AURORA®

BOXES FOR THE CONNECTION OF STRINGS FOR PHOTOVOLTAIC APPLICATIONS

INSTALLATION AND INSTRUCTION MANUAL

Models: ***PVI-STRINGCOMB / PVI-STRINGCOMB-S***
PVI-STRINGCOMB-MC / PVI-STRINGCOMB-S-MC

Rev. 1.0

DOCUMENT REVISION TABLE

Document Revision	Author	Date	Approved by	Change Description
0.0	A. Morucci S. Soldani	04-09-09	D.Nocentini	New StringComb 3L11
1.0	A. Morucci S. Soldani	14-10-09	D.Nocentini	New StringComb 3L11

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1 GENERAL INSTRUCTIONS ON THE USE AND READING OF THIS MANUAL

This documentation is valid for all PVI-STRINGCOMB(-S) products.

- The product to which this Manual refers must be used only for the purpose described in Chapter §4. Any other use is inappropriate and therefore dangerous. Power-One declines all responsibility for damages to property or persons due to use which is inappropriate and/or other than that foreseen.

- Before replacing the components in the device and mentioned in this Manual, particularly the dischargers and the fuses, the supplier must be contacted: Power-One shall accept no responsibility for damages consequent to the use of unsuitable spare parts.

- Power-One reserves the right to make any amendments to this Manual and to the device without advance notice: the most recent version of the Manual, indicating the revision number, is available at the site (www.power-one.com).

- This Manual contains important instructions regarding safety and functioning, which must be understood and carefully followed during installation and maintenance of the device.

1.1 Disposal of waste

As a manufacturer of the electrical device described in this manual, and in compliance with Decree Law 25/07/05 no.151, Power-One informs the buyer that when this product is scrapped it must be delivered to an authorised disposal centre.

1.2 Product labelling

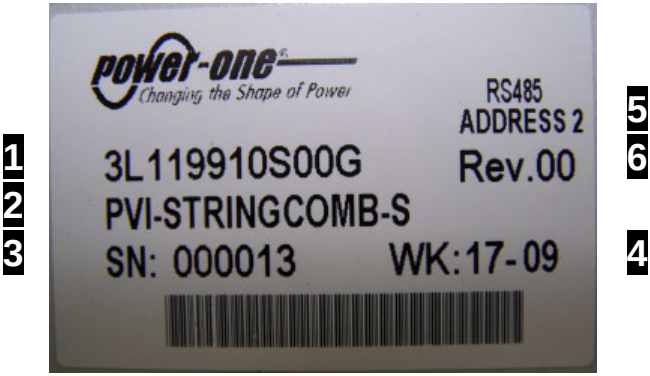


Figure 1-1: Product label (example)

The identification label affixed to the PVI-STRINGCOMB(-S) contains the following information:

1) Power-One product's production code
2) Model name
3) Serial number
4) Week/Year of production
5) Serial address RS485
6) Product revision

Figure 1-2 shows the label specifying input and output polarities.

Figure 1-2: Power inputs and outputs label

1.3 Symbols used in this Manual

To reduce the risk of electric shock, and to ensure that the device is correctly installed and ready for use, special safety symbols are used in the Manual to indicate potential risks or useful information. The symbols are:

ATTENTION
Paragraphs marked by this symbol contain actions and/or instructions which it is essential to understand and to carry out in order to avoid potential malfunctioning of the device or damage to the same and to property in general.

DANGER!
Paragraphs marked by this symbol contain specific indications which must absolutely be followed in order to avoid accidents or even death by electrocution.

IMPORTANT
Paragraphs marked by this symbol contain important information regarding use of the device.

PROTECTION!
Paragraphs marked by this symbol indicate the need for adequate protection before carrying out operations (e.g. insulating gloves for operating with voltages up to 1000Vdc, protective goggles, etc.).

1.4 Symbols used on the PVI-STRINGCOMB(-S)

The device has various labels; those with a yellow background regard the safety devices provided.
Make sure that you have read and fully understand the labels before installing the device.
The symbols used on the device, referring to electrical parts, are the following and they are also used in this Manual:

	Connection point for the earth conductor
+	Continuous positive voltage pole
-	Continuous negative voltage pole
	Direct Current (DC)
	Grounding (GND)

2 GENERAL INFORMATION AND FEATURES OF A PHOTOVOLTAIC SYSTEM

This chapter gives the PVI-STRINGCOMB(-S) user general information on photovoltaic plants which transform solar energy into electricity, which can be used in the mains network.

2.1 Photovoltaic energy

In the energy transformation process, industrialised companies (the greatest energy consumers) have been experimenting methods for energy saving and for decreasing the release of polluting substances into the environment for many years, by careful and rational consumption of known resources and by research into new forms of clean and inexhaustible energy.
Regenerating sources of energy are fundamental to solve this problem. Under these circumstances, solar energy exploitation to generate electrical (photovoltaic) energy is becoming more and more important world-wide.
Photovoltaic energy represents an enormous advantage as regards environmental protection, since the solar radiation which we receive from the sun is directly transformed into electricity without any combustion process and without the production of polluting waste.

The photovoltaic panels transform the energy irradiated by the sun into direct current, or DC type electricity (by means of a photovoltaic field, also known as a PV generator). In order to supply the mains network and thus allow for this energy to be used, it must be transformed into alternate current, or AC type electricity. AURORA inverters do this conversion, also known as DC to AC inversion, in a very efficient way, without using rotating parts but just static power electronic devices.
Used parallel to the mains supply, the alternate current produced by the inverter flows directly (through the insulation transformer) into the industrial distribution network, in turn connected to the public distribution network.
When the photovoltaic field is not generating sufficient energy, the power required to ensure proper operation of connected loads is taken from the public power grid. While if the produced energy is too much, it is directly fed to the grid, thus becoming available to other users.

According to national and local standards and regulations the produced energy can be sold to the grid or credited to the user against future consumption, thus granting a great saving of money.

2.2 Fundamental elements of a photovoltaic field: “Strings” and “Arrays”

The so-called STRINGS technology has been developed in order to reduce the installation costs of a photovoltaic system as much as possible. These costs are mainly related to the wiring operations on inverter DC side and the consequent distribution on the AC side.
A photovoltaic panel is composed of many photovoltaic cells assembled on the same mount. A STRING is composed of a certain number of panels electrically connected in series. An ARRAY is composed by one or more strings connected in parallel.
Photovoltaic systems of a certain size may be composed of several arrays, connected to one or more AURORA inverters.
The greater the number of panels in each string, the lower the cost and the less complex the wiring connections of the system.

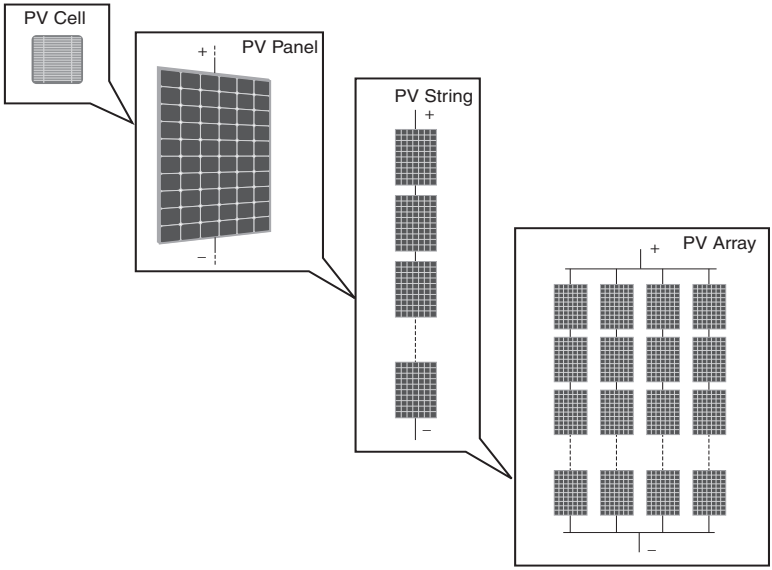


Figure 2-1: Array composition

WARNING: In no case may the voltage of the string exceed the maximum voltage admissible, otherwise the device will be damaged (see APPENDIXES).

The current of each array must also be within the limits of the inverter downstream.
There are several factors and considerations to be taken into account when designing a photovoltaic system, such as the type of panels, available room, location, long-term target output, etc. The system configurator available on Power-One's web site (www.power-one.com) may help in sizing a photovoltaic system.

3 LARGE PHV FIELDS AND PARALLEL STRINGS.

When speaking of large photovoltaic fields, the immediate image is one of large extensions of solar panels.
Since a field (array) is composed of several parallel strings, it is clear that to obtain high power the number must be increased. In this case, particular precautions must be taken in the project / installation phase, otherwise the strings may be damaged due to breakdowns in the strings themselves or to incorrect connections or dimensioning.

3.1 Why use PVI-STRINGCOMB(-S)?

Connecting strings in parallel does not entail particular problems as long as the "Uoc" voltage (Open Circuit Voltage) for each string is the same as the other strings. If not, e.g. because of considerable differences in the length of the strings or short circuits in one or more of the solar modules in a string, there can be a considerable difference in the Uoc voltage which can cause an inverted current on the string with the lower voltage (i.e. made up of a lower number of modules connected in series). Contrary to popular opinion, shading has no significant influence on this effect; this is because Bypass diodes have been adopted and they are now standard on all panels.
If the inverted current is greater than the maximum permitted for the panel, it can overheat and/or even be irreparably damaged (Figure 3-1).

Diodes can be inserted in series to each string (string blocking diodes) to prevent this problem. Using these diodes has two disadvantages: 1) The string current pass through the diode and consequently the loss of power is not negligible. 2) If there is a short circuit in the diode, there is no protection and the phenomenon in Figure 3-1 can occur.

The best solution is to use a fuse for every string.
In the event of excessive inverted current, the fuse opens and protects the string itself (Figure 3-2). If the fuse status is monitored, it is also now possible to remotely check the status of the strings which make up the photovoltaic generator. Moreover, a fuse's power losses are considerably less than a diode's. The PVI-STRINGCOMB has fuses both on the positive pole and on the negative pole of each string.

The fuse rating must be chosen by taking into consideration the maximum current that can flow through the fuse (also based on the number of strings connected to the channel in the parallel string panel) and the maximum inverted current that each string can take. The technical data sheets of the photovoltaic modules generally show the "Max Fuse Rating", i.e. the maximum fuse rating that can be adopted to protect the panel string. Usually the "Max Fuse Rating" is double of the module's short circuit current. This allow two strings to be connected directly in parallel without running the risk of damage to the panels. Nevertheless these are considerations of a general nature which must be verified by a careful check on the characteristics of the modules that make up the photovoltaic generator.

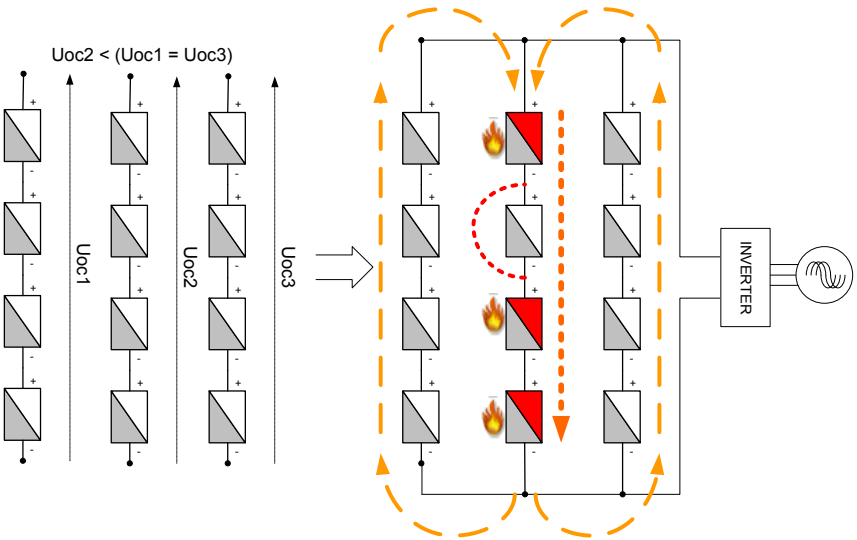


Figure 3-1: Effect of a panel breakdown with short-circuit

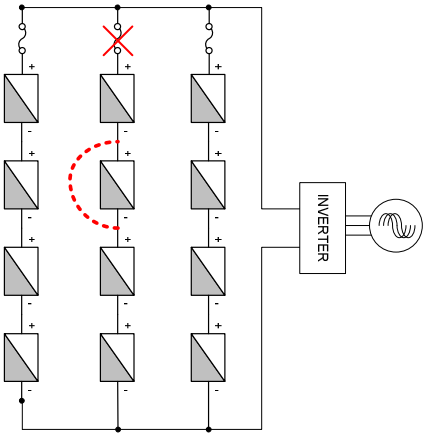


Figure 3-2: Intervention of protective fuse

With **PVI-STRINGCOMB(-S)**, the connected strings are protected and controlled. In addition, information on the string currents, and other information, can be recorded, which can be useful during system operation.

4 FIELD OF APPLICATION AND GENERAL DESCRIPTION OF THE PARALLEL STRING PANEL (PSP)

Figure 4-1: PVI-STRINGCOMB(-S)

The PVI-STRINGCOMB(-S) and its variants (Figure 4-1) are devices designed exclusively for parallel connection of the photovoltaic field strings, allowing for protection in the case of breakdown.
Besides connecting the strings, they allow the electrical quantities and other type of quantities for the entire photovoltaic field to be monitored through the following checks:

- Reading the total voltage of the field.
- Checking the operation of the internal fuses, to protect the photovoltaic panels.
- Checking of the status of the internal protection against overvoltage (DC side).
- Temperature check.
- General checks on the surrounding environment through external sensors.

Thanks to the 10 channels available, each device allows for connecting up to 10 strings individually, or 20 strings in parallel pairs. This is made possible thanks to the double-hole terminal board on each channel (from 1 to 10). Each channel is also protected by two fuses.

The "S" version has:

- a special DC switch for direct current disconnection with high voltages (1000Vdc) in class DC21A; this allows for disconnecting the string group concerned from the inverter downstream.
- remote disconnection control and an auxiliary contact for displaying the switch status.

Every device features:

- one input for resistance PT100
- analogue and digital inputs to allow for checking external magnitudes[1], such as, for example, the temperature of the photovoltaic cells, solar irradiation, environmental temperature, wind force, etc.
- a cord-type antitheft device.
- a protection against overvoltage for the serial line RS485 (supplied as an option).
- a protection against overvoltage for the DC line.

[1] The 24V sensors for measuring environment parameters can be fed by a source external to or the one internal to the PVI-STRINGCOMB(-S) (Ref.§9.3.3, §9.3.8)

Every device can be powered by an external source (24V DC). This allows the PVI-STRINGCOMB(-S) to remain running also during the night.

PSPs are available in four different versions. The differences are the presence or not of the switch disconnector and the string connection type. PSPs should be configured when placing the order using the configuration model that can be found on the internet at the following address:

www.stringcombconfigurator.com

String-combs can be configured in different ways according to:

- Number of strings that can be connected
- Cable gland type or MC4 string input connector type
- Size of fuses
- Parallel string output cable gland
- Cable gland for the ground cable

More information are available on the website.

Figure 4-2 shows an example of the connection, by means of PVI-STRINGCOMB(-S), of a 100kw centralised AURORA inverter to a photovoltaic field composed of 2 arrays (photovoltaic field A and B), each in turn consiting of 4 strings.

