● 15P00EGB100 ●

SUNWAY TG TE - STANDARD

THREE-PHASE PHOTOVOLTAIC INVERTER WITH EXTERNAL TRANSFORMER

USER MANUAL

- INSTALLATION GUIDE -

Updated: 03/07/2013
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 product 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 product in its original setting.
- Any changes to the structure or operating cycle of the product must be performed or authorized by 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 product without prior notice. If printing errors or similar are detected, the corrections will be included in the new releases of the manual.
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1. GENERAL INFORMATION ON THE PRODUCT

Figure 1: SUNWAY TG TE STANDARD line

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

The line includes the following versions:

- 800V version, suitable for field voltage ratings up to max. 880 Vdc.
- 1000V version, suitable for field voltage ratings up to max. 1000 Vdc.

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 modular design of Elettronica Santerno's inverters and the wide range of available products suit the most demanding applications quickly and successfully.

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. Operating Principles

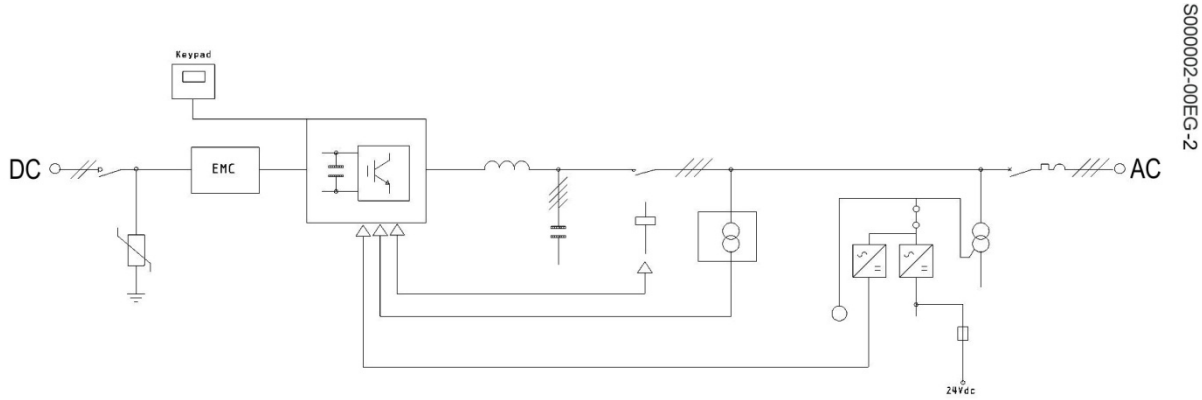


Figure 2: Single-wire diagram of a SUNWAY TG TE inverter

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 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.

AC output unit

This AC Output Unit comprises control devices, such as Contactor for the connection to the grid that can operate as an Interface Device (please refer to section 4.2), the sinusoidal filters and the output EMI filters.

The inverter is provided with an interface device operating on minimum and maximum voltage / frequency thresholds in compliance with the standards in force (see “SUNWAY TG TE CERTIFICATION AND GRID INTERFACE FILE”).

Figure 3: Block diagram

Once the SUNWAY TG TE is connected to the photovoltaic generator and is properly started, the control system synchronises with the grid and closes the parallel contactor 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 4.2.1).

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 standard RS485 comms ports for the connection to the remote monitoring system, both in local mode and in remote mode (see section 4.7).

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 8.1).

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 detection of the DC-Parallel input fuses (if a DC-Parallel cabinet is installed).

Whenever necessary, the DC input section can be completed with a DC-Parallel cabinet (please refer to section 9).

1.2. Main Integrated Standard Functions

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

- Max. 6 environmental inputs monitoring solar radiation sensors, temperature sensors and wind sensors.
- Constant check for PV isolation.
- 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 Sunway Station.

1.3. Optional Functions

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

- Data Logger Board
- GPRS Router
- Field connection with earth pole (Positive Earthed or Negative Earthed)
- Anti-condensation heater
- Power Meter
- Efficiency Meter

The PV field input parallel compartment with safety fuses on both DC-Parallel poles is also available.

1.4. Scope of this Manual

This manual covers:

- All inverters belonging to the SUNWAY TG TE STANDARD series.
- The DC-Parallel cabinet PV field input parallel compartment with safety fuses.

1.5. For Whom this Manual is Intended

This manual must be read by:

- Installers
- Operators
- Plant manager

Please refer to section 1.9.

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	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.
Certification and Grid Interface File	Contains the Declaration of Conformity to standards which are applicable to the product and information on the network interface parameters.

Table 1: Documentation supplied with the product

Name of the document	Scope
DC-Parallel Electrical and Mechanical Diagram	Contains detailed information on the internal layout and electrical diagram of the product.
DC- Parallel Final Test Certificate	It contains all the information concerning the execution and outcome of Production Tests. It also contains the configuration of the fuses installed.
DC-Parallel Declaration of Conformity	Contains the Declaration of Conformity to standards applicable to the product.

Table 2: Documentation supplied with the DC-Parallel (if present)

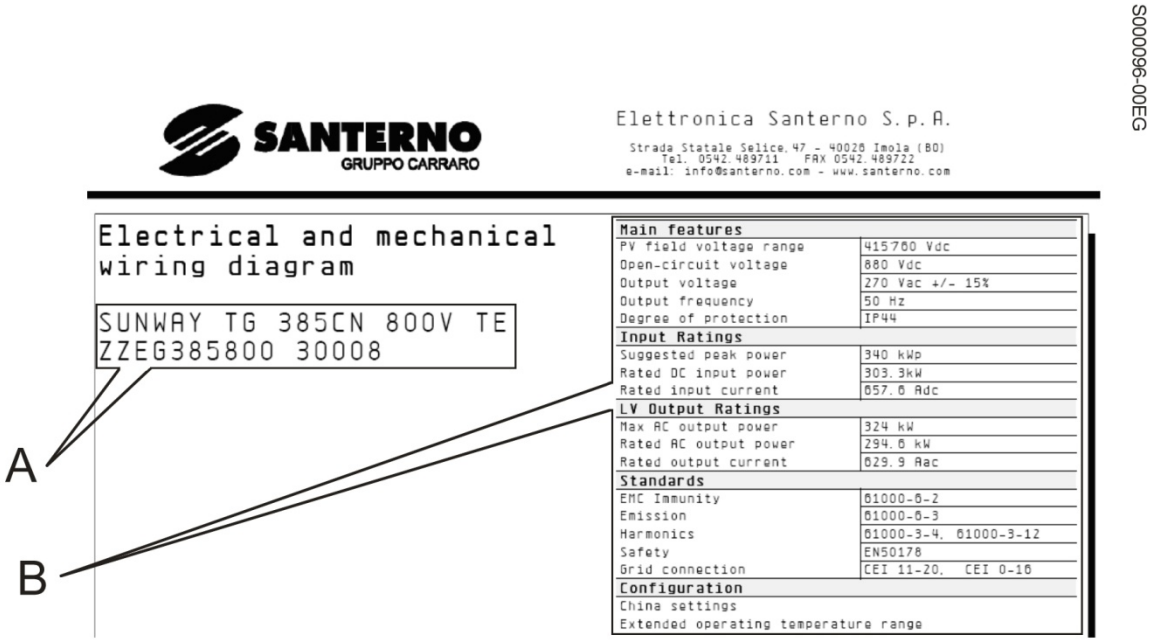
1.6.1. Preservation of the Documentation

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.

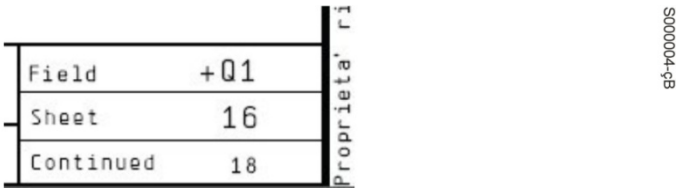
The first page of the Electrical and Mechanical Diagram contains the technical features and configuration of the inverter, as illustrated below:



A Type of inverter and code

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

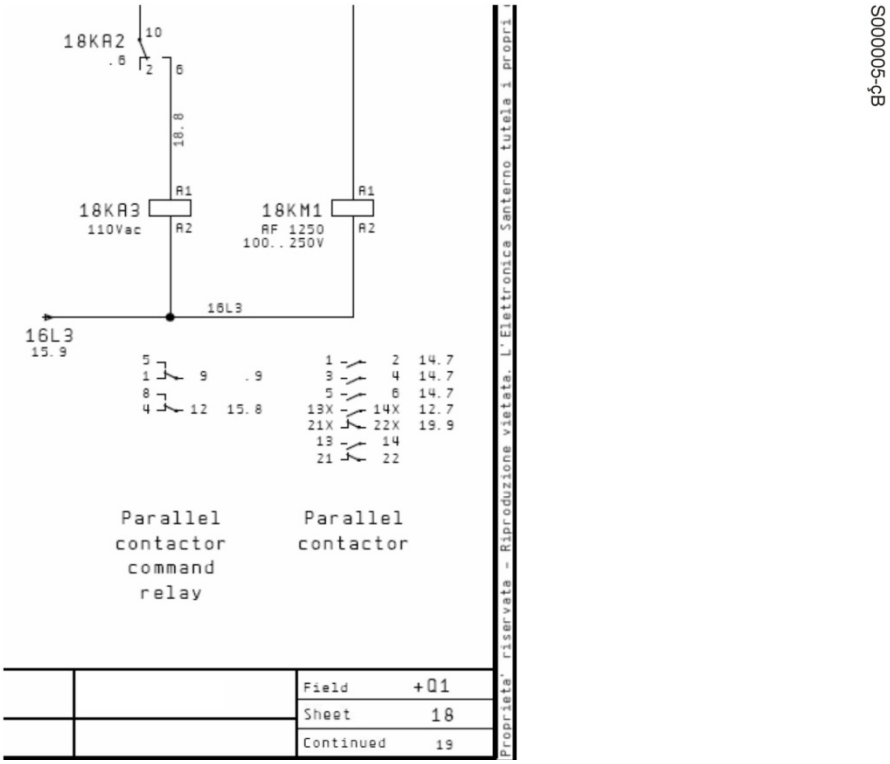
+Q1F = On the front of the electrical cabinet

+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 SUNWAY TG TE inverter. It contains all the information concerning the execution and outcome of Production Tests.

DC-PARALLEL

The Final Test Certificate for the DC-Parallel (if present), shows the exact configuration of the installed fuses for each channel.

1.7. References for the Electronic Board ID Codes

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

ID code	Description
ES768	ISOLATION CONTROL BOARD
ES821	CONTROL BOARD
ES822	RS485 GALVANIC ISOLATION BOARD
ES847	ENVIRONMENTAL SENSORS AND FIELD I/Os EXPANSION BOARD
ES851	DATA LOGGER BOARD
ES914	AUXILIARY POWER SUPPLY AND RS485 GALVANIC ISOLATION BOARD
ES942	EARTH LEAKAGE DETECTOR BOARD

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 6.1.4.

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 11 TROUBLESHOOTING. 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

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.

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 SUNWAY TG TE 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 SUNWAY TG TE, 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 1.9.

Standard EN50110-1 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 2.5.1.

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

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

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.

2.6.2. Burns

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.

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, terminal boards X1 and X2 (please refer to the Electrical and Mechanical Diagram).

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.

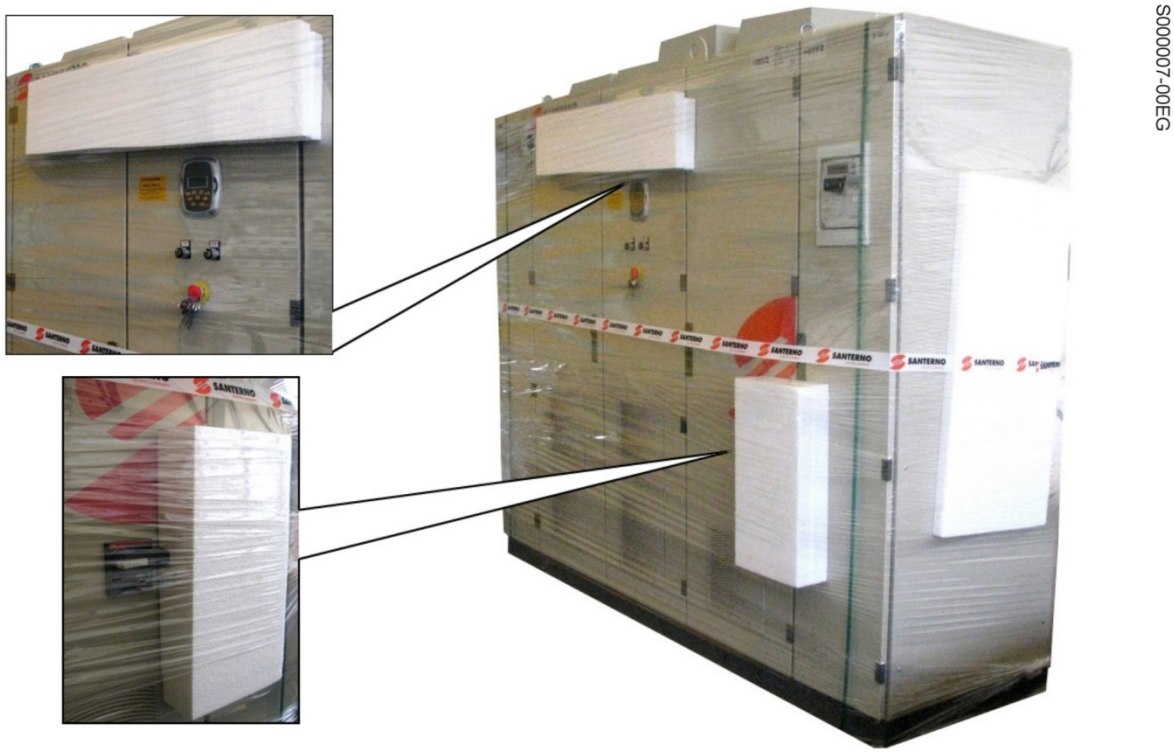


Figure 5: Packaging of SUNWAY TG TE

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 5.2). 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 YY ZZZ TE- VVV

XXX Model	See the Solar Energy catalogue
YY (optional) Country of Destination	If absent: Italy ES: Spain DE: Germany FR: France GR: Greece KR: Korea CN: China
ZZZ Maximum Vdc Field Voltage	800V: Field Voltage Max. Voc 880 Vdc 1000V: Field Voltage Max. Voc 1000 Vdc
VVV AC rated voltage	If absent, see Technical Data 310: 310 Vac 320: 320 Vac 340: 340 Vac 360: 360 Vac 380: 380 Vac

Examples:

SUNWAY TG 730 800V TE - 270	Max 880 Vdc, 340 Vac rated AC voltage
SUNWAY TG 750 1000V TE - 340	Max 1000 Vdc, 340 Vac rated AC voltage

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

4.1. Controls on the Front of the Cabinet

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

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):

Key-operated selector switch: Enable/Disable Inverter (12SA1)

This key-operated selector switch enables/disables operation of the SUNWAY TG TE.

Key-operated selector switch: door switch Enabling/Disabling (18SA2)

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.

Display/keypad (12A4)

Using the display/keypad the operator can:

- Inverter START, STOP and alarm RESET (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).

Emergency Stop Button (18SB2)

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.

The safety circuits and the release coils function at 24 V. 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 6.4.

Electric grid AC switch control lever (16QM2)

The control lever for the grid side switch, located inside the cabinet, makes it possible to connect the SUNWAY TG TE to the grid.

4.2. 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 (10QM1)

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

Grid AC Switch (16QM2)

The AC switch (PV field side) located inside the cabinet, makes it possible to connect the SUNWAY TG TE to the grid.

Grid Connection Contactor (18KM1)

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 4.2.1 and 4.2.2.

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.

4.2.1. 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.

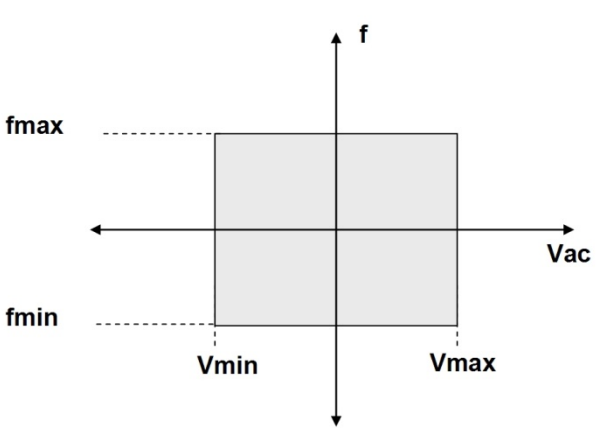


Figure 7: Interface Protection diagram

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 terminal X3, contacts 13 and 14 in the Electrical and Mechanical Diagram.

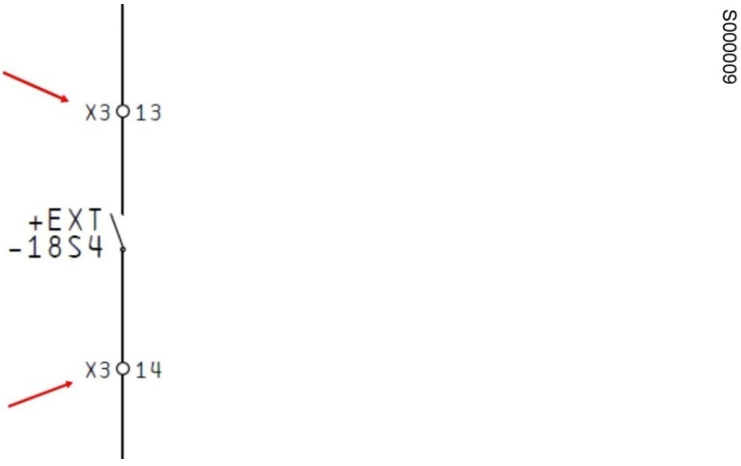


Figure 8: External Interface Protection (IP) relay connection

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.

SUNWAY TG TE inverters are configured in the factory with an external Interface Protection input enabled and a jumper on terminal X3 (contacts 13 and 14). To acquire the status of the grid from an external Interface Protection, remove the jumper and wire a normally excited NO contact on the X3 terminal board (contacts 13 and 14).

Please refer to section 6.2.

4.2.2. Grid Connection Contactor

The AC Grid Connection Contactor, located inside the cabinet, makes it possible to connect the SUNWAY TG TE 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 18KM1.

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 9: 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).

4.2.3. DC Input Switch

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

4.2.4. AC Output Switch

The AC switch (PV field side) located inside the cabinet, makes it possible to connect the SUNWAY TG TE to the grid.

The switch is equipped with a return contact, connected to the digital input MD18 (please refer to the Programming Guide).

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.

4.3. 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.

Figure 10: 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 3: Function of the display/keypad LEDs

4.3.1. 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.

4.3.2. Adjusting the Contrast, Backlighting 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 4: 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.

4.4. Converter Module

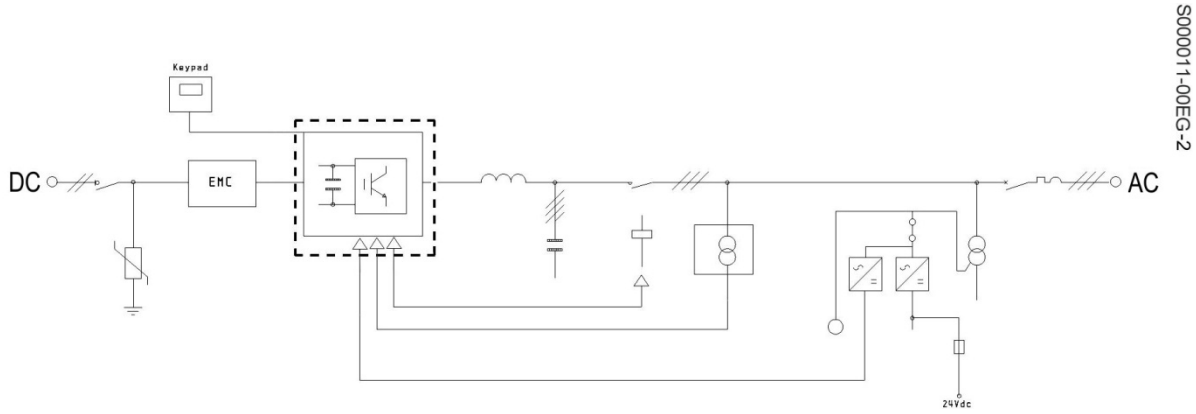


Figure 11: Single-line diagram of a SUNWAY TG TE - dotted line highlighting the converter module

SUNWAY TG TE modules 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 12U1 (11U1) 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.

Convertors can be either monolithic or modular. Larger inverters use modular converters, first-class technology in terms of performance and simplicity of maintenance operations.

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

4.5. Isolation Control Device

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

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

- 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 8.2).

WARNING

If the SUNWAY TG TE inverters are connected in parallel to a single transformer, directly or via AC-Parallel cabinets, it is advisable to program the inverter so that insulation 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 12: Isolation Control Board ES942

Figure 12: Isolation Control Board ES942

Table 5: Rotary switch position 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.

Positions 8 and 9 refer to configurations for the Earthed PV field (please refer to section 8.2).

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 5: 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 should be greater than the minimum MPPT voltage.

The factory setting envisages an isolation resistance of 100 kΩ(±10%).

4.6. Surge Protection

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 8.2).

The SPDs are referred to in the Electrical and Mechanical Diagram using the component ID codes 10AP1, 10AP2 and 10AP3.

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

Should the MCCB trip, a signalling contact is made available on terminal X3, contacts 56 and 57.

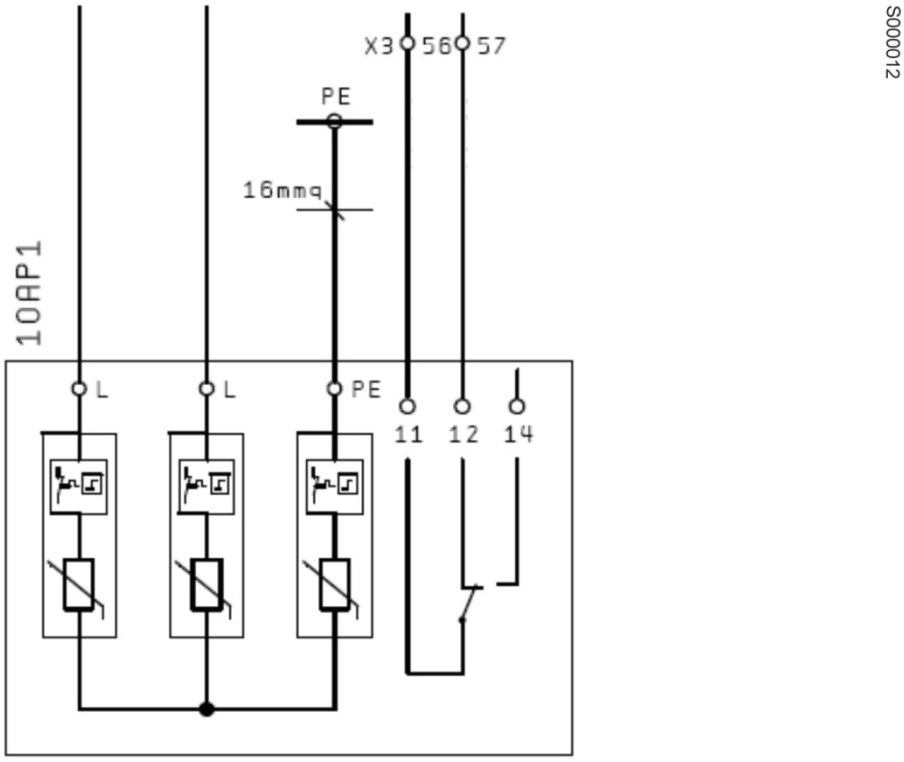


Figure 13: SPD (Surge Protective Device)

As well as the integrated MCCB, a pair of back-up fuses are installed in SUNWAY TG TE inverters which are co-ordinated with the SPDs.

No surge protective devices are provided for the AC output section.

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 12.9.

4.7. Serial Ports

SUNWAY TG TE inverters are equipped with a COM0 serial communication port for connecting external devices.

If the optional Data Logger is installed, two further serial ports (COM1 and COM2) are also made available (please refer to section 8.1) as well as an Ethernet port.

The main features of the serial ports are listed below:

- Optoisolated ports
- RS485 Bus with standard MODBUS/RTU protocol
- Auto-diagnostics of the bus electrical levels (COM0 and COM1)

For further information on remote control, serial ports and the Ethernet port, please refer to section 7.

4.8. Environmental Measures

SUNWAY TG TE inverters have six inputs for environmental measures via the environmental sensors expansion and field I/Os board.

Inputs available for SUNWAY TG TE:

- Four 12-bit resolution inputs configurable as 0-10 V f.s., 0-20 mA f.s., 0-100 mV f.s., temperature acquisition with two-wire PT100.
- Two 12-bit resolution inputs, 0-10 V f.s.

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

Environmental measure	Sensor type	Factory setting	Measure
Environmental measure 1	Sample cell	0-100 mV	Module surface radiation
Environmental measure 2	Sample cell	0-100 mV	Horizontal surface radiation
Environmental measure 3	Thermocouple	PT100	Ambient temperature
Environmental measure 4	Thermocouple	PT100	Module temperature
Environmental measure 5	Anemometer	0-10 V	Wind direction
Environmental measure 6	Anemometer	0-10 V	Wind speed

Table 6: Factory settings of environmental inputs

The environmental sensor inputs are available on the X3 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.

4.9. Acquisition of Energy Measurements from External Meters

The field I/Os and environmental sensors expansion board makes it possible to connect one or two external pulsed meters for measuring the energy delivered to the grid and the energy absorbed.

For connection of the counters, please refer to section 6.8.6.

4.10. Power Control

SUNWAY TG TE inverters come with a Power Control function for limiting the power delivered based on external request. It is possible to manage the Power Control function by:

- setting, locally or in remote mode, certain parameters
- 4-wire interface, the external signals are acquired by the environmental sensors and field I/Os expansion board
- 0-10 V analogue input. This mode is implemented on the inverter by means of a factory configuration. For this purpose, please contact the Elettronica Santerno SpA CUSTOMER SERVICE.

Please refer to the Programming Guide for correct programming of the Power Control function.

For connection of the external signals, please refer to 6.8.7.

4.11. Programmable Digital Output

A programmable digital output is available on SUNWAY TG TE inverters. It is located on terminal X3, contacts 20, 21 and 22. Please refer to the Electrical and Mechanical Diagram.

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

4.12. Ventilation System

SUNWAY TG TE inverters have a modular ventilation system made up of the following elements:

- A series of fans installed on the converter
- A series of fans inside the cabinet

The fans are driven directly by the control board.

An additional thermostat in connected to the cabinet fans for redundancy.

For the technical data concerning ventilation absorption and flow rate, please refer to section 4.12.

4.12.1. Forced Ventilation Command

During inverter operation, particularly critical ambient conditions may arise, such as low temperatures and/or a high level of relative humidity, which may cause condensation to form on the live parts of the inverter.

If the technical room is fitted with suitable sensors designed to detect critical conditions, room conditioning systems can be activated and cabinet ventilation devices can be started up. For this purpose, two terminals are available, X3-62 and X3-63 (please refer to the Electrical and Mechanical Diagram).

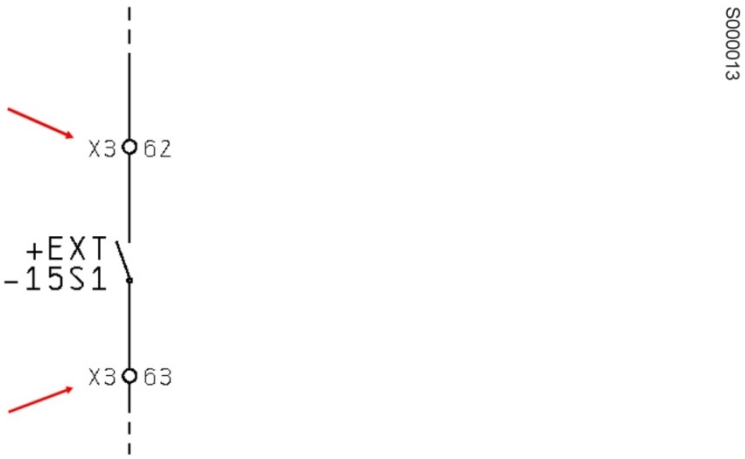


Figure 14: Contact for forced cabinet ventilation command

4.12.2. External Power Supply for Ventilation

The cabinet ventilation system may be powered by an external power source in order to save the energy delivered to meet fiscal incentives.

Please refer to section 4.12.2.

5. HANDLING AND ASSEMBLY

5.1. Conditions for Transport

Handling may be carried out using one of the following systems:

- Hoist
- Pallet jack
- Forklift

For further information, please consult section 12.7.

WARNING

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

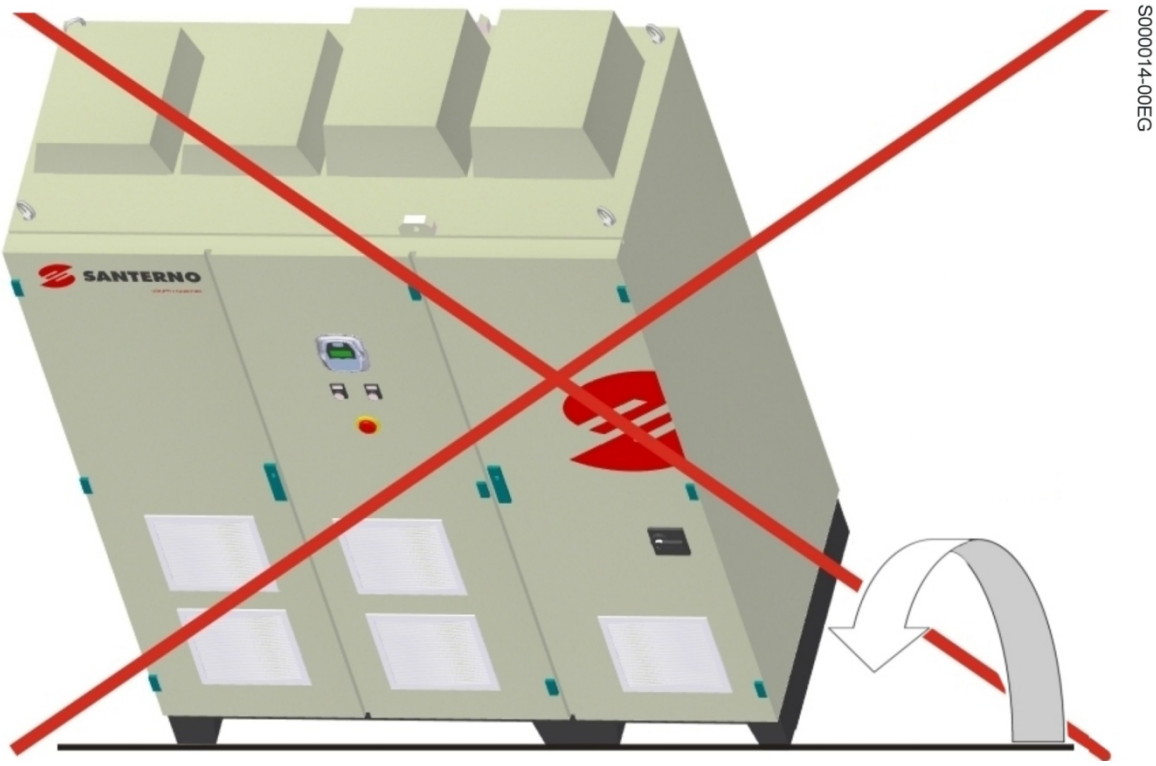


Figure 15: Inverter tilting

5.1.1. Hoisting the Equipment

To hoist the equipment use the eyebolts and/or the perforated bars incorporated in the inverter frame. Make sure that the length of the hoisting ropes is such to form an angle which does not exceed 60 °.

The following figures show the correct way of hoisting the inverter.

