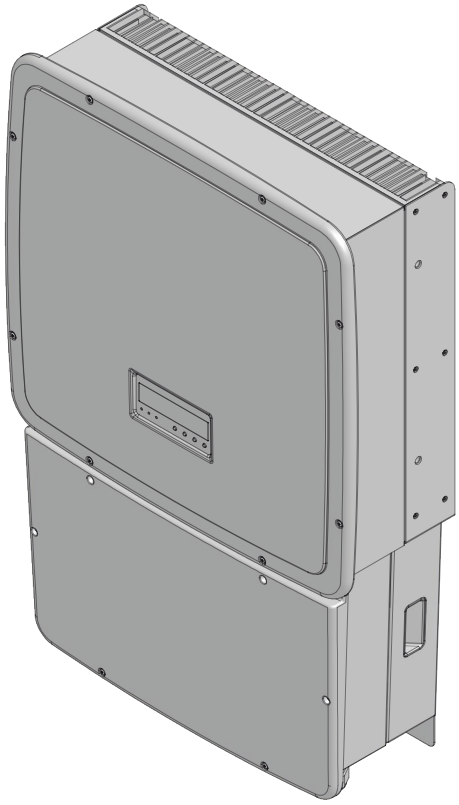
Italy Facility
Via S. Giorgio, 642
52028 Terranuova Bracciolini
Italy
+39 055 9195 1
Camarillo Facility
740 Calle Plano
Camarillo, California, 93012
United States
805-987-8741

OPERATING AND MAINTENANCE MANUAL

TRIO-20.0-TL / TRIO-27.6-TL



TRANSLATION OF THE ORIGINAL INSTRUCTIONS

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

Operators are under an obligation to read this manual and strictly follow the instructions given in it, because ***Power-One*** cannot be held responsible for damage caused to people or property, or for damage to the equipment, if the conditions described below are not complied with.

The customer is under an obligation to keep the industrial secret, and therefore the following documentation and its annexes non may not be tampered with or modified, reproduced or transferred to third parties, without the authorization of ***Power-One***.

010811AG - Code 900001MAG - Edit: 01-08-2011

1 - Introduction and general information

Warranty and supply conditions

The warranty conditions **are described in a special certificate supplied with the equipment**. The warranty conditions are also considered to be valid if the customer complies with what is described in this manual; any conditions departing from those described below must be expressly agreed in the purchase order.

Power-one declares that the equipment is in conformity with the current provisions of law in the European Economic Community and issues a DECLARATION OF CONFORMITY for it.

Not included in the supply

Power-one accepts no liability for failure to comply with the instructions for correct installation and cannot be held responsible for the systems upstream or downstream of the equipment it has supplied.
It is absolutely forbidden to make modifications to the equipment.
The Customer is fully responsible for any modifications made to the equipment.

It is not possible to anticipate the great number of installations and environments in which the equipment will be installed; it is therefore necessary to check the following: adequate spaces, suitable for housing the equipment; airborne noise produced based on the environment; possible flammability conditions, **anti-explosive equipment is NOT supplied.**

Power-one cannot be held responsible for non-production even if this is due to failures of the equipment, or the data communication system via Power Line Modem (PLM).

Power-one CANNOT be held responsible for defects or malfunctioning arising from: improper use of the equipment; deterioration due to transport or particular environmental conditions; failure to carry out maintenance or improper maintenance; tampering or temporary repairs; use or installation carried out by unqualified people.

Power-one CANNOT be held responsible for disposal of: displays, cables, batteries, accumulators, etc. The customer must dispose of these substances, which are potentially harmful to the environment, in accordance with the regulations in force in the country of installation.

Contents

The document and who it is for

The manual must be read by all the professional figures who interact with the equipment; they must also be informed **about possible residual risks.**

Purpose and structure of the document

This operating and maintenance manual is a valid guide that will enable you to work safely and carry out the operations necessary for keeping the equipment in good working order.

The document was originally written in ITALIAN; therefore, in the event of inconsistencies or doubts please ask the manufacturer for the original document.

List of annexes

In addition to this operating and maintenance manual, (if applicable or on request) the following attached documentation is supplied:
- EC declaration of conformity
- wiring diagrams and electronic diagrams
- quick installation guide
- service manual for the installer

The aforesaid documents are for professional figures and/or specialized staff. The manual and its annexes cannot make up for cultural or professional deficiencies of operators, and therefore the customer must make sure they are able to correctly interpret the information presented in the documentation.

WARNING: Part of the information given in this document is taken from the original documents of the suppliers. This document contains only the information considered necessary for the use and routine maintenance of the equipment.

Staff characteristics

The customer must make sure the operator has the necessary skill and training to do his/her job. Staff in charge of using and maintaining the equipment must be skilled, aware and mature for the described tasks and must have the reliability to correctly interpret what is described in the manual.

The employment of a person who is NOT qualified, is drunk or on narcotics, has a prosthetic mitral valve or a pacemaker is strictly forbidden.

The customer is civilly liable for the qualification and mental or physical condition of the professional figures who interact with the equipment. They must always use the personal protective equipment provided for by the laws of the country of destination and whatever is provided by their employer.

Reference regulations

The reference standards complied with in the design and manufacture of the equipment are described below.

• **2006/42/EC** Implementation of directives 89/392/EEC, 91/368/EEC, 9344/EEC and 93/68/EEC for the CE marking.

• **2006/95/EC** Low voltage directive (ex 73/23/EEC).

• **2004/108/EC** Electromagnetic Compatibility Directive, Italian Legislative Decree D.Lgs. 6/11/2007 no. 194 (ex 89/336/EEC).

• **D.Lgs. no. 81 of 9/4/2008** Implementation of the Consolidation Act on safety (ex D.Lgs. 626/94 of 18/9/1994), directives for improvement of occupational health and safety.

• **UNI EN ISO 14121-1: 2007** Safety of machinery - Principles for risk assessment.

• **IEC EN 60204-1: 2006** Safety of machinery - Electrical equipment of machines. Part 1: General requirements.

• **UNI EN 12198-2: 2009** Safety of machinery - Assessment and reduction of risks arising from radiation emitted by machinery.

• **EN ISO 11202 (October 1997)** Acoustics - Noise emitted by machinery and equipment. Measurement of emission sound pressure levels at a workstation and at other specified positions - Survey method in situ.

• **IEC 70-1 (EN 60529 June 1997)** Degrees of protection provided by enclosures (IP code).

• **ISO IEC 446 (1989)** Identification of insulated and bare conductors by colours.

• **UNI 10893: 2000** Technical product documentation - instructions for use. Organization and order of contents.

• **UNI ISO 10015: 2001** Guidelines for training.

• **ISO 7000 - DIN 30600** Graphic symbols and signs for function identification.

• **UNI 11394: 2001** Technical information - System for assessing the instructions for use of technical goods.

Symbols and signs

Table: Symbols

	In the manual and/or in some cases on the equipment, the danger or hazard zones are indicated with signs, plates, symbols or icons, like the CE marking.
	This points out that it is mandatory to consult the manual or original document, which must be available for future use and must not be damaged in any way.
	This points out operations or situations in which staff must be very careful, respectively: Generic hazard or hazardous voltage
	This points out a hazard due to the presence of heated areas or in any case areas that have hot parts (danger of burns).
	This points out that the examined area must not be entered or that the described operation must not be carried out.
	This points out that the equipment must not be worked on by anyone with a pacemaker, prosthetic mitral valve or prostheses with electronic circuits.
	This points out that it is mandatory to carry out the described operations using the clothing and/or personal protective equipment provided by the employer.
	This indicates the degree of protection of the equipment according to IEC standard 70-1 (EN 60529 June 1997).
	The system must be grounded
	This indicates the allowed temperature range
	This indicates the risk of electric shock. Time needed to discharge stored energy: 10 minutes
	This indicates that the equipment must be disposed of in accordance with the regulations in force in the country of installation.
	Respectively direct current and alternating current
	There is no transformer

Field of use, general conditions

Power-One accepts no liability for damage of any kind that may arise from incorrect or careless operations.

The equipment must not be used for uses that do not fall within the intended field of use. The equipment MUST NOT be used by inexperienced staff, or by experienced staff to carry out operations on the equipment that are not in accordance with what is described in this manual and in the attached documents.

Intended or allowed use

This equipment is a multi-string inverter designed to:
transform a direct electric current (DC)
coming from a photovoltaic generator (PV)
into an alternating electric current (AC)
Suitable for being fed into the national grid.

Limits of the field of use

The inverter can be used only with photovoltaic modules in insulation class II
The operating current dispersed during normal operation must not exceed the limits of the local standard, as the logical consequence will be disconnection from the grid.
Only one photovoltaic generator can be connected to the input of the inverter (do not connect batteries or other sources of power supply)
The inverter can be connected to the electricity grid in qualified countries only.
The inverter can be used only if all the technical characteristics are observed.

Improper or disallowed use

THE FOLLOWING ARE STRICTLY FORBIDDEN:

• Installing the equipment in environments with particular flammability conditions or in adverse or disallowed environmental conditions (temperature and humidity)..

• Using the equipment with the safety devices not working or disabled.

• Using the equipment or parts of the equipment by connecting it to other machines or equipment, unless expressly provided for.

• Modifying the operating parameters that are not accessible to the operator and/or parts of the equipment to vary the performance or change its insulations.

• Cleaning with corrosive products that may corrode parts of the equipment or generate electrostatic charges.

• Using or installing the equipment or parts of it without having read and correctly interpreted the contents of the operating and maintenance manual.

• Warming or drying rags and clothes on parts at temperature. Besides being dangerous, this would compromise the ventilation and cooling of the components.

2 - Characteristics

General conditions

The description of the characteristics of the equipment allows its main components to be identified, to refine the technical terminology used in the manual.
The technical terminology and the quick information finding system are assisted by the following:
• Contents
• Numerical index of references
• Index.
The Characteristics chapter contains information about the models, the composition of the equipment, the characteristics and technical data, the overall dimensions and the identification of the equipment.

This manual should be read in chronological order as established by the manufacturer and the reader assumes responsibility for failure to do so. All the information is given considering each time that the information of the preceding chapters has been acknowledged.

In some cases, there may be a need to separately document the operation of the software or to attach supplementary documentation to this manual for more qualified professional figures.

Models and range of equipment

The specific models of multi-string inverter that this manual is about are divided into two groups according to the maximum output power (20 kW or 27.6 kW).
For inverters of equal output power, the variant between the various models is the layout of the wiring box **02**.

The choice of model of inverter must be made by a qualified technician who knows about the installation conditions, the devices that will be installed outside the inverter and possible integration with an existing system.

- **20 kW three-phase MODELS**

TRIO-20.0-TL-OUTD: Basic version wiring box
TRIO-20.0-TL-OUTD-S2: S2 wiring box version (with AC+DC disconnect switch **14**)
TRIO-20.0-TL-OUTD-S2X: S2X wiring box version (with quick fit connectors, string fuses **22**, DC overvoltage surge arresters **15**, AC overvoltage surge arresters **18** and AC+DC disconnect switch)

- **27.6 kW three-phase MODELS**

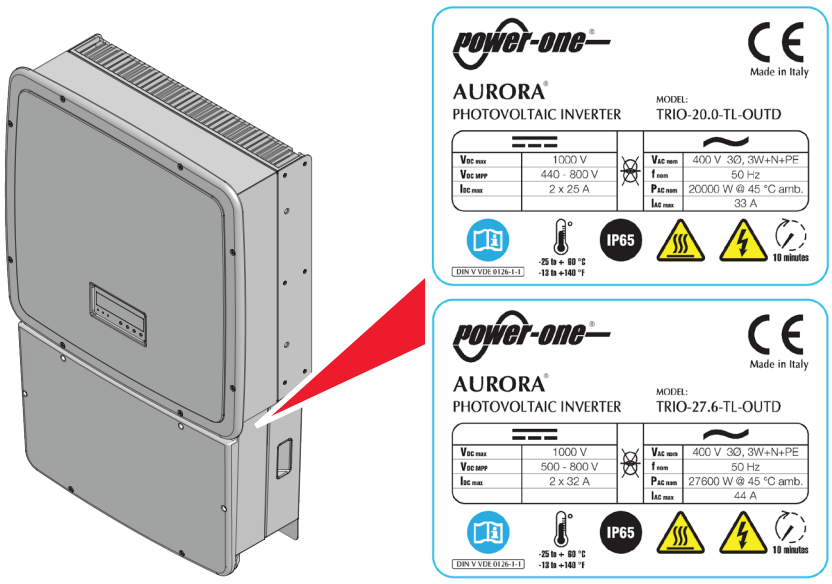
TRIO-27.6-TL-OUTD: Basic version wiring box
TRIO-27.6-TL-OUTD-S2: S2 wiring box version (with AC+DC disconnect switch)
TRIO-27.6-TL-OUTD-S2X: S2X wiring box version (with quick fit connectors, string fuses, DC overvoltage surge arresters, AC overvoltage surge arresters and AC+DC disconnect switch)

Identification of the equipment and the manufacturer

The technical data shown in this manual do not in any case replace those shown on the plates attached to the equipment.

The plates attached to the equipment must NOT be removed, damaged, dirtied, hidden, etc.

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



Characteristics and technical data

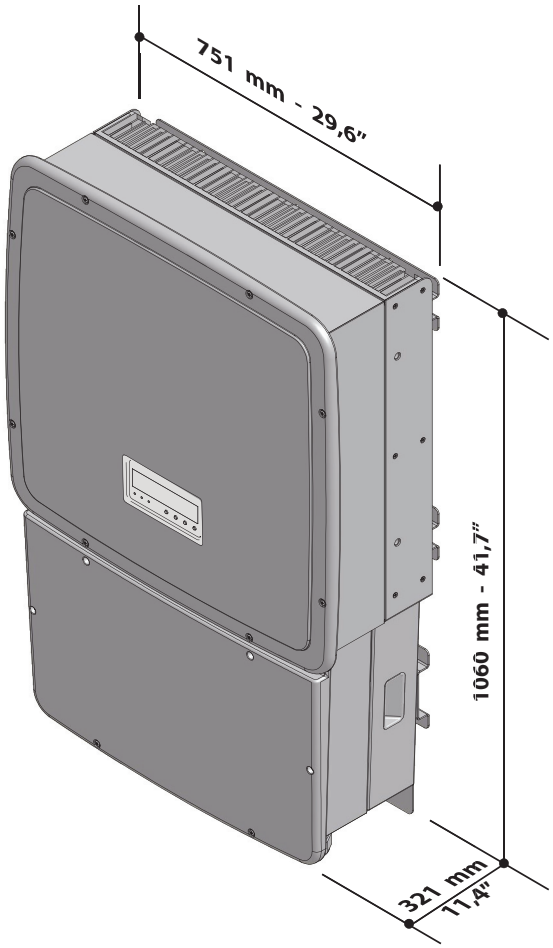
Table: Technical Data	TRIO-20.0-TL-OUTD	TRIO-27.6-TL-OUTD
Input		
Rated Input Power (Pdcr)	20500 Wp	28200 Wp
Maximum Input Power (Pdcmax)	22000 Wp	30000 Wp
Rated Input Voltage (Vdcr)	620 V	620 V
Input Activation Voltage (Vstart)	360 V (adj. 250...500 V)	360 V (adj. 250...500 V)
Input operating range (Vdcmin...Vdcmax)	0.7 x Vstart...950 V	0.7 x Vstart...950 V
Maximum Input Power for each MPPT	12000 W	16000 W
Input voltage Range for Operation at rated power with Configuration of the MPPTs in parallel	410...800 V	500...800 V
Voltage Range for Full Power Operation with Configuration of Independent MPPTs	480...800 V (@12.0 kW) / 340...800 (@8.5 kW)	500...800 V (@16.0 kW) / 385...800 (@12.2 kW)
Absolute Maximum Input Voltage (Vmax,abs)	1000 V	1000 V
Number of Independent MPPTs	2	2
Maximum current for each MPPT	25.0 A	32.0 A
Number of Pairs of DC Connections at Input	5 for each MPPT (-S2X version)	5 for each MPPT (-S2X version)
Type of Input DC Connectors	Basic and -S2: screw terminal board (max cross-section 50 mm^2) -S2X: Weidmuller or MC4 (or equivalent)	Basic and -S2: screw terminal board (max cross-section 50 mm^2) -S2X: Weidmuller or MC4 (or equivalent)
Maximum current accepted by the Input Connector (Icon,max)	20.0 A -S2X version: 10A (input fuse size)	20.0 A -S2X version: 10A (input fuse size)
Input protection		
Reverse Polarity Protection	Yes	Yes
Short Circuit Input Current	30.0 A	40.0 A
Input Overvoltage Protection - Varistors	2 for each MPPT	2 for each MPPT
Input Overvoltage Protection - DIN rail surge arrester (-S2X version)	3 (Class II) for each MPPT	3 (Class II) for each MPPT
Isolation Control	In accordance with the local standard	In accordance with the local standard
DC disconnect switch (-S2 and -S2X version)	40 A / 1000 V	40 A / 1000 V
Fuses (-S2X version)	10 A / 1000 V	10 A / 1000 V
Output		
AC connection to the Grid	3 Phases (star or delta configuration)	3 Phases (star or delta configuration)
Rated Output Power (Pacr)	20000 W	27600 W
Maximum Output Power (Pacmax)	22000 W	30000 W
Maximum apparent Output Power (Sacmax)	22300VA The rated power is also guaranteed with cos(fi) = 0.9	31000 VA The rated power is also guaranteed with cos(fi) = 0.9
Rated output voltage (Vacr)	400 Vac / N / PE	400 Vac / N / PE
Output Voltage Range (Vacmin...Vacmax)	320...480 Vac (1)	320...480 Vac (1)
Maximum Output Current (Iacmax)	33.0 A	45.0 A

Rated Output Frequency (fr)	50 Hz	50 Hz
Output Frequency Range (fmin...fmax)	47...53 Hz (2)	47...53 Hz (2)
Rated Power Factor (Cosphiacr)	> 0.995 (adj. ± 0.9)	> 0.995 (adj. ± 0.9)
Total Harmonic Distortion of Current	< 3%	< 3%
Type of AC Connections	Screw terminal board, maximum cross-section 35 mm^2	Screw terminal board, maximum cross-section 35 mm^2
Output protection		
Anti-islanding Protection	In accordance with the local standard	In accordance with the local standard
Maximum AC Overcurrent protection	34.0 A	46.0 A
Output Overvoltage Protection - Varistors	4	4
Output Overvoltage Protection - DIN Rail surge arrester (-S2X version)	4 (Class II)	4 (Class II)
Night-time disconnection	Not applicable	Not applicable
Operating performance		
Maximum Efficiency (ηmax)	98.3%	98.3%
Weighted Efficiency (EURO/CEC)	98.0% / 98.1%	98.0% / 98.1%
Power Input Threshold	40 W	40 W
Stand-by Consumption	< 8W	< 8W
NIght-time Consumption	<1W	<1W
NIght-time Consumption (Reactive Power)	110 VAR	110 VAR
Inverter Switching Frequency	15.8 kHz	15.8 kHz
Communication		
Wired Local Monitoring (opt.)	PVI-USB-RS485_232, PVI-DESKTOP	PVI-USB-RS485_232, PVI-DESKTOP
Remote Monitoring (opt.)	PVI-AEC-EVO, AURORA-UNIVERSAL	PVI-AEC-EVO, AURORA-UNIVERSAL
Wireless Local Monitoring (opt.)	PVI-DESKTOP with PVI-RADIOMODULE	PVI-DESKTOP with PVI-RADIOMODULE
User Interface	Graphic Display	Graphic Display
Environmental		
Ambient Temperature	-25...+60°C /-13...140°F with derating above 45°C/113°F	-25...+60°C /-13...140°F with derating above 45°C/113°F
Storage Temperature	-40...80°C (-40...+176°F)	-40...80°C (-40...+176°F)
Relative Humidity	0...100% condensing	0...100% condensing
Noise Emission	< 50 db(A) @ 1 m	< 50 db(A) @ 1 m
Maximum Operating Altitude	2000 m / 6560 ft	2000 m / 6560 ft
Environmental pollution classification for external environment	3	3
Environmental Category	External	External
Physical		
Environmental Protection Rating	IP 65	IP 65
Cooling system	Natural	Natural
Air Flow Required for Cooling	Not applicable	Not applicable

