18000
Overfrequency	rated	f>rated + 0.5Hz	6	rated	>60.5	10

Table 29: Trip times

14.4. Annex 4 - Maintenance Record Tables

	Electrocution hazard. Make sure that voltage has been removed from the grid and the PV field before operating on the equipment. Open the grid circuit breaker and the DC circuit breaker and take any safety measure to avoid accidental closure of both circuit breakers. Service personnel only are authorized to operate on the equipment.

Record any maintenance operation to the Maintenance Record Tables below.

OM1	Stored data and Fault List reading	Every month

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM2	Cabinet inside/outside check	6 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM3	Air filter maintenance	6 months[1]

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

[1] More often if required.

OM4	Emergency stop check	12 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM5	Door microswitch check	12 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM6	Gaskets, locks, and hinges check	12 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM7	Fans check	6 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM8	Control and auxiliary voltages (220 V and 24 V) check	6 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM9	Fuses, relays and disconnect switches check	6 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM10	Internal tightening torque check	12 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM11	SPDs check	6 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM12	Anticondensation heater check	6 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM13	DC fuse microswitch check	12 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM14	Environmental sensor calibration	12 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM15	Nameplate and warning sign check	24 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

OM16	External tightening torque check	24 months

No.	DATE	NOTES	SIGNATURE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

15. APPENDIX

15.1. Tightening Torques

Tightening torques for bar-to-bar or bar-to-Flexibar connections using 8.8 screws:

Bolt diameter	M6	M8	M10	M12	M14	M16
Tightening torque (Lb.ft./Nm)	7.37 (10)	18.44 (25)	36.87 (50)	66.38 (90)	103.3 (140)	154.89 (210)

Tightening torques for the connection of inductors and transformers using 8.8 screws:

Bolt diameter	M3	M4	M5	M6	M7	M8	M10	M12	M14
Tightening torque (Lb.ft./Nm)	0.73 (1)	2.21 (3)	3.68 (5)	6.63 (9)	10.32 (14)	15.488 (21)	30.97 (42)	53.10 (72)	(84.08) 114

15.2. ES847 Board

15.2.1. Terminals in ES847 Board

Screwable terminal board in twelve extractable sections suitable for cable cross-sections 0.08 to 1.5mm^2 (AWG 28-16).

N.	Name	Description	I/O Features	DIP-switches/Notes
1-2		NOT USED – DO NOT CONNECT		
3	CMA	Analog inputs 0V (common with control 0V)	Control board Zero Volts	
4-5	+15VM-15VM	Stabilized bipolar power supply output protected against short-circuit for external sensors	+15V, -15V; Iout max: 100mA	
6	CMA	Analog inputs 0V (common with control 0V)	Control board Zero Volts	
7-26		NOT USED – DO NOT CONNECT		
27	XAIN8/T1+	Aux analog input, AMBIENT MEASURE 1	Vfs = 10V, Rin = 30kΩ	SW1.3 = ON SW1.1-2-4 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW1.4 = ON SW1.1-2-3 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW1.2 = ON SW1.1-3-4 = OFF
		Temperature measure of thermostat # 1	Temperature measure PT100	SW1.1-4 = ON SW1.2-3 = OFF
28	CMA/T1-	0V analog input for XAIN8 feedback	Control board Zero Volts	
29	XAIN9/T2+	Aux analog input, AMBIENT MEASURE 2	Vfs = 10V, Rin = 30kΩ	SW1.7 = ON SW1.5-6-8 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW1.8 = ON SW1.5-6-7 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW1.6 = ON SW1.5-7-8 = OFF
		Temperature measure of thermostat # 2	PT100 temperature measure	SW1.5-8 = ON SW1.6-7 = OFF
30	CMA/T2-	0V analog input for XAIN9 feedback	Control board Zero Volts	
31	XAIN10/T3+	Aux analog input, AMBIENT MEASURE 3	Vfs = 10V, Rin = 30kΩ	SW2.3 = ON SW2.1-2-4 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW2.4 = ON SW2.1-2-3 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW2.2 = ON SW2.1-3-4 = OFF
		Temperature measure of thermostat # 3	PT100 temperature measure	SW2.1-4 = ON SW2.2-3 = OFF

N.	Name	Description	I/O Features	DIP-switches/ Notes
32	CMA/T3-	0V analog input for XAIN10 feedback	Control board Zero Volts	
33	XAIN11/T4+	Aux analog input, AMBIENT MEASURE 4	Vfs = 10V, Rin = 30kΩ	SW2.7 = ON SW2.5-6-8 = OFF
			Vfs = 100mV, Rin = 1MΩ	SW2.8 = ON SW2.5-6-7 = OFF
			Ifs = 20mA, Rin = 124,5Ω	SW2.6 = ON SW2.5-7-8 = OFF
		Temperature measure of thermostat # 4	PT100 temperature measure	SW2.5-8 = ON SW2.6-7 = OFF
34	CMA/T4-	0V analog input for XAIN11 feedback	Control board Zero Volts	
35	XAIN12	Aux analog input, AMBIENT MEASURE 5, 10V f.s.	Fs = 10V; Rin= 30kΩ	
36	CMA	0V analog input for XAIN12 feedback	Control board Zero Volts	
37	XAIN13	Aux analog input, AMBIENT MEASURE 6, 10V f.s.	Fs = 10V; Rin= 30kΩ	
38	CMA	0V analog input for XAIN13 feedback	Control board Zero Volts	
39	XMDI1	Multifunction, auxiliary digital input 1	Used for controlling the output power by means of a device external to the inverter	
40	XMDI2	Multifunction, auxiliary digital input 2	Used for controlling the output power by means of a device external to the inverter	
41	XMDI3	Multifunction, auxiliary digital input 3	Energy delivered from the external counter	
42	XMDI4	Multifunction, auxiliary digital input 4	Energy absorbed from the external counter	
43	CMD	Digital inputs 0V isolated in respect to control 0V	Common	
44	+24V	Aux supply output for multifunction to isolated digital inputs	+24 V	
45	XMDI5	Multifunction, auxiliary digital input 5	Used for controlling the output power by means of a device external to the inverter	
46	XMDI6	NOT USED – DO NOT CONNECT		
47	XMDI7	Multifunction, auxiliary digital input 7	Used for controlling the output power by means of a device external to the inverter	
48-62		NOT USED – DO NOT CONNECT		

