● 15P00EGB800 ●

MODULAR SUNWAY TG TE OD OUTDOOR
SUNWAY TG610 1000V TE OD
SUNWAY TG1200 1000V TE OD
SUNWAY TG900 1500V TE OD
SUNWAY TG1800 1500V TE OD

THREE-PHASE PHOTOVOLTAIC INVERTER WITH EXTERNAL TRANSFORMER

USER MANUAL

- INSTALLATION GUIDE-

Issued on 05/06/2018

Rev. 04

English

- 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.
- Elettronica Santerno 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 the Engineering Department of Elettronica Santerno.
- Elettronica Santerno assumes no responsibility for the consequences resulting by the use of non-original spare-parts.
- Elettronica Santerno 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 Elettronica Santerno and cannot be reproduced. Elettronica Santerno enforces its rights on the drawings and catalogues according to the law.

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1. GENERAL INFORMATION ON THE PRODUCT

Figure 1: SUNWAY TG TE OUTDOOR line

The SUNWAY TG TE line comprises medium-power and large-power three-phase solar inverters for the connection to the LV and MV grid.

The new product range includes modular models designed to ensure optimum reliability and performance at the most convenient costs for the shortest time-to-market of custom solutions as well.

The following versions are available:

- 1100V Version, suitable for PV field voltage ratings up to max 1100 Vdc maximum.
- 1500V Version, for PV field voltage ratings up to 1500 Vdc maximum.

The SUNWAY TG TE inverters are designed for optimum conversion efficiency and reliability. They are fully protected against short-circuits and surge and are compliant with the strictest Italian and European directives regulating the safety and energy feed-in systems.

All the SUNWAY TG TE inverters are fully compatible with Tracker applications.

The very accurate design and the quality control ensured by the ISO 9001 certification are the assets of our extremely reliable products, whose features ensure maximum durability.

Elettronica Santerno's inverters meet all safety requirements and are designed to operate in the most demanding environmental conditions.

Thanks to these features, the SUNWAY TG TE inverters represent the state-of-the-art solution for the production of energy from PV field.

NOTE

Elettronica Santerno reserves the right to make any technical changes to the cabinet models shown in the pictures without any prior notice. The same applies to the appearance of the cabinets.

1.1. Scope of this manual

This manual covers all the SUNWAY TG inverters belonging to the TG1200 and TG1800 series.

In particular:

- Sunway TG 610 1000V TE – 360/380/400/420 OD

- Sunway TG 1200 1000V TE – 360/380/400/420 OD
- Sunway TG 900 1500V TE – 580/600/610/620/630/640/660/670/690 OD
- Sunway TG 1800 1500V TE – 580/600/610/620/630/640/660/670/690 OD

Other product versions are described in the relevant SUNWAY TG TE literature (datasheets/brochures/application notes).

1.2. For whom this manual is intended

This manual must be read by:

- Installers
- Operators
- Plant manager

Please refer to section 1.9.

1.3. Operating principles

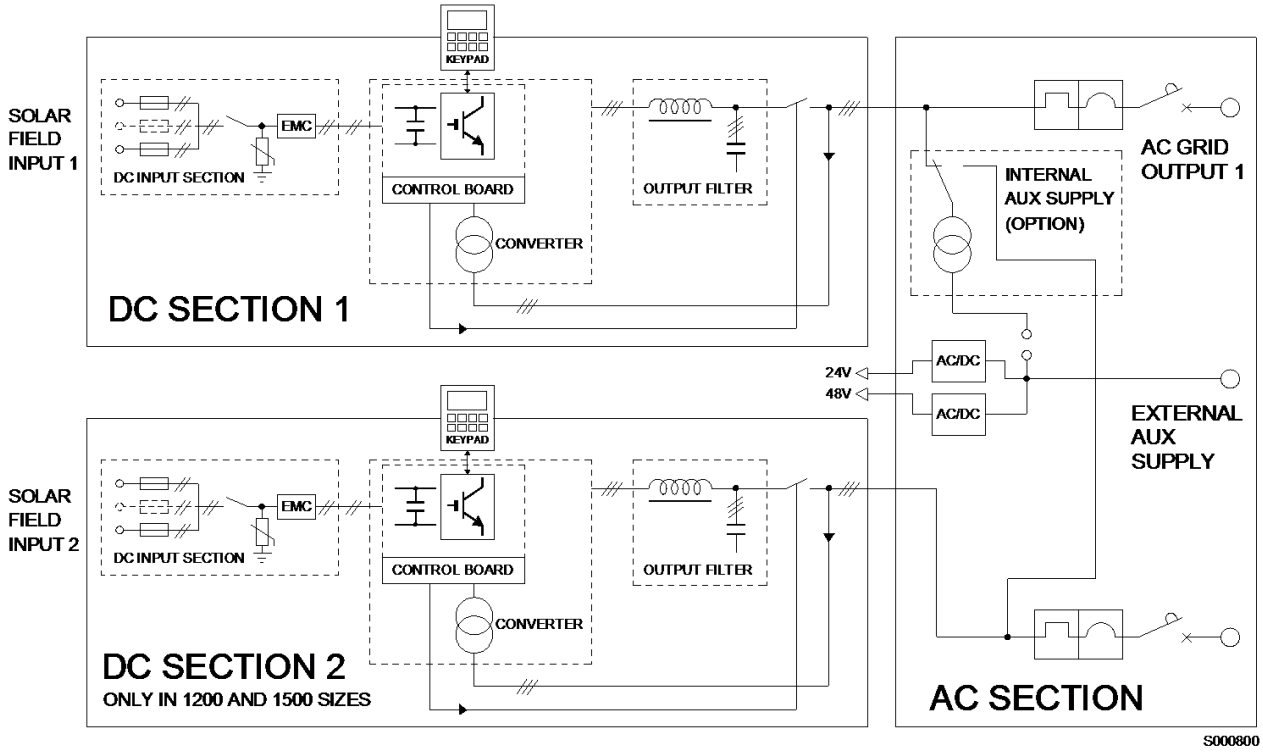


Figure 2: Single-wire diagram of a standard SUNWAY TG TE inverter

The SUNWAY TG TE inverters include the following functional blocks:

DC Input Unit
The DC Input Unit allows connecting the inverter to the photovoltaic generator. It is provided with 8 fuse-protected inputs, on-load switch, input EMI filters and SPDs. It checks the ground isolation of the PV generator.

Static Converter
The Static Converter comprises the forced switching IGBT stack and the control board. The Static Converter implements the most advanced features of the inverter, such as the control logics, the current and voltage measures, the interface protections integrated into the control software, the autodiagnostics functions and the serial communications.

Output Filter
The Output Filter transforms the PWM output of the converter into sinusoidal voltage.

AC Output Unit

The AC Output Unit comprises control devices, such as the Contactor for the connection to the grid that can operate as an Interface Device (please refer to section 4.3), the output EMI filters and the output MCCB.
The inverter is provided with an interface device operating on minimum and maximum voltage / frequency thresholds in compliance with the applicable standards.

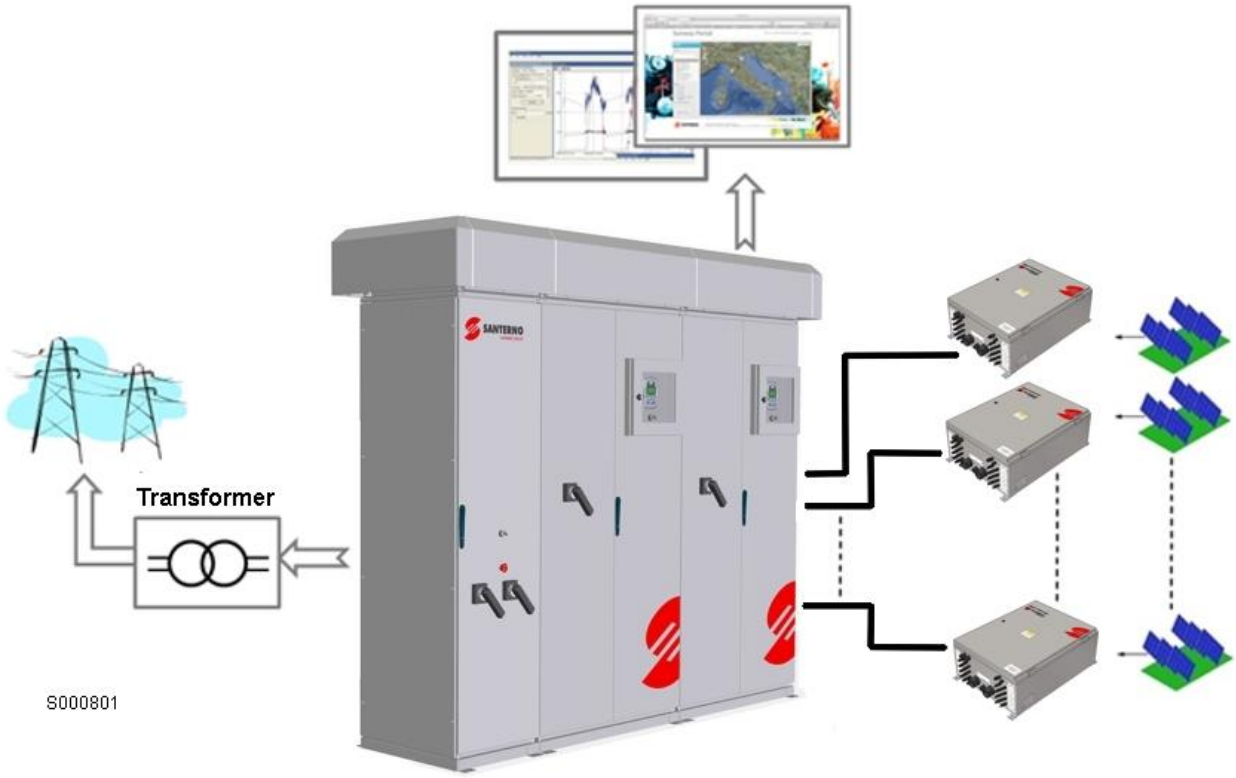


Figure 3: Block diagram

Once the SUNWAY TG TE is connected to the photovoltaic generator and is properly started (see section **Error! Reference source not found.**) the control system synchronises with the grid and closes the parallel c ontactor when the PV field voltage exceeds the starting voltage value.

The inverter will then operate as a generator of sinusoidal current with a power factor that is typically equal to 1.

The integrated MPPT (Maximum Power Point Tracker) algorithm constantly keeps the working point of the PV field at the maximum power delivered.

The grid frequency and the grid voltage values are constantly checked during normal operation. This allows detecting undesired islanding operation. Islanding detection can be performed by an external relay according to the regulations in force (see section 4.3.1).

The plant data can be read from the LCD display/keypad placed on the front wall. The plant data includes the active energy and the reactive energy, the operation time and the temperature of the internal components. The keypad allows accessing all the inverter measures and programming parameters.

The inverter is provided with one Ethernet port for the connection to the remote monitoring system, both in local mode and in remote mode (see section 4.9).

The Data Logger board is available as an option board. It is a telecommunications unit between the inverter and the connected String Box. It stores local production data and allows connecting to the Santerno Remote Monitoring (see section 8.7).

Several diagnostic functions are integrated in the inverter logic, such as the constant check of the program memory integrity, the PV field isolation monitoring, the detection of the temperature of the internal components, the detection of the input / output overcurrent, the control of input fuses.

1.4. Main integrated standard functions

The main standard functions implemented by the MODULAR SUNWAY TG TE OD are detailed below.

- 2 environmental inputs monitoring solar radiation sensors and temperature sensors.
- Constant check of PV field insulation.
- Protection against short-circuits; overvoltage and undervoltage protection for maximum reliability.
- Protection against overvoltage in the PV field input.
- Protection against PV polarity mismatch.
- Interface protection integrated into the inverter software.
- Digital input for external grid supervisor.
- Phase synchronization of carrier frequency for multi-inverter plants.
- External power supply for the ventilation system to maximize the energy delivered to the grid.
- Full integration with the remote monitoring system offered from Santerno for performance detection and trip logs.
- Full accessibility to the remote control service, both in local mode and remote mode, via laptop and via SunwayPortal.
- Full integration with the Sunway Station.

1.5. Optional functions

The main optional functions available for MODULAR SUNWAY TG TE inverters are listed below:

- Earthed pole (Positive Earthed or Negative Earthed)
- Ground fault detector interrupter (GFDI)
- Zone monitoring system
- DC EMI filter
- AC SPDs
- AC Insulation check
- AC EMI Filter
- Compatibility with single secondary transformer for multi-MPPT products
- Self-power supply
- Wattmeter for the output power measurement
- Sunway Bridge
- Single string monitoring
- Fuse-holders

1.6. Attached documentation

The SUNWAY TG TE is supplied complete with the following documents:

Name of the document	Scope
Installation Guide	Contains all the information necessary for the transport, assembly, installation and maintenance of the product.
Programming Guide (1)	Contains all the information on inverter operation and for accessing measurements and programming parameters.
Electrical and Mechanical Diagram	Contains detailed information on the internal layout and electrical diagram of the product.
Final Test Certificate	Contains all the information concerning the execution and outcome of Production Tests.

(1) Available for download from santerno.com.

Table 1: Documentation supplied with the product

1.6.1. Preservation of the documentation

All documents must be kept for the entire life span of the equipment together with the system documentation. They must be kept in a place where they are readily available.

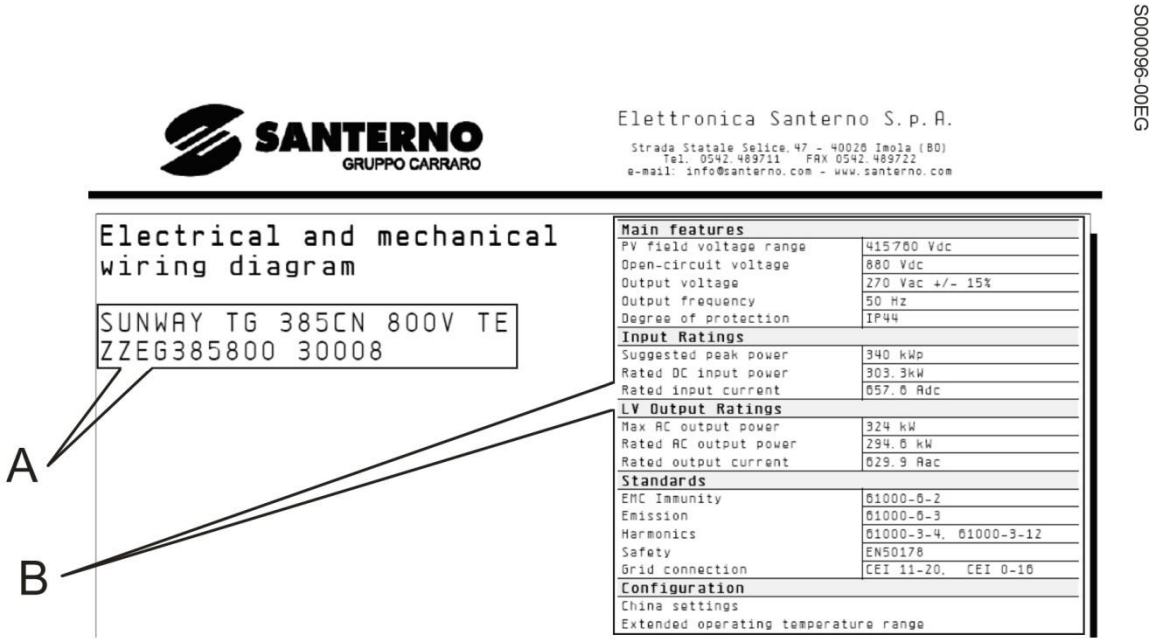
1.6.2. Electrical and mechanical diagram

To facilitate understanding of the Electrical and Mechanical Diagram and help the user to identify the various parts illustrated therein, here is a description of how it has been drawn up.

As the inverter is made up of interconnected modules, the electrical is composed of three separate parts:

- The interconnections diagram
- The AC module diagram
- The DC module diagram

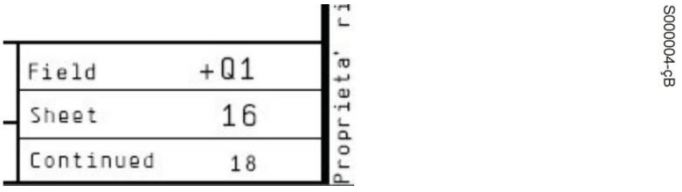
The first page of the Electrical and Mechanical Diagram contains the technical features and configuration of the inverter, as illustrated below:



A Type of inverter and Part Number

B Inverter technical data and configuration

The pages of the electrical diagram are distinguished by three different numbers in the bottom right-hand corner:



"**Field**" indicates the location of the components:

+Q1 = Inside the electrical cabinet

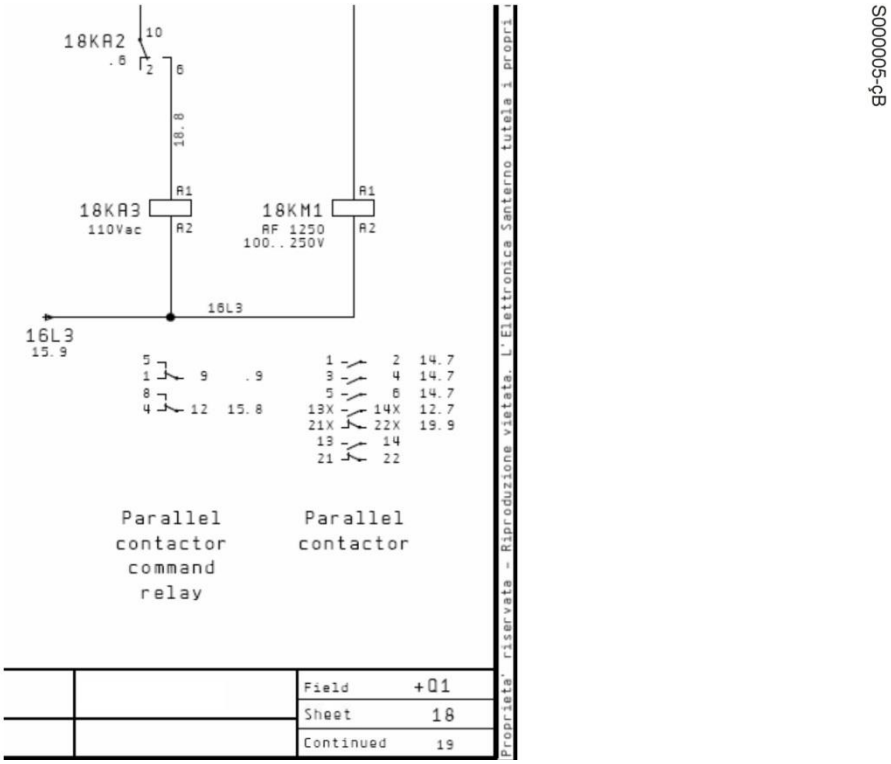
+Q1F = On the front of the electrical cabinet

+EXT = External device

"**Sheet"** indicates the progressive number of each sheet in the electrical diagram

"**Continued**" indicates the number of the following sheet

The ID code for each component and conductor relates to the first page in which the component or conductor appears, usually based on the direction of energy flow, followed by a progressive number.



Cross-references are provided in the electrical diagram for conductors and components which appear on more than one page. The cross-reference format is: Sheet. Column.

1.6.3. Final test certificate

The Final Test Certificate is drawn up by Elettronica Santerno technicians at the time of testing the MODULAR SUNWAY TG TE OD inverter. It contains all the information concerning the execution and outcome of the Production Test.

1.7. Electronic boards references

The table below indicates the electronic board ID codes used in the Electrical and Mechanical Diagram.

ID Code	Description
ES821	CONTROL BOARD
ES847	ENVIRONMENTAL SENSORS AND FIELD I/Os EXPANSION BOARD
ES851	DATA LOGGER BOARD
ES914(1)	AUXILIARY POWER SUPPLY AND RS485 GALVANIC ISOLATION BOARD

ES942(1)	EARTH LEAKAGE DETECTOR BOARD

(1) Optional

1.8. Symbols used

KEY:

DANGER

Indicates an operating procedure which, if not carried out correctly, may lead to injuries or even death caused by electric shock.

WARNING

Indicates an operating procedure which, if not carried out correctly, may cause serious damage to equipment.

NOTE

Indicates important information concerning use of the equipment.

PROHIBITION

Strictly forbids the execution of operating procedures.

1.9. Definitions

Installer
Technician responsible for setting up, positioning and installing the equipment in compliance with the system diagram and in accordance with first-class, professional criteria.

Operator
Worker who has been suitably trained and informed on the risks and relative safety procedures to be adopted. The operator can carry out routine maintenance on the equipment.

Plant manager
Person who co-ordinates or manages system management activities and is responsible for ensuring health and safety standards are adhered to.

Technical room
Place used for housing the technological systems such as the wiring, plumbing, heating, air-conditioning, lifting and telecommunications systems.

It is equipped with suitable forced-air ventilation and/or air conditioning and is also fitted with appropriate safety devices governing access, maintenance and fire-prevention.

Person in charge of running the electrical system (System Manager)
Person with the highest level of responsibility concerning operation of the electrical system. If required some of his/her tasks may be delegated to others.

Person in charge of working activities (Works Supervisor)
Person with the highest level of responsibility concerning the execution of work. If required some of his/her tasks may be delegated to others.

The Works Supervisor must give all persons involved in the execution of work activities the relative instructions concerning reasonably foreseeable dangers which may not be immediately apparent.

Skilled electrician
Someone who has been trained and has enough technical knowledge or experience to enable him/her to avoid the dangers which may be generated by electricity.

Instructed person
Someone who has been adequately advised or supervised by a skilled person to enable him/her to avoid the dangers which may be generated by electricity.

2. CAUTION STATEMENTS

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 equipment.

Only competent personnel must carry out the equipment installation.

SAFETY RECOMMENDATIONS TO FOLLOW DURING USE AND INSTALLATION OF THE EQUIPMENT:

NOTE

Always read this instruction manual thoroughly before starting the equipment.

DANGER

ALWAYS EARTH THE EQUIPMENT.

OBSERVE THE PRESCRIPTIONS CONCERNING CONDUCTOR SECTION INDICATED IN 6.4.2.

WARNING

Do not connect supply voltages which exceed the rated voltage. If voltage exceeding the rated value is applied, the internal circuits may be damaged.

In the event of an alarm, please consult section *Error! Reference source not found. Error! Reference source not found.*. ***Only restart the equipment once the problem has been rectified.***

Do not carry out isolation tests between the power terminals or between the control terminals.

Make sure that the screws on the connection terminal board have been tightened correctly.

Observe the ambient conditions for installation.

The electronic boards contain components which are sensitive to electrostatic charges. Do not touch the boards unless absolutely necessary. Should this be the case, take all the necessary precautions to prevent damages caused by electrostatic charges.

2.1. Precautions for use and prohibitions

DANGER

RISK OF ELECTRIC SHOCK

NEVER carry out operations on the equipment when it is powered.

EXPLOSION AND FIRE RISKS

The risk of explosion or fire may exist if the equipment is installed in a room containing flammable vapours. Do not install the equipment where there is a risk of explosion or fire.

PROHIBITION

The product described in this manual has not been designed to operate in potentially explosive atmospheres. Consequently, installation in such an environment is strictly prohibited.

PROHIBITION

It is forbidden to make any technical or mechanical modifications to the cabinet even when out of warranty.

Elettronica Santerno is not responsible for any risks that may arise due to unauthorised alterations, modifications or tampering.

2.2. Intended use

The SUNWAY TG TE inverters are digitally controlled appliances which convert electrical energy from a DC power source produced by photovoltaic (PV) panels into an AC current which is then delivered to the grid.

The SUNWAY TG TE inverters may only be used as described in this manual. The DC power supply must come from the PV field only. The AC output must be parallel-connected to the grid only.

Any use other than that described in this manual is to be considered inappropriate and therefore improper.

2.3. Qualified technical personnel

All work on MODULAR SUNWAY TG TE OD products must be carried out by skilled technical personnel only. By skilled personnel it is intended persons who have been suitably trained to carry out the work in question.

To commission and use the MODULAR SUNWAY TG TE OD inverters, personnel must know and understand the instructions for installation and use. In particular all safety warnings must be strictly observed.

2.4. Specific dangers linked to photovoltaic (PV) systems

PV systems have certain characteristics which are the source of additional hazards and are described below:

- A live current source is connected. Depending on the operating conditions, there may be live voltage from the PV generator or from the electrical grid. This must be taken into consideration, particularly when disconnecting parts from the system.
- Very high DC voltages are involved (with no periodic zero crossings) hence failure or the incorrect use of fuses or plugs may cause electric arcs.
- The short-circuit current of the PV generator is only slightly higher than the maximum operating current and furthermore is linked to radiation. This means that fuses may not always blow in the event of a short-circuit.
- The PV generator grid is usually an IT type, i.e. it is only earthed in the event of a fault or energy leakage. For connection to PV fields with earthing pole, connection is of the TN type, but the earth connection is protected by a fuse which may trip in the event of a single fault.
- In the event of a fault (for example a short-circuit), cutting off a generator with a high number of branches may prove to be somewhat difficult. Take great care to ensure each sub-field disconnect switch has been opened before going near the devices installed in the technical room.

2.5. Execution of work

Maintenance, configuration modifications and management operations require the involvement of all production and maintenance personnel. These activities **must be carried out in observance of health and safety regulations**.

The Standards and Laws governing this aspect vary depending on the personnel involved, methods of access and/or the tasks which may be carried out on the product and envisage constructive measures aimed at guaranteeing adequate levels of safety.

Standard EN 50110-1, second edition, identifies the people who are granted access to the product:

- Person in charge of running the electrical system (System Manager).
- Person in charge of work activities (Works Supervisor).
- Skilled electrician.

- Instructed person.

Please refer to section 1.2.

Standard EN 50110-1 governs the way work in a plant is carried out and the relationship between the aforementioned persons who may work on the plant to maintain the electrical safety conditions stipulated by European Directives.

This standard and its national equivalents must therefore be adhered to whenever it is necessary to access a PV system.

2.5.1. Placing the system in safety conditions

Affix the following warning sign next to all the PV field disconnect switches.

Figure 4: System safety warning sign

WARNING

Always operate in accordance with the indications provided in section 2.7.

NOTE

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

2.6. Personal Protective Equipment

Maintenance technicians must be provided with the following personal protective equipment as envisaged by European Directives and relative implementation of the same on national territory.

SYMBOL	DESCRIPTION

	Safety glasses/face shield	Throughout operations.
	1000 V high-voltage insulated gloves	Throughout operations.
	Dielectric helmet	Throughout operations.
	Safety footwear/dielectric boots	Throughout operations.
	Insulated tools	Throughout operations.
	Operators must also be provided with a suitable means of communication for contacting the emergency services if necessary.	

NOTE

It is always advisable to work on the electrical cabinets with THE POWER SUPPLY SWITCHED OFF and the equipment in safety conditions (please refer to section 2.7).

2.6.1. Hearing protection

The inverter and technical room cooling fans may generate considerable noise levels.

It is therefore necessary to observe all the necessary precautions aimed at protecting hearing. It is advisable to wear hearing protection when working continuously in the vicinity of the inverters.Burns protection
Some components may reach very high temperatures and still be very hot even after the equipment has been switched off.

Consequently, all the necessary precautions aimed at preventing the risk of burns must be taken. Always wear protective gloves.

2.7. Electric connections: safety procedure

Before carrying out any kind of operation inside the inverter, always place the equipment in safety conditions. To do this follow the instructions provided below:

- Make sure that the inverter is NOT running.
- Press the emergency stop button on the front door.
- Disconnect the cabinet's auxiliary power supply.
- Wait at least 10 minutes before opening the doors.
- Turn off any disconnector switches up- and downstream from the inverter.

WARNING

Before carrying out any operations inside the electrical cabinet make sure it is in safety conditions by turning it off and opening the DC side and AC side switches.

DANGER

The SUNWAY TG TE is powered by two completely separate voltage generators: the grid and the PV field. Make sure that both generators are disconnected before carrying out any kind of work inside the inverter.

DANGER

Turning off the switches on the PV field side and the grid side inhibits operation of the SUNWAY TG TE but hazardous stored residual energy may persist on the AC grid and PV field connection terminals (X2 and X2B terminal boards), on the fuse holders and on the conductors and components upstream from the DC disconnector and the AC circuit breakers (please refer to the Electrical and Mechanical Diagram).

DANGER

After turning off the inverter wait at least 10 minutes before opening the cabinet doors to give the DC-link capacitors time to discharge.

3. PRODUCT IDENTIFICATION

3.1. Checking the product on delivery

On receiving delivery of the equipment make sure that the packaging shows no signs of damage. Check that it complies with your order by referring to the nameplates described below. In the event of any damage, please contact the relative insurance company or the supplier. If the delivery does not match your order, contact the supplier immediately.

The type of packaging may vary based on the means of transport being used. If shipped by sea, the inverter is packaged inside two wooden crates, one containing the inverter, one containing the inverter rooftop.

Figure 5: Wooden crates for the MODULAR SUNWAY TG TE inverter

NOTE

The labels indicating the codes and product description and any optionals selected, may differ in colour to the ones shown in the figure.

If the equipment is to be stored before installation, make sure that the ambient conditions in the warehouse meet the necessary specifications (please refer to section 5.4). The warranty covers manufacturing defects. The manufacturer shall not be held liable for any damage which may have occurred during transport and unpacking. Under no circumstances shall the manufacturer be held liable for damage or faults caused by incorrect use, misuse, incorrect installation or inadequate temperature or humidity conditions or exposure to corrosives nor for faults caused by operation outside the rated values. Nor shall the manufacturer be held liable for consequential or accidental damage.

NOTE

For the terms of warranty please refer to the warranty certificate supplied with the product.

3.2. Product ID code

The product code identifies the inverter and is indicated on the relative nameplate. The nameplate also holds all the necessary technical data (please refer to section 12.1).

The product code is made up of the following elements:

SUNWAY TG XXX ZZZ TE- VVV YYY

XXX Model 610

		900 1200 1800
ZZZZ	**Maximum Vdc Field Voltage**	1000V: Field voltage Max. Voc 1100 Vdc 1500V: Field voltage Max. Voc 1500 Vdc
VVV	**AC rated voltage**	If absent, see Technical Data 360: 360 V_{AC} 380: 380 V_{AC} 400: 400 V_{AC} 420: 420 V_{AC} 580: 580 V_{AC} 600: 600 V_{AC} 610: 610 V_{AC} 620: 620V_{AC} 630: 630 V_{AC} 640: 640 V_{AC} 660: 660 V_{AC} 670: 670 V_{AC} 690: 690 V_{AC}
YYY	**Application**	OD: Outdoor STD: Indoor

Examples:

SUNWAY TG 610 1000V TE – 380 STD Max 1000 Vdc, 380 V_{AC} nominal voltage, indoor

SUNWAY TG 1500 1500V TE – 600 OD Max 1500 Vdc, 600 V_{ac} nominal voltage, outdoor

3.3. Product revision index

The product revision index is indicated on the nameplate. Please refer to section 12.1.

3.4. Serial Number

The inverter's serial number is indicated on the nameplate. Please refer to section 12.1.

4. PRODUCT CONFIGURATION

The SUNWAY TG TE models mentioned in section 1.1 may be made up of conversion modules functionally independent of each other and able to operate in parallel with one or more units. Each product configuration is typically composed of an AC module and a variable number of DC modules. The AC module is the point of interconnection between the inverter and the grid and contains the output AC circuit breaker. The DC modules perform DC/AC power conversion. They may operate either independently of each other by implementing individual MPPTs, or in master-slave mode, by implementing a single MPPT.

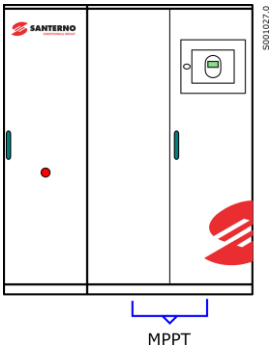
The great number of combinations of the AC and DC modules and their operating modes results in a product range with output power ratings from 600 kVA to 3200 kVA installed, applicable to multiple PV field configurations, including the earthed field configurations.

The possible configurations are given in the section below. Please refer to section **Error! Reference source not found.** for the technical specifications of each configuration.

4.1. Inverter configuration

Single Converter

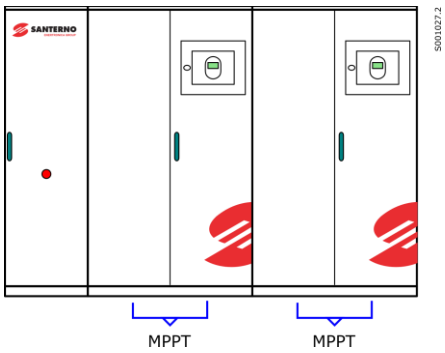
Configuration featuring **one single converter**



AC Modules	DC Modules	MPPTs
1	1	1

Minimum configuration, with only one converter and single MPPT. No coordination is required.

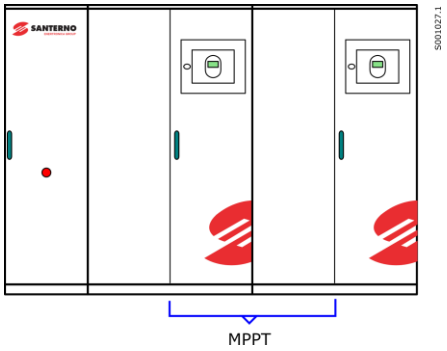
Configuration featuring **dual converter, multi-master**



AC Modules	DC Modules	MPPTs
1	2	2

Each DC module is connected to its own independent field. Each conversion module operates independently of each other and performs the MPPT function. The PV arrays may have different features and installation requirements.

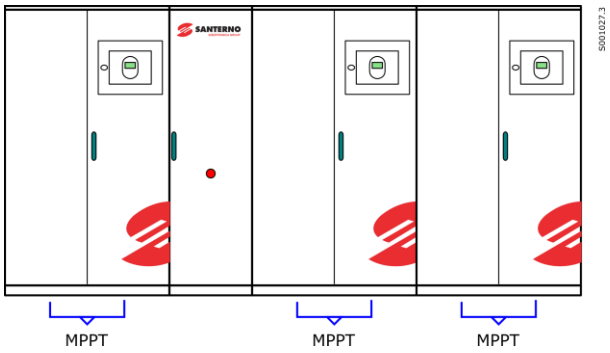
Configuration featuring **dual converter, single master**



AC Modules	DC Modules	MPPTs
1	2	1

The DC modules are connected to each other on DC side. In this mode, only one module (Master) performs MPPT function, while the other modules operate on the setpoint set by the master module.