Overvoltage Category in accordance with IEC 62109-1	II (for the DC input circuit) III (for the AC output circuit)	II (for the DC input circuit) III (for the AC output circuit)
Dimensions (H x W x D)	1060mm x 751mm x 291mm / 41.7" x 29.6" x 11.4"	1060mm x 751mm x 291mm / 41.7" x 29.6" x 11.4"
Weight	Basic and -S2: 67.0 kg / 147.70 lb S2X: 75.0 kg / 165.30 lb	Basic and -S2: 72.0 kg / 158.70 lb S2X: 80.0 kg / 176.30 lb
Packaging Dimensions (H x W x D)	737mm x 800mm x 1200mm / 29" x 31.5" x 47.2"	737mm x 800mm x 1200mm / 29" x 31.5" x 47.2"
Full Packaging Weight	Basic and -S2: 79.0 kg / 174.10 lb S2X: 87.0 kg / 191.80 lb	Basic and -S2: 84.0 kg / 185.10 lb S2X: 92.0 kg / 202.80 lb
Mounting System	Wall bracket	Wall bracket
Exposure to UV rays	Plastic covers suitable for outdoor use. Exposure to UV rays (in accordance with UL 746C)	Plastic covers suitable for outdoor use. Exposure to UV rays (in accordance with UL 746C)
Safety		
Safety Class	I	I
Isolation Level	Transformerless	Transformerless

Overall dimensions

The overall dimensions are expressed in mm and in inches

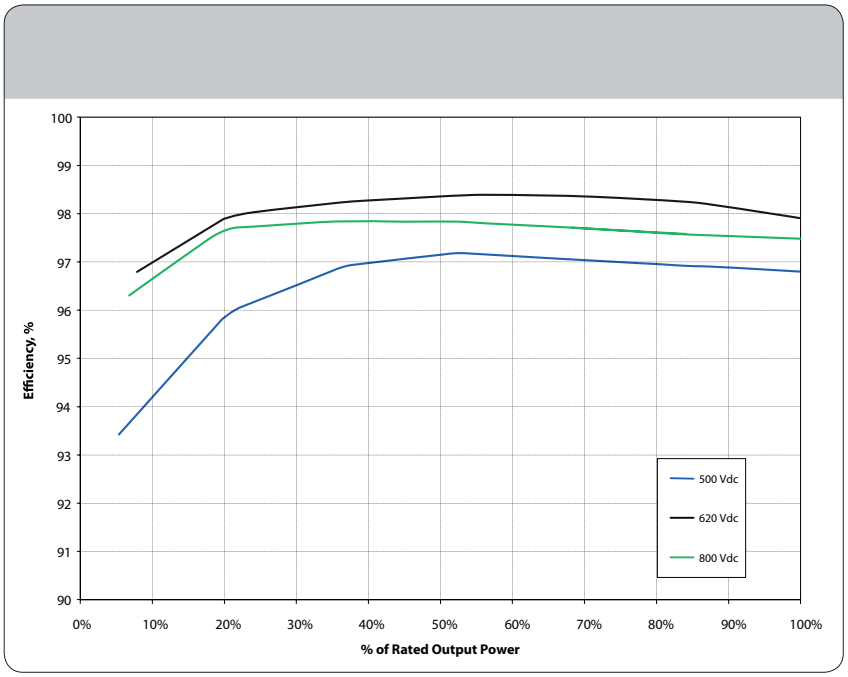


Efficiency curves

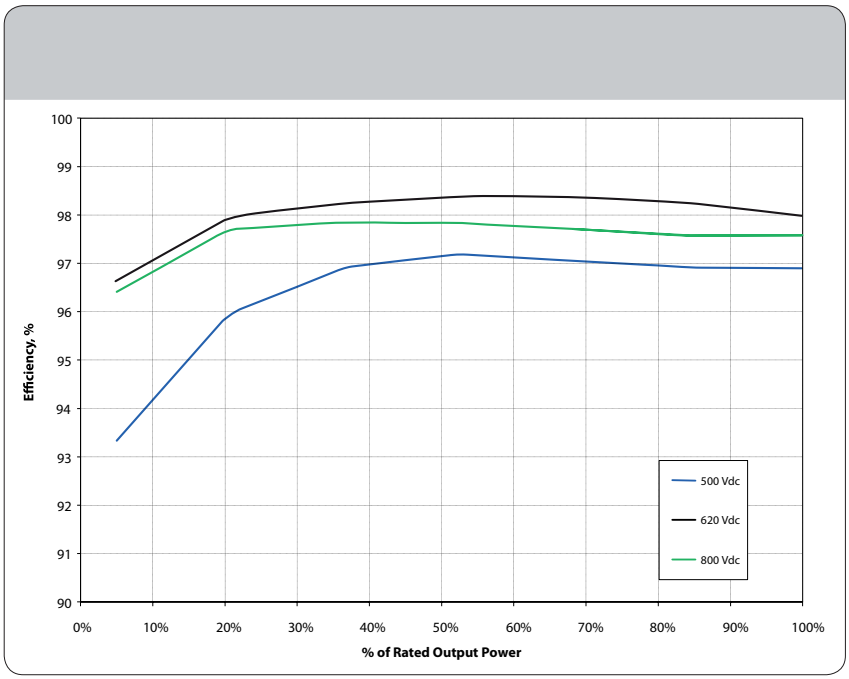
Graphs of the efficiency curves of all the models of inverter described in this manual are shown below.

The efficiency curves are linked to technical parameters that are continually being developed and improved and should therefore be considered approximate.

TRIO-20.0-TL-OUTD
TRIO-20.0-TL-OUTD-S2
TRIO-20.0-TL-OUTD-S2X



TRIO-27.6-TL-OUTD
TRIO-27.6-TL-OUTD-S2
TRIO-27.6-TL-OUTD-S2X



Characteristics of a photovoltaic generator

A PV generator consists of an assembly of photovoltaic modules that transform solar radiation into DC electrical energy and can be made up of:

Strings: X number of PV modules connected in series
Array: group of X strings connected in parallel

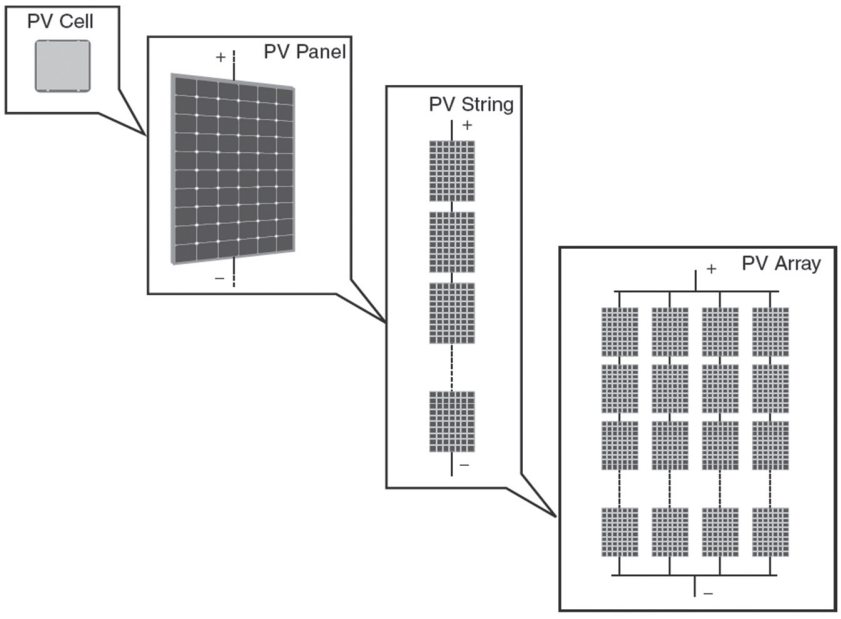
Strings and Arrays

In order to considerably reduce the cost of installing a photovoltaic system, mainly associated with the problem of wiring on the DC side of the inverter and subsequent distribution on the AC side, the **string technology** has been developed. A photovoltaic panel consists of many photovoltaic cells mounted on the same support.

- A **string** consists of a certain number of panels connected **in series**.
- An **array** consists of two or more strings connected **in parallel**.

Large photovoltaic systems can be made up of several arrays, connected to one or more inverters.

By maximizing the number of panels inserted in each string, it is possible to reduce the cost and complexity of the connection system of the photovoltaic system.



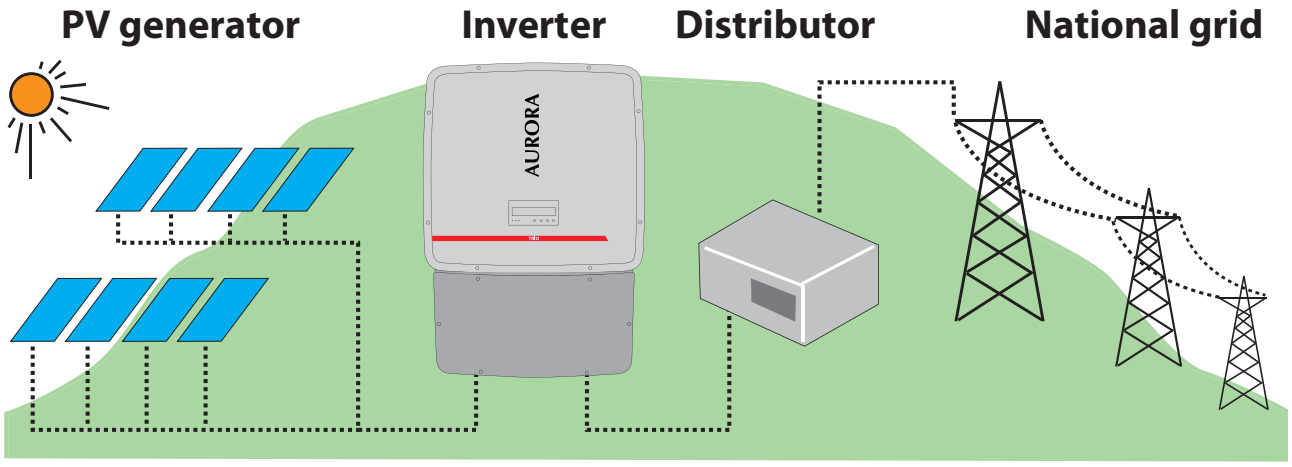
The current of each array must fall within the limits of the inverter.

To work, the inverter must be connected to the national electricity grid since its operation can be equated to a current generator that supplies power in parallel with the grid voltage. That is why inverters cannot support the grid voltage (islanding).

Description of the equipment

This equipment is a multi-string inverter that converts direct electric current from a photovoltaic generator into alternating electric current and feeds it into the national grid.
Photovoltaic panels transform energy from the sun into direct current (DC) electrical energy (through a photovoltaic field, also called photovoltaic (PV) generator; however, to feed the grid and so that this energy can be used, it has to be transformed into alternating current (AC). This conversion, known as DC to AC inversion, is made efficiently without using rotating parts and only through static electronic devices.
When used in parallel with the grid, the alternating current generated by the inverter flows directly into the domestic electrical circuit, which is in turn connected, through a distributor, to the national grid.
The solar energy system therefore powers all connected electrical devices, from lighting to household appliances, etc.
When the photovoltaic system is not supplying sufficient power, the power needed to ensure normal operation of the connected electrical devices is drawn from the national grid. If, on the other hand, excess power is produced, this is fed directly into the grid, so becoming available to other consumers.
In accordance with local and national regulations, the power produced can be sold to the grid or credited towards future consumption, so bringing about a saving of money.

Operating diagram



010811AG

Connection of several inverters together

If the photovoltaic system exceeds the capacity of a single inverter, it is possible to make a multiple connection of inverters to the system, with each one connected to a suitable section of the photovoltaic field, on the DC side, and connected to the grid on the AC side.
Each multi-string inverter will work independently of the others and will supply the grid with the maximum power available from its section of photovoltaic panels.

Notes on the sizing of the system

Decisions about how to structure a photovoltaic system depend on a certain number of factors and considerations to make, such as for example, the type of panels, the availability of space, the future location of the system, energy production goals over the long term, etc.

A configuration program that can help to correctly size the photovoltaic system is available on the web site of ***Power-One*** (www.power-one.com).

Functionality and components of the equipment

Data transmission and control
The inverter, or a network of several inverters, can also be monitored remotely through an advanced communication system based on an RS-485 serial interface or a radio module.

Radiomodule
The radiomodule card is an accessory that is used to replace the RS-485 line for data transmission to the monitoring device.

Analogue inputs
External analogue sensors for monitoring the environmental conditions (temperature, sunlight, etc.) can be connected to the inverter.
The analogue sensors are set directly from the display menus.

Configurable relay
The inverter has a configurable switching relay that can be used in various operating conditions set in the dedicated menu. A typical application example is the closing of the contact when an alarm occurs.

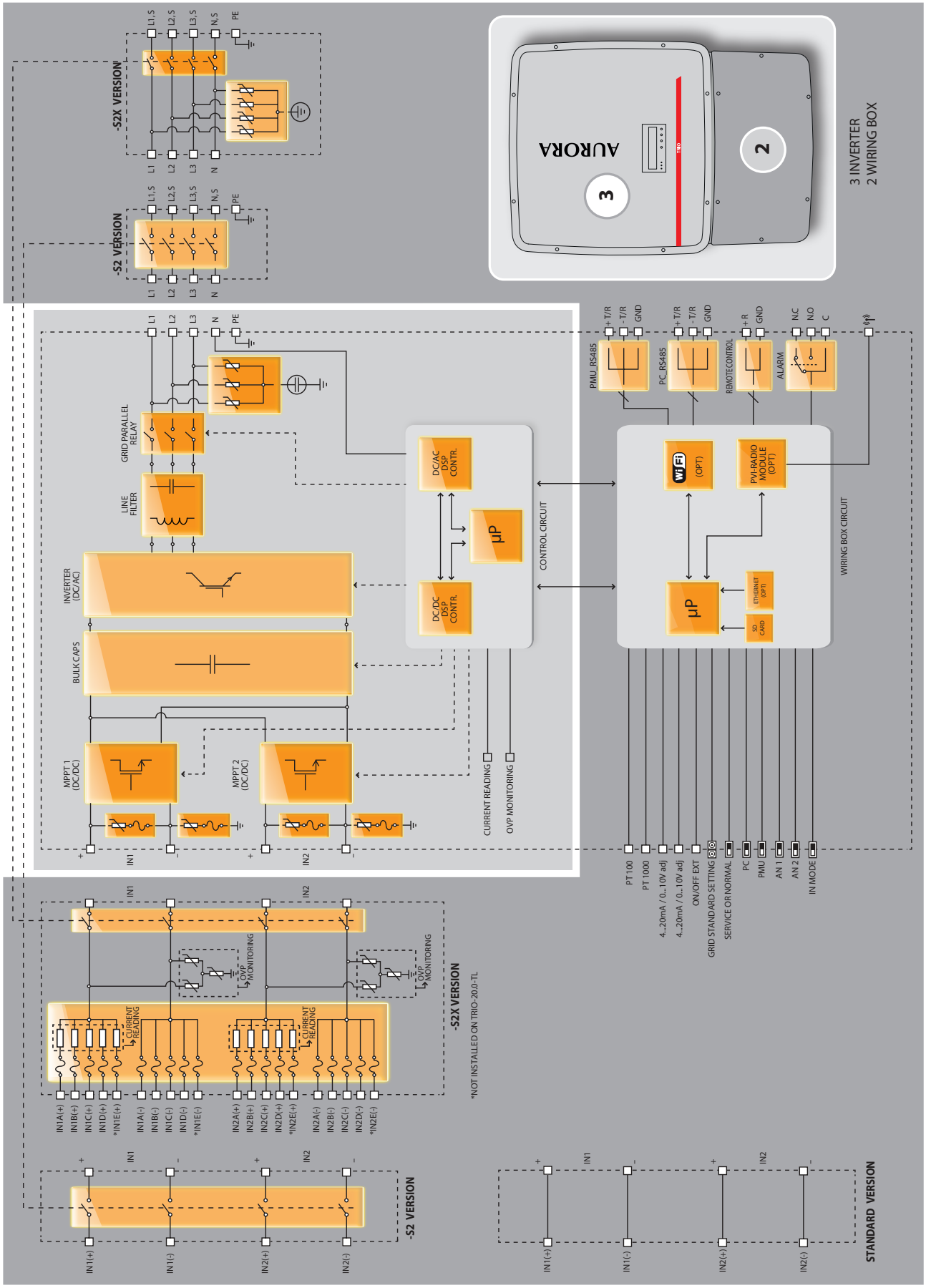
Remote switching on/off
This control can be used to switch the inverter on/off through an external (remote) control.
This function must be enabled in the menu, and if activated, the switching on of the inverter depends on the external switching on/off control as well as being dictated by the presence of the normal parameters that allow the inverter to connect to the grid.

SD card
This is used for updating the firmware (functionality implemented in a future revision of the firmware).

Feeding reactive power into the grid
The inverter is able to produce reactive power and can therefore feed it into the grid through the setting of the phase shift factor. Feed-in management can be controlled directly by the grid company through a dedicated RS485 serial interface.
For detailed information on parameters and on the characteristics of this function, please contact ***Power-One*** directly.

Topographic diagram of the equipment

The diagram shown is a topographic diagram of the operation of the inverter.
The main blocks are the input DC-DC converters (called “boosters”) and the output inverter. Both the DC-DC converters and the output inverter operate at a high switching frequency and so enable a compact size and relatively light weight to be achieved.
Each of the input converters is dedicated to a separate array with independent maximum power point tracking (MPPT) control.
This means that the two arrays can be installed with different positions and orientation. Each array is controlled by an MPPT control circuit.
The two trackers can be configured (when required) in parallel, to handle power and/or current levels higher than those a single tracker can handle.
This version of inverter is transformerless, meaning it has no galvanic isolation between input and output, which enables a further increase in conversion efficiency. The inverter is already equipped with all the necessary protective devices for safe operation in compliance with the regulations, even without an isolation transformer.
The inverter is controlled by two independent DSPs (Digital Signal Processors) and a central microprocessor.
The connection to the electricity grid is therefore controlled by two independent computers, in full compliance with electrical standards regarding system powering and safety.
The operating system performs the operation of communicating with the relevant components to carry out data analysis.
All this guarantees optimal operation of the entire unit and high efficiency in all insolation and load conditions, always in full compliance with the relevant directives, standards and provisions.