Table 30: Terminals available on ES847 board

15.2.2. Environmental and Electrical Requirements

Environmental Requirements	
Operating temperature	0 to 62°C / 32 to 143.6 °F (ambient temperature)
Relative humidity	5 to 95% (non-condensing)
Max. operating altitude	4000m (4374.45 yards) (above sea level)

Table 31: Environmental requirements

Analog inputs

Analog inputs configured in 0-10V mode	Rating			
	Min	Type	Max	Unit
Input impedance		40		kΩ
Offset and gain error in respect to full-scale value		0.5		%
Temperature coefficient of the offset and gain error			200	ppm/°C
Digital resolution			12	bits
Voltage LSB		2.44		mV/LSB
Permanent overload on the inputs causing no damage to the equipment	-30		+30	V
Cut-off frequency of the input filter (low-pass first order filter)		1		Hz
Sampling period (depending on the application software being used)	10		1000	ms

Table 32: Analog inputs configured in 0-10V mode

Analog inputs configured in 0-20mA mode	Rating			
	Min	Type	Max	Unit
Input impedance		124.5		Ω
Offset and gain error in respect to full-scale value		0.5		%
Temperature coefficient of the offset and gain error			200	ppm/°C
Digital resolution			12	bits
Voltage LSB		4.90		µA/LSB
Permanent overload on the inputs causing no damage to the equipment	-3.7		+3.7	V
Cut-off frequency of the input filter (low-pass first order filter)		1		Hz
Sampling period (depending on the application software being used)	10		1000	ms

Table 33: Analog inputs configured in 0-20mA mode

Analog inputs configured in 0-100mV mode	Rating			
	Min	Type	Max	Unit
Input impedance	1			MΩ
Offset and gain error in respect to full-scale value		0.2		%
Temperature coefficient of the offset and gain error			50	ppm/°C
Digital resolution			12	bits
Voltage LSB		24.7		µV/LSB
Permanent overload on the inputs causing no damage to the equipment	-30		+30	V
Cut-off frequency of the input filter (low-pass first order filter)		1		Hz
Sampling period (depending on the application software being used)	10		1000	ms

Table 34: Analog inputs configured in 0-100mV mode

Analog inputs configured as temperature measure with PT100	Rating			
	Min	Type	Max	Unit
Type of probe	PT100 thermostat, 2-wire connection			
Measure range	-50		125	°C
PT100 polarization current		0.67		mA
Measure temperature coefficient			50	ppm/°C
Digital resolution			12	bits
Maximum cumulative measure error over -40 to +50°C		0.5	1.5	°C
Average value of temperature LSB (SW linearization function)		0.098		°C/LSB
Permanent overload on the inputs causing no damage to the equipment	-10		+10	V
Cut-off frequency of the input filter (low-pass first order filter)		1		Hz
Sampling period (depending on the application software being used)	10		1000	ms

Table 35: Analog inputs configured as temperature measure with PT100

Power supply outputs

Specifications of the analog supply outputs	Rating			
	Min	Type	Max	Unit
Voltage available in terminal +15V (4) in respect to CMA (6)	14.25	15	15.75	V
Voltage available in terminal +15V (4) in respect to CMA (6)	-15.75	-15	-14.25	V
Maximum current that can be delivered from +15V output and that can be absorbed by –15V output			100	mA

Table 36: Specifications of the analog supply outputs

Specifications of the digital supply outputs	Rating			
	Min	Type	Max	Unit
Voltage available in terminals +24V (44 and 49) in respect to CMD (43 and 50)	21	24	27	V
Maximum current deliverable from +24V output			200	mA

Table 37: Specifications of the digital supply outputs

	Irreversible damage occurs if the min/max input/output voltage ratings are exceeded.
	The isolated supply output and the analog auxiliary output are protected by a resetting fuse capable of protecting the power supply unit inside the inverter against short-circuits. Nevertheless, it can happen that the inverter is not temporarily locked in the event of a short-circuit.

15.3. Comms Port and Comms Protocol

The Santerno TG TL NA inverters allow extended and modular connectivity, both for the Basic version and for the version with the optional Data Logger installed (see section 15.3.3).

- Full integration with Santerno's remote monitoring service for the detection of the plant performance and the alarms tripped
- Full remote monitoring accessibility for remote control in local and remote mode, both from a PC and from the SunwayPortal.

Connectivity of the Santerno TG TL NA inverters:

- Up to three RS485 Modbus/RTU serial links available (optically isolated)
- One Ethernet port available

The serial ports of the Santerno TG TL NA inverters use 2-wire RS485 plus a 0 Volt wire. The standard Modbus/RTU protocol is used.

The inverter will typically behave as a slave Modbus (i.e. it only answers to queries sent by another device); a master device (typically a PC or a Data Logger board) is then needed to start serial communications.

The serial link of the inverter reads the measures internal to the inverter and permits to read, write and save all the parameters pertaining to the inverter operation (COM0 port).

Ports COM1 and COM2 may be used as Modbus Master for communication trunk lines which the string boxes are connected to.