Inverter with two-door cabinet

S000015-00G

Figure 16: Hoisting the Inverter

Inverter with three-door cabinet

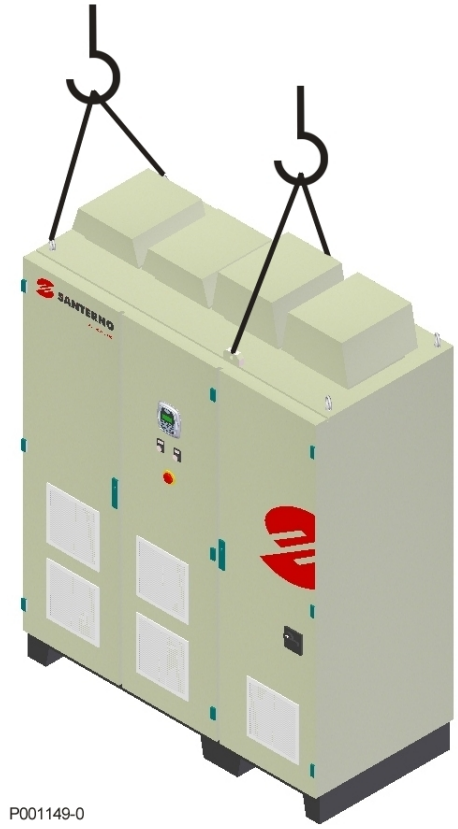


Figure 17: Hoisting the Inverter

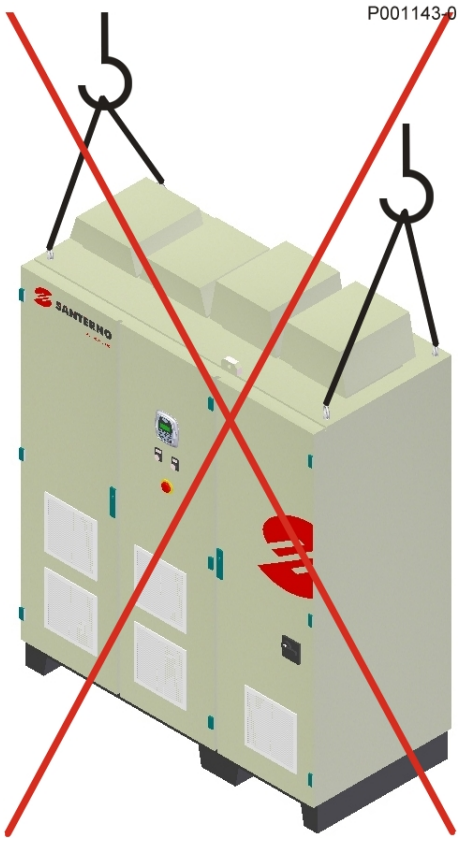


Figure 18: INCORRECT Hoisting

Inverter cabinet with more than three doors

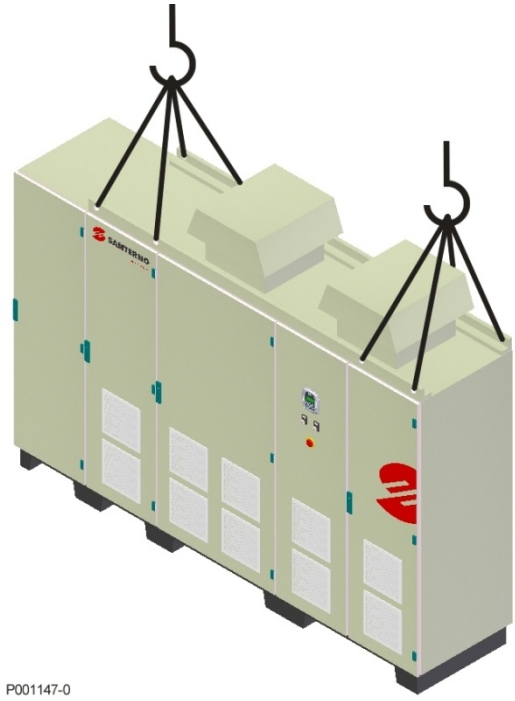


Figure 19: Hoisting the Inverter

Figure 20: INCORRECT Hoisting

5.1.2. Crane Fork Hoisting

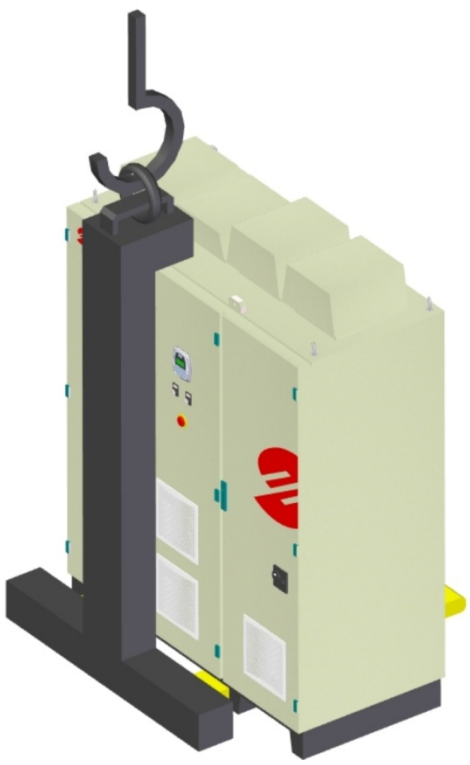


Figure 21: Hoisting the inverter with a crane fork

5.1.3. Handling Using a Pallet Jack or Forklift Truck

If the inverter is to be lifted from underneath, a forklift must be used. Position the fork tines in the spaces along the base which must be opened up beforehand by removing the central base panels.

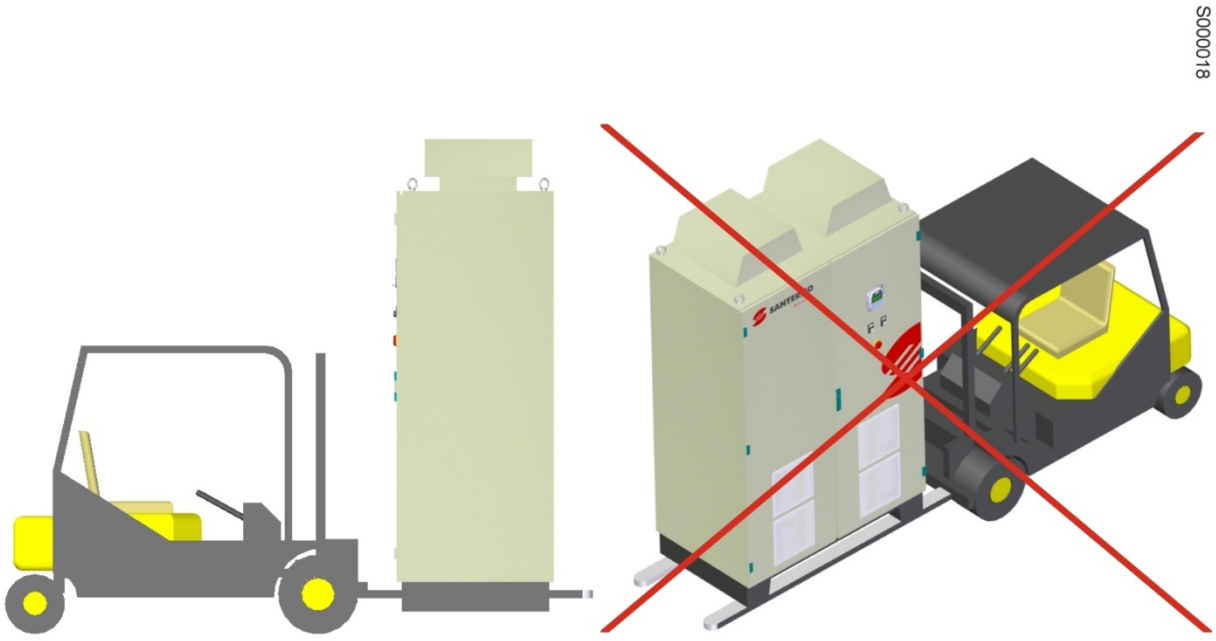


Figure 22: Lifting the equipment from underneath

5.2. 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 EN50178).
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 EN50178).
Atmospheric pressure for storage	86 – 106 kPa (categories 3k3 and 1k4 in compliance with EN50178).
Atmospheric pressure during transport	70 – 106 kPa (category 2k3 in compliance with EN50178).

Table 7: Environmental requirements for storage and transport

5.2.1. Base

To lift the cabinet off the pallet and for final positioning, remove the front and back plates found on the base so that the forklift tines can be inserted under the cabinet. Please refer to section 5.3.1.

After the cabinet has been positioned the openings can be closed off by replacing the plates.

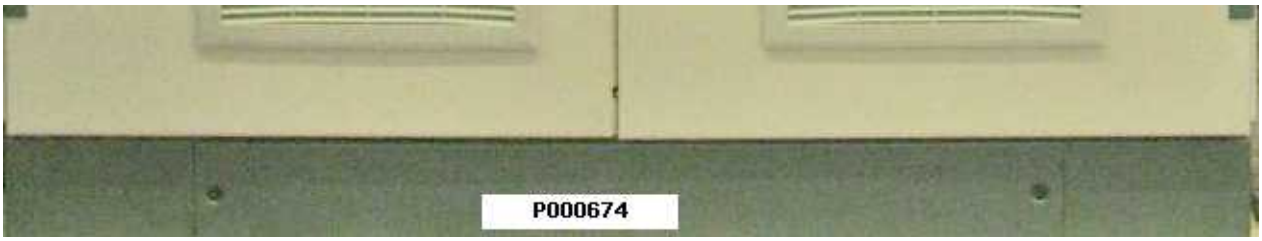


Figure 23: Base with removable plate

Figure 24: Base with the plate removed

5.3. Assembly of the Inverter on the Installation Site

All inverters belonging to the SUNWAY TG TE series are designed for indoor installation.

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.

Provide adequate ventilation or air cooling system.

NOTE

Always leave enough room in front of the inverter to be able to fully open the cabinet doors.

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.

The correct distances to be observed are indicated in Table 59: Clearance values for SUNWAY TG TE.

5.3.1. Centre of Gravity and Fork Tine Positioning

This heading concerns the position of the SUNWAY TG TE inverters' centre of gravity, with and without a DC-Parallel. The indication refers to the distance of the centre of gravity from the far left of the cabinet.

To assist in handling operations the correct position for the fork tines is indicated, taking into consideration the gaps available in the inverter base.

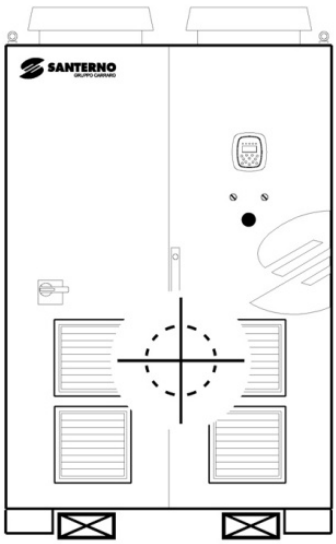
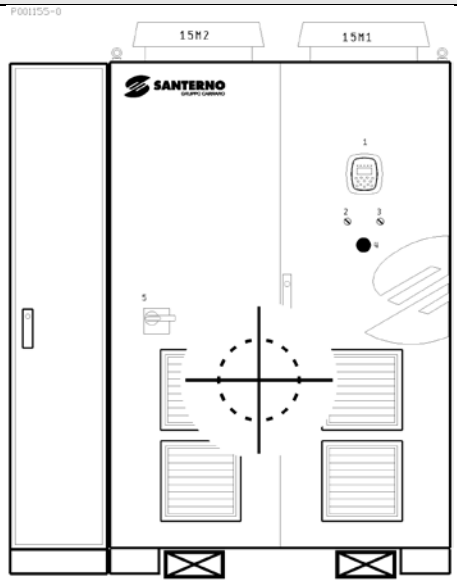
SUNWAY TG TE Two-door model W = 1400	With DC-Parallel
 S000019-00EG	

Table 8: Centre of gravity and fork tine position for two-door model W = 1400

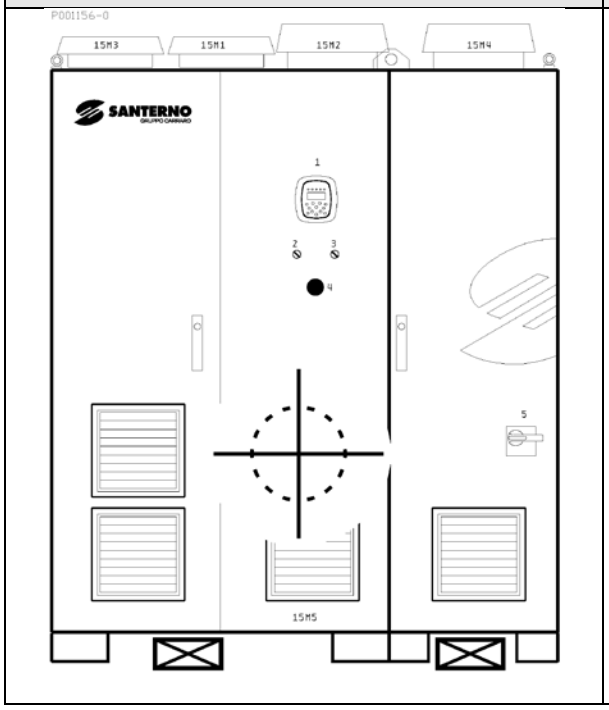
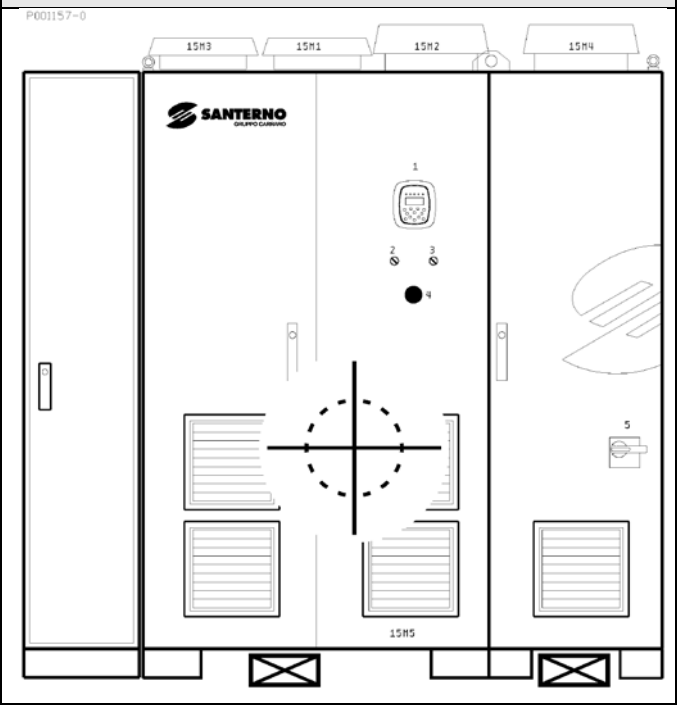
SUNWAY TG TE Three-door model W = 1800	With DC-Parallel
	

Table 9: Centre of gravity and fork tine position for three-door model W = 1800

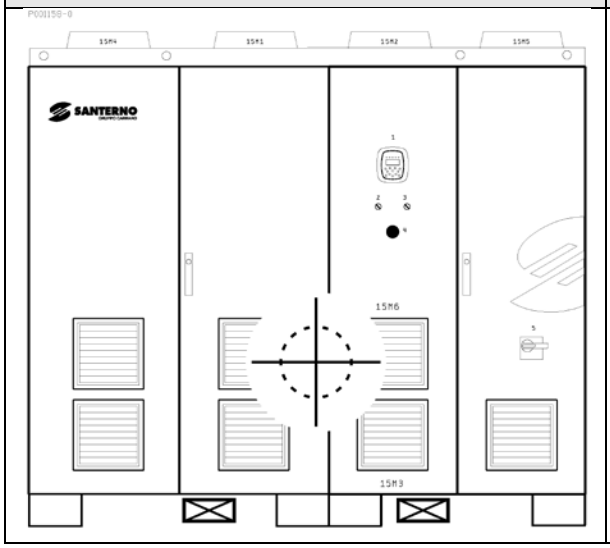
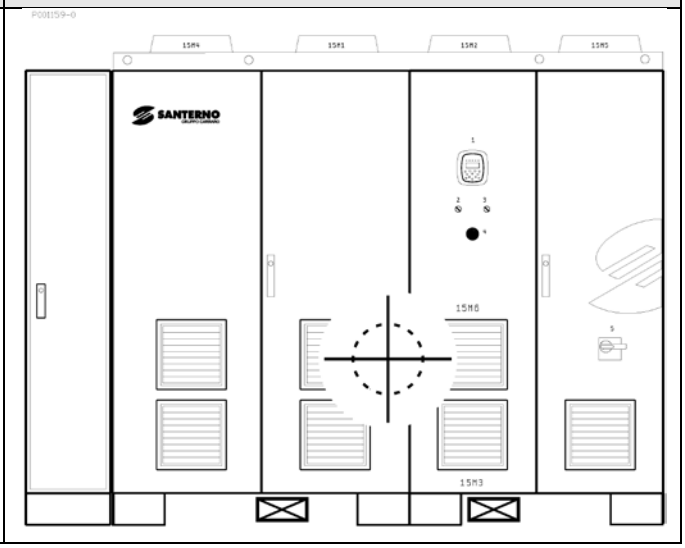
SUNWAY TG TE Four-door model W=2600	With DC-Parallel
	

Table 10: Centre of gravity and fork tine position for four-door model W = 2600

6. INSTALLATION AND COMMISSIONING

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

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

6.1. Wire Connection Terminal Board

Terminal	Type	Function
X1	Power	Three-phase AC grid
X2	Power	PV field
X3	Signals	Auxiliary terminal board
X4	Signals	COM0, COM1 and COM2 serial links
X7	Auxiliary circuits power supply	Auxiliary mains and UPS

Table 11: Wire Connection Terminal Board

6.1.1. Cable Inlet

Cable inlet is at the bottom of the cabinet. Please refer to the Electrical and Mechanical Diagram, sheets 7 and 8.

6.1.2. DC Cable Connection

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.

Please refer to section 9 if a DC-Parallel compartment is installed.

6.1.3. AC Cable Connection

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.

6.1.4. 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.

6.1.5. Connecting the Signal and Auxiliary Power Supply Cables

For the technical data concerning the number of cables to be connected, the maximum section and cable lug type, please refer to section 12.

6.2. Connection to the External Transformer

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

6.2.1. Transformer Technical Requirements

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

DATA	Unit	VALUE
Minimum Rated Power	kVA	See section 6.2.2
Frequency	Hz	According to applicable standards
Phases		3
Primary Voltage	kV	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 or Star/Delta
Secondary Neutral Terminal		Not required for inverter operation. It must not be connected to ground (see section 6.10)
Withstand Voltages - Primary: Um/FI/imp	kV	According to applicable standards
Withstand Voltages - Secondary: Um/FI/imp	kV	1.1/3
Short-Circuit Impedance (at 75°C) pri/sec	%	6% (+/- 10% tolerance)
Short-Circuit Mutual Impedance sec/sec (in case of double-wound transformer)	%	10% (+/- 10% tolerance)
Electrostatic Shield (in case of LV/MV transformer)		Provided. The shield must be earthed.
Electrostatic Shield (in case of LV/LV transformer)		Not required

Table 12: Transformer technical requirements

6.2.2. Transformer Application Requirements

The transformer shall be designed to work at rated power according to specific application requirements.

The maximum dU/dt between secondary windings and the ground shall be 500V/usec for consistency with solar inverter output characteristics.

The secondary windings shall be tolerant for pulsed waveforms of up to +/- 1500V to ground.

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

Assuming that Pout is the rated output power of the connected inverter(s), it is advisable to size the transformer for 1.1 x Pout rated power.

Example: For a system made up of the following:

No. 2 SUNWAY TG 750 1000V TE - 320

Pnom AC = 2x665 kVA = 1330 kVA

The suggested transformer sizing is 1500 kVA

Observe the prescriptions concerning cable sizing and the relative cable lugs.

Whenever necessary, an interface relay can be connected downstream from the LV/LV transformer which acts as indicated in section 4.2.1.

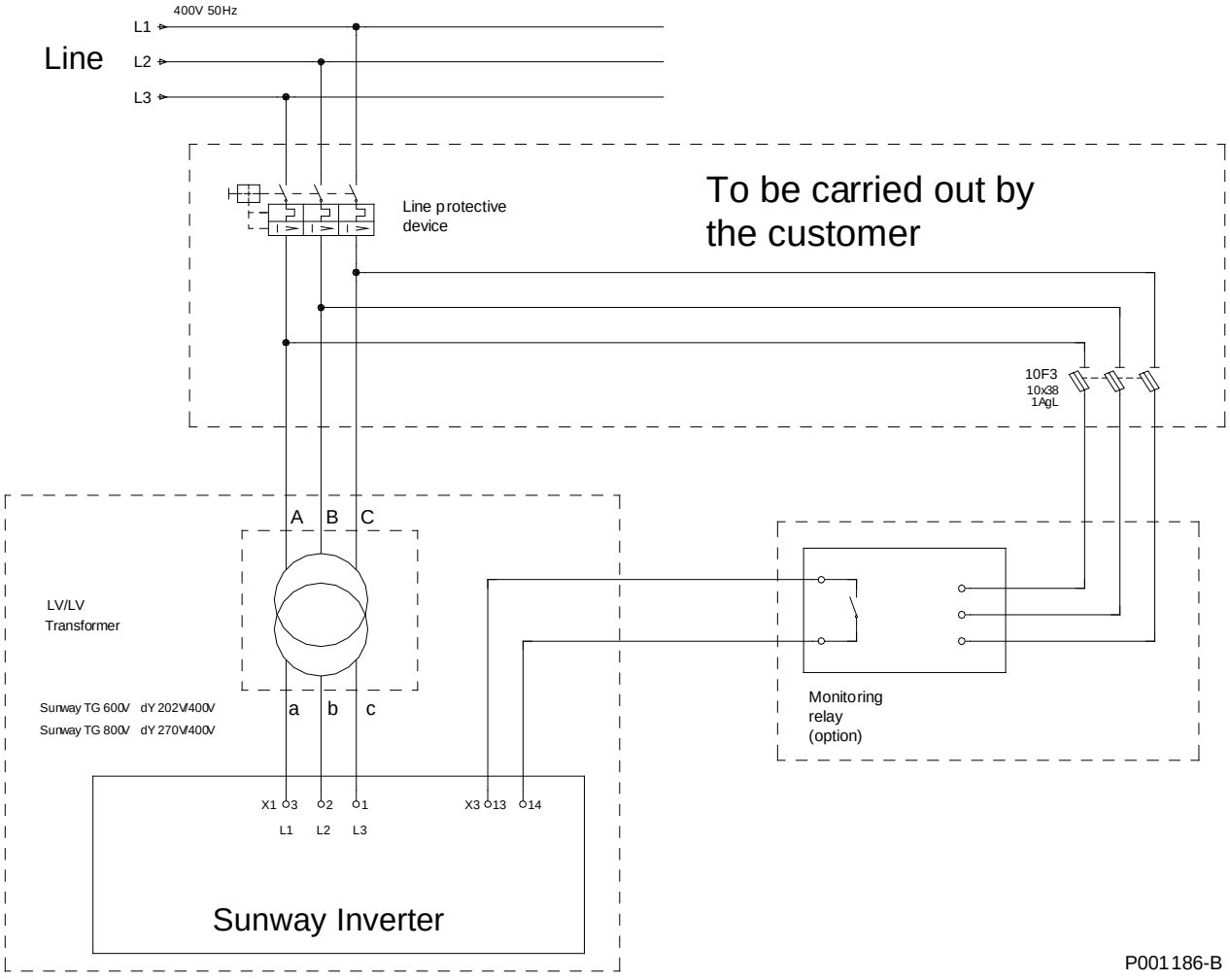


Figure 26: Connection to an interface relay downstream from the LV/LV transformer

6.3. External AC Switch Management

SUNWAY TG TE inverters are designed to be easily connected to external motor-driven AC grid connection switches. These switches must be controlled by two distinct pulse signals, one for opening and one for closing.

The two pulse signals are available on the inverter terminal X3, via relay contacts 19KA4 and 19KA5 (please refer to the Electrical and Mechanical Diagram). Duration of the signals is factory-set at 500 ms.

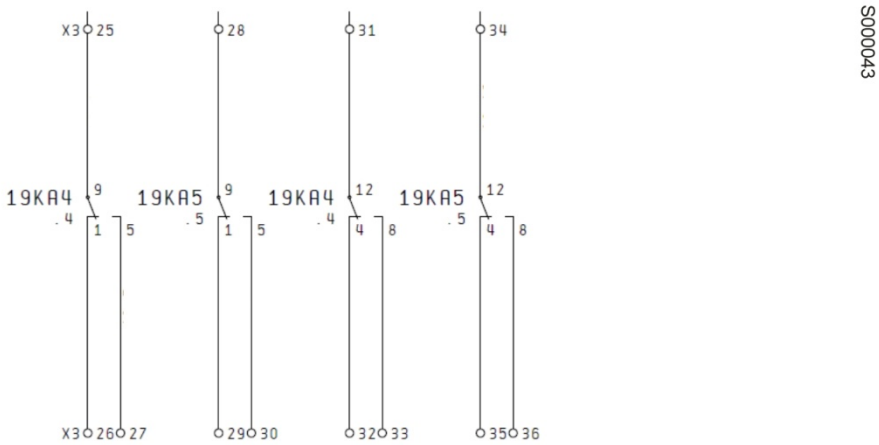


Figure 27: External AC switch connection contacts

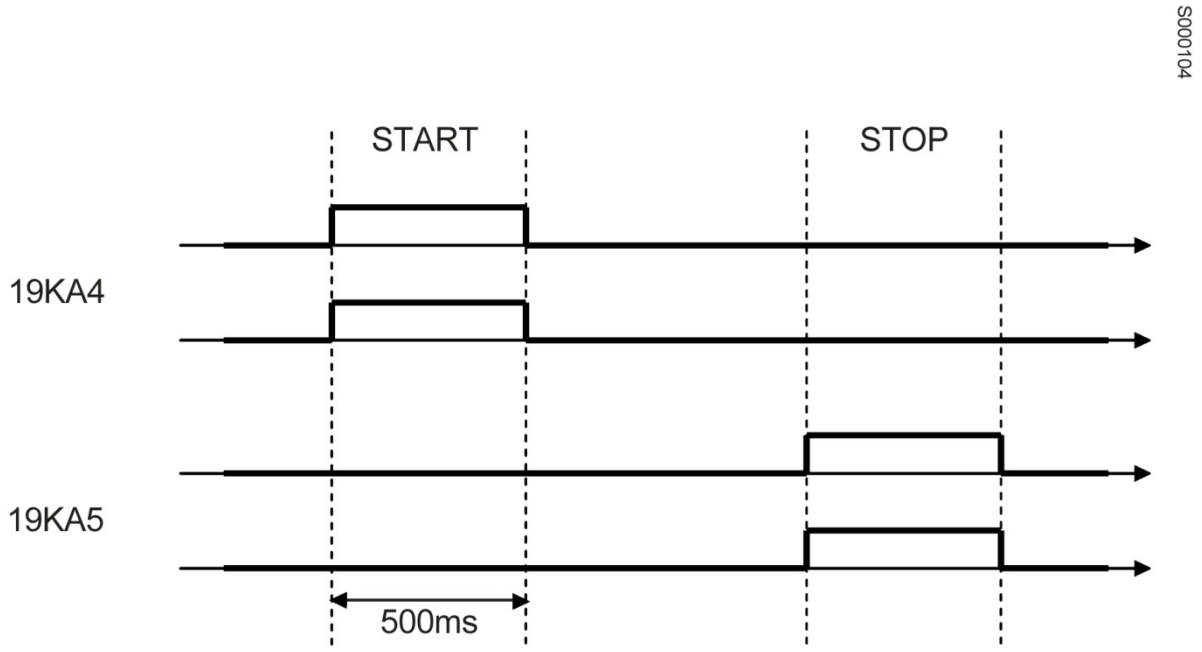


Figure 28: External AC switch contacts timing diagram

Co-ordination between parallel-connected inverters and the external AC switch (if installed) must be done through external logic, usually a system PLC.

This system provides interfacing with the AC switches installed on the Medium Voltage side and can de-energize the LV/MV transformer during night-time hours.

The operating logics can be simplified as follows:

- The system PLC permits closure of the switch as soon as requested by one of the connected inverters.
- The system PLC permits opening of the switch only if this is required by all the connected inverters.

6.4. External Emergency Stop Command Management

The emergency function can have a remote operation facility by means of a contact. For this purpose, two terminals are available, X3-60 and X3-61 (please refer to the Electrical and Mechanical Diagram).

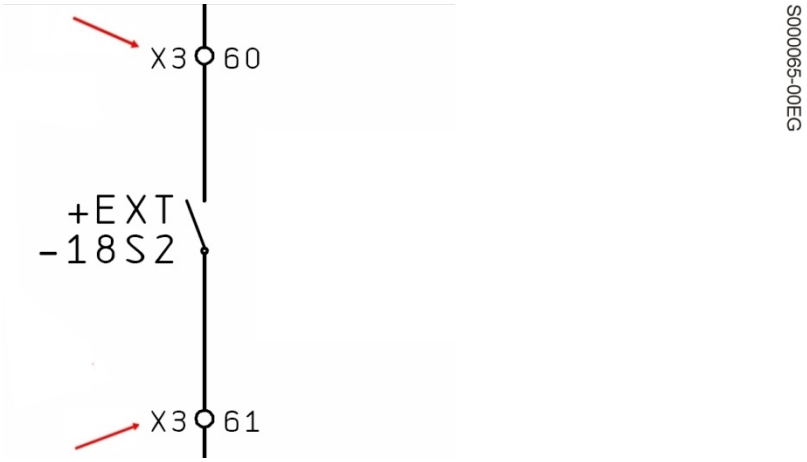


Figure 29: External emergency stop command contact

6.5. Connecting Multiple Inverters in Parallel

Up to two SUNWAY TG TE inverters can be connected to the same LV/LV or LV/MV transformer by using a double-wound transformer.

It is recommended the transformer have a y/D configuration, i.e. an inverter side star configuration. In which case neutral must never be connected to earth.

It is possible to connect the inverters in AC parallel on a single-wound transformer if the application is approved beforehand. Please contact Elettronica Santerno SpA.

6.5.1. Carrier Phase Synchronization

SUNWAY TG TE inverters are designed to reduce electrical disturbance to a minimum, using multi-stage filters specifically enhanced for PV applications.

In certain cases, such as when connecting inverters in AC parallel on a single-wound transformer, it may be useful to synchronize the carrier signals from all the inverters to reduce electrical disturbance further still.

SUNWAY TG TE inverters allow for carrier phase synchronization in multi-inverter systems. In this type of installation, one inverter acts as PMW MASTER while all the others are PMW SLAVES.

To do this, proceed as follows:

- Enable the function via a suitable parameter (please refer to the Programming Guide).
- Wire the inverters as illustrated in Table 13: Connections for PMW synchronization and in Figure 30 and Figure 31.