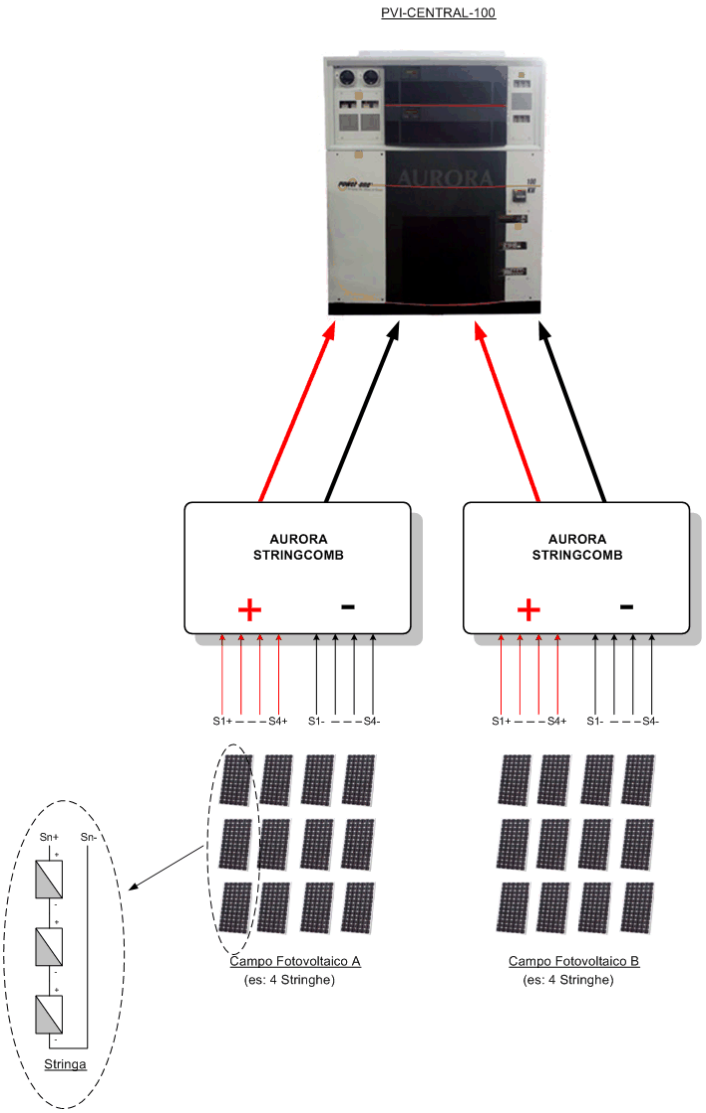


Figure 4-2: Example of a photovoltaic system

Figure 4-3 shows the representation of the front panel and the side panels, with the cable glands for the external connections and the usable connection flanges.

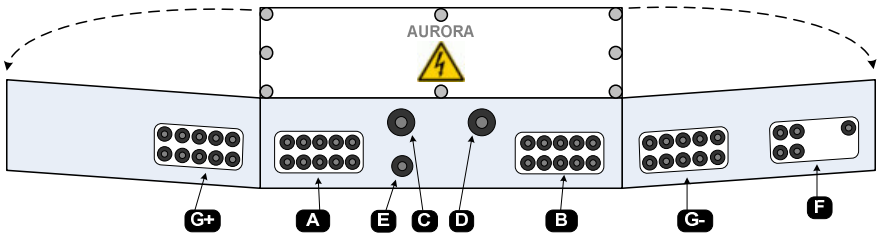


Figure 4-3: Available Inputs/Outputs + accessories

A. POSITIVE STRING “+” INPUT
B. NEGATIVE STRING “-” INPUT
C. POSITIVE STRING “+” OUTPUT
D. NEGATIVE STRING “-” OUTPUT
E. CABLE GLAND FOR THE GROUND CABLE.
F. INPUT / OUTPUT FOR THE SIGNALS COMING FROM THE ENVIRONMENTAL SENSORS, RS485 COMMUNICATION LINE, EXTERNAL POWER SUPPLY FOR THE ANTI-THEFT DEVICE AND SENSORS, ANTI-THEFT ALARM CONTACT.
G. OPTIONAL SIDE INPUTS OF THE POSITIVE AND NEGATIVE STRINGS (*)

(*) The optional lateral inputs can be used for the connection of more than 10 strings.

5 ESSENTIAL INFORMATION FOR SAFETY

If any doubts or perplexities arise when reading this information, contact the supplier.

5.1 Introduction



- For all types of maintenance (not covered in this manual) or repair, please contact the dealer. Unauthorised modifications can damage persons, property and the parallel string panel, causing the loss of product warranty.
- We strongly advise you to read all the instructions contained in this Manual and to observe the symbols of the single paragraphs before installing or using the device.
- It is extremely important and necessary to disconnect the inverter before connecting the PVI-STRINGCOMB(-S) to the photovoltaic field (installation and maintenance) by means of the DC switches inside the inverter itself, otherwise voltage could generate very dangerous situations.
- The personnel working on the PVI-STRINGCOMB(-S) must wear suitable personal protection devices.
- The device connected to the photovoltaic field and/or to the inverter is live, therefore the cover and Plexiglas guards must not be removed without authorisation from the person responsible for the system. Removal of the aforesaid protection exposes the person to the risk of electrocution.
- The electrical connections must always be made correctly and respecting the correct polarities, otherwise the device and the photovoltaic panels could be damaged.

In the case of breakdown, a voltaic arc could develop inside the box, supported by the DC source. In the worst case, this could even damage the box, possibly generate smoke, and therefore represent a danger to persons and property.
Follow the instructions in this Manual with extreme care, especially those in the chapter on installation (Ref. §9).

5.2 Overview

- Inappropriate use and/or incorrect installation can cause serious damage to persons or property.
- All operations regarding transport, installation and switching on, as well as maintenance, must be carried out by qualified, trained personnel (and complying with all national provisions on accident prevention).
- The device must not be placed in an environment where there is a risk of fire or explosion.
- It is important that the qualified and suitably trained persons, referred to in basic safety information, are expert in the assembly, installation and functioning of the device and have the necessary skills to perform the required tasks.
- It is the installer's responsibility to carry out all the tests and measures designed to guarantee the final system is adequate and complies with current laws and directives and applicable regulations including the EN 50178 standards. Failure to comply with this means that any form of guarantee and liability of Power-One is invalid. Records of the tests performed during installation shall be kept available for subsequent inspections and for the purposes intended by the standards and laws in force.

Power-One accepts no responsibility whatsoever for damage to persons or property due to incorrect interpretation of the instructions in this Manual or from inappropriate use of the device.

6 DESCRIPTION OF THE PARTS OF THE PVI-STRINGCOMB(-S)

6.1 Assembly

The PVI-STRINGCOMB(-S) is essentially composed of the following parts:

(A) Input connections for the positive pole of the strings and relative fuses
(B) Input connections for the negative pole of the strings and relative fuses
(C) Connection of signal input/output and RS485 communication.
(D) Connection of the Earth wire. (Appendix A: Technical Data)
(E) Connections for the output wires of the strings in parallel (Positive and Negative)
(F) Component to protect the DC line against overvoltage, with relevant protection fuses and component to protect the RS485 line against overvoltage.
(G) DC[2] isolating switch with trip coil opening module and auxiliary status contact.
(H) Control board for monitoring the strings.

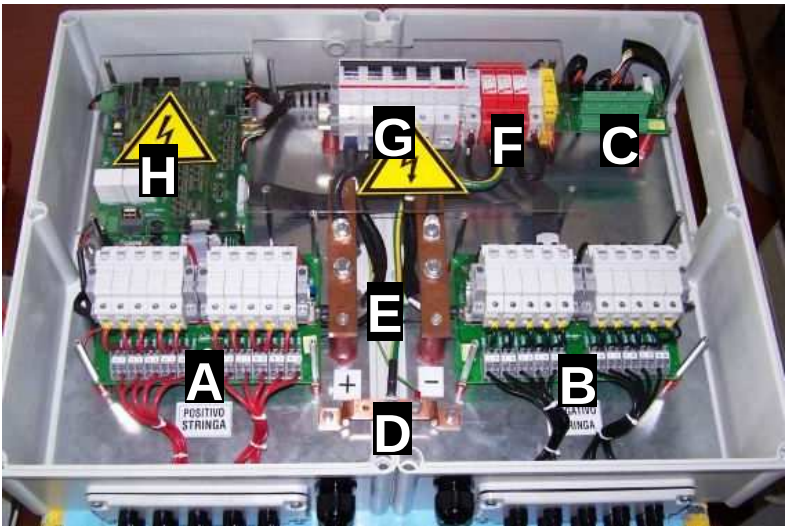


Figure 6-1: Inside of the PVI-STRINGCOMB-S

[2] Only on the PVI-STRINGCOMB-S version

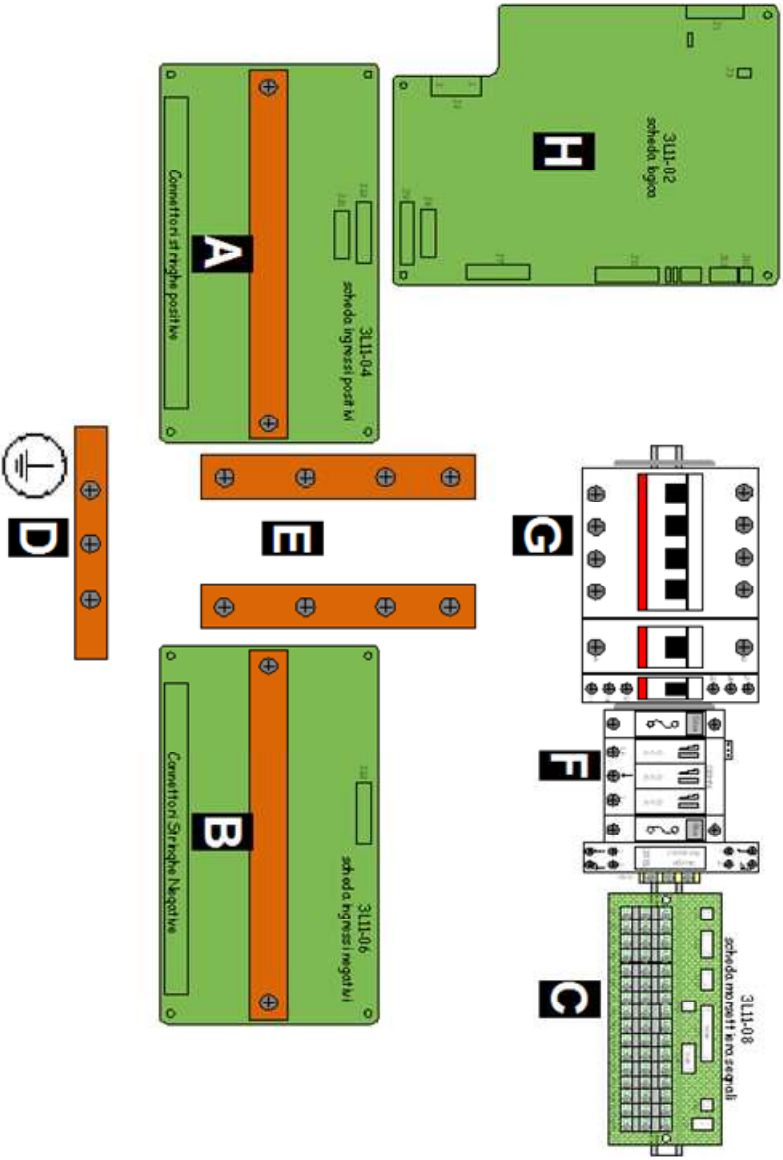


Figure 6-2: Inside the PVI-STRINGCOMB-S

6.2 Operation diagram

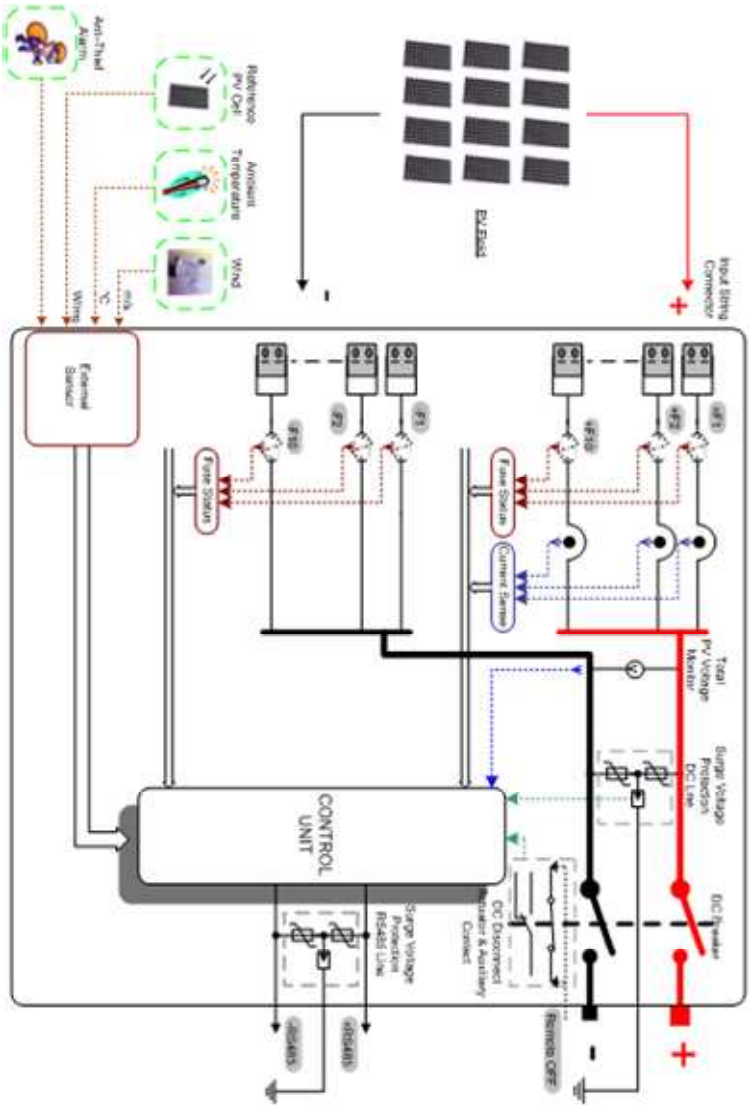


Figure 6-3: Indicative electrical diagram of the PVI-STRINGCOMB(-S)

6.3 Description of the sections

6.3.1 Input connections (Ref.§6.1 items A and B, Figure 6-1)

It is possible to connect a maximum of 20 strings using the two input boards A and B respectively dedicated to the positive and negative pole. The current that flows through each channel is detected using special sensors (these sensors are only installed on board "A"). The status of every fuse positioned to protect each string (Fuse Status) is also checked. The system also measures the global voltage of the photovoltaic field via these boards. Any anomalies in the system will be displayed via the special monitoring software or [3] on the Aurora inverter's display.

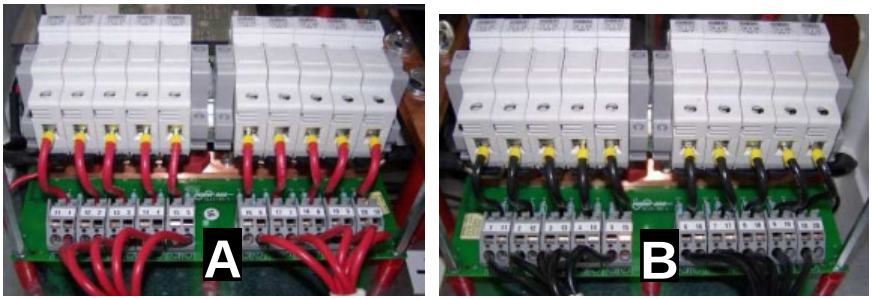


Figure 6-4: Terminal boards for positive strings input (A) and negative strings input (B) + string fuse carrier

[3] A computer is needed (not supplied)

6.3.2 Signal inputs and outputs (Ref.§6.1 item C, Figure 6-1)

The device allows access to signals terminal board (Figure 6-5) with no need to remove the Plexiglas protections located at the live areas. This section deals with connection, by the user, of the input and output signals of PVI-STRINGCOMB(-S). (Ref.§9.3)

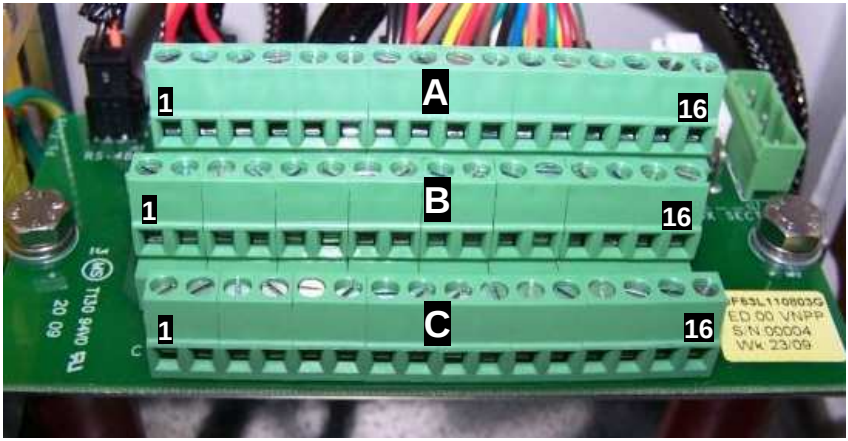


Figure 6-5: Terminal board for the connection of the analogue inputs

6.3.3 Overvoltage protection - DC side

The PVI-STRINGCOMB(-S) features a built-in device for overvoltage protection, with protection fuses (Figure 6-2 item F). If the protection trips, the control unit detects the problem and warns the user (through the software or the inverter display). The protection allows for a quick replacement of the faulty cartridges that could be viewed through the sight glass.