-S2X VERSION
-S2 VERSION
L1,S L2,S L3,S N,S PE
L1 L2 L3 N
AURORA
3
2
3 INVERTER
2 WIRING BOX
GRID PARALLEL RELAY
LINE FILTER
INVERTER (DC/AC)
BULK CAPS
MPPT 1 (DC/DC)
MPPT 2 (DC/DC)
DC/AC DSP CONTR.
DC/DC DSP CONTR.
µP
CONTROL CIRCUIT
CURRENT READING
OVP MONITORING
IN1
IN2
PMU_RS485
PC_RS485
REMOTECONTROL
ALARM
+ T/R
- T/R
GND
+ R
N.C
N.O
C
Wi Fi (OPT)
PVI-RADIO MODULE (OPT)
ETHERNET (OPT)
SD CARD
WIRING BOX CIRCUIT
PT 100
PT 1000
4...20mA / 0...10V adj
4...20mA / 0...10V adj
ON/OFF EXT
GRID STANDARD SETTING
SERVICE OR NORMAL
PC
PMU
AN 1
AN 2
IN MODE
-S2X VERSION
*NOT INSTALLED ON TRIO-20.0-TL
IN1A(+) IN1B(+) IN1C(+) IN1D(+) *IN1E(+)
IN1A(-) IN1B(-) IN1C(-) IN1D(-) *IN1E(-)
IN2A(+) IN2B(+) IN2C(+) IN2D(+) *IN2E(+)
IN2A(-) IN2B(-) IN2C(-) IN2D(-) *IN2E(-)
-S2 VERSION
IN1(+) IN1(-) IN2(+) IN2(-)
STANDARD VERSION

Protective devices

Anti-Islanding

In the event of a local grid outage by the electricity company, or when the equipment is switched off for maintenance operations, the inverter must be physically disconnected safely, to ensure protection of people working on the grid, all in accordance with the relevant national standards and laws. To prevent possible islanding, the inverter is equipped with an automatic protective disconnection system called “Anti-Islanding”.

Ground fault in the photovoltaic panels

This inverter must be used with panels connected with “floating” connections, that is, with positive and negative terminals without ground connections. An advanced ground fault protection circuit continuously monitors the ground connection and disconnects the inverter when a ground fault is detected. The ground fault condition is indicated by a red LED on the front panel.

Further protective devices

The inverter is equipped with additional protective devices to guarantee safe operation in any circumstance. These protective devices include:
- Continuous monitoring of the grid voltage to ensure the voltage and frequency values stay within operating limits;
- Control of internal temperatures to automatically limit the power if necessary to ensure the unit does not overheat (derating).
- In the S2X versions, there are also string fuses **22**, DC overvoltage surge arresters **15** and AC overvoltage surge arresters **18** integrated inside the wiring box **02**.

The numerous control devices produce a replete structure to guarantee totally safe operation.

3 - Safety and accident prevention

Safety instructions and general information

The equipment has been manufactured in accordance with the strictest accident-prevention regulations and supplied with safety devices suitable for the protection of components and operators.

For obvious reasons, it is not possible to anticipate the great number of installations and environments in which the equipment will be installed; it is therefore necessary for the customer to appropriately inform the manufacturer about particular installation conditions.

Power-One accepts no liability for failure to comply with the instructions for correct installation and cannot be held responsible for the systems upstream or downstream of the equipment it has supplied.

It is essential to provide operators with correct information. They must therefore read and comply with the technical information given in the manual and in the attached documentation.

The instructions given in the manual do not replace the safety devices and technical data for installation and operation stuck on the product, and they certainly do not replace the safety regulations in force in the country of installation and common sense rules.
The manufacturer is willing to train staff, at its premises or on site, in accordance with conditions to be set out in the contract.

Do not use the equipment if you find any operating anomalies.

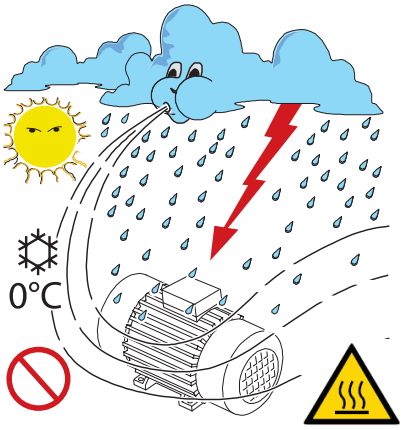
Avoid temporary repairs. All repairs should be carried out using only genuine spare parts, which must be installed in accordance with their intended use.

Liabilities arising from commercial components are delegated to their respective manufacturers.

The handling and/or lifting of very heavy parts or equipment (over 30 kg) must be carried out using suitable lifting equipment.

Hazardous areas and operations

Environmental conditions and risks



The equipment can be installed outdoors, but only in certain environmental conditions that do not prevent its normal operation. Adverse environmental conditions, such as: sun, rain, snow, wind, too hot or too cold, altitudes, humidity, etc., can lead to a reduction in performance.

Power-One CANNOT be held responsible for disposal of the equipment: displays, cables, batteries, accumulators, etc., and therefore the customer must dispose of these substances, which are potentially harmful to the environment, in accordance with the regulations in force in the country of installation.

The same precautions should be adopted when scrapping the equipment.

The equipment is not equipped to operate in environments that have particular flammability or explosive conditions.

The equipment was designed in compliance with energy conservation standards, to avoid waste and unnecessary leakage.
The manufacturer has taken into due consideration the current energy saving standards in Italy.

The customer and/or installer must appropriately instruct the operators or anyone who may come near the equipment, and highlight, if necessary with notices or other means, the hazardous areas or operations: ***magnetic fields, hazardous voltages, high temperatures, possibility of discharges, generic hazard, etc...***

Signs and plates

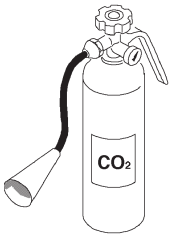
The plates attached to the equipment must NOT be removed, damaged, dirtied, hidden, etc.

The plates must be cleaned regularly and kept visible at all times, and therefore they must NOT be hidden with objects and extraneous parts (rags, boxes, equipment, etc.).
The technical data shown in this manual do not in any case replace those shown on the plates attached to the equipment.

Thermal hazard

WARNING: removal of guards or covers is allowed only **10 minutes after the voltage has been removed**; this is to let the components cool down and allow any electrostatic charges and parasitic voltages to be discharged.

When the equipment has just been switched off, it may have hot parts, as a result of overheating of the surfaces at temperature (e.g.: transformers, accumulators, coils, etc...) so be careful where you touch.



In the event of fire, use CO_2 foam extinguishers and use auto extraction systems to fight fire in closed environments.

Clothing and protective devices for staff

Power-One has eliminated sharp edges and corners, but in some cases it is not possible to do anything, and we therefore advise wearing the clothing and personal protective equipment provided by the employer.

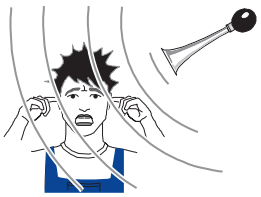
Staff must not wear clothes or accessories that can start fires or generate electrostatic charges or, in general, clothing that can impede personal safety.

All operations on the equipment should be carried out with suitably insulated instruments.

Staff must NOT go near the equipment with bare feet or wet hands.

Maintenance operations must be carried out with the equipment disconnected from the grid.

The maintenance technician must in any case make sure no one else can switch on or operate the equipment during the maintenance operations, and must report any anomaly or damage due to wear or ageing so that the correct safety conditions can be restored.



The installer or maintenance technician must always pay attention to the work environment, so that it is well lit and with sufficient spaces to ensure they have an escape route.

In the installation, consider or make sure the ***noise emitted based on the environment*** is not such that it exceeds the thresholds allowed by law (less than 80 dBA).

Residual Risks

Despite the warnings and safety systems, there are still some residual risks that cannot be eliminated.
These risks are listed in the following table with some suggestions for preventing them.

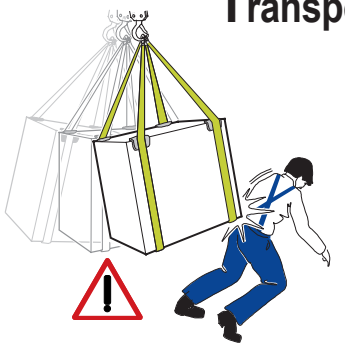
Table of residual risks

RISK ANALYSIS AND DESCRIPTION	SUGGESTED REMEDY
Noise pollution due to installation in unsuitable environments or where staff work permanently.	Reassess the environment or the place of installation.
Suitable local ventilation that does not cause overheating of the equipment and is sufficient not to create discomfort to people in the room.	Restore suitable ambient conditions and air the room.
External weather conditions, such as water seepage, low temperatures, high humidity, etc.	Maintain ambient conditions suitable for the system.
Overheating of surfaces at temperature (transformers, accumulators, coils, etc.) can cause burns. Also be careful not to block the cooling slits or systems of the equipment.	Use suitable protective equipment or wait for the parts to cool before switching on the equipment.
Inadequate cleaning: compromises cooling and does not allow the safety plates to be read.	Clean the equipment, plates and work environment adequately.
Accumulation of electrostatic energy can generate hazardous discharges.	Ensure the devices have discharged their energy before working on them.
Inadequate training of staff.	Ask for a supplementary course.
During installation, temporary fixing can involve risks of unhooking from the bracket **01**	Pay attention and prevent access to the installation area.
Accidental disconnection of the quick fit connectors with the equipment in operation, or wrong connections, can generate electric arcs.	Pay attention and prevent access to the installation area.

4 - Lifting and transport

General conditions

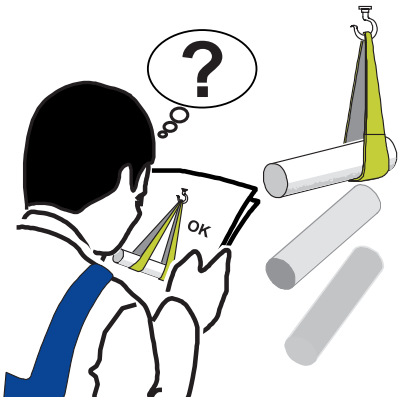
Transport and handling



Transport of the equipment, especially by road, must be carried out by suitable ways and means for protecting the components (in particular, the electronic components) from violent knocks, humidity, vibration, etc.

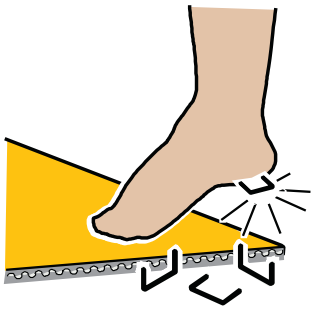
During handling, do not make any sudden or fast movements that can create dangerous swinging.

Lifting



Power-One usually stores and protects individual components by suitable means to make their transport and subsequent handling easier, but as a rule it is necessary to turn to the experience of specialized staff in charge of loading and unloading the components.
Where indicated and/or where there is provision, eyebolts or handles, which can be used as anchorage points, are inserted and/or can be inserted.
The ropes and means used for lifting must be suitable for bearing the weight of the equipment.
Do not lift several units or parts of the equipment at the same time, unless otherwise indicated.

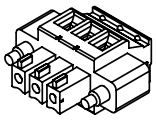
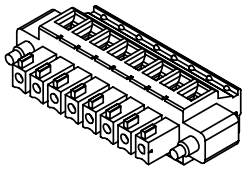
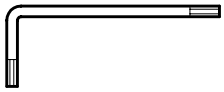
Unpacking and checking

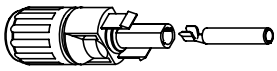
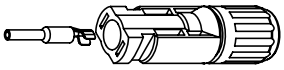


We remind you that the packaging elements (cardboard, cellophane, staples, adhesive tape, straps, etc.) can cause cuts and other injuries if not handled with care. They should be removed by suitable means and not left in the hands of irresponsible people (e.g. children).
The components of the packaging must be disposed of in accordance with the regulations in force in the country of installation.
When you open the package, check that the equipment is undamaged and make sure all the components are present.
If you find any defects or damage, stop unpacking and consult the carrier, and also promptly inform ***Power-One***.

List of components

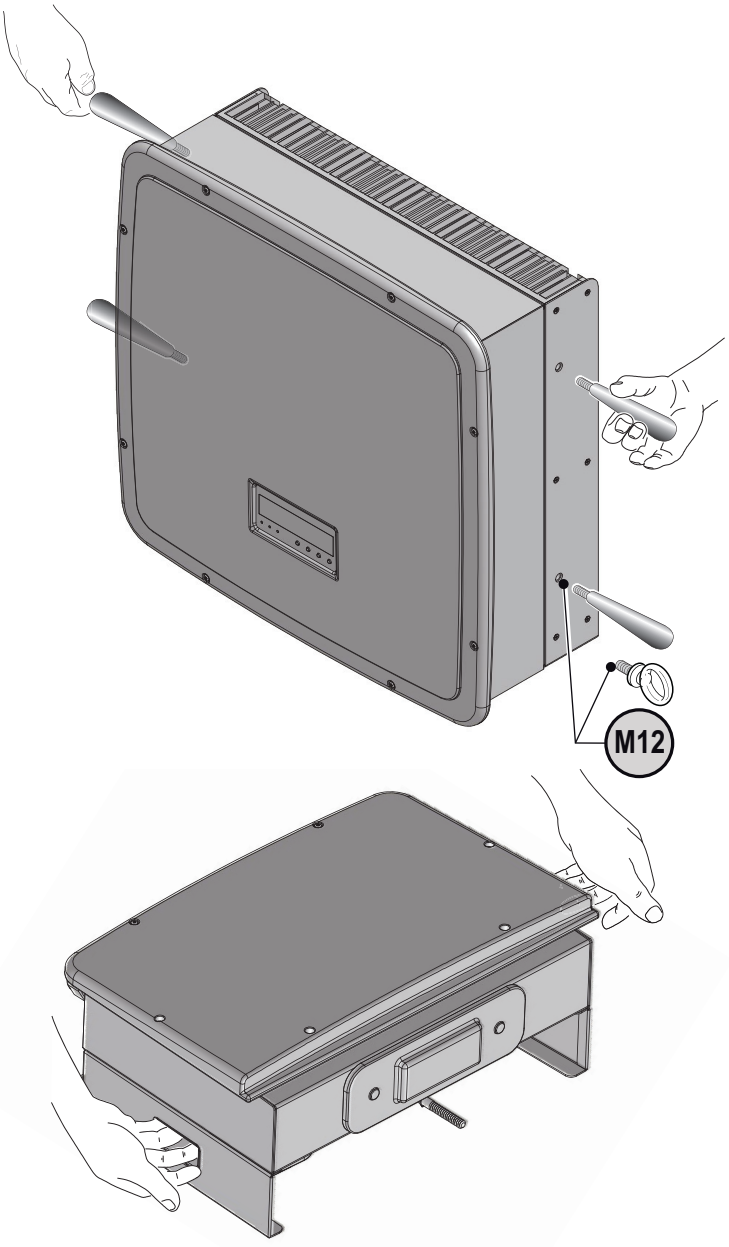
Table: Components of the equipment

	Components available for all models	Quantity
	Connector 21.2500MF/3	2
	Connector 21.2500MF/8	4
	L-key, TORX TX20	1
	Cylinder, TGM58	2
	Gasket, 36A3M2025	2
	Gland multi-entry seal plug 6mm IP68 light grey TGM613	1
	Gasket multi-entry seal neoprene M25 IP68 black	1

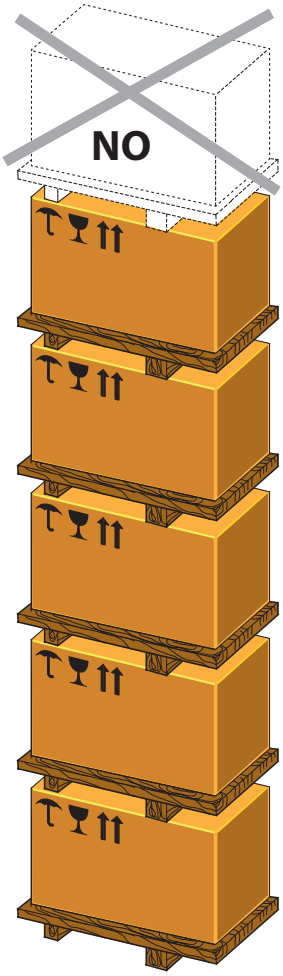
	Components available for the S2X model only	Quantity
	Female quick fit connectors	10
	Male quick fit connectors	10

Weight of the equipment units

Table: Weights	Mass weight in kg (kg)	Lifting points n°#	Minimum rope height (H, ≥mm)	Holes or Eyebolts UNI2947 (ø M mm)
INVERTER unit	TRIO-20.0: 60 kg TRIO-27.6: 65 kg	4	1.200	**M 12** mounting kit with handles **06** and eyebolts (to order)
WIRING BOX unit	Basic and -S2: 7 kg -S2X: 15 kg	2	-	-



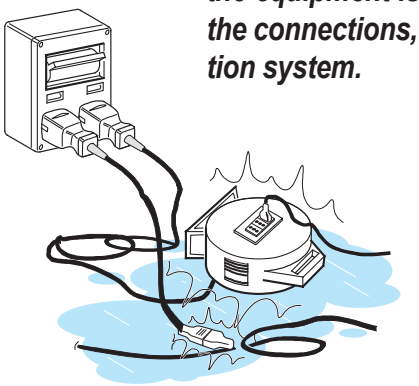
If the package is stored correctly, it can withstand **a maximum load of 4 pieces of equipment.** DO NOT stack with equipment or products other than those indicated.



010811AG

5 - Installation

General conditions



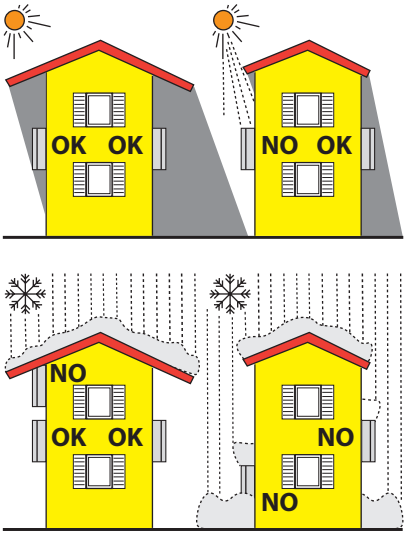
Installation of the equipment is carried out based on the system and the place in which the equipment is installed; therefore, its performance depends on the correctness of the connections, the type of photovoltaic modules and the calibrations of the distribution system.

Staff authorized to carry out the installation must be specialized and experienced in this job; they must also have received suitable training on equipment of this type.

The operation must be carried out by specialized staff; it is in any case advisable to comply with what is written in this manual and follow the diagrams and attached documentation.

The installation must be carried out with the equipment disconnected from the grid (power disconnect switch open) and with the photovoltaic panels shaded or isolated.

Environmental checks



• Consult the technical data to check the environmental parameters to be observed (degree of protection, temperature, humidity, altitude, etc.)
• Do not expose to direct sunlight to avoid unwanted power derating due to an increase in the internal temperature of the inverter.
• Do not install in small closed rooms where air cannot circulate freely.
• To avoid overheating, always make sure the flow of air around the inverter is not blocked.
• Do not install in places where gases or flammable substances may be present.
• Do not install in rooms where people live or where the prolonged presence of people or animals is expected, because of the noise (about 50dB(A) at 1 m) that the inverter makes during operation.
• Avoid electromagnetic interference that can compromise the correct operation of electronic equipment, with consequent situations of danger.

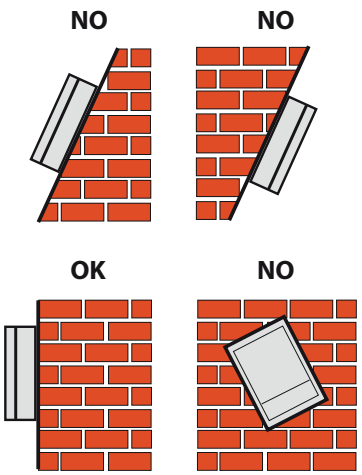
Installations above 2000 metres

On account of the rarefaction of the air (at high altitudes), particular conditions may occur that should be considered when choosing the place of installation:

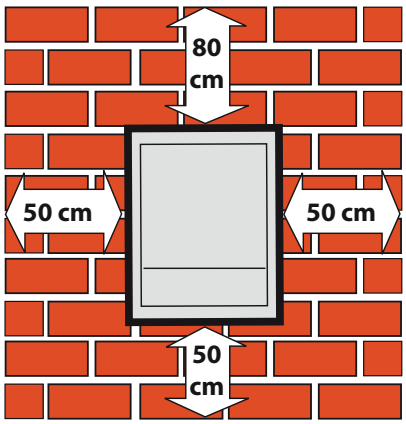
• Less efficient cooling and therefore a greater likelihood of the device going into derating because of high internal temperatures.
• Reduction in the dielectric resistance of the air that, in the presence of high operating voltages (DC input), can create electric arcs (discharges) that can reach the point of damaging the inverter.
As the altitude increases, the failure rate of some electronic components increases exponentially because of cosmic radiation.