PWM MASTER inverter		PWM SLAVE inverter
+VMDO1 (Control terminal board – 24)	----wire to--	+24V (Control terminal board – 23)
MDO1/FOUT (Control terminal board – 25)	----wire to--	MDI8 (Control terminal board – 21)
CMDO1 (Control terminal board – 26)	----wire to--	CMD (Control terminal board – 22)

Table 13: Connections for PMW synchronization

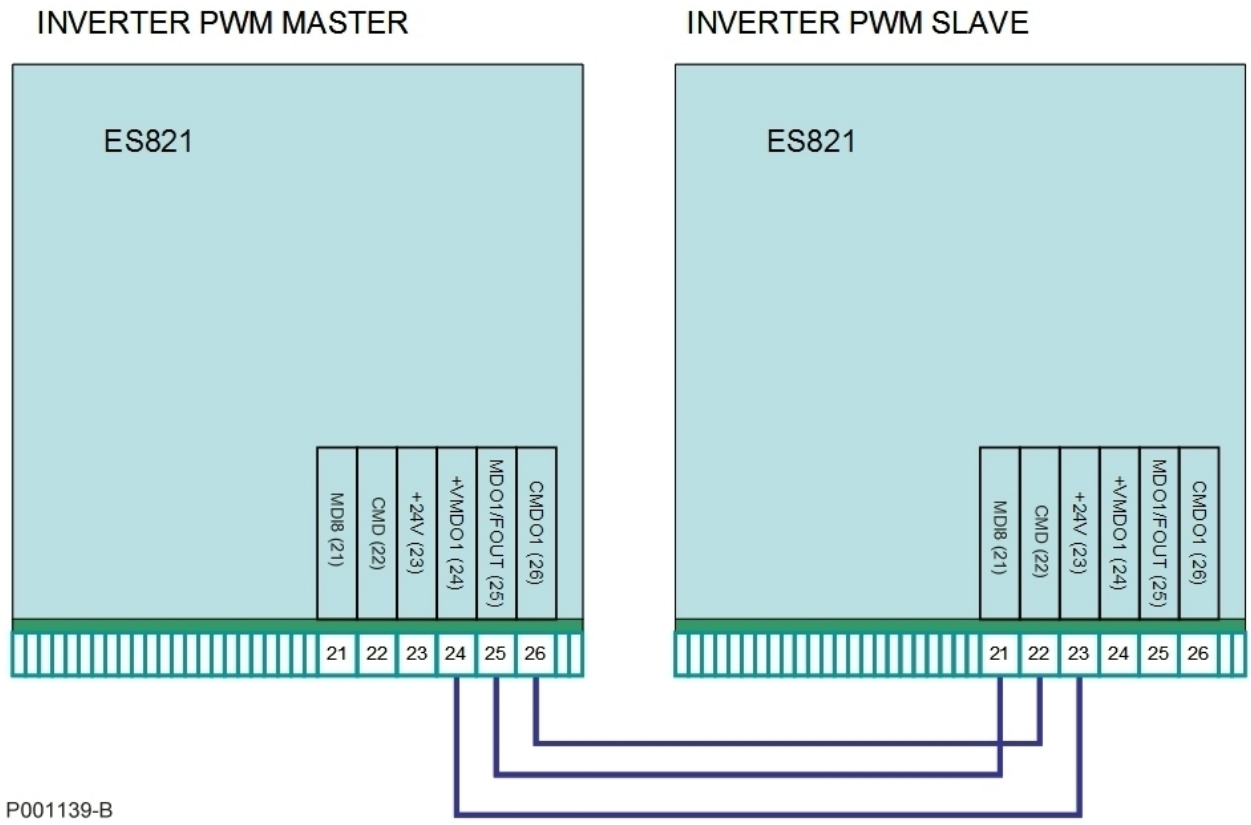


Figure 30: Wiring for phase synchronization – 2 SUNWAY TG TE inverters

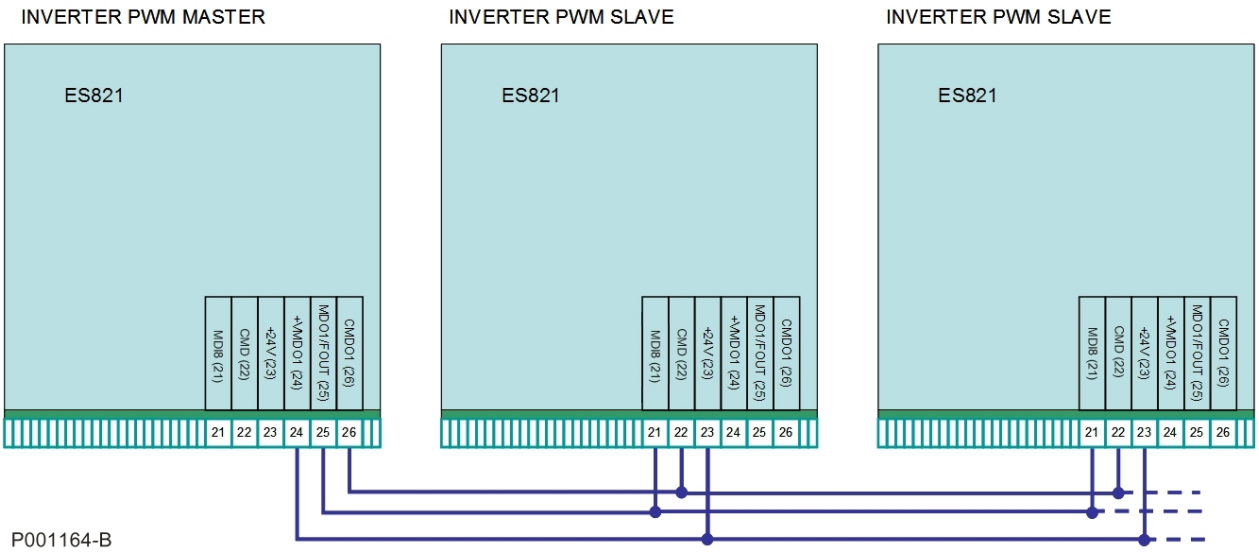


Figure 31: Wiring for phase synchronization – 3 or more SUNWAY TG TE inverters

6.6. Segregation and Lead-sealing of AC Output

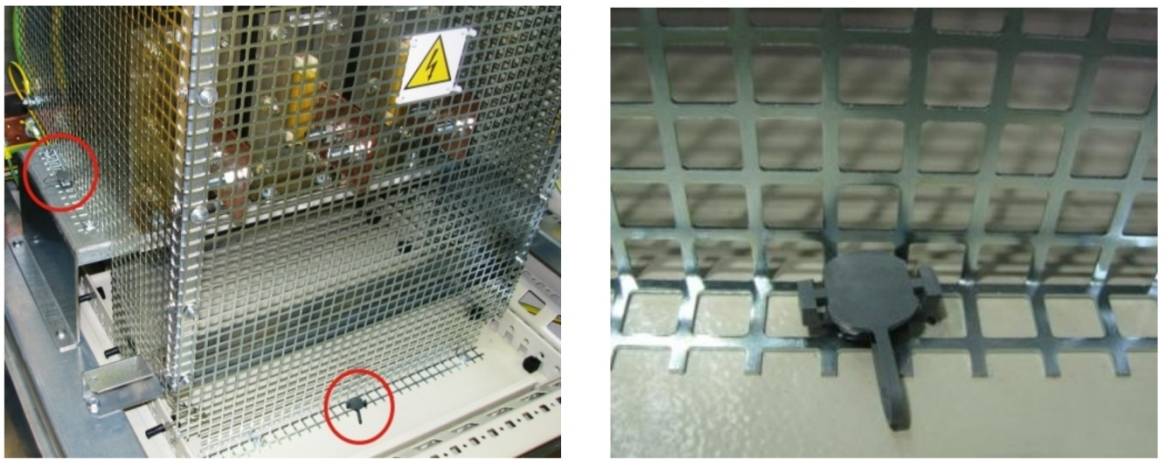
The AC output section of inverters is segregated inside a metal cage which can be lead-sealed for anti-fraud purposes.

For this purpose, the inverter is supplied with components which can be lead-sealed (see the following figures).

S000021-00EG-PQ

Figure 32: Lead-sealable cage for the AC output section

A Lead-sealable cage for the AC output section



S000022-00EG

Figure 33: Lead-sealable nut cover

6.7. Connection to the Communications Ports

Please refer to 7.4.

6.8. Connection to the Environmental and Field I/O Inputs

SUNWAY TG TE inverters have six inputs for environmental measures via the environmental sensors and field I/O expansion board. For the technical specifications of the environmental sensors and field I/Os expansion board, please refer to section 12.12.

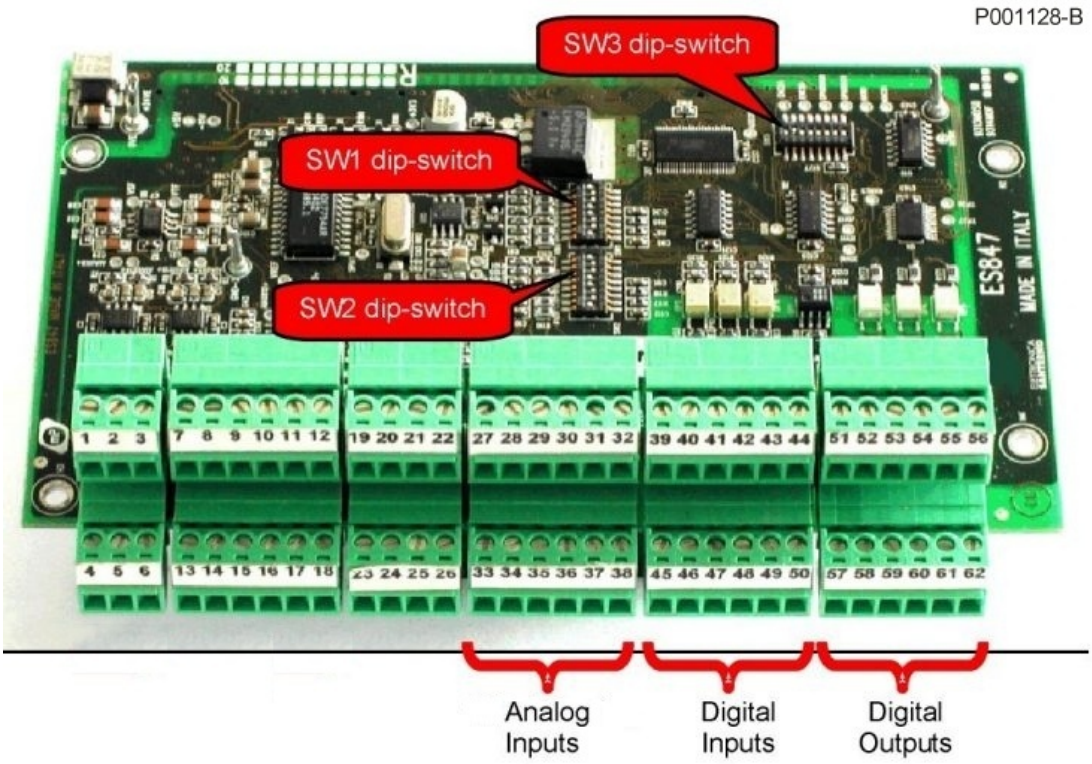


Figure 34: Environmental sensors and filed I/Os Expansion Board

6.8.1. Environmental Sensors Terminal Board

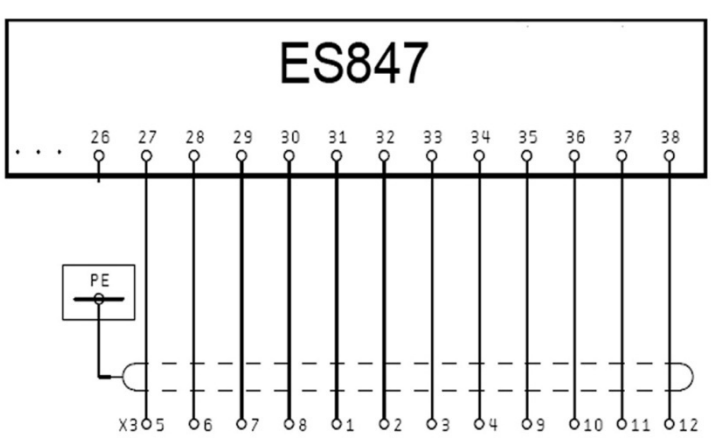


Figure 35: Diagram of environmental sensors terminal board

Environmental measure	Type of sensor set in the factory	Factory setting	Terminal
Environmental measure 1	Sample cell	0-100 mV	X3, contacts 5-6
Environmental measure 2	Sample cell	0-100 mV	X3, contacts 7-8
Environmental measure 3	Thermocouple	PT100	X3, contacts 1-2
Environmental measure 4	Thermocouple	PT100	X3, contacts 3-4
Environmental measure 5	Anemometer	0-10 V	X3, contacts 9-10
Environmental measure 6	Anemometer	0-10 V	X3, contacts 11-12

Table 14: List of environmental sensors terminals

6.8.2. Configuration DIP-switches

The environmental sensors and field I/Os expansion board is equipped with 3 configuration DIP-switches (see Figure 34: Environmental sensors and filed I/Os Expansion Board) which allow the user to set the operating mode as indicated in Table 15: Function of the 3 DIP-switches on the environmental sensors and field I/Os expansion board.

DIP-switch	Function
SW1	For setting the operating mode for the environmental analogue inputs 1 and 2
SW2	For setting the operating mode for the environmental analogue inputs 3 and 4
SW3	Factory-set configuration SW3.2=ON, SW3.5=ON, all the others OFF (do not modify)

Table 15: Function of the 3 DIP-switches on the environmental sensors and field I/Os expansion board

The following table indicates the possible configurations of the SW1 and SW 2 DIP-switches depending on the required set-up of the analogue channels.

SW1

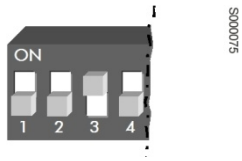
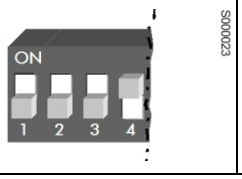
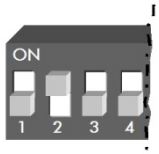
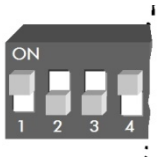
Configuration of environmental analogue channel 1			
0-10 V f.s. mode	0-100 mV f.s. mode	0-20 mA f.s. mode	Temperature reading with PT100 thermistor
			

Table 16: Environmental analogue channel 1 DIP-switch configuration

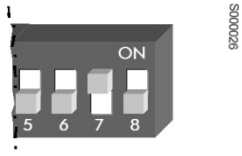
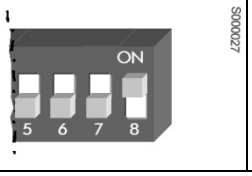
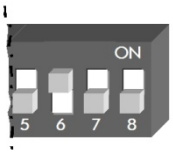
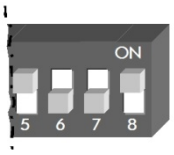
Configuration of environmental analogue channel 2			
0-10 V f.s. mode	0-100 mV f.s. mode	0-20 mA f.s. mode	Temperature reading with PT100 thermistor
			

Table 17: Environmental analogue channel 2 DIP-switch configuration

SW2

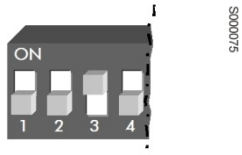
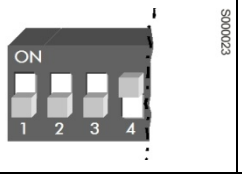
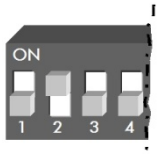
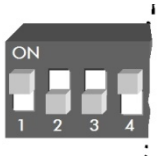
Configuration of environmental analogue channel 3			
0-10 V f.s. mode	0-100 mV f.s. mode	0-20 mA f.s. mode	Temperature reading with PT100 thermistor
			

Table 18: Environmental analogue channel 3 DIP-switch configuration

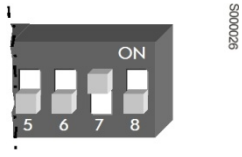
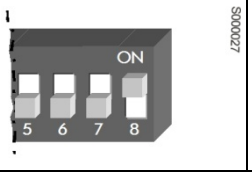
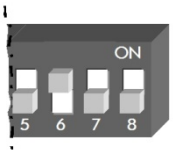
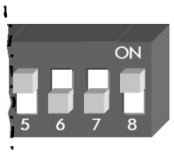
Configuration of environmental analogue channel 4			
0-10 V f.s. mode	0-100 mV f.s. mode	0-20 mA f.s. mode	Temperature reading with PT100 thermistor
			

Table 19: Environmental analogue channel 4 DIP-switch configuration

The factory settings for these DIP-switches are indicated below:

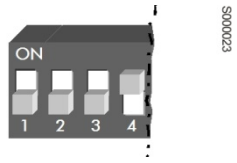
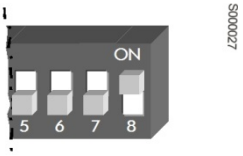
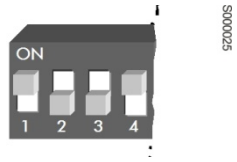
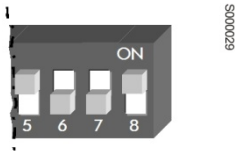
Factory-set configuration	
Environmental analogue channel 1	
0-100 mV f.s. mode	
Environmental analogue channel 2	
0-100 mV f.s. mode	
Environmental analogue channel 3	
Temperature reading with PT100 thermistor	
Environmental analogue channel 4	
Temperature reading with PT100 thermistor	

Table 20: Environmental sensors and field I/Os expansion board DIP-switch configuration

WARNING

The inputs configured for voltage have a 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.

6.8.3. 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 36: Connection to 0 – 10 V analogue input and Figure 37: Connection to 0 – 100 mV analogue input 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.

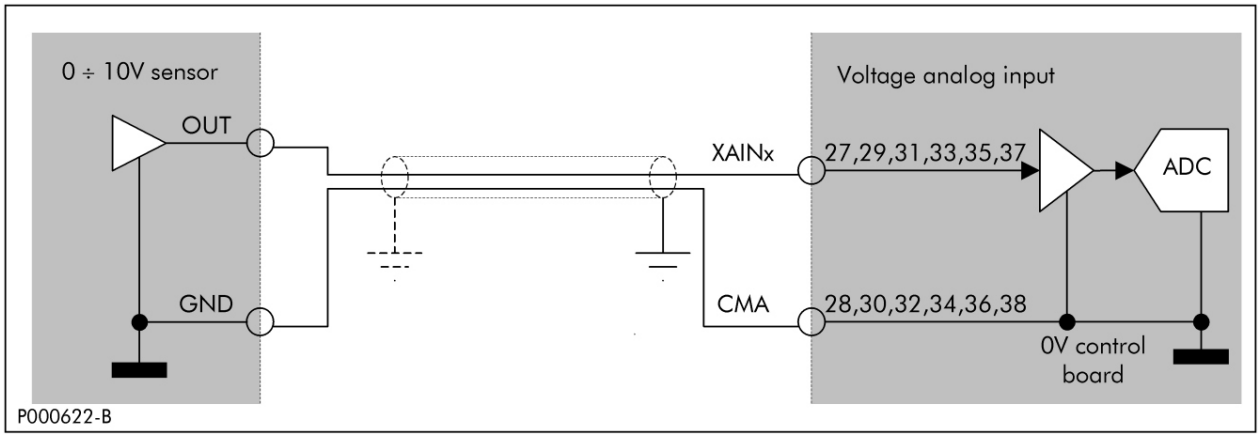


Figure 36: Connection to 0 – 10 V analogue input

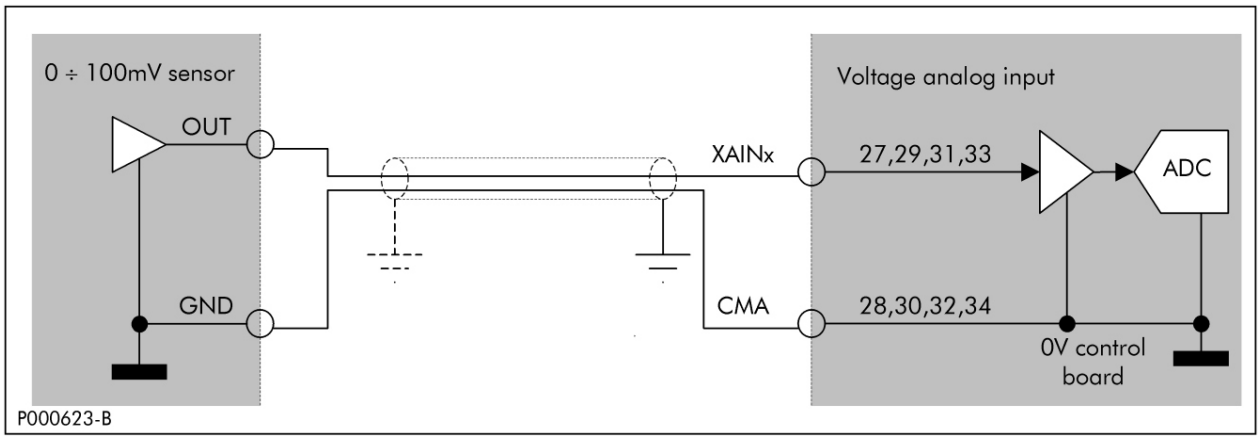


Figure 37: Connection to 0 – 100 mV analogue input

6.8.4. Analogue Inputs to Sensors with Current Output

Connection of the slow analogue inputs to current sources is illustrated in Figure 38: Connection of 0 – 20 mA (4 – 20 mA) sensors to current inputs. 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.

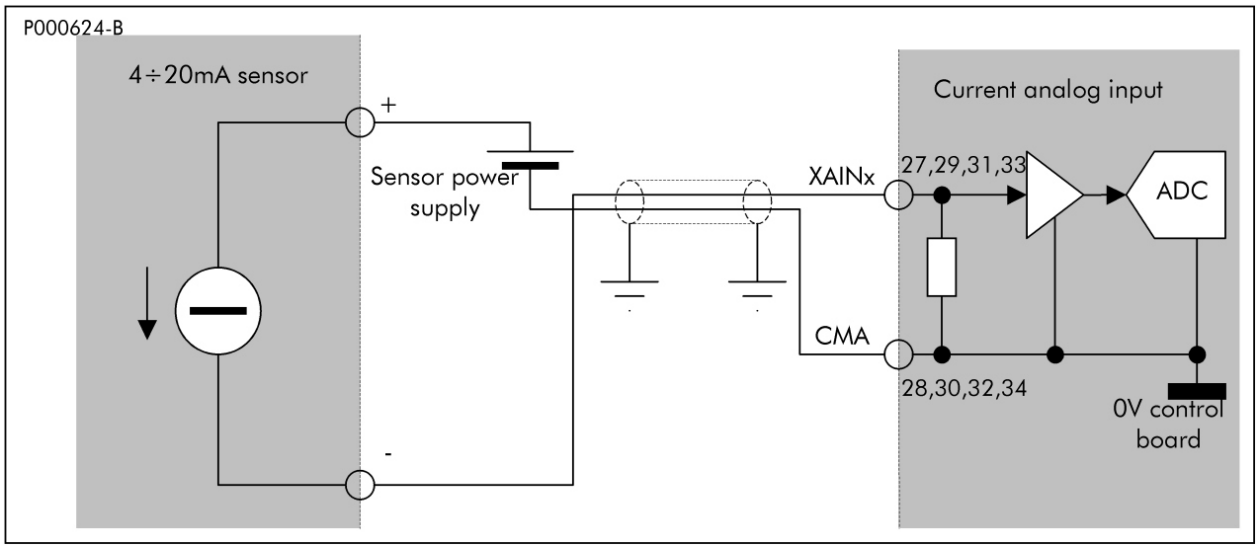


Figure 38: Connection of 0 – 20 mA (4 – 20 mA) sensors to current inputs

6.8.5. 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 39: Connection of the PT100 thermistor to the analogue channel 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).

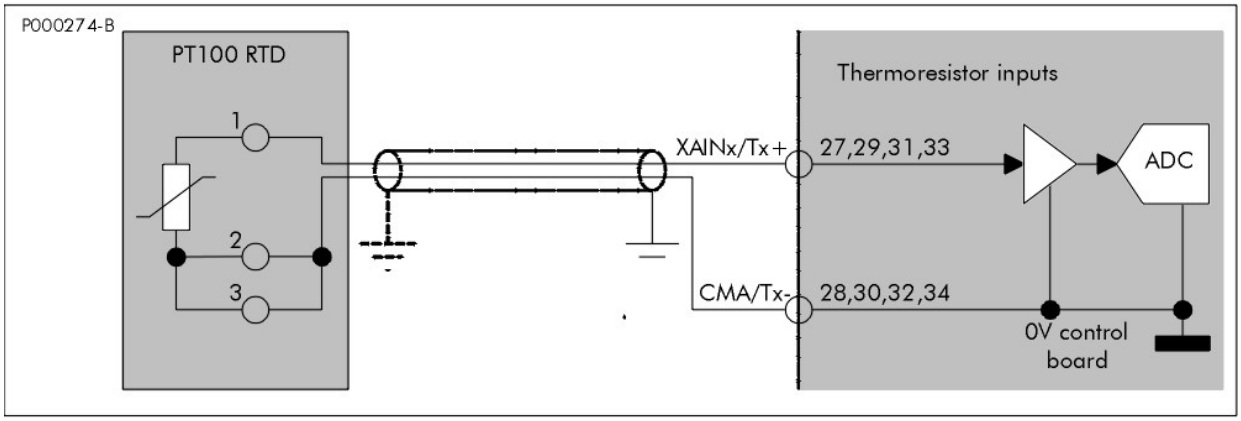


Figure 39: Connection of the PT100 thermistor to the analogue channel

6.8.6. External Pulsed Meters for Measuring Energy

The external meters are connected by means of one or two voltage-free contacts as illustrated below.

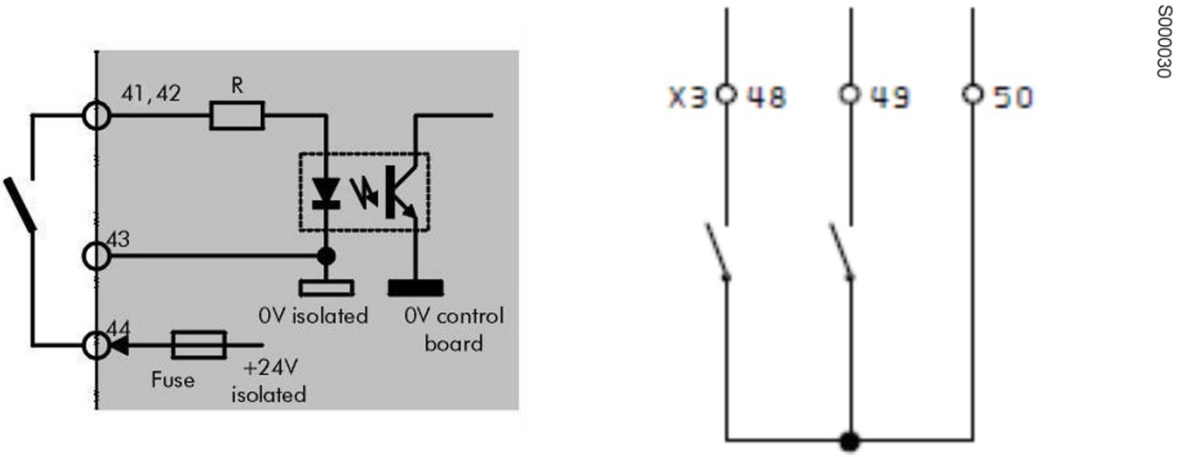


Figure 40: Connection of the external signals for pulsed meter energy measurements

Digital input	Environmental sensors and field I/Os expansion board terminal	Terminal X3	Function
XMDI3	41	48-50	Energy pulsed meter 1
XMDI4	42	49-50	Energy pulsed meter 2

Table 21: Digital inputs for external meters

NOTE

The voltage levels to be used for pulsed meters are:

0 V - Low level

24 V - High level

As an alternative, use a voltage-free or PNP contact and on-board +24V power supply.

The maximum input frequency for auxiliary digital inputs is 40 Hz.

The external contacts must be potential free. Please refer to the Programming Guide for correct setting of the scale factors of the external pulsed meters.

6.8.7. External Signals for Controlling the Power Delivered

Digital inputs available for SUNWAY TG TE:

Digital input	Board terminal	Terminal X3	Function
XMDI1	39	64-65	Multifunction auxiliary digital input 1 used for controlling the power delivered.
XMDI2	40	64-66	Multifunction auxiliary digital input 2 used for controlling the power delivered.
XMDI5	45	64-67	Multifunction auxiliary digital input 3 used for controlling the power delivered.
XMDI7	47	64-68	Multifunction auxiliary digital input 4 used for controlling the power delivered.

Table 22: Digital inputs for controlling the power delivered

4-WIRE POWER CONTROL FUNCTION

Connection of the external signals for management of the power delivered is carried out via four voltage-free contacts as illustrated below.

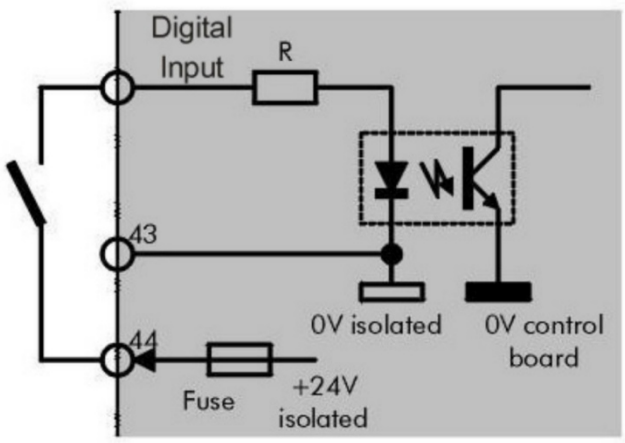


Figure 41: Connection of the external signals for controlling the power delivered

NOTE

The voltage levels to be used for the external signals for controlling the power delivered are:

0 V - Low level

24 V - High level

As an alternative, use a voltage-free or PNP contact and on-board +24V power supply.

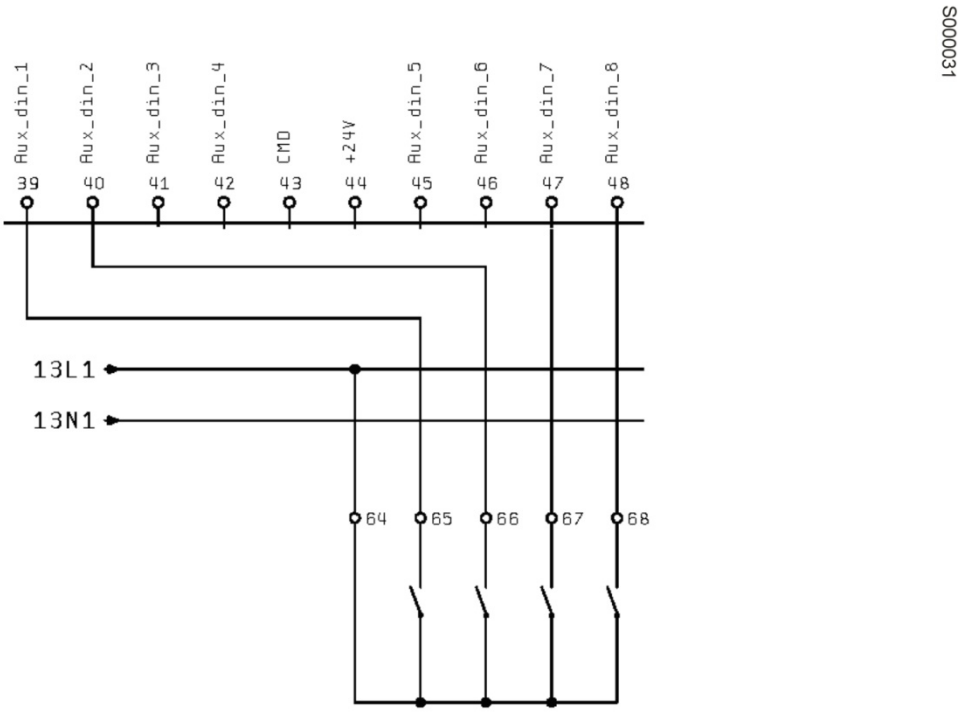


Figure 42: External signals for controlling the power delivered via four contacts

Please refer to the Programming Guide for correct programming of the Power Control function.

POWER CONTROL FUNCTION WITH 0 - 10 V ANALOGUE SIGNAL

The Power Control function allows the power delivered to be controlled also by an 0 - 10 V analogue signal.

6.9. Auxiliary Circuits Power Supply

6.9.1. UPS

SUNWAY TG TE inverters can be connected to a UPS (to guarantee back-up power for the Santerno anti-theft system) on terminals X7-3 and X7-4 (please refer to the Electrical and Mechanical Diagram).

Factory configuration involves jumpers between terminals X7-1 and X7-3 and between terminals X7-2 and X7-4.

If connection to a UPS is made, remove the jumpers between X7-1 and X7-3 and between X7-2 and X7-4. Terminals X7-1 and X7-2 remain free but must NOT be used.

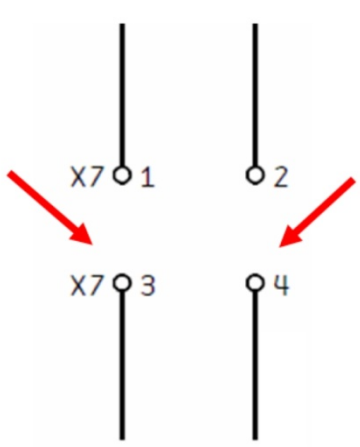


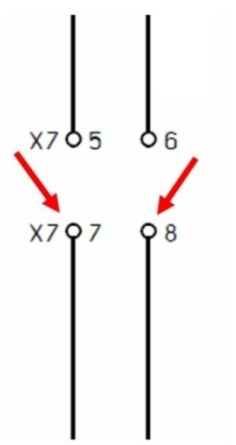
Figure 43: Terminals available for connection to a UPS

6.9.2. External Power Supply for Ventilation

The cabinet ventilation system may be powered by an external power source in order to save the energy delivered to meet fiscal incentives. For this purpose, two terminals are available, X7-7 and X7-8 (please refer to the Electrical and Mechanical Diagram).

The factory setting involves jumpers between terminals X7-5 and X7-7 and between terminals X7-6 and X7-8. If the power supply to the cabinet ventilation system is external, remove the jumpers between terminals X7-5 and X7-7 and between X7-6 and X7-8. Terminals X7-5 and X7-6 remain free but must NOT be used.

The inverter must be appropriately programmed by setting the parameter relative to the auxiliary power supply (please refer to the Programming Guide, Manager menu). In this way, the auxiliary power supply is continuously monitored so that should it be cut off, the inverter stops. Hence maximum safety is ensured for operation of the SUNWAY TG TE.



S000033

Figure 44: External Power Supply for Ventilation

6.10. Configuration of the IT/non-IT System

It is usually preferable for the PV field configuration to be an IT type.

An IT configuration guarantees continuity of service and makes it possible to handle single earth fault by means of simple detection systems.

Usually the IT configuration of the plant is lost when one of the following occurs:

- Earth fault
- Installation of the Earthed Option (please refer to section 8.2).

6.10.1. SPD Configuration

When an SPD trips, the SPD impedance drops to very low values. In this way, power surges are limited and the induced currents are discharged to protect the equipment. However, if the SPDs are earthed, they may create a low-impedance path for the plant currents, thus invalidating the IT configuration.

Whenever it is deemed necessary to install an SPD to protect the inverter AC output, certain design aspects must be taken into consideration if the Earthed option is installed. In fact, with this configuration during normal operation common mode voltages at higher switching frequency than the rated output voltage may occur.

It is therefore advisable to adopt the following SPD configuration:

- For differential mode protection, a star configuration with neutral connection (use the neutral/ star centre on the inverter side as a reference).
- For common mode protection, an appropriately sized SPD connected between neutral and earth.

6.10.2. Connection to Metering Voltage Transformer

Take great care over the connection to a metering voltage transformer. These instruments are normally used as fiscal metering devices connected to the inverter output.

Whenever these instruments are connected downstream from a LV/LV transformer, the connection can be made without following any particular instructions.

However, when they are connected to the AC output phases immediately downstream from the SUNWAY TG TE inverter, avoid connecting the windings to earth.