The ETHERNET port in the Santerno TG TL NA inverters uses a proprietary Modbus over TCP/IP standard. Connection is possible via the RemoteSunway or the Remote Monitoring services available from the SunwayPortal.

The connections pertaining to the serial ports are available on terminal board X4 as well. See Table 38.

SERIAL PORT	BASIC version	Optional Data Logger	Protocol	Terminal
COM0	Available	Available	Modbus Slave	X4, contacts 1,2,3
COM1	*Not available*	Available	Modbus Master/Slave	X4, contacts 5,6,7
COM2	Not available	Available	Modbus Master/Slave	X4, contacts 9,10,11

Table 38: Serial ports

The connection for the Ethernet port is available on the Data Logger board. See Table 39.

PORT	BASIC version	Optional Data Logger	Protocol	Terminal
Ethernet	Not available	Available	Proprietary Modbus Over TCP/IP	Data Logger board

Table 39: Ethernet port

15.3.1. Connection Topologies

The wiring topologies can be point-to-point connections or multidrop connections, as detailed in the sections below. Please refer to Electrical and Mechanical Diagram.

15.3.2. Santerno TG TL NA – BASIC Version

Configuration diagram for the BASIC version of the Santerno TG TL NA inverter.

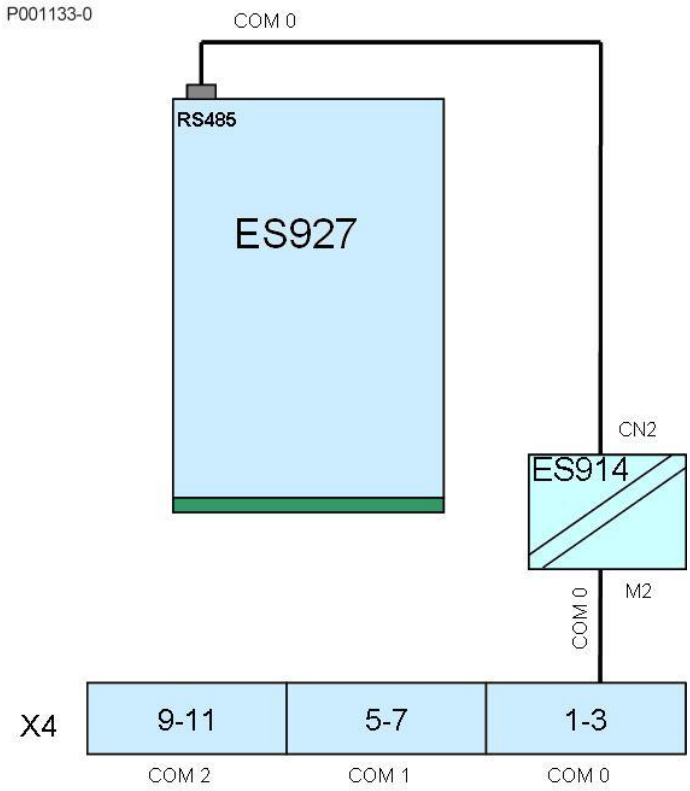


Figure 44: Configuration diagram of a basic Santerno TG TL NA inverter (no Data Logger optional board installed)

COM ports on terminal board X4:

- COM0 in ES927 control board.

The COM0 in ES927 control board is available also on terminal X4 via ES914 board, allowing galvanic isolation for RS485 serial link. This serial link can be used in Modbus Slave mode only. The default Modbus address is 1.

	The values for the voltage bus (when idle) for the COM0 port connected to the drivers in ES914 board providing RS485 galvanic isolation are the following: • 2.7 V for line A • 2.3 V for line B

15.3.3. Santerno TG TL NA with Optional Data Logger Board

Configuration diagram for the Santerno TG TL NA inverter with optional Data Logger board.

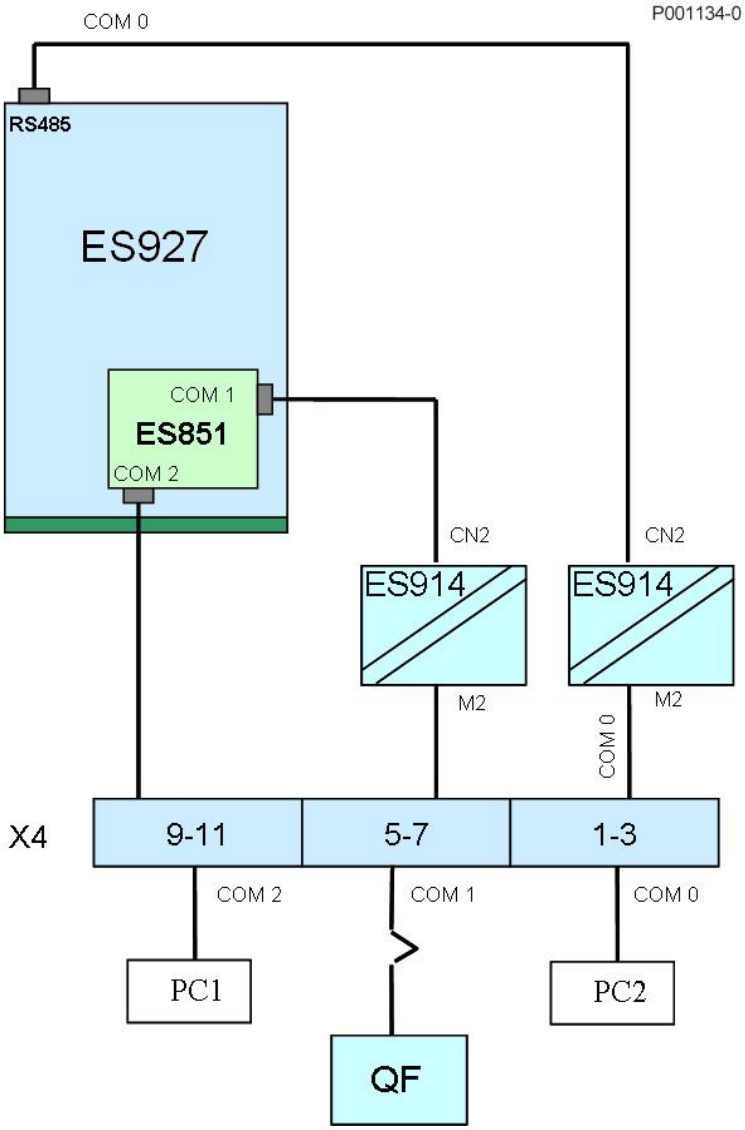


Figure 45: Configuration diagram of a Santerno TG TL NA inverter with optional Data Logger board