All installations at altitudes of over 2000 metres must be assessed case by case considering the aforesaid criticalities.

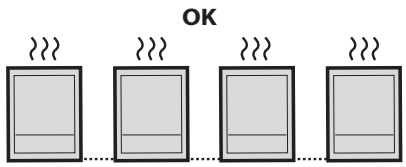
Installation position



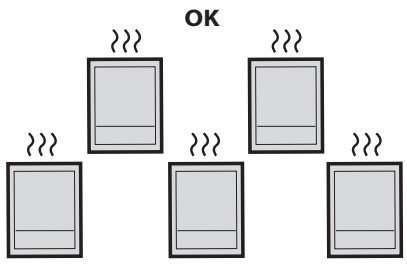
When choosing the place of installation, comply with the following conditions:
• Install on a wall or strong structure suitable for bearing the weight.
• Install in safe, easy to reach places.
• If possible, install at eye-level so that the display and status LEDs can be seen easily.
• Install at a height that considers the heaviness of the equipment. If this condition is not complied with, it can create problems in the event of servicing unless suitable means are provided to carry out the operation.
• Install vertically with a maximum inclination of +/- 5°. If this condition is not complied with, the inverter could go into temperature derating because of the worsening of heat dissipation.



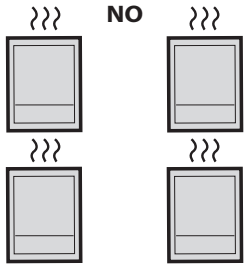
• To carry out maintenance of the hardware and software of the equipment, remove the covers on the front. Check that there are the correct safety distances for the installation that will allow the normal control and maintenance operations to be carried out.
• Comply with the indicated minimum distances.



• For a multiple installation, position the inverters side by side.



• If the space available does not allow this arrangement, position the inverters in a staggered arrangement as shown in the figure so that heat dissipation is not affected by other inverters.



Wall mounting

• Position the bracket **01** perfectly level on the wall and use it as a drilling template.

• Drill the 10 holes required using a drill with 10mm bit. The holes must be about 70mm deep.

• Fix the bracket to the wall with the 10 wall anchors, 10mm in diameter, supplied.

• Hook on the wiring box **02** iby inserting the head of the rear screws in the slots in the bracket, remove the front cover and make all the necessary connections.

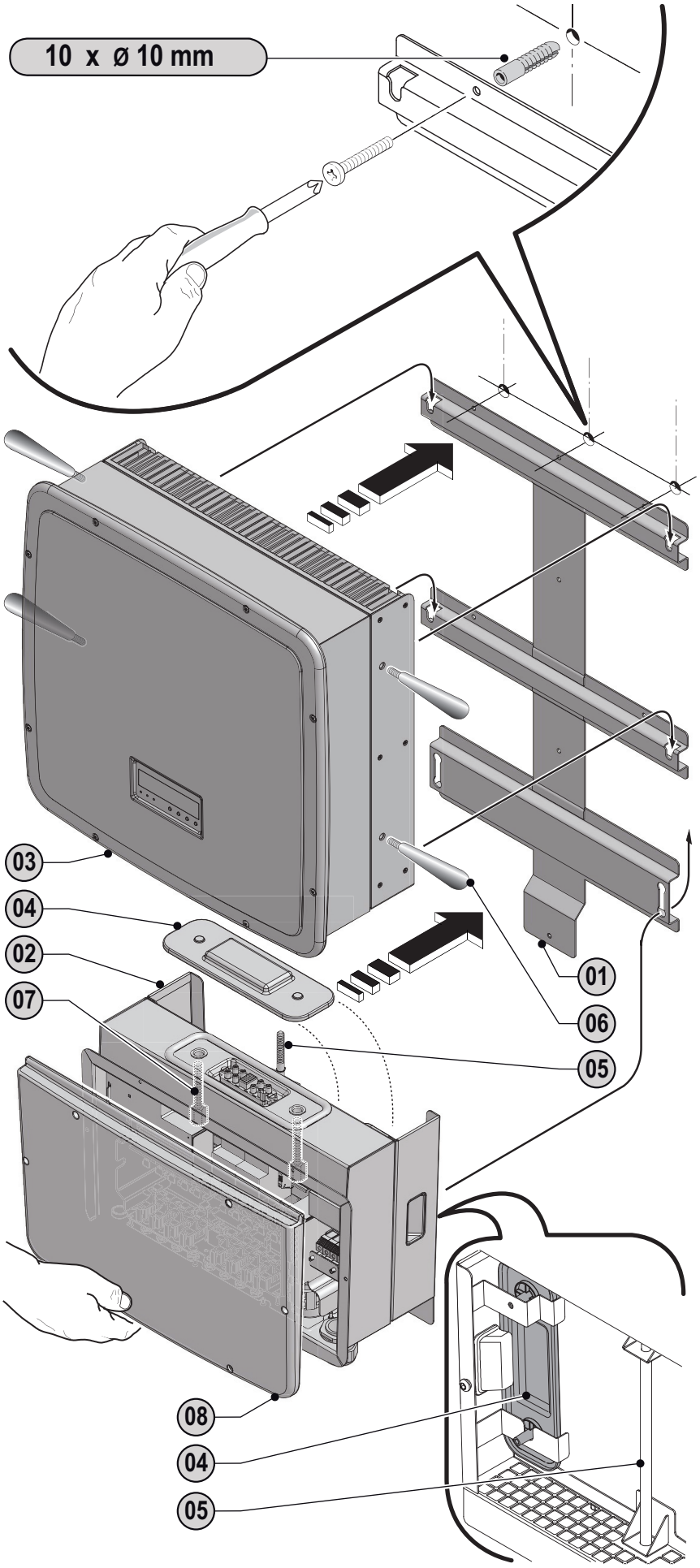
N.B. It is not necessary to install the inverter **03** at this stage.

• Remove the cover **04** to allow access to the connector between the wiring box and the inverter. Put the cover in the special pocket provided at the back of the wiring box.

• Hook the inverter to the bracket by inserting the head of the rear screws in the slots as shown in the figure. To make lifting easier, handles **06** or eyebolts (M12) can be attached to the side holes provided.

• Working from the bottom of the wiring box, connect the two parts by screwing in the clamp screw **05**.

• Once the parts are connected, screw in the two connector screws **07** situated inside the wiring box.



010811AG

Operations preparatory to PV generator connection

Checking the correct polarity of the strings

Using a voltmeter, check that the voltage of each string observes the correct polarity and falls within the input voltage limits accepted by the inverter (see technical data).

If the voltage without load of the string is near the maximum value accepted by the inverter, it must be borne in mind that with low ambient temperatures the string voltage tends to increase (in a different way according to the photovoltaic module used). In this case, it is necessary to carry out a check of the sizing of the system and/or a check on the connections of the modules of the system (e.g.: number of modules in series higher than the design number).

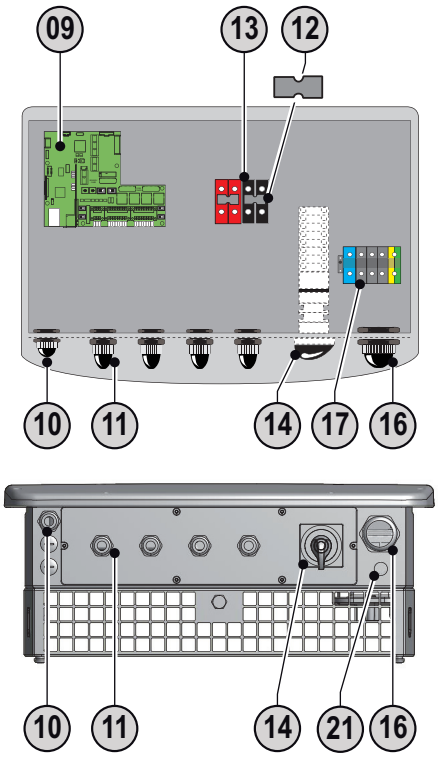
Checking of leakage to ground of the photovoltaic generator

Measure the voltage present between positive and negative pole of each string with respect to ground.
If a voltage is measured between an input pole and ground, it may be that there is a low insulation resistance of the photovoltaic generator and the installer will have to carry out a check to solve the problem.

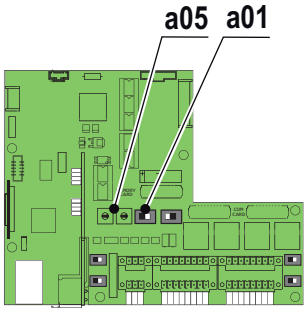
Do not connect the strings if a leakage to ground has been found because the inverter might not connect to the grid.

Wiring Box components

Basic / S2 version



For both models of inverter **03** (20 kW or 27.6 kW), three wiring boxes **02** are available with different layouts:
TRIO-XX.X-TL-OUTD: Basic version wiring box
TRIO-XX.X-TL-OUTD-S2: S2 wiring box version, like the basic version but with AC+DC disconnect switch **14**
TRIO-XX.X-TL-OUTD-S2X: S2X wiring box version, more complete version with quick fit connectors, string fuses **22**, DC overvoltage surge arresters **15**, AC overvoltage surge arresters **18** and AC+DC disconnect switch.



S2X version

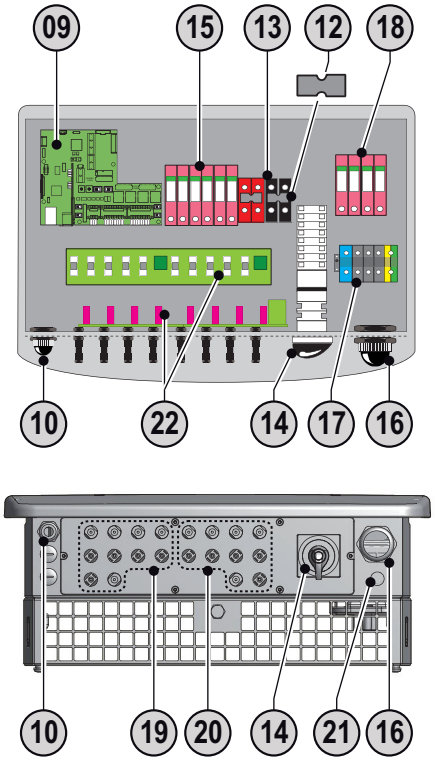
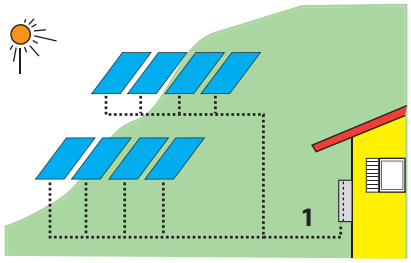
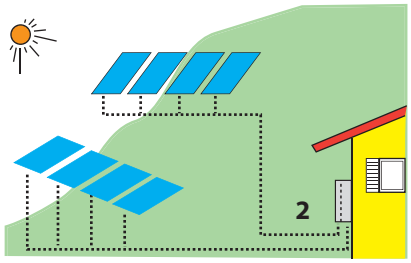


Table: electrical system components

Ref.	Description
09	communication card
10	service cable glands
11	DC cable glands
12	jumpers
13	DC input terminal board
14	AC+DC disconnect switch
15	DC overvoltage surge arresters
16	AC cable gland
17	AC output terminal board
18	AC overvoltage surge arresters
19	Input connectors (MPPT1)
20	Input connectors (MPPT2)
21	anti-condensation valve
22	string fuses
a01	Switch for setting parallel-connected or independent input channels
a05	Rotary switches for setting the country and the language of the display

Configuration of single or parallel-connected input channels

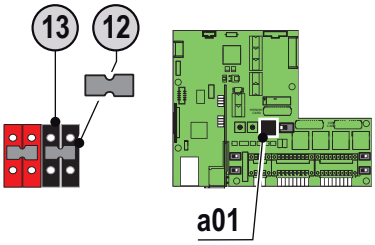




All versions of the inverter are equipped with two input channels (therefore with double maximum power point tracker MPPT) independent of each other, which can however be connected in parallel using a single MPPT.
Strings of photovoltaic modules having the same type and number of panels in series must be connected to each single channel; they must also have the same installation conditions (in terms of orientation to the SOUTH and inclination from the horizontal plane).
When connecting the two input channels in parallel, the aforesaid requirements must be observed with the benefit of being able to use the full power that can be supplied by the inverter on a single channel.
Whereas the double MPPT structure allows the management of two photovoltaic generators that are independent of each other (one for each input channel) and can differ from each other in installation conditions, type and number of photovoltaic modules connected in series. A necessary condition so that the two MPPTs can be used in independent mode is for the photovoltaic generator connected to each of the inputs to have a power lower than the power limit of the single input channel and a maximum current lower than the current limit of the single input channel.

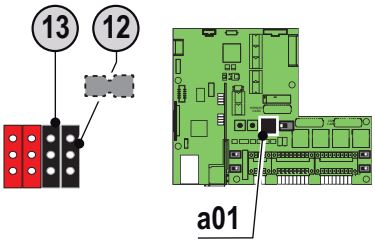
All the input parameters that must be observed for correct operation of the inverter are shown in the "technical data" table.

Configuration of parallel-connected channels



The default configuration involves the use of the two input channels (MPPT) connected in parallel. This means that the jumpers **12** between the two channels (positive and negative) of the DC input terminal board **13** are installed and that the switch a01 situated on the communication card **09** is set to"PAR" (see user interface).

Configuration of independent channels



If you want to configure the inputs to independent mode, remove the jumpers **12**, situated between the two positives and the two negatives of the input channels, and set the switch a01, situated on the communication card **09**, by moving it to the "IND" position (see user interface).

Channel configuration examples

PV generator characteristics	MPPT configuration	Notes
The photovoltaic generator consists of strings having a **different** number of modules in series from each other. The photovoltaic generator consists of strings that have **different** installation conditions from each other.	**MPPT configuration has to be INDEPENDENT**	A **NECESSARY** condition so that the two MPPTs can be used in independent mode is for the photovoltaic generator connected to each of the inputs to have a power **lower** than the power limit of the single input channel **AND** a maximum current **lower** than the current limit of the single input channel.
The photovoltaic generator consists of strings having the **same** number of modules in series as each other. The photovoltaic generator consists of strings that have the **same** installation conditions, that is to say, all the strings have the **same** inclination from the horizontal and the **same** orientation to the SOUTH. The photovoltaic generator connected to each of the inputs has a power **lower** than the power limit of the input channel **AND** a current **lower** than the current limit of the input channel.	**Possibility of choosing between the configuration with MPPT as INDEPENDENT or PARALLEL**	A **NECESSARY** condition so that the two MPPTs can be used in independent mode is for the photovoltaic generator connected to each of the inputs to have a power **lower** than the power limit of the input channel **AND** a maximum current **lower** than the current limit of the input channel. An **ADVISABLE** (*) condition so that the two MPPTs can be connected in parallel is for the photovoltaic generator connected to the two inputs to consist of strings made by the **same** number of modules in series and for all the modules to have the **same** installation conditions.
(*) This condition is advisable from the point of view of the energy production of the system, not from the point of view of inverter operation.		
The photovoltaic generator consists of strings having the **same** number of modules in series as each other. The photovoltaic generator consists of strings that have the **same** installation conditions, that is to say, all the strings have the **same** inclination from the horizontal and the **same** orientation to the SOUTH. The photovoltaic generator connected to each of the inputs has a power **higher** than the power limit of the input channel **OR** a current **higher** than the current limit of the input channel.	**MPPT configuration has to be PARALLEL**	A **SUFFICIENT** (*) condition so that the two MPPTs must be used in parallel mode is for the photovoltaic generator connected to each of the inputs to have a power **higher** than the power limit of the single input channel **OR** a maximum current **higher** than the current limit of the single input channel. An **ADVISABLE** (**) condition so that the two MPPTs can be connected in parallel is for the photovoltaic generator connected to the two inputs to consist of strings made by the same number of modules in series and for all the modules to have the same installation conditions.
(*) This condition is sufficient from the point of view of the energy production of the system, not from the point of view of inverter operation. *(**) This condition is advisable from the point of view of the energy production of the system, not from the point of view of inverter operation.*		

Input connection to the PV generator (DC side)

Once the preliminary checks have been made and it has therefore been verified that there are no problems on the photovoltaic system, and once the channel configuration has been chosen (parallel or independent), the inputs can be connected to the inverter.
The connections can also be made with the wiring box **02** detached from the inverter **03** that can be connected later for commissioning.

When working with the wiring box 02 detached, pay particular attention to outdoor installations, where the coupling connector must always be protected by installing the cover 04 on its housing.

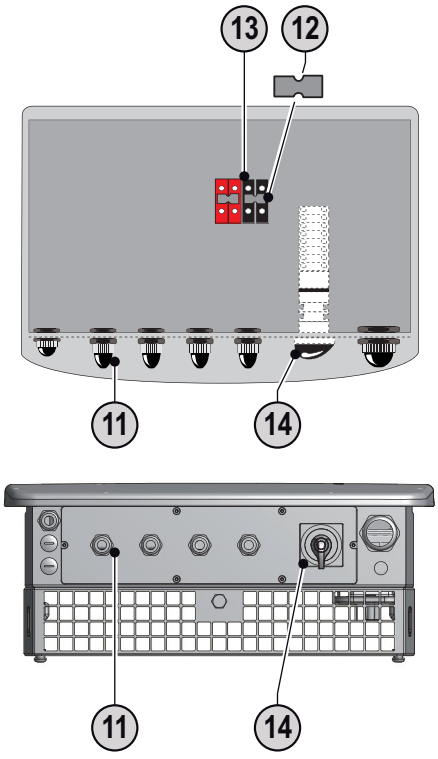
The DC side connections are different according to the wiring box used: The basic and S2 models use cable glands whereas the S2X model uses quick fit connectors (one for each pole of each string).

On the basic and S2 versions, the connection in parallel of the strings (array composition) must take place upstream of the input in the inverter and must be made by technicians during installation.

The S2X version accepts direct connection of the single strings, with connectors accessible from the outside of the wiring box **02**.

To prevent electrocution hazards, all the connection operations must be carried out with the AC+DC disconnect switch 14 open and locked.

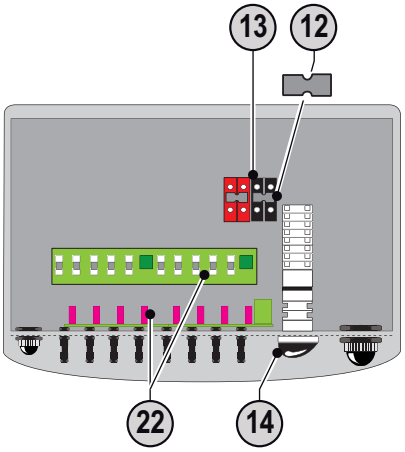
Connection of inputs on the Basic and S2 models



For these two models, connection with the DC input terminal board **13** is made by inserting the cables in the DC cable glands **11**.
The maximum accepted cable cross-section ranges from 10 to 17 mm, whereas each individual terminal of the terminal board accepts a cable with cross-section of up to 50 mm^2.

Unscrew the cable gland, remove the cover, insert the cable of suitable cross-section and connect it to the terminals on the DC input terminal board **13**.
Once the connection to the terminal board is complete, screw in the cable gland firmly and check the tightness.