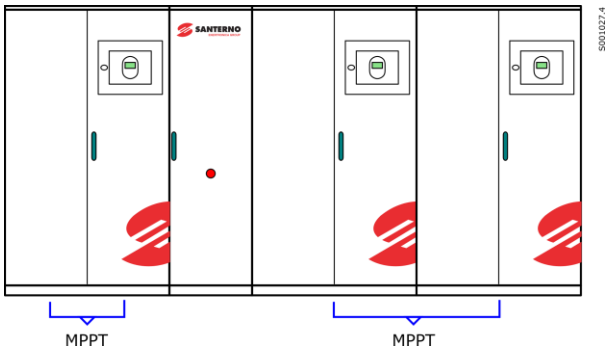
Configuration featuring **triple converter, multi-master**



AC Modules	DC Modules	MPPTs
1	3	3

Each DC section is connected to its own independent array. Each conversion module operates independently and performs the MPPT function. The PV arrays may have different features and installation requirements.

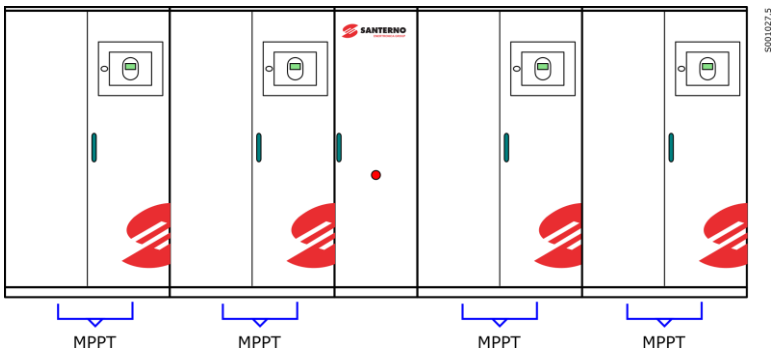
Configuration featuring **triple converter, hybrid configuration**



AC Modules	DC Modules	MPPTs
1	3	2

Two DC sections are connected in Master/Slave mode, whilst the third section operates in Master mode, independently of the other two sections.

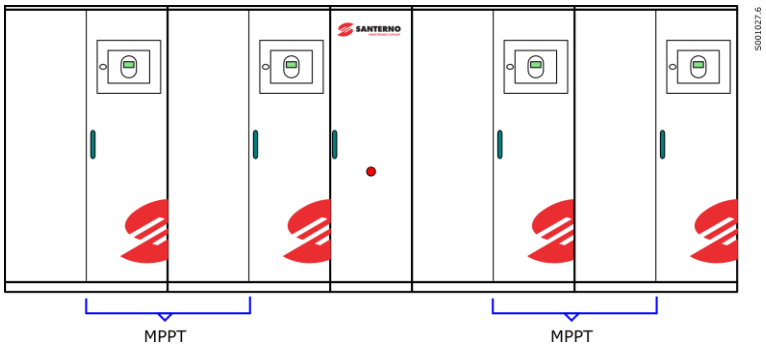
Configuration featuring **quadruple converter, multi-master**



AC Modules	DC Modules	MPPTs
1	4	4

Each DC section is connected to its own independent array. Each conversion module operates independently of each other and performs the MPPT function. Arrays may have different features and installation requirements.

Configuration featuring **quadruple converter, hybrid configuration**



AC Modules	DC Modules	MPPTs
1	4	2

The two DC sections are connected 2-by-2 in Master/Slave, mode; each pair operates independently of each other.

4.1.1. Earth bonding of the PV field

Input from the PV field may support floating fields or positive/negative earthed fields. Please refer to section 4.18.1.
All configurations described in the section above are applicable to earthed fields provided that a winding of the elevator transformer separate for each MPPT in the output transformer is available.

4.2. Cabinet front controls

Figure 6: Controls on the front of the SUNWAY TG TE

The following controls and devices are located on the front door of the inverter cabinet (the relative ID codes used in the Electrical and Mechanical Diagram are provided in the brackets):

4.2.1. AC section

Key-operated selector switch: door switch Enabling/Disabling (41SA1)
This key-operated selector switch enables/disables the door closure safety microswitches. If the safety microswitches are activated, door opening will open the switches on the PV field side and grid side.

Electric grid AC switch control lever (30QM1, 30QM2)
The control lever for the grid side switch, located inside the cabinet, makes it possible to connect the SUNWAY TG TE to the grid. One or multiple switches are present based on the presence of one or multiple DC sections.

Emergency Stop Button (41SB1)
The emergency stop button opens the switches on the PV field side and the grid side immediately, thus inhibiting operation of the SUNWAY TG TE in parallel with the grid.

4.2.2. DC section(s)

Key-operated selector switch: Enable/Disable Inverter (22SA1)
This key-operated selector switch enables/disables operation of the SUNWAY TG TE.

Display/keypad (22A1)
Using the display/keypad, the operator can:

- Send the inverter START, STOP and alarm RESET commands (start, stop, reset of the alarms tripped).
- Set machine parameters (please refer to the Programming Guide).
- See measurements and any indications concerning the operating status of the inverter (please refer to the Programming Guide).

PV field DC switch control lever (11QM1)
The lever of the PV field DC switch, located inside the cabinet, allows connecting the DC section of the SUNWAY TG TE to the PV field.

The safety circuits and the release coils function at 24 V. The SUNWAY TG TE inverters are equipped with two 24 V power supply units which operate in parallel. The first power supply unit is connected to the PV power supply source while the other is connected to the grid. In this way the inverter safety circuits are always powered by one inverter power source or the other.

The emergency function can have a remote operation facility by means of a contact available on the inverter. Please refer to section 6.5.2.

4.3. Control devices

The following control devices are located inside the inverter (the relevant ID codes used in the Electrical and Mechanical Diagram are provided in brackets):

PV Generator DC Switch (11QM1)
The DC switch (PV field side), located inside the cabinet, makes it possible to connect the inverter to the PV field.

Grid AC Circuit Breaker (30QM1, 30QM2)
The AC circuit breaker located inside the cabinet, makes it possible to connect the SUNWAY TG TE to the grid. An AC switch is present for each DC section in the cabinet.

Grid Connection Contactor (41KM1)
The grid connection contactor is closed and/or opened by the control board and is normally interlocked with the Interface Protection (DI). Please refer to sections 4.3.1 and 4.3.2.

WARNING

Before performing any operation inside the cabinet, follow the instructions given in section 2.7.

4.3.1. Interface Protection IP

The Interface Protection (IP) relay is a component which performs the function of grid supervisor.

The grid interface represents one of the inverter's main safety functions.

All the electric grid values are measured and compared with an acceptance template. If the measured values exceed the set thresholds, the inverter stops by opening the parallel contact.

The basic safety functions of the grid interface include the over/under frequency and the under/over voltage thresholds.

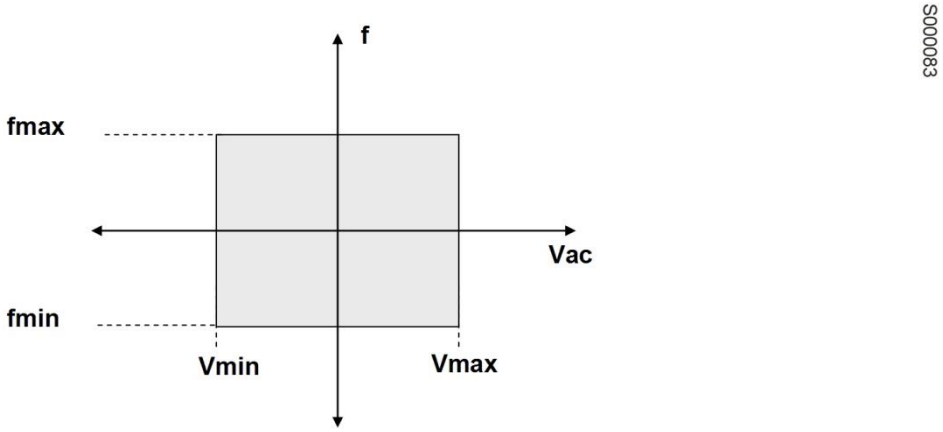


Figure 7: Interface Protection diagram

The tripping values and times depend on the connection regulations in force in different countries. Other measurements, both direct and derivative, may be considered for Interface Protection, depending on the connection regulations in force in the country of installation.

The Interface Protection function may be performed by an external device or via the control software. The two functions may also coexist and operate in parallel.

For all SUNWAY TG TE inverters, an Interface Protection function is incorporated in the control software which acts on the Grid Connection Contactor. All the parameters relative to the tripping thresholds and times are set in the factory depending on the designated geographical location of installation.

It is also possible to connect an external Interface Protection to SUNWAY TG TE inverters whenever this is prescribed by the regulations in force (e.g. CEI 0-16 for Italy). See the X6 terminal board in the AC section, contacts 17 and 18 in the Electrical and Mechanical Diagram.

For connection of an external Interface Protection, the protection acts with redundancy on inverter control:

- The control software acquires the status of external Interface Protection in real time. In the event of tripping the inverter stops and the Grid Connection Contactor is opened.
- The external Interface Protection contacts are wired in such a way as to open the Grid Connection Contactor.

The sudden tripping of the Interface Device may cause transients on the AC output line. This phenomenon may occur to a higher or lesser degree depending on the characteristics of the system and the connected loads. The wiring of the Interface Protection feedback signal contact minimizes these transients. Hence it is advisable to ensure such wiring is made in all systems.

Operation of the SUNWAY TG TE inverters is in any case guaranteed regardless of the wiring of the Interface Protection feedback signal contact.

The SUNWAY TG TE inverters are configured in the factory with an external Interface Protection input enabled and a jumper on the AC.X8 terminal board (contacts 17 and 18). To acquire the status of the grid from an external Interface Protection, remove the jumper and wire a normally excited NO contact on the AC.X8 terminal board (contacts 17 and 18).

Please refer to section 6.4.4.

4.3.2. Grid connection contactor

The AC Grid Connection Contactor, located inside the cabinet, makes it possible to connect the MODULAR SUNWAY TG TE OD to the grid.

Should the Interface Protection trip, or in the event of an alarm, the Grid Connection Contactor is opened disconnecting the inverter from the grid and stopping it. The Grid Connection Contactor is the component which can perform opening under load, sized for the maximum inverter output current. It is referred to in the Electrical and Mechanical Diagram as 41KM1.

The Connection Contactor may also act as an Interface Protection device (IP), depending on the type of system, the connection prescriptions and relative regulations in force.

The status of the AC Grid Connection Contactor is indicated by the RUN LED on the display/keypad.

Status of the RUN LED	Description
LED ON	Contactor closed, the inverter is connected to the grid.
LED OFF	Contactor open, the inverter is NOT connected to the grid.

Figure 8: RUN LED on the display/keypad

WARNING

The emergency stop button disables operation of the SUNWAY TG TE in parallel with the grid.

The contactor is equipped with a feedback signal contact, connected to the digital input MD15 (please refer to the Programming Guide).

4.3.3. DC input switch

The PV field DC disconnect switch (10QM1), located inside the cabinet, makes it possible to connect the MODULAR SUNWAY TG TE OD to the PV generator.

The disconnect switch is equipped with a return contact, connected to the digital input MD14 (please refer to the Programming Guide).

A DC disconnect switch is provided for each DC section. Please refer to the Electrical and Mechanical Diagram for more details.

4.3.4. AC output circuit breaker

The AC circuit breaker located inside the cabinet, makes it possible to connect the MODULAR SUNWAY TG TE OD to the grid.

The circuit breaker is equipped with a return contact, connected to the digital input MD13 (please refer to the Programming Guide).

An AC circuit breaker is provided for each DC module.

The control lever is located on the cabinet front side. For maximum safety this lever can be activated without having to open the doors. The lever also stops the doors from being opened unless it is in the OFF position.

4.4. Display/keypad

The display/keypad module represents the inverter's HMI interface.

It includes seven LEDs, an LCD display with four 16-character lines of text, a buzzer and nine function keys. The display shows parameter values, diagnostic messages and the value of the variables processed by the inverter.

For details concerning the structure of menus, parameter setup, the selection of measurements and the messages shown on the display, please refer to the Programming Guide.

S000010

Figure 9: Display/keypad

Key	Function
ESC	BROWSING – Used for quitting menus and submenus (the display moves up a menu level).
	PROGRAMMING – In programming mode (flashing cursor) it ends parameter modification and allows the user to select the next set of parameters (the switch from programming mode to display mode is indicated by the cursor which stops flashing). The value of the modified parameter is NOT saved on the non-volatile memory, consequently it will be lost when the equipment is turned off.
	BROWSING – Scrolls through the menus and submenus, the pages in the submenus or parameters in descending order.

	PROGRAMMING – Down arrow; decreases the value of the parameter.
^	BROWSING – Scrolls through the menus and submenus, the pages in the submenus or parameters in ascending order.
	PROGRAMMING – Up arrow; increases the value of the parameter.
SAVE/ENTER	BROWSING – For entering menus and submenus and selecting parameters for modification (the switch from display mode to programming mode is indicated by the cursor which starts flashing).
	PROGRAMMING – Saves the value of the modified parameter on the non-volatile memory to prevent the modifications from being lost when the equipment is turned off.
MENU	BROWSING - Each time this key is pressed it moves to the next status page.
TX | RX	Not used for this application.
RESET	Resets an alarm once the condition which caused it has been rectified.
START	Starts the device. The START command is stored in the memory. If the inverter switches itself off without having received the STOP command, when it comes back on, the run status will still be active and as soon as the solar radiation conditions are adequate, the inverter will connect to the grid in parallel and supply power.
STOP	Stops the device. The STOP command is stored in the memory. If the inverter switches itself off, the STOP command will still be active when it is next turned on and the operator must press the START key to start the inverter.

LED	Function
RUN	● Inverter in STOP or STAND-BY Grid Connection Contactor open
	● Inverter running Grid Connection Contactor closed
MPPT ON	● MPPT disabled
	● MPPT enabled
ALARM	● Inverter OK
	● Inverter in ALARM status
PV OK	● PV field voltage too low or too high
	● PV field voltage OK
GRID OK	● Incorrect grid parameters ***NOTE: This LED remains OFF at night and when the PV field is not correctly connected.***
	● Grid parameters OK

Table 2: Function of the display/keypad LEDs

4.4.1. Adjustment of contrast only

Press the SAVE key for more than 5 seconds; ***TUNING*** appears on the display and the LEDs above the display come on and act as a 5-stage bar whose length is proportional to the level of contrast set. Press the ⩔ and ⩓ keys to adjust the contrast. Press the SAVE key again for at least 2 seconds to return to normal operating conditions with the new contrast setting active.

4.4.2. Adjusting the contrast, backlight and buzzer

Press the TX|RX + SAVE keys for more than 5 seconds to enter full setup mode. Use the ⩔ and ⩓ keys to scroll through the seven display/keypad parameters. Once the parameter you wish to modify is displayed, select by pressing the PROG key to enter setup mode and then use the ⩔ and ⩓ keys to alter the parameter accordingly. Press SAVE to save the new value in the display/keypad unit's non-volatile memory.

The table below provides a summary of the values which can be set for the various parameters and their meanings.

Parameter	Possible values	Meaning
SW ver.	-	Indicates the version of the software installed in the display/keypad unit (cannot be modified).
Language	Not used for this application	
Contrast	**LOC**	Contrast is set locally on the display
	REM	Contrast is set by the inverter which forces the display setting
Contrast val.	**nnn**	Numerical value of contrast adjustment from 0 (low) to 255 (high)
Buzzer	**KEY**	The buzzer sounds when the keys are pressed
	REM	The buzzer is controlled by the inverter
	OFF	The buzzer is disabled
Backlight	**ON**	LCD backlighting is permanently ON
	REM	LCD backlighting is controlled by the inverter
	OFF	LCD backlighting is permanently OFF
Address	Not used for this application	

Table 3: Display/keypad parameter setup

Once all parameter values have been set, press the SAVE key for more than 2 seconds to return to normal operation.

4.5. Converter module

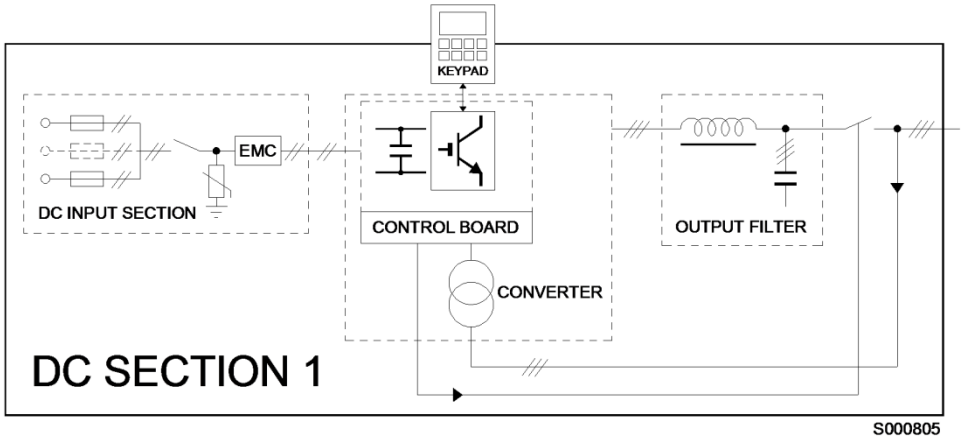


Figure 10: Single-line diagram - dotted line highlighting the converter module

The SUNWAY TG TE inverters are designed using a modular approach in order to maintain high standards in quality and guarantee maximum performance.

The conversion unit is the module with component ID code 22U1 in the Electrical and Mechanical Diagram. It houses the DSP control board and the IGBT power switching devices using avant-garde conversion technology which guarantees excellent reliability over time, even in the most demanding conditions.

Should any faults arise involving the conversion unit, the inverter has been specially designed to make repair and replacement operations quick and easy, thus limiting machine downtimes.

For further details and the list showing correspondence between the inverter and converter installed, please refer to section 12.5.

4.6. Isolation control device

4.6.1. PV field not earthed

The inverter continually checks isolation resistance between the power supply and the earth, indicating any isolation loss.

The method of intervention and signalling if isolation loss is detected can be programmed as follows:

- Isolation loss generates a WARNING signal but does not stop the inverter.
- Isolation loss generates an ALARM and stops the inverter.
- Isolation loss is disabled.

Please refer to the Programming Guide in the Alarm Auto-reset menu.

If the PV field Earthed option is installed, isolation loss is not checked. However, the inverter does indicate that earth connection fuses have blown (please refer to section 8.1).

WARNING

If multi-MPPT SUNWAY TG TE inverters are connected to a single winding in the LV/MV transformer, it is advisable to program the inverter so that isolation leakage trips an emergency alarm which stops the inverter.

It is possible to select the alarm threshold by means of the Rotary Switch CE1 located on the control board. See Figure 11.

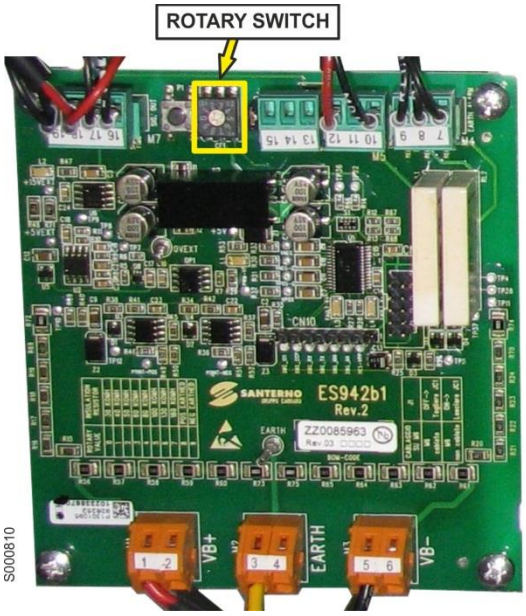


Figure 11: Isolation Control Board ES942

Table 4 indicates the relationship between the position of the Rotary Switch CE1 located on the board and the relative isolation resistance threshold values below which an alarm is generated.

The ES942 board is located inside the converter; remove the cover of the drawer housing the control board to access the board itself.

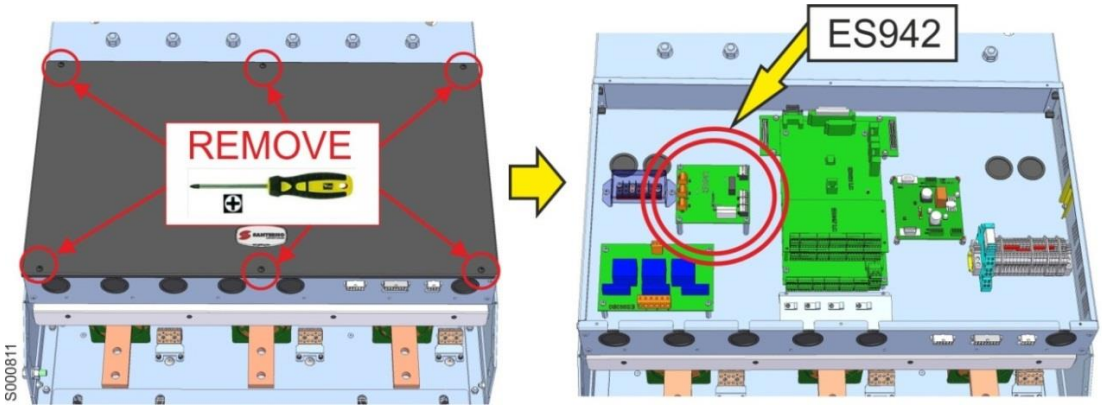


Figure 12: Accessing the ES942 board

Rotary value	Isolation resistance value
0	30 KΩ
1	40 KΩ
2	50 KΩ
3	60 KΩ
4	80 KΩ
5	100 KΩ

6	130 KΩ
7	160 KΩ
8	POS EARTHED
9	NEG EARTHED

Table 4: Rotary switch position

The board is fitted with an AUTO-TEST button. When button "P1" is kept pressed for 10 seconds, an isolation leakage alarm is simulated for 30 seconds. During the test the board's self-diagnostics LEDs (L3, L4) flash slowly.

NOTE

The PV field voltage must be greater than the minimum MPPT voltage when executing the autotest.

The factory setting envisages an isolation resistance of 100 kΩ(±10%) for PV fields that are not earthed.

Settings 8 and 9 are to be used when the PV field is positive or negative earthed and the EGFD option is not present (see section 8.3); in that case, the rotary switch is set to 30kOhm.

WARNING

Before performing any operation inside the cabinet, follow the instructions given in section 2.7.

4.6.2. Earthed PV field

If the Earth Option is installed, the dedicated option for the PV field insulation detection is required (see section 8.1).

The fuse blown signal is available when the Earthed PV field option is installed.

Fuse blowing may be programmed as follows:

- When the fuse blows, a WARNING fires, that does not stop the inverter; the inverter may start or may be kept running (default setting).
- When the fuse blows, that triggers an alarm locking the inverter (default setting).
- The fuse blown is ignored (default setting for the configuration without the *Earthed Option*).

See the Programming Guide, Alarm Autoreset menu.

4.7. Surge protection

4.7.1. DC-side protection

The SUNWAY TG TE inverters are protected from power surges on the PV field input by appropriate Class II SPDs (Surge Protective Devices), suitable for protecting the equipment from indirect discharges.

The "Y" configuration has been adopted which is perfectly compatible with Earthed or floating PV field plants (please refer to section 8.1).

The SPDs are referred to in the Electrical and Mechanical Diagram using the component ID codes 11AP1 and are located in each DC section.

Each SPD is protected by an integrated MCCB (Moulded Case Circuit Breaker) against any overload of the component.

The MCCB signalling mode may be programmed as follows:

- The MCCB trips and a WARNING fires, that does not stop the inverter; the inverter may start or may be kept running (default setting);
- The MCCB trips and an ALARM trips, that stops the inverter.

The DC-side SPD status signal is shared with the AC-side SPDs (optional).

The configuration adopted by Elettronica Santerno has proved to be very reliable and effective in the field. However, the PV plant designer may include further protective devices both in inverter input and output in addition to the ones already installed. Please refer to section 0.

4.7.2. AC-side protection

The SPDs in AC-side output section are available as an option (see section 8.9).

4.8. RS-485 connectivity

When the *String Monitoring* option is implemented, a serial port is available for each independent MPPT for the connection to the Smart String Box, X11 terminal board in the DC section, terminals 1, 2, 3, 4.

The main features of the serial ports are listed below:

- Optically isolated ports
- RS-485 Bus with standard MODBUS/RTU protocol
- Auto-diagnostics of the bus electrical levels

For further information on remote control, serial ports and the Ethernet port, please refer to section **Error! R eference source not found.**.

4.9. Ethernet connectivity

An Ethernet port is available on each DC section for the connection of external master devices. The Ethernet port is integrated into the ES851 data logger board.
The following status data are made available to the master devices via Modbus TCP protocol:

- Status of each DC section.
- Status of the String Boxes (combiner boxes), where the *String Monitoring* option is implemented.
- Status of the wattmeter, where the *Wattmeter Measuring the Output Power Option* is implemented.

4.10. Environmental measures

The SUNWAY TG TE inverters have N.2 inputs for environmental measures for each Dc section,via the environmental sensors expansion and field I/Os board. Each input may be configured as 0-10 V f.s., 0-20 mA f.s., 0-100 mV f.s., temperature acquisition with two-wire PT100.

The standard factory settings of the 2 environmental inputs are indicated in the table below:

Measure	Sensor type	Factory setting	Measure
Environmental measure 1	Solar radiation sensor	0-20 mA	Module surface radiation
Environmental measure 2	Thermocouple	PT100	Environmental temperature

Table 5: Standard factory settings of environmental inputs

The environmental sensor inputs are available on the X10 terminal board (please refer to the Electrical and Mechanical Diagram).

For the connection of the sensors, please refer to section 12.12.

For the technical specifications, please refer to section 12.12.

4.11. Programmable digital outputs

Two programmable digital outputs are available on each DC section in the SUNWAY TG TE inverters (PDO1 and PDO2) on the terminal boards (X6 and X6B). Please refer to the Electrical and Mechanical Diagram.

Programmable output	Type of output	Default setting
PDO1	Relay contact	DC insulation loss signal
PDO2	Relay contact	Inverter running signal

Table 6: Factory settings of the programmable digital outputs

For further details on how to program the digital output, please refer to the Programming Guide.

4.12. Ventilation system

The SUNWAY TG TE inverters feature a modular ventilation system, made up of the following elements:

- A fan set installed on the converter.
- A fan set in the cabinet.

The fans are controlled directly by the control board. A thermostat is connected to the cabinet fans by way of a redundant connection.

The inverter features a diagnostic function for the fan status, one function for each fan set. Malfunctioning, if any, is signalled by a dedicated warning, displayed on the keypad and available as a parameter for the acquisition from external masters. For more details, please refer to the Programming Guide.

For technical data related to absorption and flow rate of the ventilation system, please refer to section 4.12.Auxiliary power supply
The electronic components inside the cabinet, the ventilation system and, if need be, the combiner boxes are power supplied by a power supply source called auxiliary power supply (external power supply source). This allows not to affect the energy produced and computed for the feed-in tariffs, as the aux power supply is generated upstream from the plant power meter. The auxiliary power supply is to be connected to terminals 3-4 in X10.

If an external power supply source is not available, power supply can be obtained internally to the cabinet by way of the *Self-power supply* option.

Please refer to section **Error! Reference source not found.**.

4.13. Power supply from UPS

The internal electronic components, the ventilation system and the combiner boxes that have been excluded may be supplied by an external UPS. In that way, the inverter is detected by the remote monitoring system also when power is down, within the endurance range of the UPS connected to the inverter. Power supply via UPS is required for the inverters featuring PV field voltage up to 1500V.

See section 6.

Please refer to the Electrical and Mechanical Diagram.

4.14. DC input fuses

NOTE

Fuses are to be ordered separately from the inverter, based on the target application.

The chosen fuses must be defined in the order confirmation.

The DC inputs in the Sunway TG TE are fuse-protected both on the positive pole and on the negative pole. Fuses are to be properly dimensioned based on the configuration of the PV field.
The DC modules may house fuse-holders NH1 XL, NH2 and NH3 L. The chosen fuse-holders must be defined in the order confirmation.

5. HANDLING AND ASSEMBLY

5.1. Packaging

Different packaging modes are available depending on the transport mode. When shipped in a shipping container, the product is contained within two wooden crates, one containing the inverter, one containing the rooftop. The inverter packaging may be lighter for shorter transport lengths.

Figure 13: Wooden crate for inverter shipment

Figure 14: Wooden crate for inverter rooftop shipment

WARNING

For safety reasons and to ensure correct operation, it is strictly PROHIBITED to tilt the SUNWAY TG TE inverters forward or backwards.

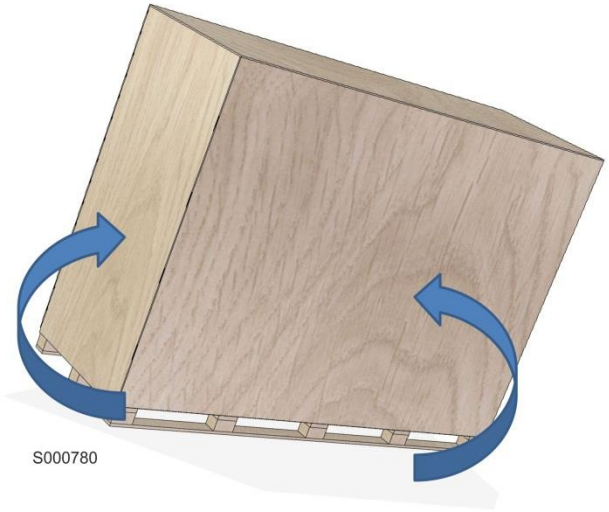


Figure 15: Inverter tilting

WARNING

Handling and transport must meet the requirements given in Table 11.

5.2. Handling the packaged inverter

Being as the inverter package is on a pallet, the only handling method allowed is using a fork lift truck or a different means of transportation provided with forks.

Features	SUNWAY TG610 1000 TE SUNWAY TG 900 1500 TE	SUNWAY TG1200 1000 TE SUNWAY TG 1800 1500 TE
Dimensions [L x W x H] [cm] Packaged inverter	200x111x235	320x111x235
Weight of packaged inverter [kg]	**2000**	**3000**
Dimensions [L x W x H] [cm] Packaged rooftop	213x111x49.5	333x111x49.5
Weight of packaged rooftop [kg]		

Table 7: Dimensions of the inverter complete with crate and pallet

WARNING

Do not handle the inverter by hoisting it with belts or similar tools as they can affect integrity of the wooden crate and the product.

5.3. Handling the unpackaged inverter on the installation place

Once the crate and the overseas bag have been removed, the cabinet is as shown in Figure 16.

Figure 16: The inverter unpacked

5.3.1. Hoisting the equipment

In order to put the inverter in the installation place, it has to be hoisted as follows:

- Use the eyebolt and the lifting brackets mounted on the inverter hardware.
- Make sure that the length of the hoisting ropes is such to form an angle between the ropes and the cabinet exceeding 60°.

The following figures show the correct way of hoisting inverters.

Figure 17: Hoisting the inverter (TG1200 1000V TE, TG1800 1500V TE)

WARNING

Make sure that the load is evenly distributed among the eyebolts.

Figure 18: Hoisting a 3-door inverter

5.3.2. Settling the equipment on its final location

The Modular SUNWAY TG TE inverters are designed for outdoor installation. Clearance must be respected around the installed inverter.

Please refer to section **Error! Reference source not found.**.

NOTE

Always leave enough room in front of the inverter to be able to fully open the cabinet doors. For more details please refer to section 12.2.

In order to prevent problems in door closure and/or incorrect operation of the door microswitches, the cabinet must be perfectly level even using shims if necessary.

5.3.3. Assembling the rooftop

Once the external wood crate has been removed, the inverter is as in Figure 19.

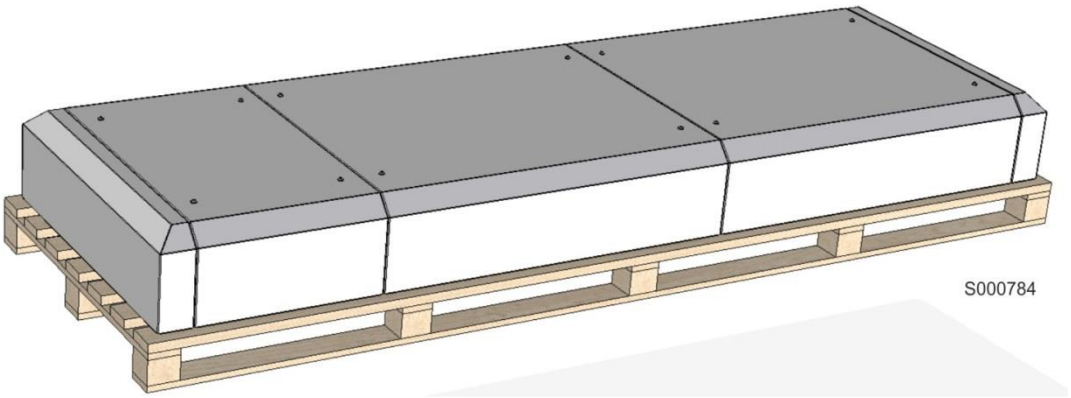


Figure 19: Rooftop removed from the crate

Some M8 eyebolts are supplied, that must replace other screws located on top of the rooftop so that it can be lifted from the pallet and placed onto the cabinet.
Hoisting must be similar to the hoisting procedure shown for the inverter cabinet.
Afterwards, restore the initial conditions by reassembling the special screws complete with their seals.

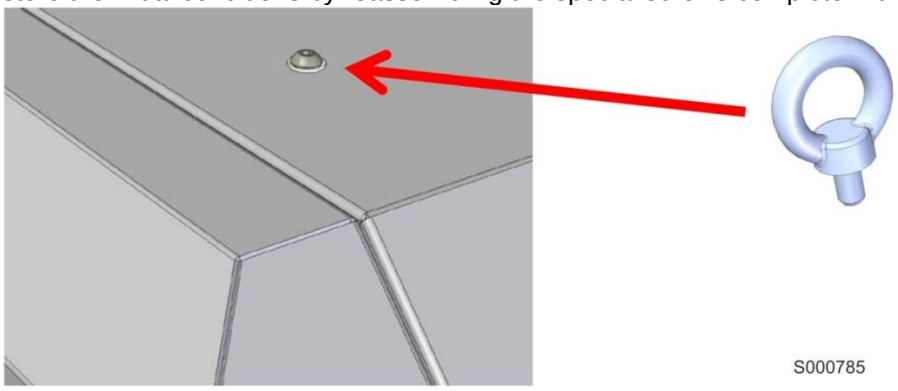


Figure 20: Mounting the eyebolts to hoist the inverter rooftop

Once the cabinet has been placed in its final location, remove the eyebolts and lifting brackets from the cabinet top.