*Presence of the ground cable connected to the relevant bar (*Figure 6-1 *item D) is necessary to ensure correct operation of this component.*

6.3.4 Overvoltage protection - RS485

PVI-STRINGCOMB(-S) can feature an (optional) overvoltage protection on the RS485 communication line (Figure 6-2 item F). The protection allows for quick replacement of the faulty cartridges.

*Presence of the ground cable connected to the relevant bar (*Figure 6-1 *item D) is necessary to ensure correct operation of this component.*

6.3.5 DC isolating switch (Ref.§6.1 item G, Figure 6-1)

PVI-STRINGCOMB(-S) (only version –S) is fitted with a DC isolating switch in class DC21A. The isolating switch fully disconnects the strings linked to box so as to allow any required servicing of the devices downstream (e.g. inverter).
The isolating switch can be opened via remote control thanks to a disconnect device provided as standard. The available status contact allows the system to always be aware of the switch position.

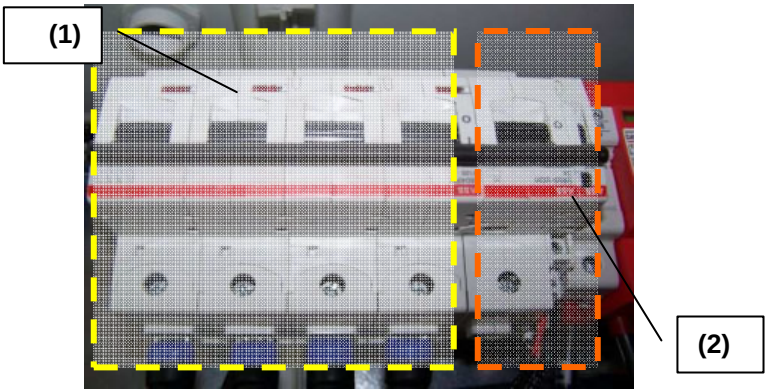


Figure 6-6: DC isolating switch (1), component for remote disconnection and auxiliary status contact (2).

6.3.6 Control unit and serial communication

The control board fits a microcontroller that manages all signals detected in order to display them via the monitoring software. The same data is then transmitted outside through the serial communication line (RS485).

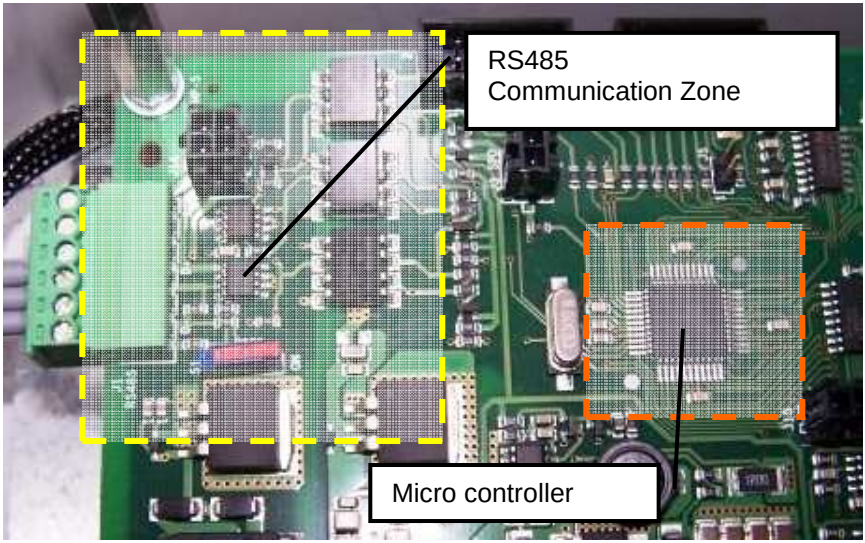


Figure 6-7: Detail of the Micro-controller and RS485 Serial Zone

7 CONNECTION OF THE RS485 LINE

The connection for communications sent out from the PVI-STRINGCOMB(-S) uses the RS485 serial line.

The type of connection between the Aurora inverter and the PVI-STRINGCOMB(-S) must be made as indicated in Figure 7-1 and Figure 7-2.

Termination of the line is already provided for inside the inverter (120 ohm).

The last PVI-STRINGCOMB(-S) must be terminated with 120ohm. This operation is explained in §9.3.2.

Use of a computer is not a key to system operation. **But it is necessary in order to assign the FIELD NUMBER upon installation** (Ref.§9.3.20, §12.4.2)

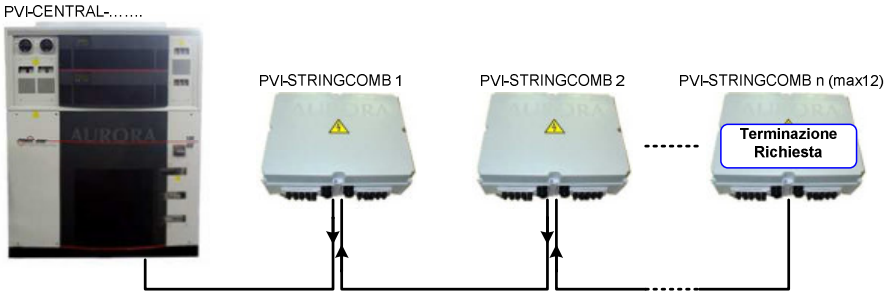


Figure 7-1: Modality for the passage of the serial wire

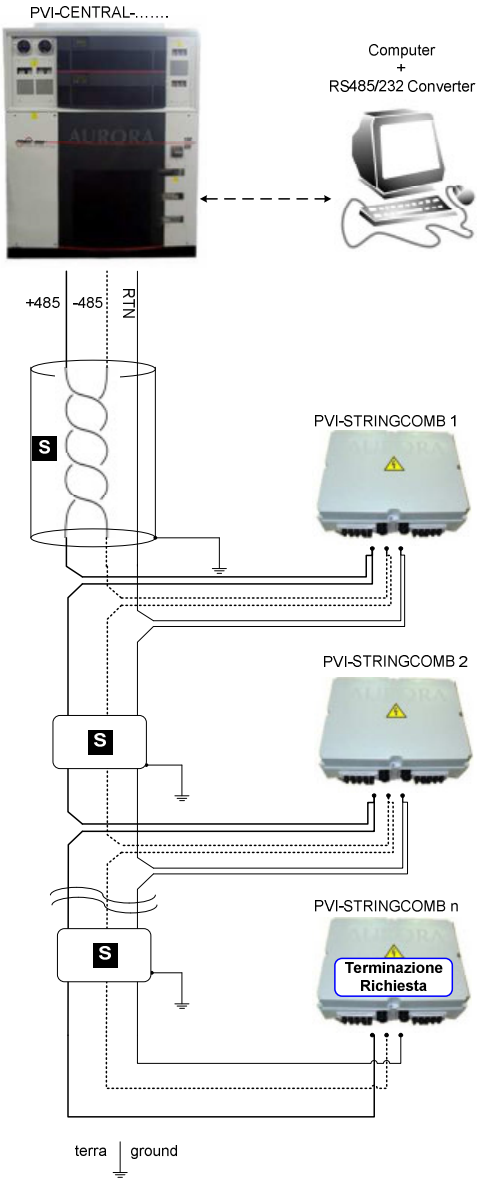


Figure 7-2: Type of connection for the PVI-STRINGCOMB(-S)

7.1 Connection methods

The RS485 line from the PVI-STRINGCOMB(-S) can be connected in the following ways:

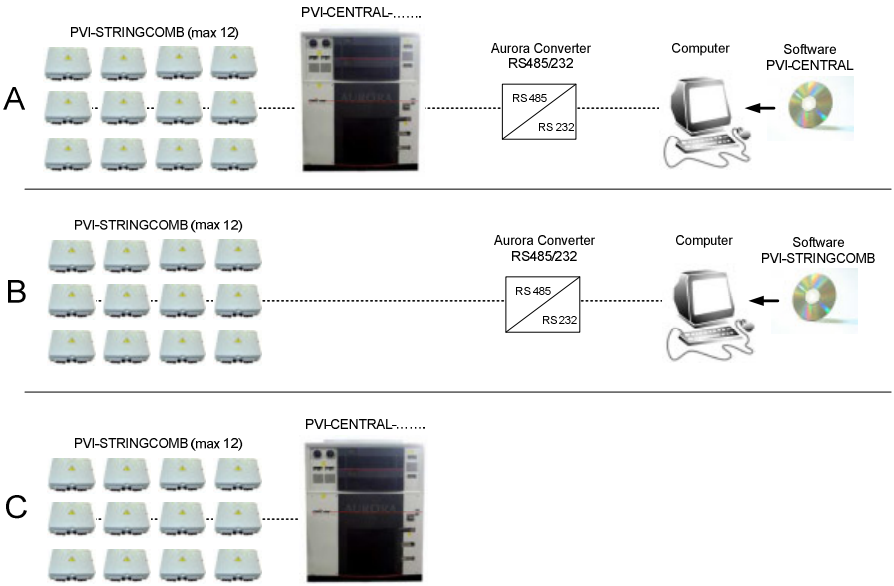


Figure 7-3: Connection methods

Where:

A) is the most complete configuration. The PVI-STRINGCOMB(-S) must be connected only by means of the AURORA inverter. The Computer must be connected to the RS485 of the inverter. In this case the software used to monitor the PVI-STRINGCOMB(-S) is that of the Aurora inverter.

B) This configuration must be used during installation to set the FIELD NUMBER. In this case, the computer communicates directly with the PVI-STRINGCOMB(-S). The necessary software is that of the PVI-STRINGCOMB(-S).

C) The PVI-STRINGCOMB(-S) are monitored exclusively by means of the display of the AURORA inverter.

8 TRANSPORT AND STORAGE

Transport and storage of the device before installation require no particular attention. However, it is good practice to follow the indications below:

Temperature during transport / storage must be respected (Ref. §Appendix A: Technical Data). Since there are electronic circuits and electric connections inside the container, care must be taken to avoid falls or blows which could later endanger regular operation of the device and people's safety would be at risk during installation and/or operation.

It is good practice to check that the device is intact before starting installation. Any anomalies in the plastic container or the existence of any loose objects which are not part of the accessories supplied must be considered as alarm signals. In such cases, contact the supplier.

9 INSTALLATION

All cables used (Ref. §**Error! Reference source not found.** point A, point B, point E) and connected to the strings or under field voltage, must comply with the minimum insulation requirements of 1000Vdc.
In case the low voltage cables are carried together with the cables from the photovoltaic field, the installer must ensure that the main electrical insulation conditions are guaranteed.

The environmental situation and positioning can influence the operation of the PVI-STRINGCOMB(-S); therefore, the indications below must be followed.

9.1 Place of installation

With regard to the place where the device will be positioned, the following warnings must be considered.

Do not place the PVI-STRINGCOMB(-S) near inhabited areas or in the attic. Escape routes must be kept free.
A position out of doors must always be chosen.

Do not install the device in a position where it is exposed to direct sunlight: the high temperature could compromise functioning of the electronic components. The boxes should be installed under the solar panels in a protected position.

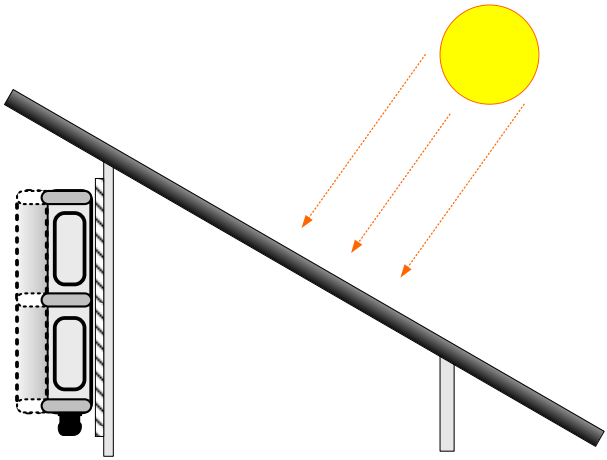


Figure 9-1: Example of box position

The supports on which the device is fitted must be of non-flammable material. There must be no inflammable material in the vicinity and if the device is positioned indoors, it is advisable to install a smoke detecting device.

When drawing up the project for the system, the data relative to environmental conditions should be taken into account (Ref. Appendix A: Technical Data).

Since no external heat sink unit is foreseen, the device must be kept in a well-aerated place.

9.2 Positioning

The device should normally be positioned with the wire input/output sockets at a low position: no other position is admitted.

The only purpose of the cable glands is to prevent water from entering the container. They must absolutely not support the weight of the wires. It is therefore necessary to provide for a system to support the weight of the wires.

The figures below also show the position of the mounting holes and a possible solution for supporting the wires (see detail SC in Figure 9-2 and the Figure 9-3 as an example of complete use).

Access to the holes is possible only by removing the cover. The holes indicated by the dotted arrow need not necessarily be used (the installer must assess the strength of the support and/or the type of anchorage used).

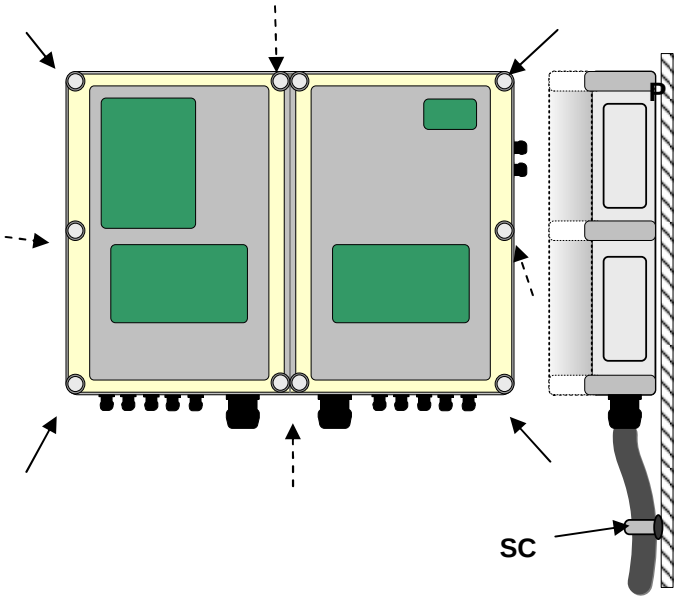


Figure 9-2: Positioning of the box and an example of wire support

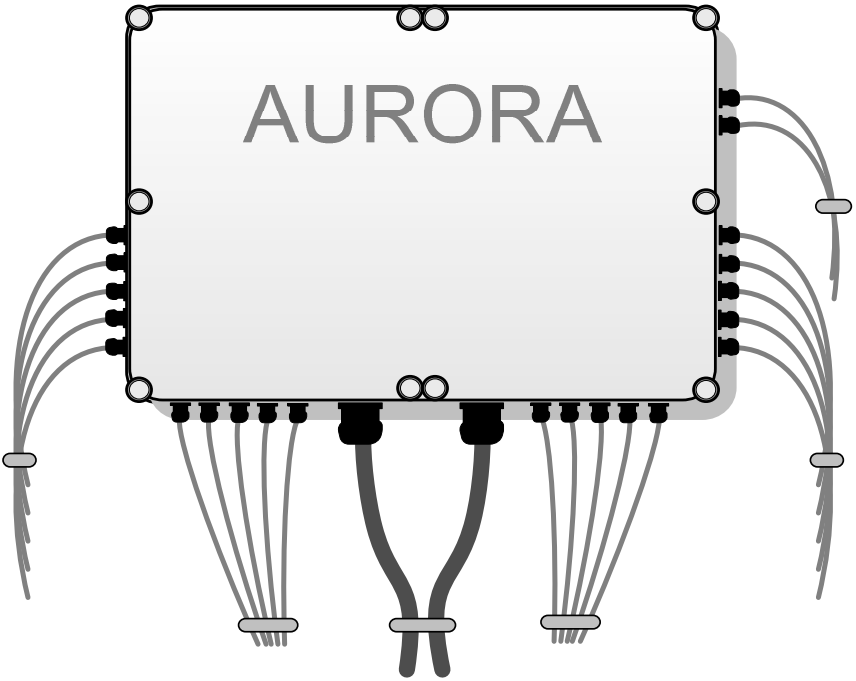


Figure 9-3: Complete use of the PVI-STRINGCOMB(-S) (20 strings)

9.3 Electrical Connection

After correct positioning of the device (Ref. §9) having checked that there is no external electrical connection, make the electrical connections, with the box open, as indicated here below:

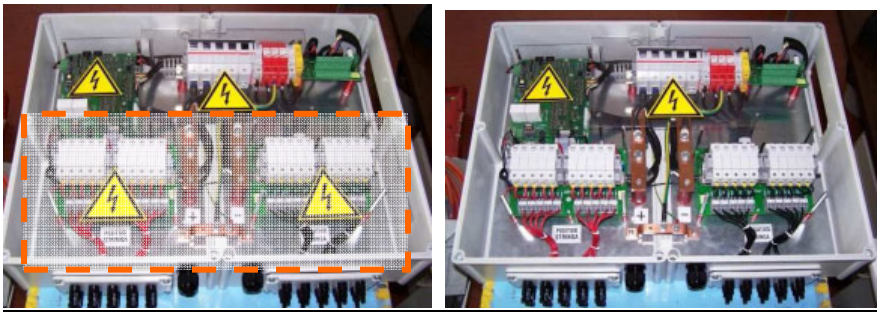


Figure 9-4: Removal of the Plexiglas guards

Now connect all signals listed below, items 1 to 10, since at this stage the device is not connected to the photovoltaic field.