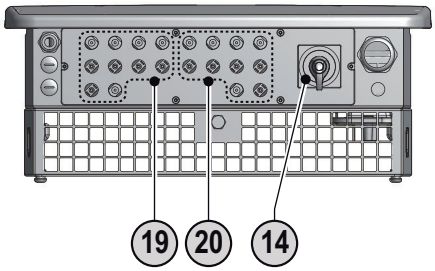
Connection of inputs on the S2X model



For string connections using the S2X wiring box, the quick fit connectors (multicontact or weidmuller) situated at the bottom of the mechanism are used.

For each input channel, there are two units of 10 connectors:
- Input connectors (MPPT1) **19** with codes from 1A to 1E (5 strings)
- Input connectors (MPPT2) **20** with codes from 2A to 2E (5 strings)

Connect all the strings included in the design of the system and always check the tightness of the connectors.



If some string inputs are not used, check that there are covers on the connectors and install them if they are missing.
This operation is necessary for the tightness of the inverter and to avoid damaging the free connector that could be used at a later date.

In this version of the wiring box, it is NECESSARY not to carry out the paralleling of the strings outside the inverter. This is because the string fuses 22, situated on each input, are not sized to take strings in parallel (array). This operation can cause damage to the fuse and consequently malfunctioning of the inverter.

Procedure for installing quick fit connectors

The quick fit connectors **(S2X model only)** supplied can be of two different types:

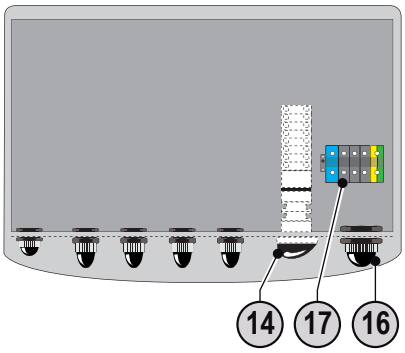
WEIDMULLER

The installation of Weidmuller connectors does not require special tools.
- Strip the end of the cable to which you are going to attach the connector (after making sure it conforms to the limits of the connector).
- Insert the cable in the connector until you hear a locking “click”.
- Fully tighten the knurled ring nut for optimum locking.

MULTICONTACT (or equivalent)

The installation of Multicontact connectors requires crimping that must be carried out using a suitable tool.
- Strip the end of the cable to which you are going to attach the connector (after making sure it conforms to the limits of the connector).
- Attach the terminal to the conductor using the special crimping pliers.
- Insert the cable with terminal into the connector until you hear the click that indicates the terminal is locked inside the connector.
- Firmly tighten the cable gland to finish the operation.

Grid output connection (AC side)

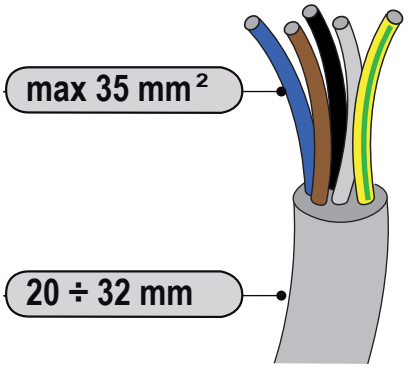


For the connection of the inverter to the grid, you can choose between a star connection (3 phases + neutral) and a delta connection (3 phases). **In any case, connection of the inverter to ground is mandatory.** The cable you use can be 5-pole (star configuration) or 4-pole (delta configuration) and must pass through the AC cable gland **16** to make the connections to the AC output terminal board **17**.

The connections can also be made with the wiring box **02** detached from the inverter **03** that can be connected later to be put in service.

When working with the wiring box 02 detached, pay particular attention to outdoor installations, where the coupling connector must always be protected by installing the cover 04 on its housing.

Characteristics and sizing of the line cable



The cross-section of the AC line conductor must be sized in order to prevent unwanted disconnections of the inverter from the grid due to high impedance of the line that connects the inverter to the power supply point; In fact, if the impedance is too high, it causes an increase in the AC voltage that, on reaching the limit set by the country of installation, causes the inverter to switch off.

The table shows the maximum length of the line conductor based on the cross-section of this conductor:

Cross-section of the line conductor (mm^2)	Maximum length of the line conductor (m)	
	TRIO-20.0-TL-OUTD	TRIO-27.6-TL-OUTD
10	42m	30m
16	70m	50m
25	100m	78m
35	138m	98m

The values are calculated considering an energy loss along the line (in rated power conditions) not exceeding 1%.

Load protection switch (AC disconnect switch)

To protect the AC connection line of the inverter, we recommend installing a device for protection against over current and leakage with the following characteristics:

	TRIO-20.0-TL-OUTD	TRIO-27.6-TL-OUTD
Type	Automatic circuit breaker with differential thermal magnetic protection	
Voltage/Current rating	40A/400V	63A/400V
Magnetic protection characteristic	B/C	B/C
Type of differential protection	A/AC	A/AC
Differential sensitivity	300mA	300mA
Number of poles	3/4	3/4

Choice of differential protection downstream of the inverter

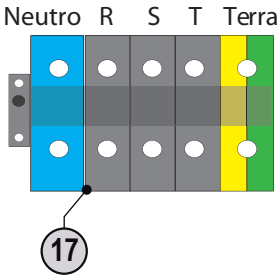
In accordance with article 712.413.1.1.1.2 of Section 712 of IEC Standard 64-8/7, we hereby declare that, because of their construction, Power One Aurora inverters do not inject ground fault direct currents.

The use of an AC type circuit breaker with differential thermal magnetic protection with tripping current of 300 mA is advisable so as to prevent false tripping, due to the normal capacitive leakage current of photovoltaic modules.

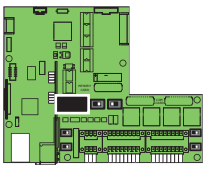
All ***Power-One*** Aurora string inverters marketed in Europe are equipped with a device for protection against ground faults in accordance with the safety standard set in Germany by Standard VDE V 0126-1-1:2006-02 (please refer to section 4.7 of the Standard).
In particular, ***Power-One*** Aurora inverters are equipped with a redundancy on the reading of the ground leakage current sensitive to all components of both direct and alternating current. Measurement of the ground leakage current is carried out at the same time and independently by 2 different processors: it is sufficient for one of the two to detect an anomaly to trip the protection, with consequent separation from the grid and stopping of the conversion process.
There is an absolute threshold of 300 mA of total leakage current AC+DC with protection tripping time at a max. of 300 msec.
In addition, there are another three tripping levels with thresholds respectively at 30 mA/sec, 60 mA/sec and 150 mA/sec to cover the “rapid” changes in fault current induced by accidental contact with leaking live parts. The max. tripping times are progressively shortened as the speed of change in the fault current increases and, starting from the 300 msec/max for the 30 mA/sec change, they are shortened respectively to 150 msec and 40 msec for 60 mA and 150 mA changes.
It should in any case be noted that the integrated device only protects the system against ground faults that occur upstream of the AC terminals of the inverter (namely towards the DC side of the photovoltaic system and consequently towards the photovoltaic modules). The leakage currents that can occur in the AC section between the draw/feed in point and the inverter are not detected and require an external protection device.
For protection of the AC line, on the basis of the aforesaid with regard to the differential protection integrated in ***Power-One*** Aurora inverters, **it is not necessary to install a type B ground fault interrupter**.

Connection to the AC side terminal board

To prevent electrocution hazards, all the connection operations must be carried out with the disconnect switch downstream of the inverter (grid side) open and locked.

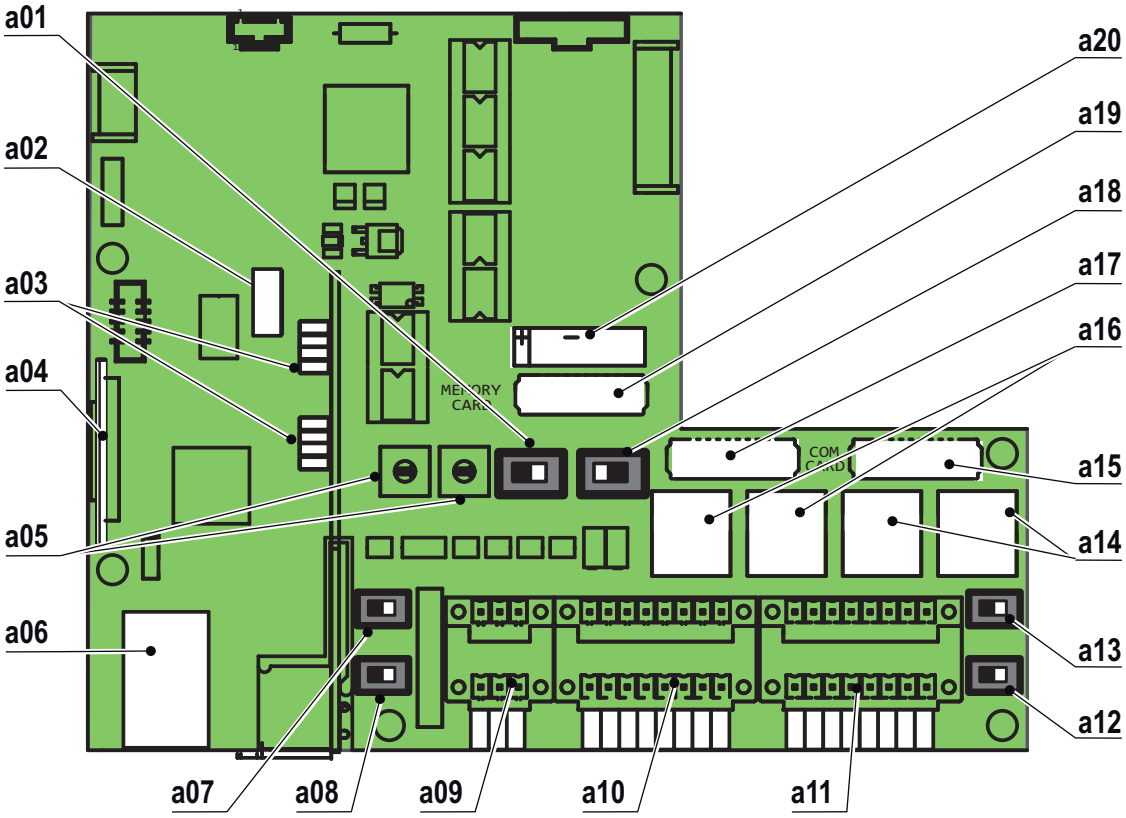


For all models, connection with the AC output terminal board **17** is made by inserting the cables in the AC cable glands **16**.
The maximum accepted cable cross-section ranges from 20 to 32 mm, whereas each individual terminal of the terminal board accepts a cable with cross-section of up to 35 mm^2.
Unscrew the cable gland, remove the cover, insert the cable of suitable cross-section and connect the conductors (Neutral, R, S, T and Ground) to the terminals on the AC output terminal board **14**.
The connection of the inverter to the grid can be with three wires (delta configuration) or with four wires (star configuration).
Be careful not to change round one of the phases with neutral!
Once the connection to the terminal board is complete, screw in the cable gland firmly and check the tightness.



Before connecting the inverter to the national grid, the standard of the country must be set. To do this, turn the two rotary switches a05 following the table shown in the relevant chapter.

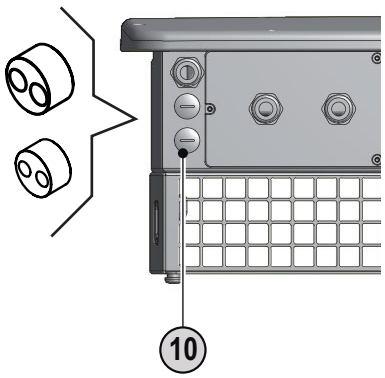
Communication card



Communication card 09

Ref.	Description
a01	Switch for setting parallel-connected or independent input channels
a02	Connector for the installation of WIFI modules (**NOT ACTIVE**)
a03	Connectors for radiomodule card installation
a04	Housing for memory card SD CARD
a05	Rotary switches for setting the standard of the country and the language of the display
a06	Ethernet port (**NOT ACTIVE**)
a07	Switch for setting analogue sensor 1 to Volts or mA
a08	Switch for setting analogue sensor 2 to Volts or mA
a09	Connection to the multi-function relay
a10	Connection of environmental sensors: AN1, AN2, PT100, PT1000 and tachometer (wind version only)
a11	Connection of the RS485 (PC) line, RS485 (PMU) line, of the auxiliary 5V and of the remote ON/OFF
a12	Switch for setting the termination resistance of the RS485 (PMU) line
a13	Switch for setting the termination resistance of the RS485 (PC) line
a14	Connection of the RS485 (PC) line on RJ45 connector
a15	RS485 (PC) communication card housing
a16	Connection of the RS485 (PMU) line on RJ45 connector
a17	RS485 (PMU) communication card housing
a18	Switch for setting the inverter in normal or service mode
a19	Inverter data memory card housing
a20	Battery housing

Connections to the communication card



Each cable that must be connected to the communication card **09** must go through the three service cable glands **10**.

• One of size M25 that accepts a cable with cross-section of between 10mm and 17mm. Two-hole gaskets are supplied for insertion in the cable gland, which allow two separate cables with cross-section of up to 6mm to go through.

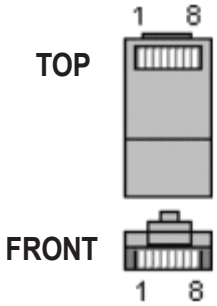
• Two of size M20 that accept a cable with cross-section of between 7mm and 13mm. Two-hole gaskets are supplied for insertion in the cable gland, which allow two separate cables with cross-section of up to 5mm to go through.

The sensor cables are connected to the communication card **09** by means of the terminal connectors supplied.
The cables for connecting the RS485 (PC) and RS485 (PMU) line can use both the terminal connectors a11 and a RJ45 connector, to be connected to the dedicated port a14 or a16.
The two RJ45 connectors (A) and (B) available for RS485 (PC) and RS485 (PMU) communication are equivalent to one another and can be used without distinction for the end or for the restart of the line in making the daisy chain connection of the inverters.
This also applies to connections made using the terminal connectors a11.

Serial communication (RS485)

There are two RS485 communication lines on the inverter:
PC - dedicated line for connecting the inverter to monitoring devices or for making the daisy-chain connection (“in-out”) of several inverters. The line can also even accept power management controls.
PMU (power management unit) - dedicated line for power management by the power distributor in the country where the inverter is installed.

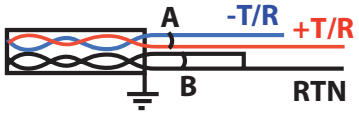
Two different types of connection can be made for each line:
• Connection of the conductors using terminal connectors a11 (+T/R, -T/R and GND)
• Connection via RJ45 connectors connected to ports a14 or a16 crimped according to the following arrangement:



Pin N°	Function
1	not used
2	not used
3	+T/R
4	not used
5	-T/R
6	not used
7	GND
8	not used

Use a connector with metal body to provide cable shield continuity!

For long distance connections, the connection on terminal connector is preferable using a shielded twisted pair cable with characteristic impedance of Z0=120 Ohm like the one shown in the following table:

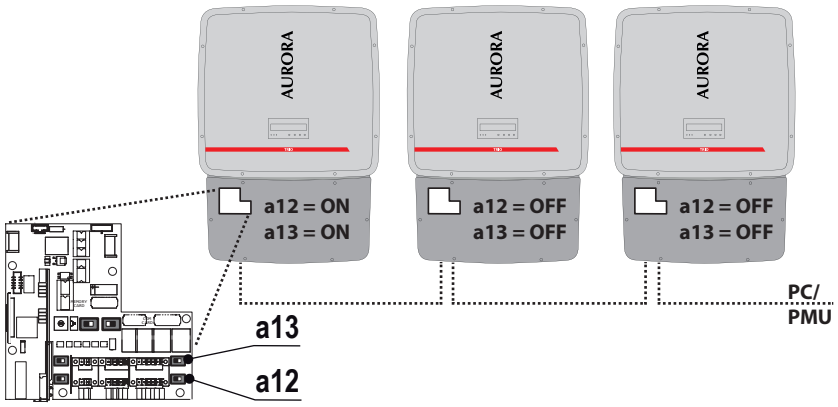


Signal	Symbol	Pair	Cable
Positive data	+T/R	A	1
Negative data	-T/R	A	2
Reference	RTN	B	1+2

Shield continuity must be provided along the communication line using the SH terminal and must be grounded at a single point.

Procedure for connection to a monitoring system

Connect all the units of the RS485 chain in accordance with the “daisy-chain” arrangement (“in-out”) observing the correspondence between signals, and activate the termination resistance of the communication line in the last element of the chain by switching switch a12 or a13 (to ON position) being careful to switch the switch of the serial line used (PC or PMU).

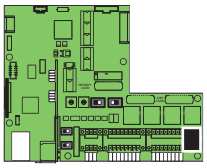


If a single inverter is connected to the monitoring system, activate the termination resistance of the communication line by switching switch a12 or a13 (to ON position).

Set a different RS485 address on each inverter of the chain. **No inverter should have "Auto" as its address**. An address can be chosen freely from out of 2 to 63.
The address on the inverter is set through the display and the push-button panel (see relevant chapter).

We recommend not exceeding a length of 1000m for the communication line.

No more than 62 inverters can be connected to the same RS485 line.



When using an RS-485 connection, if one or more inverters are added later to the system, you must remember to return to OFF position the switch of the termination resistance used (PC or PMU) of the inverter that was previously the last one of the system.

Each inverter is dispatched with two (2) as the predefined RS485 address and with switch for setting termination resistance a12 or a13 to OFF position.

Monitoring systems

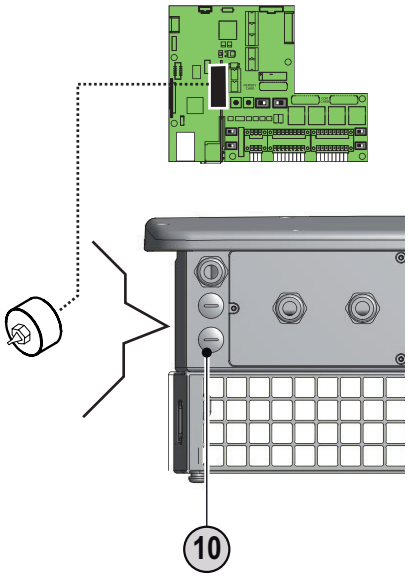
The RS485 line can be connected to various monitoring devices that can be in **local** or **remote** mode.

For local monitoring, ***Power-One*** recommends connecting its PVI-USB-RS485_232 adaptor between the first unit of the daisy-chain and the computer.

Equivalent devices found on the market can also be used for the same purpose, but, bearing in mind that they have never been specifically tested, Power-One cannot guarantee correct operation of the connection.

Please note that these devices may also require an external termination impedance, whereas this is **not necessary** with the Aurora PVI-USB-RS485_232.

Radiomodule

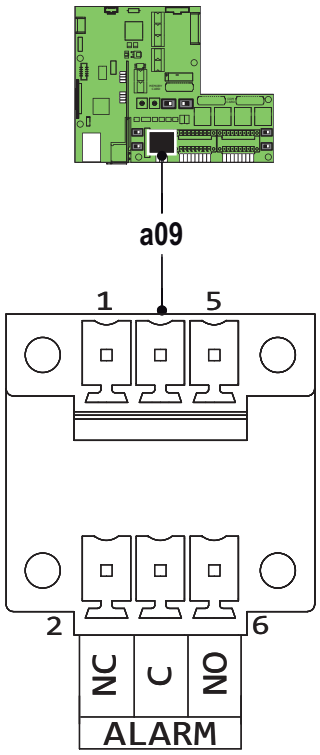


The radiomodule card is an accessory used to replace the RS485 line for data transmission to the monitoring device.