- PC1: a PC, a PLC or a different Modbus Master device
- PC2: a PC, a PLC or a different Modbus Master device
- QF: a trunk line (RS485) between the inverter and the string boxes (e.g. connected to subfield modules)

COM ports in terminal board X4:

- COM0, ES927 Control board
- COM1, ES851 Data Logger board
- COM2, ES851 Data Logger board

The COM0 port in ES927 control board is available also on terminal board X4 via ES914 board, allowing galvanic isolation for RS485 serial link. This serial link can be used in Modbus Slave mode only.

The COM1 port in the Data Logger board is available also on terminal board X4 by means of ES914 board, allowing galvanic isolation for RS485 serial link. This serial link can be used in Modbus Master or Slave mode. The COM1 port can be used as Modbus Master for PV field trunk lines to the string boxes.

The COM2 port in control board ES927 is available directly on terminal board X4. The COM2 port is galvanically isolated inside the Data Logger board. It can be can be used in Modbus Master or Slave mode. The COM2 can be used as Modbus Master, but the COM1 is more suitable for the PV field trunk lines reaching the string boxes.

CAUTION	If the COM1 port is used as a Master port for the PV field trunk to the string boxes, manually program the routing table in Data Logger board over COM1 port.

	The values for the voltage bus (when idle) for COM2 port connected to the drivers of the Data Logger board are the following: • 2.6 V for line A • 2.4 V for line B
	The terminators for COM2 port are disabled. If the COM2 is used for the multidrop connection between inverters, only the terminators of the last connection must be enabled.

15.3.4. Interconnection of Santerno TG TL NA Inverters with Optional Data Logger Board

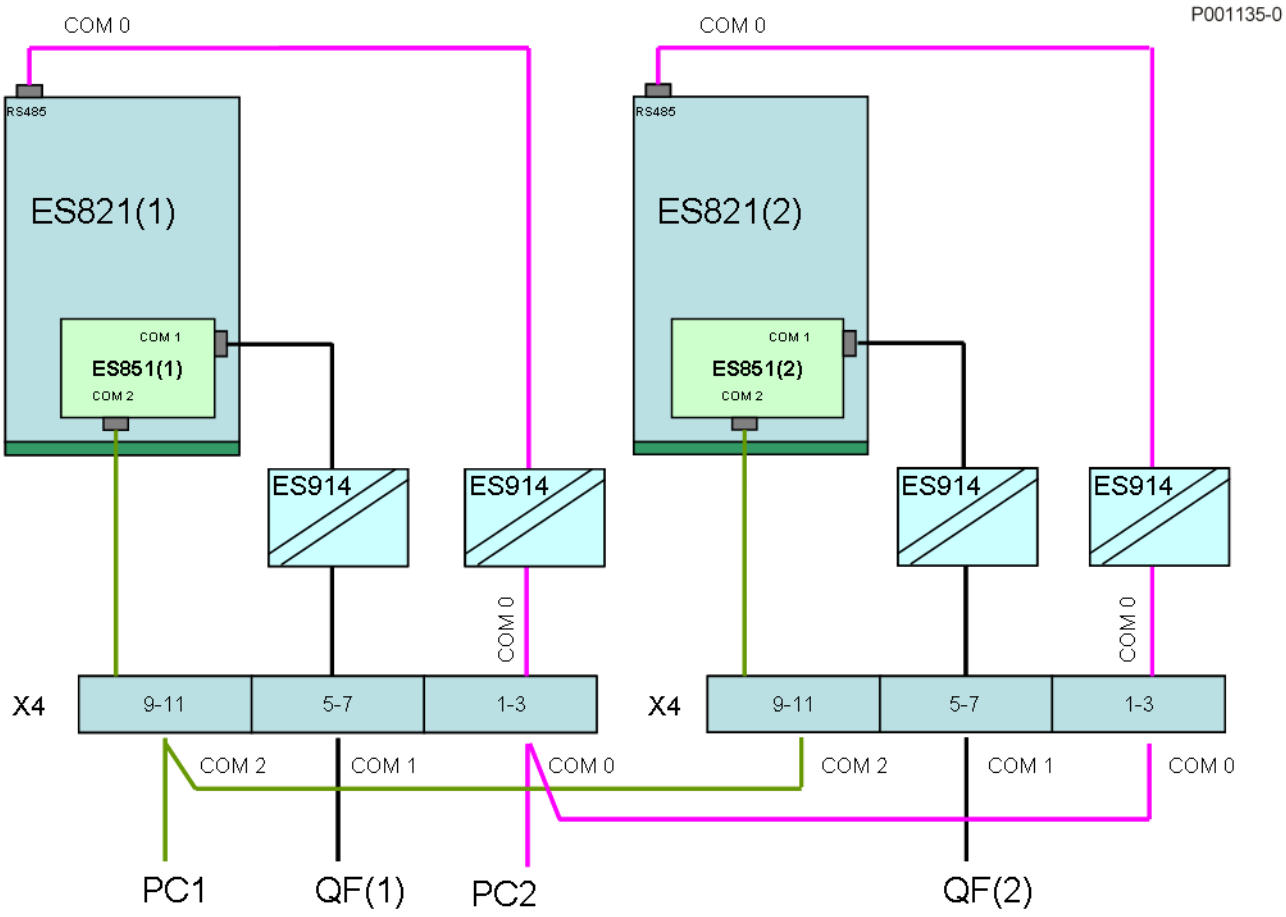


Figure 46: Configuration diagram for Santerno TG TL NA with multiple optional Data Logger boards