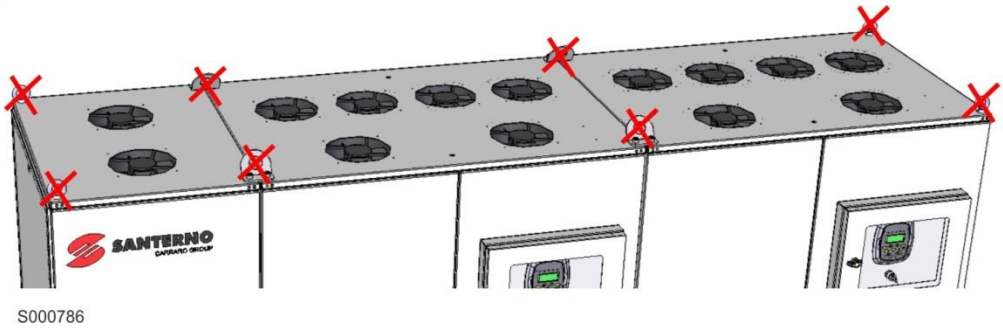


Figure 21: Removing the eyebolts and lifting brackets from the rooftop

In their place, insert the threaded pins supplied (see Figure 22).

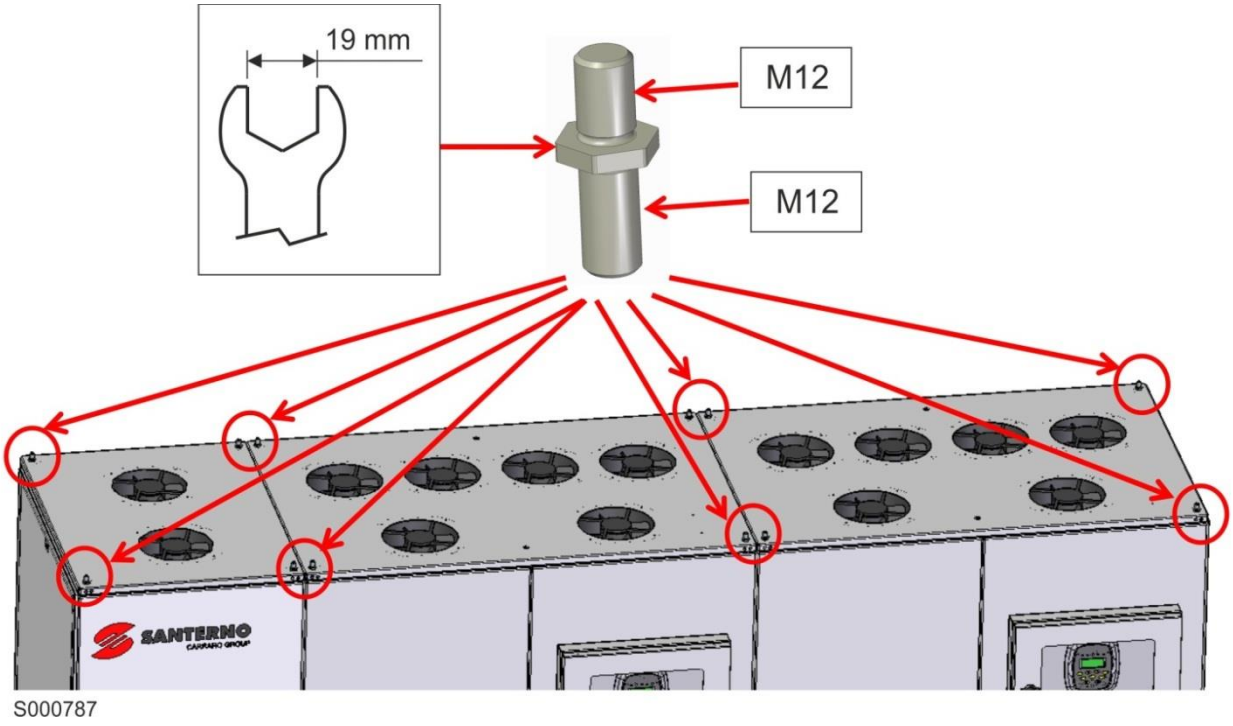


Figure 22: Mounting the fixing elements on the rooftop

Lift the cooling rooftop (see Figure 23) by using the eyebolts previously mounted. Place the rooftop on the inverter, making sure that the holes match, then insert M10 pins on the cabinet.

Figure 23: Placing the rooftop on the inverter

Once the ventilation rooftop is in place, fasten it with the M10 nuts and washers supplied (see Figure 25).

Figure 24: Fastening the rooftop to the inverter

Once the mounting procedure is completed, replace the eyebolts with the screws removed prior to fasten the rooftop to the cabinet.

5.4. Environmental requirements for storage and transport

Required conditions	
Ambient temperature for storage and transport	-25 °C ÷ +60 °C
Ambient humidity for storage	From 5% – 95%, from 1 g/m^3 – 25 g/m^3, with no condensation or ice formation (category 3K3 in compliance with EN 50178).
Ambient humidity during transport	Maximum 95% up to 60 g/m^3. Slight condensation may occur when the equipment is not running (category 2k3 in compliance with EN 50178).
Atmospheric pressure for storage	86 – 106 kPa (categories 3k3 and 1k4 in compliance with EN 50178).

Atmospheric pressure during transport	70 – 106 kPa (category 2k3 in compliance with EN 50178).

Table 8: Environmental requirements for storage and transport

WARNING

Environmental conditions significantly affect the life-expectancy of inverters, consequently DO NOT install the inverter in a location which does not meet the required specifications.

6. INSTALLATION AND COMMISSIONING

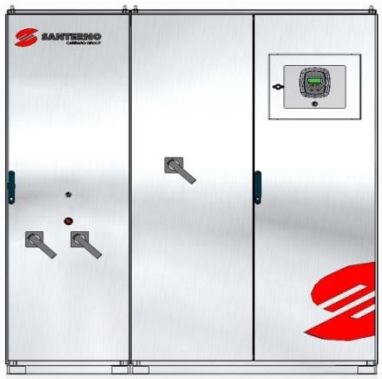
The following paragraphs provide information on power and signal cable connection, on how to connect multiple inverters in parallel and on commissioning.

Figure 25: Internal view of the SUNWAY TG TE inverter cabinet

Cable entry is at the bottom of the cabinet. Please refer to the Electrical and Mechanical Diagram.

The inverter may have different configurations:

Configuration featuring **single converter (TG610 1000V and TG750 1500V)**



AC Section	DC Section	MPPT
1	1	1

Minimum configuration, only one converter and one MPPT. No coordination required.

Configuration featuring **dual converter, multi-master (TG1200 1000V and TG1400 1500V)**

AC Section	DC Section	MPPT
1	2	2

Each DC column is connected to its own independent PV field. Each conversion module operates independently of each other and performs the MPPT function. The PV arrays may have different features and installation requirements. The transformer may be single secondary or double secondary.

6.1. Wire connection terminal board

The terminal boards and input/output wire connection terminals are given in the table below. Throughout this document, the DC and AC suffixes will be used when referring to terminal boards and wire terminals for the terminals related to the DC and AC section respectively, followed by their ID number. For example, terminal board “X2” in the AC section will be referred to as AC.X2.

Location	Identifier	Type	Function
AC Module	**X2**	Power terminal board	AC Three-phase grid
AC Module	**X6**	Signal terminal board	I/O Terminal board
AC Module	**X10**	Auxiliary power supply terminal board	230 V_{AC} Auxiliary terminal board
AC Module	**38A1**	Ethernet Switch (*)	Data connection (remote monitoring)
DC Module	**10 F1 … F36**	DC fuses	PV field
DC Module	**X10**	Signal terminal board	Environmental sensors
DC Module	**X11**	Signal terminal board	RS-485 COM1 serial link (optional)

Table 9: Wire Connection Terminal Board

6.2. General prescriptions on connections

WARNING

No cable glands to be left open. Either route a cable through or fit a compatible sealing insert into every each cable gland to preserve the IP54 ingress protection degree. Cable glands left open let water, dust and insects in, thus voiding the product warranty.

WARNING

All cable glands must be accurately tightened to preserve the IP54 ingress protection degree. Cable glands loosely tightened let water, dust and insects in, thus voiding the product warranty.

6.3. DC modules power connections

6.3.1. Removing the grilles

The protective grilles ensure IP20 degree of protection in respect to the live components. Remove the protective grilles to gain access to the power terminals.

DANGER

Before removing the grilles and connecting the inverter to the grid, make sure that no voltage is present in all power supply sources, such as PV field, grid and auxiliary power supply source. This prevents voltage from being applied to the inverter terminals when installing the equipment.

DANGER

After turning off the inverter, wait at least 10 minutes before carrying out any connection modifications, in order to give the DC-link capacitors time to discharge.

6.3.2. DC cable connection

Each DC module is provided with N.8 inputs that are fuse-protected. The cables coming from the PV field, typically the string boxes (combiner boxes), are to be connected directly to the fuse-holder terminals. For the technical data concerning the number of cables to be connected, the maximum allowable cross-section and cable lug type, please refer to section 12.7.2.

Cable entry is at the bottom of the DC section (Figure 26). Do the following:

1. Insert the cable into the cable gland
2. Strip the cable.
3. Crimp the lug.
4. Clean the contact surface with a clean cloth and ethanol-based cleanser.
5. Do not touch the contact surface once cleaned.
6. Use the nut and bolt supplied to fasten the lug by applying the required torque.

Do the same for all the cables to be connected. Plug the unused cable lugs.

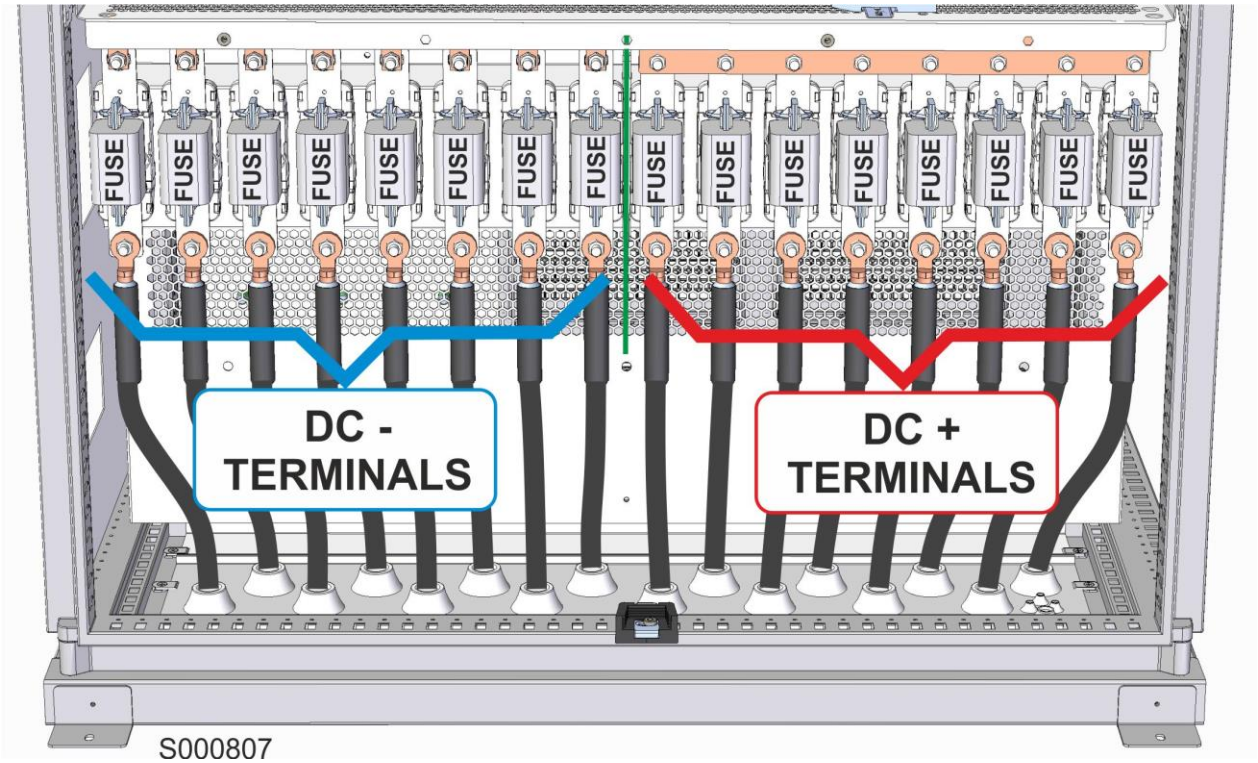


Figure 26: DC power cable inlet

DANGER

Make sure that the equipment is isolated before connecting the DC cables.

Isolate all power supply sources connected to the DC cables prior to carrying out any operation.

Check if DC cables are properly connected by doing the following:

1. Remove the protective fuses.
2. Apply voltage to the DC inputs by closing the disconnector switches in the string boxes (combiner boxes).
3. Check polarity in all the connected subfields.
4. Isolate the DC power supply sources again by opening the string boxes (combiner boxes) disconnect switches.
5. Check if DC power supply sources are properly isolated.
6. Insert the fuses.

6.4. AC modules power connections

6.4.1. Removing the grilles

The protective grilles ensure IP20 degree of protection in respect to the live components. Remove the protective grilles to gain access to the power terminals.

DANGER

Before removing the grilles and connecting the inverter to the grid, make sure that no voltage is present in all power supply sources, such as PV field, grid and auxiliary power supply source. This prevents voltage from being applied to the inverter terminals when installing the equipment.

6.4.2. Connecting earth cables

For the technical data concerning the number of cables to be connected, the maximum allowable cross-section and cable lug type, please refer to section 12.7.2.

The AC module is provided with N. 3 inputs dedicated to earthing. The earth cables are to be connected to the earth bar. For technical data related to the type of connectable cable, the maximum allowable cross-section and the type of cable lug, please refer to section 12.8.

Cable entry is at the bottom of the DC section. Do the following:

1. Insert the cable into the cable gland.
2. Strip the cable.
3. Crimp the lug.
4. Clean the contact surface with a clean cloth and ethanol-based cleanser.
5. If oxidized, clean the contact surface with an abrasive tool until metal slightly shines, then remove metal dust with a clean cloth and ethanol-based cleanser.
6. Do not touch the contact surface once cleaned.
7. Use the nut and bolt supplied to fasten the lug by applying the required torque (see section 12.8.3).
8. Tighten the cable lug.

Do the same for all the cables to be connected. Plug the unused cable lugs.

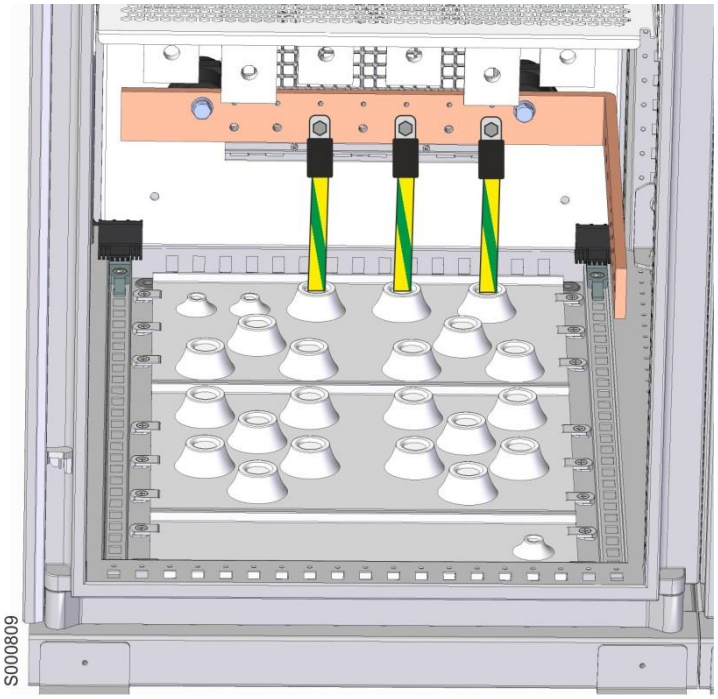


Figure 27: Earth cables inlet

Operation sequence:

- Remove the bottom plate.
- Insert the cable lugs.
- Route cables through the plate holes.
- Re-position and fasten the bottom plate.
- Completion of the cable lug (tighten the internal nut)
- Connect of the ferrules to the DC.X2 terminal board
- Close the unused cable lugs.

6.4.3. AC cables connection

For the technical data related to the connectable cables, their maximum cross-section and the type of cable lug, please refer to 12.8. The AC module may have one or two AC output terminal boards, based on the number of available DC sections (1 or 2). The AC module may be connected to a single- or double-secondary transformer.

Inverter	AC Outputs	X2 Terminal board	X2B Terminal board	Phase Sequence	Transformer Connection
SUNWAY TG 610 1000V TE	1	DC Module converter output	Not present	Irrelevant	Irrelevant
SUNWAY TG 750 1500V TE	1				
SUNWAY TG 1200 1000V TE	2	DC1 Module converter output	Module converter output DC2	Irrelevant	Connect to terminal X2-1 (X2-2, X2-3) the

SUNWAY TG 1500 1500V TE	2				same phase as the transformer phase connected to terminal X2B-1 (X2-2, X2-3) (see Figure 28)

Table 10: AC Module output terminals

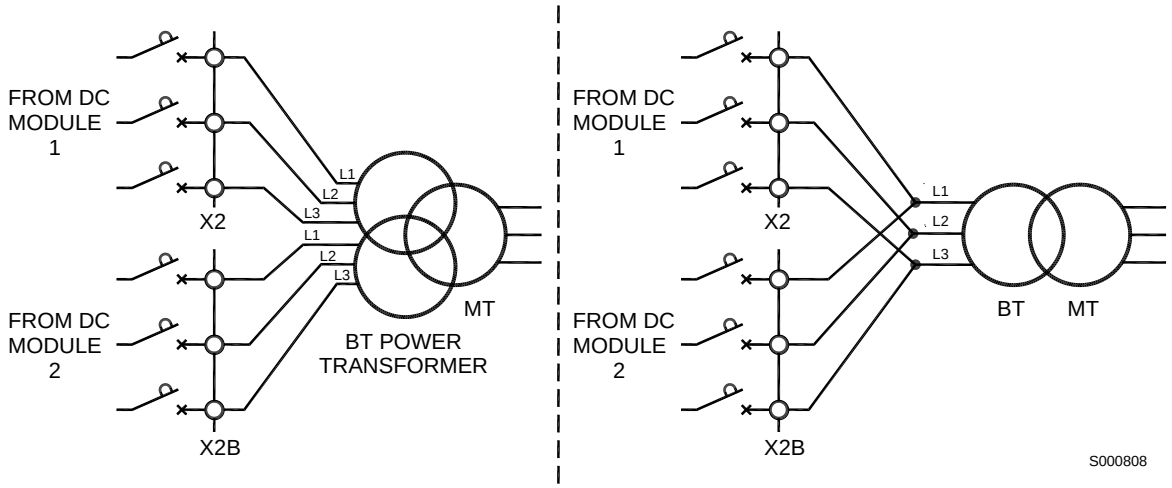


Figure 28: LV/MV Transformer connection

WARNING

The number of terminals in the X2 terminal board varies based on the product configuration. The correct connection of the AC cables based on the LV/MV transformer configuration is essential. A wrong connection of the AC cables may cause the inverter malfunction and damage.

The AC module is provided with N. 3 inputs dedicated to the connection of each grid phase. For technical data concerning the connectable cable, the maximum allowable cable cross-section and the type of cable lug, please refer to section 12.8.

Cable entry is at the bottom of the AC section. Do the following:

1. Insert the cable into the cable lug.
2. Strip the cable.
3. Crimp the ferrule.
4. Clean the contact surface with a clean cloth and ethanol-based cleanser.
5. If oxidized, clean the contact surface with an abrasive tool until metal slightly shines, then remove metal dust with a clean cloth and ethanol-based cleanser.
6. Do not touch the contact surface once cleaned.
7. Use the nut and bolt supplied to fasten the ferrule by applying the required torque (please refer to section 12.8.3).
8. Tighten the cable lug.

Do the same for all the cables to be connected. Plug the unused cable lugs.

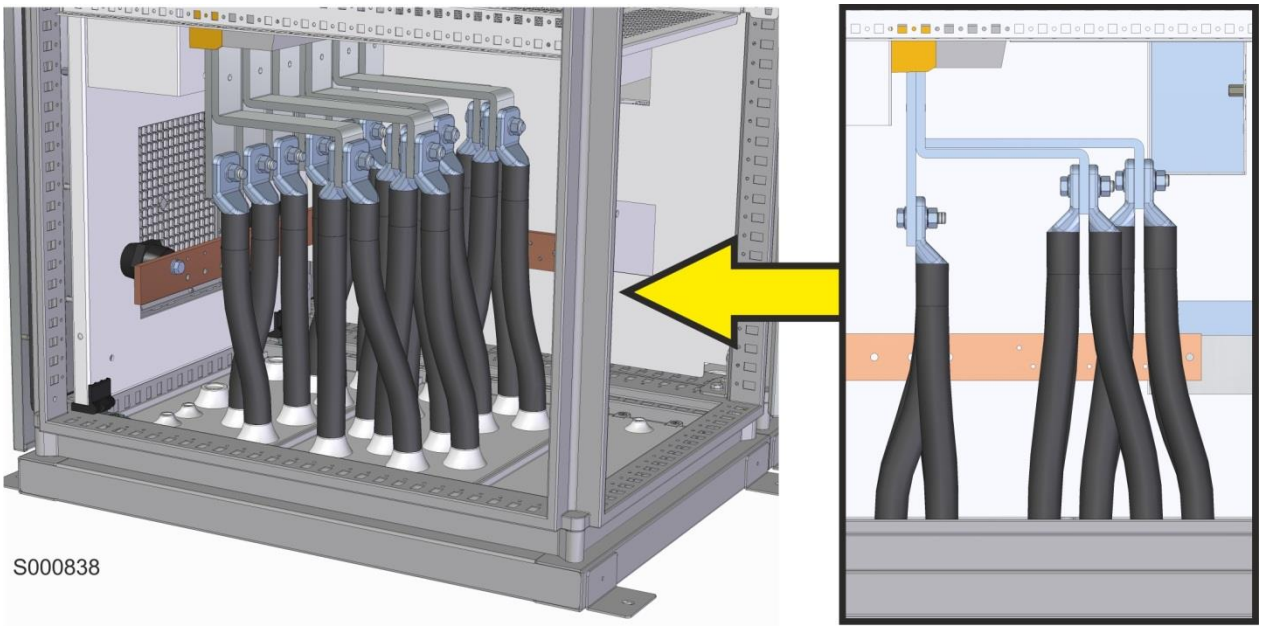


Figure 29: AC cable entry

DANGER

Make sure that voltage is removed before connecting the AC cables.

Isolate all power supply sources before carrying out any operation on the inverter.

NOTE

Observe the following when connecting AC cables:

- *All cables must be the same length*
- *Cables must be grouped by three, one conductor per phase.*

6.4.4. Connection to the external transformer

The following minimum requirements must be met when installing the external transformer.

6.4.4.1. Transformer technical requirements

The transformer shall be designed to meet or exceed the following technical requirements.

Requirement	Unit	Value
Minimum Rated Power	kVA	110% of rated inverter power
Frequency	Hz	50/60 Hz +/- tolerance according to applicable standards
Phases		3
Primary Voltage	kV	As per plant dimensioning, considering the tolerance according to applicable standards

Secondary Voltage	V	Based on inverter AC output voltage
Primary Tapping Voltage Range		(+2) (-2) x 2.5% (Suggested)
Primary/Secondary Connection		Delta/Star
Secondary Neutral Terminal		Not required for inverter operation. It must not be connected to earth.
Primary Testing Voltages: Um/imp	kV	According to applicable standards
Induced voltage test - Secondary	kV	According to applicable standards
Applied voltage test - Secondary	kV	3 for transformers applied to 1000V inverters 4 for transformers applied to 1500V inverters
Short-Circuit Impedance (at 75°C) pri/sec	%	6% (+/- 10% tolerance)
Short-Circuit Mutual Impedance sec/sec (in case of double-wound transformer)	%	8% (+/- 20% tolerance)
Maximum difference between short-circuit impedance sec1/prim and short-circuit impedance sec2/prim (*)	%	10%
Electrostatic shield		Yes. Shield must be earthed.

Table 11: Transformer technical requirements

(*) For example, if the SC impedance between sec1/pri is 6%, the impedance between sec2/prim may range between 5.4 and 6.6%.

6.4.4.2. Transformer application requirements

The transformer shall be designed to work at rated power according to specific application requirements. Because it is connected to an inverter power supplied by a PV field, stress to the winding isolation in respect to the earth potential is much more severe.

A 500V/µsec dU/dt between secondary windings and the earth is present. The secondary windings shall be tolerant for pulsed waveforms of up to +/- 1500V or 2100 V to earth for PV fields with open-circuit voltage up to 1100 V or 1500 V respectively.

The transformer shall operate with a maximum THD current generated by the inverter at full power equal to 3%.

If a double winding transformer is used, the transformer must be capable of operating with only one live secondary.

6.4.4.3. Application requirements of the transformer

In general, it is recommended that the transformer has a number of windings equal to the number of independent MPPTs implemented into the chosen inverter configuration by connecting each winding to the AC output corresponding to each MPPT.

The AC outputs corresponding to the DC sections utilized in separate MPPTs may be connected in parallel to the same winding only provided that the dedicated option be installed (see 8.10) and the application be approved. Please contact Elettronica Santerno SpA.

It is also advisable that y/D configuration (inverter-side star) is adopted for the transformer. In that case, the neutral must not be earthed.

In case a double secondary transformer is chosen, a transformer configuration either with concentric windings (LV, MV, LV) or with four windings (double tier) is recommended.

	MPPT	Secondary

		Floating field	Earthed field
Single converter, single master	1	1	1
Dual converter, multi-master	2	1(1) or 2	2

(1) Optional single secondary compatibility required

6.5. Power supply connection

For the technical data concerning the number of connectable cables, the maximum allowable cable cross-section and cable lug type, please refer to section 12.7.2.

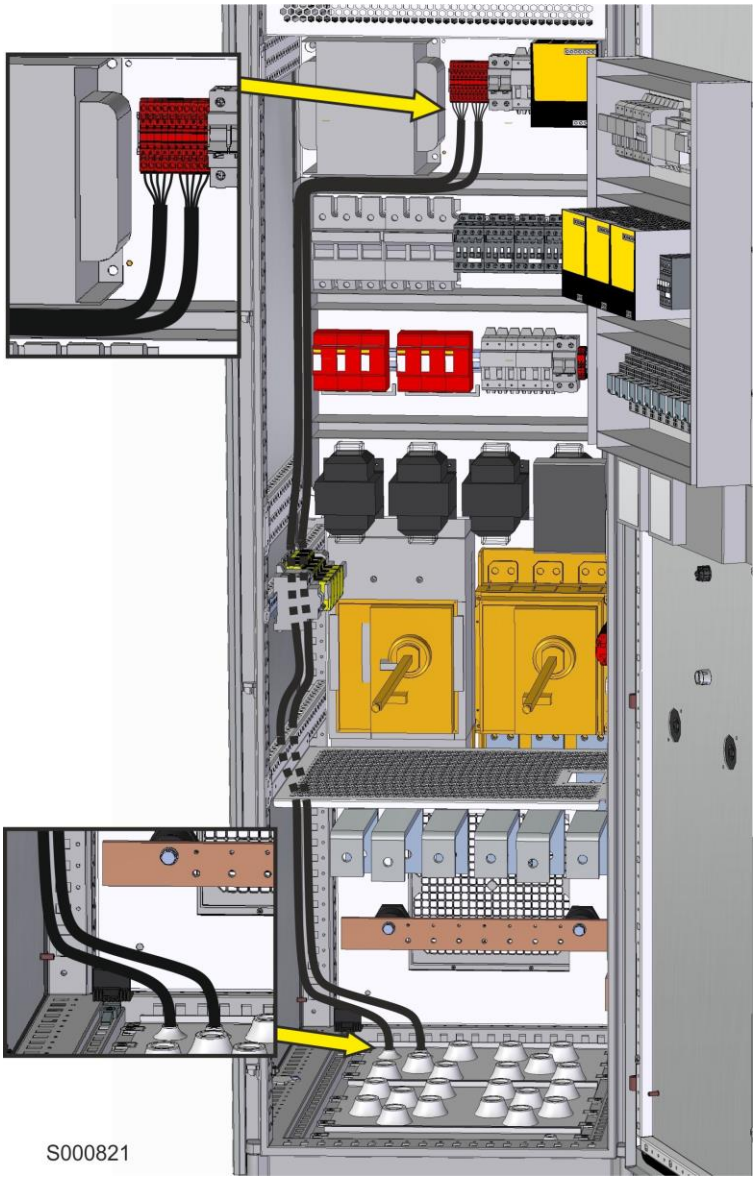


Figure 30: Location of the auxiliary power supply terminal board

The terminal board for the power supply cable connection is X10 in the AC section (Figure 30).

Terminal board	Location	Function
AC.X10	1	Self-power supply output Without *Self-power Supply Option*: not connected With *Self-power Supply Option*: terminal 1 is short-circuited to 3 and terminal 2 is short-circuited to 4.
	2	
	3	230 V_{AC} auxiliary power supply (to be used when the d *Self-power Supply Option*) is not fitted.
	4	
	5	UPS Bypass. Without UPS: make a jumper between 7 and 8 With UPS: leave 7 and 8 open
	6	
	7	UPS Input
	8	
	9	Smart String Box auxiliary power supply, dependent on *String Monitoring* option.

6.5.1. Auxiliary power supply connection

The Sunway TG TE inverters require 230 V_{AC} (+/- 10%) auxiliary power supplied dimensioned for auxiliary consumptions defined in 12.3.

The auxiliary power supply, fed externally to the inverter, is to be connected to AC.X10-3 and AC.X10-4.

If no external power supply source is available, it can be obtained internally to the cabinet via the *Self-power supply option*.

WARNING

If the* Self-power supply option *is installed, connecting an external auxiliary power supply source is forbidden.

6.5.2. UPS connection

The SUNWAY TG TE inverters may be connected to a UPS to ensure back-up power supply via terminals 7-8 AC.X10. For the UPS dimensioning refer to the consumptions of the internal electronics. See section **Error! Reference source not found.** Factory setting envisages jumpers between X10-5 and X10-7 and b etween X10-6 and X10-8.

If a UPS is connected, remove jumpers between X10-5 and X10-7 and between X10-6 and X10-8. Terminals X10-5 and X10-6 are kept free, but must not be used.

Please refer to the Electrical and Mechanical Diagram.

WARNING

Connecting the UPS to terminals 5 and 6 may damage the inverter internal circuits as well as the UPS.

6.5.3. Connection to string boxes power supply (optional)

If the *String Monitoring* option is installed to terminals AC.X10-9 and AC.X10-10, 230 V_{AC} power supply obtained from the auxiliary power supply is available. It is protected by dedicated MCCB and RCD.

The MCCB thermal trip current is 10 A.

6.6. Signal connection

6.6.1. Accessing the boards internal to the converter

During commissioning, it may be necessary to access the converter control board:

- To configure the environmental signal DIP-switches (6.6.3)
- To connect the Ethernet cable (6.7.1.1)

Figure 31 shows how to remove the carter protecting the control boards and shows the location of the control boards inside the converter.

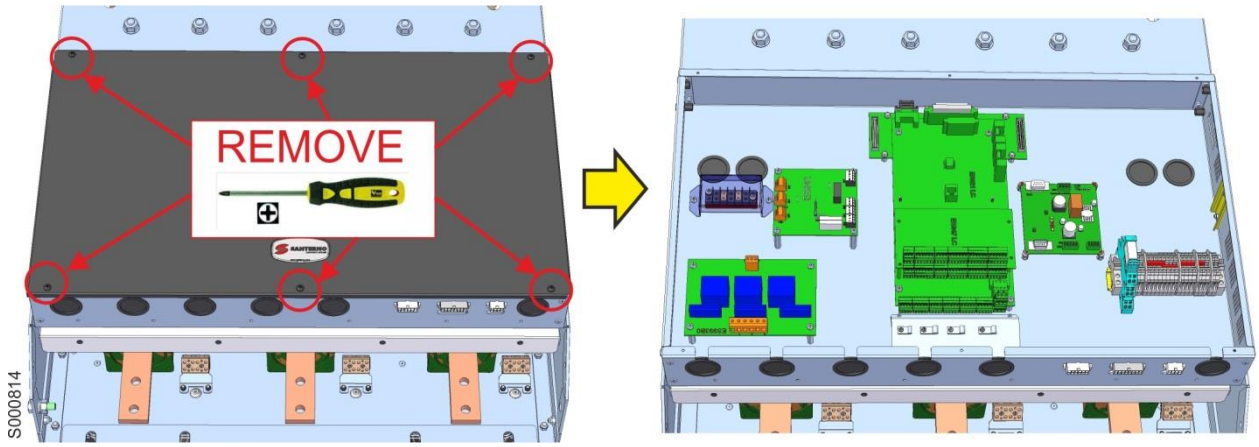


Figure 31: Removing the carter to access the boards in the converter

6.6.2. Connection of the digital inputs and outputs

The X6 terminal board for the connection of the digital inputs and outputs is the terminal board housed in the AC section (AC.X6; Figure 32).