9.3.1 Removal of the guards

Remove the Plexiglas guards by unscrewing the supporting screws. It is recommended to remove one guard at a time (i.e. remove the positive-side guard, connect the positive strings, close the guard and proceed in the same way on the side for negative voltage) in order to avoid any accidental contact. (Ref. §9.3.10, §9.3.12, §9.3.13)

9.3.2 Serial Communication

Connect the 3 incoming wires of the RS485 line (485+, 485- and RTN) respectively to connector A,B,C pin 1 and the 3 outgoing wires to connector A,B,C pin 2, as indicated in Figure 9-5 and in Table 9-1 given below. If the device is the last of the chain, there will be only 3 wires.

If the device is the last of the chain, the termination resistance must be enabled by the special micro-switch (Figure 9-7).

The resistance is connected when the micro-switch is set to ON (towards the board inside).
It is recommended to be careful when changing switch position, use a plastic tool.

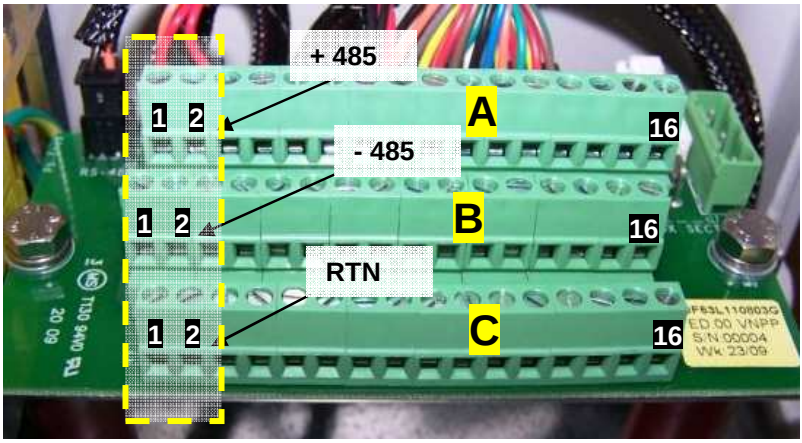


Figure 9-5: RS485 line terminal board

X1	
A	+485_USR
B	-485_USR
C	RTN

X2	
A	+485_USR
B	-485_USR
C	RTN

Table 9-1: Table of RS485 connection

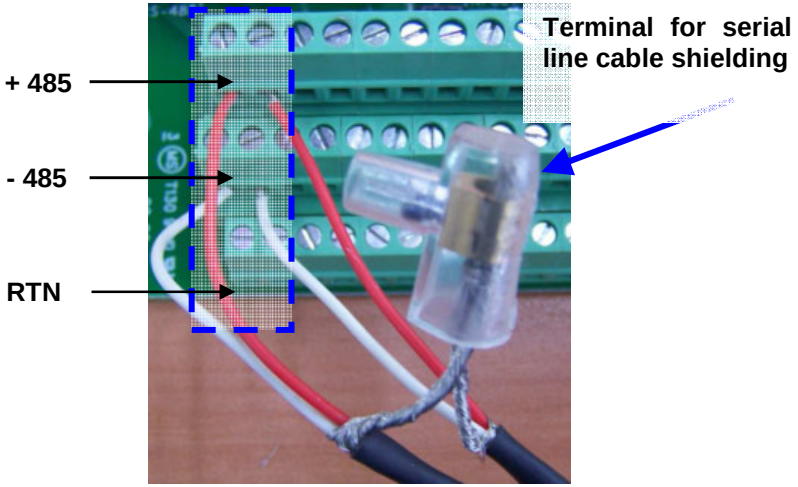


Figure 9-6: Ground terminal for RS485 line shielding

Warning! **The metal braid** of shielded cables used for connecting the RS485 line **shall be fitted with a wire terminal** (Figure 9-6) and grounded at one single point of the system

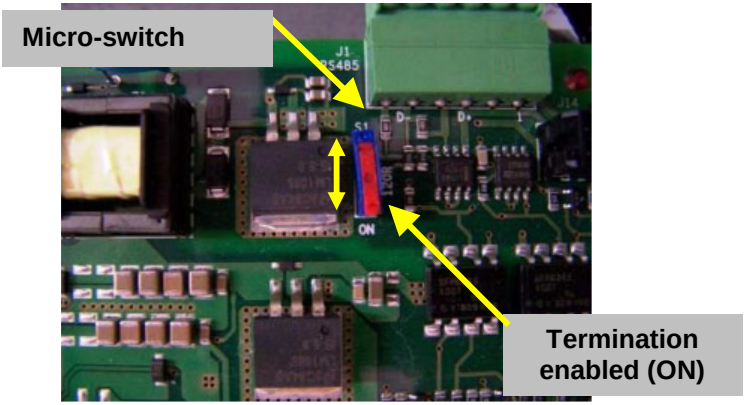


Figure 9-7: Micro-switch for RS485 line termination

Also see Chapter § 7 for RS485 line connection with any other PVI-STRINGCOMB(-S) devices and with the inverter.

9.3.3 Analogue inputs

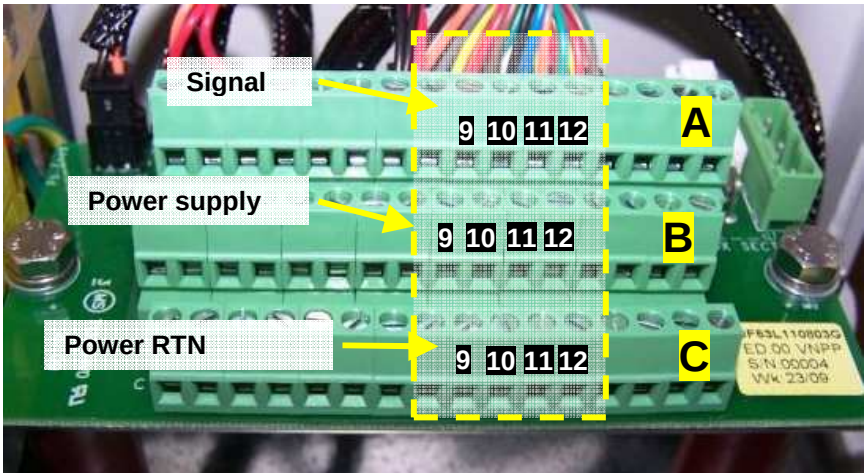


Figure 9-8 : Terminals for analogue inputs connection

X9		J11
A	AUX_IN_3	4
B	+24V	6
C	+24V_RTN	5

X10		J11
A	AUX_IN_1	1
B	+24V	3
C	+24V_RTN	2

X11		J11
A	AUX_IN_4	10
B	+24V	12
C	+24V_RTN	11

X12		J11
A	AUX_IN_2	7
B	+24V	9
C	+24V_RTN	8

Table 9-2: Table of analogue inputs connection

Table 9-2 lists the signals (0-10V) with the corresponding indication on the monitoring software (Ref. §12.8.3).

The AUX_IN_2 input[4] can be disabled without disconnecting it, so that a PT100 probe can be used (see Figure 9-9 and Table 9-3 for connection guidelines). To obtain this condition, use the relevant software (Ref.§11, §12, §12.8.3)

[4] This is not available if the PT100 input is used.

The auxiliary inputs could also be used for other sensors, other than the indicated ones, as far as they output a signal voltage of 0-10V (Ref. §Appendix A: Technical Data)

9.3.4 PT100 Input

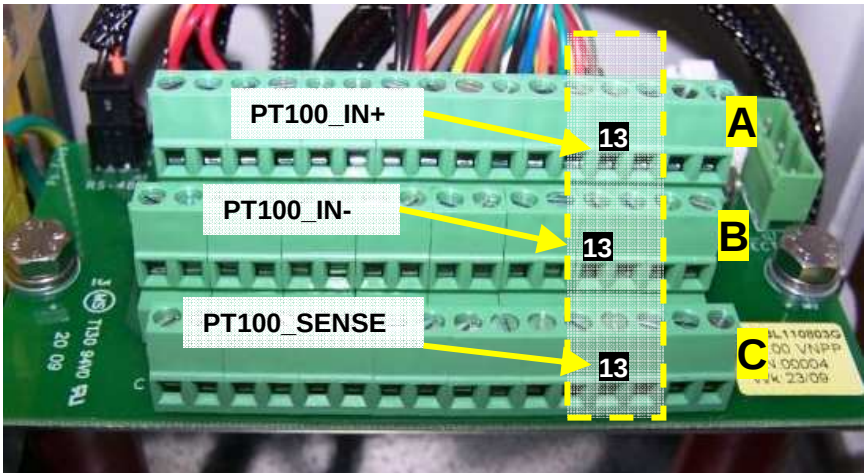


Figure 9-9: Terminals for PT100 sensor connection

X13	
A	PT100_IN+
B	PT100_IN-
C	PT100_SENSE

Table 9-3: Table of PT100 connection

Note: The signals “PT100_SENSE” and “PT100_IN-” have the same potential.

9.3.5 Antitheft system input / output

Remove the jumper (J) provided as standard and connected between the terminals 7-8 of the Terminal Block A (Figure 9-11).
Connect the antitheft system input wire as shown in Figure 9-10, Figure 9-11, Table 9-4.

The alarm wire (a normal wire) is not supplied as standard and shall be adjusted according to system complexity.

Make sure that overall wire resistance is below 400Ω.

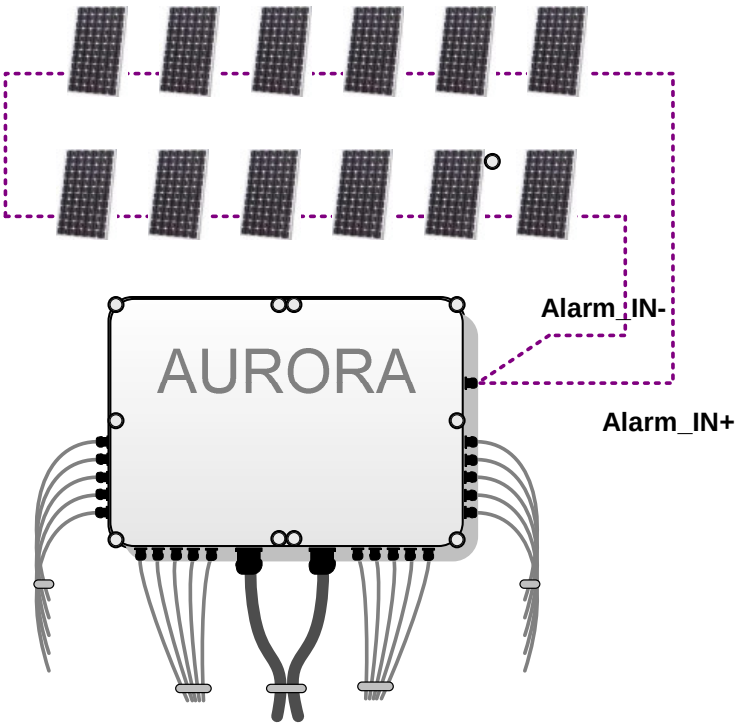


Figure 9-10: Example of antitheft system connection

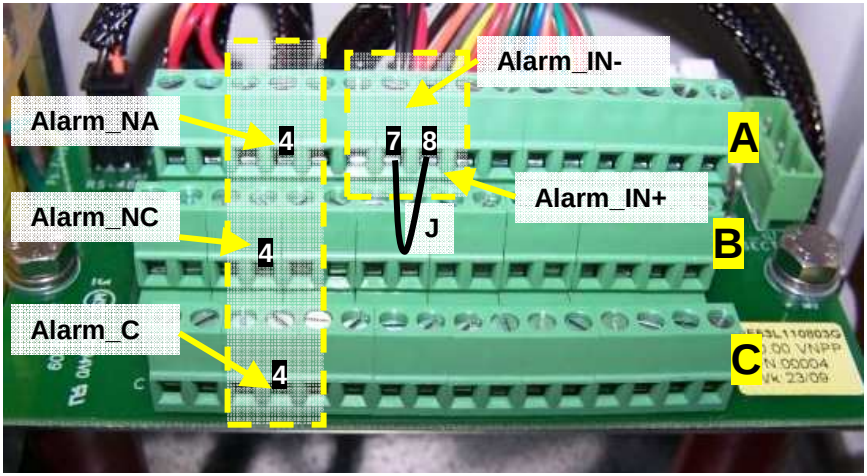


Figure 9-11: Terminals for antitheft system alarm connection

X4	
A	ALARM_NA
B	ALARM_NC
C	ALARM_C

Riferimento contatti con
ALLARME ATTIVO

X7	
A	ALARM_IN-
B	+24VEXT
C	+24VEXT_RTN

X8	
A	ALARM_IN+
B	+24V
C	+24V_RTN

Table 9-4: Table of antitheft system alarm connection

Please refer to software section (Ref.§11, §12, §12.7 item 3) for alarm management options.

Alarm signal can be remotely controlled not only via the monitoring software, but also through the built-in auxiliary contact (Figure 9-11, Table 9-4 “X4”). (Ref.§Appendix A: Technical Data).

9.3.6 Digital inputs

Table 9-5 lists the available digital input signals that can be monitored:

- DIG1[5] general input with two (selectable) functions.
- DIG2 general input.

WARNING: Digital inputs shall not be powered nor connected to any power supply.

Short-circuit or open signals DIG1+ and DIG1- (or DIG2+ and DIG2-) to detect the status of an auxiliary contact through the monitoring interface (Ref.§11, §12.7, §12.8.4).

DIG1 can also be used to check the DC isolating switch auxiliary status contact (Ref. §12.8.4) with no need to disconnect it since connection for this is already preset.

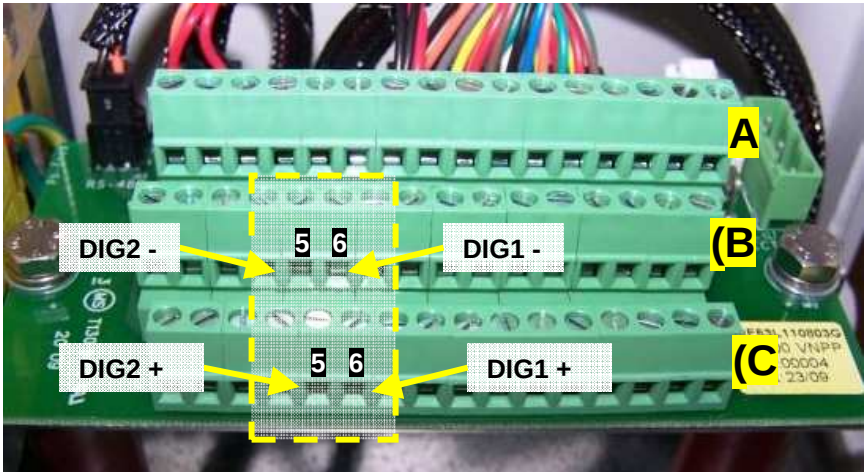


Figure 9-12: Terminals for digital inputs connection

[5] This input can be selected and can be used to check DC isolating switch status.