The following external communication devices are shown in the diagram above:

- PC1: a PC, a PLC or a different Modbus Master device
- PC2: a PC, a PLC or a different Modbus Master device
- QF(1): a trunk line (RS485) between the inverter and the string boxes (e.g. connected to subfield modules).
- QF(2): a second trunk line (RS485) between the inverter and the string boxes (e.g. connected to subfield modules).

15.3.5. Point-to-Point Connection

The point-to-point connection is made by connecting the inverter to a PC, a PLC or a different Master Modbus device.

If a PC is used, this must be provided with one RS485 port, which is provided as an optional for most industrial computers. When only USB ports are available, a USB/RS485 converter is required, which can be ordered directly from Santerno Inc. It is advisable to use the port COM0 on the inverter and to enable the line terminators.

15.3.6. Multidrop Connection

A multidrop connection of multiple Santerno TG TL NA inverters can be made to the RS485 bus.

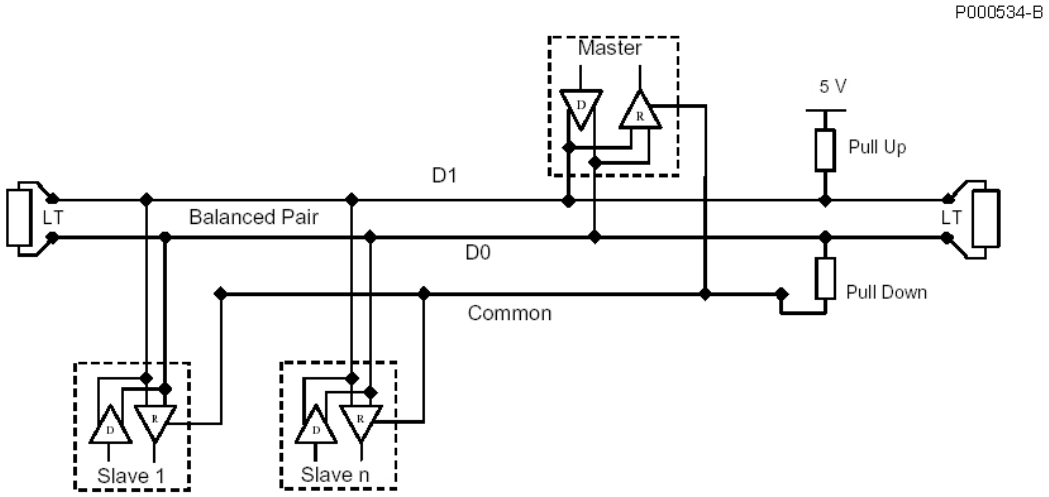


Figure 47: Multidrop connection diagram

Provide a linear wiring (not a star wiring) for RS485 multidrop line. The first device in the multidrop connection will have only one outgoing line, while the last device will have only one incoming line. The line terminator is to be installed on the first device and the last device.

The devices connected to RS485 serial link are called “nodes”. The maximum number of nodes that can be connected depends on the following:

- Logic limit of the bus, or 247
- Length of the connection
- Baudrate
- Electronic drivers being used

The line drivers of the Santerno TG TL NA inverters accept maximum 30 devices connected in multidrop mode. The cable paths should be no longer than 500m. If more than 30 devices are to be connected to the same line, or if the cable path exceeds 500m, RS485 repeaters should be used.

	The baudrate by default of the RS485 bus is 57600 bauds. It is suggested that this value be not exceeded. Lower baudrates can be set up (38400, 19200 or 9600 bauds) if communications failures occur.

Each inverter is identified by a unique ID for the connection to the PC.

15.3.7. Connection

Use terminal board X4 for the connection to the serial link. Please refer to section 15.3 Comms Port and Comms Protocol.

CAUTION	The module wiring is to be done when NO VOLTAGE is applied to the inverter. Take all the safety measures required before operating on the connectors and before handling the control board.

The MODBUS-IDA (http://www.modbus.org) association defines the type of connection for MODBUS communications over RS485 serial link, which is used by the Santerno TG TL NA inverter, as a "2-wire cable". Specifications are as follows:

Wiring cable	
Type of cable	Screened cable composed of a balanced pair named D1/D0 + common conductor ('Common'). Recommended cable: Belden 3106A Paired EIA Industrial RS-485 PLTC/CM.
Min. cross-section for the conductors	AWG23 corresponding to 0.258mm^2. For long paths, cross-sections up to 0.75mm^2 are recommended.
Max. length	500 meters based on the max. distance measured between the two stations that are farthest apart
Characteristic impedance	Greater than 100Ω (recommended): typically 120Ω

	All the devices connected to the communication multidrop network should be grounded to a common conductor to minimize any difference of ground potentials between devices that can adversely affect communications.
	All the devices connected to the communication multidrop network should have their common conductor (0V) connected in common to minimize any difference of ground potentials between devices that can adversely affect communications.
	The common terminal for the supply of the inverter control board is isolated from grounding. If one or multiple inverters are connected to a communication device with a grounded common (typically a computer), a low-impedance path between control boards and grounding occurs. High-frequency disturbance could come from the inverter power components and affect the operation of the communication device. If this happens, provide the communication device with a galvanically isolated RS485 communications interface or with a galvanically isolated RS485/RS232 converter.