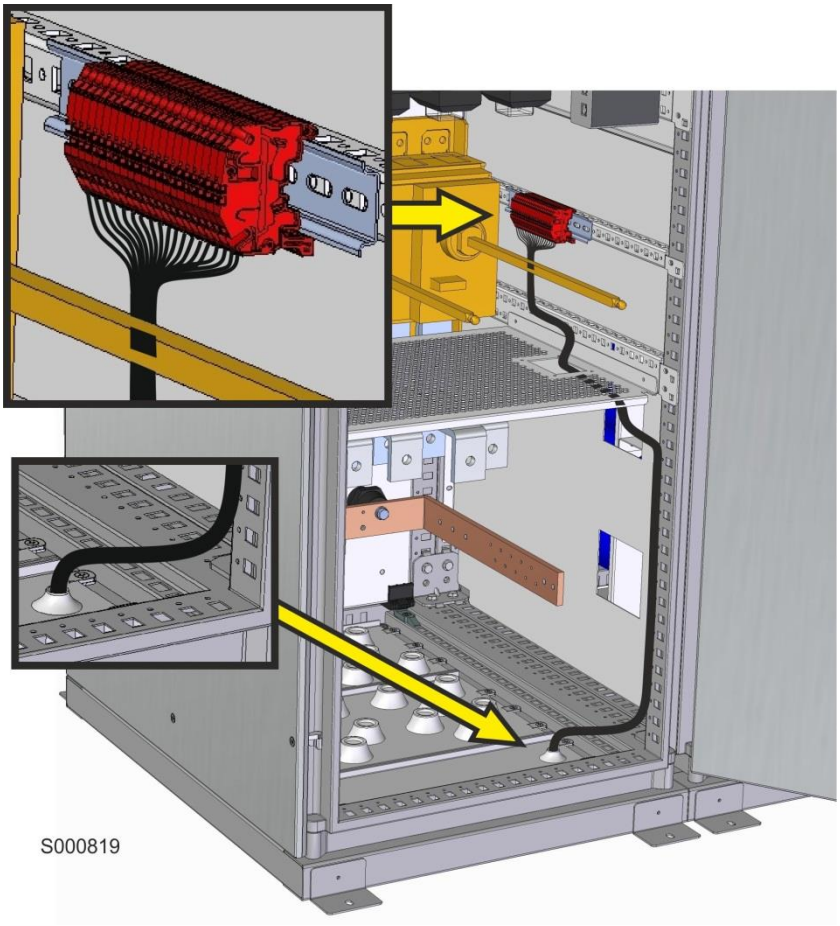


Figure 32: Location of the digital input terminal board

Terminal	Position	Name	Function and electrical specifications
AC.X6	1	OUT1 RELAY1-COM	**Programmable output 1, DC1 converter module** Refer to the Programming Guide for the isolation loss of the PV field connected to the DC1 module. Voltage-free contacts: 230Vac/10A - 30Vdc/1
	2	OUT1 RELAY1-NC	
	3	OUT1 RELAY1-NO	
	4	OUT1 RELAY2-COM	**Programmable output 1, DC2 converter module** Refer to the Programming Guide for the isolation loss of the PV field connected to the DC2 module. Voltage-free contacts: 230Vac/10A - 30Vdc/10A
	5	OUT1 RELAY2-NC	
	6	OUT1 RELAY2-NO	
	7	OUT2 RELAY1-COM	**Programmable output 2, DC1 module converter** Refer to the Programming Guide. Factory setting: relay energized with converter in section DC1 running. Voltage free-contacts: 230Vac/10A - 30Vdc/10A
	8	OUT2 RELAY1-NC	
	9	OUT2 RELAY1-NO	
	10	OUT2 RELAY2-COM	**Programmable output 2, DC2 module converter** Refer to the Programming Guide. Factory setting: relay energized with converter in section DC2 running. Voltage-free contacts: 230Vac/10A - 30Vdc/10A
	11	OUT2 RELAY2-NC	
	12	OUT2 RELAY2-NO	
	13	EMERGENCY STOP	**Emergency signal** When short-circuiting the two terminals, the inverter stops in an emergency. Leave unconnected if not used. Connect to a voltage-free contact. The emergency stops causes the following: • Stops the inverter. • Opens the PV-side disconnect switch. • Opens the grid-side switch.
	14		
	15	EXTERNAL GRID INTERFACE	

	16		External interface protection input. Short-circuiting the two terminals enables power delivery. Make a jumper if unused. Connect to a voltage-free contact if used.
	17	EMERGENCY BUTTON STATUS	**Emergency button status** The two terminals: • Voltage-free contact closed when pressing the pushbutton • Voltage-free contact open when the pushbutton is not pressed ELECTRICAL SPECIFICATIONS: 230Vac/2A 24Vdc 0.5A
	18		
	19	INVERTER RUN CONTROL	**Inverter run control** Short-circuiting the two terminals enables power delivery. Make a jumper if not used. Connect to a voltage-free contact if used.
	20		

6.6.3. Connection to the environmental inputs

The reference terminal board for the connection of the digital inputs and outputs is the X10 located in the DC module (DC.X10). Two environmental sensors may be connected to each DC module.

CAUTION

Connecting different environmental sensors from the ones defined in the default configuration must be done in accordance with the instructions given in section 0.

The non-observance of the instructions given in section 0 may cause irreversible damage to the inverter.

NOTE

Some environmental inputs may be reserved for internal use in Sunway Skid platforms. Please refer to the documentation of the Sunway Skid for details.

Terminal	Position	Function
DC.X10	1	Environmental input 1 Factory default: 0-20 mA input for the connection of a sensor for solar radiation measurement.
	2	Environmental input 0V
	3	Environmental input 2 Factory default: PTC input for temperature measurement
	4	Environmental inputs 0V

Table 12: Environmental inputs connection

6.6.3.1. Connecting Custom Environmental Sensors

WARNING

The analogue and digital inputs of the environmental signal expansion board are at the control board potential. If sensors different from the reference sensors are connected (sample cell and PT100), which require to be power supplied, a SELV power supply source is required, which is not supplied with the product.

The environmental measurement inputs are available from the environmental sensors and field I/Os expansion board (ES847). Please refer to section 12.12 for the technical specifications of the ES847 board.

To gain access to the ES847 board please refer to section 6.6.1.

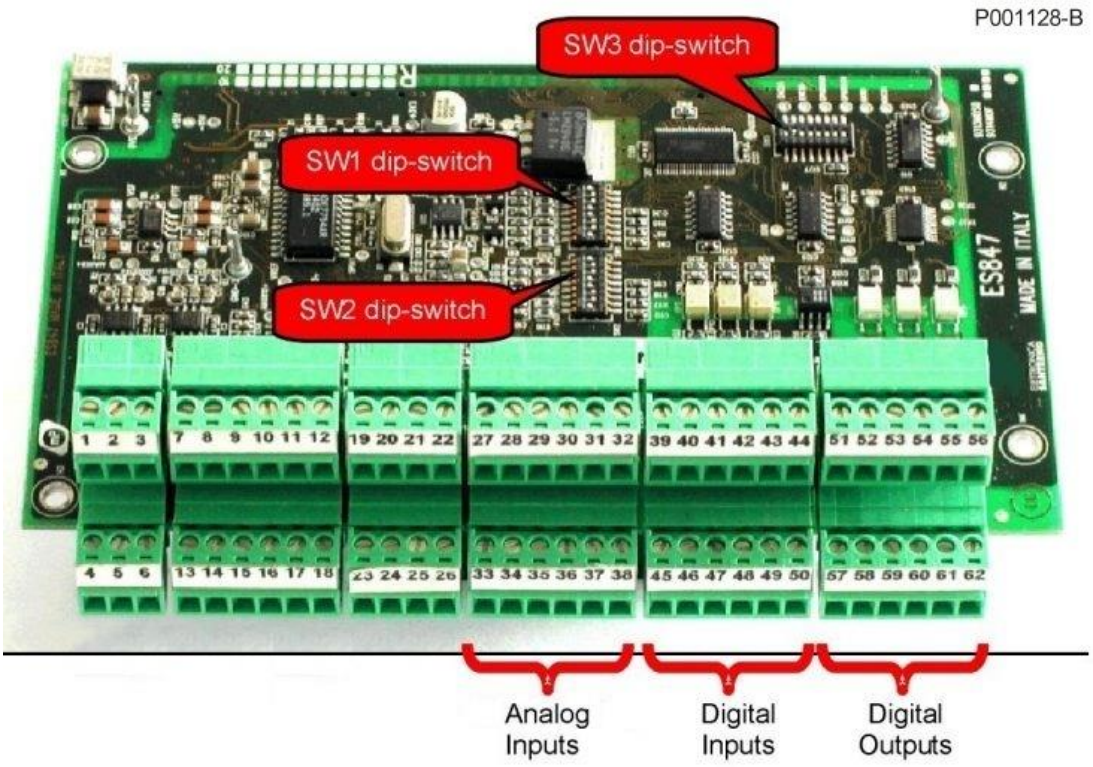


Figure 33: Environmental sensors and field I/Os Expansion Board

ES847 Channel	Function	Factory-set type of sensor	Factory setting
1	Environmental input 1	Solar radiation sensor (1)	0-20 mA
2	Environmental input 2	Thermoresistor (1)	PT100
3	Temperature measurement (2)	Thermoresistor (2)	PT100
4	Temperature measurement (2)	Thermoresistor (2)	PT100
5	Not used	-	0-10 V
6	Not used	-	0-10 V

(1) Customer use (2) Santerno use

Table 13: List of analogue inputs in ES847 board

The environmental sensors and field I/Os expansion board is provided with N.2 DIP-switches for the configuration of the analogue inputs (see Figure 32) allowing setting up the operating mode as per Table 14.

DIP-switch	Operation
SW1	Sets operate mode of analogue inputs 1 and 2
SW2	Sets the operating mode of analogue inputs 3 and 4 (internal use only, not to be changed).

Table 14: Function of the 2 DIP-switches on the environmental sensors and I/Os expansion board

The following table indicates the possible configurations of the SW1 and SW2 DIP-switches depending on the required set-up of the analogue channels.

SW1

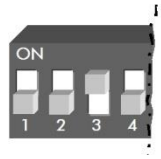
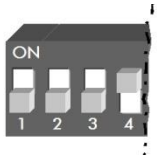
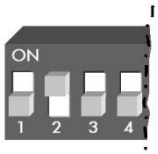
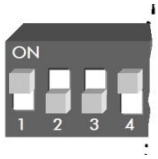
Configuration of environmental analogue channel 1			
0-10 V f.s.	0-100 mV f.s.	**0-20 mA f.s.**	PT100
			

Table 15: Environmental analogue channel 1 DIP-switch configuration

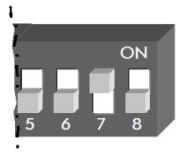
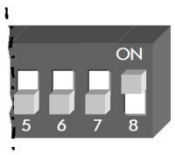
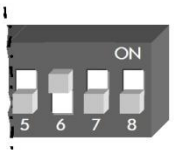
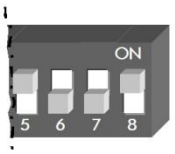
Configuration of environmental analogue channel 2			
0-10 V f.s.	0-100 mV f.s.	0-20 mA f.s.	**PT100**
			

Table 16: Environmental analogue channel 2 DIP-switch configuration

SW2

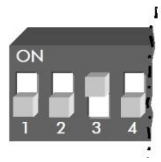
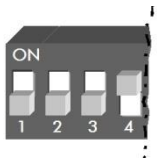
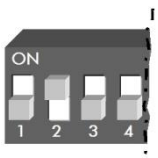
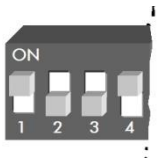
Configuration of environmental analogue channel 3 (1)			
0-10 V f.s.	0-100 mV f.s.	0-20 mA f.s.	**PT100**
			
(1) Internal use only			

Table 17: Environmental analogue channel 3 DIP-switch configuration

Configuration of environmental analogue channel 4 (1)

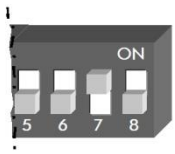
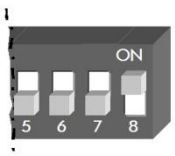
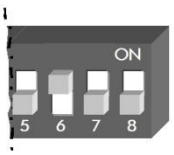
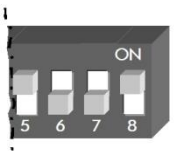
0-10 V f.s. mode	0-100 mV f.s. mode	0-20 mA f.s. mode	**PT100**
			
(1) Internal use only			

Table 18: Environmental analogue channel 4 DIP-switch configuration

WARNING

The inputs configured for voltage have high input impedance and must never be left open if active. Isolating a conductor relative to an analogue input configured as a voltage input does not guarantee that the channel reading will be zero. Zero is only correctly detected if the input is wired to a low-impedance or short-circuited signal source. Therefore, do not put relay contacts in series on the inputs to reset the reading.

NOTE

It is necessary to set the software parameters to match the DIP-switch settings. Hardware configuration settings which do not correspond with the type of acquisition set in the parameters produce results which do not reflect the values actually acquired (Please refer to the Programming Guide)

A voltage or current value which exceeds the upper full scale value or is less than the lower full scale value produces a saturated acquired value of the maximum and minimum measures respectively.

6.6.3.2. Analogue Inputs to Sensors with Voltage Output

It is advisable to carry out connection of the voltage source using a shielded twisted pair by connecting the braid onto the side of the environmental sensors and field I/O expansion board.

Although the “slow” acquisition analogue channels have a cut-off frequency just above 10 Hz, and hence the main source of disturbance, i.e. the grid frequency, is already reduced, it is advisable to take care over the connections especially for configurations with a full scale of 100mV or with connections using cables over 10 metres in length. Figure 34 and Figure 35 provide an example of the connection for voltage source acquisition.

Appropriately set the DIP-switches for configuring the relative analogue channel used, setting the full scale at 10 V f.s. or 100 mV f.s depending on needs and setting the relative programming parameter to be consistent with the settings just made.

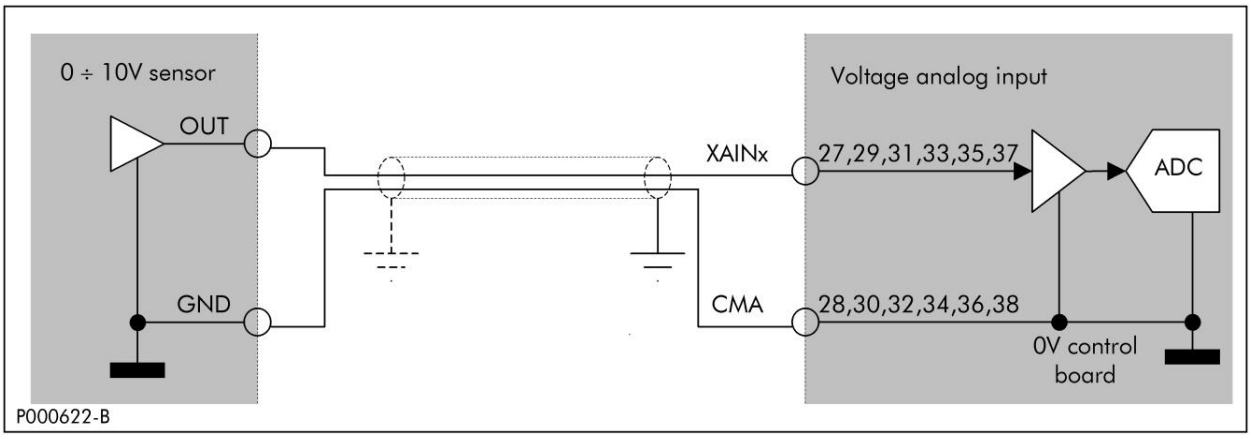


Figure 34: Connection to 0 – 10 V analogue input

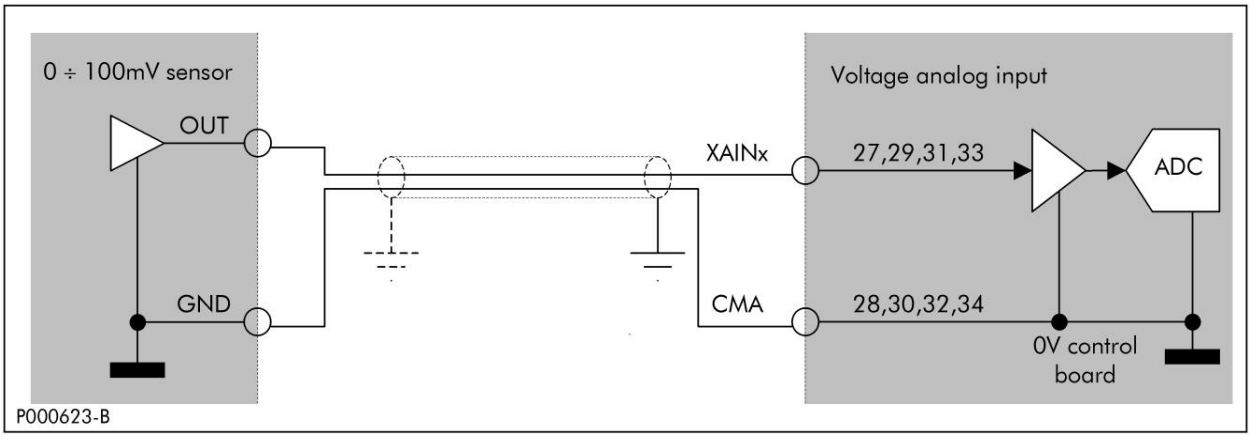


Figure 35: Connection to 0 – 100 mV analogue input

6.6.3.3. Analogue Inputs to Sensors with Current Output

Connection of the slow analogue inputs to current sources is illustrated in Figure 36. The channels capable of receiving current signals with 20 mA f.s. are XAIN8, XAIN9, XAIN10 and XAIN11, which correspond to terminals 27, 29, 31 and 33. As always, it is necessary to set the configuration DIP-switches relative to the analogue channel used by setting the end scale at 20 mA f.s and setting the relative programming parameter at 0 – 20 mA or 4 – 20 mA.

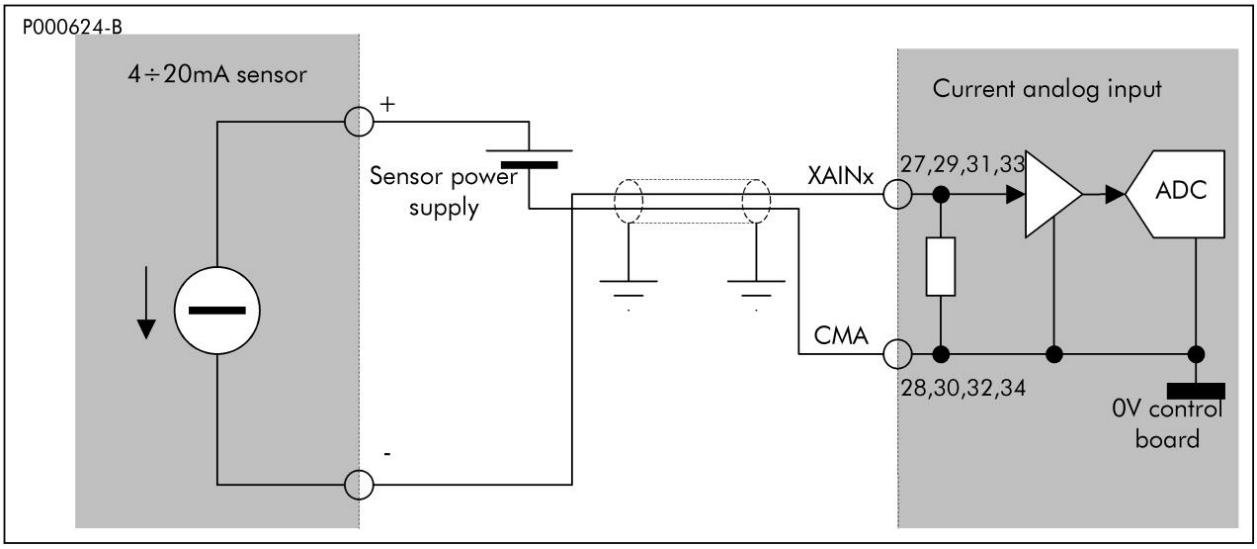


Figure 36: Connection of 0 – 20 mA (4 – 20 mA) sensors to current inputs

6.6.3.4. Analogue Inputs to PT100 Thermistor

The environmental sensors and field I/Os expansion board makes it possible to directly carry out temperature measurements by means of the connection to the standard PT100 thermistor. To simplify wiring a two-wire connection has been adopted. For this reason it is highly recommended to limit the length of the connection cable and ensure that the cable is not exposed to high temperature variations during operation. The channels capable of receiving PT100 signals are XAIN8, XAIN9, XAIN10 and XAIN11, corresponding to terminals 27, 29, 31 and 33. Figure 37 illustrates how to carry out connection: it is advisable to use a shielded cable whose braid is connected directly to the inverter's metal frame using the cable holding terminals provided.

If the connection is made using a cable over 10 metres in length, system measurement calibration must be carried out. For example, if the connection is made using a 1 mm^2 (AWG 17) shielded twisted pair, a reading error equal to approximately +1°C occurs for every 10 metres of cable.

Measurement calibration is obtained by connecting, in place of the sensor, a PT100 sensor emulator set at 0°C (or a precision resistor at 100 Ω 0.1%) to the line terminals and then correcting the relative offset value (please refer to the Programming Guide).

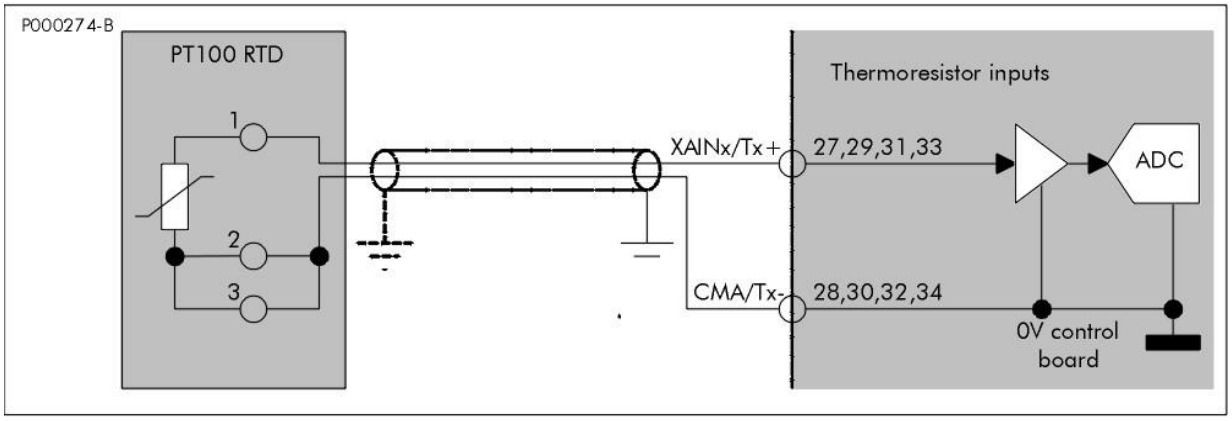


Figure 37: Connection of the PT100 thermistor to the analogue channel

6.7. Datalogger

Each converter is equipped with a Data Logger board, which is allocated to the following functions:

- Local storage of the production data.
- Connection to a remote monitoring system via Ethernet over Modbus TCP/IP protocol.
- Communication with Smart String Boxes (combiner boxes), via RS-485 (COM1) serial port (*String Monitoring* option required).
- Communication with the option board for the acquisition of the input current (zone monitoring).

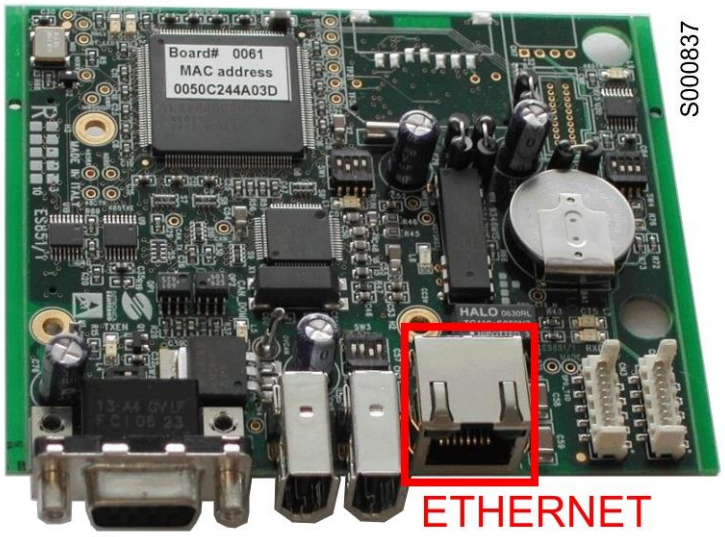


Figure 38: Data Logger option board

The Data Logger board is installed on the converter control board.

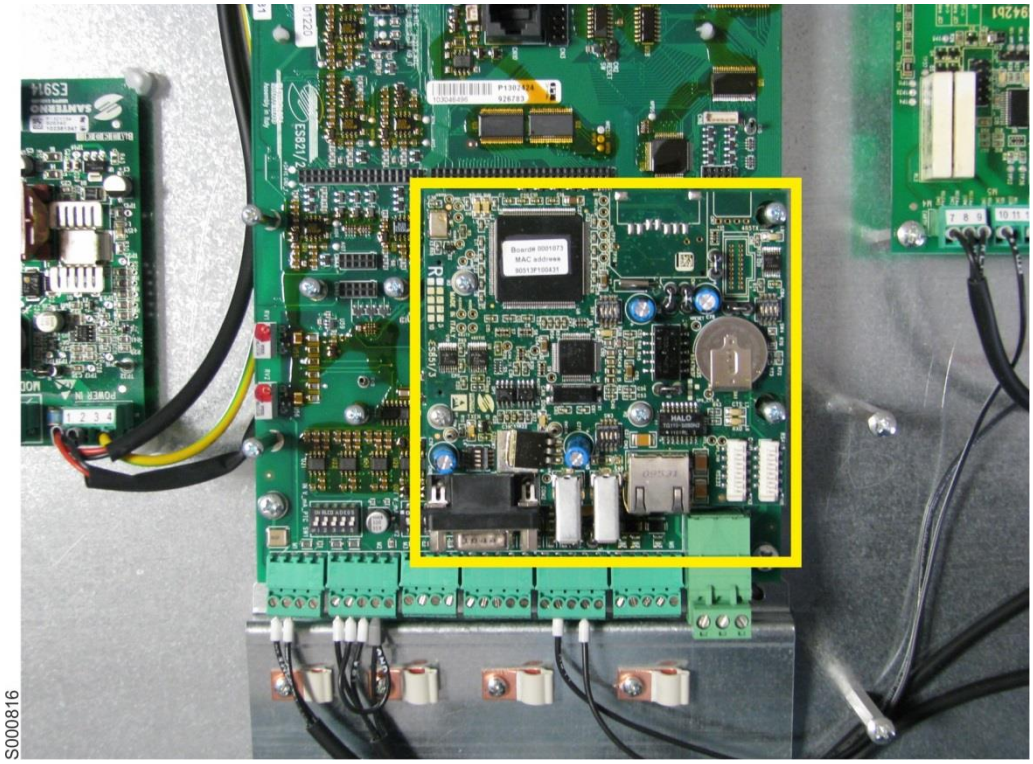


Figure 39: Location of the Data Logger option board

Each Data Logger board is capable of monitoring up to a maximum of 40 devices which are multidrop connected on the RS485 bus. On the bus the Data Logger operates acts as Modbus Master while the other devices (typically the Smart String Boxes) act as Modbus Slaves.

Should Santerno devices, such as Smart String Boxes, be multidrop connected, for user ease it is possible to use pre-set log configurations. Using these settings, the maximum number of devices which can be monitored is 15 units.

It is always possible to increase the number of units monitored by reducing the number of variables present in each log.

For further details, please refer to the Data Logger's Programming Guide.

6.7.1. Connection to the communications ports

The following communications ports are made available by the inverter:

- One Ethernet port for each DC module for the remote monitoring of the equipment;
- One optional RS-485 port for each DC module reserved to the String Box monitoring

6.7.1.1. Ethernet Port

Connection to the Ethernet port is to be made directly to the data logger board. Figure 38 shows the position of the Ethernet port on the ES851 board. Figure 40 and Figure 41 show the Ethernet cable path inside the DC section.

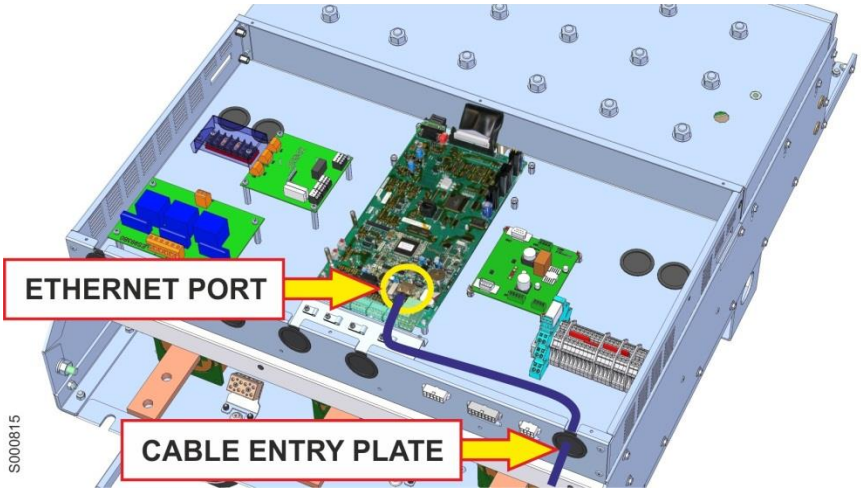


Figure 40: Ethernet cable path inside the converter

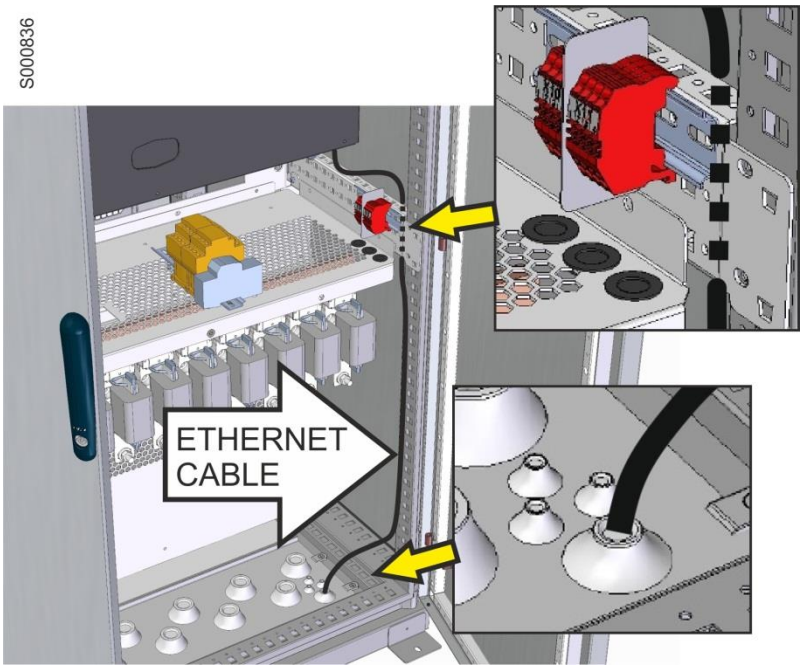


Figure 41: Ethernet cable path inside the DC section

6.7.1.2. RS-485 Serial Link

The serial link is present only when the string monitoring option is available. The serial link is to be connected to the X11 terminal board. Figure 42 shows the position of the terminal board inside the DC module.

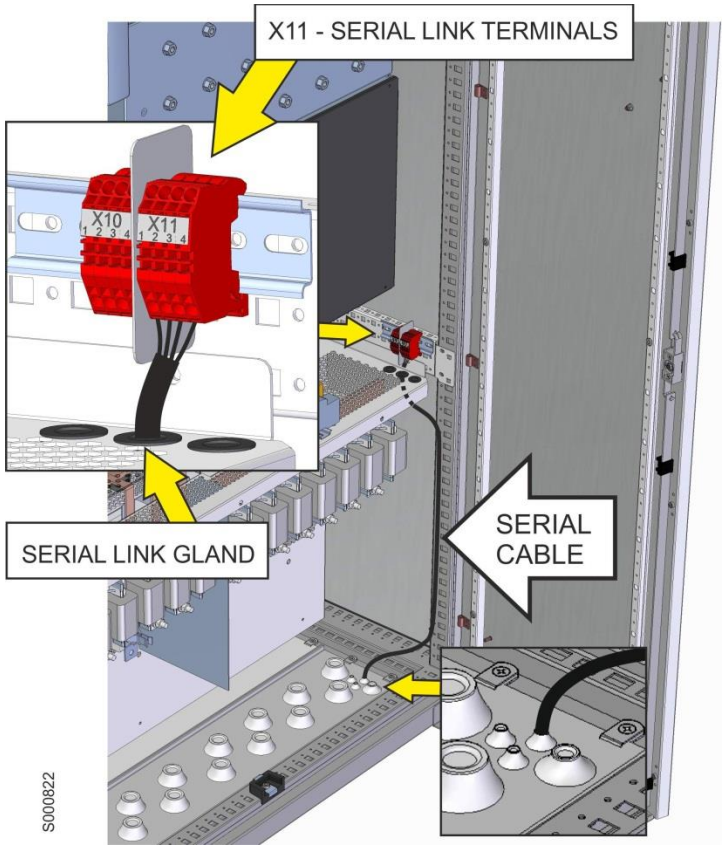


Figure 42: Serial link terminal board

Terminal board	Position	Function
DC.X11	1	(TX/RX A) Differential input/output A (bidirectional) according to the RS-485 standard. Positive polarity in respect to pin 2 for one MARK. D1 signal according to the nomenclature from the MODBUS-IDA association.
	2	(TX/RX B) Differential input/output B (bidirectional) according to the RS-485 standard. Negative polarity in respect to pin 1 for one MARK. D0 signal according to the nomenclature from the MODBUS-IDA association.
	3	0V(GND) serial link zero volt. “Common” according to the MODBUS-IDA association.
	4	Shield.

For details related to communications please refer to section **Error! Reference source not found.**.

NOTES

The serial link zero volt is isolated both in respect to the environmental signal 0V and the digital signal 0V.

6.8. Installation of voltage transducers (VTs)

If a measurement VT is to be connected to the AC output phases of the SUNWAY TG TE inverter, earthing the transformer windings is forbidden.

The VT impedance is guaranteed at grid frequency only. Common mode currents at switching frequency are present in the plant and might affect the VT. In case of earth fault occurring in the PV field, not-null average currents may flow in the low-impedance VT windings to ground. Those currents might quickly saturate the VT cores and damage them.

Adopt the following configuration to connect the VT to the inverter AC output:

- Delta configuration.
- Star configuration referred to the neutral (use the neutral obtained from the star centre of the LV/MV transformer).

It is advisable to use VTs with isolation voltage to earth of at least 2500 V_{AC}/50 Hz/60s for the 1000V version and 3000 V_{AC}/50 Hz/60s for the 1500V version.

6.9. Reassembling the protective grilles

The figure below shows the safety grilles that have been reassembled (see Figure 43).

Figure 43: Protective grilles reassembled

6.10. Commissioning

This chapter deals with the essential procedures involved in equipment commissioning.

DANGER

Do not apply power to the product if the internal protective grilles have been removed. Always carry out the operations described in section 6.9 before starting up the inverter.

WARNING

Wire the inverter in accordance with the instructions given in the sections above before starting the inverter.

Checks:

- Check that the key-operated selector switch on the cabinet front of each DC module for inverter enable/disable is set to OFF.
- Check that the DC disconnector 11-QM1 in each DC module is open
- Check that all the disconnect switches in the string boxes are closed
- Check that all AC circuit breakers 30-QMx located on the AC modules are open (their number varies based on the product configuration).
- Close the upstream master switch to power supply the inverter AC output.

Inverter power supply:

- Carry out at least one of the operations below to apply power to the inverter (the display on each DC module will come on):
  - Enable auxiliary power supply from UPS
  - Enable auxiliary power supply
  - If the *Self-consumption option* is installed, close the AC circuit breaker
- When the displays are on, make sure that no alarm have tripped or warning has fired
- If still open, close the AC circuit breaker. After a few seconds the GRID LED on the display comes on.