The radiomodule card is installed vertically on the communication card **09** by connecting the two a03 connectors. In turn, wiring ending with an antenna installed outside the wiring box is connected to the radiomodule:

The part of the wiring box where the antenna will be installed will be in place of one of the service cable glands **10** of size M20.

Configurable relay



NC = Normally closed
C = Common contact
NO = Normally open

The inverter has a multi-function relay a09, whose switching can be configured. It can be connected with normally open contact (being connected between the NO terminal and the common contact C) and with normally closed contact (being connected between the NC terminal and the common contact C).
This contact can be used in four different operating configurations that can be set in the dedicated menu.

Operating modes

• **Production**: the relay switches whenever a connection to (and therefore a disconnection from) the grid occurs.
So if the NO (or NC) contact is chosen, the contact will stay open (or closed) until the inverter is connected to the grid; once the inverter connects to the grid and starts to export power, the relay switches state and therefore closes (or opens).
When the inverter disconnects from the grid, the relay contact returns to its position of rest, namely open (or closed).

• **Alarm**: the relay switches whenever there is an alarm on the inverter (Error). No switching occurs when there is a Warning.
So if the NO (or NC) contact is chosen, the contact will stay open (or closed) until the inverter reports an error; once the inverter reports an error, the relay switches state and therefore closes (or opens).
The contact remains switched from its rest condition until normal operation is restored.

• **Alarm** (configurable): the relay switches whenever there is an alarm (Error) or a Warning, which have been previously selected by the user through the dedicated menu.
If the NO (or NC) contact is chosen, the contact will stay open (or closed) until the inverter reports an error or a warning out of those selected from the menu; once the inverter displays an error or a warning out of those selected, the relay switches state and therefore closes (or opens) the contact. The relay remains switched from its rest condition until the alarm or warning has disappeared.

• **Crepuscular**: the relay usually switches when the voltage from the photovoltaic generator exceeds/falls below the threshold set for grid connection.
If the NO (or NC) contact is chosen, the contact will stay open (or closed) until the inverter has an input voltage higher than the one selected for grid connection. The contact remains switched from its rest condition for as long as the inverter is switched on (even if not connected to the grid). This mode is useful for disconnecting large output transformers that could have unnecessary consumption during the night.

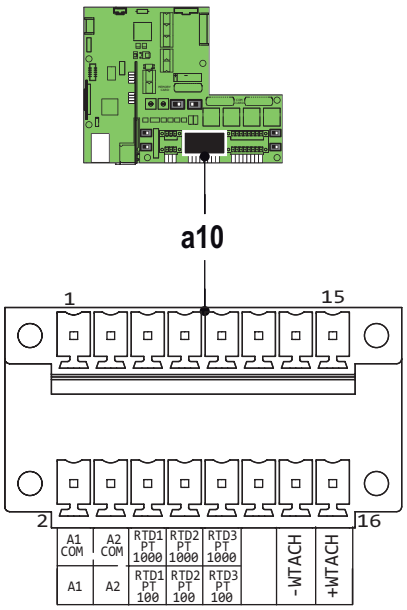
The device to be connected to the relay can be of different types (light, sound, etc) but must comply with the following requirements:

Alternating current
Maximum Voltage: 240 Vac Maximum Current: 1 A

Direct current
Maximum Voltage: 30 Vdc Maximum Current: 0.8 A

Cable requirements
External diameter: from 5 to 17 mm
Conductor cross-section: from 0.14 to 1.5 mm^2

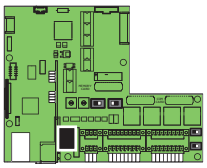
Environmental sensors



External sensors for monitoring environmental conditions can be connected to the connectors of the environmental sensors a10:

AN1 - Analogue sensor 1 connection
AN2 - Analogue sensor 2 connection
PT100 - Connection of a PT100 temperature sensor
PT1000 - Connection of a PT1000 temperature sensor

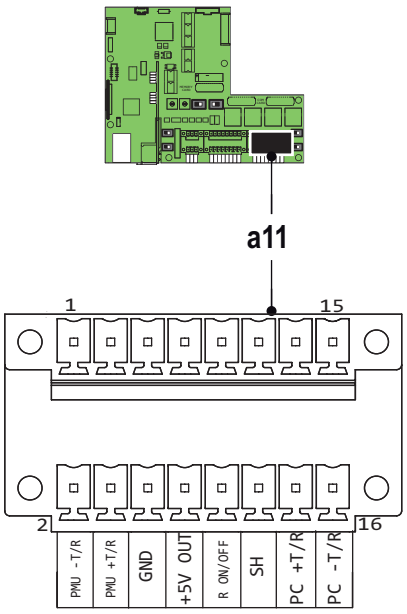
Setting of the connected analogue sensors must be carried out by setting the following values in the relevant menu:
- GAIN
- OFFSET
- Unit of measure



For each analogue sensor, AN1 and AN2, it is also necessary to set the switch, a07 or a08, to select whether the reading is in Volts or mA.

Each sensor model has precise configuration values that must be set meticulously.

Remote control



The connection and disconnection of the inverter to and from the grid can be controlled through an external control.
The function must be enabled in the relevant menu. If the remote control function is disabled, the switching on of the inverter is dictated by the presence of the normal parameters that allow the inverter to connect to the grid.
If the remote control function is operating, besides being dictated by the presence of the normal parameters that allow the inverter to connect to the grid, the switching on of the inverter also depends on the state of the R ON/OFF terminal compared to the GND terminal present on the connector a11 of the communication card **09**.
When the R ON/OFF signal is brought to the same potential as the GND signal (i.e. by making a short circuit between the two terminals of the connector), this causes the inverter to disconnect from the grid.
The remote control OFF condition is shown on the display.
The connections of this control are made between the “R ON/OFF” input and “GND”. Since this is a digital input, there are no requirements to be observed as regards cable cross-section (it only needs to comply with the sizing requirement for passing cables through the cable glands and the terminal connector).

Auxiliary 5 V output

There is an auxiliary 5 V output on connector a11. The maximum allowed absorption by this auxiliary supply voltage is 100mA.

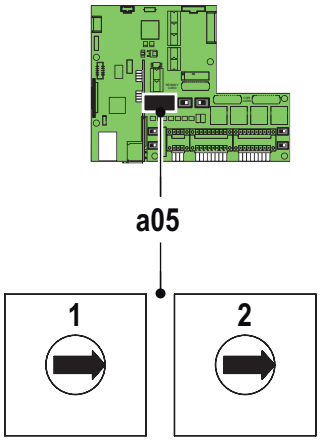
SD card

The inverter is equipped with a slot for insertion of an SD Card memory. The maximum size of the SD Card is 4 GB. The SD Card is not supplied with the inverter; the functionalities of the SD Card will be implemented with subsequent versions of the Firmware of the communication card.

Setting the country and the language

There are different grid parameters (dictated by the electricity distributor) according to the country in which the inverter is installed.

Setting the grid standard for the country of installation is a necessary operation before commissioning, and the installer must know the correct standard to be configured.



The inverter is configured using the rotary switches a05.
Before turning the rotary switches, make sure the inverter is switched off!
At the same time as the grid standard is set, **the language of the display menus** is also set.

Table: country standard and language

The table below shows which country grid standard and menu language are assigned to the various positions of the rotary switches a05

Switch 1	Switch 2	Country Grid Standard	Display menu language
0	0	NON-ASSIGNED	ENGLISH
0	1	VDE 0126 @ 400V	GERMAN
0	5	ENEL @ 400V	ITALIAN
F	F	Reserved	

The predefined setting is **0 / 0** and means no grid standard is selected and the display language is English (in this case, the “Set Country” message will appear on the display).

If a position of switches not assigned on the display **23** is selected, “Invalid Selection” appears.

Saving the country standard and language

The settings become fixed after 24 hours of operation of the inverter (it does not need to be connected to the grid, and only needs to be powered).
The time remaining before the settings become fixed can be seen in the dedicated menu, and a notice appears if the time has expired.

Once the settings are fixed, turning the rotary switches will produce no effect. In this condition, only the language can be changed through the dedicated menu.

At any time and for any reason, the ENGLISH language of the display menu can be set by simultaneously pressing the “ESC” and “ENTER” buttons for at least 3 seconds.

6 - Instruments

General conditions

One of the first rules for preventing damage to the equipment and to the operator is to have a thorough knowledge of the INSTRUMENTS. We therefore advise you to read this manual carefully. If you are not sure about anything or there is discordance of information, please ask for more detailed information.

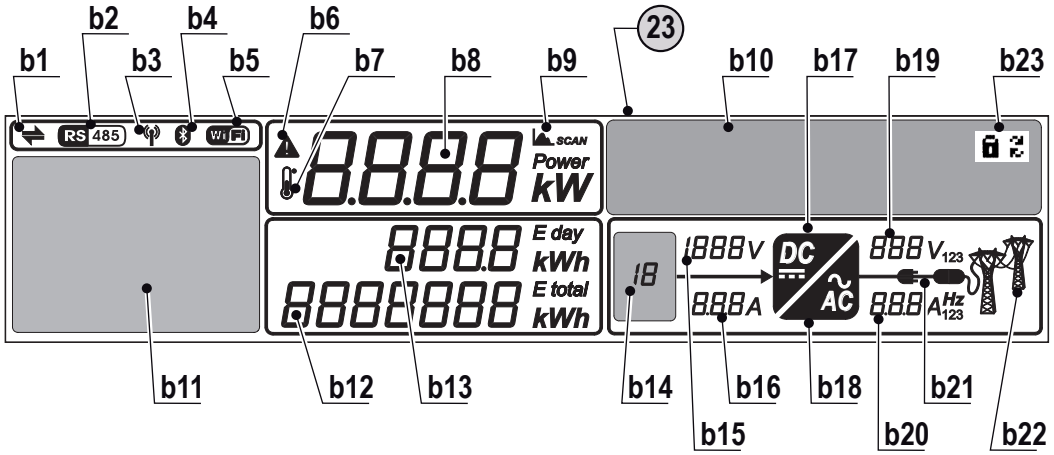
Do not use the equipment if:
- you do not have suitable qualifications to work on this equipment or similar products;
- you are unable to understand how it works;
- you are not sure what will happen when the buttons or switches are operated;
- you notice any operating anomalies;
- there are doubts or contradictions between your experience, the manual and/or other operators.

Power-One cannot be held responsible for damage to the equipment or the operator if caused by incompetence, insufficient qualifications or lack of training.

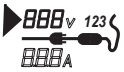
Display and keypad

Description of symbols and display fields

The operating parameters of the equipment are displayed through the display **23**: warnings, alarms, channels, voltages, etc.
During operation, the display behaves dynamically, which allows some information to be displayed cyclically (see relevant chapter).



N°	Symbol	Function	Description
b1		Tx-R	Indicates the transmission and reception of data through the RS485 line.
b2	RS 485	RS485	Indicates the presence of the RS485 communication line.
b3		RF	Indicates the presence of the radio communication line. (NOT available)
b4		Bluetooth	Indicates the presence and enablement of the bluetooth communication line (NOT available).
b5	Wi Fi	WiFi	Indicates the presence and enablement of the WiFi communication line. (NOT available)
b6		Warning	Indicates that the MPPT is detached (functionality to be defined clearly).
b7		Temperature derating	Indicates that the inverter is in derating due to high internal temperature.
b8		Instantaneous power value	Displays the instantaneous power that the inverter is feeding into the grid.
b9		MPP scan	Indicates that the MPP scan function has been enabled through the menu.
b10		Graphic Display	Displays the inverter parameters in rotation and displays the error codes (if present). It is used for moving through the menu.
b11		Power graph	Displays the power trend of the inverter (from 0 to 100%) over 8/16/24 hours; this parameter can be set.

N°	Symbol	Function	Description
b12		Total Energy Value	Displays the total energy produced since installation of the inverter.
b13		Daily energy value	Displays the energy produced over a day.
b14		Photovoltaic generator	Indicates that the PV generator voltage is higher than the Vstart of the inverter. The indicated number represents the string or channel of which the voltage and current are displayed (in the case of channels in parallel, 1 is always displayed).
b15		DC voltage value	Displays the direct voltage from the input channel of the photovoltaic generator.
b16		DC current value	Displays the direct current from the input channel of the photovoltaic generator.
b17		DC/DC circuit part	Indicates the DC/DC input circuit part (Booster)
b18		DC/AC circuit part	Indicates the circuit part for conversion from DC to AC.
b19		AC voltage value	Displays the reading of the grid voltage (alternating voltage). The number at the side indicates the phase of which the AC voltage value is displayed.
b20		AC current value	Displays the reading of the current or frequency that is fed into the grid (alternating voltage). The number at the side indicates the phase 1, 2 or 3 of which the AC current value is displayed.
b21		Connection to the grid	These are displayed in sequence during connection to the grid. Warning lights 22 and 23 stay on if connected to the grid or warning lights 19 and 22 stay on if not connected.
b22		Grid status	If on, it indicates that the grid check was successful and that the grid falls within all the parameters set by the electricity distributor.
b23		Cyclic display activated/ deactivated	At the top right of the graphic display b10, a padlock or two arrows will be displayed depending on whether the display of data on the display b10 is locked (padlock) or cyclic (arrows).

Description of the keypad

Through the combination of LED panel buttons **25**, under the display **23,** values can be set or data can be displayed by scrolling them.
Some LEDs are also shown on the keypad for status conditions.

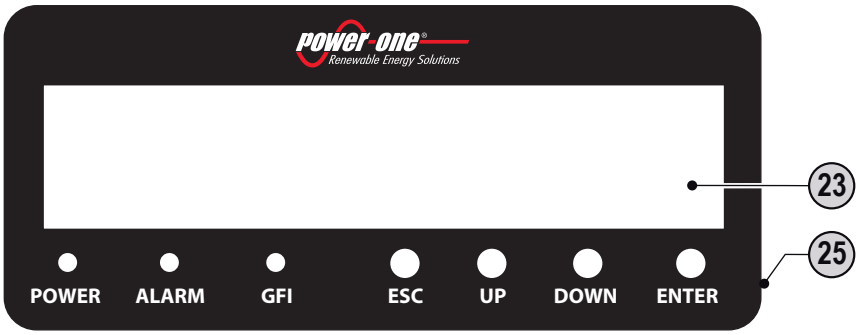


Table: Function of buttons and LEDs

Green POWER LED	Indicates that the inverter is working correctly. This LED flashes while the grid is being checked when the unit is commissioned. If a valid grid voltage is measured, the LED stays on continuously, provided there is sufficient sunlight to activate the unit. If not, the LED continues to flash until there is sufficient sunlight for activation. During this phase, the LCD display shows the “Waiting for sun….” message.
Yellow ALARM LED	Indicates that the inverter has detected an anomaly. The type of problem is shown on the display.
Red GFI LED	The “GFI” (ground fault) LED indicates that the inverter has detected a ground fault on the DC side of the photovoltaic generator. When this fault is detected, the inverter immediately disconnects from the grid and the relevant error warning appears on the LCD display.
ESC button	This button allows you to exit a mode.
UP button	This allows you to read the data on the display by scrolling upwards, or to increase the set value to correct it during data entry.
DOWN button	This allows you to read the data on the display by scrolling downwards, or to decrease the set value to correct it during data entry.
ENTER button	This allows you to confirm the operation or to enter the set data item.

In their various possible multiple combinations, the LEDs can indicate conditions that are different from the original single one; see the various descriptions given in the manual.

In their various possible multiple combinations, the buttons allow you to obtain actions that are different from the original single one; see the various descriptions given in the manual.

7 - Operation

General conditions

Before checking the operation of the equipment, it is necessary to have a thorough knowledge of the INSTRUMENTS chapter and the functions that have been enabled in the installation.
The equipment operates automatically without the aid of an operator; operating state is controlled through the instruments.

The interpretation or variation of some data is reserved exclusively for specialized and qualified staff.

The direct voltage entering the inverter must not exceed the maximum values shown in the technical data in order to avoid damaging the equipment.
Consult the technical data for further details.

Even during operation, check that the environmental and logistic conditions are correct (see installation chapter).
Make sure that the said conditions have not changed over time and that the equipment is not exposed to adverse weather conditions and has not been isolated with foreign bodies.

Monitoring and data transmission

As a rule, the inverter operates automatically and does not require special checks. When there is not enough solar radiation to supply power for export to the grid, (e.g. during the night) it disconnects automatically and goes into stand-by mode.
The operating cycle is automatically restored when there is sufficient solar radiation. At this point, the luminous LEDs on the LED panel **25** will indicate this state.

User interface mode

The inverter is able to provide information about its operation through the following instruments:
• Warning lights (luminous LEDs)
• LCD display for displaying operating data
• Data transmission on dedicated RS-485 serial line. The data can be collected by a PC or a data logger equipped with an RS-485 port. If the RS-485 line is used, it may be advisable to use the RS-485/RS232 serial interface converter model number PVI-USB-RS485_232. It is also possible to use an optional data logger PVI-AEC-EVO.

Types of data available

The inverter provides two types of data, which are usable through the relevant interface software and/or through the display **23**.

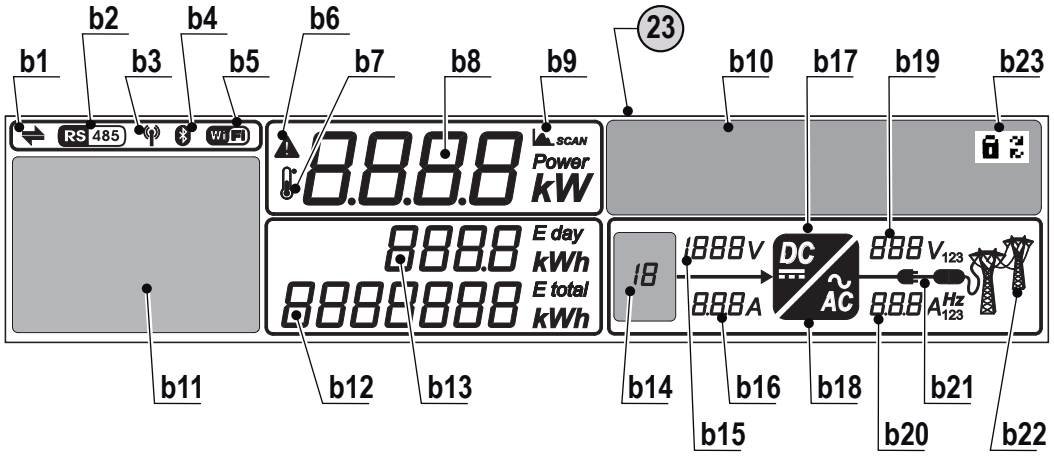
Real-time operating data
Real-time operating data can be transmitted on request through the communication lines and are not recorded in the inverter. For data transmission to a PC, the free Communicator software supplied with the inverter can be used (please check at www.power-one.com for more updated versions).

Internally stored data
The inverter internally stores a set of data that are necessary for processing statistical data and an error log with time marking.

Commissioning

Do not place objects of any kind on the inverter during operation!

Do not touch the heatsink while the inverter is operating!
Some parts may be very hot and cause burns.



NOTE: Before proceeding with commissioning, make sure you have carried out all the checks and verifications indicated in the section on preliminary checks.

The inverter commissioning procedure is as follows:

• Put the AC+DC disconnect switch **14** in ON position. If there are two separate external disconnect switches (one for DC and the other for AC), first close the AC disconnect switch and then the DC disconnect switch. There is no order of priority for opening the disconnect switches.

• Once the inverter is powered, first of all, icon b14 comes on to indicate that the voltage from the photovoltaic generator has exceeded the Vstart threshold (voltage necessary for connecting the inverter to the grid).
For input voltages lower than Vstart, the icon remains off, the "Waiting for sun" message is shown on the display and the voltage and current values are present (icons b15 and b16).