X5	
A	-
B	DIG2_IN-
C	DIG2_IN+

X6	
A	-
B	DIG1_IN-
C	DIG1_IN+

Table 9-5: Table of digital inputs connection

9.3.7 Remote disconnection module

The remote disconnection module allows you to trigger the DC isolating switch (that can be manually reset).
To open the isolating switch a (24VAC or DC) voltage shall be applied to the terminals indicated in Figure 9-13 and Table 9-6.

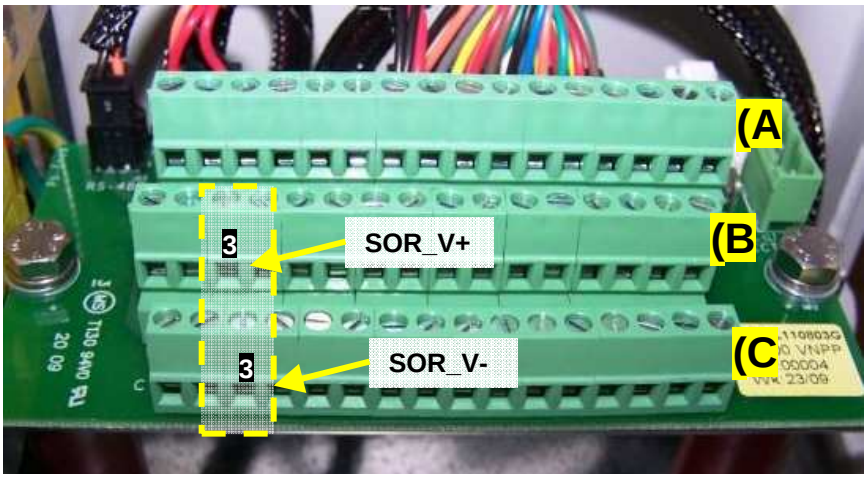


Figure 9-13 : Terminals for remote disconnection module connection

X3	
A	-
B	SOR_V+
C	SOR_V-

Table 9-6: Table of remote disconnection module connection

9.3.8 +24VDC external power supply

PVI-STRINGCOMB(-S) is directly powered by the photovoltaic field, so it is not usually operating at night.

PVI-STRINGCOMB can be kept active at night using an insulated external power supply (24Vdc: Ref. §Appendix A: Technical Data).
In this way any antitheft, monitoring and serial communication functions will stay active.

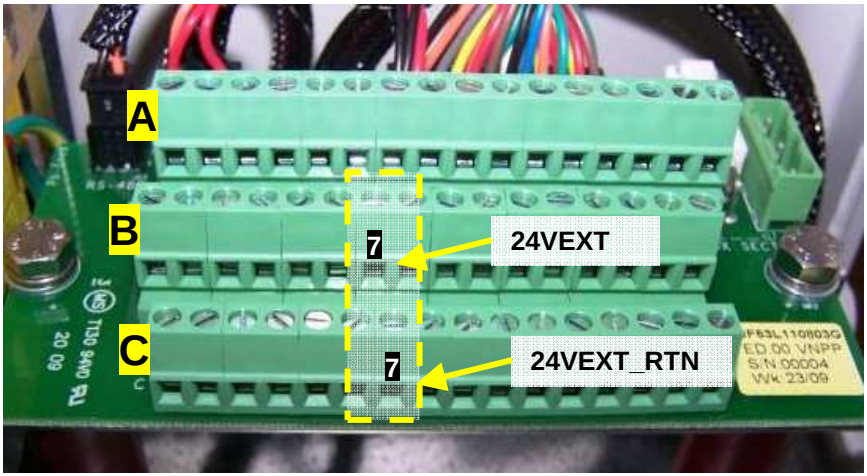


Figure 9-14: Terminals for external +24VDC supply connection

X7	
A	ALARM_IN-
B	+24VEXT
C	+24VEXT_RTN

Table 9-7: Table of external +24VDC supply connection

When an external (24VDC) power supply is used, set S3 switch, in Figure 9-15, to ON-EXT position.

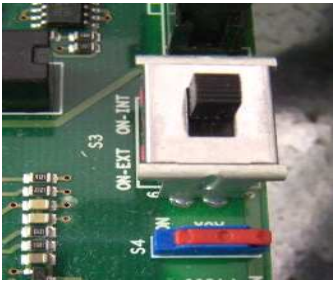


Figure 9-15: External +24VDC supply switch

If no external power supply is used, make sure the S3 switch is set to ON-INT position.

9.3.9 Isolating switch auxiliary status contact

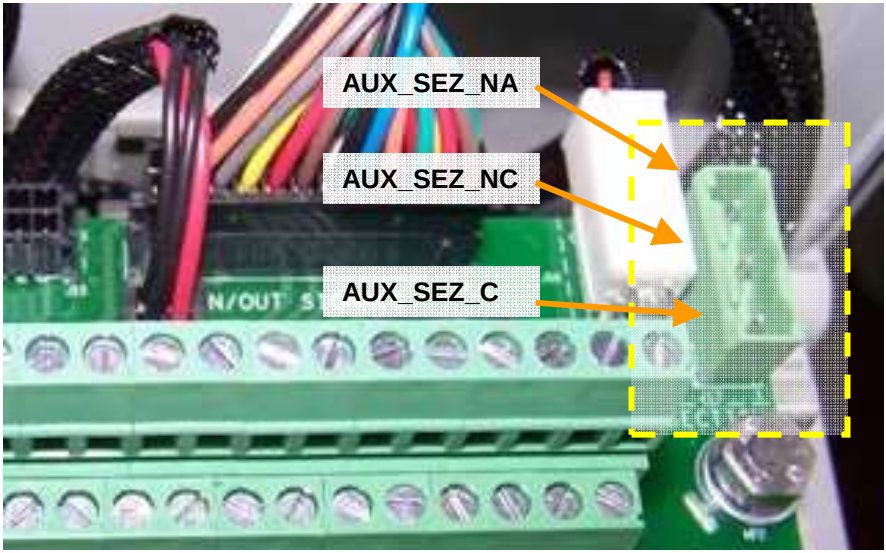


Figure 9-16: Isolating switch status connector

The DC isolating switch status can be remotely checked through the auxiliary contact (Figure 6-6). (Ref.§Appendix A: Technical Data).

J17	
1	AUX_SEZ_C
2	AUX_SEZ_NC
3	AUX_SEZ_NA

Riferimento contatti con SEZIONATORE ON

Table 9-8: Table of isolating switch auxiliary contact connection

9.3.10 Earth connection

Ground the earth terminal, passing the wire through the gland indicated as "E".

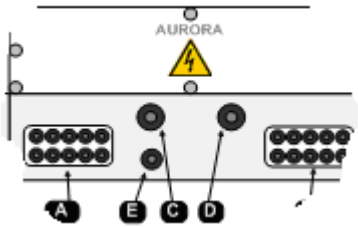


Figure 9-17: Cable gland for ground connection

9.3.11 Check on inverter side connections

Before continuing with the next steps, check that:

(A) The switches/isolators of the DC voltage are OFF (in the inverter)
(B) The wires coming from the inverter are not live! (check directly with a voltage meter)

9.3.11.1 Connection of the positive output wire (+)

After checking the above, pass the wire (positive pole) coming from the inverter through the cable gland “C” of the Figure 4-3 and connect it, with the screw and nut, to the “+” bar.

The copper bar for the positive pole features a threaded bore and M10 bolt with washers (supplied) (Ref. §Appendix A: Technical Data). Check that the lug is tight.

9.3.11.2 Connection of the negative output wire (-)

Carefully follow the instructions of the previous point for the negative pole. Pass the wire coming from the inverter through the gland “D” of the Figure 4-3 and connect it, with the screw and nut, to the “-” bar.

The copper bar for the negative pole features a threaded bore and M10 bolt with washers (supplied) (Ref. §Appendix A: Technical Data). Check that the lug is tight.

9.3.12 Connection of the positive pole of the strings (+) [for max 10 strings]

The positive of pole of the strings must be connected to the terminal board indicated by the label “STRING POSITIVE”.

Figure 9-18: Cable gland for positive strings connection

Insert the special screwdriver (Figure 9-19) into the clamp (pushing it home!) in order to completely open the contact. Push the wire (positive pole) coming from the string through the cable gland provided (Figure 9-18) and connect it individually to the terminal. Then remove the screwdriver and pull on the wire to check that it is correctly inserted. Repeat the operation for all the other wires.

Connect all the wires according to a logical sequence, S1+ with F1, S2+ with F2, …., S10+ with F10, where F1, F2, ..., F10 indicate the position of the fuses (on the board for positive strings, Figure 6-4 “A”, F1 is the first on the left while F10 is the last one on the right, at the output bar to positive pole).

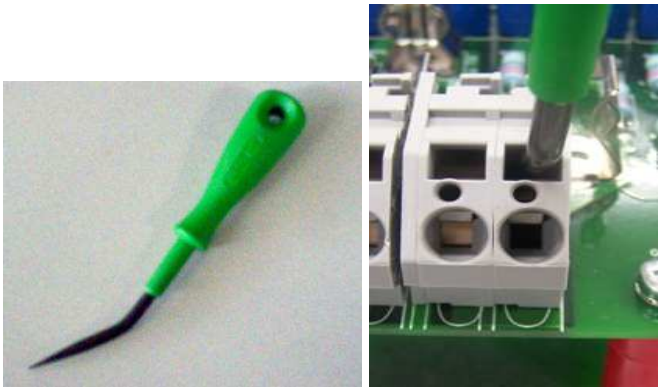


Figure 9-19: Use the special screwdriver on the terminals

Replace the Plexiglas panel on the positive side using the specific screws, paying particular attention not to accidentally touch the exposed electrical parts.

9.3.13 Connection of the Negative poles of the strings (-) [for max 10 strings]



The positive of pole of the strings must be connected to the terminal board indicated by the label “STRING NEGATIVE”.

Figure 9-20: Cable gland for negative strings connection

Insert the special screwdriver provided (Figure 9-19) into the clamp (pushing it home!) in order to completely open the contact. Push the wire (negative pole) coming from the string through the cable gland provided (Figure 9-20) and connect it individually to the terminal. Then remove the screwdriver and pull on the wire to check that it is correctly inserted. Repeat the operation for all the other wires.

Connect all the negative wires according to the same logical sequence used for the positive ones, S1- with F11, S2- with F12, …., S10- with F20, where F11, F12, ..., F20 indicate the position of the fuses (on the board for positive strings, Figure 6-4 “B”, F11 is the first on the left at the output bar to negative pole while F20 is the last one on the right).

Check that the LED indicated in the figure is flashing (in case of problems, see Chapter §13)

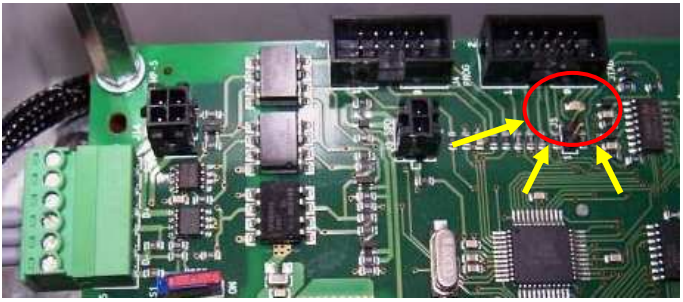


Figure 9-21: LED indicating normal operation

Replace the Plexiglas panel on the negative side using the specific screws, paying particular attention not to accidentally touch the exposed electrical parts.

9.3.14 Connection of Strings [over 10 strings]

If more than 10 strings must be connected, they must be connected in parallel, two by two, according to the following logical sequence, for example:

For positive poles: (S1+, S2+ with F1), (S3+, S4+ with F2), …..,(S19+, S20+ with F10)

For negative poles: (S1-, S2- with F11), (S3-, S4- with F12), ….., (S19-, S20- with F20)

To connect the strings, both positive and negative poles, the instructions in §9.3.12 and 9.3.13 respectively must be strictly followed.

In this case, the cable glands to be used must be positioned on the side flanges (Figure 4-3)

9.3.15 Setting the DC switch (only version –S)

If there is a switch/isolator (PVI-STRINGCOMB-S), it must be opened, turning it to position 0 (green window).

9.3.16 Connection of the other PVI-STRINGCOMB(-S)

If there are other PVI-STRINGCOMB(-S) devices, carry out the same procedures described above before going on to the next step.

9.3.17 Closing the DC switch (only version –S)

If the devices are of the PVI-STRINGCOMB-S type, close the switch/isolator in order to send voltage to the inverter.

9.3.18 Final checks

(A) Check that the cable glands are tightened.
(B) Make sure that any unused cable glands are plugged off with the caps provided.
(C) **If the PVI-STRINGCOMB(-S) on which you are working is the last of the serial chain, make sure that the termination is correctly inserted** (Ref. §9.3.2). Otherwise, make sure that the termination is disconnected.
(D) Take note of the Serial Number (S/N) given on the label affixed to the external surface (Figure 1-1).

9.3.19 Closing the cover

Place the cover on the base and tighten all the 8 screws using a suitable flat blade screwdriver of the correct size for plastic screws, to avoid damaging it. In order to close the cover correctly, it is advisable to do the screws loosely at first and tighten them when the cover is perfectly placed.

9.3.20 Assigning the FIELD NUMBER

At this point, it is necessary to assign a number to the PVI-STRINGCOMB(-S) devices connected to the system.
For this, a Computer containing the monitoring software is required (Ref. **§**11), using the direct connection of Figure 7-3 as indicated in point B.
In general, follow the instructions given in (Chapter §12).

To make the S/N association of the PVI-STRINGCOMB(-S) with the chosen identity number (Field Number) more evident, the number should be written on the outside of the container.

10 DISCONNECTION AND MAINTENANCE

This chapter describes the operations necessary to disconnect the device and to operate inside the same safely.
The type of disconnection depends on the work to be carried out.
If the device is being scrapped, it must be completely disconnected.

The equipment is designed to provide a lifetime operation of not less than five years, in the environment and for the type of application specified. No routine maintenance operations are envisaged, whereas unscheduled maintenance interventions are not generally predictable and are due to verify the installation, to disconnect the photovoltaic field and to replace faulty components.

10.1 Disconnection of the PVI-STRINGCOMB(-S)

If it is necessary to remove the PVI-STRINGCOMB(-S) or, in any case, to insulate it completely from the rest of the system, it is absolutely necessary to disconnect the device on both DC sides, i.e. from the photovoltaic field and from the inverter. To do this, the voltage supplied by the individual strings and that from the DC output voltage connected to the inverter must be cut off.

10.1.1 Complete disconnection

Proceed according to the following steps and according to the instructions and precautions given in the points referred to below (Ref. §9.3):

1) Switch off the inverter and disconnect it from the DC side (§9.3.11 excluding point (B)).
2) Open the cover.
3) Open the DC switch (§9.3.15), if present (model PVI-STRINGCOMB-S).
4) Remove the Plexiglas panel on positive side (§9.3.1) and disconnect the positive strings as explained under paragraph §9.3.12.
5) Remove the Plexiglas panel on negative side (§9.3.1) and disconnect the negative strings as explained under paragraph §9.3.13.
6) Before proceeding with the next step, make sure that the DC output wire is not under voltage using a voltage meter (§9.3.11 point (B)).
7) Disconnect the + and – output wires from the respective bar (§9.3.11.1, §9.3.11.2).
8) Loosen the relative cable gland and extract the wires and protect them with adequate insulating protection.
9) Loosen the cable gland of the earth wire, then disconnect it and pull it out.
10) Loosen the cable gland of the communication wire, unscrew the single wires from the Figure 9-5 terminal board and pull it out.
11) Repeat the same operations for any external sensor wires.
12) Reposition the Plexiglas panels, Figure 9-4, unscrew the supporting screws indicated in Figure 9-2 and then refit the cover.
13) If the device is being scrapped, take the PVI-STRINGCOMB(-S) to an authorised disposal centre.

10.1.2 Disconnecting the strings

This paragraph is complementary to the previous paragraph and indicates only the ways for disconnecting the strings.

Before proceeding, open the box and remove the protective devices as indicated in points 1, 2 and 3 of Paragraph §10.1.1.



1) Referring to points 4 and 5 of §10.1.1 (for positive and negative strings, respectively), insert a suitable screwdriver (Figure 9-19) fully home in the terminal, so as to fully open the contact and help wire removal.
2) Unscrew the relative cable gland, disconnect the wire from the terminals and extract it from the box.
3) Protect the wire with a suitable insulating cap.
4) Then remove the screwdriver and proceed with the same sequence for all the other wires of the same board.