NOTE

The optional Interface Protection (IP) is sensitive to the phase sequence of the grid voltage. If installed and the GRID LED does not light up on the display this may be due to incorrect phase sequence. Check the LED indicators on the device. If necessary, invert the two phases on the X1 terminal board.

- Close the DC disconnect switch. If the PV field voltage is above the minimum threshold, the “PV OK” LED comes on.
- Do the following on the first DC module:
  - Turn the enable/disable key-operated selector switch to START
  - Press the button from the keypad. If the no-load voltage of the PV field exceeds the value set in parameter P020*1.1 in the PV Field menu, the inverter will run and will start delivering power to the grid.
- Repeat the operations listed above for each DC module.

NOTE

Pressing of the START button is a condition stored in the system memory, hence, if the SUNWAY TG TE power supply is cut off without an alarm tripping or without the STOP button being pressed, the inverter will still have the RUN command active when the power supply comes back on.

7. COMMUNICATIONS AND REMOTE MONITORING

The SUNWAY TG TE inverters provide extensive and modular connectivity:

- Full integration with the Santerno remote monitoring system for checking production performance and detecting alarms.
- Complete remote monitoring accessibility in both local and remote mode from PC and SunwayPortal web portal.

Connectivity of the SUNWAY TG TE inverters:

- N.1 RS-485 serial link over Modbus/RTU protocol isolated in each DC section (COM1 on the DC.X11 terminal board) for the communication between the inverters and the Smart String Box trunks (*String Box Monitoring* option)
- N.1 Ethernet port available on Modbus/TCP protocol in each DC section for communication between the inverters and the remote monitoring system.

7.1. Communication ports and protocol

The SUNWAY TG TE inverter serial ports use 2-wire RS485 electric standard plus a 0 volt reference wire and standard Modbus/RTU protocol.

The inverter behaves as a Modbus Master in respect to the Smart String Boxes, i.e. it sends queries to the devices connected to the communication trunk.

The Ethernet port of the SUNWAY TG TE inverters uses a standard Modbus over proprietary TCP/IP.

Connection to the Ethernet port allows reading the internal measurements, as well as reading, writing and saving all operation parameters of the inverters.

Connection is made using the RemoteSunway application or using one of the remote monitoring services made available by the SunwayPortal.

Protocol and availability relative to the serial ports are indicated below.

Communication Port	Protocol	Options required
Ethernet	Proprietary Modbus TCP/IP	None
COM1	Modbus Master	String Monitoring

Table 19: Communication ports

For specifications concerning the protocol, programming of the serial parameters, the Modbus address etc., please refer to the Programming Guide.

7.2. Connection topologies

7.2.1. Basic version

Configuration diagram for the basic version of the SUNWAY TG TE.

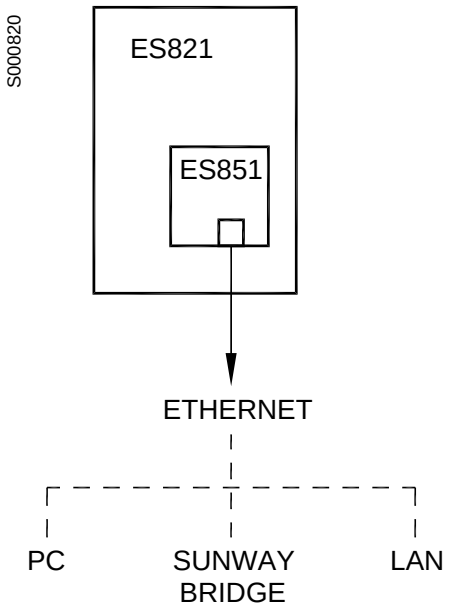


Figure 44: Communication port of the SUNWAY TG TE – basic version

The basic version implements an Ethernet line that can be connected to a PC for local monitoring via the Remote Sunway. Each DC section has its own Ethernet connection; if it is necessary to establish a connection simultaneously to both converters, an external switch may be used.

7.2.2. Optional string monitoring system

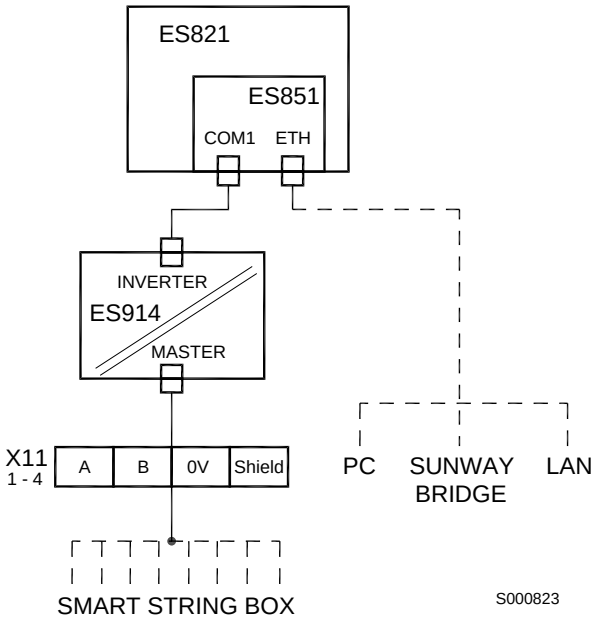


Figure 45: Configuration diagram of the SUNWAY TG TE with optional Data Logger board

The COM1 serial link on the Data Logger board is available on the DC.X11 terminal board via the RS-485 galvanic isolation board. This serial link can be used in Modbus Master mode to communicate with the PV field trunks to the Smart String Boxes.

NOTE

The standby bus voltage values for COM2, connected to the RS485 galvanic isolation board drivers are:

2.6 V between line A (D1) and 0 V

2.4 V between line B (D0) and 0 V

WARNING

If the COM1 is used as a Master port for the PV field trunk lines to the Smart String Boxes, manually program the Data Logger board routing table on COM1. Please refer to the Data Logger Programming Guide.

7.3. Connection

7.3.1. RS-485 bus – main principles

The MODBUS-IDA organization (http://www.modbus.org) defines the connection for Modbus communication on RS485 serial link (used by the inverter) as 2-wire cable type. For this type of cable, the following specifications are recommended:

Connection cable	
Type of cable	Shielded cable made up of a balanced pair known as D1/D0 + common conductor. Recommended cable: Belden 3106A Paired EIA Industrial RS485 PLTC/CM.
Minimum cross-section for conductors	AWG23 corresponding to 0.258 mm^2. For long lengths it is advisable to use a larger section, up to 0.75 mm^2.
Maximum length	500 metres with reference to the maximum distance measured between the two stations furthest apart.
Impedance specifications	Recommended over 100 Ω, usually 120 Ω.

Table 20: Connection cable

It is advisable to connect all the equipment connected to the multidrop connection network to the earth by means of a common conductor. In this way, any differences in earth potential between different equipment which may interfere with communications is reduced to a minimum.

The common terminal 0V connection is necessary. An 0V connection which is common to all equipment in the multidrop communication network minimizes possible differences of reference potential between the equipment which could interfere with communication.

The common reference of control board power supply is isolated in relation to earth. By connecting one or more inverters to a communication device with a common earth (for example a PC) a low-impedance path between the control board and earth is obtained. It is possible that disturbances conducted at high frequency from the power parts of the inverter may transit along this path and this can cause malfunctions to the communication apparatus.

It is always advisable to equip the communication equipment with a galvanically isolated RS485 communication interface or a galvanically isolated RS485/USB convertor.

WARNING

Cat. 5 2-, 3- or 4-pair data transmission cables cannot be used for the serial connection, not even over short sections.

Wiring operations of the module must be carried out when the inverter is NOT powered. Remember to take all the necessary precautions before accessing the connectors and before handling the board.

7.3.2. RS-485 bus - multidrop connection

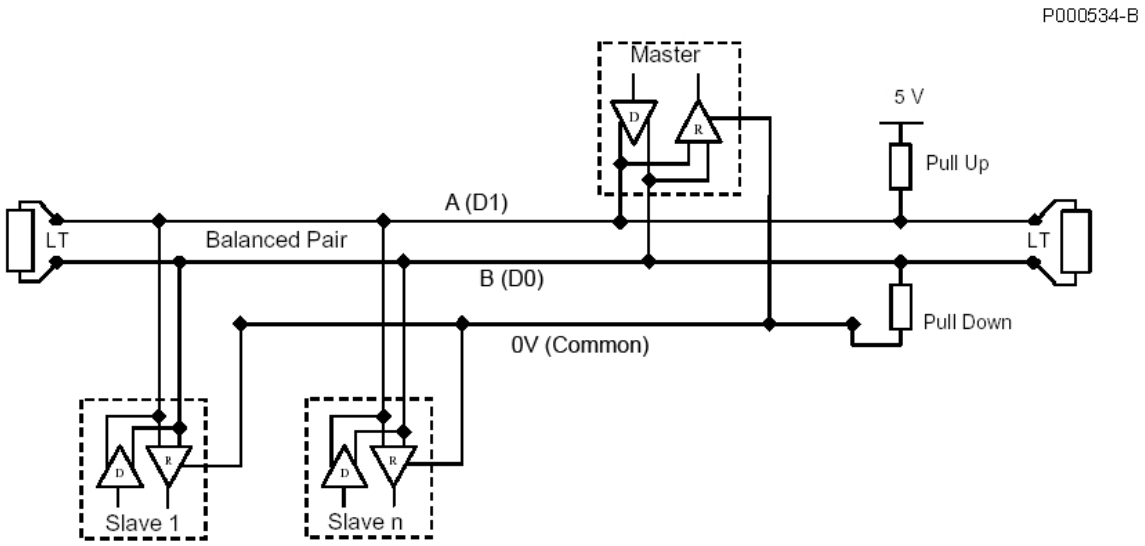


Figure 46: Multidrop connection diagram

The RS485 multidrop line to multiple devices must be wired using a linear and not a star topography: each device connected to the line must be connected by an incoming cable from the previous device and have an outgoing cable to connect the next device. The exceptions are obviously the first and last devices in the chain which, will have only an outgoing line and an incoming line respectively.

Elements participating in a RS485 section are called nodes. The maximum number of nodes which can be connected on a section is limited to the following aspects:

- Logic limit of the bus, equal to 247
- Length of the connection
- Transmission speed
- Electronic drivers used

The limit set by the line drivers used in SUNWAY TG TE inverters is 30 devices. It is not advisable to use section lengths exceeding 500m. Should it be necessary to connect more than 30 devices on the same line or over a length exceeding 500 m, it is advisable to break the connection up into more than one section using RS485 repeaters.

NOTE

The RS485 bus default rate is 38400 baud. It is not advisable to exceed this value. In the event of communication disturbances, it is possible to set the rate at a lower value (19200 or 9600 baud).

7.3.3. COM1 port

Serial Port	Options Required	Optically Isolated Port	Terminal and contacts
COM1	String monitoring	Yes	DC.X11-1: A (D1) DC.X11-2: B (D0) DC.X11-3: 0V

Table 21: COM1 serial port connection

Galvanic isolation between the inverter's COM1 serial port and the external communication devices is obtained by means of the RS-485 ES914 board, integrating the following:

- An INVERTER port for the connection between the isolation board and the inverter

- A MASTER port for the connection between the isolation board and the external devices

The INVERTER port terminators must not be modified in respect to the factory setting.

The MASTER ports are as follows:

DIP-switch	Function	Factory setting	Notes
SW1-1, SW1-2 MASTER Port Terminators	Master side RS485 terminator	Both ON: terminators enabled	ON: 150 Ω resistor between A (D1) and B (D0), 430 Ω resistor between A (D1) and +5 VE, 430 Ω resistor between B (D0) and 0 VE. OFF: no termination and polarization resistor.

Table 22: SW1 and SW2 termination DIP-switches on RS-485 galvanic isolation board

NOTE

Incorrect setting of the terminators in a multidrop line may inhibit communication and lead to communication difficulties particularly at high baud rates. If more than the two prescribed terminators have been installed on a line some drivers may enter protection mode for thermal overload thus blocking the communication of some devices.

To access the SW1 DIP-switch remove the front protective cover from the RS-485 galvanic isolation board (see section 6.6.1).

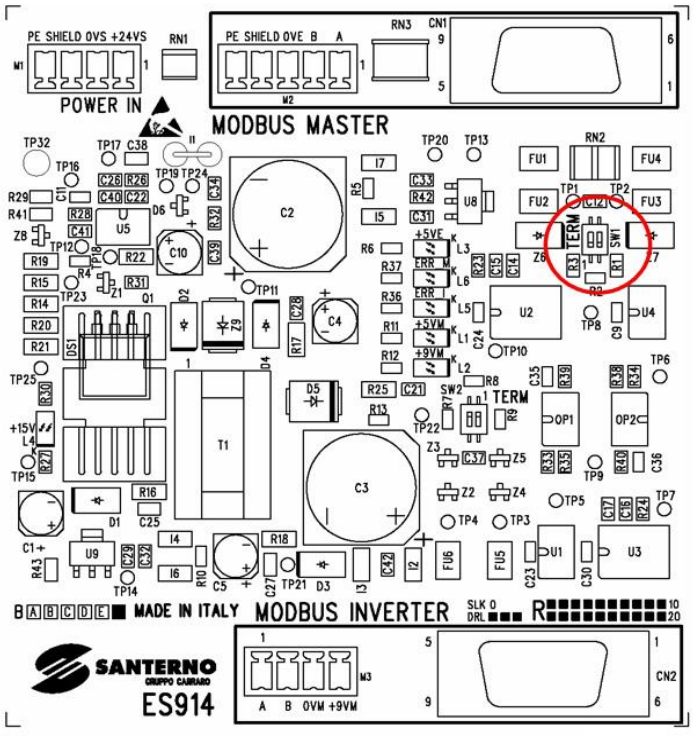
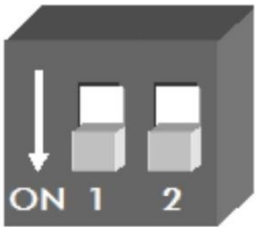


Figure 47: Location of the SW1 termination DIP-switches

The factory setting of the DIP-switch is indicated in the following figure.



S000097

Figure 48: SW1 termination DIP-switch

RS-485 GALVANIC ISOLATION BOARD SIGNALLING LEDS

NOTE

The standby bus voltage values for COM0 and COM1, connected to the RS485 galvanic isolation board drivers are:

2.8 V between line A (D1) and 0 V

2.2 V between line B (D0) and 0 V

The RS485 galvanic isolation board is equipped with five LEDs:

- Three LEDs indicate the presence of the various board power supply voltages.

LED	Colour	Function
L1	Green	Supply voltage detected for inverter side RS-485 circuits (5 V)
L2	Green	Supply voltage detected for inverter (9 V)
L3	Green	Supply voltage detected for Master side RS-485 circuits (5 V)

Table 23: Voltage indicator LEDs

- Two LEDs for indicating fault conditions concerning the RS485 signals to the inverter and the Master.

LED	Colour	Function
L5	Red	Inverter side RS-485 signal faults
L6	Red	Master side RS-485 signal faults

Table 24: FAULT indicator LEDs

A FAULT indication is only to be considered valid when the line is correctly terminated, i.e. the SW2 DIP-switch is set to ON.

Fault conditions may be due to one of the following:

- Differential voltage between A (D1) and B (D0) below 450 mV.
- A (D1) or B (D0) exceed the common mode voltage range [–7 V; 12 V].
- A (D1) or B (D0) connected to a fixed voltage (this condition can only be detected when communication has been established).

In the event of serial communication problems, please consult section **Error! Reference source not found.**.

7.3.4. Ethernet port

Port	Options required	Terminal and contacts
Ethernet	Standard supplied	RJ45 on Data Logger board

Table 25: Ethernet port connection

The Data Logger board provides a standard RJ45 connector (IEEE 802) for 10/100 Ethernet connection (100Base-TX, 10Base-T). The layout of the pins is the same as that found on each network board serving the PC.

The pin layout is as follows:

Pin	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

Table 26: RJ45 connector on the Data Logger Board

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

- through a LAN network (company or plant Ethernet network)
- with direct point-to-point connection

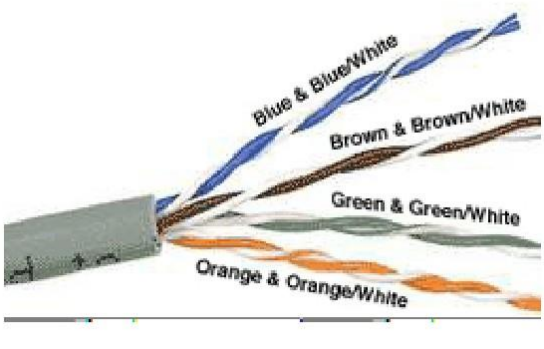
The connection via a LAN network can be carried out in the same way as for a PC. Use a standard connection cable to the Switch or Hub or a Straight-Through TIA/EIA.568-B cat. 5UTP cable (LAN patch cable).

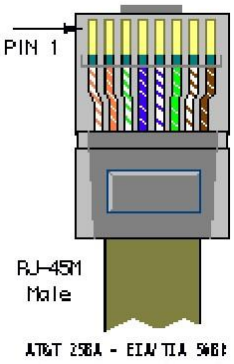
NOTE

The interface board cannot be connected to old LAN networks made using Thin Ethernet coaxial cables (10base2). Connection to this type of network is only possible using a Hub with both Thin Ethernet (10base2) and 100Base-TX o 10Base-T connectors. The LAN uses a star topology with each member element connected to the Hub or Switch by its own cable.

The following figure illustrates the layout of the pairs in a cat. 5 UTP cable and the standard colour arrangement used for Straight-Through cables.

P000518-B





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

Figure 49: Layout of pairs in cat. 5 UTP cable

The direct point-to-point connections is carried out using a Cross-Over TIA/EIA-568-B cat. 5 cable. This type of cable crosses over the pairs so that the TD+/TD- pair on one side corresponds to the RD+/RD- pair on the other and vice versa.

The following table illustrates the colour matching on the connector pins for the Cross-Over cable and the cross-over diagram of the two pairs used by the 100Base-TX o 10Base-T connection.

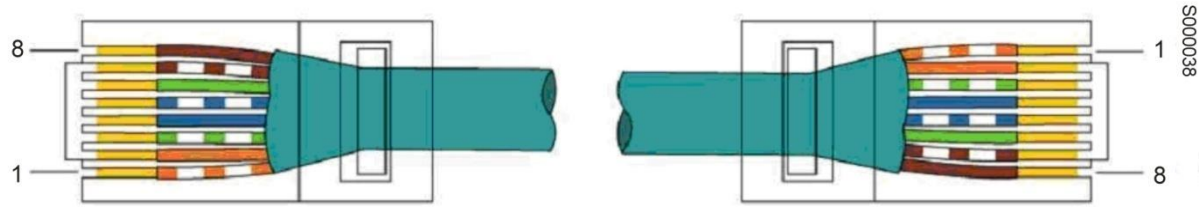


Figure 50: EIA/TIA 568 standard patch cable, UTP/STP cat.5

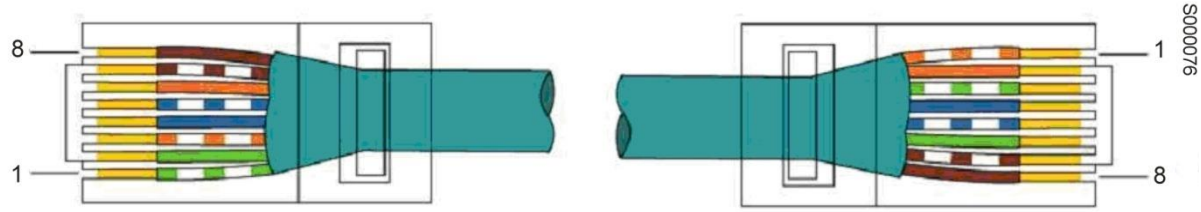


Figure 51: EIA/TIA 568 cross-over cable, UTP/STP cat.5

NOTE

The maximum length of the UTP cat. 5 cable envisaged by Standard IEEE 802 (calculated on the maximum transit time allowed by the protocol) is 100 m.

Use only and exclusively certified LAN cables, cat.5 UTP or higher, for Ethernet cabling. Unless otherwise dictated by length or particular cabling needs, use commercial cables with connectors.

In the event of Ethernet communication problems, please consult section **Error! Reference source not found.**.

8. OPTIONALS

NOTE

All the optionals described in this section are to be ordered at the same time as ordering the inverter.

8.1. Hard grounding

DANGER

Earthed-pole systems are NON IT systems.

The *Hard Grounding* fuse is not a safety device against direct contacts.

If the *Hard Grounding* fuse blows due to a fault, the field configuration may be floating. If the fault persists, the field configuration may be inverted in relation to the original configuration.

Certain technologies used for PV modules require particular polarization of the field with regards to earth. This polarization is called:

- Positive Earthed, when the positive pole of the PV field must be earthed.
- Negative Earthed, when the negative pole of the PV field must be earthed.

Two corresponding options are available for the SUNWAY TG TE inverters, the *Hard Grounding Positive Earthed* option and the *Hard Grounding Negative Earthed* option; both guarantee full compatibility with all PV modules available on the market.

All the live parts of the SUNWAY TG TE inverters are floating in relation to the earth potential. By connecting a floating PV generator to the inverter, the overall low-frequency system upstream from the isolation transformer is consequently an IT type. On the other hand, earthing the PV plant results in a non-IT system.

The SUNWAY TG TE inverters modified for use of earthed modules have the field pole connected to earth via a fuse. This device is NOT designed to protect the safety of persons but only to protect the equipment from short circuits to earth of the negative pole which could cause overheating with consequent fire risk.

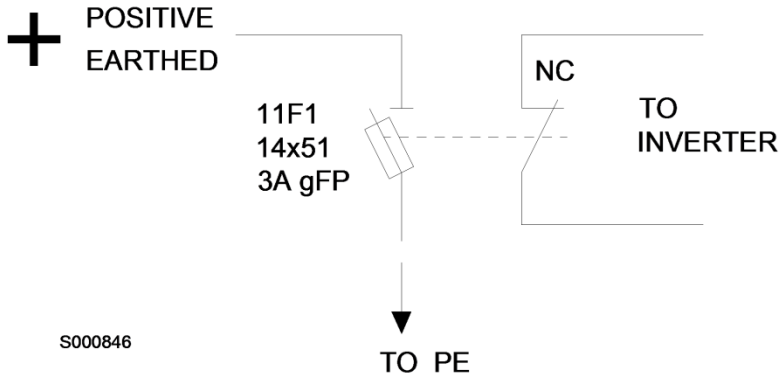


Figure 52: Hard Grounding Option – connection of the positive pole to earth

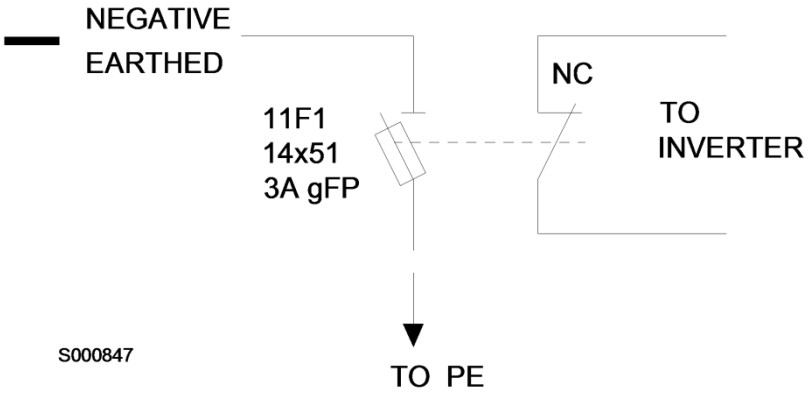


Figure 53: Hard Grounding Option – connection of the negative pole to earth

Installation of the Earthed option on SUNWAY TG TE inverters inhibits continual isolation control. The EGFD option may be installed as well. Please refer to section 8.3).

If the fuses blow, an isolation loss alarm is triggered. Please refer to section 4.6.

Installation of the *Hard Grounding* option on the SUNWAY TG TE inverters involves certain system restrictions:

- The AC outputs related to separate DC modules must be connected to the grid via their own isolation transformer or dedicated transformer of the same transformer;
- The 11F1 fuse must be the only earthing point for the system related to the DC section.

DANGER

Do not earth any other point of the PV field.

If the neutral is present on the inverter-side winding, this is NEVER to be earthed.

NOTE

Grounding fuse is installed upstream of the DC switch. This ensures polarization of the PV field even when the DC switch is open.

8.2. Hard grounding – Additional safety warnings

DANGER

Always avoid direct contact with the field contactors, provided that the PV plant is in safety conditions in accordance with the safety procedures described in the manuals of all the devices connected to the PV field.

DANGER

Earthed-pole systems are NON-IT systems.

The *Hard Grounding* fuse is not a safety device against direct contacts. The fuse is NOT designed to safeguard human life but for operational purposes.

If the *Hard Grounding* fuse blows due to a fault, the field configuration may be floating. If the fault persists, the field configuration may be inverted in relation to the original configuration.

The standard MODULAR SUNWAY TG TE has a PV field connection separate from earth and incorporates a device for controlling field loss of isolation to earth.

Installation of the Earthed option modifies the electrical status of the field conductors which could therefore be at a hazardous potential regards earth. It is therefore necessary to adopt measures to guarantee personnel safety.

Example with *Hard Grounding Positive Earthed* option

Even under no-fault conditions, in case of inadvertent contact with the negative pole, a fault loop occurs, supplied by the PV field, that closes through the fuse and the operator's body. In the event of inadvertent contact with the negative pole, the fault current is limited only by the resistance of the operator's body and is an electric risk for the operator.

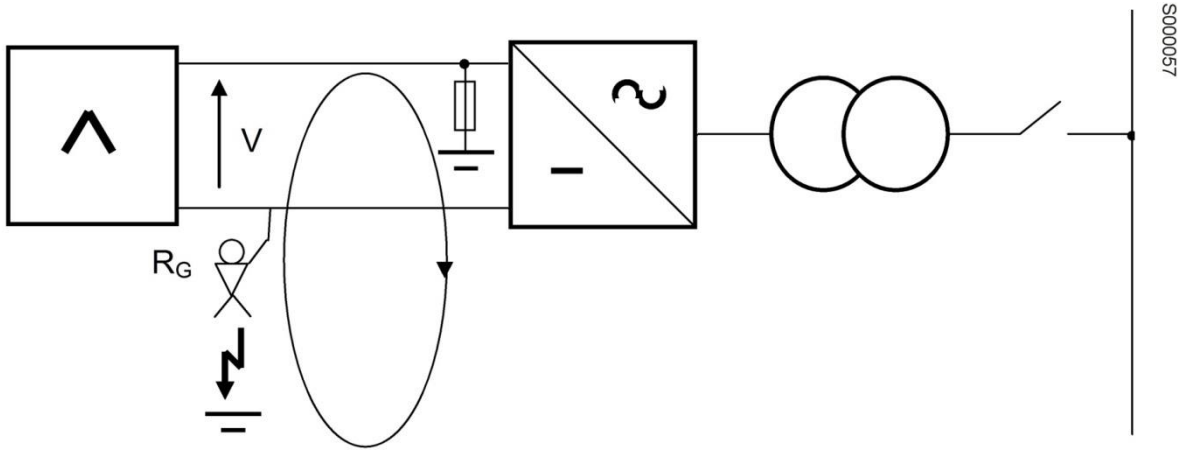


Figure 54: Direct contact with live pole (even under no-fault conditions)

WARNING

The isolation to earth control of the PV field poles is NOT active.

In addition, in case of fault, the electric status of the PV field may change due to the fault itself and the fact that the earth fuse blows. In particular, should the fault persist, the positive pole may have a dangerous potential in respect to ground. In case of inadvertent contact with the negative pole, a fault loop occurs, supplied by the PV field, that closes through the fuse and the operator's body. In the event of inadvertent contact with the negative pole, the fault current is limited only by the resistance of the operator's body and is an electric risk for the operator.

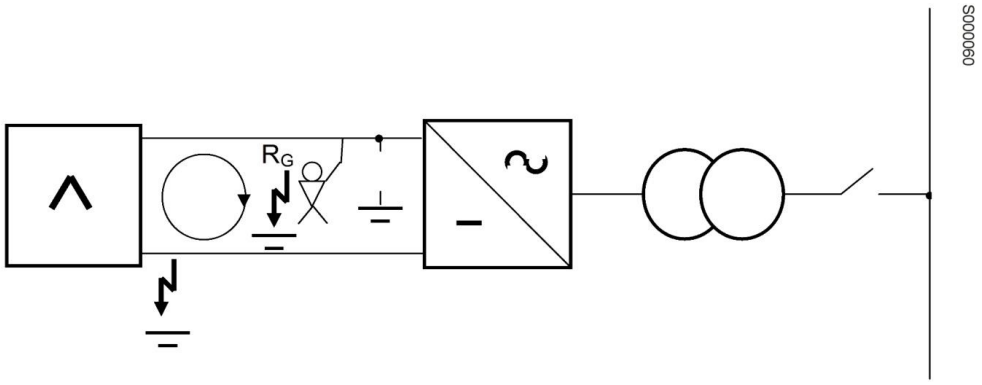


Figure 55: Direct contact on a non-earthed pole due to earth fault on the other pole

8.3. Hard grounding – Earth ground fault detection

The Positive Earthed and Negative Earthed options may be integrated with the Earthed Ground Fault Detection (EGFD) option, enabling detecting first fault to earth conditions in earthed PV fields, also on the Positive Earthed or Negative Earthed (Blind spot) conductor.

Detecting the first fault to earth of the earthed conductor prevents the double fault condition from occurring, which is not detected by the earthing fuse.

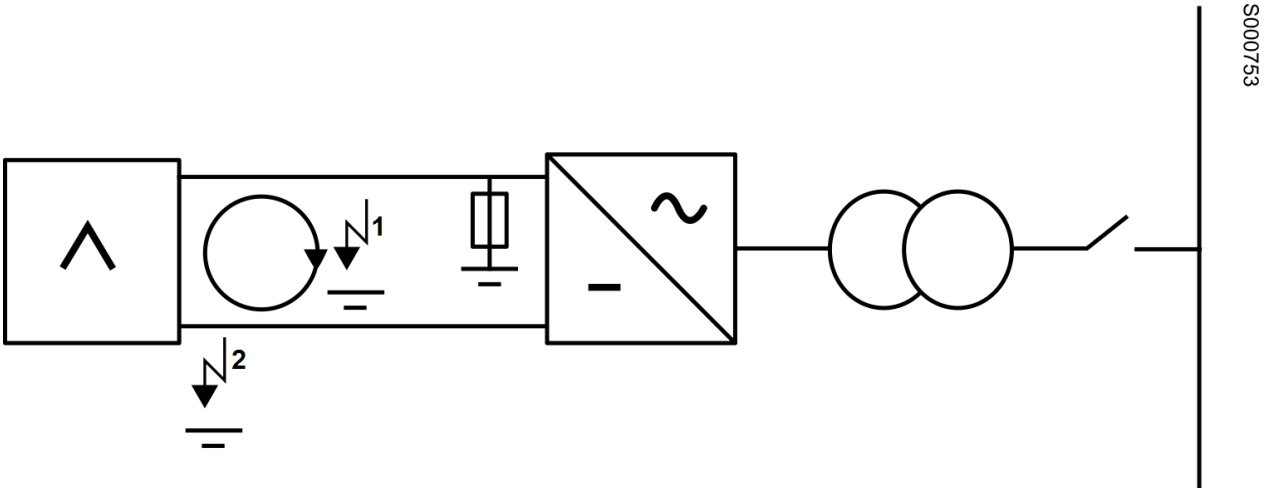


Figure 56: Fault current loop in case of double fault to earth

The fault loop is shown in the figure above. If the impedance of the short-circuit fault to earth does not cause the earthing fuse to blow, leakage current occurs in fault 2. That leakage current cannot be detected if the EGFD option is not fitted, thus causing dangerous situations also leading to fire risks.

8.4. Soft grounding

DANGER

Earthed-pole systems are NON IT systems.

The *Soft Grounding* resistor is not a safety device against direct contacts.

Should the *Soft Grounding* resistor break open, the field may be left floating.

SUNWAY TG TE inverters may be equipped with an optional *Soft Grounding* kit, comprising a resistor and a series contactor, connected to the negative input pole at the DC side. The kit is meant as a means to prevent potential induced degradation (PID) on crystalline modules. The degradation is avoided by reducing the amplitude of the negative voltage between the negative pole of the field and earth. Such voltage, which is around half of the panels voltage in floating fields, triggers the panel degradation. Reducing it to significantly lower values scales the degradation down to negligible levels over the entire life of the plant.

All the live parts of the SUNWAY TG TE inverters are floating in relation to the earth potential. By connecting a floating PV generator to the inverter, the overall low-frequency system upstream from the isolation transformer is consequently an IT type. On the other hand, connecting the photovoltaic field to earth via a resistor results in a non-IT system.

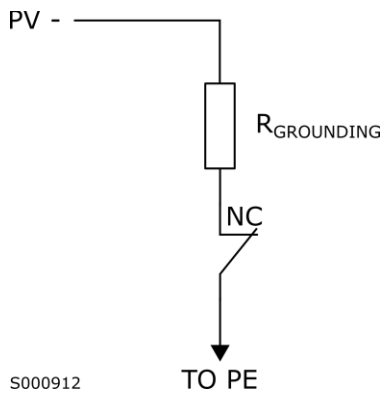


Figure 57: Soft grounding option connection schematic

Installation of the *Soft Grounding* option on SUNWAY TG TE inverters inhibits continual isolation control.

Before connection to grid, the *Soft Grounding* resistor is temporarily disconnected from earth in order to perform an isolation check on both poles of the photovoltaic field. This enables detection of a fault on the grounded pole. In case an isolation loss is detected, an alarm is triggered. Please refer to section 4.6.

Installation of the *Soft Grounding* kit on the SUNWAY TG TE inverters involves certain system restrictions:

- *Compatibility with Single Secondary for Multi-MPPT Products* option must be installed in case the inverter features multiple MPPTs and is connected to a single secondary transformer.

DANGER

Do not connect any other point of the PV field to earth.

If the neutral is present on the inverter-side winding, this is NEVER to be earthed.

NOTE

Grounding resistor is installed upstream of the DC switch. This ensures polarization of the PV field even when the DC switch is open.

8.5. Soft grounding – Additional safety warnings

DANGER

Always avoid direct contact with the field contactors, provided that the PV plant is in safety conditions in accordance with the safety procedures described in the manuals of all the devices connected to the PV field.

DANGER

Earthed-pole systems are NON-IT systems.