In fact, VT impedance is guaranteed at grid frequency only. Common mode currents exist in the system at a switching frequency which could adversely affect the VT. Furthermore, if an earth fault occurs on the PV field, average non-null currents arise which find a low-impedance path through the VT windings to earth. These currents can rapidly saturate and consequently damage the TV cores.

Use the following configurations to connect the VTs to the inverter's AC output:

- Delta connection
- Star connection with neutral connection (use the neutral/star centre on the inverter side for reference).

6.11. Commissioning

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

WARNING

Before interconnecting the SUNWAY TG TE to the PV field, check that all the power, signal and auxiliary connections are securely tightened.

Before connecting the PV field cables to the inverter, check:

- if the polarity of the individual sub-field connections to the DC-Parallel (if installed) is correct.

- if the polarity of the individual string connections to the String Boxes (if installed) is correct.

Checks:

- Check DC switch 10-QM1 is open.
- Check grid AC switch 16-QM12 is open.
- Check the emergency stop button is released and inhibit door safety by means of the relative Key-operated selector switch located on the front of the cabinet.
- Access terminal board X2 and check the correct polarity of the PV field input terminals.
- Turn on the main switch upstream to power the inverter's AC output.
- Check the correctness of the phase-to-phase voltage at terminal board X1.

Inverter power supply:

- Close the DC switch located inside the cabinet. If the field voltage is sufficient, the inverter comes on in STOPPED status.
- Close the AC switch. 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.

- The equipment is now ready to deliver active power to the grid with power factor = 1 and is ready for automatic maximum power point tracking (Automatic MPPT) Close the cabinet doors and enable door safety by means of the relative Key-operated selector switch located on the front of the cabinet.
- Enable the cabinet by means of the relative Key-operated selector switch located on the front of the cabinet and press the START button on the display/keypad. If the open-circuit voltage of the PV field exceeds the value set in parameter P020*1.1 (Field Menu), the inverter will start running and begin delivering power to the grid.

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.

- To reset any alarm, press RESET on the display/keypad. If the cause which caused the alarm has been removed, the alarms are reset and the START command can be given to restart the inverter.

NOTE

Alarms which are automatically reset (please refer to the Programming Guide, Autoreset Menu) do not end the run command. So, as soon as the alarm which generated the alarm has ceased to exist, the alarm will be reset automatically and the inverter will return to run mode without the START button being pressed.

Pressing the emergency stop button brings the inverter to a standstill and the grid interface devices open.

WARNING

When an alarm message appears, find out what caused the alarm before restarting the inverter.

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.

7. COMMUNICATIONS AND REMOTE MONITORING

7.1. General Information

SUNWAY TG TE inverters provide extensive and modular connectivity, both in the basic version and the version with the optional Data Logger (please refer to section 8.1).

- 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 SUNWAY TG TE inverters:

- Up to three RS485 Modbus/RTU serial links available
- Ethernet port available

7.2. Communication Ports and Protocol Used

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 usually behaves as a Modbus slave, i.e. it responds to requests made by a Modbus Master device, usually a PC, Data Logger board or a PLC.

Via the serial connection to the inverter internal measurements can be read and all operating parameters can be read, written and saved (COM0 port).

The COM1 and COM2 ports can be used as Modbus Masters for the field trunk lines the Smart String Boxes are connected to.

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

CommunicationPort	Available with BASIC configuration	Available with Data Logger optional	Protocol
COM0	Yes	Yes	Slave Modbus
COM1	No	Yes	Master/Slave Modbus
COM2	No	Yes	Master/Slave Modbus
Ethernet	No	Yes	Modbus Over Proprietary TCP/IP

Table 23: Communication ports

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

7.3. Connection Topologies

The connection topologies may be point-to-point or multidrop. The connection methods are described below.

7.3.1. SUNWAY TG TE - Basic Version

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

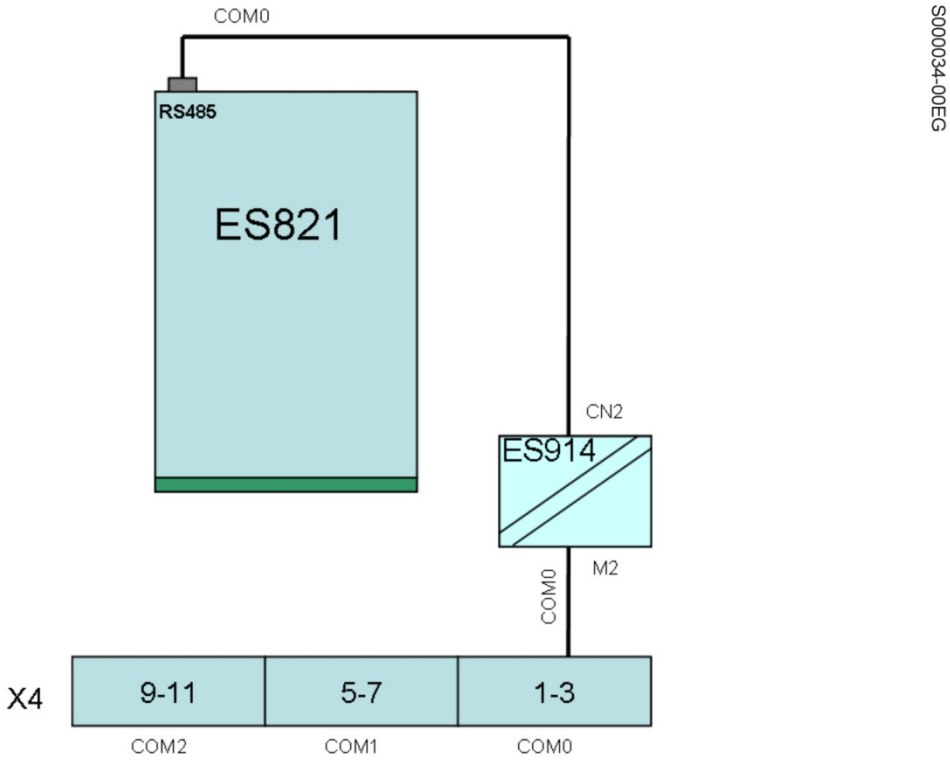


Figure 45: Configuration diagram of SUNWAY TG TE without optional Data Logger board

Communication ports on X4 terminal board:

- COM0 control board

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

NOTE

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

2.7 V between line A (D1) and 0 V

2.3 V between line B (D0) and 0 V

7.3.2. SUNWAY TG TE with Optional Data Logger Board

Configuration diagram of SUNWAY TG TE with optional Data Logger board

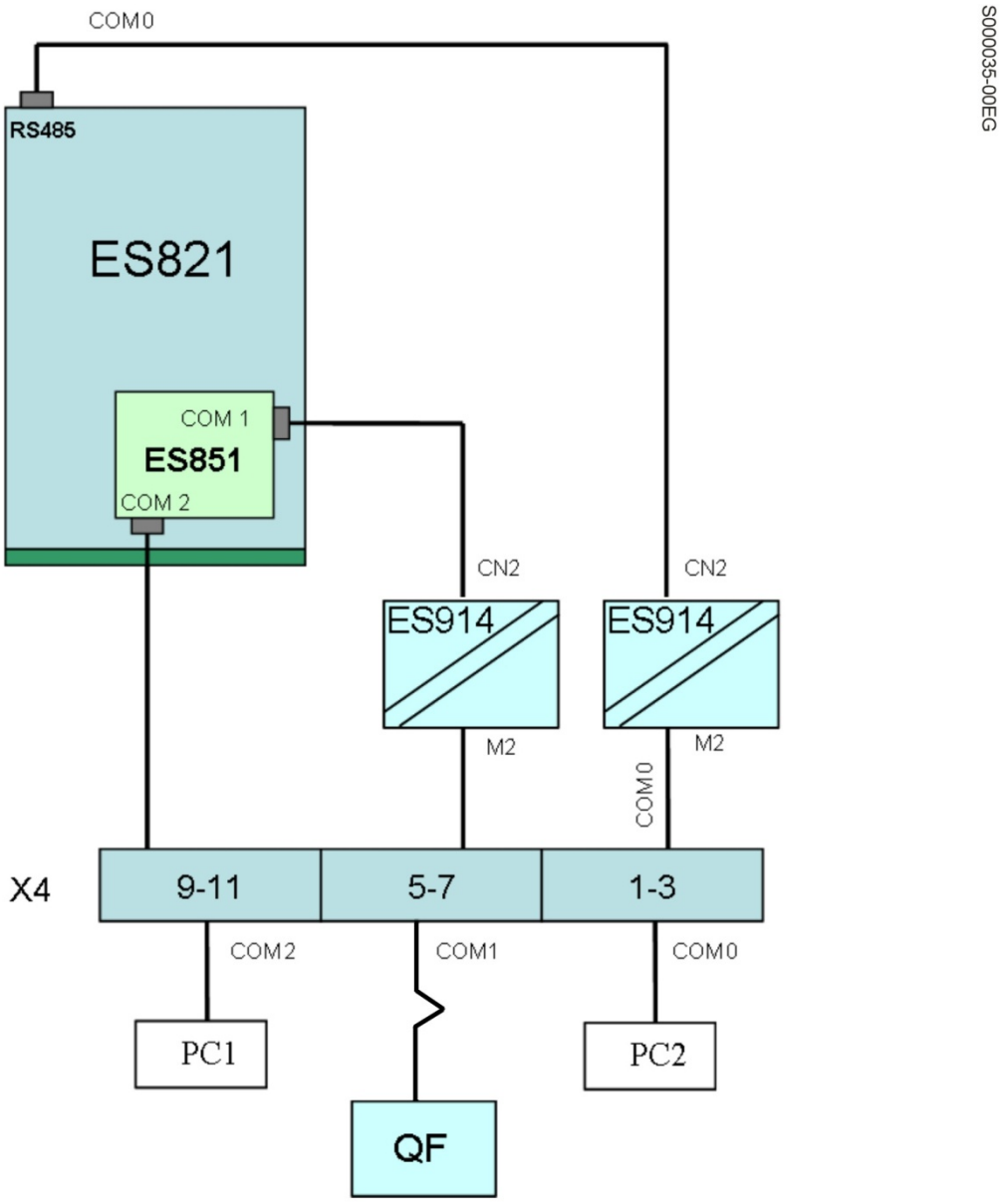


Figure 46: Configuration diagram of SUNWAY TG TE with optional Data Logger board

- PC1: a PC, PLC or other Modbus Master device.
- PC2: a PC, PLC or other Modbus Master device.
- QF: RS485 communication trunk line between the inverter and the Smart String Box (for example modules in a subfield).

Communication ports on X4 terminal board:

- COM0 control board.
- COM1 Data Logger.
- COM2 Data Logger.

The COM0 serial link on the control board is available on the X4 terminal board via the RS485 galvanic isolation board. This serial link can only be used in Modbus Slave mode.

The COM1 serial link on the Data Logger board is available on the X4 terminal board via the RS485 galvanic isolation board. This serial link can be used in Modbus Master or Slave mode. The COM1 port can be used as Modbus Master for the field trunk lines to the Smart String Boxes.

The COM2 serial link on the control board is available directly on the X4 terminal board. This serial link is galvanically isolated inside the Data Logger board. It can be used in Modbus Master or Slave mode. The COM1 port can be used as Modbus Master but it is preferable to use COM1 for the field trunk lines 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

For COM2 the terminators are enabled by default. If the COM2 is used for a multidrop connection between the inverters, only the last section must be terminated.

WARNING

If the COM1 is used as a Master port for the 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.

7.3.3. Interconnection of SUNWAY TG TE with Optional Data Logger Board

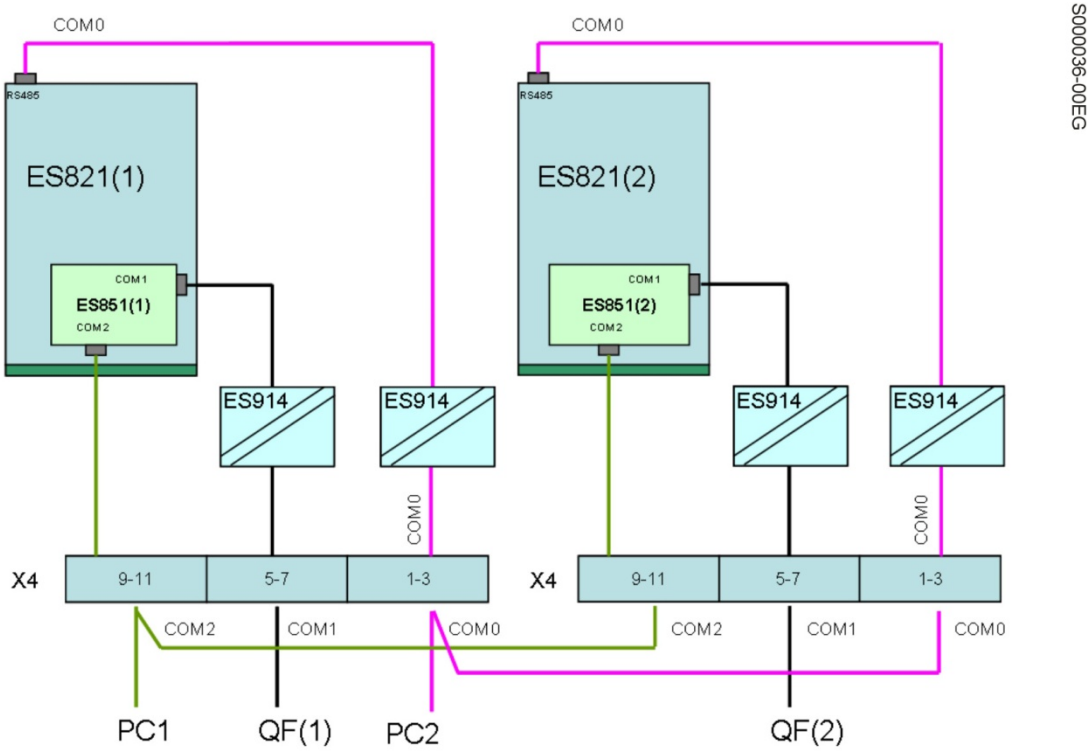


Figure 47: Configuration diagram of SUNWAY TG TE with multiple Data Logger boards

Connection to the following external communication devices is indicated in the diagram above:

- PC1: a PC, PLC or other Modbus Master device.
- PC2: a PC, PLC or other Modbus Master device.
- QF(1): RS485 communication trunk line between the inverter and the Smart String Box (for example modules in a subfield).
- QF(2): a second RS485 communication trunk line between the inverter and the Smart String Box (for example, modules in a second subfield).

7.3.4. Point-to-Point Connection

A point-to-point connection is made via a wired connection between the inverter and a PC, a PLC or other Modbus Master device.

If a PC is used it must be equipped with a RS485 port which is usually available as an optional on industrial PCs. If only USB ports are available, a USB to RS485 converter must be used. Elettronica Santerno is able to supply you with a converter if required. It is advisable to use the COM0 port on the inverter and enable the line terminators.

7.3.5. Multidrop Connection

It is possible to connect a series of SUNWAY TG TE inverters using a multidrop connection on RS485 bus.

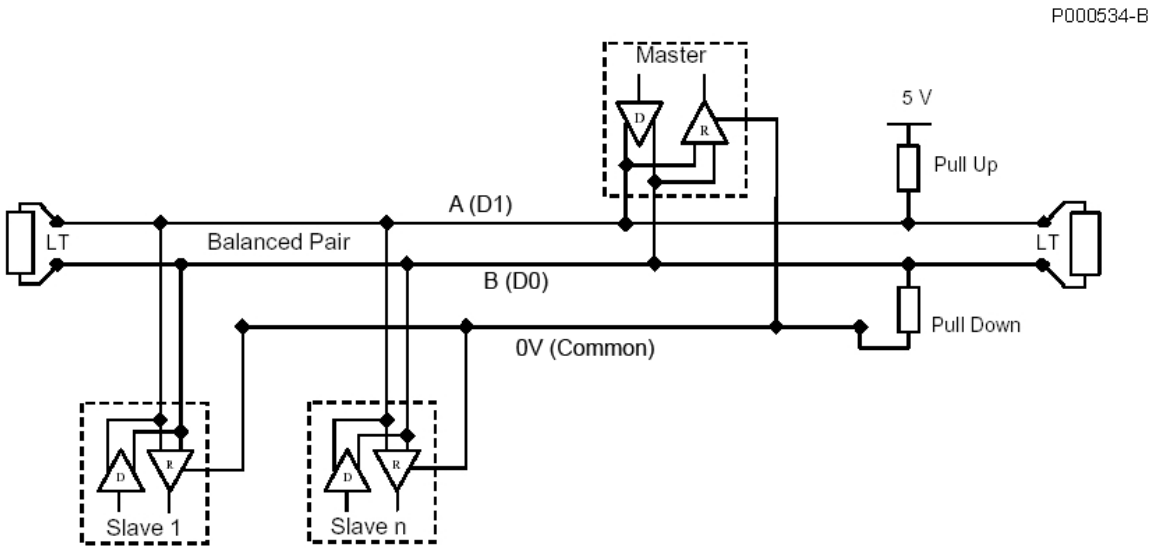


Figure 48: Multidrop connection diagram

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).

Each inverter has its own identification number to distinguish it in a univocal manner in the network under one PC. To change the factory settings of the Modbus address, please refer to the Programming Guide.

7.4. Connection

7.4.1. RS485 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 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 24: 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.

7.4.2. COM0 and COM1 Ports

Serial port	Available with BASIC configuration	Available with Data Logger optional	Optoisolated port	Terminal and contacts
COM0	Yes	Yes	Yes	X4-1: A (D1) X4-2: B (D0) X4-3: 0V
COM1	No	Yes	Yes	X4-5: A (D1) X4-6: B (D0) X4-7: 0V

Table 25: COM0 and COM1 serial port connection

The galvanic isolation between the inverter's COM0 and COM1 serial ports and the external communication devices is implemented by means of the RS485 galvanic isolation boards, referred to as 13A1 and 22A3 on the Electrical and Mechanical Diagram.

The RS485 line terminators on the COM0 and COM1 serial ports are enabled on the RS485 galvanic isolation board. The INVERTER port terminators must not be modified.

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
SW2-1, SW2-2 INVERTER Port Terminators	Inverter side RS485 terminator do not change	Both ON: terminators enabled do not change	ON: 150 Ω resistor between A (D1) and B (D0), 430 Ω resistor between A (D1) and +5 VM, 430 Ω resistor between B (D0) and 0 VM OFF: no termination and polarization resistor

Table 26: COM0 and COM1 – SW1 termination DIP-switch

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-switches remove the front protective cover from the RS485 galvanic isolation board.

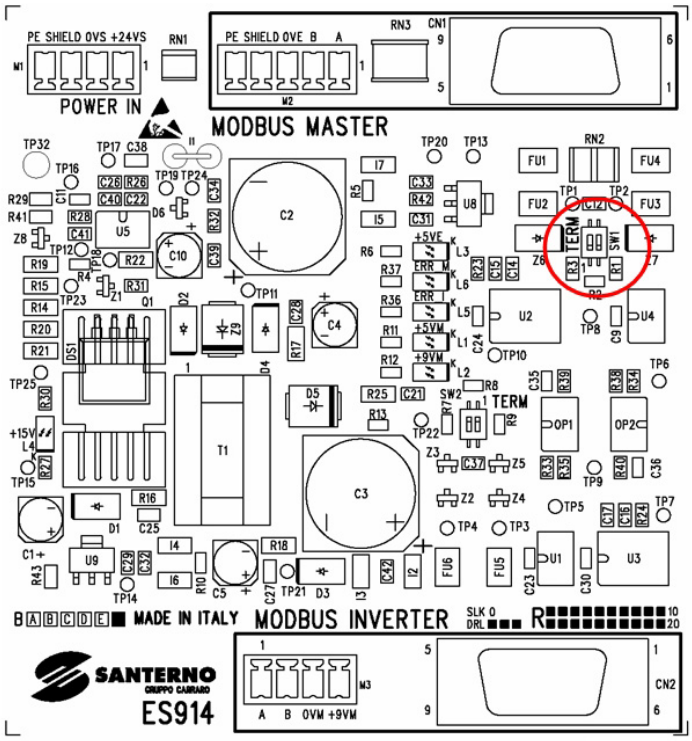


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Figure 49: COM0 and COM1 – Location of the SW1 termination DIP-switches

The factory settings of the DIP-switches are indicated in the following figure.

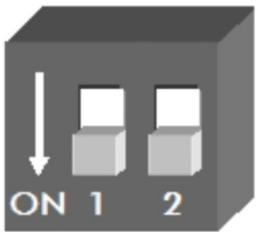

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Figure 50: SW1 termination DIP-switches

RS485 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 RS485 circuits (5 V)
L2	Green	Supply voltage detected for inverter (9 V)
L3	Green	Supply voltage detected for Master side RS485 circuits (5 V)

Table 27: 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 RS485 signal faults
L6	Red	Master side RS485 signal faults

Table 28: FAULT indicator LEDs

A FAULT indication is only to be considered valid when the line is correctly terminated, i.e. the SW1 and SW2 DIP-switches are 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).

Figure 51: Position of LEDs and DIP-switches shows the signalling LEDs and the configuration DIP-switches.

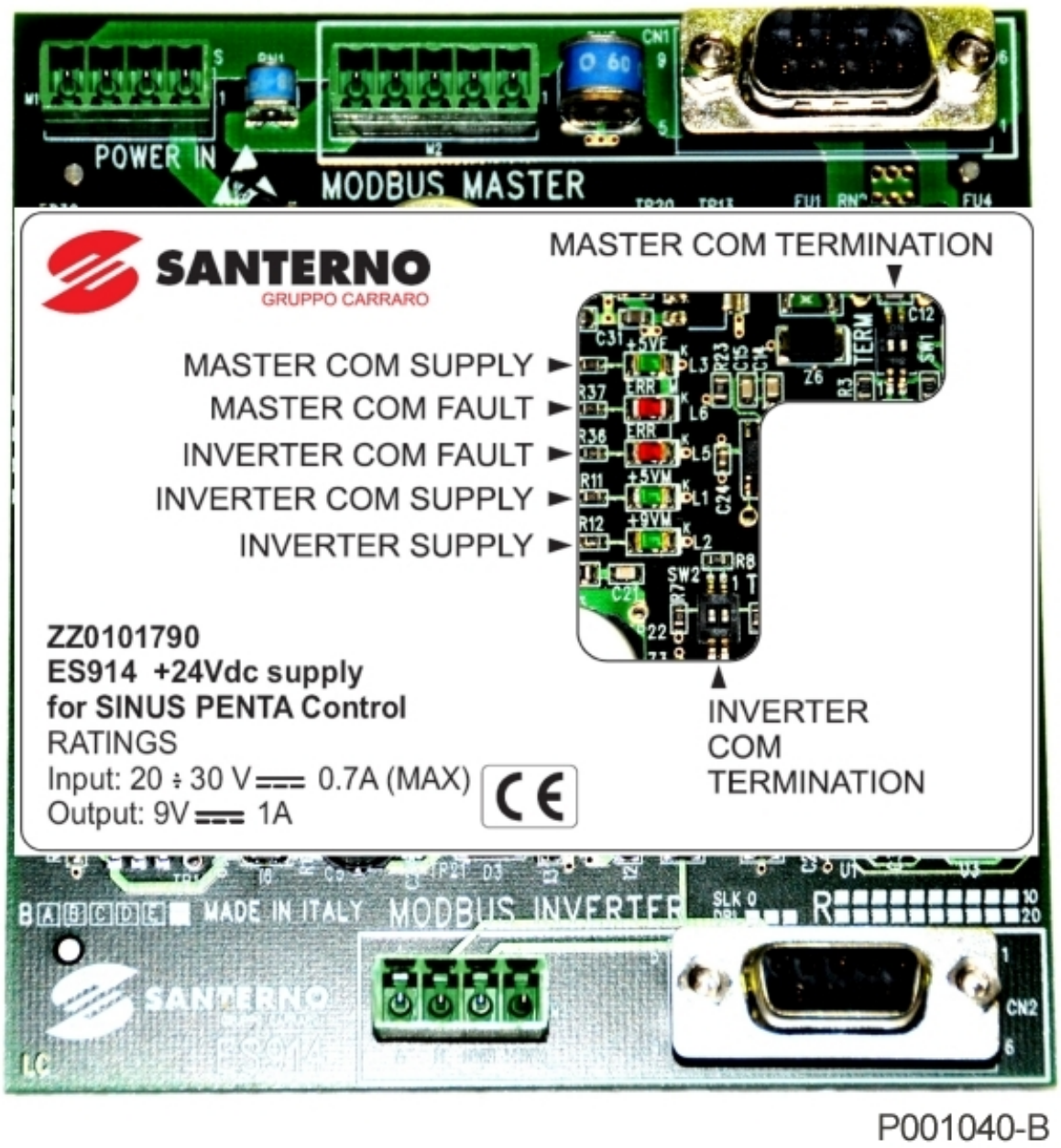

Figure 51: Position of LEDs and DIP-switches

In the event of serial communication problems, please consult section 11.

7.4.3. COM2 Port

Serial port	Available with BASIC configuration	Available with Data Logger optional	Optoisolated port	Terminal and contacts
COM2	No	Yes	Yes	DB9 on Data Logger board

Table 29: COM2 serial port connection

The galvanic isolation between the inverter's COM2 serial port and the external communication devices is implemented via the Data Logger board. Terminators of the RS485 line of the COM2 serial port are inserted on the Data Logger board.

The pin layout is as follows:

NO.	Name	Description
1		Not connected
2		Not connected
3	A (D1)	Line RS485 A (D1)
4		Not available in this application
5	0VM	Earth signal/isolated power supply
6		Not available in this application
7		Not connected
8	B (D0)	Line RS485 B (D0)
9		Not connected
frame	PE	Inverter earth

Table 30: DB9 connector

DIP-switch	Function	Factory setting	Notes
SW2-1, SW2-2 RS485 driver power supply	RS485 driver power supply	Both ON: RS485 internal insulated driver power supply	ON: RS485 internal insulated driver power supply OFF: RS485 external insulated driver power supply from connector pin 6
SW2-3, SW2-4 COM2 port terminators	COM2 RS485 terminator	Both ON: terminators on	ON: 120 Ω resistor between A (D1) and B (D0), 1500 Ω resistor between A (D1) and +5 VM, 1500 Ω resistor between B (D0) and 0 VM OFF: no termination and polarization resistor

Table 31: SW2 termination DIP-switches

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 SW2 DIP-switches, remove the protective front cover on the converter and dismantle the environmental sensors and field I/Os expansion board.

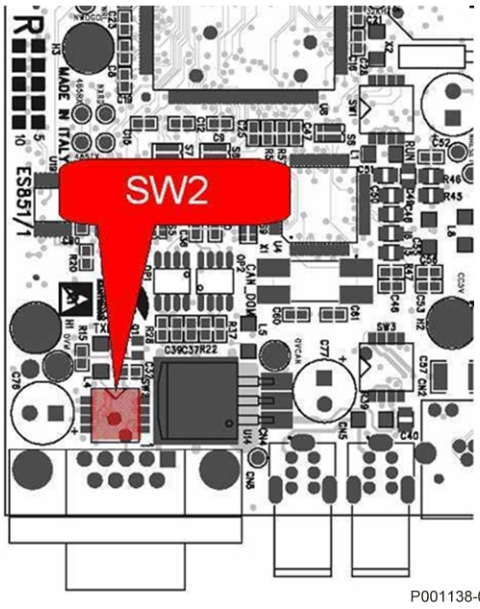

Figure 52: COM2 – Location of the SW2 termination DIP-switches

The factory settings of the DIP-switches are indicated in the following figure.

S000037

Figure 53: SW2 termination DIP-switches

In the event of serial communication problems, please consult section 11.

7.4.4. Ethernet Port

Port	Available with BASIC configuration	Available with Data Logger optional	Terminal and contacts
Ethernet	No	Yes	RJ45 on Data Logger board

Table 32: 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:

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

Table 33: RJ45 connector

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.

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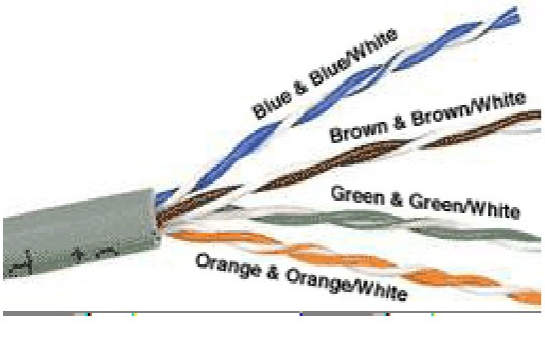

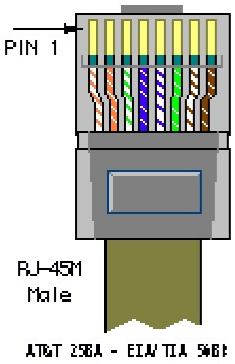

Pin	Wire color
1	orange/white
2	orange
3	green/white
4	blue
5	blue/white
6	green
7	brown/white
8	brown

Figure 54: 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.

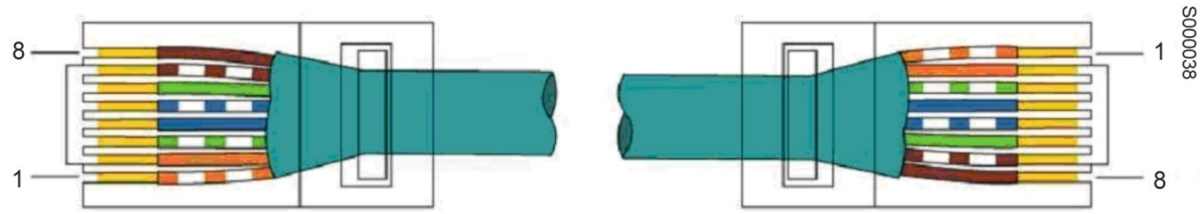

Figure 55: EIA/TIA 568 standard patch cable, UTP/STP cat.5

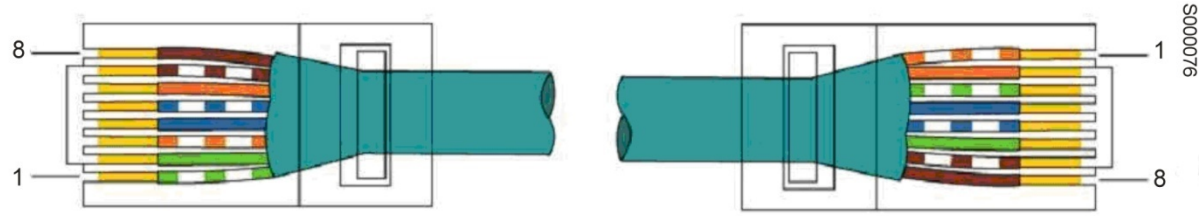

Figure 56: EIA/TIA 568 cross-over cable, UTP/STP cat.5

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 11.

8. OPTIONALS

8.1. Data Logger - Optional

The Data Logger board is available as an optional. This is a telecommunication unit which carries out the functions of local production data storage, inverter-inverter or inverter-Smart String Box connection, all in remote control connection with Santerno.

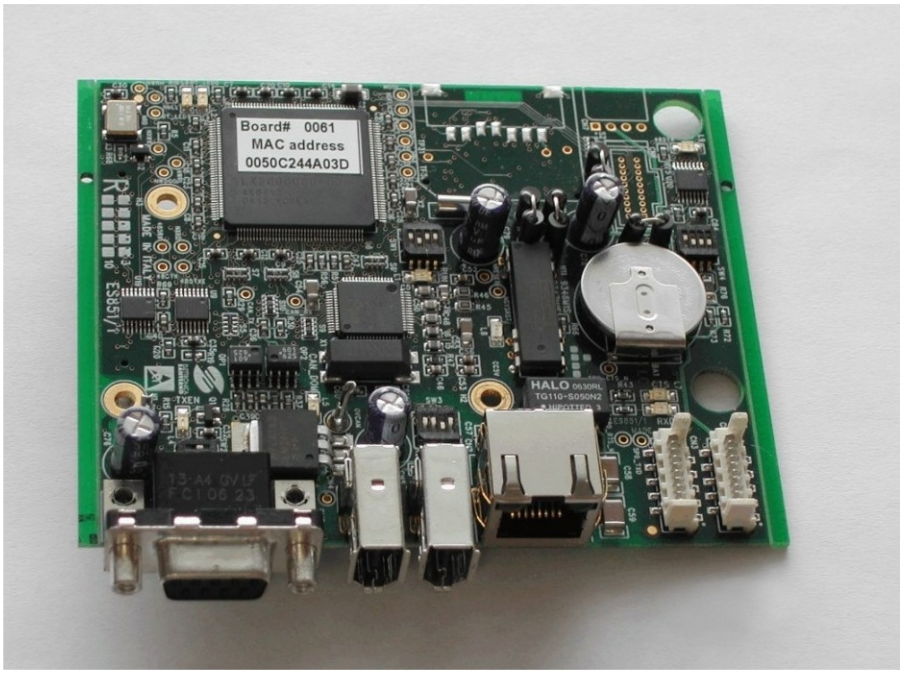

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Figure 57: Data Logger board - Optional

NOTE

To be ordered at the same time as ordering the inverter.