• Then, if there are no irregularities due to the checking of the grid voltage and frequency parameters, the grid connection sequence starts. Once all the checks are finished, if all the grid parameters are complied with, icon b22 comes on.
This check can take several minutes (from at least 30 seconds to no more than a few minutes), depending on grid conditions and grid standard settings.

• At this point, icon b17 flashes to indicate the start-up phase of the DC-DC circuit part (booster). This icon will stay on steady once the booster is operating at steady state (this icon will normally flash for only a few seconds).
Almost at the same time as icon b17 comes on (steady), icon b18 will come on to indicate that the inverter circuit part has begun working (DC-AC).

• Immediately after this, the procedure of connection to the grid will start, during which icon b21 will come on and the icons on the line will be displayed in sequence until the inverter is connected. After the inverter is connected, the icons on the whole line b21 will come on steady.
If the inverter disconnects from the grid, the icons of the left side (cable and plug) of the line b21 will stay on.

• Once the connection sequence has been completed, the inverter starts to operate and indicates its correct operation by making a sound and by the green LED coming on steady on the LED panel **25**. This means there is sufficient solar radiation to feed power into the grid.

• If the checking of the grid does not give a positive result, the unit will repeat the procedure until all the parameters that allow connection to the grid (grid voltage and frequency, insulation resistance) are within the range. During this procedure, the green LED flashes.

Dynamic behaviour of the display

• If the MPPT scan function is enabled, icon b9 will be shown on the display. See configuration in the MPPT settings menu section. This icon will flash during scanning.

• During operation, the following values are displayed in rotation:
- Voltage and current (b15 and b16) from the PV generator. According to the configuration or model of the inverter, the voltages and currents of one or both channels (or of the single strings) will be displayed. The input channel considered is indicated by the value entered on icon b14.
- Voltage and current (b19 and b20) on the various phases. According to the model of inverter, the voltages and currents of one (1) or three phases (1,2,3) will be displayed. The phase considered is shown on the right side of the voltage and current values.
At the end of the aforesaid display, the grid frequency will be indicated in field b20 and the line voltage will be indicated in field b19.
At the same time, the main readings made by the inverter will be displayed in rotation on the graphic display b10.

• If the icons b21 on the left side (cable and plug) stay on with the assembled plug off, it means the inverter is disconnected from the grid; if the icons of the assembled plug and the pylons are on, it means the grid “is good” for connection.

LED behaviour

● = LED on
⊗ = LED flashing
⊠ = LED off
(x) = Any one of the conditions described above

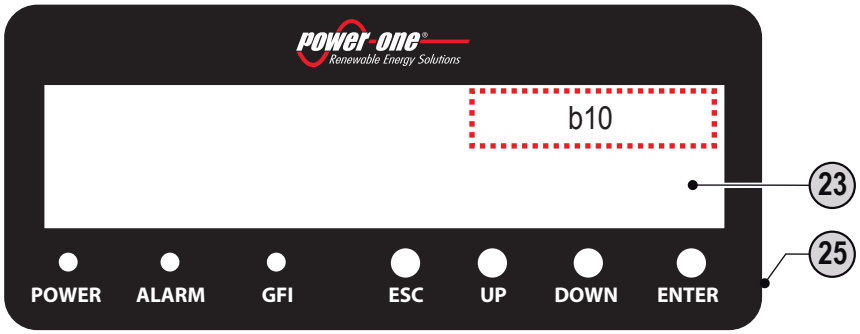
The following table shows all the possible combinations of activation of the LEDs, situated on the LED panel **25** in relation to the operating state of the inverter.

Table: LED behaviour

Status of the LEDs	Operating state	Notes
green: ⊗ yellow: ⊗ red: ⊗	Night mode (auto switch-off of the inverter)	The inverter is in night time switch-off mode (input voltage 70% less than the start-up voltage set for both inputs).
green: ⊠ yellow: ⊗ red: ⊗	Inverter initialization (loading of settings and wait for grid check)	This is a transition state due to the checking of the operating conditions. During this phase, the input power is sufficient and the inverter checks the conditions necessary for connection to the grid (for example: value of the input voltage, value of the insulation resistance, etc.).
green: ● yellow: ⊗ red: ⊗	The inverter is connected and feeds power into the grid	The machine is operating normally. During this phase, the inverter automatically carries out a research and analysis of the maximum power point (MPP) available from the photovoltaic generator.
green: (x) yellow: (x) red: ●	Anomaly in the insulation system of the photovoltaic generator	The inverter indicates that too low an insulation resistance (R iso) has been detected (presence of a leakage to ground of the PV generator) and feeds the power extracted from the photovoltaic generator into the grid. The problem may be connected with an insulation fault in the PV modules or in the connections (DC side).
green: ⊗ yellow: ● red: ⊗	We have: Anomaly (warning: W warning codes) Error (error: E warning codes)	Whenever the control system of the inverter detects an anomaly (W) or fault (E) in the operation of the monitored system, the yellow LED comes on steady and a message indicating the type of problem found appears on the display **23**. The error can be inside or outside the inverter (see Alarm messages).
green: ⊗ yellow: ⊠ red: ⊗	Internal ventilation anomaly	Indicates an operating anomaly in the internal ventilation. This does not cause much of a problem to the inverter because the fan starts only at high temperatures combined with high output powers.
green: ⊠ yellow: ● red: ⊗	Disconnection from the grid	Indicates that the grid voltage for allowing the inverter to connect to the grid is not present. The inverter shows the No Vac message on the display.
green: ⊗ yellow: ⊠ red: ⊗	Failure to link the wiring box or the display card to the control card of the inverter.	Indicates that the installed wiring box (only if replacing the inverter) was already associated with another inverter and that it cannot be associated with the new inverter.

Specifications on the behaviour of the LEDs

Next to each state of the inverter, indicated through the steady or intermittent lighting of the relevant LED, a message that identifies the operation it is carrying out or the detected fault/anomaly is also shown on the display **23**, section b10, (see relevant chapter).



In the event of malfunctioning, it is extremely dangerous to try to eliminate the fault personally. The instructions given below must be strictly followed; if you do not have the experience and necessary qualification to work safely, please contact a specialized technician.

Insulation fault LED

What to do after an insulation fault warning
When the red LED comes on, first try to reset the warning through the multi-function button ESC on the LED panel **25**.
If the inverter duly reconnects to the grid, the fault was due to temporary phenomena.

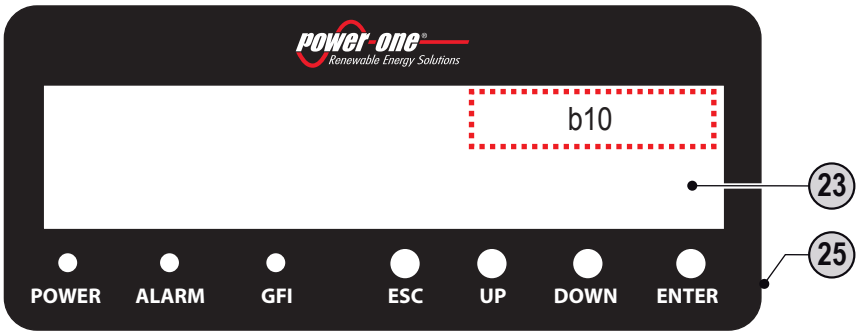
We advise having the system inspected by the installer or a specialized technician if this malfunctioning occurs frequently.

If the inverter does not reconnect to the grid, make it safe by isolating it (by means of the disconnect switches) on the both the DC side and the AC side, and then contact the installer or an authorized service centre to have the photovoltaic generator fault repaired.

Description of the menus

The display **23** has a section b10 (graphic display) for moving through the menu using the buttons of the LED panel **25**.
Section b10 consists of 2 lines with 16 characters per line and can be used to:

- display the operating state of the inverter and the statistical data;
- display the service messages for the operator;
- display the alarm and fault messages for the operator;
- changing the settings of the inverter.



Using the display buttons

- The UP and DOWN buttons of the LED panel **25** are used to move around a menu or to increase/decrease the settable values.

- The ESC button allows access to the three main sub-menus, STATISTICS, SETTINGS and INFORMATION.
This allows you to return to the previous sub-menu while moving through the menus.

- The ENTER button allows access to the required sub-menu while moving though the menus and allows the main menu scroll mode to be changed (icons b23 are activated):
CYCLIC: Cyclic display of the main parameters of the inverter.
LOCKED: Display locked on the screen you want to monitor continuously.

Statistics menu

Selecting STATISTICS from the three main sub-menus gives access to:

• **Total**
This section of the menu allows you to display the Total statistics:
Time: Total operating time
E-tot: Total energy produced
Val. : Total production value, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu
CO_2: Amount of CO_2 saved compared to fossil fuels

• **Partial**
This section of the menu allows you to display the partial statistics:
Time: Partial operating time
E-par: Partial energy produced
PPeak: Peak power value
Val. : Partial production value, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu
CO_2: Partial amount of CO_2 saved

* To reset all the counters of this sub-menu, press the ENTER button for more than 3 seconds. At the end of this time, you will hear a sound repeated 3 times.

• **Today**
This section of the menu allows you to display the daily statistics:
E-day: Daily energy produced
Ppeak: daily peak power value
Val. : Daily production value, calculated with the currency and conversion coefficient
set in the relevant section of the SETTINGS menu
CO_2: Amount of CO_2 saved daily

• **Last 7 days**
This section of the menu allows you to display the statistics for the last 7 days:
E-7d: Energy produced over the last 7 days
Val. : Value of production for the last 7 days, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu
CO_2: Amount of CO_2 saved over the last 7 days

• Last month

This section of the menu allows you to display the statistics for the last month:

E-mon: Energy produced during the current month

Val. : Value of production for the last month, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu

CO_2: Amount of CO_2 saved during the current month

• Last 30 days

This section of the menu allows you to display the statistics for the last 30 days:

E-30d: Energy produced over the last 30 days

Val. : Value of production for the last 30 days, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu

CO_2: Amount of CO_2 saved over the last 30 days

• Last 365 days

This section of the menu allows you to display the statistics for the last 365 days:

E-365: Energy produced over the last 365 days

Val. : Value of production for the last 365 days, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu

CO_2: Amount of CO_2 saved over the last 365 days

• User period

This section of the menu allows the statistics for a period selected by the user to be displayed:

Once the start and end dates for the period have been set, the following data are available:

E: Energy produced during the selected period

Val. : Value of production for the selected period, calculated with the currency and conversion coefficient set in the relevant section of the SETTINGS menu

CO_2: Amount of CO_2 saved during the selected period

Settings menu

When SETTINGS is selected from the three main sub-menus, the first screen for the password is displayed in the display.
The default password is "0000".
This can be changed using the display buttons, always following the same procedure:
• Use ENTER to scroll the digits (from left to right)
• Use ESC to return to the previous digit (from right to left)
• Press ESC several times to return to the previous menus
• Use DOWN to progressively scroll the numerical scale downwards (from 9 to 0)
• Use UP to progressively scroll the numerical scale upwards (from 0 to 9)
After entering the password, press ENTER to access the information gathered in this section:

• Address
This section of the menu allows you to set the address for the serial communication of single inverters connected to the RS485 line.
The addresses that can be assigned are 2 to 63. Use the UP and DOWN buttons to scroll the numerical scale.
At present, the 'AUTO' selection cannot be used

• Setting of Display
This section of the menu allows you to set the characteristics of the display:
1. Light: setting of the mode and adjustment of the brightness of the display
Mode:
On: Light always on
Off: Light always off
AUTO: Automatic light control. The light comes on whenever a button is pressed and stays on for 30 sec, after which it gradually goes out.
Intensity: adjustment of display brightness (scale from 1 to 9)
2. Contrast: adjustment of display contrast (scale from 1 to 9)
3. Buzzer: button sound setting
On: the sound of the buttons is activated
Off: the sound of the buttons is deactivated

• Service
This section of the menu is reserved for installers. To access this, it is necessary to have a dedicated password that will be provided by the Power-One Service.

• New PW
This section of the menu allows you to change the password for accessing the settings menu (default 0000).

We ADVISE you to be very careful in memorizing the new password.
If the Password is misplaced, it will not be possible to access the inverter, since there is no Reset function for security reasons.

• Currency
This section of the menu allows you to set the name of the currency and the value given to 1 kWh of energy produced. The correct setting of these parameters allows you to display the actual earning/saving given by the system. **Name:** the chosen value is set (default is Euro)
Val/KWh: indicates the cost/incentive of 1 KWh expressed in the chosen currency (default is 0.50).

• Date/Time
Allows you to set the current date and time (daylight saving time not included)

• Language
Allows you to set the required menu language

• Vstart
This section of the menu allows you to set the Vstart voltage (separately for both channels if they are configured in independent mode), to adapt it to the requirements of the system.

We advise changing the activation voltage only if really necessary and to set it to the correct value: the photovoltaic generator sizing instrument available on the Internet site of Power-One indicates whether it is necessary to change the Vstart and the value to set.

• Autotest
After the Autotest procedure, the following information is available:
- Nominal threshold (set in the inverter)
- Value of the quantity found during autotest
- Nominal operation time (set in the inverter)
- Operation time found

The values can be used to fill in the attached ENEL documents.
If the test is not passed, the machine stops until the test is passed.
The tests that can be carried out are the following:
Max Voltage: Disconnection from the grid due to “Overvoltage” that can be carried out on the three phases R, S and T.
Min Voltage: Disconnection from the grid due to “Undervoltage” that can be carried out on the three phases R, S and T.
Max Frequency: Disconnection from the grid due to “Over Frequency”
Min Frequency: Disconnection from the grid due to “Under Frequency”

• Alarm

This section of the menu allows you to set the switching of a relay contact (available as a normally open contact – N.O. – and also as a normally closed contact – N.C.). This contact can be used, for example, to: activate a siren or a visual alarm, control the disconnect device of an external transformer, or control an external device. Maximum ratings of the alarm contact: 240Vac/1A and 30Vdc/0.8A

The switching of the relay can be set in 4 different modes:

PRODUCTION: the relay switches when the inverter connects to the grid.

ALARM: the relay switches when there is an alarm (code E).

ALARM (conf.): the relay switches if there are alarms (code E) or warnings (code W) chosen by the user from a list (the list may also show choices that are not envisaged for the specific model).

CREPUSCULAR: the relay switches only when it exceeds the input voltage set for connection to the grid.

• Remote Control

This section of the menu allows you to enable/disable the connection/disconnection of the inverter to/from the grid through the relevant control signal (R ON/OFF).

Disable: the connection/disconnection of the inverter to/from the grid is dictated by the input (voltage from the photovoltaic generator) and output (grid voltage) parameters of the inverter.

Enable: the connection/disconnection of the inverter to/from the grid is dictated by the state of the R ON/OFF signal compared to the GND signal as well as by the input (voltage from the photovoltaic generator) and output (grid voltage) parameters of the inverter.

• UV prot. T

This section of the menu allows you to set the time for which the inverter stays connected to the grid after the input voltage has dropped below the Under Voltage limit (set at 70% of Vstart). Power-One sets the time at 60 sec. The user can set it at from 1 to 3600 sec.

Example: with the UV Prot.time set at 60 seconds, if the Vin drops below 70% of Vstart at 9:00, the inverter stays connected to the grid (taking power from it) until 9:01.

• MPPT

This section of the menu allows you to set the parameters of the maximum power point search (MPPT) function. This function is useful when there are shadowed areas on the PV generator that can create several maximum power points in the work curve.

MPPT amplitude: the amplitude of the interference introduced in DC is chosen through the setting of this parameter to establish the optimal working point. There are 3 settings to choose from (LOW, MEDIUM, HIGH). The default setting is MEDIUM.

Multi-max scan: through the setting of this parameter, you can enable/

disable the scan, decide the frequency with which the scan is carried out and override it manually.
Enable/Disable: Enables/Disables the scan for identifying the maximum power point of the system.
Scan Interval: this allows you to set the interval of time between scans. It must be borne in mind that, the shorter the interval between scans, the greater will be the loss of production due to the fact that, during the scan, energy is transferred to the grid but not at the maximum power point. Each scan takes 2 seconds.
Manual Scan: Allows you to start (asynchronously to the periodicity set through the Scan Interval) the manual scanning of the photovoltaic generator for peak point tracking.

• Analogue Inputs
This section of the menu allows you to set the analogue sensors connected at the input (AN1 and AN2)
Setting of Gain: Allows you to set the gain of the sensor
Setting of Offset: Allows you to set the offset of the sensor
Setting of Unit of M.: Allows you to set the unit of measure of the sensor

SENSORS PT100 AND PT1000
(can be directly connected to the corresponding analogue input; the PT100/PT1000 inputs of the acquisition card do not require the configuration of gain and offset)
• PVI-AEC-T100-ADH: adhesive PT100 sensor for module temperature measurement
• PVI-AEC-T100-BOX: PT100 sensor for ambient temperature measurement in IP65 container.
• PVI-AEC-T1000-BOX: PT1000 sensor for ambient temperature measurement in IP65 container.

Table: sensors with voltage output (0...10V)

Model/Description	Gain	Offset	U.o.M.
PVI-AEC-IRR: irradiation sensor	120	0	W/sq m
PVI-AEC-IRR-T: irradiation sensor with integrated cell temperature sensor	Irradiation: 120 Cell temp.: 10.869	Irradiation: 0 Cell temp.: -20	Irradiation: W/sq m Cell temp.: °C
PVI-AEC-CONV-T100: PT100 sensor (ADH or BOX) connected to PT100/0…10Vdc converter	15	-50	°C
PVI-AEC-T1000-INTEGR: Ambient temperature sensor with integrated 0...10Vdc converter	10	-50	°C
PVI-AEC-WIND-COMPACT: Wind speed sensor	5	0	m/s

• Alarm Msg
This section of the menu allows you to enter a customized message that is displayed on the display immediately after the specific error message has been displayed.
Enable/Disable: Enables/Disables the display of customized messages
Writing of Msg: you can write your customized message that can be written on two lines of 16 characters each. To write the message, use the UP/DOWN arrows to choose the character you wish to enter and press ENTER to confirm.

Information menu

• Product ID
Allows you to display the product identification code.

• Serial No.
Allows you to display the serial number of the equipment.

• Firmware
Allows you to display the revision of the firmware installed in the equipment.

• Country selector
Allows you to display information regarding the grid standard set with the rotary selectors.
- Current value: Displays the set grid standard.
- New value: If the position of the rotary switches is changed (a new grid standard is therefore selected) during operation, the new standard selected will be displayed but will be made effective only after the equipment has been switched off and then on again and only if the time remaining for carrying out this operation has not expired (24h of operation).
- Set new: Allows you to confirm/set the new grid standard set in the "New value" section of the previous menu. When this function is used, there will be no correspondence between the standard selected on the display and the position of the rotary selectors.
- Time remaining: Displays the time remaining in which it is still possible to set a new grid standard. When the time expires, "Locked" will be displayed, which indicates it is not possible to change the grid standard again.

• Fuse control (only for -S2X versions)
• Strings: Displays the voltage and the state of the strings present at the input of the equipment. A string can be in one of the following states: OK, OFF (damaged) and ABS (absent)
• Currents: Displays the current and the state of the strings present at the input of the equipment. A string current can be in one of the following states: OK, UNB (unbalanced current) and ABS (absent)

AUTOTEST procedure

Complies with the guide for connections to the electricity grid of ENEL distribuzione

According to the "guide for connections to the electricity grid of ENEL distribuzione", the autotest can be started through the display menu or using an RS485/USB converter through the dedicated interface software.
The necessary conditions for being able to carry out the Autotest are as follows:

- To have set the ENEL grid standard.
- The inverter must be connected to the grid so as to be able to simulate the disconnection condition.
- Do not carry out any operations during execution of the test.
- Check that the device is permanently connected to the grid.