The *Soft Grounding* resistor is not a safety device against direct contacts. The resistor is NOT designed to safeguard human life but for operational purposes.

If the *Soft Grounding* resistor breaks open due to a fault, the field may be left floating.

The standard MODULAR SUNWAY TG TE has a PV field connection separate from earth and incorporates a device for controlling field loss of isolation to earth.

Installation of the *Soft Grounding* option modifies the electrical status of the field conductors which could therefore be at a hazardous potential from earth. It is therefore necessary to adopt measures to guarantee personnel safety.

Even under no-fault conditions, in case of inadvertent contact with the positive pole, a fault loop occurs, supplied by the PV field, that closes through the *Soft Grounding* resistor and the operator's body. The fault current is limited only by the series resistance of the operator's body and of the *Soft Grounding* resistor. The resulting current may harm the operator.

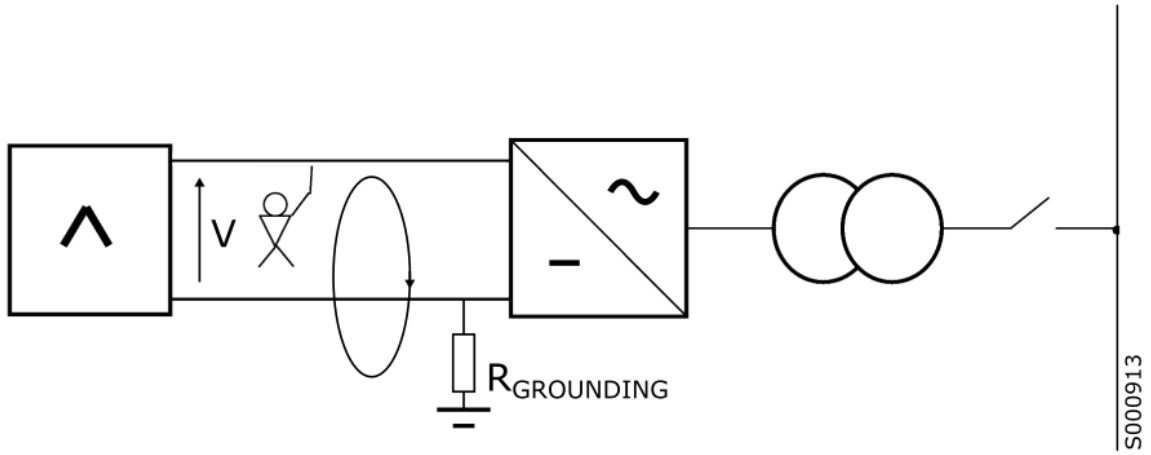


Figure 58: Direct contact with live pole (even under no-fault conditions)

WARNING

The isolation to earth control of the PV field poles is NOT active.

In addition, the grounded pole may be at a dangerous potential with respect to ground. In case of inadvertent contact with the negative pole, a fault loop occurs, supplied by the PV field, that closes through the *Soft Grounding* resistor and the operator's body. The fault current is limited only by the series resistance of the operator's body and of the *Soft Grounding* resistor. The resulting current may harm the operator.

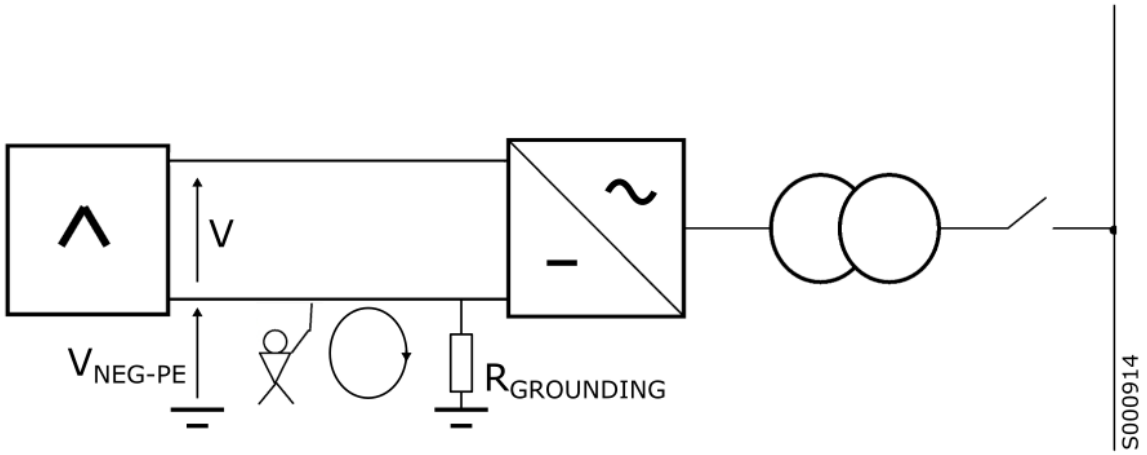


Figure 59: Direct contact on a soft grounded pole

8.6. Zone monitoring

The following functions are available:

- Current measurement of each DC input
- Processing of the detected measurements in order to detect underperforming or open inputs.

The system is integrated with the remote monitoring system, so data may be accessed via Ethernet.

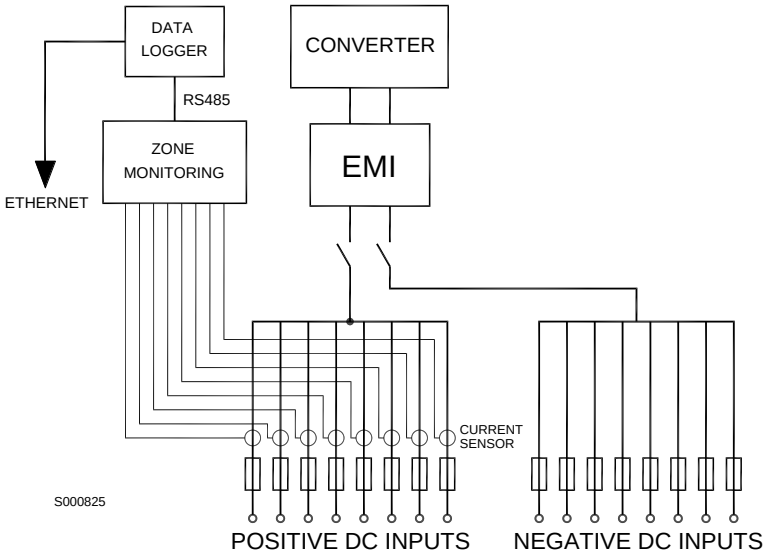


Figure 60: Zone monitoring

8.7. DC EMI filter

An EMI filter may be installed on each DC module. The filter reduces the radiofrequency conducted disturbance in the PV field. It is advisable that DC filters be installed when remote monitoring systems (Smart String Boxes), alarm circuits, video camera and/or other devices sensitive to radiofrequency disturbance are installed in the PV field.

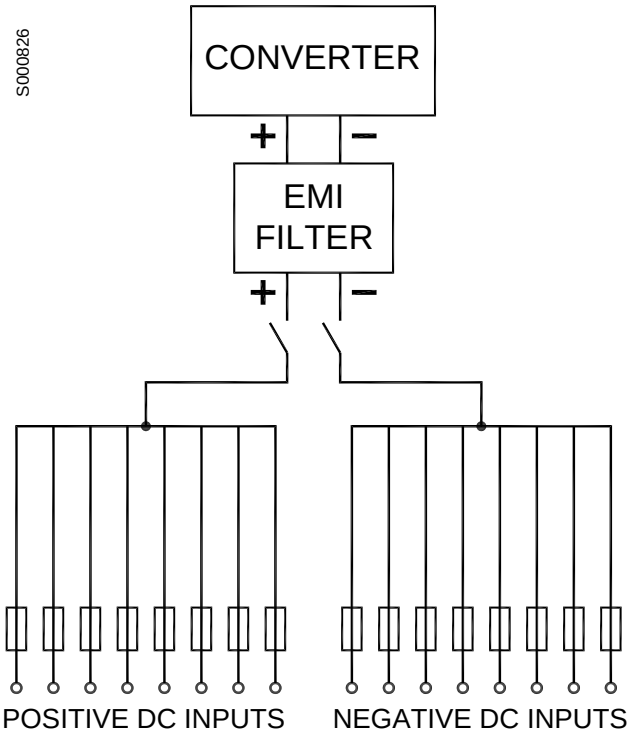


Figure 61: DC EMI Filter

8.8. AC-side SPDs

The AC-side SPDs (Class II) are connected to each AC output section of the inverter.

This option is recommended for long cable paths between the inverter and LV/MV transformer.

The SPDs are referenced to in the Electrical and Mechanical Diagram as 30A1 and 30A2 (in the inverters equipped with two DC modules).

Each SPD is protected by an integrated thermal circuit breaker against voltage surge.

The thermal circuit breaker signalling mode may be programmed as follows:

- The thermal circuit breaker trips and a WARNING fires, that does not stop the inverter; the inverter may start or may be kept running (default setting);
- The thermal circuit breaker trips and an ALARM trips, that stops the inverter.

The status signalling of the AC-side SPDs is shared with the DC-side SPDs.

8.9. AC insulation check

The AC Insulation Check allows detecting insulation loss between the AC terminals of the inverter and the LV/MV transformer. Insulation check is a continual check.

The AC insulation check may be programmed as follows:

- The control unit trips and a WARNING fires, that does not stop the inverter; the inverter may start or may be kept running (default setting);
- The control unit trips and an ALARM trips, that stops the inverter.

8.10. Compatibility with single secondary for multi-MPPT products

The SUNWAY TG TE inverters configured with multiple MPPTs may be connected to a single winding of the LV/MV transformer, provided that the *Compatibility with Single Secondary for Multi-MPPT Products option* is installed.

This option consists of the following:

- De-coupling inductors between the AC outputs related to independent MPPTs
- Synchronisation system between the conversion modules related to independent MPPTs

8.11. Self-power supply

The SUNWAY TG TE require 230 V_{AC} (+/- 10%) auxiliary power supply.

If an external power supply source is available, it can be shunted directly internally to the cabinet by way of the *Self-power Supply Option*.

WARNING

When the* Self-power Supply *is installed, it is forbidden to connect an external power supply source.

8.12. String monitoring

The *String Monitoring* option is required for the communication to the Smart String Box trunks.

The String Monitoring option implements galvanic isolation of RS-485 serial port available on the data Logger board for communication to Slave devices (COM1). Connection to RS-485 bus is done via the DC.X9 terminal board on each DC module. The line terminations are inserted as a factory setting.

For details on the RS-485 connection, please refer to section 7.3.3.

230Vac 10A auxiliary power supply is also available to power supply the control circuits of the string boxes (see 6.5.3).

8.13. Independent output power measurement (wattmeter)

A wattmeter and its relevant CT and VT may be installed on the AC output related to each independent MPPT. All the measurements are made available via Modbus RTU RS-485 protocol only and may be integrated with Santerno's remote monitoring system.

8.14. Sunway Bridge

Optionally, it is possible to equip each Sunway TG TE inverter with a Sunway Bridge unit implementing the most advanced and complete functionality of history data monitoring and logging. When available, the Sunway Bridge unit also acts as a communications gateway with the inverter.

Please refer to the product manual for details.

8.15. AC EMI filter

The Sunway TG TE inverters comply with the applicable requirements in terms of electromagnetic emissions.
In case of custom requirements, an optional EMI filter may be installed at the inverter output. Please contact Elettronica Santerno SpA.

8.16. Fuse-holders

The inverter may be equipped with three types of fuse-holders: NH1XL, NH2, NH3L. The type of fuse-holder required is to be specified at the time when ordering the product.

8.17. External cooling system control

The inverter may be equipped with an optional three-phase relay for controlling an external cooling system.

9. DC INPUT COMPONENTS DIMENSIONING

9.1. DC input fuses dimensioning

NOTE

The DC input fuses are to be ordered separately.

The DC inputs of the SUNWAY TG TE are fuse-protected both on the positive pole and on the negative pole. The fuses status is detected by the control electronics and made available as equipment status info. The fuses to be installed must be compatible with the type of fuse-holder used (please refer to section 8.16).

The configuration of the fuses installed on each input is given in the Final Test Certificate.

S000092

FUSIBILI INSTALLATI / INSTALLED FUSES			
INGRESSO / INPUT	PLUS (+) POLE	MINUS (-) POLE	SINGLE / PARALLEL
1	160	160	■ Single ☐ Parallel ☐ S.C.
2	160	160	
3	160	160	■ Single ☐ Parallel ☐ S.C.
4	160	160	
5			☐ Single ■ Parallel ☐ S.C.
6	125	125	
7			☐ Single ■ Parallel ☐ S.C.
8	125	125	
-			☐ Single ☐ Parallel ☐ S.C.
-			

Figure 62: Fuse configuration example as in the Final Test Certificate

NOTE

The formulas below are given as an example and are to be checked based on the fuses being used.

When designing utility-scale plants, it may be required that subfields having different power ratings are to be configured for the same PV array. It is therefore advisable to protect each cable entry to the inverter with fuses having different sizes. This section covers the criteria for the correct dimensioning of the input fuses.

The I_N rated fuses are normally related to 30 °C ambient temperature. Apply A1 derating coefficient for applications at higher ambient temperature.

The fuses are to be chosen in order to obtain:

$$I_N \geq \frac{I_{SC}}{A1}$$

where

$$A1 = \sqrt{\frac{130 - T_{INT\ MAX}}{100}}$$

I_N is the rated fuse current, I_{SC} is the maximum short-circuit current of the PV field portion connected to the input in question, and $T_{INT\ MAX}$ is the maximum temperature internal to the cabinet attained during operation; as initial approximation, this should be:

$$T_{INT} = T_{AMB} + 10°C$$

EXAMPLE:

Consider $T_{INT\ MAX}$ = 60 °C. A1= 0.836. A 200 A rated fuse is compatible with input current ratings up to 167 A.

In PV plants, current is a function of solar radiation. The values in Table 27 are given as an indication for the fuse trip time based on the current flowing and the fuse size.

Fuse size In [A]	Current 2 x In [A]	Trip time [s]	Current 3 x In [A]	Trip time [s]	Current 4 x In [A]	Trip time [s]
50	100	150	150	10	200	2
63	126	150	189	20	252	2
80	160	100	240	10	320	1
100	200	200	300	30	400	7
125	250	200	375	25	500	7
160	320	300	480	40	640	15
200 A	400	400	600	60	800	18

Table 27: Trip time of NH1-XL fuses

9.2. DC input cable dimensioning

The connection cables between the String Boxes, which are typically located in proximity to PV modules, and the inverters, located in the technical room, normally carry the current delivered from the string units connected to one single String Box.

Since the PV field is a limited current generator, even in case of short-circuit, the current delivered by that generator cannot exceed the maximum dimensioning value. This does not apply to the current carried by the cables.

Consider short-circuit occurring downstream from a String Box but upstream from the inverter cabinet (see Figure 63). In that case, the current carried by all the String Boxes but one is delivered to the cable portion ranging from the point where short-circuit occurs to the point of connection to the inverter.

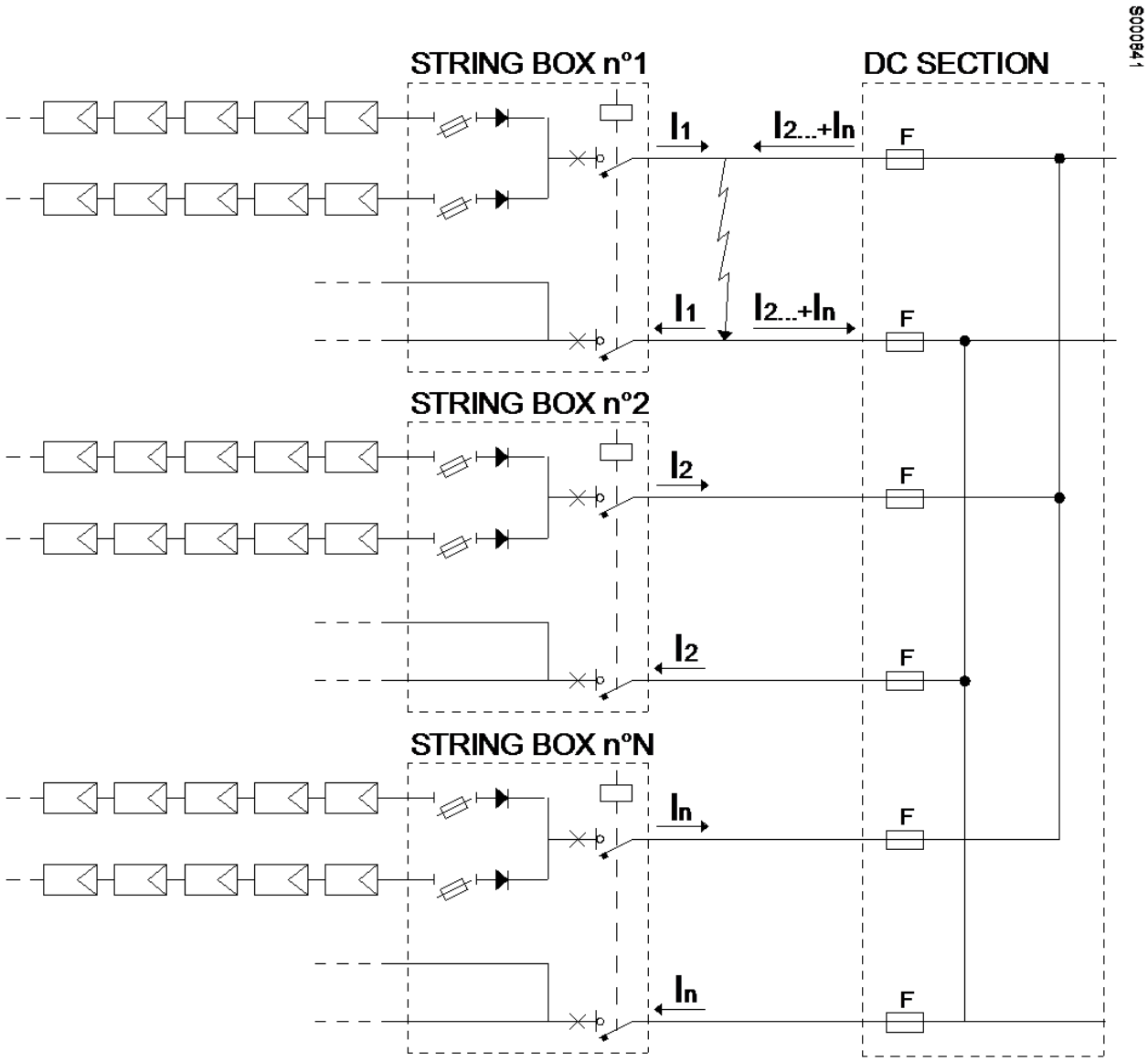


Figure 63: Short-circuit occurring upstream from the inverter

In that case, the current delivered from all the other String Boxes is carried by the portion between the short-circuit and the inverter. Fuses will blow as Table 27.

10. MAINTENANCE

Adequate maintenance ensures conversion performance and inverter reliability is maintained over time.

This heading describes all the activities required to keep machine parts which are subject to wear and deterioration and/or components which are essential for guaranteeing safety and optimum performance in good condition.

Access to products for the purpose of maintenance, modifications and management involves all persons responsible for production and maintenance. It must be carried out in observance of the health and safety regulations described in section 2.5.

The minimum maintenance interval is indicated in section 10.1.

Equipment installed in an environment where there is a high concentration of dust requires more frequent maintenance than generally indicated.

The activities described may involve stopping the inverter. Once the maintenance procedure has been completed restart the inverter by pressing the START button.

WARNING

Failure to observe the maintenance prescriptions may result in the product warranty conditions being nullified.

NOTE

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

WARNING

In case of long downtimes, run the inverter fans for 24h before restarting the product in order to suppress condensation.
Please contact Elettronica Santerno SpA Customer Service for the necessary corrective actions.

10.1. Maintenance sheet

Maintenance tasks	Minimum Frequency
Read the stored data and Fault List	Every month
Checking the external/internal conditions of the electrical cabinet	Every 6 months
Air filter maintenance	Every 6 months
Check the emergency stop button	Every 12 months
Checking the door microswitches	Every 12 months
Check gaskets	Every 12 months
Check locks and hinges	Every 12 months
Check the fans	Every 6 months

Check control and auxiliary voltages (110 V and 24 V)	Every 6 months
Check fuses and disconnect switches	Every 6 months
Check SPDs	Every 6 months
Check that cables and bars are securely tightened	Every 12 months
Calibrate environmental sensors	Every 12 months
Check the condition of nameplate and warning signs	Every 24 months
The frequency of scheduled maintenance may need to be increased depending on the location in which the equipment is installed and the relative ambient conditions.	

Table 28: Maintenance Sheet

DC- Parallel Maintenance	Minimum Frequency
Check the DC-Parallel cables and bars are securely tightened	Every 12 months
Checking the fuse status switches on the DC-Parallel (if installed)	Every 12 months

Table 29: Integrated DC- Parallel Maintenance Sheet

10.2. Reading the fault list archives

To guarantee correct operation of the system all its components must be correctly matched up. Incorrect operation leads to lower yields 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 analysed at least once a month. To do this, proceed as described in the Programming Guide.

10.3. Checking the external and internal conditions

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 isolating 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.
- Check that the ventilation ducts on the inductors and transformers are clear.

Should it be necessary to clean the MODULAR SUNWAY TG TE OD, always adopt adequate measures. The electronic section in the MODULAR SUNWAY TG TE OD 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 the instructions.

10.4. 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.

Inverters of the MODULAR SUNWAY TG TE OD line are equipped with air intake grilles fitted with felt filters. Maintenance activities consist of replacing the felt filters.

The air intake grilles are located on the inverter rooftop, both on the front and the rear side.

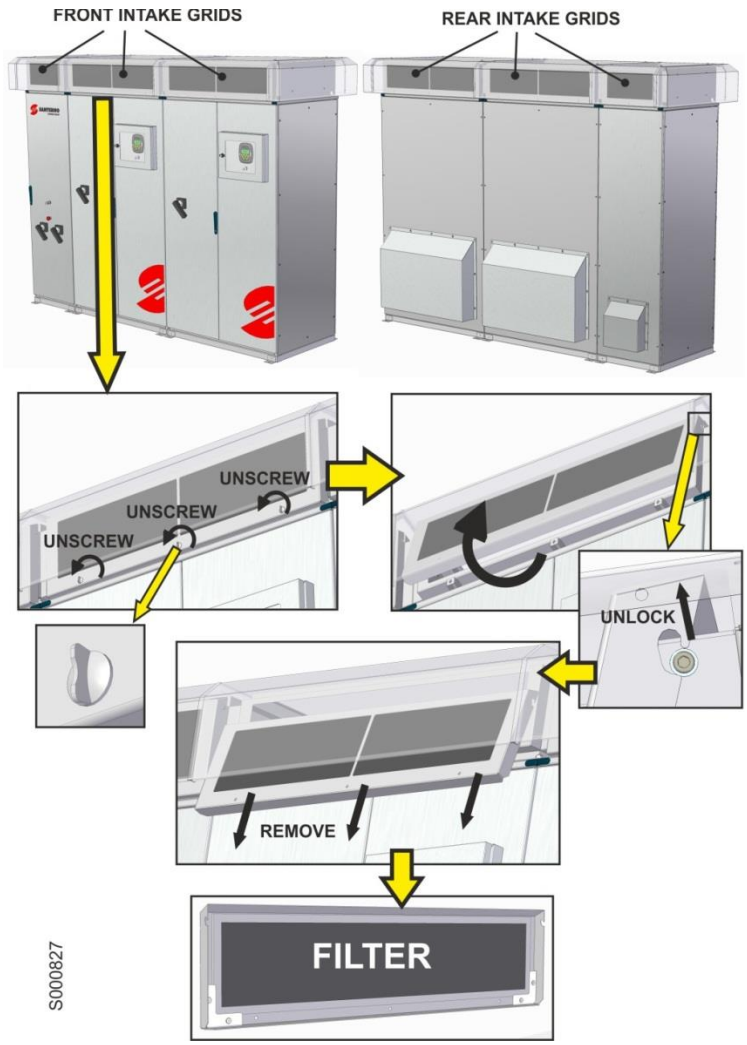


Figure 64: Replacing the filter felts

The figure above shows how to remove the air intake grilles in order to replace the filter felts.

Once the felts have been removed, reassemble the inverter parts in the reverse order.

WARNING

The air intake grilles are to be reassembled carefully. In particular, make sure that the grilles are perfectly tightened against their counter-frames. Wrong mounting may affect the IP rating of the inverter.

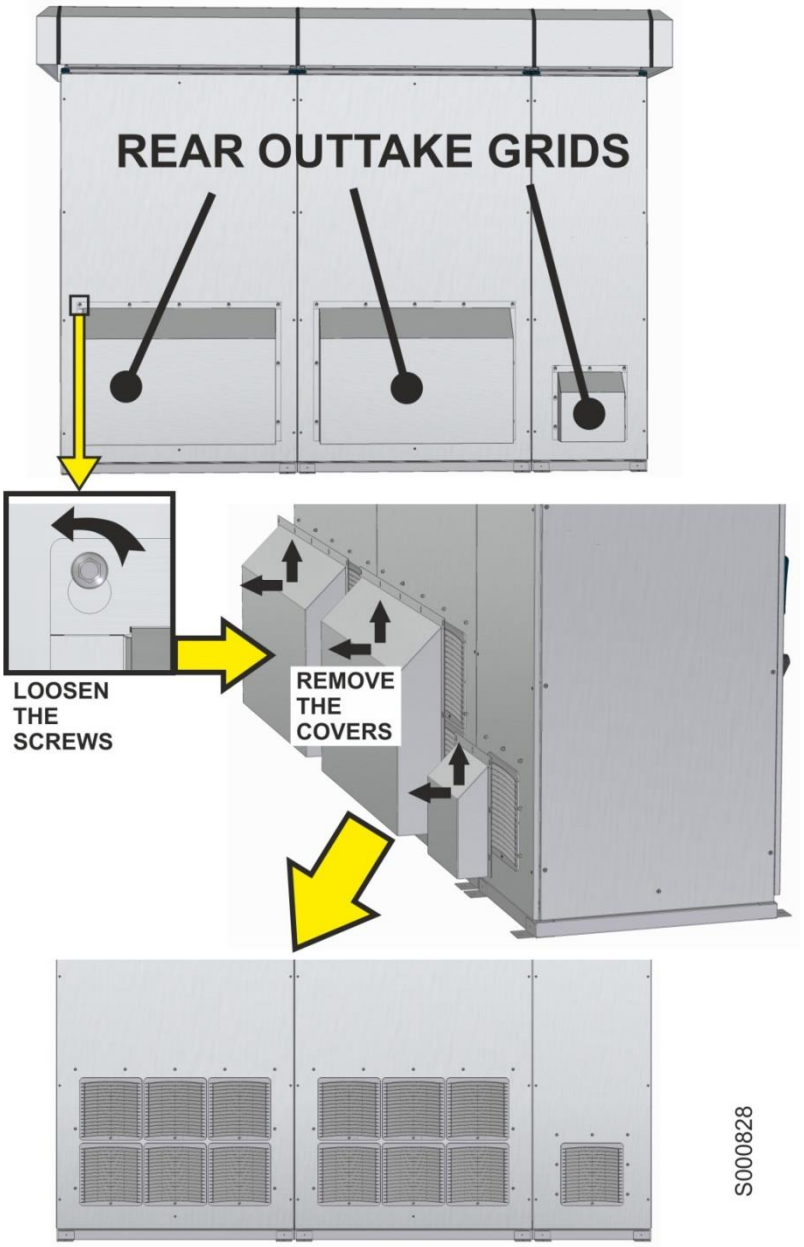


Figure 65: Removing the carter protecting the air outtake grilles

The front air intake grille can be removed by inserting a screwdriver in the point indicated (Figure 66) and gently levering it out. The filter is held in a cavity in the air intake grille which is securely fastened to the cabinet door.

All air intake grille filters should be replaced at the same time, both passive filters and those installed on the fan units. The type of felt filters used must be suitable for the application.

For the relative technical specifications, please refer section **Error! Reference source not found.**. R eplacement filters can be ordered from Elettronica Santerno.

NOTE

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

Figure 66: Filter replacement

WARNING

The carter protecting the air intake grilles is to be reassembled carefully. In particular, make sure that the covering is perfectly fastened to the cabinet wall. Wrong mounting may affect the IP rating of the inverter.

10.5. Checking the emergency stop button

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 the instructions.

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

- STOP the inverter.
- Make sure that key-operated selector switch 41SA1 (microswitch disabling door opening, see 10.6) is turned to DISABLED.
- 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.
- Open the doors.
- Check that the AC and DC control devices on the inverter are correctly opened.
- Close the electrical cabinet doors.
- Release the emergency stop button.
- Close the AC and DC control devices on the inverter.
- Turn key-operated selector switch 41SA1 (microswitch disabling door opening, see to ENABLED.
- Press START to restart the inverter.

10.6. 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 the instructions.

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.
- Make sure that key-operated selector switch 41SA1 is turned to ENABLED.
- Open the electrical cabinet doors.
- Check that the AC and DC control devices on the inverter are correctly opened.
- Close electrical cabinet doors.
- Press START to restart the inverter.

10.7. 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 to use talc to stop the seals from sticking to the sheet metal of the cabinet over time.
- Check correct operation of the inverter cabinet and compartment locks by locking and unlocking the doors.
- Check the door hinges operate smoothly.
- Spray all movable parts and parts subject to wear with a water-free lubricant.

10.8. 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 the instructions.

Check operation and noisiness of all the fans. Depending on the size of the inverter, there may by fans on the cabinet doors (please refer to section **Error! Reference source not found.**).

10.8.1. Converter fans

The converter features self-diagnostics of the fans operation. If a warning related to fan operation is displayed (check each DC module), please contact Elettronica Santerno's Customer Service.

10.8.2. Cabinet fans

On top of each DC module a fan unit is installed for air intake. In case of power supply loss, a warning appears. A warning also appears in case of malfunctioning or slow speed of rotation of one of 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.

The fans can be started up by gently heating the temperature sensor with a hairdryer.

At the end of inspection:

- Close electrical cabinet doors.
- Turn key-operated selector switch 41SA1 to ENABLED.

10.9. Checking control and auxiliary voltages

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 the instructions.

To check the cabinet control and auxiliary voltages, follow the instructions provided below.

The exact position of the control points can be seen on the Electrical and Mechanical Diagram.

10.9.1. Checking 24Vdc

For 1100V models, 24Vdc auxiliary power supply is obtained both from 230Vac auxiliary power supply and from the PV generator with separate power supply units. The 24vdc is checked to make sure that both power supply units are properly operating. Checking 24Vdc may be overridden for inverter models with PV field voltage ratings up to 1500Vdc, as the inverter is not started up in case of malfunction of the 230Vac/24Vdc power supply unit.

To check the 24 Vdc power supply 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 all the DC section displays come on.
- Close the DC disconnect switch of the PV generator (11QM1) of all the DC modules.
- Open the AC grid circuit breakers (30QM1 and 30QM2, if present).
- Check if the display comes on on both the DC sections (at least 400Vdc field voltage is required).

10.9.2. Checking 48Vdc

48Vdc Auxiliary power supply powers the fans of the converter heatsinks.

If the 48V is not applied, a warning message is displayed on the DC sections.

10.9.3. 230Vac auxiliary power supply

To check the 110 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 door of the AC module.
- Check the presence of 230 Vac voltage on the terminals X10 3 and 4.
- Check voltage presence downstream from fuses 27F2, 27F3, 27F4 and 27F5 (see Figure 67).
- Close the electrical cabinet door.
- Turn the key-operated selector switch 41SA1 to ENABLED.

Figure 67: Checking the 110 Vac control power supply

- Close electrical cabinet doors.
- Turn key-operated selector switch 18SA2 to ENABLED.

10.10. Checking the relays, fuses and disconnect switches

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.

10.11. Checking the SPDs

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.

Inspect the state of the SPDs (Surge Protective Devices) by checking the status of the button/slot on the discharger.

Each DC module is provided with one SPD and, if the *AC SPDs* option is present, one AC SPD is also provided.

The exact position of the SPDs can be seen on the Electrical and Mechanical Diagram.

Figure 68: Surge Protective Device

Button/slot Status	SPD Status
Button/slot with green indicator visible	SPD ready for use
Button/slot with red indicator visible	SPD faulty

Please refer to Table 53.

10.12. Calibration of environmental sensors

The MODULAR SUNWAY TG TE OD inverters have special calibration parameters for each channel relative to the environmental measures. Please refer to the Programming Guide.

10.13. Checking the tightening torque

The MODULAR SUNWAY TG TE OD inverters 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 in the field, in order to guarantee correct tightness of the electrical contacts, periodical checking of the tightening torques is to be carried out over the equipment's life cycle.

- Check the tightness of all the terminal clamps for connecting the power wiring and tighten if necessary.
- Pay particular attention to any colour variations or anomalies concerning the isolation and the terminals.
- Please refer to section 1.6, section **Error! Reference source not found.** and to the Electrical and M echanical Diagram of the inverter.

10.14. Checking the status switches for DC inputs fuses

In order to guarantee correct signalling in the event of fuse blowing suitably frequent checks must be carried out during the equipment's operating life to make sure signalling microswitches are operating correctly.

- Make sure all the upstream String Box disconnect switches are open, this ensures no voltage is applied to the fuses. Being as all the fuses are parallel connected downstream, if just one string box is powered the same voltage is present in all the fuses.
- STOP the inverter.

- Open the switch on the DC side of the converter.
- Make sure that the inverter that hosts the DC-Parallel is powered by the AC grid supply only and that the display/keypad is turned on.
- Make sure that the key-operated selector switch 41SA1 is set to DISABLED.
- Make sure that parameter C276 = Warning (Please refer to the Programming Guide).
- Open the door of the DC input section and remove the cover protecting the fuse holders where microswitch testing is to be carried out.
- Extract each microswitch from its support.
- Open the microswitch contact.
- Check that the inverter display/keypad of the DC module where the signal control is being done indicates “Warning”: W29 STR.FUSE KO.