CAUTION	Category 5 cables (two-pair, three-pair or four-pair) cannot be used for obtaining the serial link, even for short cable paths.

15.3.8. COM0 and COM1 Ports

The connection to COM0 and COM1 ports is made by means of terminal board X4. See section 15.3 Comms Port and Comms Protocol.

	The COM1 port is available only if the Data Logger option is installed.

The board indicated as 13A1 and 22A3 in the Electrical and Mechanical Diagram implements the galvanic isolation of RS485 signals on terminals X4 of the inverter and the external communication devices. The two RS485 ports in ES914 board are the following:

- MASTER port: connection to devices external to the inverter
- INVERTER port: connection to the ports internal to the inverter. It cannot be accessed by the user.

The line termination can be ON in each port on ES914 board featuring RS485 galvanic isolation. The INVERTER port termination must not be altered.

DIP-SWITCHES FOR RS485 LINK TERMINATION

DIP-switch	Function	Factory setting	Notes
SW1-1, SW1-2 MASTER port terminations	RS485 termination, Master side	Both ON: terminations ON	ON: 150Ω resistor between A and B; 430Ω resistor between A and +5VE; 430Ω resistor between B and 0VE. OFF: no termination resistor and no polarization resistor
SW2-1, SW2-2 INVERTER port terminations	RS485 termination, inverter side **Do not change**	Both ON: terminations ON **Do not change**	ON: 150Ω resistor between A and B; 430Ω resistor between A and +5VM, 430Ω resistor between B and 0VM. OFF: no termination resistor and no polarization resistor

	Communication does not take place or is adversely affected if multidrop terminators are not properly set, especially in case of high baud rate. If more than two terminators are fitted, some drivers can enter the protection mode due to thermal overload, thus stopping dialoguing with some of the connected devices.

Remove the front cover protecting ES914 board featuring RS485 galvanic isolation to gain access to DIP-switch SW1.

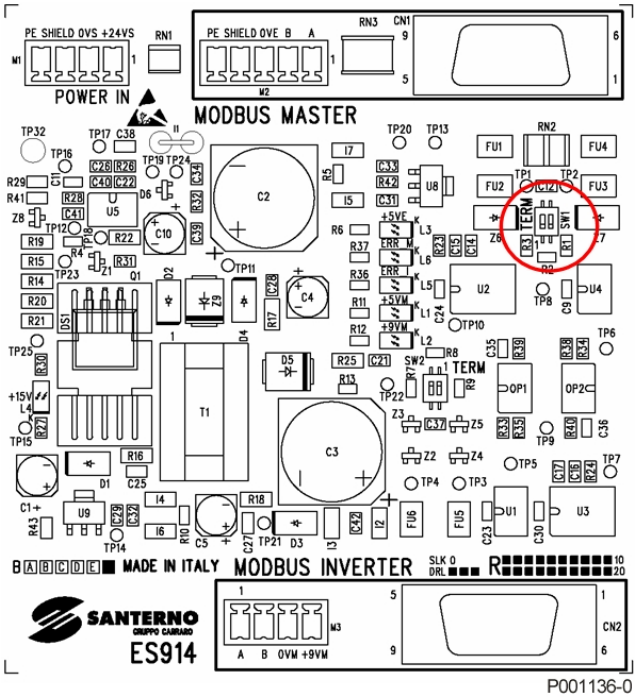


Figure 48: Location of DIP-switch SW1

The factory setting of the DIP-switches is given in the figure below.

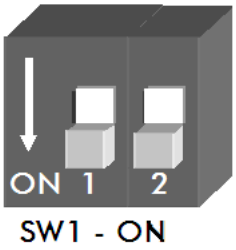


Figure 49: DIP-switch for ES914 board (galvanic isolation RS485 link terminator)

INDICATOR LEDS for RS485 galvanic isolation board (ES914)

When the bus is idle, its voltage values for COM0 and COM1connected to the drivers in RS485 galvanic isolation board (ES914) are as follows:

- 2.8 V for link A
- 2.2 V for link B

ES914 board is equipped with 5 LEDs. 3 LEDs are for the detection of the power supply voltages of the board.

LED	Color	Function
L1	Green	Supply voltage detected for RS485 circuits on the inverter side (5V)
L2	Green	Inverter supply voltage detected (9V)
L3	Green	Supply voltage detected for RS485 circuits on the Master side (5V)

Table 40: Voltage indicator LEDs

2 LEDs are available for the detection of faults occurring in RS485 signals, both to the inverter and to the Master. The FAULT indication is legal only when DIP-switches SW1 and SW2 are both ON.

LED	Color	Function
L5	Red	RS485 signal faults (to the inverter)
L6	Red	RS485 signal faults (to the Master)

Table 41: Fault indicator LEDs

The possible faults are given below:

- Differential voltage between A and B lower than 450 mV
- A or B exceeds the common mode voltage range [–7 V; 12 V]
- A or B is connected to a fixed voltage (this fault can be detected only when communication is established).

Figure 50 shows the indicator LEDs and the configuration DIP-switches.

Figure 50: Location of the indicator LEDs and of the DIP-switches

15.3.9. COM2 Port

The connection to COM2 communication port is made by means of terminal board X4. See Table 38.

	COM2 port is available only if the optional Data Logger is installed.

DIP-SWITCHES FOR RS485 LINK TERMINATIONS

DIP-switch	Function	Factory setting	Notes
SW-1, SW2-2 RS485 driver power supply	RS485 driver power supply	Both ON: internal isolated RS485 power supply	ON: Internal isolated RS485 driver power supply OFF: External isolated RS485 driver power supply from pin 6 in the connector
SW2-3, SW2-4 COM2 port terminators	COM2 RS485 termination	Both OFF: terminators off	ON: 120Ω resistor between A and B, 1500Ω resistor between A and +5VM, 1500Ω resistor between B and 0VM OFF: no termination resistor and no polarization resistor

Remove the front cover protecting the converter and remove ES847 board (environmental sensors and PV field I/Os expansion board) to reach DIP-switch SW2.