10.2 Maintenance (replacement of fuses / dischargers)

Maintenance inside the PVI-STRINGCOMB(-S) must be carried out following the procedures described below.

10.2.1 Replacing the dischargers

In this case, it is not necessary to disconnect the inverter since the overvoltage protection devices have cartridges which can be extracted without risk.



1) Open the cover.
2) Find the faulty cartridges, i.e. those with a red window.
3) Pull out the damaged cartridge and replace it with a new one, pushing it firmly home.
4) Repeat the operation for any other damaged cartridges.
5) Check if present the fuses on the sides of the discharger. These should be replaced if they are opened.
6) Check, by means of the monitoring software and according to the procedure described in Paragraphs § 12.6 and §12.7, that the new cartridges work correctly.
7) Refit the cover.

10.2.2 Replacing the fuses

Before proceeding, comply with the instructions given in points 1, 2, 3 of Paragraph §10.1.1.



1) Remove the faulty fuse, indicated by the monitoring software (Paragraphs §12.6 and §12.7) and replace it with a new fuse of the same type and part number.
2) Repeat the operation for any other faulty fuses.
3) Check that the monitoring software (Paragraphs §12.6 and §12.7) signals no other blown fuse.
4) Close the DC switch, if present (model PVI-STRINGCOMB-S).
5) Refit cover and close it.

11 BEFORE USING THE SOFTWARE

The software developed for the PVI-STRINGCOMB(-S) allows for setting the parameters for transmission (e.g. baud-rate) and control (e.g. overcurrent limit) and for monitoring electrical magnitudes (e.g. string current values).

The computer must have a free COM serial port to be able to communicate with PVI-STRINGCOMB(-S).

Since, as mentioned above in Chapter §7, the serial transmission standard of the PVI-STRINGCOMB(-S) is the RS485, while the COM port of the computer uses the RS232 standard, **an AURORA RS232/485 adaptor must be used** (Aurora 232/485 Converter).
Make sure that the configuration is that shown in Figure 7-3 B.

11.1 Installation of software

Insert the CD provided with the PVI-STRINGCOMB(-S) into the computer and launch the “setup.exe” program, then follow the instructions which come onto the screen.

Afterwards, the icon  “Aurora StringComb Installer” will appear on your Desktop[6] and in the menu *Start* → *Programs* → *Aurora StringComb Installer*.

The next chapter shows how to use the PVI-STRINGCOMB(-S) configuration and monitoring programs.

[6] Future software versions could have a different icon.

12 MONITORING AND CONFIGURATION INTERFACE

12.1 Conventions used

In this chapter the following conventions are used in the text:

- [**BUTTON**]: indicates a button
- (*selection list*): indicates a list from which an item must be selected
- *Menu name:* indicates the name of a menu

12.2 Access levels

The software allows for two separate access levels:

- **Standard (User)**: this only allows monitoring. The alarm/measurement parameters can not be modified. Some of the program windows have hidden and/or limited functions.
- **Advanced (Technic)**: this allows for monitoring and modification of the alarm/measurement parameters. All the program functions are enabled except for some which are the exclusive competence of the manufacturer.


The password for advanced access is “aurora”[7].

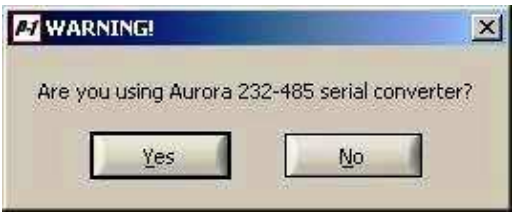
[7] The password can not be changed. Always use small letters (lower case).

12.3 First installation

➲ Click twice on the icon  of the “Aurora StringComb Installer” program and wait for the following window to appear:

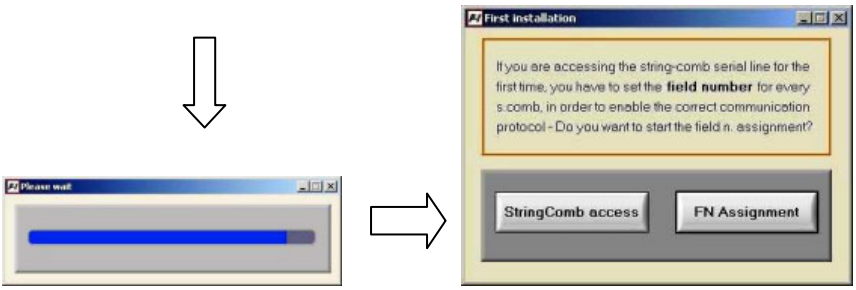
Do not change the baud-rate parameter (default 9600)

➲ Choose the COM port (*COM List*) to which the RS485/232 converter is connected.
➲ Press [**Configure COM**].

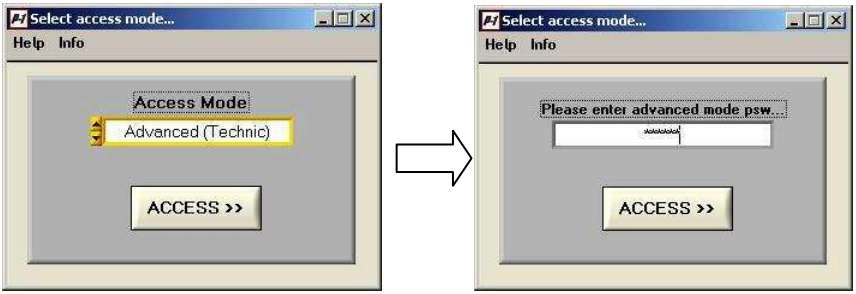


➲ Choose [**YES**] if you are using an AURORA converter.
➲ Choose [**NO**] if you are using a converter from another supplier (**in this case Power-One does not guarantee compatibility for operation**) and make sure that the converter is configured at 9600 bps.

➲ The following wait bar will appear before the next window:



➲ If it is the first connection to the PVI-STRINGCOMB(-S) it is essential to assign the FIELD NUMBER to the various units. Press [**FN Assignment**], then choose the Technic access mode and press [**ACCESS>>**].



➲ Enter the advanced access password “aurora” and press [**ACCESS>>**].
➲ If it is not the first installation or if, in any case, you have decided to assign the Field Number, see the next paragraph; otherwise go directly to Paragraph 12.5.

- Enter the advanced access password “aurora” and press [**ACCESS>>**].
- If it is not the first installation or if, in any case, you have decided to assign the Field Number, see the next paragraph; otherwise go directly to Paragraph 12.5.

12.4 Assigning the Field Number

12.4.1 What is the Field Number?

During the installation phase (Paragraph §9.3.18 item D), the serial numbers (S/N) of all the PVI-STRINGCOMB(-S) devices of the system have been noted and the creation of an installation map has been suggested, with indication of the identification numbers (Field Numbers) (see the example in Figure 12-1).

Every Aurora StringComb must be assigned a Field Number.

The figure below shows a system with 4 PVI-STRINGCOMB(-S) installed.
The boxes are positioned in three separate zones, called A, B and C.
For example, FN=1 will be assigned to S/N 30, FN=2 will be assigned to S/N 77, FN=3 will be assigned to S/N 96, and FN=4 to S/N 02.

In conclusion, the Field Number and an installation map allow for identifying the position of the PVI-STRINGCOMB(-S) devices which are part of the system.

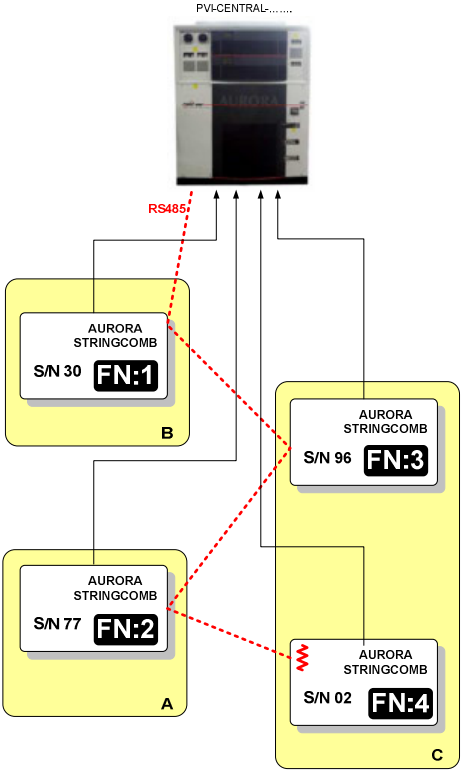
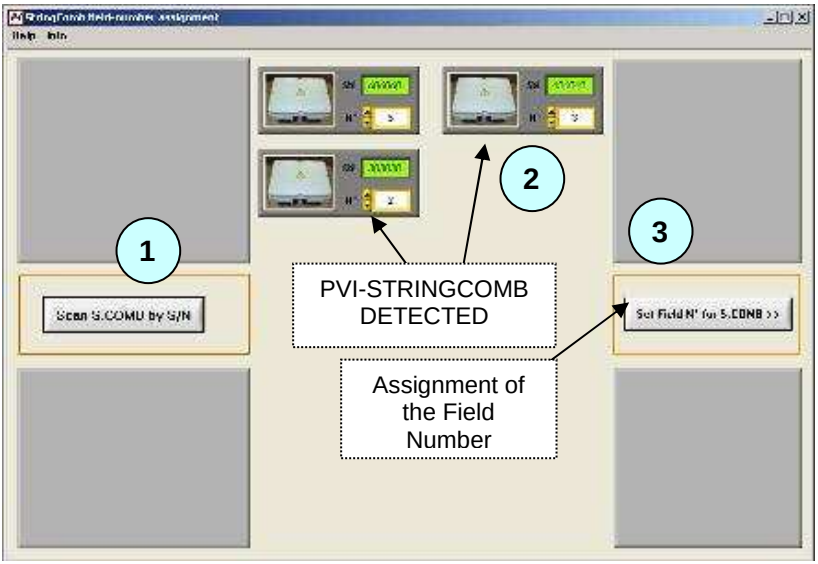


Figure 12-1: Example of a complete system map

12.4.2 Operations for assigning the Field Number

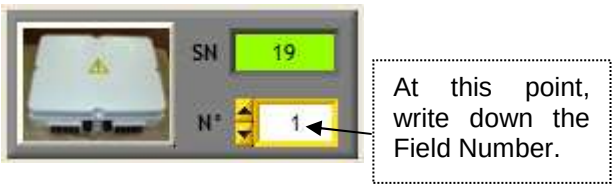
➲ From this window, the Field Number can be assigned to all the PVI-STRINGCOMB(-S) connected on the RS485 line.



Follow the steps below:

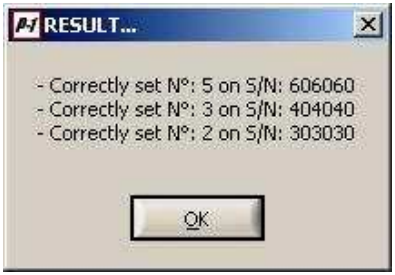
① **Press** [**Scan S.COMB by S/N**]: the system will find all the STRINGCOMB devices connected and operating. Every unit will be identified by a different S/N.

② **Set the No.**: assign the Field Number (default is always 1) to each unit found and according to the description given in Paragraph §12.4.1.

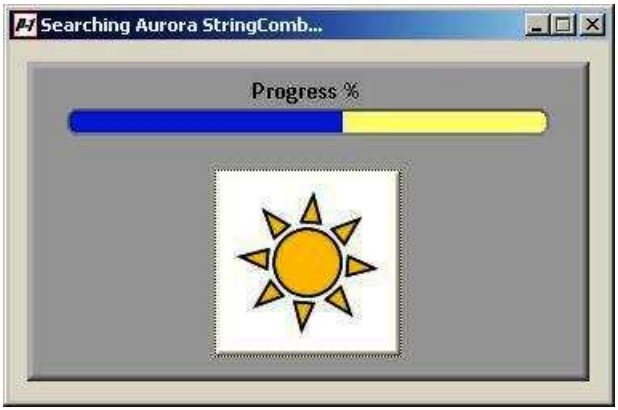


After assigning all the FN, go on to the next point.

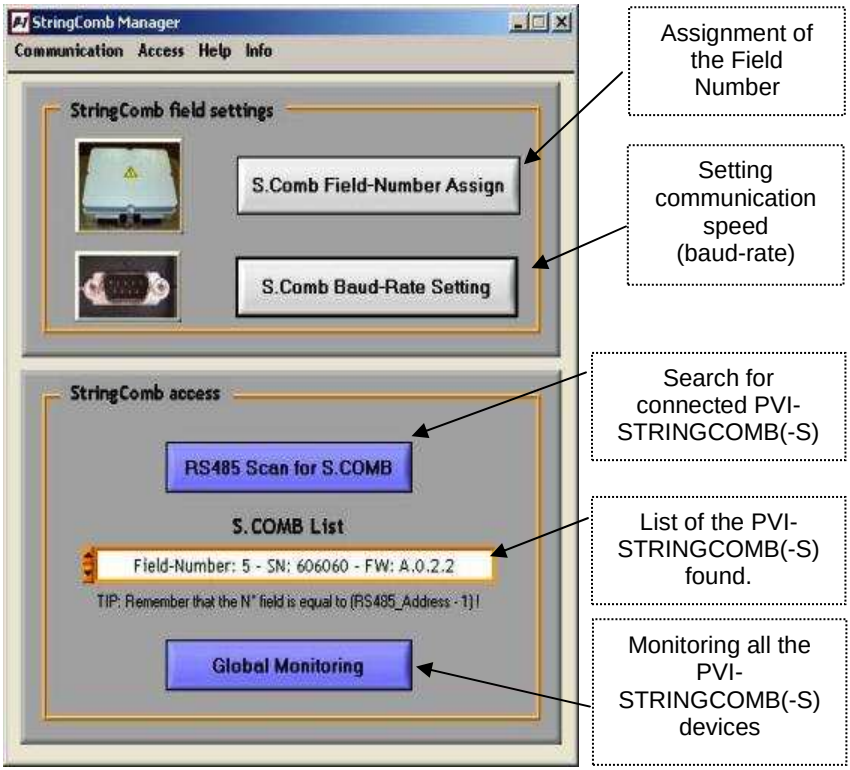
③ **Press** [**Set Field N°for S.COMB >>**]: The Field Numbers (FN) will be assigned to all the StringComb and the following confirmation window will be displayed.



- Check that the operation has been carried out correctly and then press [**OK**]: if there are any errors, press [**OK**] and then repeat the operation.
- Close the window by pressing the button . The program will look for the connected PVI-STRINGCOMB(-S) devices.



12.5 PVI-STRINGCOMB Manager

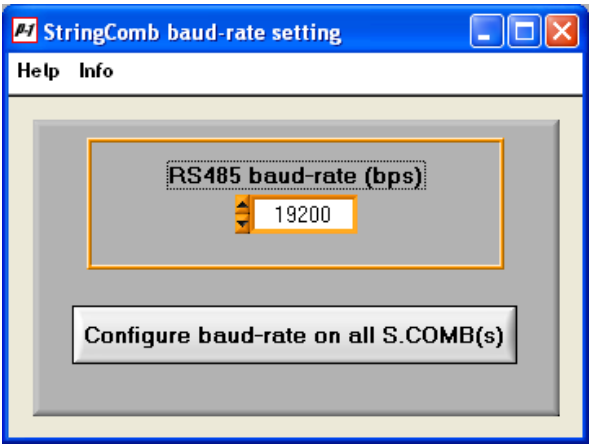


➲ The *StringComb Manager* window gives access to all the functions as indicated in the figure.

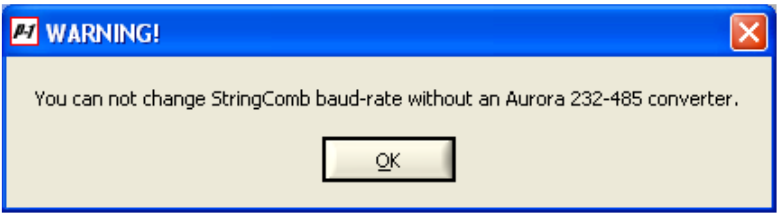
☞ The "StringComb field settings" zone is visible only in the "Advanced (Technic)" mode

12.5.1 S.Comb Baud-Rate Setting

Communication speed of the PVI-STRINGCOMB(-S) is set by means of this window, accessible by pressing [**S.Comb Baud-Rate setting**] in the window *StringComb Manager*.



- Select the speed and press the key [**Configure baud-rate on all S.COMB(s)**].
- The following window will appear if a converter other than the Aurora RS232-485 Converter is used.