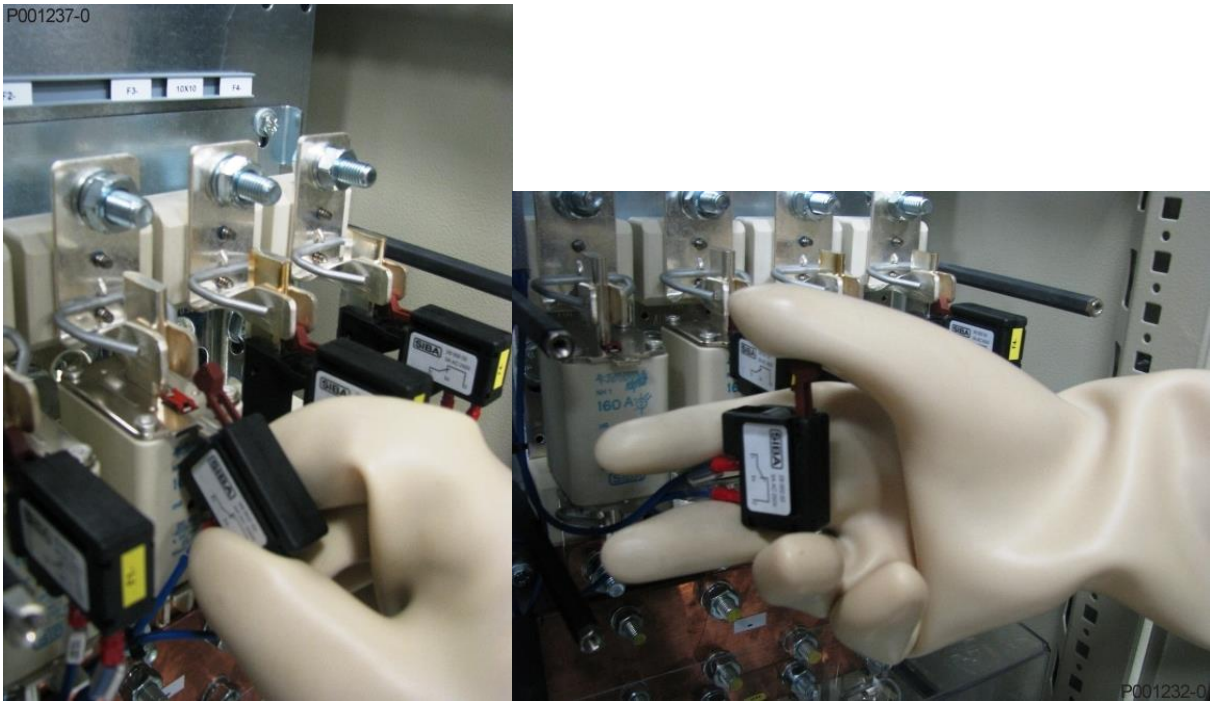


Figure 69: Testing of DC-Parallel fuse status switch

Once the status switches have been checked, follow the instructions above in the reverse order.

11. TROUBLESHOOTING

The SUNWAY TG TE products are completely protected against short-circuits and overvoltage caused by system failure or temporary phenomena. Furthermore, the control system performs complete self-diagnosis operations to help personnel solve any problems which may occasionally arise. The modular design of Elettronica Santerno inverters makes repair and/or reset operations quick and easy to perform.

This chapter indicates the most likely causes of the most common problems. The steps to be taken to remove these causes are also described.

NOTE

If the problem persists, please contact the Elettronica Santerno SpA CUSTOMER SERVICE.

11.1. Self-diagnostics

The inverter's self-diagnostics system detects and records most malfunctions and provides technical support elements which are useful for problem solving.

The elements providing support for diagnostic functions are as follows:

- Display/keypad, thanks to the messages which appear on the display and the indicator LEDs.
- Indicator LEDs on the RS485 galvanic isolation board.
- Indicator LEDs on the Data Logger board.
- Indicator LEDs on the control board.
- Mxxx measures relative to inverter functions, accessible from the display/keypad, in remote and/or local remote control.
- Inverter Fault List, accessible from the display/keypad, in remote and/or local remote control.

When a protection device trips or an alarm is given, the inverter stops and the ALARM LED comes on. The corresponding alarm is displayed on the display/keypad.

When an alarm occurs, the inverter records it in the Alarms list together with the time of occurrence (Supply Time and Operation Time), the status of the inverter and the value of certain sampling measurements taken at the time of alarm tripping. The stored data is very useful in helping to determine the cause which triggered the alarm and consequent removal of the alarm condition.

All the details relative to the alarms can be found in the Programming Guide.

11.2. Malfunctioning at start-up

11.2.1. The inverter has stopped by itself

- Check the inverter Enabling/Disabling key-operated selector switch (22SA1).
- Check the status of the digital inputs by way of measurement M032 (see the Programming Guide) on the displays in the DC modules. In particular, MDI1 (START STOP) and MDI2 (ENABLE must be closed). The inverter is STOPPED if one of these three conditions is true: MDI1 open (X6 19-20 terminal board, AC module), stop command sent via remote connection and Stop button pressed.

11.2.2. The inverter does not start when the START button is pressed

- Check that the PV OK LED is ON.
- Check that the GRID OK LED is ON.
- Check the status of the digital inputs, M032 measure (please refer to the Programming Guide).
- Check that the C004 Remote Command parameter is not active (please refer to the Programming Guide).

11.2.3. The PV OK LED is OFF

- Check if the inverter disconnect switch is closed.

- Check the DC voltage value read by the inverter, Measures Menu (please refer to the Programming Guide).
- Check that the set P020 value is compatible with the configuration of the strings (please refer to the Programming Guide).

11.2.4. The GRID OK LED is OFF

- Check if the grid AC switch is closed.
- Check the AC voltage value read by the inverter, Measures Menu (please refer to the Programming Guide).
- Check the value of the C020 and C021 grid parameters (please refer to the Programming Guide).
- Check the state of the external Interface Protection (AC module, terminals X6 17-20, visible on M032 MDI6).

11.2.5. Isolation loss detected

- Check if the inverter disconnect switch is closed.
- If the Earthed optional is not installed, with the DC disconnect switch closed, check if voltages are balanced in relation to earth (max. allowable margin = 5%).
- Open the DC disconnect switch.
- With the DC disconnect switch open, check if voltages are balanced in relation to earth (max. allowable margin = 10%) and that neither is near 0V.
- If the Earthed optional is installed, check the state of fuses 11F1 on each DC module.
- Check the status of the digital inputs, M032 measure (please refer to the Programming Guide).

11.3. Malfunctioning during operation

11.3.1. Isolation loss detected

Please refer to section 11.2.

11.3.2. The inverter does not produce the power expected

- Check that the air inlet filters are clean.
- Check that disconnect switches are closed on all String Boxes.
- Check MPPT is enabled (MPPT LED = ON, please refer to the Programming Guide).
- Check the P020 value (please refer to the Programming Guide).
- In the event of overheating, the inverter protects itself by derating its output power. Check the temperature measurements (please refer to the Programming Guide).
- Check that all its input fuses are intact.

11.3.1. The inverter trips

Alarms trip when malfunctioning occurs that may affect the inverter integrity. Please refer to the Programming Guide for details.

- Press RESET from the display/keypad to reset the alarms tripped. If the cause responsible for the alarm has disappeared, the alarm tripped is reset and the START command is to be given again.

NOTE

The alarms that are automatically reset (see the Autoreset Menu in the Programming Guide) do not clear the RUN status from the inverter memory, hence once that the causes responsible for the alarms tripped have been solved, they will be automatically reset and the inverter will still have the RUN command active.

WARNING

When an alarm message appears, identify the cause responsible for the alarm before restarting the inverter.

11.4. Malfunction of communication ports

11.4.1. Serial communication problems

- Check that all the programming parameters are correct.
- For malfunctions in serial communication affecting the COM1 port (present when the String Monitoring option is available) consult the self-diagnosis indicator LEDs on the RS485 galvanic isolation board (ES914).

The RS485 galvanic isolation board is equipped with a total of five LEDs, three LEDs for signalling the presence of various power supply voltages for the board itself and two LEDs for indicating fault conditions concerning the RS485 signals. The FAULT indication can only be considered valid if the line has been correctly terminated, i.e. DIP-switches SW1 and SW2 are both in the ON position.

LED	Colour	Function
L1	Green	Supply voltage [5 V] detected for inverter side RS485 circuits
L2	Green	Inverter supply voltage [9 V] detected
L3	Green	Supply voltage [5 V] detected for Master side RS485 circuits
L5	Red	Inverter side RS-485 signal faults
L6	Red	COM1 port side RS-485 signal faults

Table 30: RS485 galvanic isolation board self-diagnosis LEDs

DANGER

The galvanic isolation board is located inside the converter. Remove the front carter from the converter to gain access to the board. Make sure that the cabinet is in safe conditions before accessing the board.

Do the following:

- Stop the inverter
- Open the DC disconnect switches on the present DC modules
- Open the AC circuit breakers on the AC module
- Cut off auxiliary power supply
- Open the door of the DC module to be checked
- Remove the top protective grille from the DC section
- Remove the front carter from the converter (see section 6.6.1)
- Reassemble the protective grille
- Apply 230V auxiliary voltage

Fault conditions may be due to one of the following:

- Differential voltage between A and B below 450 mV.
- A or B exceed the common mode voltage range [-7 V; 12 V].
- A or B connected to a fixed voltage (this condition can only be detected when communication has been established).

Please refer to section 4.8 for the location of the indicator LEDs and the configuration DIP-switches.

Figure 70: ES914 isolation board

11.4.2. Ethernet communication problems

- Check that all the programming parameters are correct.
- Check the Ethernet port self-diagnosis LEDs on the Data Logger board.

DANGER

The Data Logger board is located inside the converter. Remove the front carter from the converter to check the Data Logger board. Be sure that the electrical cabinet is in safety conditions before checking Ethernet communication.

11.5. Safety devices tripped

11.5.1. AC circuit breaker tripped

- Check if the emergency stop button has been pressed.

- Check the status of the digital inputs, M032 measure (please refer to the Programming Guide), in particular:
    - Check the contacts of the key-operated selector switches on the DC modules.
    - Check the status of the AC output circuit breaker feedback signal contacts.
- When the switch is open RUN status is lost. Press START.

11.5.2. DC disconnection switch tripped

- Check the polarity of the PV field poles.
- Check if the emergency stop button has been pressed.
- Check the status of the digital inputs, M032 measure (please refer to the Programming Guide), in particular:
    - Check the contacts of the key-operated selector switches on the inverter door.
    - Check the status of the AC output switch feedback signal contacts.
- When the disconnect switch is open RUN status is lost. Press START.

11.5.3. SPDs tripped or fuses blown

- Make sure the DC disconnect switch is closed.
- If the inverter is NOT equipped with the Earthed Optional: check that voltages are balanced in relation to earth (max. allowable margin; 5% - 10%).
- If the inverter is equipped with the Positive Earthed Optional: check that the positive pole voltage is close to 0V.
- If the inverter is equipped with the Negative Earthed Optional: check that the negative pole voltage is close to 0V.
- Open the DC disconnect switch.
- If the inverter is NOT equipped with the Earthed Optional: check that voltages are balanced in relation to earth (max. allowable margin; 5% - 10%).
- If the inverter is equipped with the Positive Earthed Optional: check that the positive pole voltage is close to 0V.
- If the inverter is equipped with the Negative Earthed Optional: check that the negative pole voltage is close to 0V.
- If the inverter is equipped with the Earthed Optional check the earth polarization fuses. Please refer to section 8.1.

11.5.4. Blown earth fuses for negative or positive earthed options

- Check for any earth faults on the PV field. Proceed as described in section 11.5.3.
- Check for any earth faults downstream from the AC output.

11.5.5. Replacing a fuse in the DC sections

To replace a fuse, proceed as follows:

- Make sure that all the disconnect switches for the upstream strings are open: 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 in the DC section being maintained is NOT running, i.e. that it is STOPPED.
- Open the disconnect switch on the DC side of the converter.
- On the AC section, open the output switch related to the DC section where the damaged fuse needs replacing.

- Make sure that key-operated selector switch 41SA1 is set to DISABLED.
- Open the door on the DC section and remove the lower grille covering the base of the input fuse-holder.
- Remove the auxiliary contact kit from the damaged fuse.
- Remove the faulty fuse using the special isolated handle provided.
- Install a new fuse using the special isolated handle provided.
- Reconnect the auxiliary contact kit to the new fuse.
- Reassemble the protective grille.

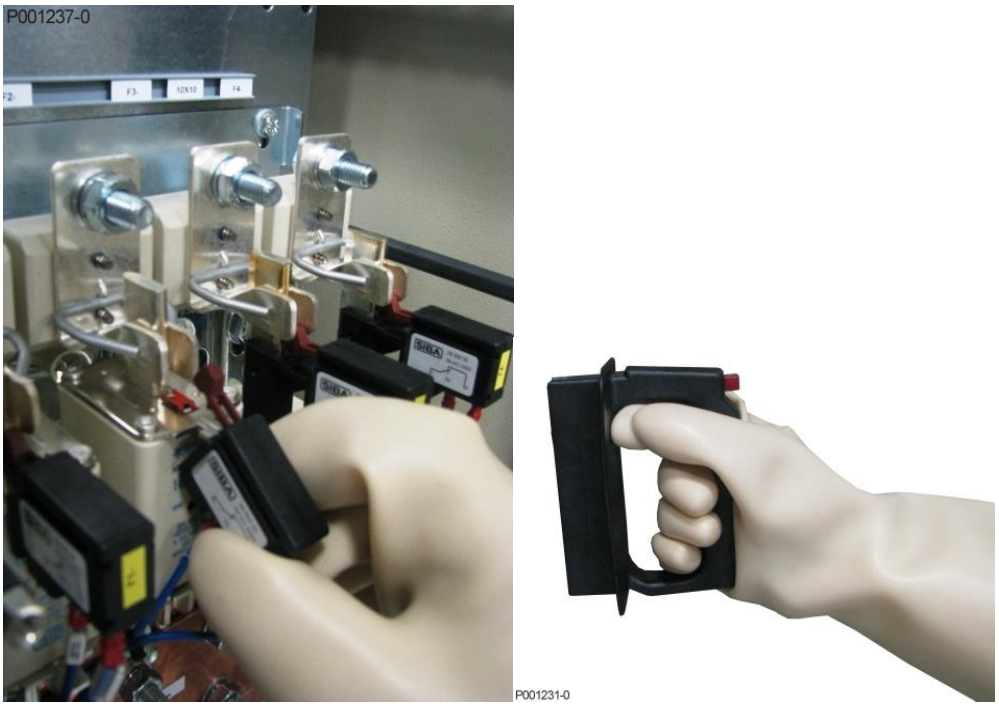


Figure 71: Extracting the fuse: disconnection of a microswitch and handle for removing the fuse

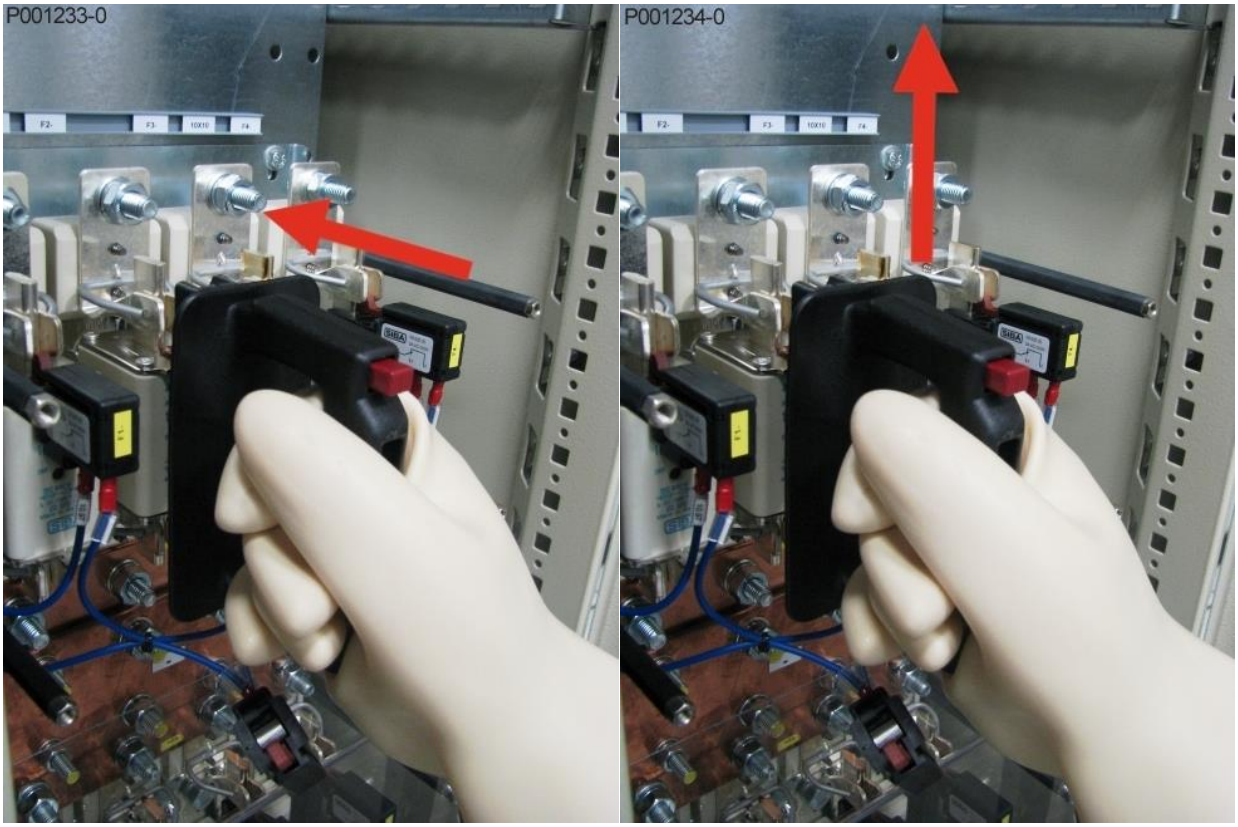


Figure 72: Extracting the fuse: using the isolated handle for removing the fuse

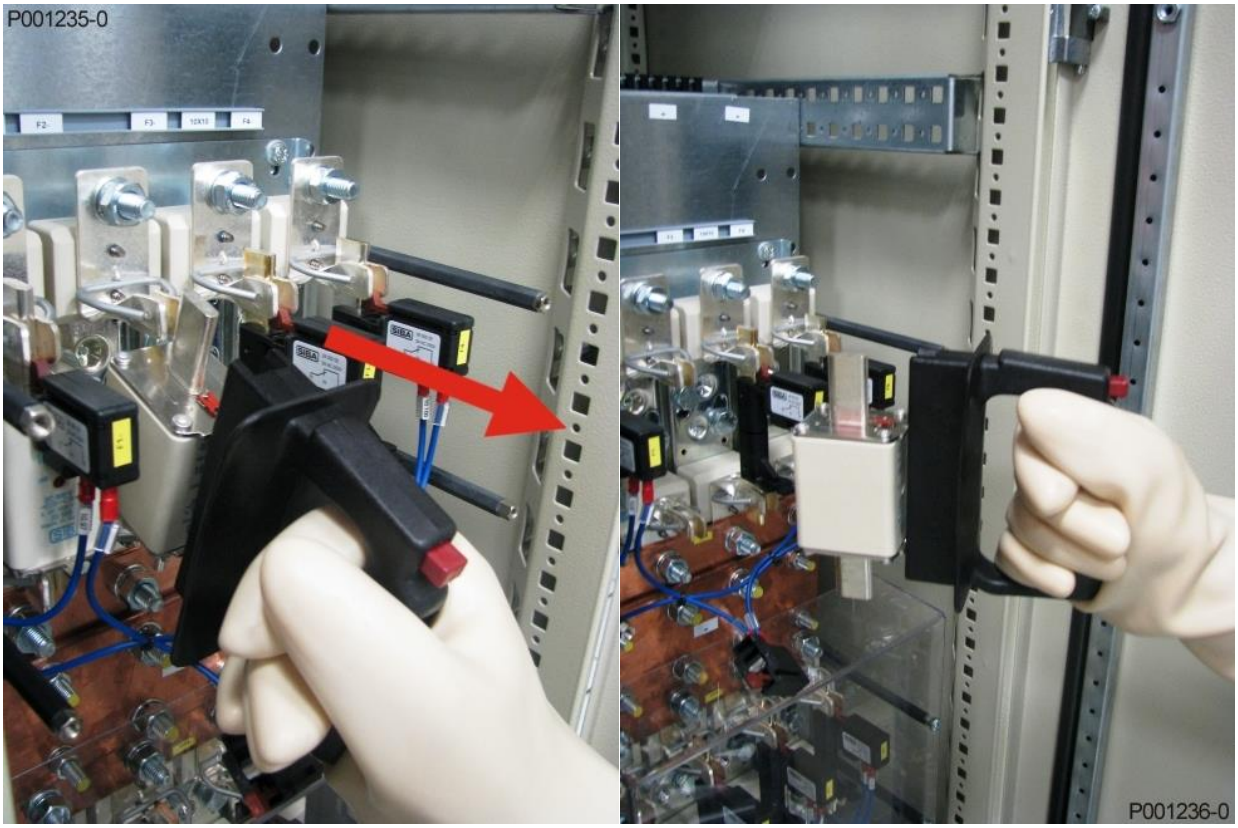


Figure 73: Extracting the fuse: using the isolated handle for removing the fuse

Once the fuse has been replaced, restore all the conditions for inverter operation (please refer to section 6.9).

11.6. General principles in the event of failure

Access to the PV system components for the purpose of maintenance, modifications and management involves all persons responsible for production and maintenance. It must be carried out in observance of the health and safety regulations described in section 2.5.

11.6.1. Fault containment

The following prescriptions are of a general nature.

- Place the equipment affected by the fault in safety conditions. This operation may involve stopping and disconnecting all the up- and downstream devices. Please refer to section 2.4.
- If the fault has occurred inside an inverter, press an emergency stop button to cut the inverter off up- and downstream. Open the disconnect switches of all the string boxes so that the entire DC input section is safe.
- In multi-inverter systems it is usually sufficient to cut off the inverter affected by the fault both up- and downstream so that the other inverters can remain in operation.
- If the fault has occurred in one of the components downstream from the inverter (AC parallel cabinet, external transformer, metering cabinet etc.) STOP all the machines and then press the emergency stop button to cut off the inverter both up- and downstream.
- If the fault has occurred in one of the components upstream from the inverter (String Box, etc.) STOP all the machines and then press the emergency stop button to cut off the inverter both up- and downstream. Open the disconnect switches of all the String Boxes so that the entire DC input section is safe.
- If the fault has occurred in one of the String Boxes, please refer to the relevant User Manual.
- Proceed with analysis of the causes and consequences of the fault.

NOTE

If necessary, please contact the Elettronica Santerno SpA CUSTOMER SERVICE.

11.6.2. Fault analysis

This section covers the main principles to be observed when analysing the causes and consequences of faults.

A PV inverter usually operates as part of an overall system. All the components adopt various protective measures therefore, in general, the consequences of a generic fault affecting an upstream component or element does not extend to other components downstream.

However, the causes and the consequences of any faults which may arise need investigating on the plant as a whole.

Fault investigation and analysis activities represent one of the most hazardous tasks assigned to maintenance technicians. This manual only provides indications of an extremely generic nature concerning the precautions which must be adopted when fault investigation and analysis activities need to be carried out on live components.

In the event of a fault, before proceeding to resolve the problem, the following tasks must be performed to evaluate:

- The state of components and the system as a whole:
  - Check the state of the contacts.
  - Check the state of cables.
  - Check the status of any interface protection installed in the system.
  - Check the state of all protective elements installed in the system.
  - Check the state of any auxiliary power supplies.
  - Check the level of humidity present on system components.
- If faults have occurred on each box, inverter and/or the system:
  - Check for any earth faults on the DC side and the AC side.

- Make sure all prescriptions have been observed relative to the neutral connection or those relative to field configuration (floating, Positive Earthed, Negative Earthed).
- Check the state of the SPDs.

Once all the aforementioned steps have been performed, proceed with evaluating:

- The causes of faults.
- The consequences of faults on the electrical, electromechanical and electronic components.
- The steps to be taken to remove the cause of the fault.

Once all the aforementioned steps have been performed, proceed with rectifying the causes of the fault.

NOTE

If necessary, please contact the Elettronica Santerno SpA CUSTOMER SERVICE.

11.6.3. DC section parallel fault analysis

This section describes faults relative to one or more DC section fuses blowing (if present). If a fuse blow, procedures cannot be limited to simply replacing the fuse. Suitable analysis of the fault which caused the problem must be also carried out.

Before replacing a blown fuse, the following tasks must be performed to evaluate:

- If faults have occurred on each inverted and/or the system.
- The causes of faults.
- The consequences of faults on the electrical, electromechanical and electronic components.
- The steps to be taken to remove the cause of the fault.

Once all the aforementioned steps have been performed, proceed with replacing the damaged fuse(s).

NOTE

If necessary, please contact the Elettronica Santerno SpA CUSTOMER SERVICE.

11.7. How to contact the Customer Service

Should it be necessary to contact the Elettronica Santerno SpA CUSTOMER SERVICE, please provide the following data:

- Equipment model
- Serial Number
- Date of commissioning
- Order confirmation reference, if available

If the equipment in question is an inverter, it is advisable to recover the following information from the memory:

- Number of operating hours (please refer to the Programming Guide)
- Fault list (please refer to the Programming Guide)

This operation can be carried out using the display/keypad or by using the Remote Sunway program with local or remote connection.

Should it be necessary to send the equipment in for repair or to return the equipment, contact the Elettronica Santerno SpA CUSTOMER SERVICE, to agree upon the terms.

12. TECHNICAL DATA

12.1. Nameplate

Each nameplate indicates the product's technical data and identification details.

- Name of the product.
- Part number assigned to the product by Elettronica Santerno.
- Technical data (rated input/output voltage and current, rated power, etc.)
- CE marking and indications of the relative reference Standards applied in the construction of the equipment (CE is a registered collective trademark).
- Product revision index.
- Serial Number: identifies the product serial number

The nameplate measures 100 x 70 mm and is silver in colour.

Example of a nameplate on a MODULAR SUNWAY TG TE OD inverter:

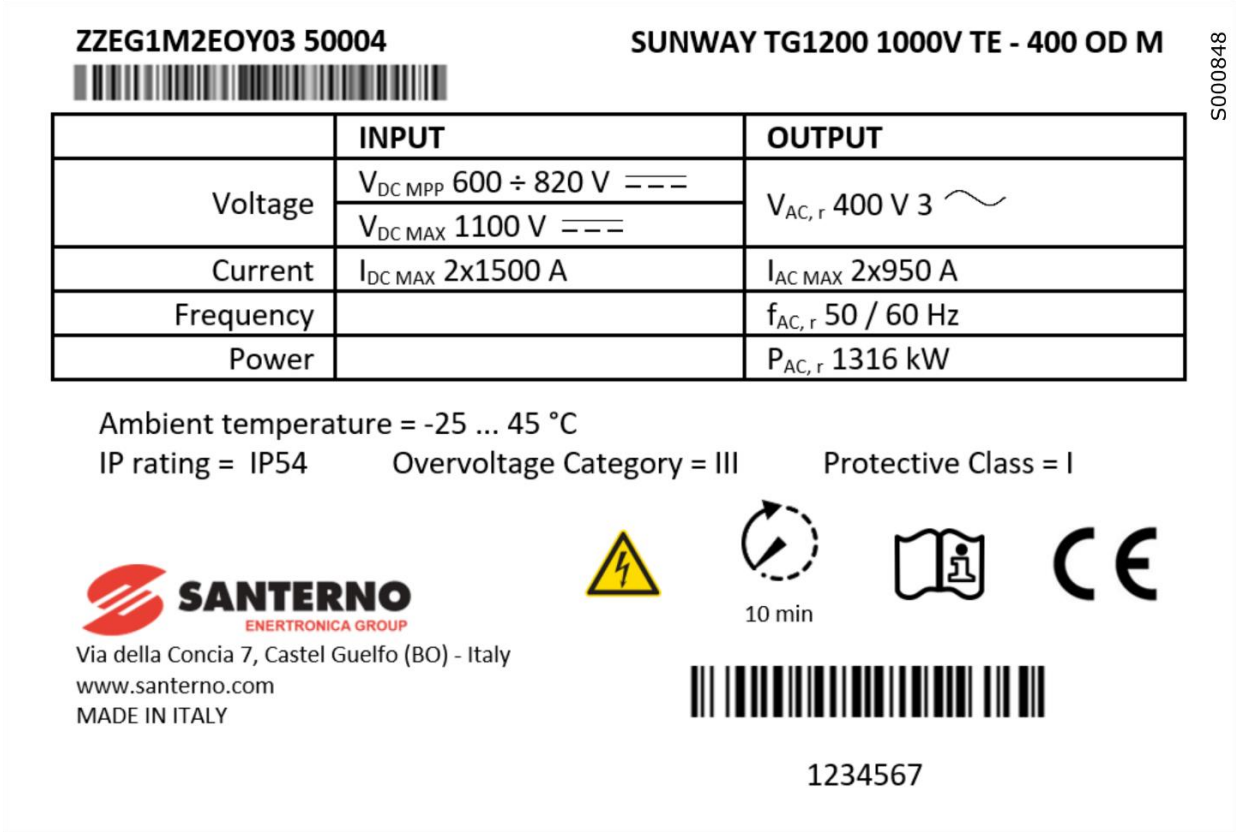


Figure 74: Example of a nameplate of a SUNWAY TG TE inverter

12.2. Installation specifications

Installation specifications for MODULAR SUNWAY TG TE OD	
Operating ambient temperature	Minimum temperature: -10 °C (-25 °C with optional anti-condensation heater) Maximum temperature: see section 12.3
Operating ambient humidity	From 4% to 100%
Altitude	Up to 1000 m ASL For higher altitudes, please refer to sections 0 and 12.3.4.
Installation site	Outdoor
Degree of protection	IP54
Degree of pollution	Class 3S2 or better, according to IEC 60721-3-3
Transformer	External LV/MV

Table 31: Installation specifications for MODULAR SUNWAY TG TE OD

Model	Noise [dBA]
SUNWAY TG 610 1100V TE	69
SUNWAY TG 1200 1100V TE	71
SUNWAY TG 900 1500V TE	69
SUNWAY TG 1800 1500V TE	71

Table 32: SUNWAY TG TE Noise (1m; Tamb=25°C)

12.2.1. Clearance

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

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

An additional minimum clearance of 61cm from the ceiling shall be left for ventilation purposes and for lifting the inverter from top.

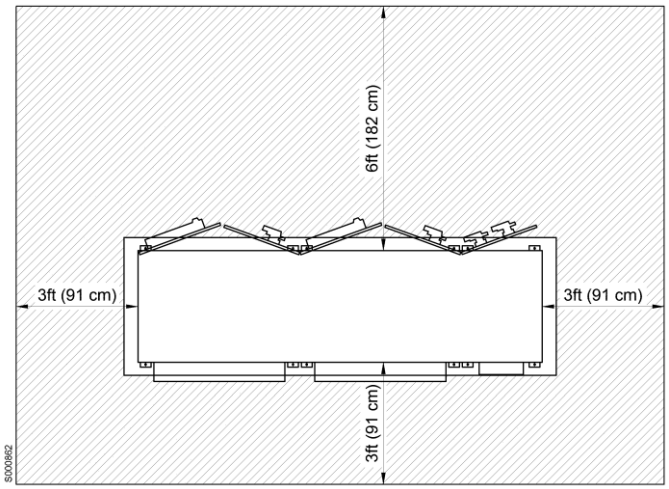


Figure 75 : Minimum clearance

NOTE

If necessary, please contact the Elettronica Santerno SpA CUSTOMER SERVICE.

12.3. Electrical specifications

MODULAR SUNWAY TG TE OD (*)		U. M.	1000V TE	1500V TE
Maximum DC input voltage		V_{DC}	1000	
Output frequency		Hz	50/60	
Residual ripple voltage on the PV field			<1%	
Total distortion of grid current			≤3%	
Power factor			Default: 1 Circular capability	
Uc Pulse withstanding voltage	DC Input	kV	4.8	6
	AC Output		4	

Table 33: SUNWAY TG TE OUTDOOR electrical specifications

(*) The values in the table may be changed to suit special applications.

12.3.1. SUNWAY TG 1000V TE OD

	SUNWAY TG610 1000V TE – 360	SUNWAY TG610 1000V TE – 380	SUNWAY TG610 1000V TE – 400	SUNWAY TG610 1000V TE – 420	SUNWAY TG1200 1000V TE – 202	SUNWAY TG1200 1000V TE – 360	SUNWAY TG1200 1000V TE – 380	SUNWAY TG1200 1000V TE – 400	SUNWAY TG1200 1000V TE – 420
DC INPUT									
Max DC input current [A]	1500				2*1500				
MPPT Range [V]	540-820	570-820	600-820	630-820	315-820	540-820	570-820	600-820	630-820
Extended MPPT range [V]	520-1000	540-1000	570-1000	620-1000	290-850	520-1000	540-1000	570-1000	620-1000
AC OUTPUT (1)									
Rated AC output current [A]	950				1900				
Rated grid voltage [V_{AC}]	360	380	400	420	202	360	380	400	420
Rated power [kVA]	592	625	658	691	665	1185	1251	1316	1382
EFFICIENCY									
Maximum efficiency	98.7 %				98.7 %				
European efficiency	98.4 %				98.4 %				
GENERAL SPECS									
Degree of protection	IP54								
In Stop mode [W]	50				90				
In the night-time [W]	50				90				
Auxiliary consumptions [W] (2)	1700				2700				

Table 34: Technical data for SUNWAY TG 1000V TE by model

(1) @ T_A=45°C
(2) Does not include the combiner boxes power supply

12.3.2. SUNWAY TG 1500V TE OD

	SUNWAY TG900 1500V TE – 580	SUNWAY TG900 1500V TE – 590	SUNWAY TG900 1500V TE – 600	SUNWAY TG900 1500V TE – 610	SUNWAY TG900 1500V TE – 620	SUNWAY TG900 1500V TE – 630	SUNWAY TG900 1500V TE – 640	SUNWAY TG900 1500V TE – 650	SUNWAY TG900 1500V TE – 660	SUNWAY TG900 1500V TE – 670	SUNWAY TG900 1500V TE – 690	SUNWAY TG1800 1500V TE – 580	SUNWAY TG1800 1500V TE – 590	SUNWAY TG1800 1500V TE – 600	SUNWAY TG1800 1500V TE – 610	SUNWAY TG1800 1500V TE – 620	SUNWAY TG1800 1500V TE – 630	SUNWAY TG1800 1500V TE – 640	SUNWAY TG1800 1500V TE – 650	SUNWAY TG1800 1500V TE – 660	SUNWAY TG1800 1500V TE – 670	SUNWAY TG1800 1500V TE – 690
DC INPUT																						
Max DC input current [A]	1500											2*1500										
MPPT Range [V]	850	860	880	890	910	920	930	950	960	980	1000	850	860	880	890	910	920	930	950	960	980	1000
	1200																					
Extended MPPT range [V]	830	840	860	870	880	900	910	930	940	960	980	830	840	860	870	880	900	910	930	940	960	980
	1500																					
AC [1] OUTPUT																						
Rated AC output current [A]	800											1600										
Rated grid voltage [V_{AC}]	580	590	600	610	620	630	640	650	660	670	690	580	590	600	610	620	630	640	650	660	670	690
Rated power [kVA]	803	817	830	844	859	873	887	901	915	928	956	1606	1634	1660	1688	1718	1746	1774	1802	1829	1856	1912
EFFICIENCY																						
Maximum efficiency	98.7 %											98.7 %										
European efficiency	98.4 %											98.4 %										
GENERAL SPECS																						
Degree of protection	IP54																					
In Stop mode [W]	50											90										
In the night-time [W]	50											90										
Auxiliary consumptions [W] [2]	1700											2700										

Table 35: Technical data of SUNWAY TG 1500V TE for TG 900, TG 1800 models

(1) @ T_A=45°C
(2) Does not include the combiner boxes power supply

12.3.3. Maximum voltage derating

When equipment is installed at a high altitude, the maximum DC voltage, i.e. the maximum Voc value applicable to the product in accordance with section 12.3 must be derated as indicated in the table:

Altitude [m]	Maximum DC voltage/max. Voc
0-4000m asl	Unchanged

Table 36: Maximum DC voltage based on altitude

If equipment is to be installed at over 4000 m, please contact Elettronica Santerno SpA.