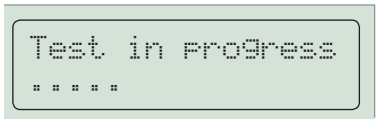
Execution of the autotest through the display menu

Go to SETTINGS > Autotest >

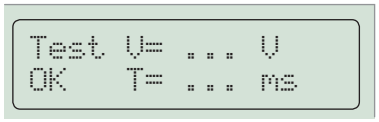
OV Test R
OV Test S
OV Test T
UV Test R
UV Test S
UV Test T
OF Test
UF Test

In the section of the menu dedicated to the Autotest, the type of test the device is to start can be selected from the following:
OV Test: Disconnection from the grid due to "Overvoltage"
UV Test: Disconnection from the grid due to "Undervoltage"
OF Test: Disconnection from the grid due to "Over Frequency"
UF Test: Disconnection from the grid due to "Under Frequency"
The OV and UV tests can be carried out on each single phase (R;S;T)

Description of the tests that can be carried out

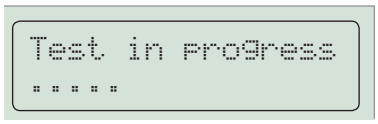


OV Test
During this test, the limit set for the maximum grid voltage (AC) is gradually reduced until the threshold is reached where disconnection of the inverter from the grid occurs. A message indicating the start of the test is shown on the display.



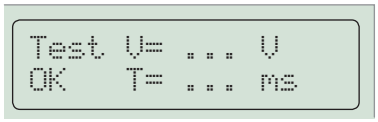
At the end of the test, when the inverter has disconnected from the grid, the test result will be shown on the display.

Press the ESC button to go to the Autotest menu again to select the next test to be carried out.



UV Test

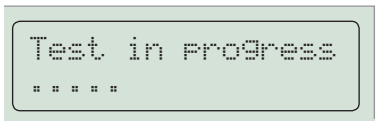
During this test, the limit set for the minimum grid voltage (AC) is gradually increased until the threshold is reached where disconnection of the inverter from the grid occurs. A message indicating the start of the test is shown on the display.



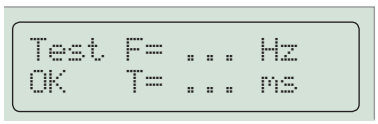
At the end of the test, when the inverter has disconnected from the grid, the test result will be shown on the display.

Press the ESC button to go to the Autotest menu again to select the next test to be carried out.

OF Test



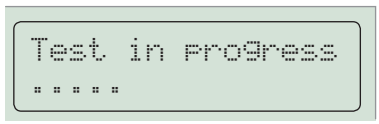
During this test, the limit set for the maximum grid frequency (Hz) is gradually reduced until the threshold is reached where disconnection of the inverter from the grid occurs. A message indicating the start of the test is shown on the display.



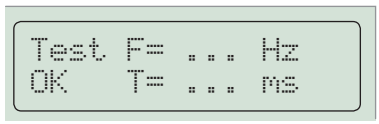
At the end of the test, when the inverter has disconnected from the grid, the test result will be shown on the display.

Press the ESC button to go to the Autotest menu again to select the next test to be carried out.

UF Test



During this test, the limit set for the minimum grid frequency (Hz) is gradually increased until the threshold is reached where disconnection of the inverter from the grid occurs. A message indicating the start of the test is shown on the display.



At the end of the test, when the inverter has disconnected from the grid, the test result will be shown on the display.

Press the ESC button to go to the Autotest menu again to select the next test to be carried out.

Once one of the tests (of the Autotest section) has been started, it takes place automatically. After the test has finished correctly, the inverter restores the factory-set switch-off values.

8 - Maintenance

General conditions

Checking and maintenance operations must be carried out by specialized staff assigned to carry out this work.

Maintenance operations must be carried out with the equipment disconnected from the grid, unless otherwise indicated.

For cleaning, DO NOT use rags made of filamentary material or corrosive products that may corrode parts of the equipment or generate electrostatic charges.
Avoid temporary repairs. All repairs should be carried out using only genuine spare parts.
The maintenance technician is under an obligation to promptly report any anomalies.

DO NOT allow the equipment to be used if problems of any kind are found, and restore the normal conditions correctly or in case make sure this is done.

Always use the personal protective equipment provided by the employer and comply with the safety conditions of the Accident prevention chapter.

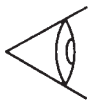
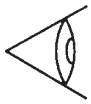
Power-One accepts no liability if the checking and maintenance cycles indicated in this manual and in the attached documentation are not complied with correctly, and also when maintenance is entrusted to unqualified staff.

To maintain the correct working performance, have the systems checked by your installer after **about 5 years** of activity.

Routine maintenance

Routine maintenance operations can be carried out directly by the user or by the installer.

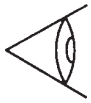
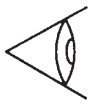
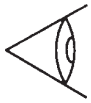
Table: routine maintenance

200 h		Clean the equipment **once a month**; in particular, the lower grille on the wiring box **02** through which the air for cooling the heatsink **26** passes and the heatsink. If possible, use compressed air, an extractor or suitable pipe cleaners.
1,000 h		Clean the photovoltaic panels **every six months**, at the change of season or as necessary. The performance of the system depends very much on the condition of the PV panels. To clean, follow the specifications of the PV panel supplier.
1,000 h		**Every six months** or in the event of malfunctioning, check that the environmental conditions have not changed drastically (exposure to weather conditions); also check that the inverter or PV panels have not been shaded or isolated by foreign bodies.
2,000 h		**Once a year** or in the event of malfunctioning, check the tightness of the cable glands **10** or **11**, the fixing of the connectors and the fixing of the front cover **08**. Seepages may cause problems of damp and consequent short circuits.

Special maintenance

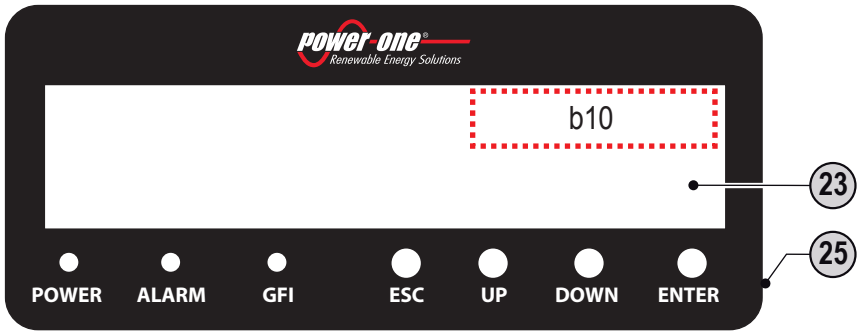
Special maintenance operations can be carried out only by the installer or qualified staff.

Table: special maintenance

1,000 h		**Every six months** or in the event of anomalies, especially after violent weather conditions, check the DC overvoltage surge arresters **15 (error W019)** and the AC overvoltage surge arresters **18 (error W018)**. Both surge arresters are class II. Also check the fuses **(error W017 only for S2X version)** and replace the damaged ones**.** Before starting the inverter again, the cause of the fault must be resolved.
1,000 h		**Every six months** or in the event of malfunctioning, check the tightness of all the connections, especially the quick fit connectors, the cable glands **10** and **11**, the terminal boards and the screws of the front cover **08**.
1,000 h		**Every six months** or in the event of malfunctioning, check the inverter cooling fans. Before connecting to the grid, the inverter carries out a test on the internal fans and, in the event of an anomaly, generates an alarm signal.
2,000 h		**Once a year** or in the event of malfunctioning, check the backup battery and replace it if necessary. The battery normally lasts 10 years, but many conditions can reduce its efficiency. The battery is in the V housing of the communication card **09.**

Alarm Messages

The equipment is able to indicate errors/warnings on the display only if the input voltage is higher than the Vdcmin voltage (POWER LED flashing or on; see operation chapter).
The messages and their codes are indicated on the highlighted part b10 of the display **23**.



Display Message	Display Codes	Alarm	Description
Ground Fault	Red LED	Ground Fault	Detection of a ground leakage current in the DC section of the system. Measure the insulation resistance. The alarm is indicated by the lighting up of the red LED on the front of the inverter.
Degauss error	---	Degaussing state fail	Degaussing error inside the inverter.
Input OC	E001	Input Overcurrent	Detection of inverter input current above the set overcurrent threshold.
Input OV	E002	Input Overvoltage	Detection of inverter input voltage (coming from the PV generator) above the operating threshold. The alarm is triggered before reaching the threshold beyond which the inverter will be damaged, and in this case the inverter does not start.
No Parameters	E003	Internal Parameters Error	The main microcontroller is unable to correctly initialize the two DSPs (booster stage and inverter stage). This is usually due to communication problems on the internal bus of the inverter.
Bulk OV	E004	Bulk Overvoltage	Error inside the inverter. The alarm is generated when the voltage at the ends of the bulk capacitors exceeds the Over Voltage threshold.
Comm.Error	E005	Internal Communication Error	Communication problems between the control devices inside the inverter.
Output OC	E006	Output Overcurrent	The inverter output current exceeds the output overcurrent threshold of the inverter.
IGBT Sat	E007	IGBT Saturation	One of the active devices of the inverter is in saturation state.
Internal error	E009	Internal Error	Error inside the inverter that cannot be checked externally.
Bulk Low	E010	Low Bulk Voltage	Causes outside the inverter: a low inverter input voltage (just above the activation voltage) that is not accompanied by sufficient availability of power from the photovoltaic generator (typical condition of periods of insufficient irradiation).
Ramp Fail	E011	Bulk ramp timeout	Error inside the inverter regarding the time for starting steady state operation of the DC-DC circuit part (Booster).
DcDc Fail	E012	Booster module error revealed by Inverter	Error inside the inverter regarding the operation of the DC-DC circuit part (Booster).

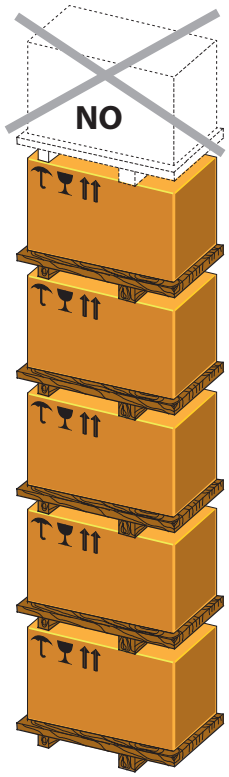
Wrong Mode	E013	Wrong Input Mode (parallel instead of independent)	The inverter is configured with parallel inputs. In this particular configuration, the inverter carries out the input voltage check of each of the two channels, and the alarm is triggered if the two voltages differ by more than 20Vdc.
Over Temp.	E014	Over-temperature	External temperature above 60°C. The measurement of the temperatures is carried out internally and is affected by the heat dissipated by the components of the inverter.
Bulk Cap Fail	E015	Bulk Capacitor Fail	Error inside the inverter regarding a problem in the bulk capacitors.
Inverter Fail	E016	Inverter module error revealed by Booster	Problem in the inverter circuit part (DC/AC). Error inside the inverter that cannot be checked externally.
Start Timeout	E017	Inverter module start-up timeout	Error inside the inverter regarding the time for starting steady state operation of the DC-AC circuit part (Inverter).
Ground Fault	E018	Leakage current fail	Presence of ground leakage current in the DC section of the system. The alarm is accompanied by the lighting up of the red GFI LED on the front of the inverter. The inverter may even also generate the E018 alarm message for AC leakage currents associated with the capacitive nature of the photovoltaic generator with respect to ground.
Self Test Error 3	E019	Leakage current sensor self-test fail	Before connecting to the grid, the inverter carries out an autotest that regards the leakage current sensor. The test is carried out by "forcing" a current of known value in the leakage current sensor: the microprocessor compares the read value with the known value. The error is generated if the value is not within the allowed tolerance.
Self Test Error 1	E020	Booster relay self-test fail	Before connecting to the grid, the inverter carries out some internal tests. One of these tests regards the correct operation of the booster relay. The test is carried out by "forcing" the switching of the relay and checking its functionality. The error is generated if there is a problem with the operation of the relay.
Self Test Error 2	E021	Inverter relay self-test fail	Before connecting to the grid, the inverter carries out a test that regards the operation of the inverter relay. The test is carried out by "forcing" the switching of the relay and checking its functionality. The error is generated if there is a problem with the operation of the relay.
Self Test Error 4	E022	Relay self-test timeout	Time taken to execute the autotest carried out on the relays of the DC_AC circuit part (inverter) is too long. This may indicate a problem associated with the relays.
DC inj error	E023	Dc-Injection out of range	The error is generated if the direct component of the current supplied to the grid exceeds the threshold of 0.5% of the rated operating current. In any case, the inverter does not stop because of the E023 error, but tries to connect to the grid again. Sporadic repetition of the error is a sign of large grid distortions or sudden changes in irradiation, whereas a systematic repetition of error indicates an inverter fault.
Internal error	E024	Internal Error	Error inside the inverter that cannot be checked externally.
Riso Low	E025 (not shown on the display)	Low insulation resistance	Before connecting to the grid, the inverter measures the insulation resistance of the PV generator with respect to ground. If the value of the insulation resistance measured by the inverter is below 1Mohm, the inverter does not connect to the grid and shows the "Riso Low" error. **Causes:** - Damaged PV panels. - Junction boxes of the panels not properly sealed, with water seepage and/or damp. **(Damp increases leakage and can therefore be the cause of a reduction in insulation resistance).** - Problems in connections between the panels (not perfectly connected). - Poor quality cable junctions. - Presence of unsuitable (trigger voltage lower than the characteristics of the PV generator strings) or damaged overvoltage surge arresters outside the inverter in the DC section. - Presence of damp inside the field panel, if there is one.

Vref Error	E026	Bad internal reference voltage	Wrong measurement of the reference voltage inside the equipment
Error Meas V	E027	VGrid Measures Fault	Error in internal measurement of the grid voltage to obtain a measurement redundancy (2 measurements on the same parameter by two different circuits).
Error Meas F	E028	FGrid Measures Fault	Error in internal measurement of the grid frequency to obtain a measurement redundancy (2 measurements on the same parameter by two different circuits).
Error Meas Z	E029	ZGrid Measures Fault	Error in internal measurement of the insulation resistance of the PV generator with respect to ground to obtain a measurement redundancy (2 measurements on the same parameter carried out by two different circuits).
Error Meas Ileak	E030	ILeak Measures Fault	Error in the internal measurement (carried out when the inverter is connected to the grid) of the leakage current of the DC side (PV generator) with respect to ground (imposed by regulations) to have a measurement redundancy (2 measurements on the same parameter carried out by two different circuits).
Error Read V	E031	Wrong V Measure	Measurement of the internal voltage at the ends of the output relay out of range. There is too great a difference in voltage between the input and the output of the output relay.
Error Read I	E032	Wrong I Measure	Measurement of the output voltage unbalance (carried out between the three phases) out of range (only in three-phase models).
UTH	E033	Under Temperature	Temperature outside the inverter below -25°C
Interlock fail	E034	IGBT not ready	Error inside the inverter that cannot be checked externally.
Remote Off	E035	Waiting remote ON	The inverter has been switched off remotely (remote OFF) and remains in waiting state for the signal that will switch it on again (remote ON). **Error not shown on the display.**
Vout Avg error	E036	Average Vout out of range	The average grid voltage value (every 10 minutes) does not fall within the allowed ranges. The grid voltage at the point connected to the inverter is too high. Grid impedance too high. Towards the end of the timeout, the inverter limits the power to check whether the grid voltage stabilizes within the normal parameters. If this does not happen, the inverter disconnects from the grid.
Riso Low	E037	Low insulation resistance (amorphous mode only)	Error available in “Amorphous” mode only. Function enabled only in inverters equipped with grounding kit for monitoring the voltage at the ends of the grounding resistor. The error appears when the voltage at the ends of the resistor connected between ground and pole of the photovoltaic generator exceeds 30V for more than 30 minutes or 120V for more than one second.
Mid Bulk OV	E038	Mid bulk OV	Error inside the inverter.
Sun Low	W001	(Low input voltage at switch-on)	Insufficient irradiation. Wrong configuration of the PV generator or a configuration “at the limit” as regards the minimum input voltage of the inverter.
Input UV	W002	(Low input voltage at switch-off)	Insufficient irradiation. Wrong configuration of the photovoltaic generator or a configuration “at the limit” as regards the minimum input voltage of the inverter.
Grid Fail	W003	Grid Fail (grid voltage parameters outside the limits)	The grid parameters fall outside the limits set by the grid company. No grid voltage (after the warning, the inverter goes on "No Vac") Unstable grid voltage (downwards and upwards) Unstable grid frequency
Grid OV	W004	Output Overvoltage	Output voltage above the parameters
Grid UV	W005	Output Under-voltage	Output voltage below the parameters
Grid OF	W006	Output Over-frequency	The grid frequency has exceeded the upper limit set by the grid company disconnecting from the grid.
Grid UF	W007	Output Under-frequency	The grid frequency has exceeded the lower limit set by the grid company disconnecting from the grid.

Z grid Hi	W008	Grid impedance out of range	The grid impedance has exceeded the limits.
Table fail	W009	Empty Wind Table	**(wind models only)**
Fan Fail	W010	Fan Fail	This error appears when there is malfunctioning of the fan(s) inside the inverter. In this condition, the yellow LED on the front panel flashes. **Error not shown on the display.**
Bulk UV	W011	Bulk Under-voltage	Reading of the internal voltage on the bulk capacitors carried out when the inverter is connected to the grid.
Battery low	W012	Low internal clock battery voltage	Internal battery for maintenance of the date/time settings is discharged or damaged.
Clk fail	W013	Internal clock fail	The alarm appears when the time shown on the display differs by more than 1 minute from the internal time of the microprocessors and indicates clock circuit malfunctioning. Error inside the inverter that cannot be resolved with external operations.
Jbox fail	W017	Fuse-control board fail (DC string fail)	Fuses on the boards are damaged. Check that input current on the string does not exceed the rating of the fuses (if string parallels have been made outside the inverter).
SPD AC protection open	W018	SPD AC protection open	Overvoltage surge arresters situated on the AC side are damaged. Look at the inspection window present on each surge arrester (AC side). If it is red, the surge arrester is damaged and the cartridge must be replaced.
SPD DC protection open	W019	SPD DC protection open	Overvoltage surge arresters situated on the DC side are damaged. Look at the inspection window present on each surge arrester (DC side). If it is red, the surge arrester is damaged and the cartridge must be replaced.

Storage and dismantling

Storage of the equipment or prolonged stop



If the equipment is not used immediately or is stored for long periods, check that it is correctly packed and contact ***Power-One*** for storage instructions.
The equipment must be stored in well-ventilated indoor areas that do not have characteristics that might damage the components of the equipment.

If the package is stored correctly, it can withstand **a maximum load of 4 pieces of equipment.** DO NOT stack with equipment or products other than those indicated.

Restarting after a long or prolonged stop requires a check and, in some cases, the removal of oxidation and dust that will also have settled inside the equipment if not suitable protected.

Dismantling, decommissioning and disposal

Power-One CANNOT be held responsible for disposal of the equipment: displays, cables, batteries, accumulators, etc., and therefore the customer must dispose of these substances, which are potentially harmful to the environment, in accordance with the regulations in force in the country of installation.

If the equipment is dismantled, to dispose of the products it consists of, you must stick to the regulations in force in the country of destination and in any case avoid causing any kind of pollution.

Dispose of the various types of materials that the parts of the equipment consist of in dumps that are suitable for the purpose.

Table: disposal of components

COMPONENT	MATERIAL OF CONSTRUCTION
Frame, brackets, supports	Arc-welded steel FE37
Casing or covers	ABS, plastic
Paint	RAL .....
Gaskets and seals	Rubber / Teflon / Viton
Electrical cables	Copper / Rubber
Cable trays	Polyethylene / Nylon
Backup battery	Nickel / Lead/ Lithium