If transmission speed is changed using a different converter, other than the Aurora RS232-485 Converter, it is highly likely that you will no longer be able to communicate with the PVI-STRINGCOMB(-S).
DO NOT CHANGE SPEED WITHOUT USING AN AURORA CONVERTER.

12.6 PVI-STRINGCOMB Monitoring (Global)

➲ After pressing the button [**Global Monitoring**] in the S.C.*Manager* window, you can then display all the PVI-STRINGCOMB(-S) devices in operation and the relative main parameters as in Figure 12-2.

Figure 12-2: Global Monitoring Panel

➲ In the above situation, it can be noticed that:
- the system is composed of 3 PVI-STRINGCOMB(-S);
- S/N 303030 has been assigned FIELD NUMBER no.2, S/N 404040 has been assigned FIELD NUMBER no.3 and S/N 606060 has been assigned FIELD NUMBER no.5.
- They are all signalling the absence of faulty situations (green icon)
- The shadowed StringComb are not present.
- For every StringComb, the system measures the global current (Amps) of the photovoltaic field (Global Current), the global voltage (Volt) of the field, and lastly the internal temperature in degrees centigrade (Inner Temp).

➲ To see the detail of every single StringComb, press on the menu *S.COMB Selection* → *S.COMB Manager*. Then select the PVI-STRINGCOMB(-S) to be displayed and press [**Enter Selected S.COMB**].

12.7 PVI-STRINGCOMB Monitoring (Single)

The main screen of the monitoring system is divided as follows:

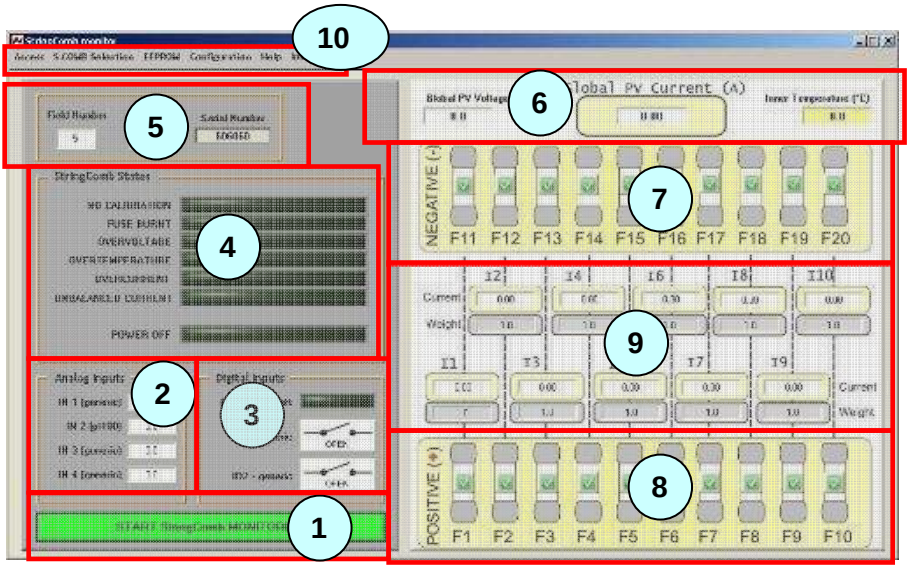


Figure 12-3: Single Monitoring Panel

(1) **Monitoring start button**. It flashes when monitoring is started.
(2) **Levels of signals coming from the external sensors**. The measurement of these levels can be set from the menu *Configuration* → *Aux-inputs settings* (see Paragraph §12.8.3).
(3) **Digital signals and antitheft warning light status**. The measurement of these levels can be set from the menu *Configuration* → *Digital Inputs settings* (Ref. §12.8.4).
(4) **PVI-STRINGCOMB(-S) Status.** Parameter status indication: green (OK) / red (NOT OK).

The failure indications (red) are the following:

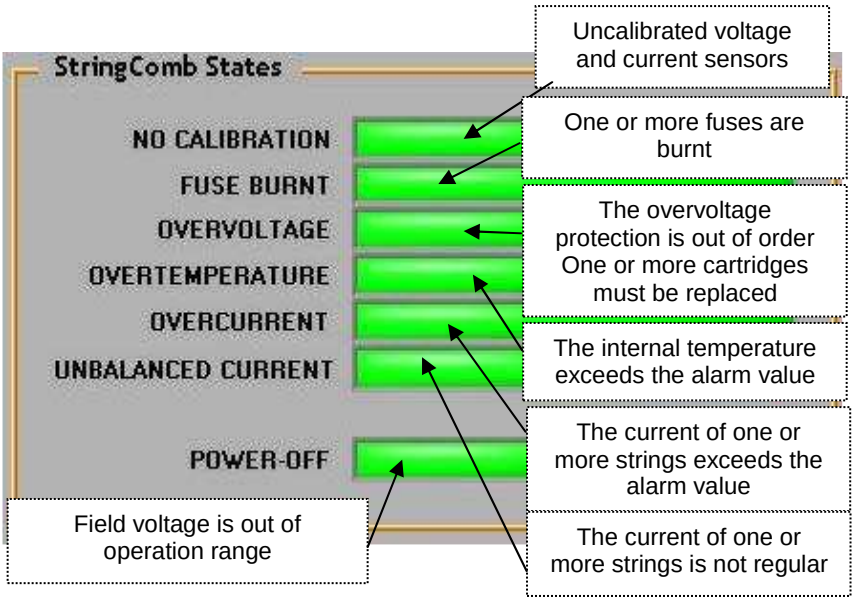


Figure 12-4: PVI-STRINGCOMB(-S) Status Panel

(5) **Address and S/N**: it shows the Field Number (FN) and the Serial Number of the PVI-STRINGCOMB(-S) monitored. The RS485 address is also shown, which is always the same as FN+1.
(6) **Global data**: These include the voltage and total current of the field. The temperature inside the StringComb is also shown.
(7) **Negative (-) String Fuse Status**: This indicates the status of the fuses from F11 to F20 with a green (OK) or red (FAILURE) signal.
(8) **Positive (+) String Fuse Status**: This indicates the status of the fuses from F1 to F10 with a green (OK) or red (FAILURE) signal.
(9) **String current and weight**: the next figure shows how to interpret the window in question:

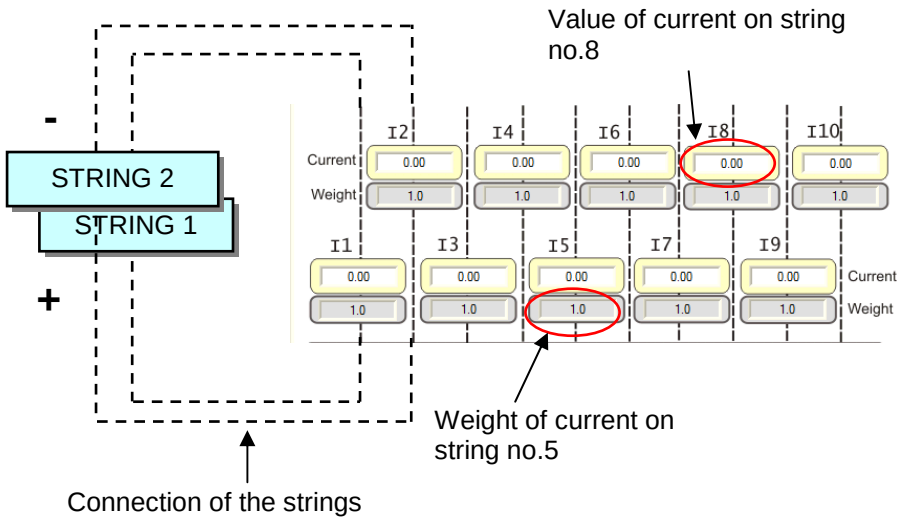
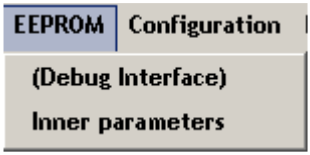


Figure 12-5: Current / weight reading panel

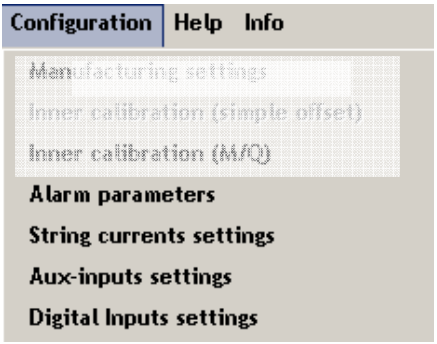
(10) **Monitor panel menu**: the following figures show the construction of the main menus:

Choice of "advanced" or "standard" mode and return to the Manager (Paragraph §12.5).

Return directly to the Manager (Paragraph §12.5).



Access to the Debug mode and to the internal memory settings (*).



Access to (only Advanced):

Factory settings (*)

Internal current calibration (*)

Alarm parameters

Setting of current "weights"

Setting of Auxiliary inputs

Setting of Digital inputs

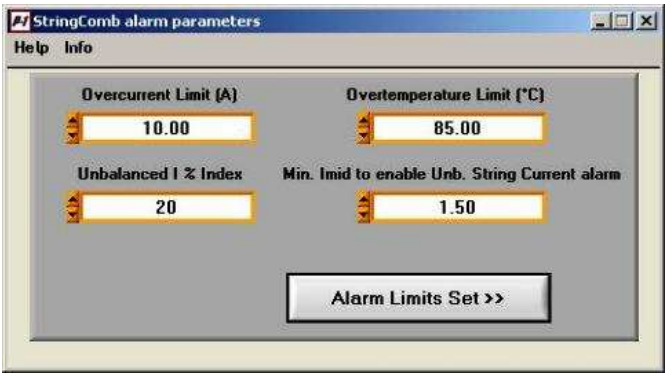
The *Info* menu shows the version of the software.

(*) Software sections reserved for the manufacturer's use. These sections are not accessible and are deactivated.

12.8 Detail of Configuration sub-menu

12.8.1 Configuration → Alarm Parameters

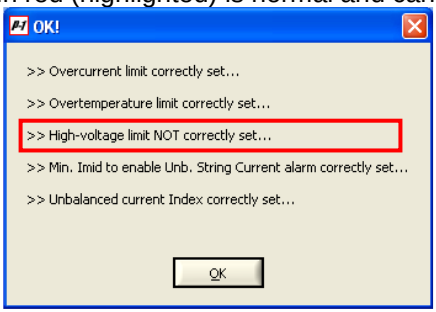
In this section, the following alarm levels of the PVI-STRINGCOMB(-S) can be modified:



- Overcurrent on the string.
- Maximum internal temperature (a setting of more than 90℃ is not recommended).
- Current percentage index to establish conditions of imbalance.
- Average minimum current above which imbalance is detected.

➲ Press [**Alarm Limits Set >>**] to save the new limits. A confirmation window of the new settings will appear.

NOTE: The indication in red (highlighted) is normal and can be ignored.



➲ Check that the operation has been carried out correctly and then press [**OK**]: if there are any errors, press [**OK**] and then repeat the operation.

Press the button  to close the window and return to the StringComb Monitor screen.

EXAMPLE:
10 strings are used. Index of imbalance set at 10%. Average minimum current for imbalance 2A. All weights are at 1.

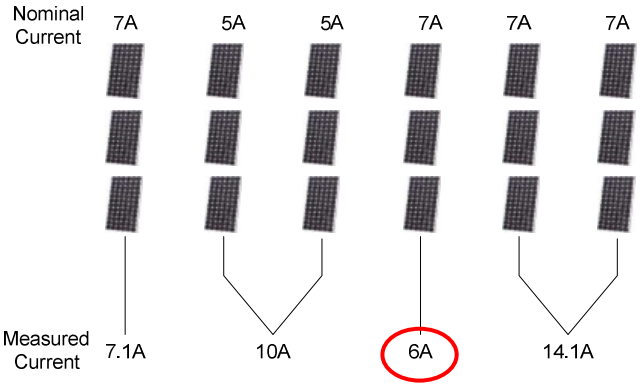
CASE 1: 9 strings are issuing 1.5A except one which is issuing 0A. The average current is 1.35A. No anomaly signal is triggered off.

CASE 2: 8 strings are issuing 5A, one 4.5A and one 2.5A. The average current is 4.7A. The limits within which imbalance is not detected are 4.23A – 5.17A. No anomaly signal is triggered off on the string with 4.5A and on the strings with 5A. A current imbalance signal will be generated on the string with 2.5A.

12.8.2 Configuration → String Current Settings

DO NOT CONFIGURE THESE SETTINGS BEFORE READING THIS PARAGRAPH.
Before calibrating the current weights, it is absolutely essential for the system planner to check that the current of each string complies with the nominal values of the current of the solar panels used.

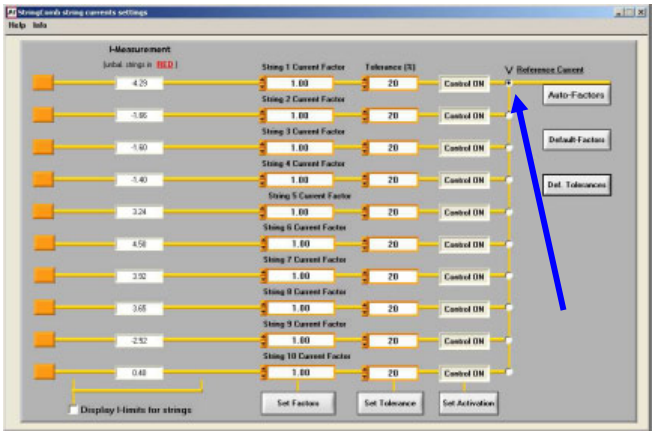
An example is given below (valid for light and temperature conditions which are the same as the nominal conditions indicated in the data sheet of the panels used):



The figure shows that in nominal conditions of light the 4th string does not output the nominal current foreseen.

In this case, before calibrating the weights, it is necessary to check whether the string in question has any anomalies.

This panel allows for setting the “weight” of the current of every string so that the most accurate imbalance control is possible.



To set the weight of every string, carry out the following procedure:

Carry out the following operations in conditions of fixed light so that the parameters will be constant.

- *Automatic method*

  a) Choose, by selection (using the arrow shown in the figure), a reference string, the weight of which will be maintained always at 1.
  b) Press [**Auto-Factors**]. The program will calculate the weights of all strings automatically.

- *Manual method*

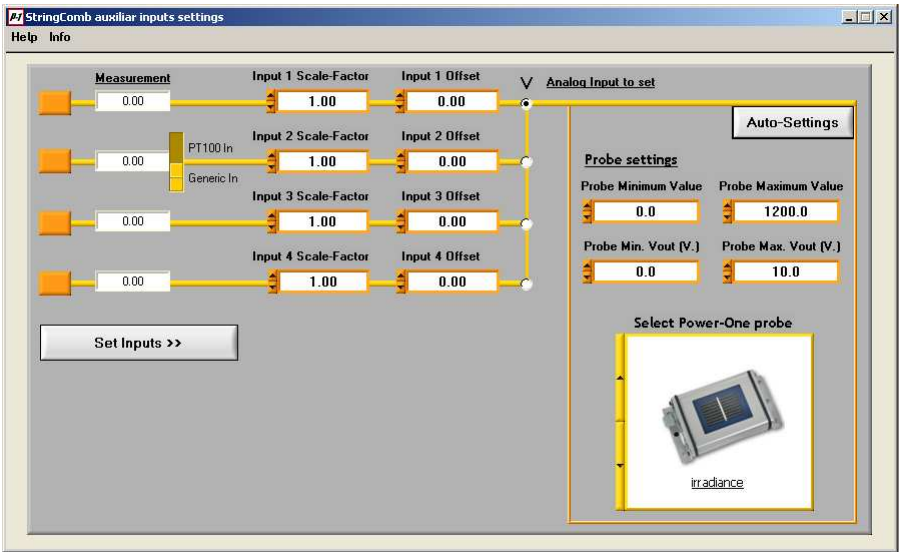
  a) Choose a reference string, the weight of which will be maintained always at 1.
  b) Calculate the weight of the other strings by dividing the current of every string by that of reference.
  c) Note down the weights of every string and set them on the right hand panel.

- Manually set the weights of the unused strings at 0.
- Then press [**Set I-Factors >>**] to save the new "weights". A confirmation window of the new settings will appear.
- Check that the operation has been carried out correctly and then press [**OK**]: if there are any errors, press [**OK**] and then repeat the operation.

Press the button  to close the window and return to the StringComb Monitor screen.