The Data Logger board is installed on the converter control board which can be accessed by opening the front cover.

Figure 58: Location of the optional Data Logger 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 act as Modbus Slaves.

Should Santerno devices, such as SUNWAY M XS, SUNWAY M PLUS, SUNWAY TG, SUNWAY TG TE, Smart String Box, etc. 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.

Two serial communication ports and an Ethernet port are available on the Data Logger board.

- COM1, COM2: RS485 Modbus/RTU serial links.
- Ethernet.

Please refer to section 7.1.

8.2. Earthed Option – Connection of the PV Field to Earth

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 SUNWAY TG TE inverters, the Positive Earthed option and the Negative Earthed option; both guarantee full compatibility with all PV modules available on the market.

All the live parts of 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.

Please refer to section 6.10 for an overview of IT/non-IT distribution.

NOTE

To be ordered at the same time as ordering the inverter.

SUNWAY TG TE inverters modified for use of SunPower modules therefore have a positive 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.

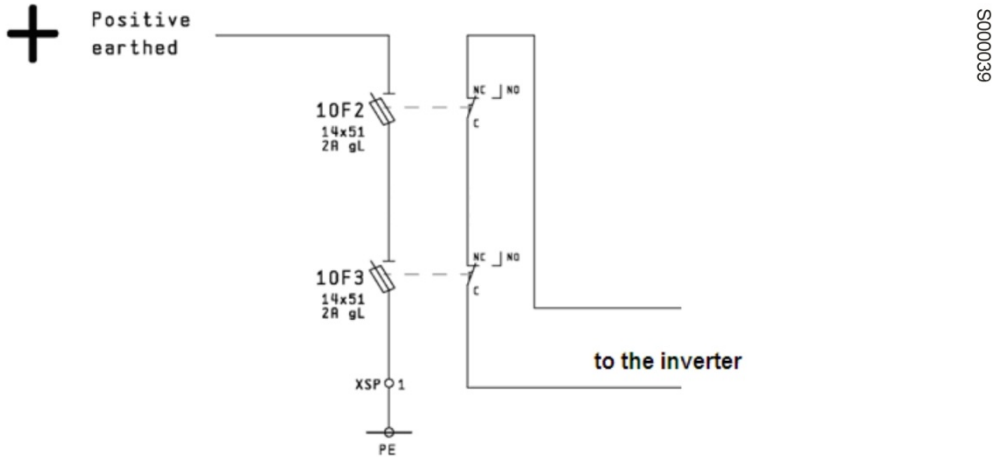

Figure 59: Positive Earthed option – connection of the positive pole to earth

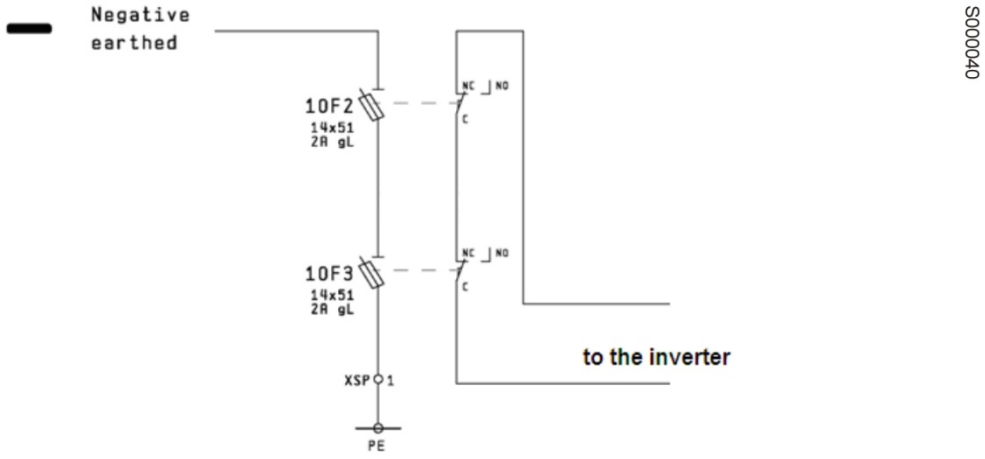

Figure 60: Negative option – connection of the negative pole to earth

Installation of the Earthed option on SUNWAY TG TE inverters inhibits continual isolation control.

If the fuses blow, an isolation loss alarm is triggered which is in fact a loss of polarization.

Please refer to section 4.5.

DANGER

Earthed-pole systems are NON IT systems.

The earth polarization fuse is not a safety device against direct contacts.

If the earth polarization 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.

Installation of the Earthed optional on SUNWAY TG TE involves certain system restrictions:

- Each individual SUNWAY TG TE inverter with the Earthed optional must be connected to the grid via its own isolation transformer.
- Up to two SUNWAY TG TE inverters with the Earthed optional can be connected to the same LV/LV or LV/MV transformer by using a double-wound transformer.
- The node located on terminal XSP-1, under fuses 10F2 and 10F3 must be the only earthing point for the system.

Do not earth any other point of the PV field.

Never earth the neutral (if present) on the inverter-side winding.

8.2.1. Additional Safety Warnings for the Earthed Option

The standard 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.

DANGER

Earthed-pole systems are NON-IT systems.

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

If the earth polarization 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.

Example with Positive Earthed option:

In the event of inadvertent contact with the negative pole the fault current is limited only by the resistance of the operator's body.

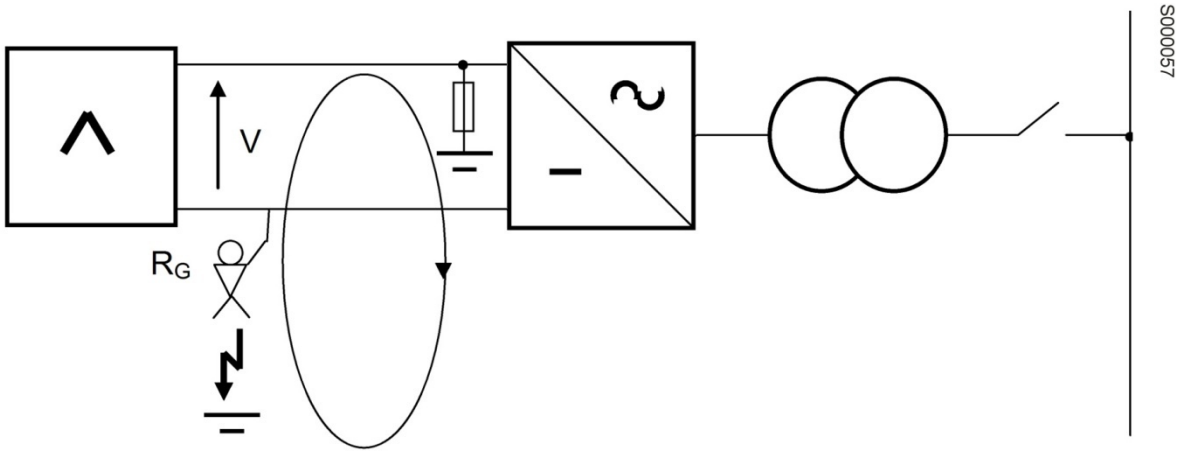

Figure 61: Direct contact with live pole

A fault loop occurs powered by the PV field which closes via the fuse and the operator.

WARNING

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

In the event of inadvertent contact with the positive pole the potential difference the operator is subject to is zero, hence the fault current is also zero.

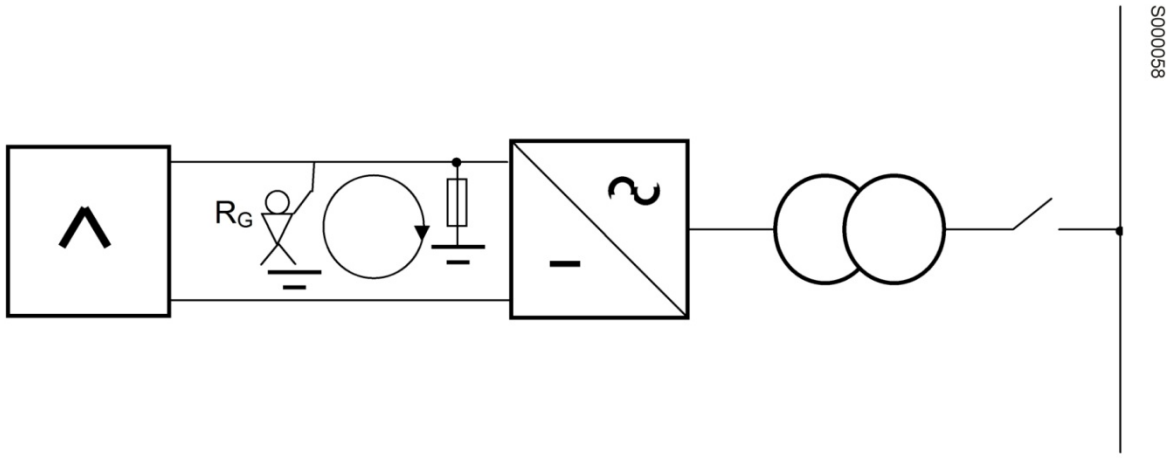

Figure 62: Direct contact with voltage-free pole

Opening of the connection fuse modifies the electrical status of the PV field. Inadvertent contact with the positive pole of the PV field is initially non-hazardous but becomes so once the fuse has blown.

In the event of a negative pole earth fault, the fuse is blown and opens.

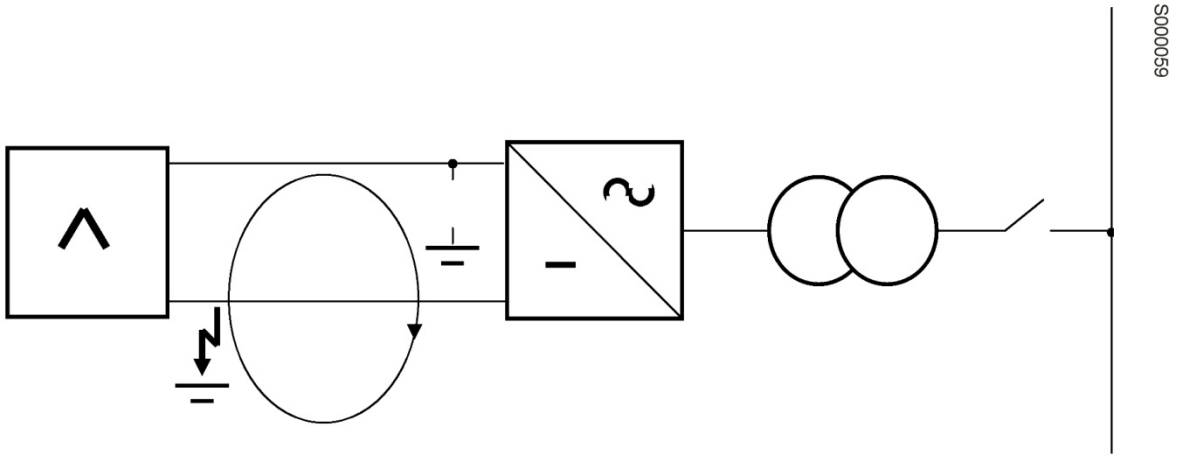

Figure 63: Dead short to earth and polarization fuse blowing

If the fault to earth of the negative pole persists, in the event of inadvertent contact with the positive pole the potential difference the operator is subject to is equal to the PV field voltage. The fault current is not zero.

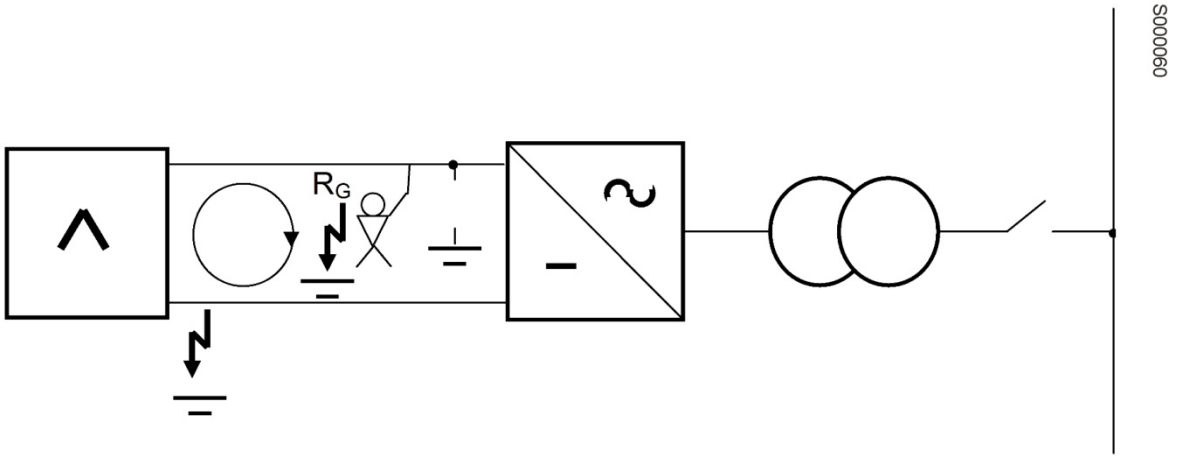

Figure 64: Direct contact with pole which is no longer voltage-free

8.3. GPRS Optional

A GPRS Router is available as an optional. It can be used only if the Data Logger optional is also installed.

The router, connected to the Ethernet port on the Data Logger board, is housed inside the inverter. The push-through router aerial is installed on the roof. For instructions on how to install the SIM card and programme the Router, see the manual provided with the device.

Please refer to the inverter Electrical and Mechanical Diagram.

8.4. Optional Anti-Condensation Heater

An anti-condensation heater is available as an optional.

The heater makes it possible to extend the bottom temperature range for inverter operation to -25°C. All the technical data is provided in section 12.2.

Please refer to the inverter Electrical and Mechanical Diagram.

NOTE

To be ordered at the same time as ordering the inverter.

8.5. DC Measurements

Current measurement sensors can be mounted on each DC input of the DC-Parallel. The measurements are available in Modbus RTU protocols.

It is recommended that the Data Logger optional is also installed.

8.6. AC Power Meter

A door-mounted AC power meter and its relative CTs and VTs are installed on the AC output of each inverter. All the measurements are available via RS485 Modbus RTU communication and integrated with Santerno Remote Control.

It is recommended that the Data Logger optional is also installed.

8.7. Real-time Efficiency Measurements

A kit is available to measure conversion efficiency in real time. It can be used only if the Data Logger optional is installed.

9. DC-PARALLEL

S000111

Figure 65: DC-Parallel

9.1. General Information on the Product

Medium- and high-power PV generator systems are made up of a high number of strings. To optimize the connection topology and enhance the protection and monitoring systems, the parallel connection of the strings is carried out on more than one level, usually a first parallel level and a second parallel level.

Elettronica Santerno offers a complete range of products for string parallel connections, String Boxes and Smart String Boxes for creating the first parallel level and the DC-Parallel for creating the second parallel level.

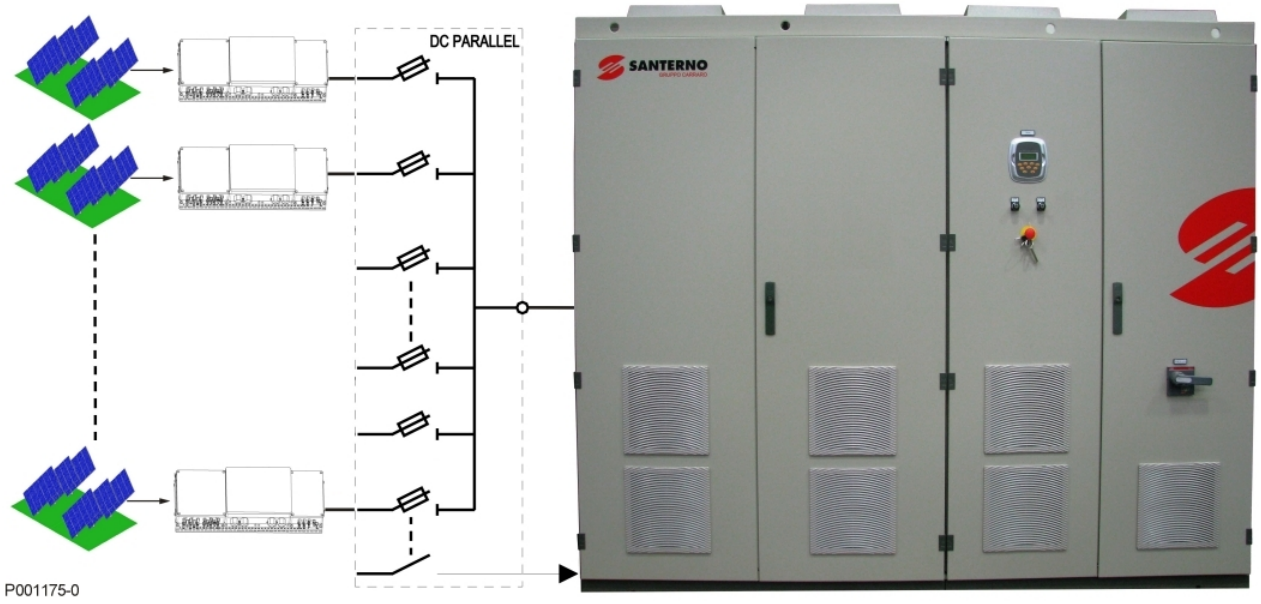

Figure 66: General electrical diagram of the PV field with two levels of parallel connections

The DC-Parallel cabinet is available in different sizes, depending on the number of connectable cables and the maximum allowable current.

NOTE

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

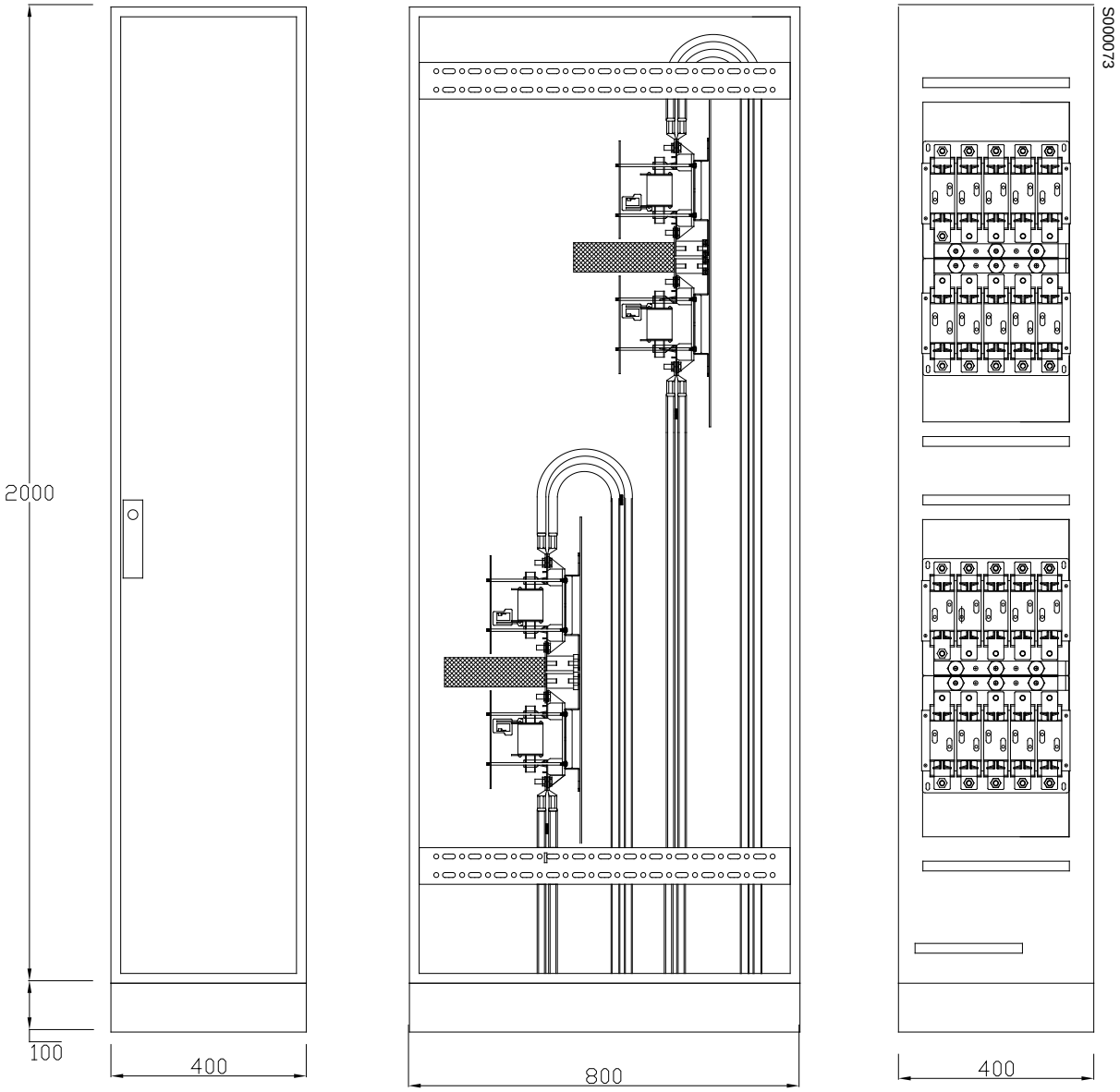

Figure 67: DC-Parallel with 10 inputs

9.2. Product ID Code

The product ID code identifies the cabinet 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 DC-Parallel		**X2/X1 Y P S**
X2/X1	**Number of inputs**	X2: maximum number of inputs on paralleled fuses X1: maximum number of inputs on single fuses (not paralleled)
Y	**Cabinet + base height**	A:1800 mm + 150 mm B:2000 mm + 100 mm D:2000 mm + 150 mm
P	**Depth**	5=500 mm 6=600 mm 8=800 mm
S	**Installation**	S= Stand Alone

Examples:
SUNWAY DC-Parallel 4/8 - B6
SUNWAY DC-Parallel 4/10 - D8
SUNWAY DC-Parallel 8/16 - D8 - S

9.3. Technical Specifications

- Variable number of inputs depending on the model (from 4 – 20).
- Protection provided by fuses installed on both poles of the PV field.
- Blown fuse signalling contact.
- Maximum flexibility thanks to the possibility of being able to parallel-connect two inputs.
- Factory assembly with SUNWAY TG TE inverter.
- Stand-Alone version also available.

All the technical data is provided in section 9.

9.3.1. Fuse Installation

When designing large-scale PV systems it may be necessary to configure subfields of non-uniform power. In this case, it is advisable to protect each inverter incoming line with different size fuses (please refer to section 12.13.2).

The DC-Parallel cabinet can be equipped with a set of different size fuses. The fuses must be ordered separately.

The Final Test Certificate indicates the exact configuration of the fuses installed for each input.

S000062

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 68: Example of fuse configuration provided in the Final Test Certificate

INCREASING THE CAPACITY OF THE INPUTS

If the current of a single input exceeds the maximum allowable size of the fuse, it is possible to parallel-connect the physical inputs in pairs and hence double the current capacity; however, the maximum number of allowable inputs is reduced as a result.

To parallel-connect two inputs, use the special parallel bars provided in the kit supplied with the DC-Parallel. The individual inputs which are parallel-connected in pairs are defined Paralleled Inputs. See the figure below.

S000063

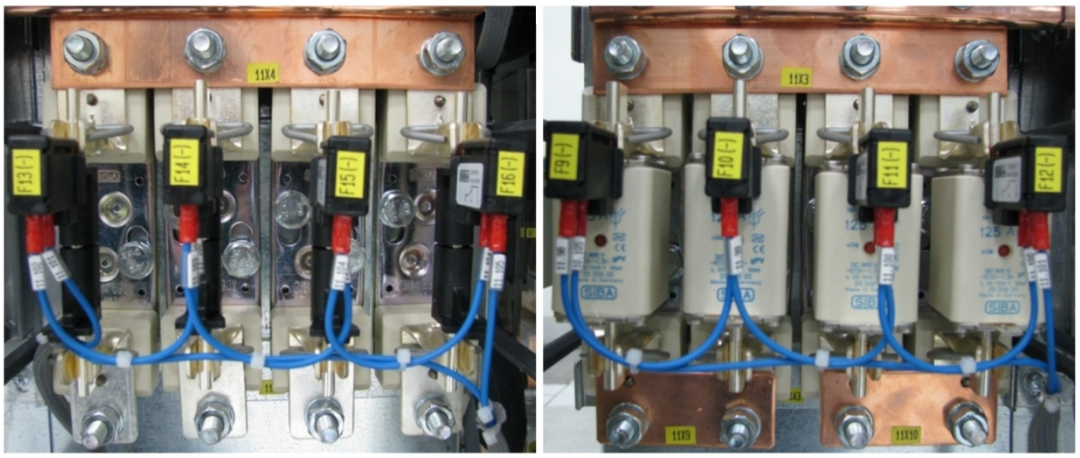

Figure 69: Single and paralleled inputs

9.3.2. Input Current Capacity

This heading deals with correct sizing of the fuses installed in the DC-Parallel.

The rated capacity values usually refer to an ambient temperature of 30 °C. For applications at higher ambient temperature, a proper derating coefficient must be applied.

As a reference, refer to the following formula, that has always to be verified according to the fuse specs.

Single fuse on one DC input

$$A1 = \sqrt{\frac{125 - Tamb\_max}{100}}$$

Double parallel-connected fuses on one DC input

$$A2 = \sqrt{\frac{125 - Tamb\_max}{100}} - 0.05$$

Where Tamb_max is the maximum ambient temperature when the DC-Parallel is operating.

EXAMPLE No. 1:

Considering Tamb_max = 40 °C

- A1= 92.2
- The DC-Parallel with 4 non-paralleled inputs with a 200 A fuse installed can take a theoretical maximum current of 184.3 A on each individual input. It is therefore recommended that 180 A on each individual input be considered.

EXAMPLE No. 2:

Considering Tamb_max = 50 °C

- A1= 86.6
- The DC-Parallel with 4 non-paralleled inputs with a 200 A fuse installed can take a theoretical maximum current of 173.2 A on each individual input. It is therefore recommended that 170 A on each individual input be considered.

EXAMPLE No. 3:

Considering Tamb_max = 40 °C

- A1= 92.2
- The DC-Parallel with 8 non-paralleled inputs with a 200 A fuse installed can take a maximum theoretical current of 184.3 A. It is therefore recommended that 180 A on each individual input be considered.
- If it is necessary to have an input which takes 240 A: in this case, the special parallel bars provided in the kit supplied with the cabinet must be utilized to parallel-connect the inputs in pairs. The number of available inputs is halved.
- A2= 87.2
- Using a 160 A fuse for each physical channel, a theoretical current capacity of 139.5 A is achieved. It is therefore recommended that 135 A on each individual input be considered. The two parallel inputs guarantee a capacity of 2x135 = 270 A which is suitable for the purpose.

9.3.3. Cable Sizing

The connection cables between the String Boxes (normally located near the PV modules) and the DC-Parallel (located in the technical room) usually carry all the current from the group of strings which belong to the individual String Boxes.

Being as the PV field is a current-limited generator, even in the event of a short circuit the current delivered by this kind of generator cannot exceed the maximum sizing value. However, this concept is not valid for the current flowing through the cables.

Take as an example a short circuit which occurs downstream from the String Box but upstream from the connection to the DC-Parallel (see Figure 70: Short circuit located upstream from the DC-Parallel). When this happens, the current from all the strings bar one is localized in the section of cable between the point where the short circuit has occurred and the connection to the DC-Parallel.

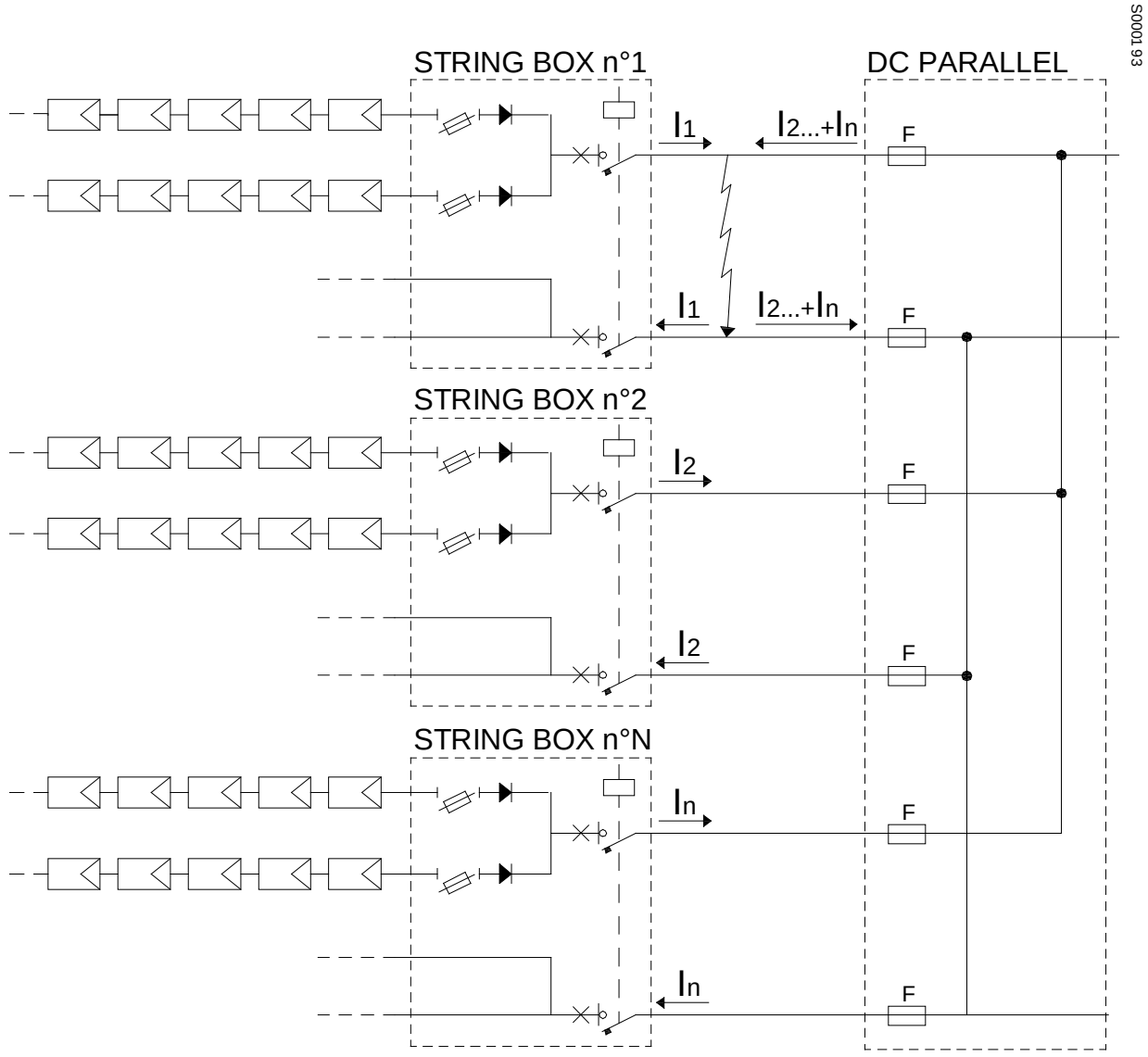

Figure 70: Short circuit located upstream from the DC-Parallel

In PV systems, the current depends on radiation. Table 34: Trip time of fuses indicates the expected time of fuse tripping depending on the short-circuit current flowing and the size of fuses.

Fuse size In [A]		DC current 2 x In [A]	Trip time [s]		DC current 3 x In [A]	Trip time [s]		DC 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 34: Trip time of fuses NH1-XL

Please refer to the DC-Parallel's Electrical and Mechanical Diagram to check the recommended section of cables outgoing from the DC-Parallel to the inverter.

9.4. Product Installation

9.4.1. Mechanical Assembly

The DC-Parallel is usually supplied already attached to the inverter it is to be connected to, hence only the electrical connections to the String Boxes must be carried out.

Should it not be possible to fit the DC-Parallel onto the SUNWAY TG TE inverter, due to limited space availability in the technical room, the DC-Parallel can be installed in a separate cabinet (please refer to section 9.5)

A specific Stand-Alone DC-Parallel is also available to be integrated into Sunway Station LS power stations.

Regardless of the type of installation selected, the DC-Parallel is always to be considered an integral part of the inverter configuration. For information on handling, assembly and commissioning, please refer to sections 4, 5 and 6.

All the necessary measures must be taken to ensure that the equipment is not exposed to direct sunlight. These measures are to ensure that the internal temperature of the DC-Parallel remains within the prescribed limits.

9.4.2. Electric Connection

WARNING

Be sure to operate in accordance with the indications provided in section 2.5.

The DC-Parallel input cables come from the String Boxes installed on the PV field. For each input, electrical connections are made to copper bars suitably arranged for connecting two conductors per pole (please refer to Figure 72: Connection of cables coming from the String Boxes: front view and Figure 73: Connection of cables coming from the String Boxes: side view). There are no terminals.

The output cables from the DC-Parallel are connected to the SUNWAY TG TE inverter input.

For each output, electrical connections are made to copper bars which hold the positive and negative poles of the PV field (please refer to Figure 74: DC-Parallel: side and front view). There are no terminals.