12.3.4. Rated current derating and uprating

The inverters of the SUNWAY TG TE series automatically adjust the output current at ambient temperature. Figure 75 shows the maximum current pattern based on ambient temperature for installation at sea level.

If the ambient temperature drops below the rated current setpoint, the inverter automatically increases the output current within the limits in Figure 75.

Viceversa, if the ambient temperature exceeds the specified temperature at full power, the inverter limits its output current to protect the internal components against overtemperature.

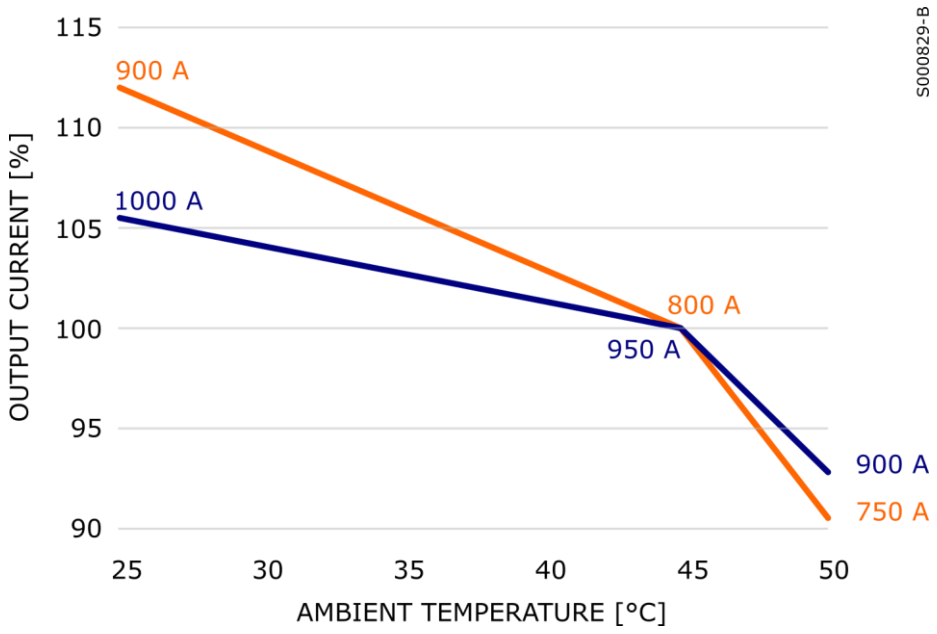


Figure 76: Temperature derating (at sea level)

For installations above 1000 m a.s.l., the output current is to be decreased by the K_A factor. The temperature trend is shown in Figure 77.

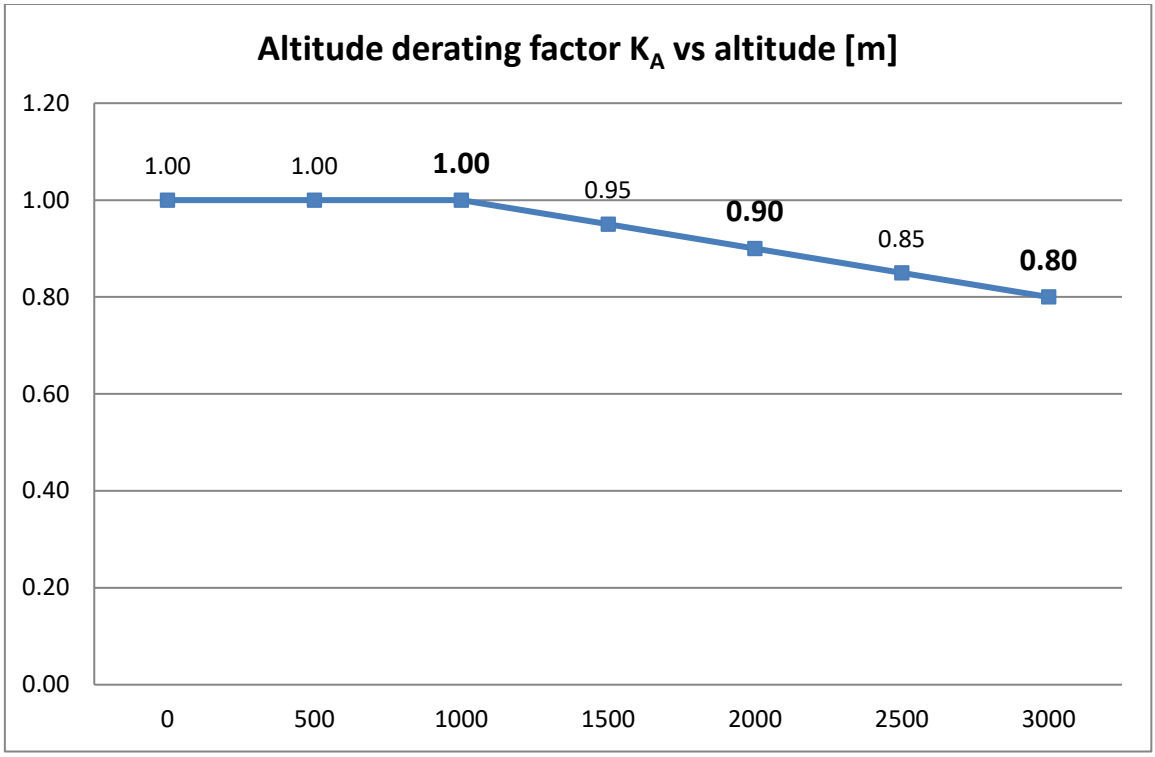


Figure 77: Coefficient Kt for temperature derating (at sea level)

Defined $I_{OUT\,0}$ as the output current at sea level, the IOUT output current at a given altitude is obtained as:

$$I_{OUT}(altitude) = I_{OUT\,0} * K_A(altitude)$$

NOTE

The values in the figure above may change based on specific applications.

For applications above 3000 m, please contact Elettronica Santerno.

12.3.5. Short-circuit current contribution

The maximum short-circuit time-current mask has been evaluated in a system always including a low voltage transformer, as illustrated in the figures below:

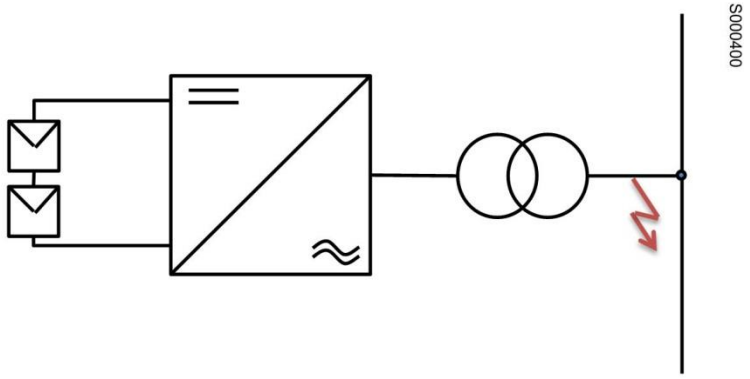


Figure 78: Short circuit localization in the SUNWAY TG TE inverters

The following assumptions considered as general cases are taken into account:

- Transformer short-circuit voltage: 6%
- Transformer losses: 1%

Under the assumptions above, the short-circuit current is included in the dashed area in the graph below:

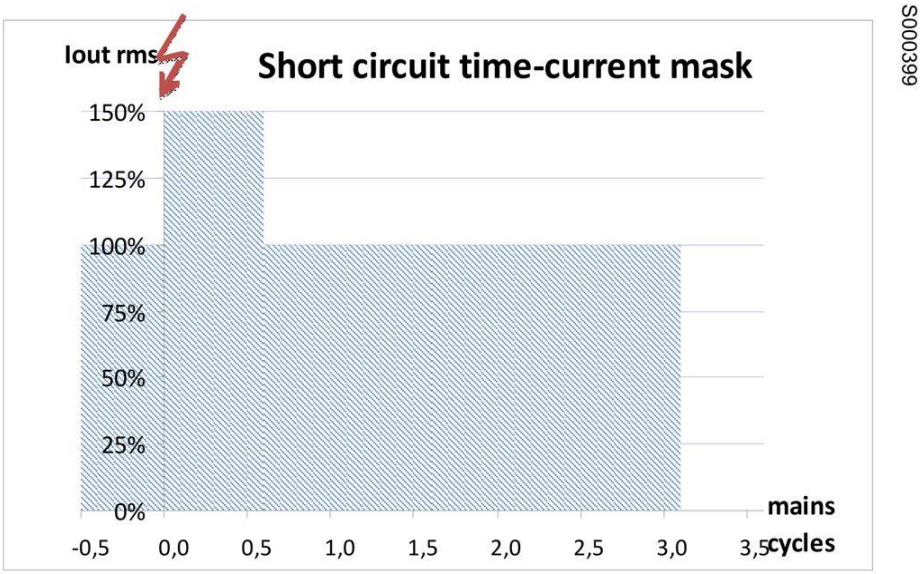


Figure 79: Maximum short-circuit time-current mask

12.4. Inverter views

SUNWAY TG TE	IP54
TG610 1000V TE	
TG900 1500V TE	
TG1200 1000V TE	
TG1800 1500V TE	

Table 37: Inverter views

12.5. Installed converter module

Inverter Model	Converter	Converter Layout	Type of converter
TG 610 1000V TE	SUNWAY S62		Monolithic

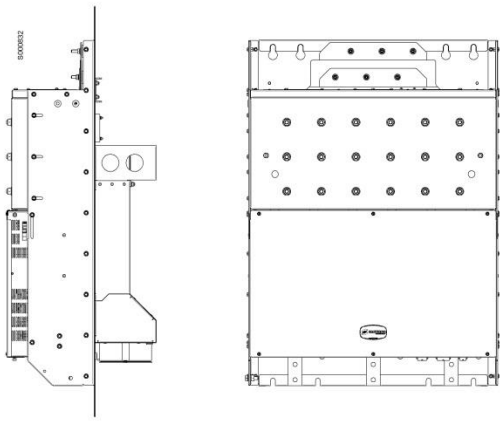
TG 1200 1000V TE			
TG 900 1500V TE			
TG 1800 1500V TE			

Table 38: Converter Module

12.6. Inverter ventilation system

Ventilation system absorption and flow rate data for SUNWAY TG TE inverters is provided below. The technical data of the felt filter in accordance with EN 779 and EUROVENT classification is also provided.

Inverter Model	Ventilation flow rate [m^3/h]	Ventilation system absorption [W]
TG 610 1000V TE	3000	1230
TG 900 1500V TE		
TG 1200 1000V TE	4900	2300
TG 1800 1500V TE		

Table 39: SUNWAY TG TE ventilation technical data

	EN 779	EUROVENT
Type of felt	G2	EU 2

Table 40: Classification of the felt filter installed in the air intake grilles

WARNING

The air ventilation outlet must not be obstructed in any way by walls or other objects standing in front of it at a distance less than prescribed in section 12.2.1.

No ducting structure of any kind is allowed unless expressly authorized by Elettronica Santerno.

12.7. Dimensions and weights

12.7.1. Packaged inverter

Inverter Model	Roofless Inverter	Roof

	Dimensions WxHxD [mm]	Weight [kg]	Dimensions WxHxD [mm]	Weight [kg]
TG 610 1000V TE OD	2000 x 2350 x 1110	1770	2130 x 495 x 1110	200
TG 900 1500V TE OD				
TG 1200 1000V TE OD	3200 x 2350 x 1110	2770	3330 x 495 x 1110	300
TG 1800 1500V TE OD				

Table 41: SUNWAY TG TE dimensions and weights

Inverter Model	Hoisting with ropes from top	Lifting with forks from bottom
TG 610 1000V TE OD	NO	YES
TG 900 1500V TE OD		
TG 1200 1000V TE OD	NO	YES
TG 1800 1500V TE OD		

Table 42: Handling methods of the packaged inverter

12.7.2. Inverter without packaging

The dimensions and weight of the inverter including the rooftop are given in the table below.

Inverter Model	Dimensions WxHxD [mm]	Weight [kg]
TG 610 1000V TE OD	2025 x 2375 x 1075	1770
TG 900 1500V TE OD		
TG 1200 1000V TE OD	3225 x 2375 x 1075	2770
TG 1800 1500V TE OD		

Table 43: Dimensions and weights of the SUNWAY TG TE inverters

Inverter Model	Hoisting with ropes from top	Lifting with forks from bottom
TG 610 1000V TE OD	Yes	NO
TG 900 1500V TE OD		
TG 1200 1000V TE OD	Yes	NO

TG 1800 1500V TE OD		

Table 44: Handling modes

WARNING

Remove the inverter rooftop before handling the inverter.

Handling the inverter is allowed exclusively as described in section 5.3. Different handling methods may damage the equipment and lead to serious dangerous situations.

12.8. Connection of power and signal cables

12.8.1. DC connection - input cables

Cables coming from the PV field are to be connected directly to the fuse holders.

Inverter model	Terminal	N. of connectable cables	Rated voltage to ground and to a different conductor (V)	Max. allowable cable cross-section [mm²]	Outer cable diameter [mm]	Screw supplied	Tightening torque [Nm]	Max. cable lug [mm]
TG 610 1000V TE OD	Bar	8	1000	300	27÷35	M10 with fuse-holder NH1XL and NH2 M12 with fuse-holder NH3L	32 Nm with fuse-holder NH1XL and NH2 38Nm with fuse-holder NH3L	36
TG 900 1500V TE OD	Bar	7	1500					
TG 1200 1000V TE OD	Bar	16 (8+8)	1000					
TG 1800 1500V TE OD	Bar	14 (7+7)	1500					

Table 45: Input DC Cable connection data

WARNING

The fuse-holder terminals are not compatible with aluminum conductors. Bi-metal cable lugs are required when using aluminum conductors.

In case cables with diameter cross-sections smaller than the minimum allowable cross-section for the cable lug are used, the special adaptors are required in order not to affect the equipment degree of protection.

12.8.2. AC connection - output cables

Inverter model	Location	Terminal board identification	Type of terminal	N. of connectable cables per phase	Maximum voltage and RMS voltage to ground (V)	Max. cable cross-section [mm²]	Recommended cross-section [mm²]	Cable outer diameter [mm]	Screw supplied	Tightening torque [Nm]	Max. cable lug width [mm]
TG 610 1000V TE	AC Module	X7	2 bars 50mm for each output phase (tin soldered aluminum)	3	1400/800	300	Aluminum: 3 parallel cables 300 mm² for each output phase Copper: 3 parallel cables 185mm² for each output phase	27÷35	M12	60-80	36
TG 900 1500V TE					2000/1100						
TG 1200 1000V TE		X7 DC1 Module converter X7B DC2 Module converter			1400/800						
TG 1800 1500V TE					2000/1100						

Table 46: Technical data for AC output cables

WARNING

In case cables with cross-sections smaller than the minimum allowable cross-section for the cable lug are used, the special adaptors are required in order not to affect the equipment degree of protection.

The recommended cable cross-section relates to 90°C isolated cables, 45°C ambient temperature, installed in air.

Always check cable layout conditions.

12.8.3. Connection of earth cables

Inverter model	Collocation	Terminal identification	Type of terminal	N. of connectable cables	Max. cable cross-section [mm²]	Cable outer diameter [mm]	Screw supplied	Tightening torque [Nm]	Max. cable lug width [mm]
TG 610 1000V TE		⏚		3	300	27÷35	M12	60-80	36

TG 900 1500V TE	AC Module		Copper bar						
TG 1200 1000V TE									
TG 1800 1500V TE									

Table 47: Technical data for earth cables

DANGER

Always observe the regulations applicable to the installation place for the dimensioning of the earth cables.

12.8.4. Connection of auxiliary power supply cables

The auxiliary power supply is to be connected only if the *Self-power supply option* is not installed.

Inverter Model	Terminals	Voltage/ Frequency	Power [VA]	Minimum allowable cable cross-section [mm²]	Maximum allowable cable cross section [mm²]
TG 610 1000V TE	X10 3-4 AC module	230Vac 50-60Hz	2700	0.5	2.5
TG 900 1500V TE					
TG 1200 1000V TE	X10 3-4 AC module	230Vac 50-60Hz	4000	0.5	2.5
TG 1800 1500V TE					

Table 48: Technical data for auxiliary power supply cables

12.8.5. Connecting the UPS

To connect the UPS, remove the jumpers between terminals 5 and 7 and 6 and 8 in X10 in the AC module.

Inverter Model	Terminals	Voltage/ Frequency	Average Power [VA]	Peak Power (1s) [VA]	Minimum allowable cable cross-section [mm²]	Maximum allowable cable cross section [mm²]
TG 610 1000V TE	X10 7-8 AC Module	230 Vac 50-60 Hz	100	500	0.5	2.5
TG 900 1500V TE						
TG 1200 1000V TE		230 Vac	150	950	0.5	2.5

TG 1800 1500V TE	X10 7-8 AC Module	50-60 Hz				

Table 49: Technical data for power supply from UPS

12.8.6. String box power supply

When the String Box option is present, a power supply line for the Smart String Boxes is available.

Inverter Model	Terminals	Voltage / Frequency	Available power [VA]	Minimum cable cross-section [mm^2]	Maximum cable cross-section [mm^2]
TG 610 1000V TE	X10 9-10 AC module	230Vac 50-60Hz	500	0.5	2.5
TG 900 1500V TE					
TG 1200 1000V TE	X10 9-10 AC module	230Vac 50-60Hz	1000	0.5	2.5
TG 1800 1500V TE					

Table 50: Technical data for power supply from UPS

12.8.7. Input/Output signals connection

Inverter Model	Terminal board	Minimum cable cross-section [mm^2]	Maximum cable cross-section [mm^2]
ALL	X6, AC module	0.5	2.5

Table 51: Signal cable technical data

12.8.8. Environmental inputs connection

Inverter Model	Terminal board	Minimum cable cross-section [mm^2]	Maximum cable cross-section [mm^2]
ALL	X10, DC module	0.5	2.5

Table 52: Environmental inputs technical data

12.9. PV-Side SPD Specifications

The technical specifications for SPDs are provided in the table below.

Technical specifications		
	1000V TE	1500V TE

Rated voltage of PV Plant [V]	1000	1500
Maximum voltage of PV Plant [V]	1000	1500
Rated discharge current [kA]	12.5	12.5
Response time [ns]	25	25
Configuration	Y-connection of N.3 SPDs to varistor	
UP safety level (L-L / L-PE) [kV]	4	6
Remote signal contact		
Type	1 NO/NC	
Maximum range	250 Vac - 0.5 A	
Cable cross-section [mm^2]	1.5	
Environmental conditions		
Operating temperature [°C]	-40...+80	
General specifications		
Removable cartridges	Yes	
UL94 Fire resistance	V0	

Table 53: SPD technical specifications

12.10. Grid-side SPD Configuration

When an SPD trips, its impedance SPD drops to very low values. This limits surge and drains induced currents for equipment safety. However, if the SPDs are earthed, they may create a low-impedance path for the plant currents, thus nullifying the IT configuration.

If the SPDs are installed to protect the AC inverter output, be careful to properly consider the plant design, should an Earthed option be required. This configuration can cause switching frequency common mode voltage to be greater than the output rated voltage.

It is therefore advisable to adopt the following SPD configuration:

- For the differential mode protection, a star configuration connected to the neutral (use the neutral/start centre on the inverter side as a reference) is advisable
- For the common mode protection, a properly dimensioned SPD connected between the neutral and the earth is advisable

If the grid-side SPDs are required, the PV field configuration for the proper dimensioning of the SPDs is to be specified when ordering the product.

12.11. Control Board

Screw terminal board with 6 separate removable sections suitable for 0.08 - 1.5 mm^2 (AWG 28-16) cables.

No.	Name	Description	I/O Features	DIP-switch
1	CMA	0V for main reference (connected to control 0V).	0V control board	
2	REF	Analogue input which can be configured as a voltage input or current input Analogue input available for the Power Control function if configured as a voltage input.	Vfs = ±10 V Rin: 50 kΩ Resolution: 12 bits	SW1-1: Off
			0 (4) – 20 mA Rin = 250 Ω Resolution: 11 bits	SW1-1: On
3	-10VR	Negative -10 V power supply output	-10 V Imax: 10 mA	
4	+10VR	Positive +10 V power supply output	+10V Imax: 10 mA	
5	AIN1+	Analogue grid voltage input.	Vfs = ±10 V Rin: 50 kΩ Resolution: 12 bits	SW1-2: Off
6	AIN1-		n/a	SW1-2: On
7	AIN2+	Analogue grid voltage input.	Vfs = ±10 V Rin: 50 kΩ Resolution: 12 bits	SW1-3: Off SW1-4.5: Off
8	AIN2-		n/a	SW1-3: On SW1-4.5: Off
9	CMA	0V for auxiliary inputs (connected to control 0V).		
10	AO1	Delivered active power fed back to AO1 analogue output. Please refer to the Programming Guide.	Vout = ±10 V Ioutmax = 5 mA Resolution: 11 bits	SW2-1: On SW2-2: Off
			0 (4) – 20 mA Voutmax = 10 V Resolution: 10 bits	SW2-1: Off SW2-2: On
11	AO2	Field voltage fed back to AO2 analogue output. Please refer to the Programming Guide.	Vout = ±10 V Ioutmax = 5 mA Resolution: 11 bits	SW2-3: On SW2-4: Off
			0 (4) – 20 mA Voutmax = 10 V Resolution: 10 bits	SW2-3: Off SW2-4: On
12	AO3	Field current fed back to AO3 analogue output. Please refer to the Programming Guide.	Vout = ±10 V Ioutmax = 5 mA Resolution: 11 bits	SW2-5: On SW2-6: Off
			0 (4) – 20 mA Voutmax = 10 V Resolution: 10 bits	SW2-5: Off W2-6: On

No.	Name	Description	I/O Features	DIP-switch
13	CMA	0V for analogue outputs (connected to control 0V).		

Table 54: Terminals 1 - 13 available on the control board

No.	Name	Description	I/O Features	DIP-switch
14	MDI1	Digital input Please refer to the Electrical and Mechanical diagram	Optoisolated digital inputs 24 Vdc: positive logic (PNP type) active with high signal in relation to CMD (terminal 22).	
15	MDI2 (ENABLE)	Input active: inverter enabled to run Input not active: inverter disabled		
16	MDI3	Digital input Please refer to the Electrical and Mechanical diagram		
17	MDI4	Digital input Please refer to the Electrical and Mechanical diagram		
18	MDI5	Digital input Please refer to the Electrical and Mechanical diagram		
19	MDI6	Digital input Please refer to the Electrical and Mechanical diagram		
20	MDI7	Digital input Please refer to the Electrical and Mechanical diagram		
21	MDI8	Digital input Used for carrier phase synchronization		
22	CMD	0V digital input isolated in relation to control 0V Used for carrier phase synchronization	Optoisolated 0V digital inputs	
23	+24V	Auxiliary power supply output for digital inputs. Used for carrier phase synchronization	+24 V±15% max: 100 mA Protected by self-resetting fuse	
24	+VMDO1	Power supply input for MDO1 output Used for carrier phase synchronization	20 ÷ 48 Vdc Isc = 10 mA + output current (max 60 mA)	
25	MDO1 /FOUT	Multifunction digital output 1: frequency output Used for carrier phase synchronization	Push-pull optoisolated digital output Iout = 50 mA max fout max 100 kHz.	
26	CMDO1	0V multifunction digital output 1 Used for carrier phase synchronization	MDO1 common power supply and output	

No.	Name	Description	I/O Features	DIP-switch
27	MDO2	Digital output Please refer to the Electrical and Mechanical diagram	Isolated digital output; open collector type; Vomax = 48 V Iomax = 50 mA	
28	CMDO2	MDO2 common digital output	MDO2 common digital output	
29	MDO3-NC	Digital relay output 3 (NC contact) Please refer to the Electrical and Mechanical diagram	Switch contact: with low level logic the common terminal is closed with NC terminal, with high level logic common terminal is closed with NO Vomax = 250 Vac Iomax = 3 A Vomax = 30 Vdc Iomax = 3 A	
30	MDO3-C	Digital relay output 3 (common) Please refer to the Electrical and Mechanical diagram		
31	MDO3-NO	Digital relay output 3 (NO contact) Please refer to the Electrical and Mechanical diagram		
32	MDO4-NC	Multifunction digital relay output 4 (NC contact) Please refer to the Electrical and Mechanical diagram		
33	MDO4-C	Multifunction digital relay output 4 (common) Please refer to the Electrical and Mechanical diagram		
34	MDO4-NO	Multifunction digital relay output 4 (NO contact) Please refer to the Electrical and Mechanical diagram		

Table 55: Terminals 14 - 34 available on the control board

12.12. Environmental sensors and field I/Os expansion board

12.12.1. List of signals to terminal board

Screw terminal board with 12 separate removable sections suitable for 0.08 - 1.5 mm^2 (AWG 28-16) cables.

No.	Name	Description	I/O Features	DIP-switch
1-2		NOT USED – DO NOT CONNECT		
3	CMA	Analogue inputs 0 V (common with control 0V)	0V control board	
4-5	+15VM-15VM	Stabilized bipolar power supply output protected against short-circuit by external sensors	+15 V -15 V Iout max: 100 mA	
6	CMA	Analogue inputs 0 V (common with control 0V)	0V control board	

No.	Name	Description	I/O Features	DIP-switch
7-26		NOT USED – DO NOT CONNECT		
27	**XAIN1/T1+**	ENVIRONMENTAL MEASURE 1 auxiliary analogue input	Voltage input: 0-10 V Rin = 30 kΩ	SW1.3 = ON SW1.1-2-4 = OFF
			Voltage input: 0-100mV Rin = 1 MΩ	SW1.4 = ON SW1.1-2-3 = OFF
			Current input: 0-20mA Rin = 124,5 Ω	SW1.2 = ON SW1.1-3-4 = OFF
			PT100 Temperature measurement	SW1.1 and 1.4 ON SW1.2 and 1.3 OFF
		Default	Solar radiation measurement via 0-20mA output	SW1.2 = ON SW1.1-3-4 = OFF
28	**CMA/T1-**	Analogue inputs 0V for XAIN8 feedback	0V control board	
29	**XAIN2/T2+**	ENVIRONMENTAL MEASURE 2 auxiliary analogue input	Voltage input: 0-10 V Rin = 30 kΩ	SW1.7 = ON SW1.5-6-8 = OFF
			Voltage input: 0-100mV Rin = 1 MΩ	SW1.8 = ON SW1.5-6-7 = OFF
			Current input: 0-20mA Rin = 124.5 Ω	SW1.6 = ON SW1.5-7-8 = OFF
		Default	PT100 Temperature measurement	SW1.5-8 = ON SW1.6-7 = OFF
30	**CMA/T2-**	Analogue inputs 0V for XAIN9 feedback	Vfs = 10 V Rin = 30 kΩ	SW2.3 = ON SW2.1-2-4 = OFF
31	**XAIN10/T3+**	ENVIRONMENTAL MEASURE 3 auxiliary analogue input **USED FOR THE MEASUREMENT OF THE TEMPERATURE INTERNAL TO THE INVERTER – DO NOT ALTER DIP-SWITCH SETTINGS**	Vfs = 100 mV Rin = 1 MΩ	SW2.4 = ON SW2.1-2-3 = OFF
			Ifs = 20 mA Rin = 124.5 Ω	SW2.2 = ON SW2.1-3-4 = OFF
			PT100 Temperature measure	SW2.1-4 = ON SW2.2-3 = OFF
32	**CMA/T3-**	Analogue inputs 0V for XAIN3 feedback	0V control board	

No.	Name	Description	I/O Features	DIP-switch
33	**XAIN11/T4+**	ENVIRONMENTAL MEASURE 4 auxiliary analogue input **USED FOR THE MEASUREMENT OF THE TEMPERATURE INTERNAL TO THE INVERTER – DO NOT ALTER DIP-SWITCH SETTINGS**	PT100 Temperature measure	SW2.5-8 = ON SW2.6-7 = OFF
34	**CMA/T4-**	Analogue inputs 0V for XAIN11 feedback	0V control board	
35	**XAIN12**	Auxiliary analog input NOT USED	Voltage input: 0-10 V Rin= 30 kΩ	
36	**CMA**	Analogue inputs 0V for XAIN12 feedback	0V control board	
37	**XAIN13**	Auxiliary analog input NOT USED	Voltage input: 0-10 V Rin= 30 kΩ	
38	**CMA**	Analogue inputs 0V for XAIN13 feedback	0V control board	
39	**XMDI1**	Multifunction auxiliary digital input 1	24 Vdc optoisolated digital inputs; positive logic (PNP type): active with high signal in respect to CMD 43-49).	
40	**XMDI2**	Multifunction auxiliary digital input 2		
41	**XMDI3**	Multifunction auxiliary digital input 3		
42	**XMDI4**	Multifunction auxiliary digital input 4		

No.	Name	Description	I/O Features	DIP-switch
43	**CMD**	0V digital input isolated in relation to control 0V	Common	
44	**+24V**	Auxiliary power supply output for optoisolated multifunction digital inputs.	+24 V	
45	**XMDI5**	Multifunction auxiliary digital input 5	24 Vdc opoisaleted digital inputs; positive logic (PNP type): active with high signal in respect to CMD (terminals 43-49).	
46	**XMDI6**	Multifunction auxiliary digital input 6		
47	**XMDI7**	Multifunction auxiliary digital input 7		

No.	Name	Description	I/O Features	DIP-switch
	XMDI8	Multifunction auxiliary digital input 8		
49	**CMD**	Digital inputs isolated 0V in respect to control 0V	Common	
50	**+24V**	Auxiliary power supply output for multifunction optoisolated inputs	+24 V	
51-62		NOT USED		

Table 56: Terminals available on the environmental sensors and field I/O board

12.13. Electrical specifications

ANALOGUE INPUTS

Analogue inputs configured in 0-10 V mode	Rating			
	Min	Typ	Max	Unit
Input impedance		40		kΩ
Cumulative offset and gain error in relation to full scale value		0.5		%
Temperature coefficient of the offset and gain error			200	ppm/°C
Digital resolution			12	bit
Voltage LSB value		2.44		mV/LSB
Permanent overload on the inputs without causing damage	-30		+30	V
Input filter cut-off frequency (low-pass first order filter)		1		Hz
Sampling period (depending on the application SW in use)	10		1000	ms

Table 57: Analogue inputs configured in 0 - 10 V mode

Analogue inputs configured in 0-20 mA mode	Rating			
	Min	Typ	Max	Unit
Input impedance		40		kΩ
Cumulative offset and gain error in relation to full scale value		0.5		%
Temperature coefficient of the offset and gain error			200	ppm/°C
Digital resolution			12	bit

Voltage LSB value		2.44		mV/LSB
Permanent overload on the inputs without causing damage	-3.7		+30	V
Input filter cut-off frequency (low-pass first order filter)		1		Hz
Sampling period (depending on the application SW in use)	10		1000	ms

Table 58: Analogue inputs configured in 0 - 100 mA mode

Analogue inputs configured in 0-100 mV mode	Rating			
	Min	Typ	Max	Unit
Input impedance	1			MΩ
Cumulative offset and gain error in relation to full scale value		0.2		%
Temperature coefficient of the offset and gain error			50	ppm/°C
Digital resolution			12	bits
Voltage LSB value		24.7		µV/LSB
Permanent overload on the inputs without causing damage	-30		+30	V
Input filter cut-off frequency (low-pass first order filter)		1		Hz
Sampling period (depending on the application SW in use)	10		1000	ms

Table 59: Analogue inputs configured in 0 - 100 mV mode

Analogue inputs configured as temperature measurement with PT100	Rating			
	Min	Typ	Max	Unit
Type of probe	2-wire connection PT100 thermistor			
Measurement range	-50		125	°C
PT100 element polarization current		0.67		mA
Temperature measurement coefficient			50	ppm/°C
Digital resolution			12	bits
Maximum cumulative measurement error over -40 °C ÷ +50 °C temperature range		0.5	1.5	°C
Mean value of temperature LSB (SW linearization function)		0.098		°C/LSB

Permanent overload on the inputs without causing damage	-10		+10	V
Input filter cut-off frequency (low-pass first order filter)		1		Hz
Sampling period (depending on the application SW in use)	10		1000	ms

Table 60: Analogue inputs configured as temperature measurement with PT100

POWER SUPPLY OUTPUTS

Specifications of the analogue power supply outputs	Rating			
	Min	Typ	Max	Unit
Voltage available at terminal +15 V (4) with respect to CMA (6)	14.25	15	15.75	V
Voltage available at terminal -15 V (5) with respect to CMA (6)	-15.75	-15	-14.25	V
Maximum current which can be delivered from output +15 V and be absorbed by output -15 V			100	mA

Table 61: Specifications of the analogue power supply outputs

Specifications of the digital power supply outputs	Rating			
	Min	Typ	Max	Unit
Voltage available at terminals +24 V (44 + 49) with respect to CMA (43 and 50)	21	24	27	V
Maximum current which can be delivered from output +24 V			200	mA

Table 62: Specifications of the digital power supply outputs

WARNING

If the maximum/minimum input or output voltage ratings are exceeded, irreparable damage to the equipment may occur.

NOTE

The isolated power supply output and the analogue auxiliary output are protected by a resettable fuse capable of protecting the power supply unit inside the inverter against faults following a short circuit, but it cannot be guaranteed that the inverter will temporarily cease operation in the event of a short circuit.

13. DECLARATIONS OF CONFORMITY

The declarations of conformity are available for download from santerno.com.

14. ANNEXES

14.1. Revision Index

Revision 01:

- Index removed.
- 1100V version on page 11 rectified.
- Cable gland/lug terminology rectified in sections 6.6.2 and 6.6.3.
- Figure 26 rectified.
- Table 34 updated.

Revision 04:

- Sunway TG900 and Sunway TG1800 @ 580-690 Vac specifications added