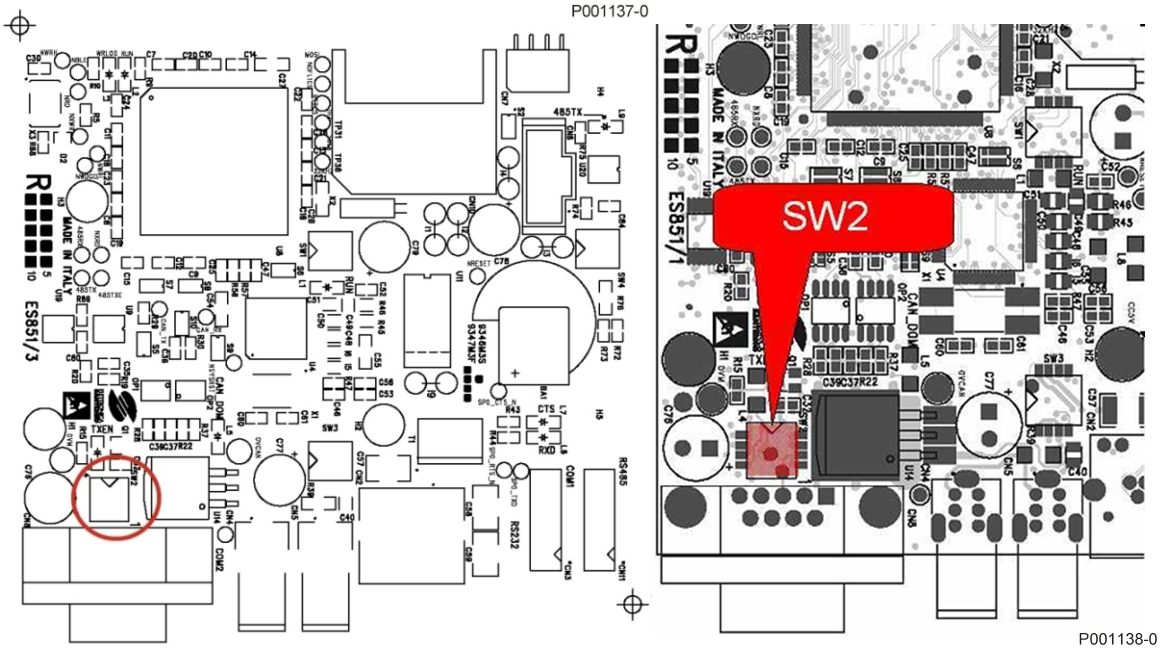


Figure 51: Location of DIP-switch SW2 on the Data Logger board

The figure below shows the factory settings of the DIP-switches.

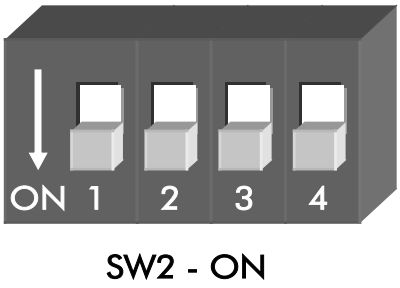


Figure 52: DIP-switch for Data Logger terminator

15.3.10. Ethernet Port

The Data Logger board is provided with the standard RJ45 connector (IEEE 802) for 10/100 (100Base-TX, 10Base-T) Ethernet connections. The pin layout is the same as the one found in any network adapter on PCs.

	The Ethernet port is available only if the Data Logger option is installed.

Pin layout:

No.	Name	Description
1	TD+	Positive signal transmission line
2	TD-	Negative signal transmission line
3	RD+	Positive signal receiving line
4	Term	Terminated pair, not used
5	Term	Terminated pair, not used
6	RD-	Negative signal receiving line
7	Term	Terminated pair, not used
8	Term	Terminated pair, not used

Figure 53: RJ45 connector

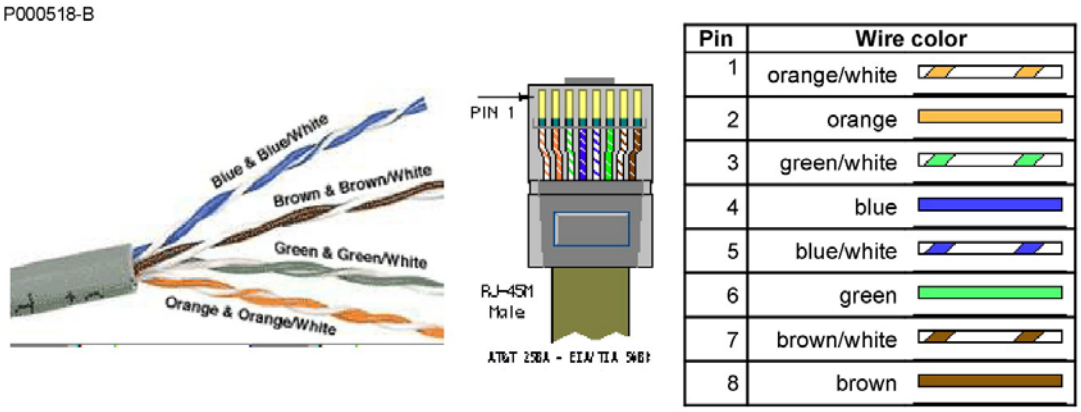
The Data Logger board can be connected through the Ethernet interface to an Ethernet control device with Modbus/TCP Master (PC) protocol in one of the following ways:

- Through a LAN (e.g. Ethernet business network)
- Through a direct point-to-point connection.