The equipment is powered by just one DC voltage source from the PV field. However, being as the number of power supply sources is equal to the number of strings connected, make sure that all the disconnect switches for the upstream strings are open if you wish to disconnect the cabinet.

Equipment connection is the Customer's responsibility.

DANGER

NO MAIN INPUT DISCONNECT SWITCH IS PROVIDED.

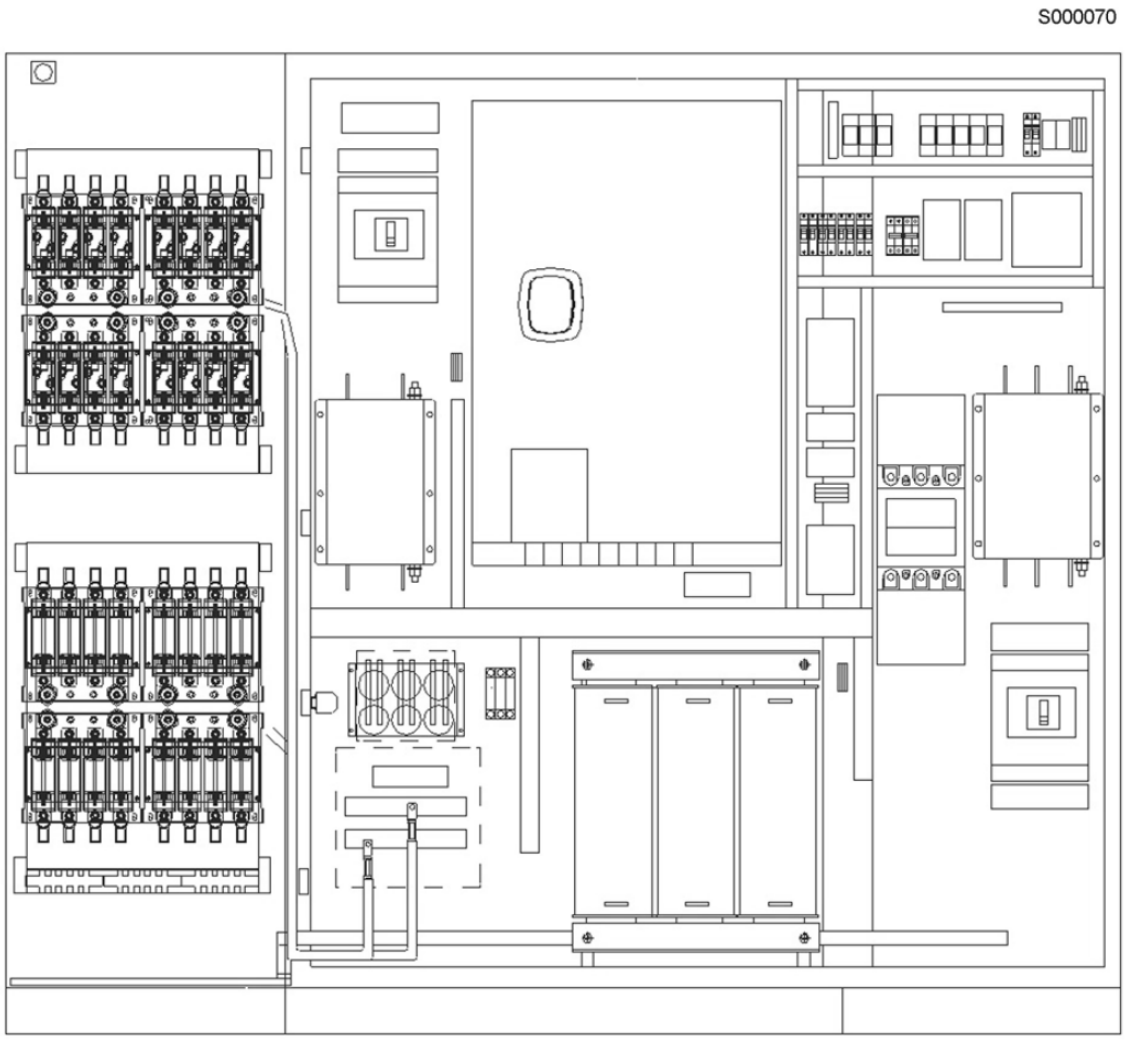

Figure 71: Composition of a SUNWAY TG TE inverter with a DC-Parallel

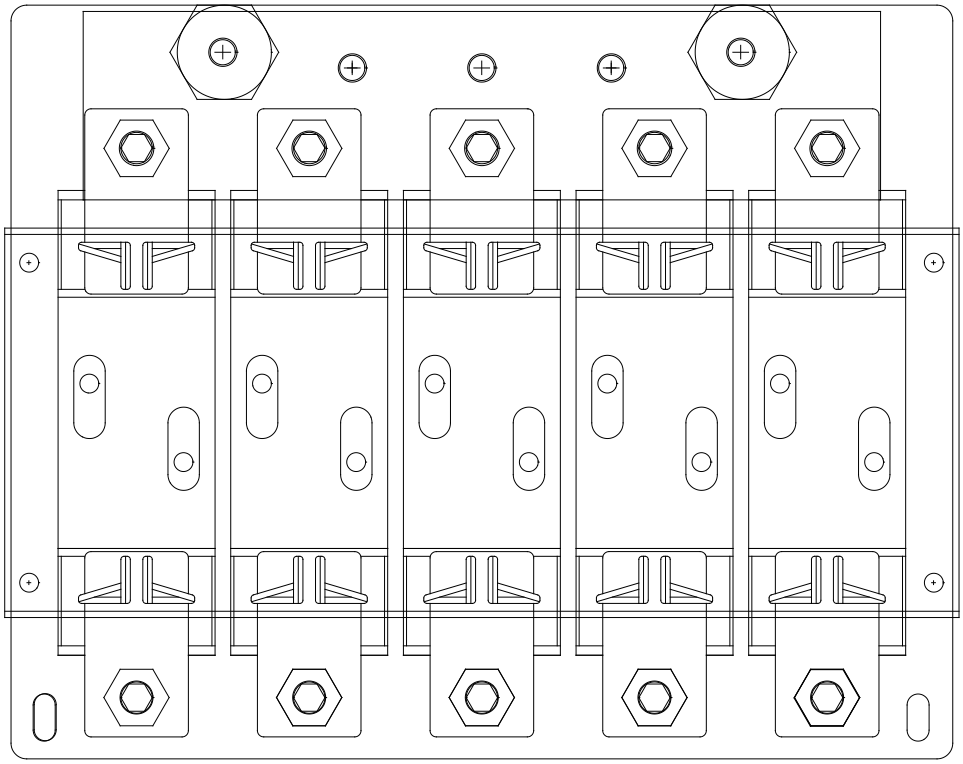

Figure 72: Connection of cables coming from the String Boxes: front view

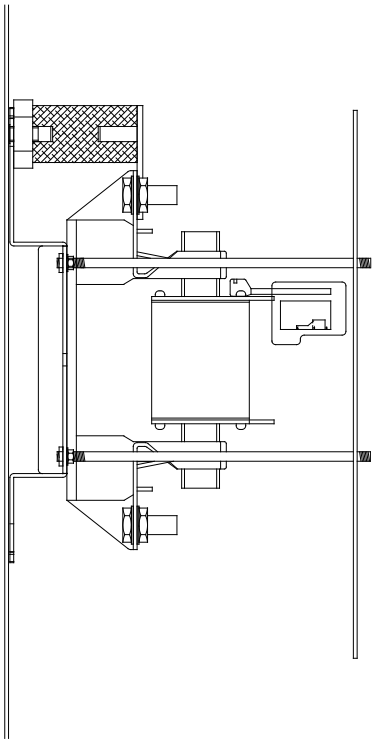

Figure 73: Connection of cables coming from the String Boxes: side view

9.4.3. Wire Fastening

Housing of the cables coming from the String Boxes is usually on two levels, spaced depending on the depth of the cabinet. This solution makes it possible to make the most of all the space available, facilitating the job of fastening the wires to the specially arranged bars and ensuring correct clearance between cables. In this way the two poles are completely separated thus preventing the risk of accidental short-circuits.

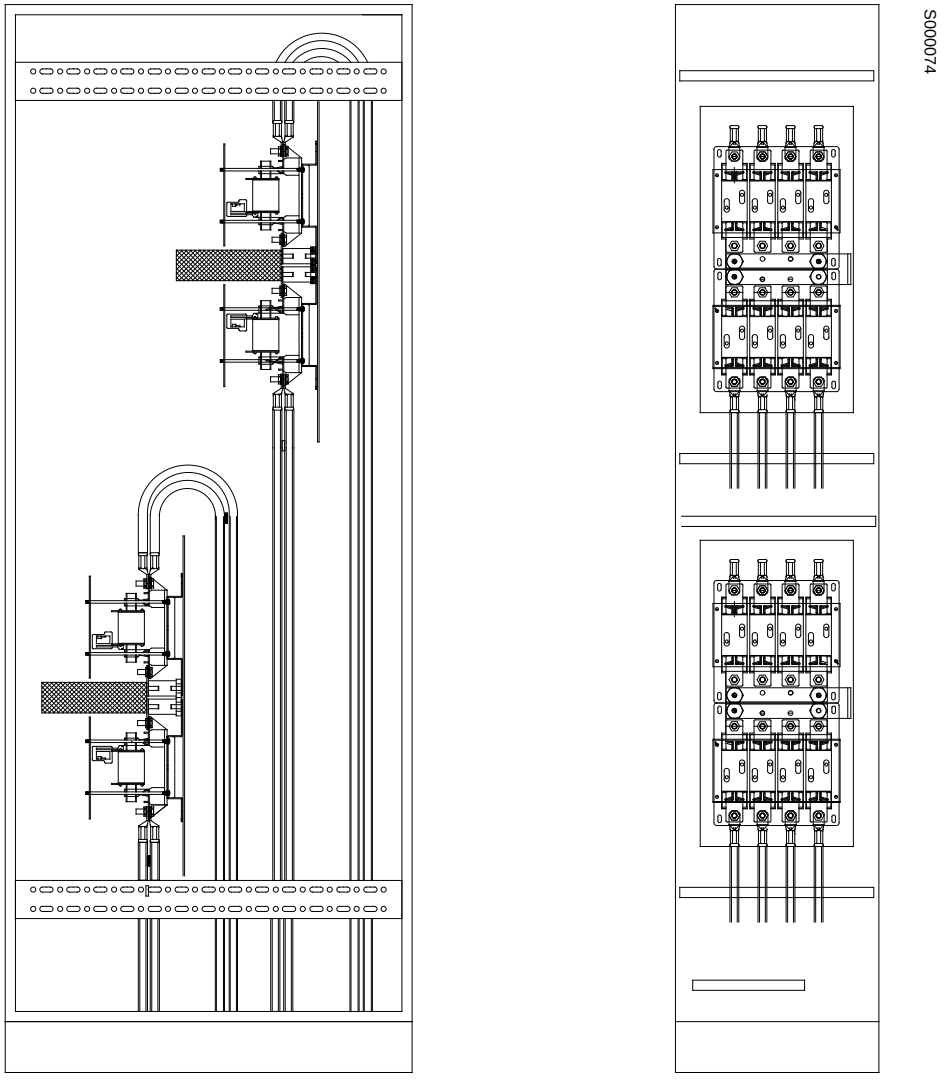

Figure 74: DC-Parallel: side and front view

9.5. Stand-Alone DC-Parallel

The Stand-Alone DC-Parallel can be installed in the technical room separately from the SUNWAY TG TE inverter.

The Stand-Alone DC-Parallel can be installed with its back directly up against the cabin wall.

The Stand-Alone DC-Parallel can be positioned on the same wall as the SUNWAY TG TE (see Figure 75), or on a different wall (see Figure 76). Whatever the installation position, always observe the clearance values indicated in Table 75: Clearance Values for Stand-Alone DC-Parallel required for ensuring adequate cooling of the compartment and operator access.

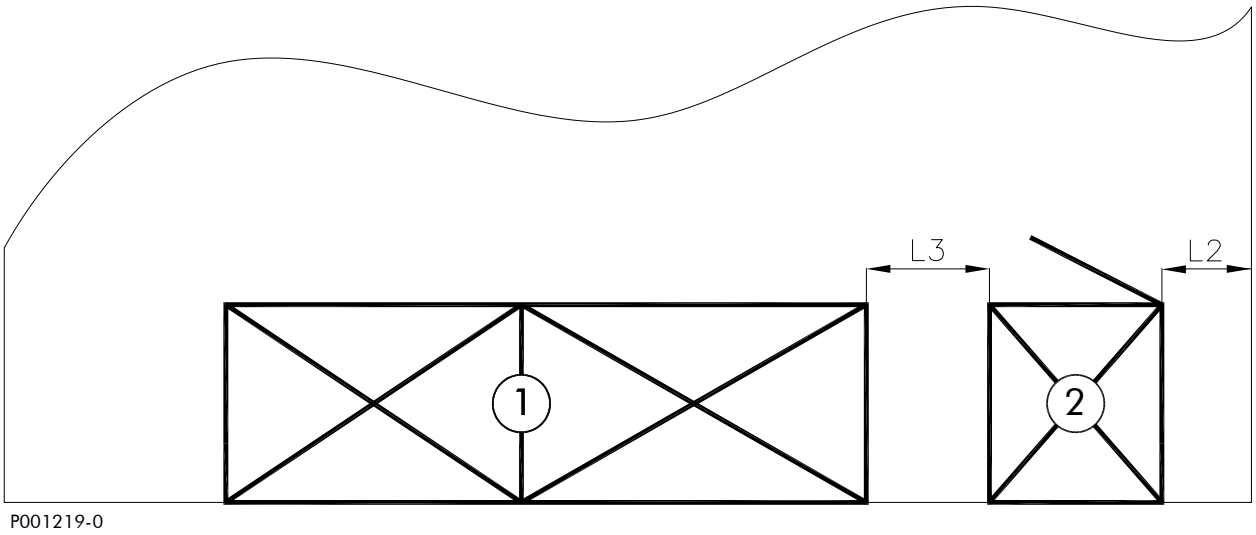

Figure 75: Positioning of the Stand-Alone DC-Parallel on the same wall as the SUNWAY TG TE inverter

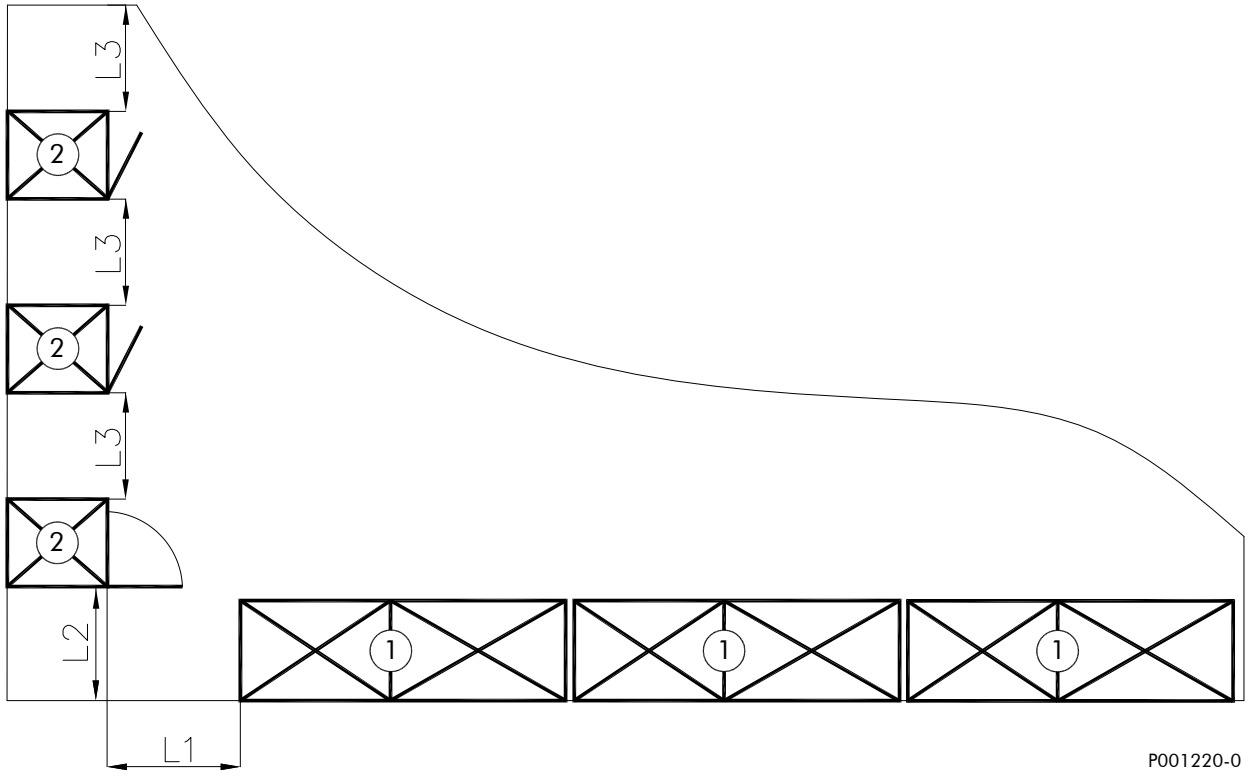

Figure 76: Positioning of the Stand-Alone DC-Parallel on a different wall to the SUNWAY TG TE inverter

Product identification	
1	SUNWAY TG TE
2	SUNWAY DC-Parallel

9.5.1. Stand-Alone DC-Parallel Electrical Connection

The figures below indicate how to connect the positive and negative pole power cables.

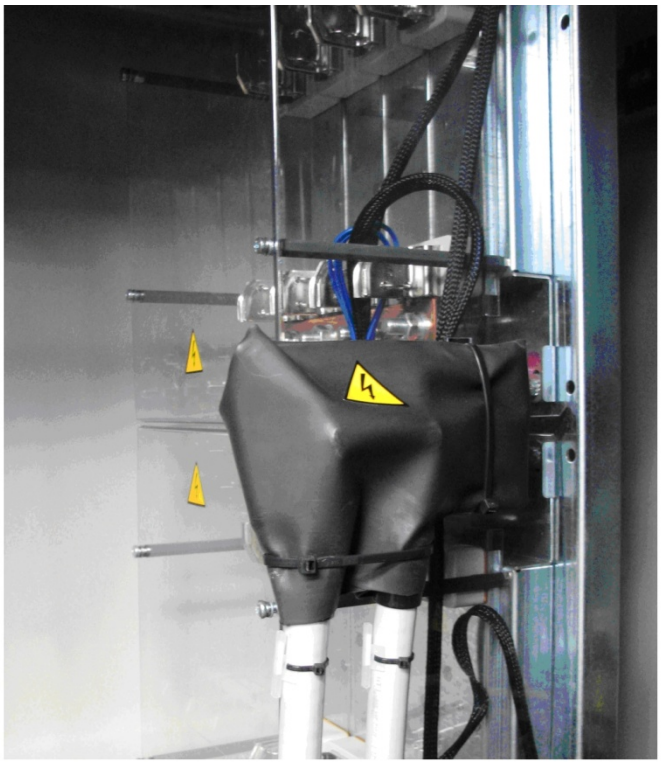

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Figure 77: Stand-Alone DC-Parallel: Connection of positive pole power cable

S000099

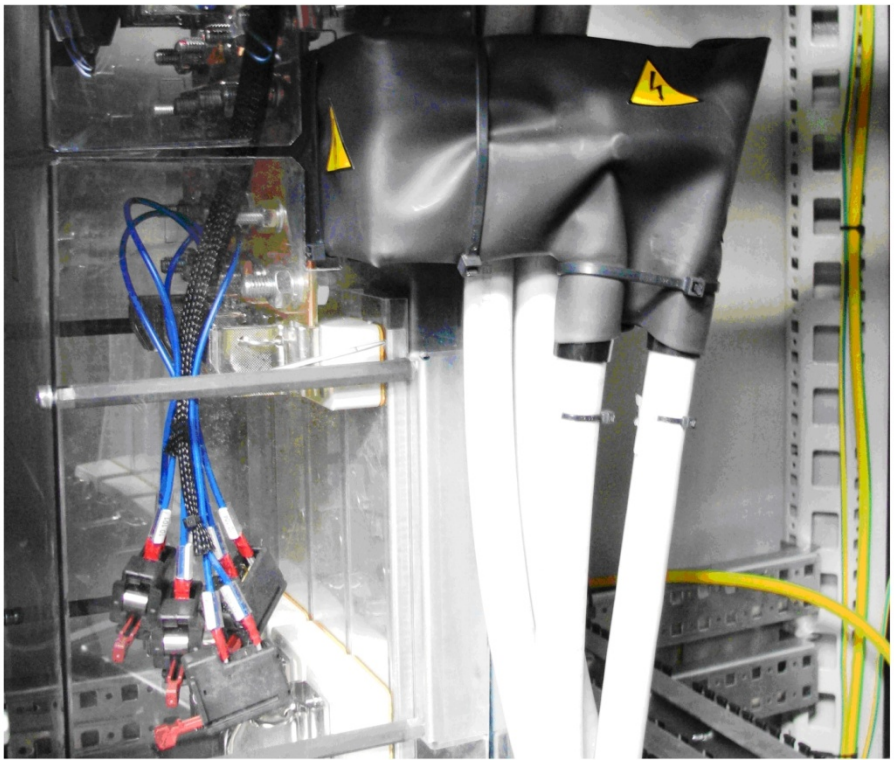


Figure 78: Stand-Alone DC-Parallel: Connection of negative pole power cable

To complete connection to the Stand-Alone DC-Parallel Table 35 provides indications on connecting the signal cables:

- DC-Parallel door microswitch
- Fuse blowing microswitch chain

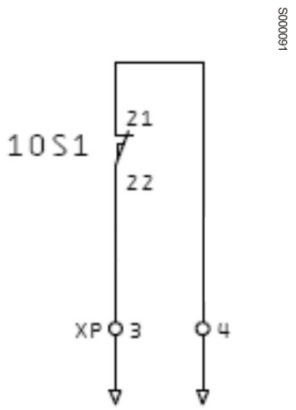
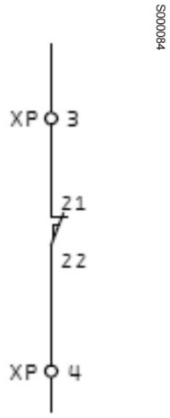
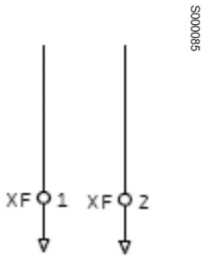
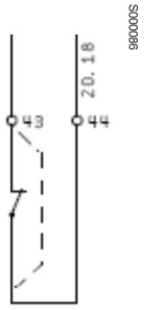
Signal	DC-Parallel	SUNWAY TG TE	Cable section [mm^2]
door microswitch	XP 3, 4	XP 3, 4	1.5
			
fuse blowing microswitches	XF 1, 2	X3 43, 44	1.5
			

Table 35: Connection of signal cables

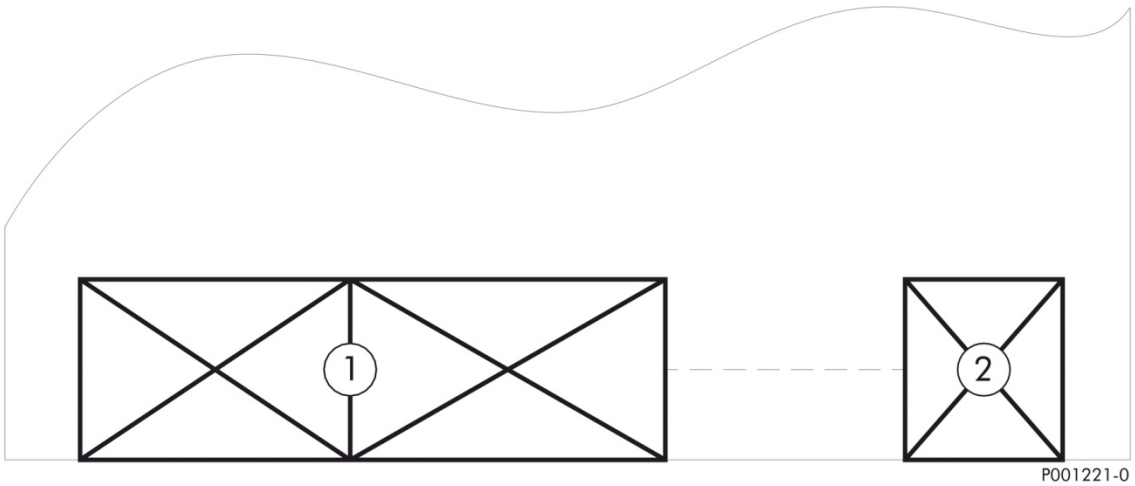


Figure 79: Electric connection of the Stand-Alone DC-Parallel on the same wall as the SUNWAY TG TE

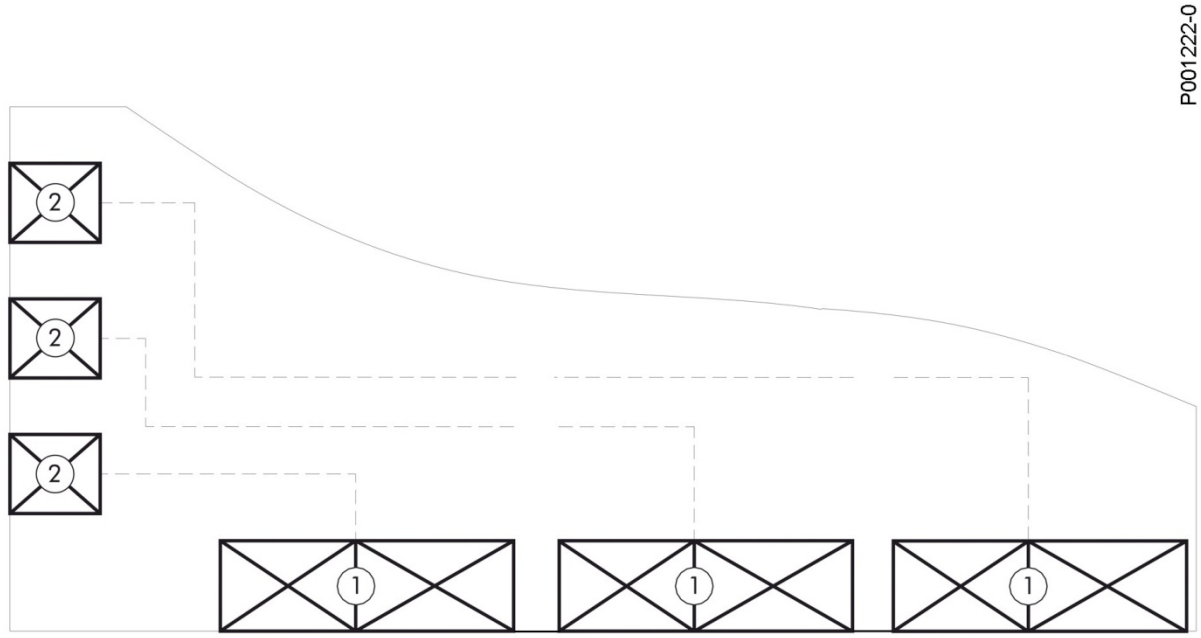


Figure 80: Electric connection of the Stand-Alone DC-Parallel on a different wall to the SUNWAY TG TE

Product identification	
1	SUNWAY TG TE
2	SUNWAY DC-Parallel

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.

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 36: Maintenance Sheet

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

Table 37: 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/Internal Conditions of the Electrical Cabinet

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

OVERALL CONDITION OF THE CABINET:

- Check the external condition of the cabinet.
- Check the state of the insulating sheaths on the conductors.
- Check that there are no signs of overheating on the power conductors (especially near the connection points on the equipment).
- Check that there are no signs of cable gnawing caused by rodents.
- Check the state of all the signs/nameplates affixed to the equipment. Signs must always be in good condition and legible.

GENERAL CABINET CLEANING

- Check the interior of the cabinet for the build-up of dust, dirt, humidity and infiltration of water from the outside.
- Check that the ventilation ducts on the inductors and transformers are clear.

Should it be necessary to clean the SUNWAY TG TE, always adopt adequate measures. The electronic section in the SUNWAY TG TE 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 SUNWAY TG TE line are equipped with air intake grilles fitted with felt filters. Maintenance activities consist of replacing the felt filters.

The front air intake grille can be removed by inserting a screwdriver in the point indicated (Figure 81:) 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 12. Replacement 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.

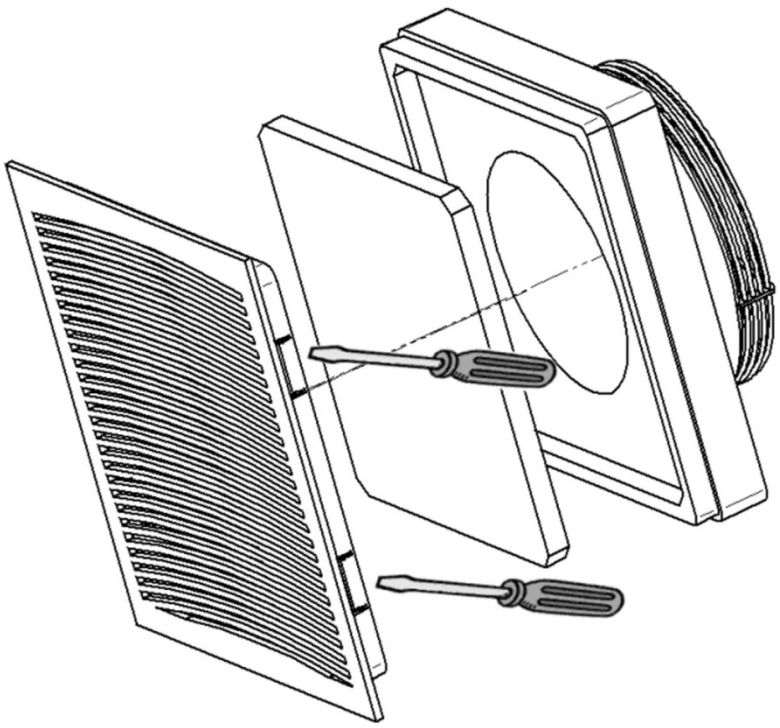


Figure 81: Filter replacement

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 18SA2 is turned to DISABLED.
- Open the doors.
- Make sure that the inverter is connected to both supply voltages (DC and AC) and that it is powered.
- Check that the external emergency stop button has not been activated.
- Press the emergency stop button.
- Check that the AC and DC control devices on the inverter are correctly opened.
- Release the emergency stop button.
- Close the AC and DC control devices on the inverter.
- Close electrical cabinet doors.
- Turn key-operated selector switch 18SA2 to ENABLED.

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 18SA2 is turned to ENABLED.
- Open the doors.
- Check that the AC and DC control devices on the inverter are correctly opened.
- Turn key-operated selector switch 18SA2 to DISABLED.
- Close the AC and DC control devices on the inverter.
- Close electrical cabinet doors.
- Turn key-operated selector switch 18SA2 to ENABLED.

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 12).

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 18SA2 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 18SA2 to ENABLED.

10.9. Checking Control and Auxiliary Voltages (110 V and 24 V)

DANGER

Electric shock and burns hazard: coming into contact with live PV field or grid components can lead to serious injury and even death!

Do not touch any components other than those specifically indicated in 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.

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 key-operated selector switch 18SA2 is turned to DISABLED.
- Open the doors.
- Check the presence of 24 Vdc control voltage on the terminals referring to fuse holder 16F3 (see Figure 82: Checking the 24 Vdc control power supply).

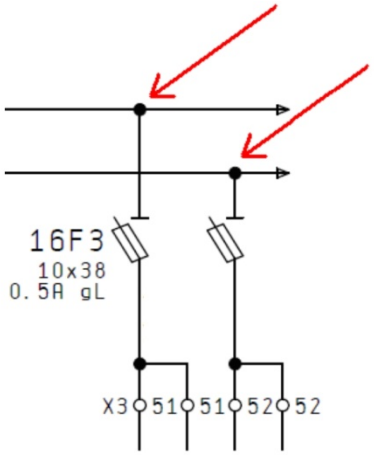


Figure 82: Checking the 24 Vdc control power supply

- Open the PV generator DC switch (10QM1).
- Check the presence of 24 Vdc control voltage on the terminals referring to fuse holder 16F3.
- Close the PV generator DC switch (10QM1).
- Open the electric grid AC switch (16QM2).
- Check the presence of 24 Vdc control voltage on the terminals referring to fuse holder 16F3.
- Close the electric grid AC switch (16QM2).
- Close electrical cabinet doors.
- Turn key-operated selector switch -operated selector switch to ENABLED.

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 18SA2 is turned to DISABLED.
- Open the doors.
- Check the presence of 110 Vac voltage on the terminals referring to fuse holder 16F3 (see Figure 83: Checking the 110 Vac control power supply).

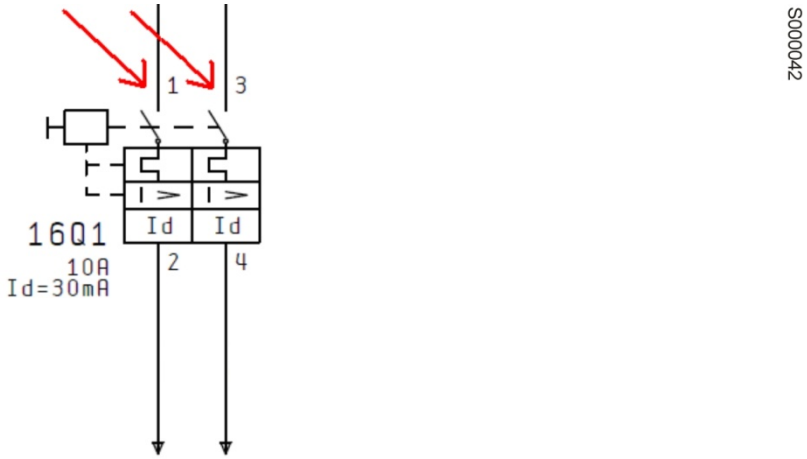


Figure 83: Checking the 110 Vac control power supply

- 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.

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

Figure 84: 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 Table 58: SPD technical specifications.

10.12. Calibration of Environmental Sensors

SUNWAY TG TE 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

SUNWAY TG TE 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 insulation and the terminals.

Please refer to Table 54: Technical data for DC input cables, Table 55: Technical data for AC output cables, to section 1.6 and the inverter's Electrical and Mechanical Diagram.

10.14. Checking the Tightening Torques on the DC-Parallel

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 insulation and the terminals.

Please refer to Table 38: Tightening torques for DC-Parallel contacts and the DC-Parallel's Electrical and Mechanical Diagram.

Contact	Tightening torque	Screws provided
Connection of cables coming from the String Boxes	32 N/m	M10

Table 38: Tightening torques for DC-Parallel contacts

10.15. Checking the Fuse Status Switches on the DC-Parallel

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.
- Make sure that the inverter connected to the DC-Parallel is NOT running, i.e. that it is STOPPED.
- Open the switch on the DC side of the converter.
- Make sure that the inverter connected to the DC-Parallel is powered by the AC grid supply only and that the display/keypad is turned on.
- Make sure that the C273 parameter = Warning (Please refer to the Programming Guide).
- Open the door of the DC-Parallel and remove the Lexan cover protecting the bottom of the fuse holder where microswitch testing is to be carried out.
- Extract each microswitch from its support.
- Open the microswitch contact.
- Check that the inverter display/keypad indicates “Warning”: W29 STR.FUSE KO.

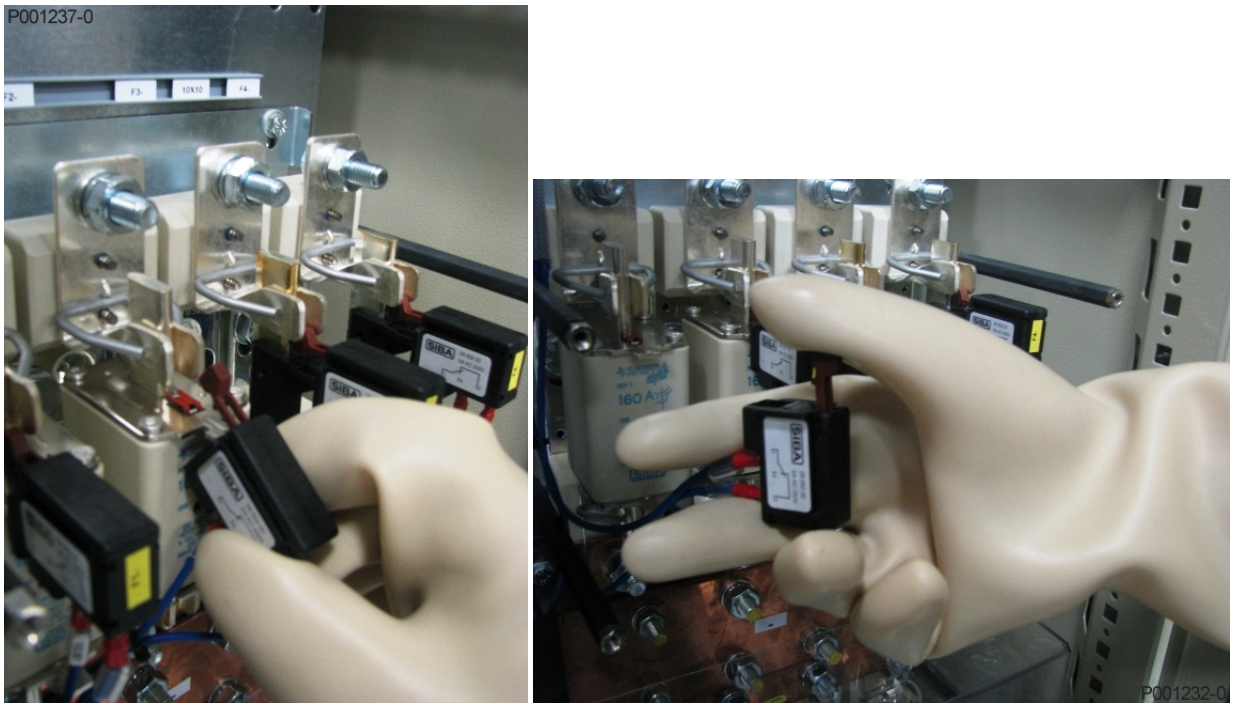


Figure 85: Testing of DC-Parallel fuse status switch

11. TROUBLESHOOTING

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 (12SA1).
- Check the AC switch return contact MD18 (please refer to the Programming Guide).
- Check the status of the digital inputs, M032 measure (please refer to the Programming Guide).

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 (if installed).

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 10F2 and 10F3.
- 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).
- If a DC-Parallel is installed, check that all its input fuses are intact.

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 COM0 and COM1 ports consult the self-diagnosis indicator LEDs on the RS485 galvanic isolation board.

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	Colore	Funzione
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 RS485 signal faults
L6	Red	COM0 or COM1 port side RS485 signals fault

Table 39: RS485 galvanic isolation board self-diagnosis LEDs

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 Figure 53: Position of LEDs and DIP-switches for the location of the indicator LEDs and the configuration DIP-switches.

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.

11.5. Safety Devices Tripped

11.5.1. AC Switch 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 inverter door.
    - Check the status of the AC output switch 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 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 8.2.

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-Parallel

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 connected to the DC-Parallel is NOT running, i.e. that it is STOPPED.
- Open the switch on the DC side of the converter
- Open the door of the DC-Parallel and remove the Lexan cover protecting the bottom of the fuse holder where the damaged fuse needs replacing.
- Remove the auxiliary contact kit from the damaged fuse.
- Remove the faulty fuse using the special insulated handle provided.
- Install a new fuse using the special insulated handle provided.
- Reconnect the auxiliary contact kit to the new fuse.
- Replace the Lexan cover protecting the bottom of the fuse holder where the fuse has been replaced.

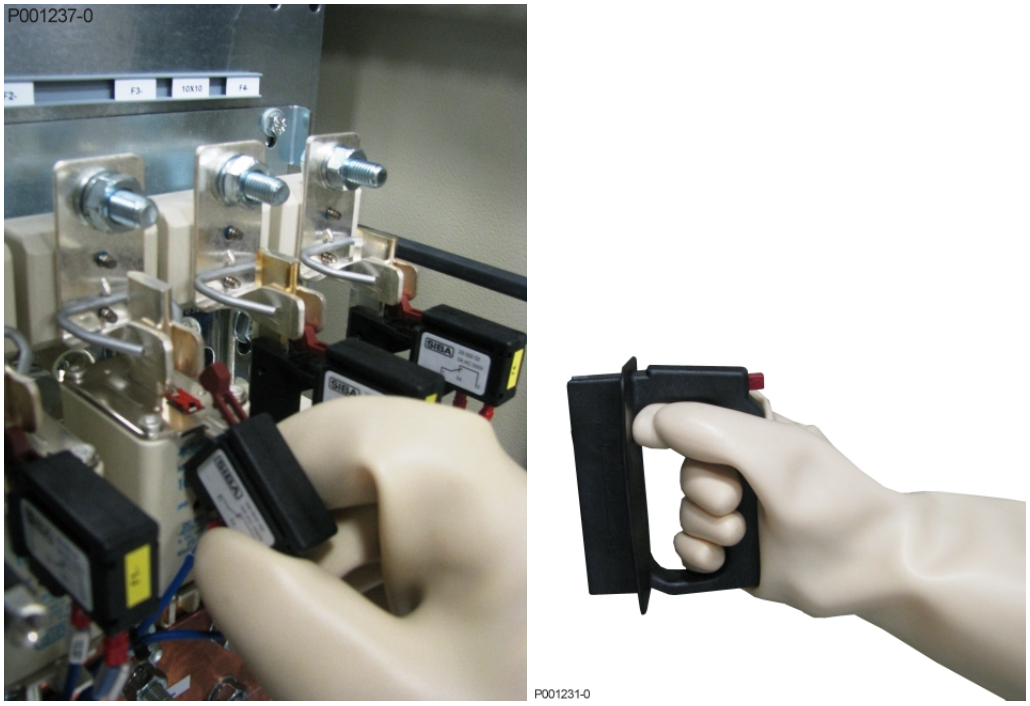


Figure 86: Extracting the fuse: disconnection of microswitch and handle for removing the fuse

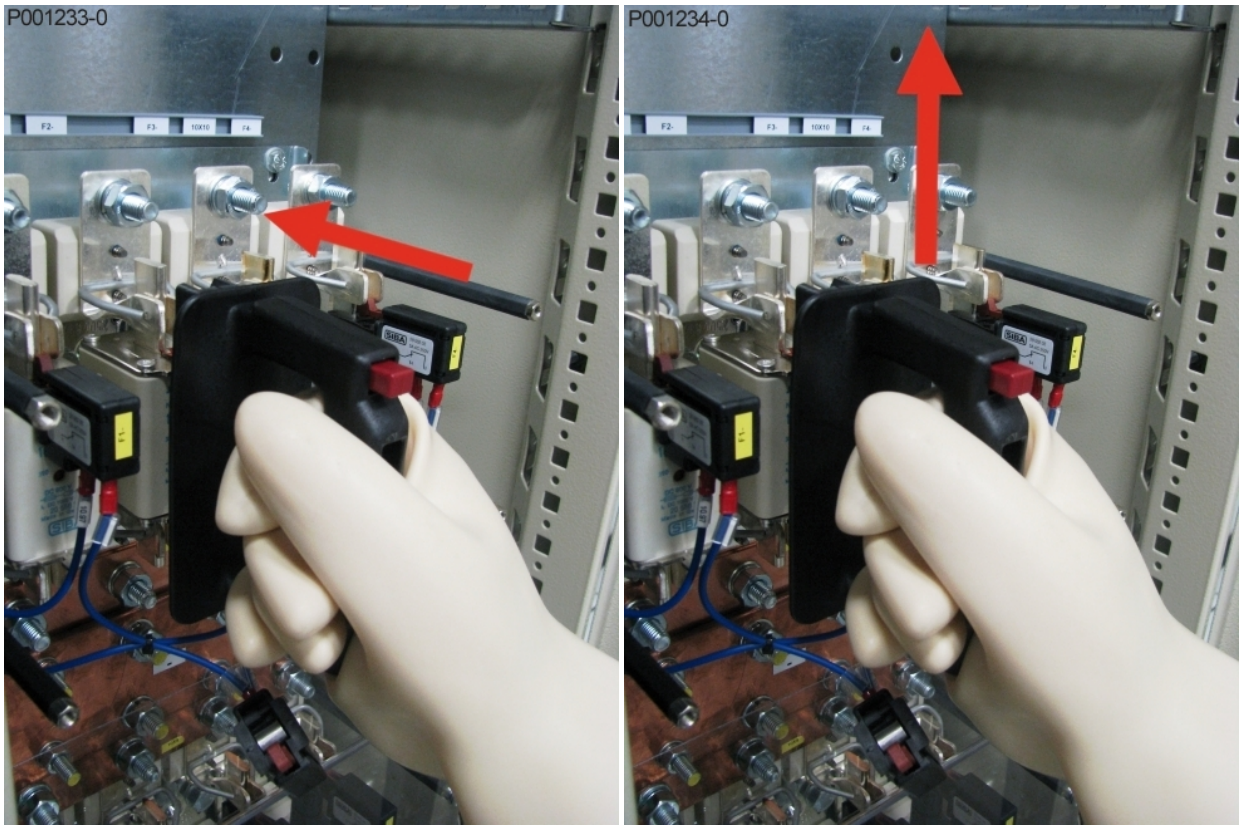


Figure 87: Extracting the fuse: using the insulated handle for removing the fuse

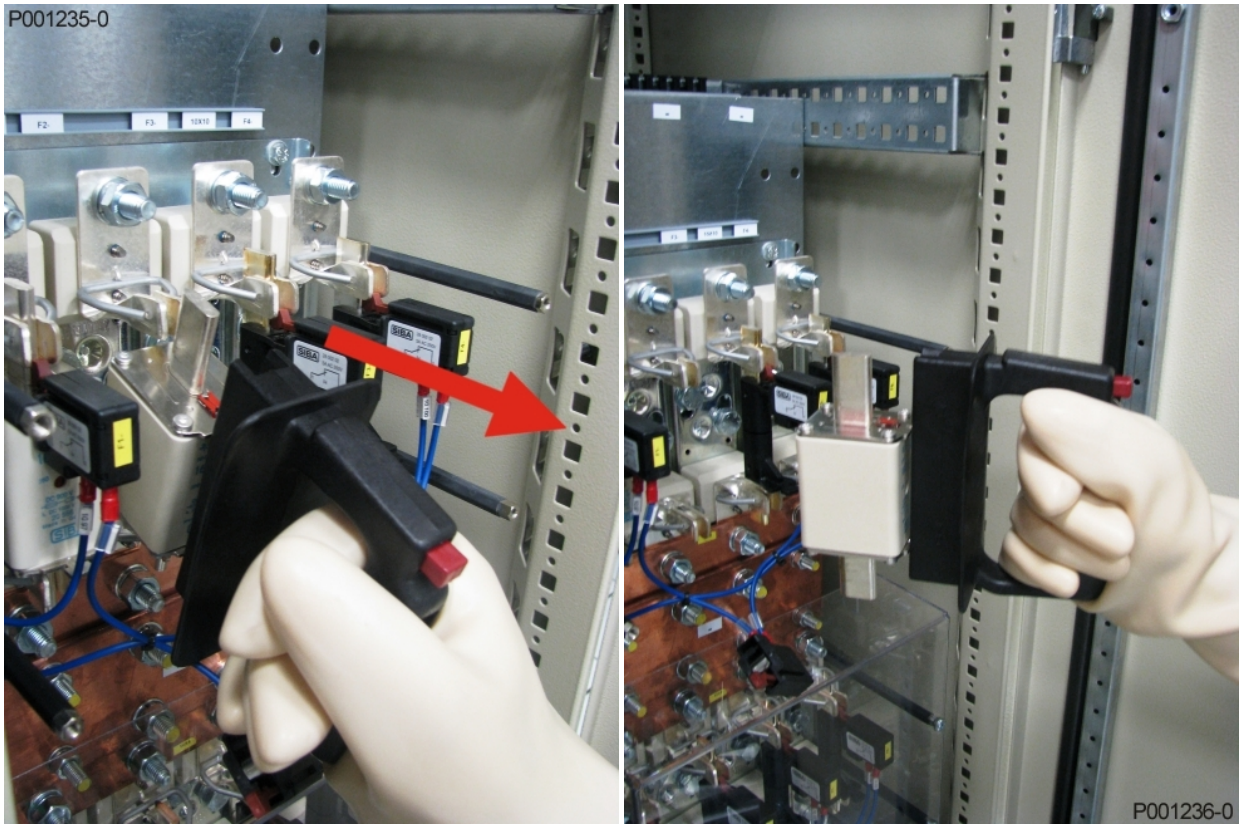


Figure 88: Extracting the fuse: using the insulated handle for removing the fuse

Once the fuse has been replaced, restore all the conditions for inverter operation (please refer to section 6.11).

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, including the DC-Parallel (if installed).
- 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 (DC-parallel, 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, including the DC-Parallel (if installed).
- If the fault has occurred in one of the String Boxes, open all the strings connected in input and open the disconnect switches of all the String Boxes in order to place all the equipment in safety conditions, including the cable output section.
- 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 and relative fuses.

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-Parallel Fault Analysis (if present)

This section describes faults relative to one or more DC-Parallel fuses blowing. 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.

12.1.1. SUNWAY TG TE

SUNWAY TG TE nameplates are affixed to each individual inverter. They indicate all the data relative to the inverter.

Example of a nameplate on a SUNWAY TG TE inverter:

S000067-00EG

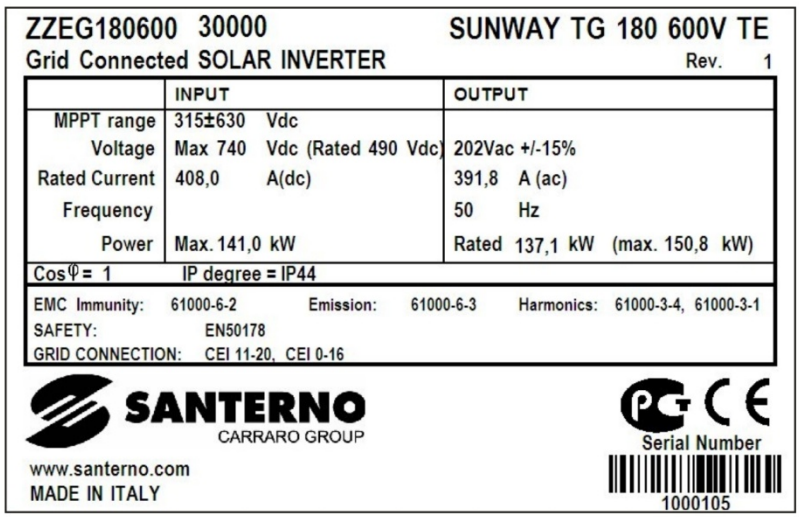


Figure 89: SUNWAY TG TE nameplate

S000087-00EG

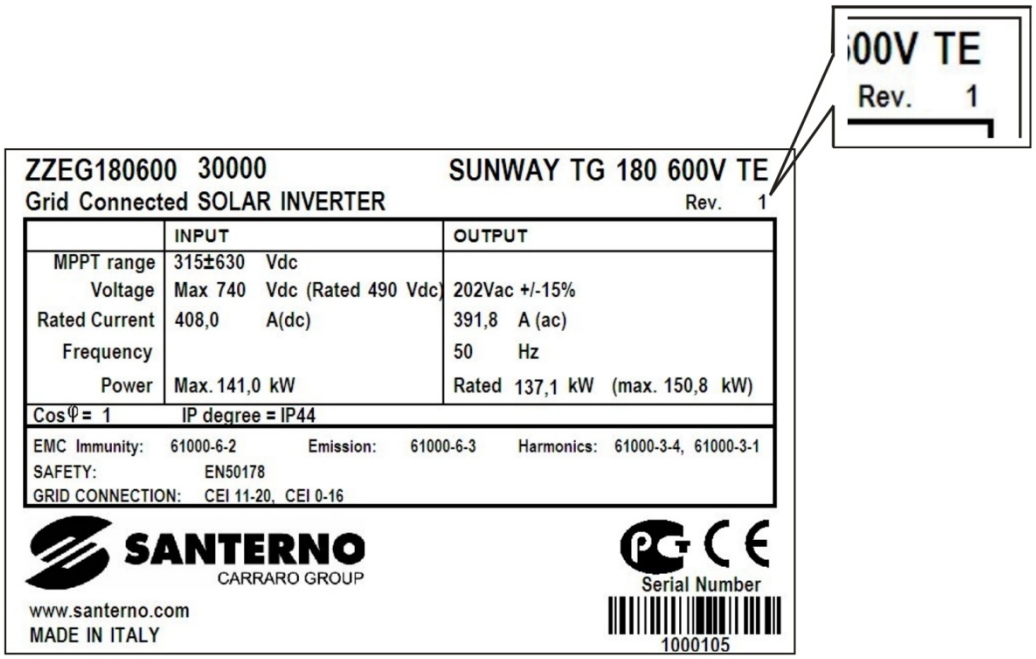


Figure 90: Inverter revision index

Other examples of the nameplate affixed to SUNWAY TG TE inverters for various geographical locations:

S000108-00EG

Figure 91: Examples of SUNWAY TG TE nameplates

12.1.2. DC-Parallel

The nameplate for the DC-Parallel cabinet is affixed to each individual appliance and holds all the equipment data.

Example of a DC-Parallel nameplate:

S000069

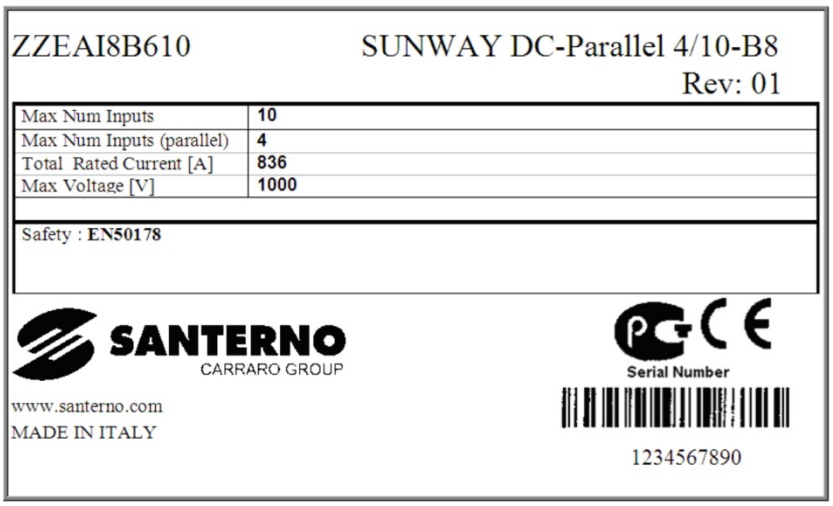


Figure 92: DC-Parallel Nameplate

12.2. Installation Specifications

Installation specifications for SUNWAY TG TE	
Operating ambient temperature	Minimum temperature: -10 °C (-25 °C with optional anti-condensation heater) Maximum temperature: see section 12.3
Operating ambient humidity	From 5% – 95%, from 1 g/m^3 – 25 g/m^3, with no condensation or ice formation (category 3k3 in compliance with EN50178)
Altitude	Up to 1000 m ASL For higher altitudes, please refer to sections 12.3.3 and 12.3.4.
Installation site	Do not install the equipment where it is exposed to direct sunlight or where it is exposed to conductive dust, corrosive gases, vibrations, water spray or dripping. Do not install in salty environments.
Degree of protection	IP20, IP44
Degree of pollution	Class 3S2 or higher, according to IEC 60721-3-3
Transformer	External LV/LV or LV/MV

Table 40: Installation specifications for SUNWAY TG TE

SUNWAY TG TE Model	Noise emissions [dBA]
SUNWAY TG 175 800V TE	77
SUNWAY TG 240 800V TE	77
SUNWAY TG 300 800V TE	77
SUNWAY TG 310 800V TE	77
SUNWAY TG 385 800V TE	79
SUNWAY TG 485 800V TE	79
SUNWAY TG 610 800V TE	76
SUNWAY TG 730 800V TE	76
SUNWAY TG 750 1000V TE	76
SUNWAY TG 760 1000V TE	78

Table 41: SUNWAY TG TE noise emissions

12.3. Electrical Specifications

SUNWAY TG TE (*)	U.M.	800V TE	1000V TE
Maximum DC input voltage	V	880 Vdc	1000 Vdc
Output frequency	Hz	50/60	
Residual ripple voltage on the PV field		<1%	
Total distortion of grid current		≤3%	
Power factor		Default: 1 Programmable range: 0.9 lead/lag	
Uc Pulse withstanding voltage	kV	4 kV: DC input	
		4 kV: AC output	

Table 42: SUNWAY TG TE electrical specifications

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

12.3.1. SUNWAY TG 800V TE

SUNWAY (*)	TG175 800V TE - 270 STD	TG240 800V TE - 270 STD	TG300 800V TE - 270 STD	TG310 800V TE - 270 STD	TG385 800V TE - 270 STD	TG485 800V TE - 270 STD	TG610 800V TE - 270 STD	TG730 800V TE - 270 STD
DC INPUT								
Rated DC input power	141 kW	188 kW	206 kW	246 kW	304 kW	386 kW	482 kW	578 kW
Max DC input current (**)	304.5 A	408 A	446.6 A	532.8 A	657.6 A	835.6 A	1044 A	1253.4 A
PV field voltage range	415÷760V	415÷760V	415÷760V	476÷760V	415÷760V	415÷760V	415÷760V	415÷760V
AC OUTPUT								
Rated power	136.4 kVA @ 40°C	182.7 kVA @ 40°C	200 kVA @ 40°C	238.6 kVA @ 40°C	294.6 kVA @ 40°C	374.3 kVA @ 40°C	467.8 kVA @ 50°C	561.2 kVA @ 40°C
Rated grid voltage	270 V	270 V	270 V	270 V	270 V	270 V	270 V	270 V
Rated AC output current	291.6 A	390.7 A	427.7 A	510.3 A	629.9 A	800.3 A	1000.4 A	1200 A
EFFICIENCY								
Max Efficiency	98.4 %	98.4 %	98.4 %	98.4 %	98.4 %	98.4 %	98.5 %	98.5 %
EU Efficiency	97.8 %	97.8 %	97.8 %	97.9 %	97.9 %	98.0 %	98.0 %	98.0 %
Noise emission @ 1m	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)
Insulation voltage to ground and between input and output	2.5kV	2.5kV	2.5kV	2.5kV	2.5kV	2.5kV	2.5kV	2.5kV
GENERAL DATA								
Degree of protection	IP44	IP44	IP44	IP44	IP44	IP44	IP44	IP44
Fresh air consumption	2500 m^3/h	2500 m^3/h	3250 m^3/h	3250 m^3/h	4000 m^3/h	5000 m^3/h	6680 m^3/h	6680 m^3/h
LOSSES								
Stop mode losses	20 W	20 W	20 W	20 W	20 W	20 W	45 W	45 W
Night losses	20 W	20 W	20 W	20 W	20 W	20 W	45 W	45 W
Auxiliary consumption	20 W	20 W	20 W	20 W	20 W	45 W	45 W	45 W
Fan losses	310 W	310 W	651 W	651 W	736 W	1506 W	2230 W	2230 W

Table 43: Technical data for SUNWAY TG 800V TE models – 270

(*) The values in the table may be changed to suit special applications. Auxiliary consumptions are not considered when calculating the product efficiency.

(**) Maximum DC current that the inverter can accept as input current. However, a photovoltaic generator dimensioned for higher current ratings may be connected to the equipment with no risk to damage the inverter. If this is the case, the inverter will limit its power output so that the input current will not exceed the maximum DC current value given in the table above.

SUNWAY (*)	TG175 800V TE - 310 STD	TG240 800V TE - 310 STD	TG300 800V TE - 310 STD	TG310 800V TE - 310 STD	TG385 800V TE - 310 STD	TG485 800V TE - 310 STD
DC INPUT						
Rated DC input power	161.4 kW	216.3 kW	236.7 kW	282.5 kW	348.7 kW	443.0 kW
Max. DC input current (**)	304.5 A	408 A	446.6 A	532.8 A	657.6 A	835.6 A
PV field voltage range	476÷760V	476÷760V	476÷760V	476÷760V	476÷760V	476÷760V
AC OUTPUT						
Rated power	156.6 kVA @ 40°C	209.8 kVA @ 40°C	229.6 kVA @ 40°C	274 kVA @ 40°C	338.2 kVA @ 40°C	430 kVA @ 40°C
Rated grid voltage	310 V	310 V	310 V	310 V	310 V	310 V
Rated AC output current	291.6 A	390.7 A	427.7 A	510.3 A	629.9 A	800.3 A
EFFICIENCY						
Max Efficiency	98.5 %	98.5 %	98.5 %	98.5 %	98.5 %	98.5 %
EU Efficiency	98.0 %	98.0 %	98.0 %	98.0 %	98.0 %	98.0 %
Noise emission @ 1m	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)	75 dB(A)
Insulation voltage to ground and between input and output	2.5kV	2.5kV	2.5kV	2.5kV	2.5kV	2.5kV
GENERAL DATA						
Degree of protection	IP44	IP44	IP44	IP44	IP44	IP44
Cooling system	Forced air	Forced air	Forced air	Forced air	Forced air	Forced air
Fresh air consumption	2500 m^3/h	2500 m^3/h	3250 m^3/h	3250 m^3/h	4000 m^3/h	5000 m^3/h
LOSSES						
Stop mode losses	20 W	20 W	20 W	20 W	20 W	20 W
Night losses	20 W	20 W	20 W	20 W	20 W	20 W
Auxiliary consumption	20 W	20 W	20 W	20 W	20 W	45 W
Fan losses	310 W	310 W	651 W	651 W	736 W	1506 W

Table 44: Technical data for SUNWAY TG 800V TE models - 310

(*) The values in the table may be changed to suit special applications. Auxiliary consumptions are not considered when calculating the product efficiency.

(**) Maximum DC current that the inverter can accept as input current. However, a photovoltaic generator dimensioned for higher current ratings may be connected to the equipment with no risk to damage the inverter. If this is the case, the inverter will limit its power output so that the input current will not exceed the maximum DC current value given in the table above.

12.3.2. SUNWAY TG 1000V TE

SUNWAY (*)	SUNWAY TG750 1000V TE - 320 STD	SUNWAY TG610 1000V TE - 340 STD	SUNWAY TG750 1000V TE - 340 STD	SUNWAY TG760 1000V TE - 340 STD	SUNWAY TG610 1000V TE - 360 STD	SUNWAY TG750 1000V TE - 360 STD	SUNWAY TG760 1000V TE - 360 STD	SUNWAY TG750 1000V TE - 380 STD	SUNWAY TG760 1000V TE - 380 STD
DC INPUT									
Rated DC input power	685 kW	608 kW	728 kW	779 kW	644 kW	772 kW	824 kW	814 kW	871 kW
Max. DC input current (**)	1253.4 A	1044 A	1253.4 A	1500 A	1044 A	1253.4 A	1500 A	1253.4 A	1500 A
PV field voltage range	495÷820V	525÷820V	525÷820V	525÷820V	550÷820V	550÷820V	550÷820V	580÷820V	580÷820V
AC OUTPUT									
Rated power	665 kVA @ 40°C (***)	590 kVA @ 50°C	707 kVA @ 40°C (***)	756 kVA @ 50°C	625 kVA @ 50°C	749 kVA @ 40°C (***)	800 kVA @ 50°C	790 kVA @ 40°C (***)	844 kVA @ 50°C
Rated grid voltage	320 V	340 V	340 V	340 V	360 V	360 V	360 V	380 V	380 V
Rated AC output current	1200 A	1000 A	1200 A	1283 A	1000 A	1200 A	1283 A	1200 A	1283 A
EFFICIENCY									
Max Efficiency	98.5 %	98.5 %	98.5 %	98.6 %	98.5 %	98.5 %	98.6 %	98.5 %	98.6 %
EU Efficiency	98.2 %	98.1 %	98.2 %	98.3 %	98.2 %	98.2 %	98.3 %	98.2 %	98.3 %
GENERAL DATA									
Degree of protection	IP20	IP20	IP20	IP20	IP20	IP20	IP20	IP20	IP20
Fresh air consumption	9600 m^3/h	8000 m^3/h	9600 m^3/h	12000 m^3/h	8000 m^3/h	9600 m^3/h	12000 m^3/h	9600 m^3/h	12000 m^3/h
LOSSES									
Stop mode losses	45 W	45 W	45 W	45 W	45 W	45 W	45 W	45 W	45 W
Night losses	45 W	45 W	45 W	45 W	45 W	45 W	45 W	45 W	45 W
Auxiliary consumption	25 W	25 W	25 W	25 W	25 W	25 W	25 W	25 W	25 W
Fan losses	2095 W	1775 W	2095 W	2165 W	1775 W	2095 W	2165 W	2095 W	2165 W

Table 45: Technical data for SUNWAY TG 1000V TE models

(*) The values in the table may be changed to suit special applications. Auxiliary consumptions are not considered when calculating the product efficiency.

(**) Maximum DC current that the inverter can accept as input current. However, a photovoltaic generator dimensioned for higher current ratings may be connected to the equipment with no risk to damage the inverter. If this is the case, the inverter will limit its power output so that the input current will not exceed the maximum DC current value given in the table above.

(***) Extended temperature range available on demand.

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
0-2000	Unchanged
2001-3000	Do not exceed 846 V

Table 46: Maximum DC voltage based on altitude

If equipment is to be installed at over 3000 m, please contact Elettronica Santerno SpA.

12.3.4. Rated Current Derating

If the ambient temperature exceeds the specified full-power temperature, the inverter limits its output current in order to protect its internal components from overheating. Figure 93 shows the graph indicating the maximum power delivered based on ambient temperatures (valid for equipment installed at sea level).