The Internet connection through a LAN is obtained by connecting the Data Logger to the Switch or the Hub using a standard cable or a Straight-Through Cable TIA/EIA-568-B, cat. 5 UTP (Patch cable for LAN).

	The Ethernet interface board cannot be connected to old LANs using Thin Ethernet (10base2) coaxial cables. Connection to this type of LANs is possible using a Hub provided with both Thin Ethernet (10base2) connectors and 100Base-TX or 10Base-T connectors. The LAN topology is a star one, with each node connected to the Hub or the Switch through its cable.

The figure below shows the Cable of Cat. 5 for Ethernet and the standard color arrangement in the connector.



Pin	Wire color
1	orange/white
2	orange
3	green/white
4	blue
5	blue/white
6	green
7	brown/white
8	brown

Figure 54: Pair layout in a 5 UTP cable

Direct point-to-point connection is obtained with a Cross-Over Cable TIA/EIA-568-B, cat. 5. This type of cable performs a cross-over of the pairs so that the TD+/TD- pair corresponds to the RD+/RD- pair, and vice versa.

The table below shows the color matching on the connector pins for the Cross-Over Cable and the crossover diagram of the two pairs used from 100Base-TX or 10Base-T connection.

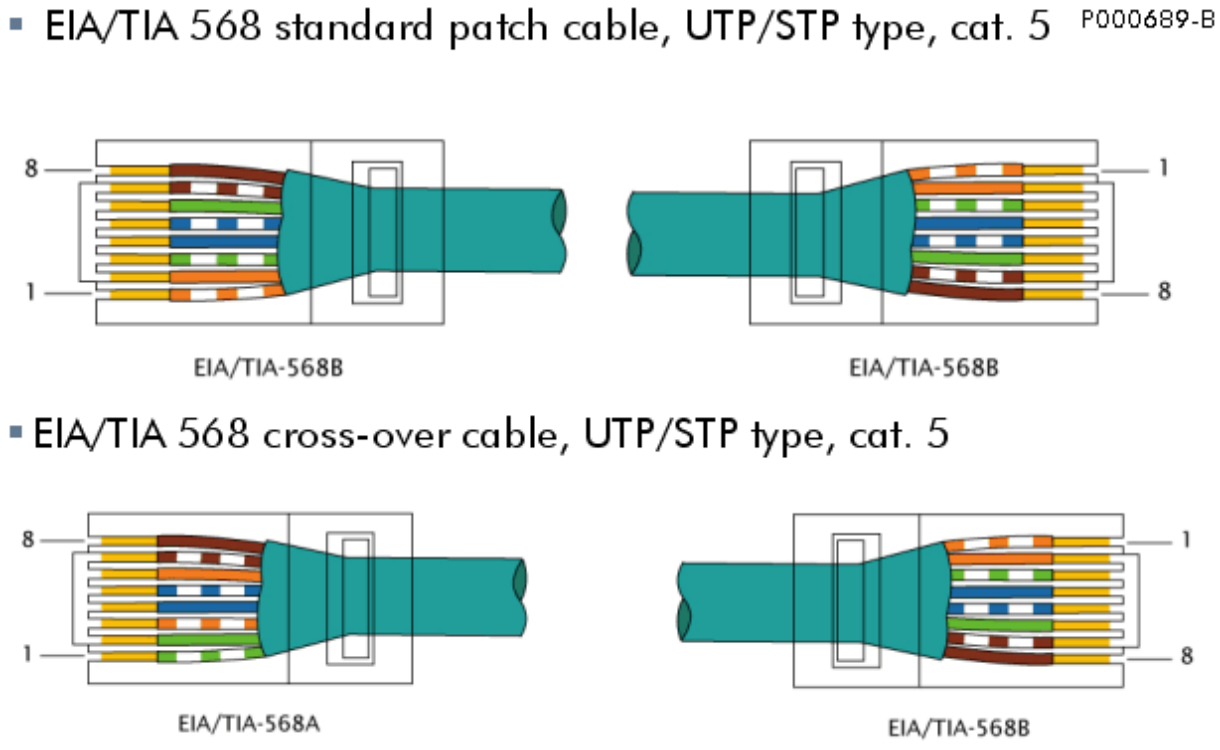


Figure 55: Standard patch cable and cross-over cable EIA/TIA 568 type UTP/STP cat. 5

	The inverter is typically installed with other electric/electronic devices inside a cubicle. Normally, the electromagnetic pollution inside the cubicle is remarkable and is due to both radiofrequency disturbance caused by the inverters and to bursts caused by the electromechanical devices. To avoid propagating disturbance to Ethernet cables, they must be segregated and kept as far as possible from the other power cables and signal cables in the cubicle. Disturbance propagated to Ethernet cables may affect the correct operation of the inverter and the other devices (computers, PLCs, Switches, Routers) connected to the same LAN.
	The maximum length of the LAN cable, cat. 5 UTP allowed by IEEE 802 standards results from the max. transit time allowed from the protocol and is equal to 100m. The longer the cable length, the higher the risk of communications failure.
	For Ethernet wiring, only use cables certified for LAN cables of 5 UTP category or higher. For standard wiring, avoid creating your own cables; Straight-Through or Cross-Over cables should be purchased from an authorized dealer.
	For a proper configuration and utilization of the communications board, the user should be familiar with the basics of the TCP/IP protocol and the MAC address, the IP address and the ARP (Address Resolution Protocol). The basic document on the Web is RFC1180 – “A TCP/IP Tutorial”. The English version can be downloaded from: http://www.faqs.org/ftp/rfc/pdf/rfc1180.txt.pdf.