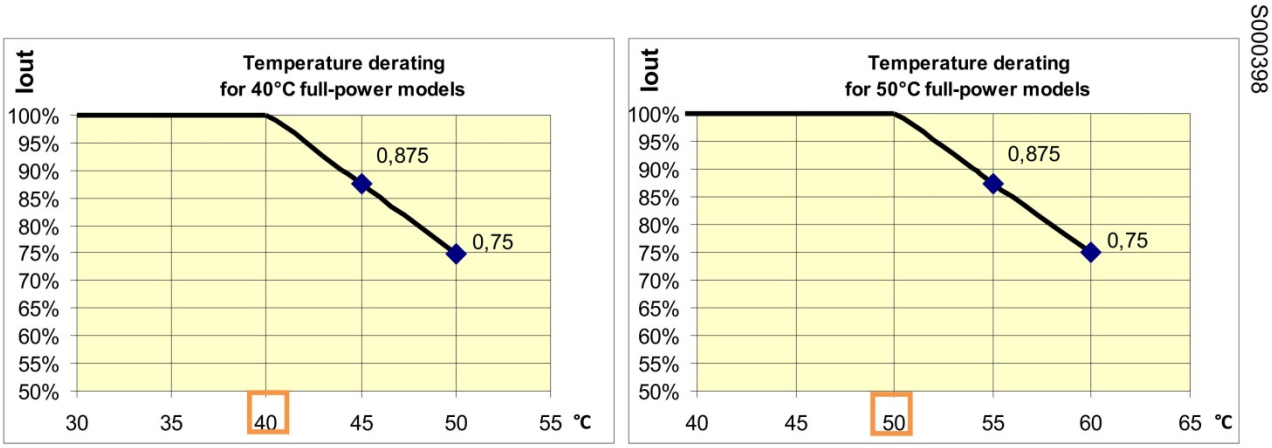


Figure 93: Temperature derating (at sea level)

Generally speaking, both temperature and altitude affect the continuous power output of the inverter.

To calculate the rated current, coefficient **'Kt'** is assigned to temperature while coefficient **'Ka'** is assigned to altitude. Please refer to Figure 94 and Figure 95.

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

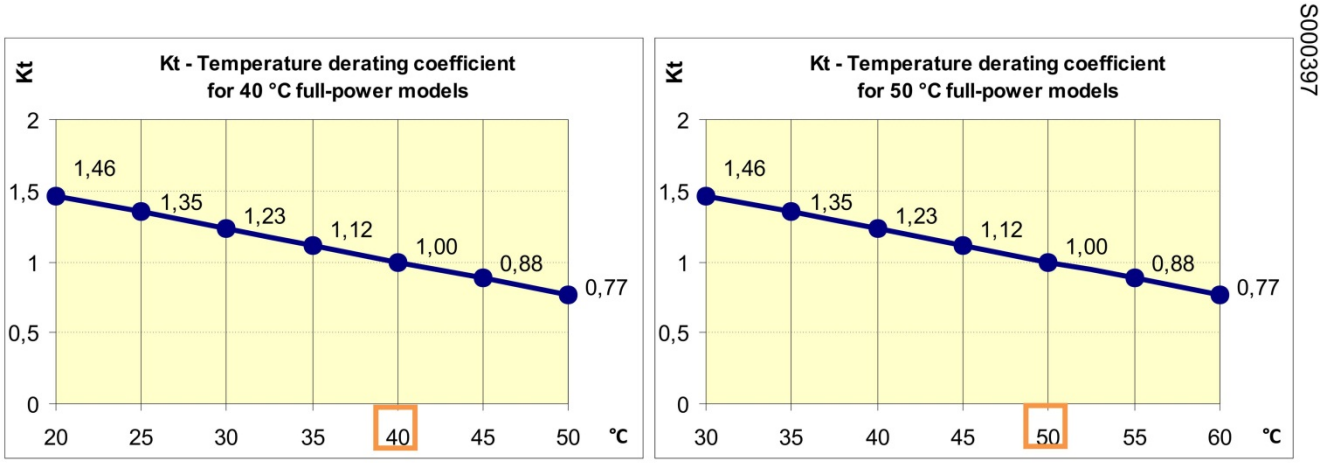


Figure 94: Coefficient Kt for temperature derating (at sea level)

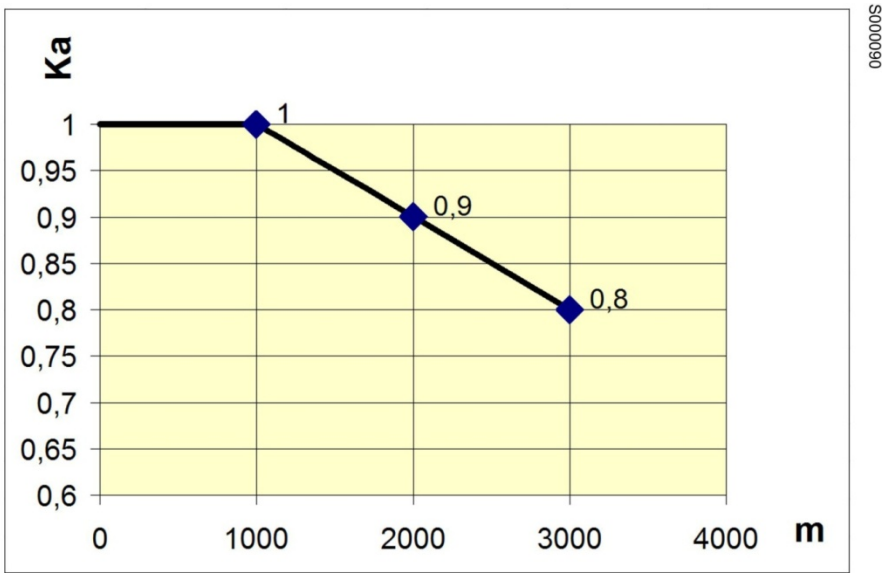


Figure 95: Coefficient Ka for altitude derating

To calculate rated current derating the following method of calculation is used:

Calculation of coefficients	Condition	Calculation of the rated output current
Ktot = Kt x Ka	If Ktot ≥ 1	Unchanged
Ktot = Kt x Ka	If Ktot < 1	Rated output current reduced by a Ktot factor

Table 47: Calculation of the rated current reduction coefficient

EXAMPLE No. 1:

Installation of a SUNWAY TG 385 800V TE inverter with Pnom = 294.6 kVA:

altitude = 800 m
max. ambient temp. = 35 ° C
Ktot = Kt x Ka = 1.12 * 1.0 = 1.12, the rated power remains unchanged

altitude = 2500 m
max. ambient temp. = 35 ° C
Ktot = Kt x Ka = 1.12 * 0.85 = 0.95, the rated power is reduced to 280.5 kW

altitude = 2500 m
max. ambient temp. = 30 ° C
Ktot = Kt x Ka = 1.23 * 0.85 = 1.04, the rated power remains unchanged

EXAMPLE No. 2:

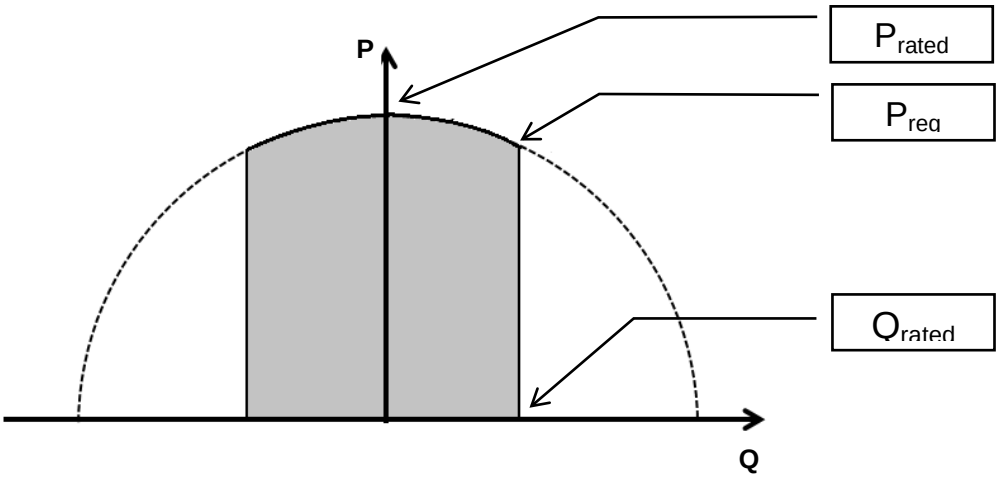
Installation of a SUNWAY TG 610 1000V TE inverter with Pnom = 590 kVA

altitude = 800 m
max. ambient temp. = 40 ° C
Ktot = Kt x Ka = 1.23 * 1.0 = 1.23, the rated power remains unchanged

altitude = 1500 m
max. ambient temp. = 40 ° C
Ktot = Kt x Ka = 1.24 * 0.95 = 1.178, the rated power remains unchanged

altitude = 500 m
max. ambient temp. = 55 ° C
Ktot = Kt x Ka = 1 * 0.875 = 0.875, the power will be derated to 516.25 kVA.

12.3.5. P-Q Diagram



SUNWAY TG TE (*)	PF_Capability	Prated [kVA]	Preg [KW]	Qrated [KVAR]
SUNWAY TG175 800V TE - 270 STD	0.9 lead/lag	136.4	122.8	59.5
SUNWAY TG175 800V TE - 310 STD	0.9 lead/lag	156.6	140.9	68.3
SUNWAY TG240 800V TE - 270 STD	0.9 lead/lag	182.7	164.4	79.6
SUNWAY TG300 800V TE - 270 STD	0.9 lead/lag	200	180.0	87.2
SUNWAY TG240 800V TE - 310 STD	0.9 lead/lag	209.8	188.8	91.4
SUNWAY TG300 800V TE - 310 STD	0.9 lead/lag	229.6	206.6	100.1
SUNWAY TG310 800V TE - 270 STD	0.9 lead/lag	238.6	214.7	104.0
SUNWAY TG310 800V TE - 310 STD	0.9 lead/lag	274	246.6	119.4
SUNWAY TG385 800V TE - 270 STD	0.9 lead/lag	294.6	265.1	128.4
SUNWAY TG385 800V TE - 310 STD	0.9 lead/lag	338.2	304.4	147.4
SUNWAY TG485 800V TE - 270 STD	0.9 lead/lag	374.3	336.9	163.2
SUNWAY TG485 800V TE - 310 STD	0.9 lead/lag	430	387.0	187.4
SUNWAY TG610 800V TE - 270 STD	0.9 lead/lag	467.8	421.0	203.9
SUNWAY TG730 800V TE - 270 STD	0.9 lead/lag	561.2	505.1	244.6
SUNWAY TG610 1000V TE - 340 STD	0.9 lead/lag	590	531.0	257.2
SUNWAY TG610 1000V TE - 360 STD	0.9 lead/lag	625	562.5	272.4
SUNWAY TG750 1000V TE - 320 STD	0.9 lead/lag	665	598.5	289.9
SUNWAY TG750 1000V TE - 340 STD	0.9 lead/lag	707	636.3	308.2
SUNWAY TG750 1000V TE - 360 STD	0.9 lead/lag	749	674.1	326.5
SUNWAY TG760 1000V TE - 340 STD	0.9 lead/lag	756	680.4	329.5
SUNWAY TG750 1000V TE - 380 STD	0.9 lead/lag	790	711.0	344.4
SUNWAY TG760 1000V TE - 360 STD	0.9 lead/lag	800	720.0	348.7
SUNWAY TG760 1000V TE - 380 STD	0.9 lead/lag	844	759.6	367.9

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

12.3.6. 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:

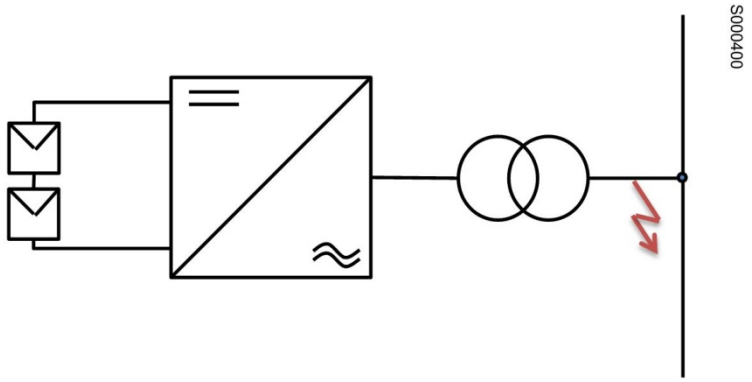


Figure 96: Short circuit localization in the SUNWAY TG TE inverters

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:

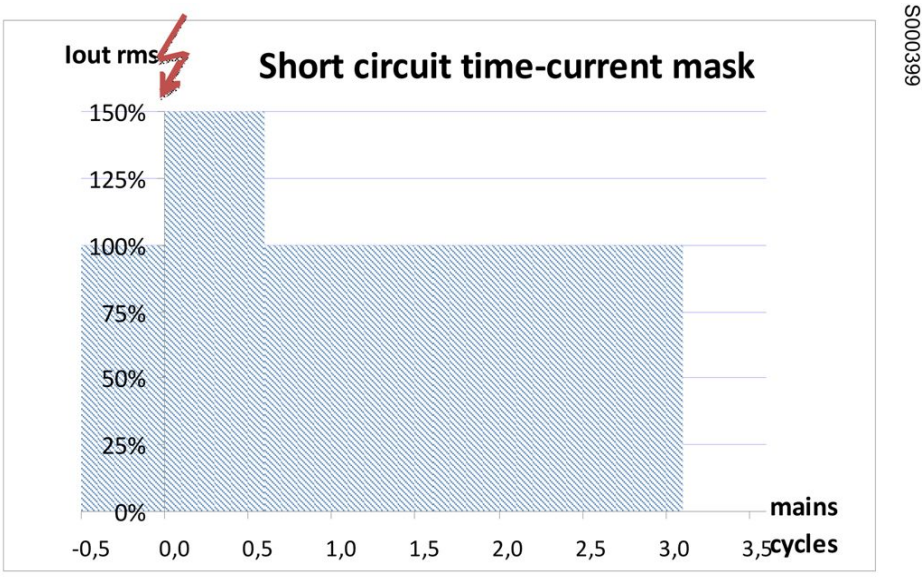


Figure 97: Maximum short-circuit time-current mask

Where the Y-axis is the rated output current and the X-axis indicates the mains cycles.

In the graph, a short-circuit occurs at time zero. The consequent maximum short-circuit current is expected to be limited to 150% of the rated current for a duration of one half-cycle. Starting from the second half-cycle, the maximum short circuit current is limited to 100% of the rated current, for a duration depending on the LVRT mask.

If the LVRT is not enabled, the duration depends on the grid monitor relay settings. The minimum duration can be as short as few mains cycles.

12.4. Inverter Views

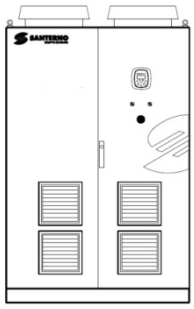
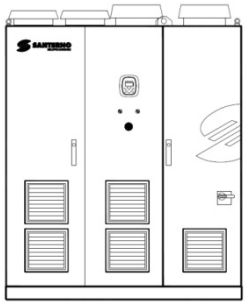
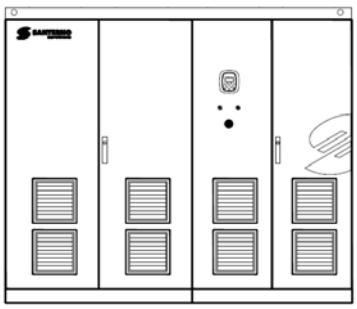
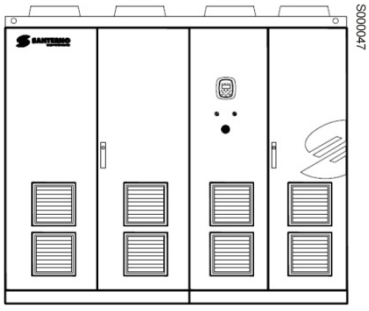
SUNWAY TG TE	IP20	IP44
TG175 800V TE	-	
TG240 800V TE		
TG310 800V TE	-	
TG385 800V TE		
TG485 800V TE		
TG610 800V TE		
TG730 800V TE		
TG750 800V TE		
TG750 1000V TE		
TG760 1000V TE		

Table 48: Inverter views

12.5. Installed Converter Module

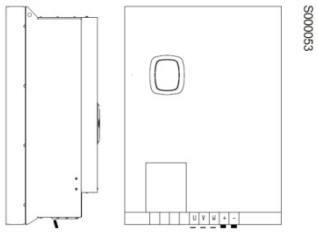
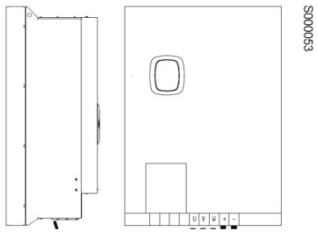
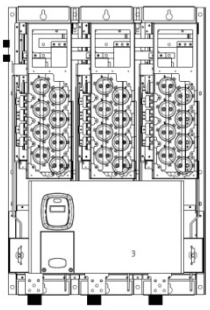
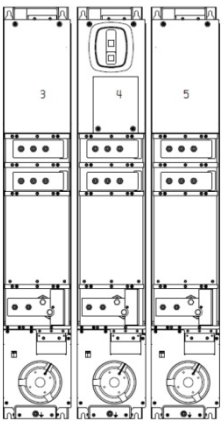
SUNWAY TG TE Model	Converter installed	Converter layout	Type of converter
SUNWAY TG 175 800V TE	SUNWAY 175		Monolithic converter
SUNWAY TG 240 800V TE	SUNWAY 240		
SUNWAY TG 300 800V TE	SUNWAY 300		Monolithic converter
SUNWAY TG 310 800V TE	SUNWAY 310		
SUNWAY TG 385 800V TE	SUNWAY 385		
SUNWAY TG 485 800V TE	SUNWAY 485		Monolithic converter
SUNWAY TG 610 800V TE	SUNWAY 610		Modular converter
SUNWAY TG 730 800V TE	SUNWAY 730		
SUNWAY TG 750 1000V TE	SUNWAY 750		
SUNWAY TG 760 1000V TE	SUNWAY 760		

Table 49: 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.

SUNWAY TG TE Model	Ventilation flow rate [m^3/h]	Ventilation system absorption [W]
SUNWAY TG 175 800V TE	2500	310
SUNWAY TG 240 800V TE	2500	310
SUNWAY TG 300 800V TE	3250	651
SUNWAY TG 310 800V TE	3250	651
SUNWAY TG 385 800V TE	4000	736
SUNWAY TG 485 800V TE	5000	1506
SUNWAY TG 610 800V TE	6680 (IP44) 8000 (IP20)	2230 (IP44) 1775 (IP20)
SUNWAY TG 730 800V TE	6680 (IP44) 8000 (IP20)	2230 (IP44) 1775 (IP20)
SUNWAY TG 750 1000V TE	9600	2095
SUNWAY TG 760 1000V TE	12000	2165

Table 50: SUNWAY TG TE ventilation technical data

	EN 779	EUROVENT
Type of felt filter	G3	EU 3

Table 51: 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 12.10.

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

12.7. Dimensions and Weights

SUNWAY TG TE Model	Dimensions WxHxD [mm]	Weight [Kg]
SUNWAY TG 175 800V TE	1400x2270x600	640
SUNWAY TG 240 800V TE	1400x2270x600	730
SUNWAY TG 300 800V TE	1800x2270x800	970
SUNWAY TG 310 800V TE	1800x2270x800	970
SUNWAY TG 385 800V TE	1800x2270x800	1030
SUNWAY TG 485 800V TE	2600x2270x800	1470
SUNWAY TG 610 800V TE	2600x2475x800	1700
SUNWAY TG 730 800V TE	2600x2475x800	1800
SUNWAY TG 750 1000V TE	2600x2475x800	1800
SUNWAY TG 760 1000V TE	2600x2475x800	2000

Table 52: SUNWAY TG TE dimensions and weights

SUNWAY TG TE Model	Hoisting with cables from above	Hoisting with forklift from underneath
SUNWAY TG 175 800V TE	Yes	Yes
SUNWAY TG 240 800V TE	Yes	Yes
SUNWAY TG 300 800V TE	Yes	Yes
SUNWAY TG 310 800V TE	Yes	Yes
SUNWAY TG 385 800V TE	Yes	Yes
SUNWAY TG 485 800V TE	Yes	Yes
SUNWAY TG 610 800V TE	Yes	Yes
SUNWAY TG 730 800V TE	Yes	Yes
SUNWAY TG 750 1000V TE	Yes	Yes
SUNWAY TG 760 1000V TE	Yes	Yes

Table 53: Handling methods

12.8. Connection of Power and Signal Cables

12.8.1. DC Connection - Input Cables

SUNWAY TG TE Model	Terminal	No. of cables per pole	Max. cable section [mm²]	Screws provided	Tightening torque [Nm]	Max. lug width [mm]
SUNWAY TG 175 800V TE	X2	4	240	M10	50	39
SUNWAY TG 240 800V TE	X2	4	240	M10	50	39
SUNWAY TG 300 800V TE	X2	4	240	M12	85	39
SUNWAY TG 310 800V TE	X2	4	240	M12	85	39
SUNWAY TG 385 800V TE	X2	4	240	M12	85	39
SUNWAY TG 485 800V TE	X2	4	240	M12	85	39
SUNWAY TG 610 800V TE SUNWAY TG 730 800V TE SUNWAY TG 750 1000V TE SUNWAY TG 760 1000V TE	X2	4	240	M12	85	39
		8	150			

Table 54: Technical data for DC input cables

12.8.2. AC Connection - Output Cables

SUNWAY TG TE Model	Terminal	No. of cables per pole	Max. cable section [mm²]	Screws provided	Tightening torque [Nm]	Max. lug width [mm]
SUNWAY TG 175 800V TE	X1	2	240	M10	50	39
SUNWAY TG 240 800V TE	X1	4	240	M12	85	39
SUNWAY TG 300 800V TE	X1	4	240	M12	85	39
SUNWAY TG 310 800V TE	X1	4	240	M12	85	39
SUNWAY TG 385 800V TE	X1	4	240	M12	85	39
SUNWAY TG 485 800V TE	X1	4	240	M12	85	39
SUNWAY TG 610 800V TE	X1	4	240	M12	85	39
SUNWAY TG 730 800V TE	X1	4	240	M12	85	39
SUNWAY TG 750 1000V TE	X1	4	240	M12	85	39
SUNWAY TG 760 1000V TE	X1	4	240	M12	85	39

Table 55: Technical data for AC output cables

12.8.3. Connection of Earth Cables

SUNWAY TG TE Model	No. of cables per connection	Screws provided	Minimum conductor section
SUNWAY TG 175 800V TE	6	M10	35
SUNWAY TG 240 800V TE	6	M10	35
SUNWAY TG 300 800V TE	4	M12	35
SUNWAY TG 310 800V TE	4	M12	35
SUNWAY TG 385 800V TE	4	M12	35
SUNWAY TG 485 800V TE	4	M12	50
SUNWAY TG 610 800V TE	5	M12	70
SUNWAY TG 730 800V TE	5	M12	70
SUNWAY TG 750 1000V TE	5	M12	70
SUNWAY TG 760 1000V TE	5	M12	70

Table 56: Technical data for earth cables

In observance of safety regulations, never use earth connection cables which have a smaller section than indicated in the table above.

12.8.4. Connection of Signal and Auxiliary Power Supply Cables

SUNWAY TG TE Model	Terminal	Min. cable section [mm^2]	Max. cable section [mm^2]
ALL	X3	0.5	2.5
ALL	X4	0.5	2.5
ALL	X7	0.5	6

Table 57: Technical data for signal cables

12.9. SPD

Technical specifications for SPDs are provided in the table below.

Technical Specifications	
Rated voltage of system	1000 V
Maximum voltage of system	1120 V
Back-up power supply	4 A
Rated discharge current	20 kA
Response time	25 ns
Residual current	< 1 mA
Configuration	Y connection of three SPDs to varistor
UP level of protection (L-L / L-PE)	3.8 kV
L tightening torque	2.8 Nm
Remote signal contact	
Type	1 NO/NC
Minimum range	12Vdc - 10 mA
Maximum range	250 Vac - 1 A
Cable section	1.5 [mm^2]
Ambient conditions	
Operating temperature	-40 ... +80
Maximum altitude	2000
General specifications	
Removable cartridges	Yes
UL94 Fire resistance	V0

Table 58: SPD technical specifications

12.10. Technical Room

The inverters can be positioned with their backs right up against the cabinet wall, as long as care is taken not to obstruct any air vents in the cabinet itself.

SUNWAY TG TE Model	Air cooling towers	Air ventilation unit with front filter	Grilles with front filters	Grilles with side filters	Clearance values [mm]			
					Front	RH/LH side	Ceiling	Back
SUNWAY TG 175 800V TE	YES	No	YES	No	800	-	200	-
SUNWAY TG 240 800V TE	YES	No	YES	No	800	-	200	-
SUNWAY TG 300 800V TE	YES	YES	YES	No	800	-	200	-
SUNWAY TG 310 800V TE	YES	YES	YES	No	800	-	200	-
SUNWAY TG 385 800V TE	YES	YES	YES	No	800	-	200	-
SUNWAY TG 485 800V TE	YES	YES	YES	No	800	-	200 (IP44) 400 (IP20)	-
SUNWAY TG 610 800V TE	YES	YES	YES	YES	800	600	400	-
SUNWAY TG 730 800V TE	YES	YES	YES	YES	800	600	400	-
SUNWAY TG 750 1000V TE	YES	YES	YES	No	800	600	400	-
SUNWAY TG 760 1000V TE	YES	YES	YES	No	800	600	400	600

Table 59: Clearance values for SUNWAY TG TE

The clearance values may be reduced only if explicitly agreed upon with Elettronica Santerno, depending on the product application conditions and on the presence of air-conditioning systems in the technical room.

NOTE

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

12.10.1. Air Exchange and Flow Rate

Inverters dissipate heat into the surrounding environment which must be removed.

The technical room must be equipped with an adequate system for removing excess heat (air conditioning or forced ventilation). The system must be able to keep the air temperature below the full-power temperature of the inverter.

Calculate heat dissipation at around 3% of the rated power for each inverter installed.

Pdmax = 3% Pnom AC

For example:

System made up of:

No. 2 SUNWAY TG 385 800V TE

Pnom AC = 296 kW

Consider dissipation equal to 2 x 3% x 296 kW = 17.76 kW

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.o.	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.o.	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

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

Table 60: 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 resettable 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)	

No.	Name	Description	I/O Features	DIP-switch
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	
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 61: 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	
7-26		NOT USED – DO NOT CONNECT		
27	**XAIN8/T1+**	ENVIRONMENTAL MEASURE 1 auxiliary analogue input	Vfs = 10 V Rin = 30 kΩ	SW1.3 = ON SW1.1-2-4 = OFF
			Vfs = 100 Mv Rin = 1 MΩ	SW1.4 = ON SW1.1-2-3 = OFF
			Ifs = 20 mA Rin = 124.5 Ω	SW1.2 = ON SW1.1-3-4 = OFF
		Thermistor 1 temperature measure	PT100 Temperature measure	SW1.1-4 = ON SW1.2-3 = OFF
28	**CMA/T1-**	Analogue inputs 0V for XAIN8 feedback	0V control board	
29	**XAIN9/T2+**	ENVIRONMENTAL MEASURE 2 auxiliary analogue input	Vfs = 10 V Rin = 30 kΩ	SW1.7 = ON SW1.5-6-8 = OFF
			Vfs = 100 mV Rin = 1 MΩ	SW1.8 = ON SW1.5-6-7 = OFF
			Ifs = 20 mA Rin = 124.5 Ω	SW1.6 = ON SW1.5-7-8 = OFF
		Thermistor 2 temperature measure	PT100 Temperature measure	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

No.	Name	Description	I/O Features	DIP-switch
31	XAIN10/T3+	ENVIRONMENTAL MEASURE 3 auxiliary analogue input	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
		Thermistor 3 temperature measure	PT100 Temperature measure	SW2.1-4 = ON SW2.2-3 = OFF
32	CMA/T3-	Analogue inputs 0V for XAIN10 feedback	0V control board	
33	XAIN11/T4+	ENVIRONMENTAL MEASURE 4 auxiliary analogue input	Vfs = 10 V Rin = 30 kΩ	SW2.7 = ON SW2.5-6-8 = OFF
			Vfs = 100 mV Rin = 1 MΩ	SW2.8 = ON SW2.5-6-7 = OFF
			Ifs = 20 mA Rin = 124.5 Ω	SW2.6 = ON SW2.5-7-8 = OFF
		Thermistor 4 temperature measure	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 analogue input 10 V f.s. ENVIRONMENTAL MEASURE 5	Fs = 10 V Rin= 30 kΩ	
36	CMA	Analogue inputs 0V for XAIN12 feedback	0V control board	
37	XAIN13	Auxiliary analogue input 10 V f.s. ENVIRONMENTAL MEASURE 6	Fs = 10 V Rin= 30 kΩ	
38	CMA	Analogue inputs 0V for XAIN13 feedback	0V control board	
39	XMDI1	Multifunction auxiliary digital input 1	Used for controlling the output power by a device outside the inverter.	
40	XMDI2	Multifunction auxiliary digital input 2	Used for controlling the output power by a device outside the inverter.	
41	XMDI3	Multifunction auxiliary digital input 3	Energy delivered from external meter	
42	XMDI4	Multifunction auxiliary digital input 4	Energy absorbed by external meter	

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	Used for controlling the output power by a device outside the inverter.	
46	**XMDI6**	NOT USED – DO NOT CONNECT		
47	**XMDI7**	Multifunction auxiliary digital input 7	Used for controlling the output power by a device outside the inverter.	
48-62		NOT USED – DO NOT CONNECT		

Table 62: Terminals available on the environmental sensors and field I/O board

12.12.2. 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	bits
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 63: 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	bits
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 64: Analogue inputs configured in 0 - 20 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 65: 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 66: 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 67: 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 68: 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.

12.13. DC-Parallel

12.13.1. DC-Parallel Electrical Specifications

DC-PARALLEL (*)	
Maximum Voc	1000 Vdc
Maximum total current	1500 A
Uc Pulse withstanding voltage for each DC input	4 kV
Uc Pulse withstanding voltage for each DC output	4 kV

Table 69: DC-Parallel Electrical Specifications

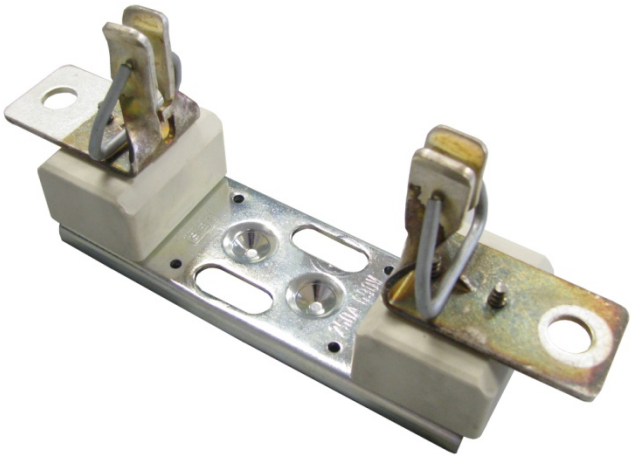
(*) The values in the table may be changed to suit special applications.

12.13.2. Fuses

Use NH1 or NH3 fuses for DC applications.

S000240

Figure 98: NH1 fuse and blade



S000241

Figure 99: Fuse-holder for NH1 fuse and blade

12.13.3. Clearance Values for Stand-Alone DC-Parallel

Table 70 provides indications concerning the distance (L1, L2 and L3) from walls which must be observed as shown in Figure 76 e Figure 77.

Model	Type of ventilation	Clearance values [mm]			
		L1	L2	L3	Ceiling
SUNWAY DC-Parallel 4/8-B6-S	Natural	700	300	500	200
SUNWAY DC-Parallel 4/8-B8-S	Natural	700	300	500	200
SUNWAY DC-Parallel 4/10-B8-S	Natural	700	300	500	200
SUNWAY DC-Parallel 4/10-D8-S	Natural	700	300	500	200
SUNWAY DC-Parallel 8/16-B8-S	Natural	700	300	500	200
SUNWAY DC-Parallel 8/16-D8-S	Natural	700	300	500	200
SUNWAY DC-Parallel 8/20-D8-S	Natural	700	300	500	200
SUNWAY DC-Parallel 8/16-B5-S	Natural	700	-	-	200

Table 70: Clearance Values for Stand-Alone DC-Parallel

13. DECLARATION OF CONFORMITY

Please refer to the “CERTIFICATION AND GRID INTERFACE FILE”.

14. ANNEXES

14.1. Index of revisions

Revision 04

- Standard model range covered: 800V - 1000V
- Section 3.2 Product ID Code updated
- Sections 6.2.1 Transformer Technical Requirements and 6.2.2 Transformer Application Requirements added
- Sections 8.5 DC Measurements, 8.6 AC Power Meter, 8.7 Real-time Efficiency Measurements added
- Section 9.3.2 Input Current Capacity updated
- Table 34: Trip time of fuses NH1-XL updated
- Sections 12.2 Installation Specifications and 12.3 Electrical Specifications updated
- Technical data for Sunway TG 800V TE and Sunway TG 1000V TE updated
- Current derating tables updated
- Sections 12.3.5 P-Q Diagram and 12.3.6 Short-Circuit Current Contribution added