12.8.3 Configuration → Aux Inputs Settings

This panel allows for setting the scale factor for each of the auxiliary inputs and a possible offset.

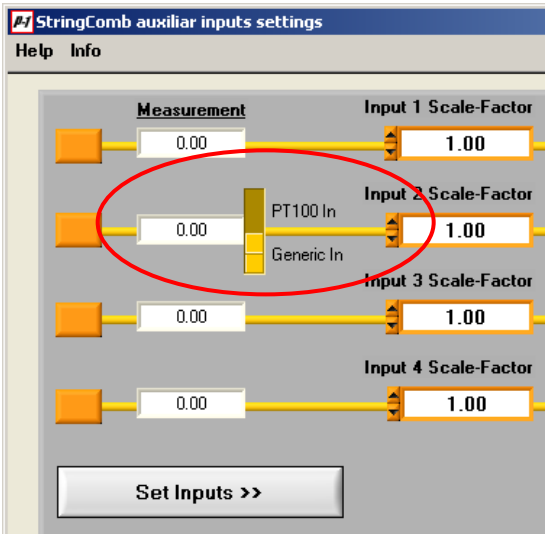


The scale factor is multiplied by the value of the input voltage. Therefore, a variation in the input voltage between 0 and 10V will be displayed by default (Scale Factor = 1) as 0-10.

The offset is added to the scaled value.

- ➲ Press [**Set Inputs >>**] to save the values. A confirmation window of the settings will appear.
- ➲ Check that the operation has been carried out correctly and then press [**OK**]: if there are any errors, press [**OK**] and then repeat the operation.

T_Cell input function can be switched (Ref.§9.3.3) and said input can be used for PT100 sensor reading.



➲ Move cursor to PT100 side. A confirmation window of the settings will appear.

➲ On control board (Figure 6-1 H), set S2 switch (Figure 12-6) to ON and press [**OK**].
➲ Carry out the same procedure to restore general opearting mode of ID1 input.

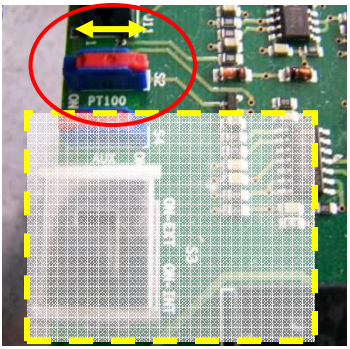


Figure 12-6: S2 switch to enable PT100

Figure 12-7 shows the difference in IN2 monitoring: before and after selection.

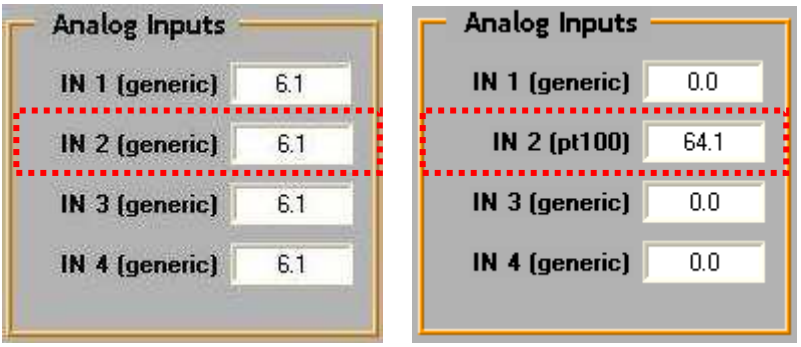
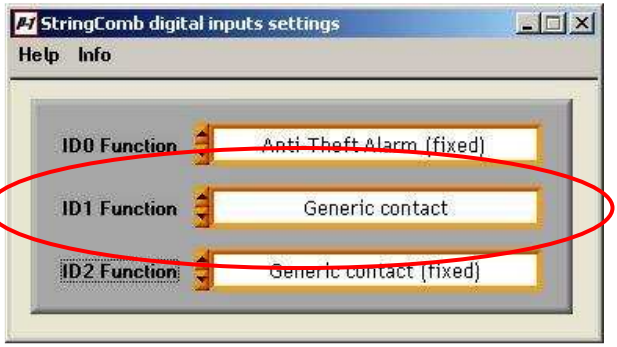


Figure 12-7: Auxiliary inputs monitoring (IN2 Generic, IN2 PT100)

12.8.4 Configuration → Digital Inputs Settings

This window allows user to view the association of digital inputs ID0, ID1 and ID2. "ID1" input can be used as general contact or to check isolating switch status (Figure 6-1), using the corresponding drop-down menu.



➲ From the drop-down menu, select "Generic contact" or "DC isolation switch state". A confirmation window of the software settings will appear.

- On control board (Figure 6-1 H), set S4 switch (Figure 12-8) to ON and press [**OK**].
- Carry out the same procedure to restore general function.

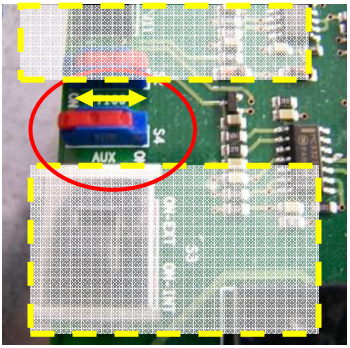
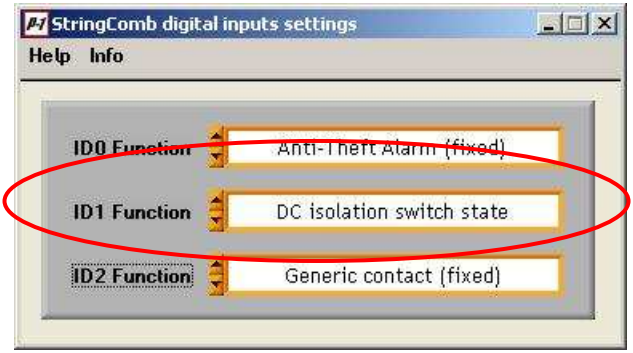


Figure 12-8: S4 switch to enable isolating switch status check



- Press the button  to close the window and return to the StringComb Monitor screen.

The
Figure 12-9 shows the difference in ID1 monitoring: before and after selection.

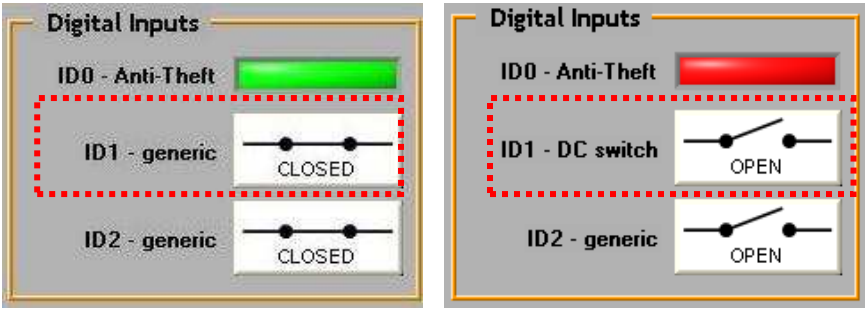
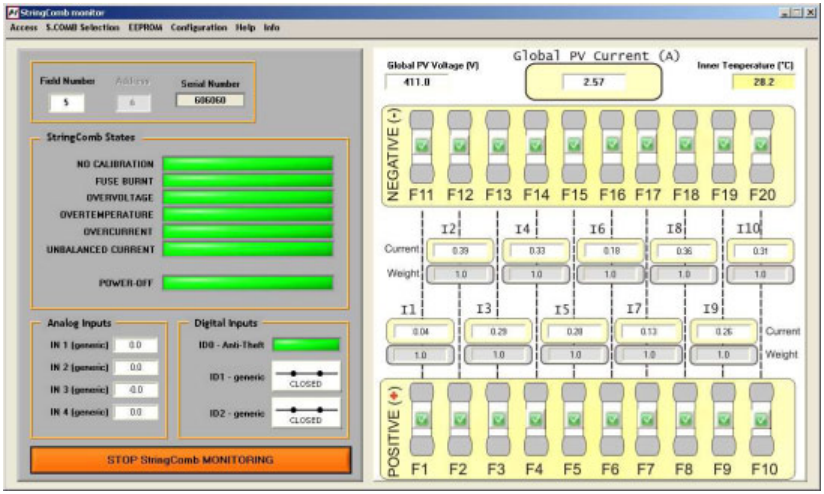


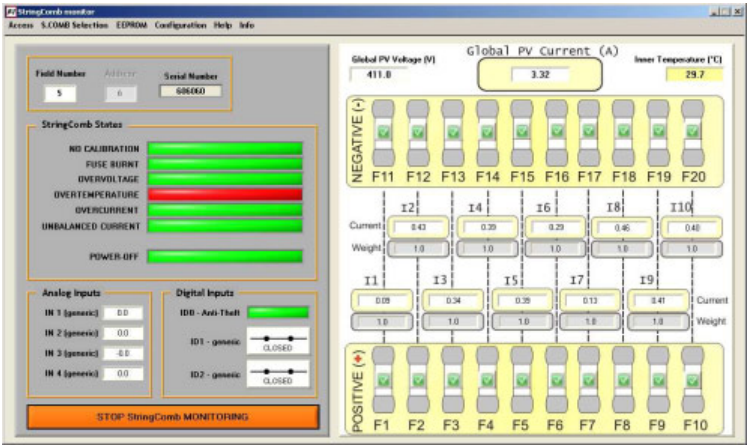
Figure 12-9: Digital inputs monitoring (ID1 Generic, ID1 DCswitch)

12.9 MONITORING EXAMPLES

Any picture in this section is given as a reference only and might show some not realistic situations. Our purpose being exclusively to demonstrate and bring examples of the monitoring software operation.



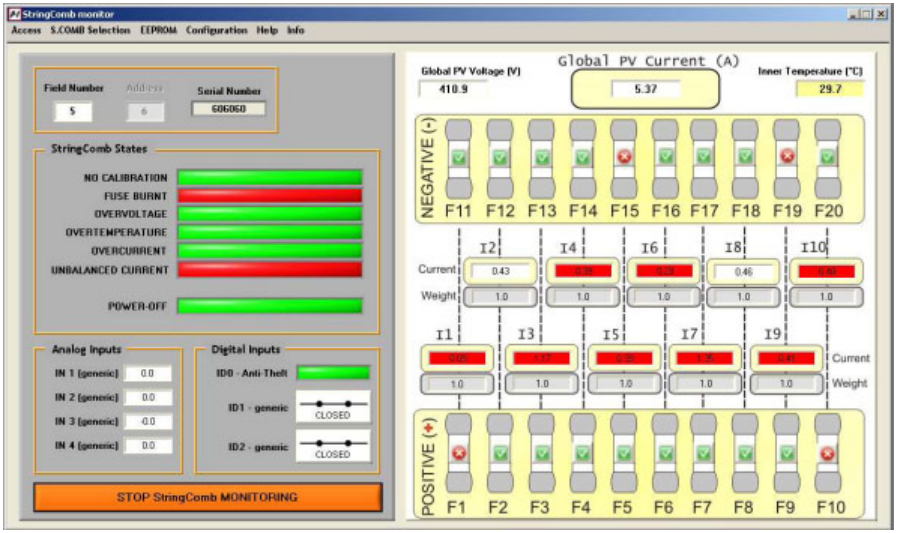
The first screen shows normal operation: Following is the indication of an “overtemperature” fault (Ref. §12.8.1)



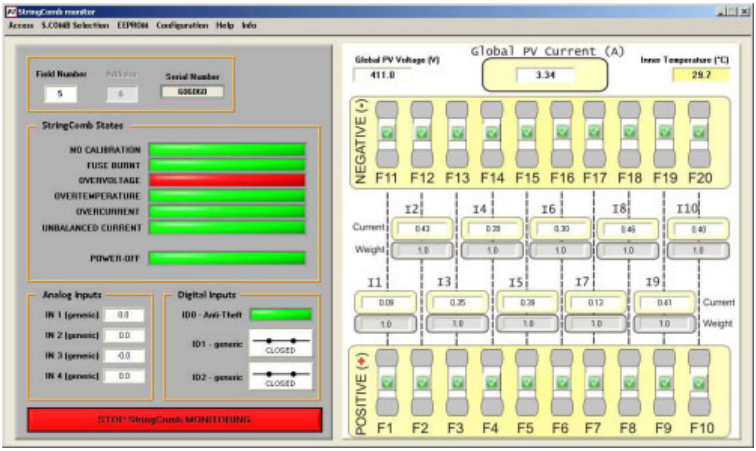
The following page warns about some faults:

- Fuses F1, F10, F15, F19 faulty
- Unbalance of current I1, I3, I4, I5, I6, I7, I9 and I10

“Unbalanced Current” and “Fuse Burnt” are indicated on the status panel.

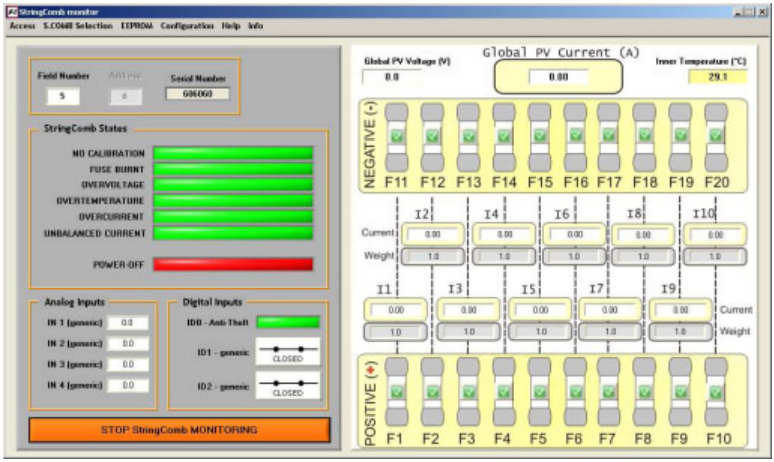


Below is the page indicating possible tripping of the “overvoltage” protection.



The page below indicates “power-off” condition.

“Power-off” conditions are true when field voltage goes beyond the operation range (Ref. §Appendix A: Technical Data). Under these conditions, PVI-STRINGCOMB(-S) automatically limits some internal functions. This situation persists until field voltage goes back within specified range.



13 TROUBLESHOOTING

Follow the indications of the following table if the problem found coincides with that in the table.
In the case of doubt or if none of the solutions is of any help, you must contact the supplier.

Table 13-1: Troubleshooting

PROBLEM	POSSIBLE CAUSE	SOLUTION
Software		
The serial communication of one or more StringCombs does not work	a) The line is interrupted b) Incorrect terminal c) Incorrect Field Number d) Board failure	Check that: a) There are no interruptions on the line b) Only the terminal of the last element of the chain is enabled (§7 and § 9.3-9.3.2) c) There are no two identical addresses (§12.4) d) Contact the supplier
The system signals that one string is not working (No current)	a) The string is not connected b) The string is faulty	a) Check that the + and – ends are correctly installed. b) The string has an interruption in the circuit outside the PVI-STRINGCOMB(-S).
The system signals that some strings are not working (Current imbalance)	a) The weights set in the software are incorrect. b) The strings may not be similar.	a) Check the assignment of the current weights in the software. b) Make sure that the solar panels are of the same type.
Communication works but none of the STRINGCOMB devices are "visible" from the program scan	a) The baud-rate configuration of the PVI-STRINGCOMB(-S) is different from that of the converters. b) The converter is incompatible	a) Use the default 9600 baud rate configuration. b) Use an Aurora RS485/232 converter.
Discharger (OVR) out of order	The OVR has been triggered (for excess voltage) and must be replaced.	Replace the damaged cartridge(s) (§10.2.1)

PROBLEM	POSSIBLE CAUSE	SOLUTION
Burnt fuse	Too much current flowed to the string	Change the fuse (§10.2.2) If the problem arises again, check for anomalies on the string.
The single monitor window shows no parameter or signal	The button [**Start StringComb Monitoring**] button has not been pressed.	Press the [**Start StringComb Monitoring**] button.
Environment and Visual Controls		
Red led On	The Micro is blocked	Contact the supplier
Red led off	a) Board power failure b) Probable board fault	a) The board is fed directly from the panels. Check that the environmental conditions are adequate (e.g.: that there is sunlight). Also check that at least one string (+ and -) is connected and that the string fuses are connected. b) Contact the supplier
There is water inside the box	a) The box was not correctly closed. b) The cable glands were not tightened correctly. c) The box is damaged	a) Check correct sealing and that the surface supporting the PVI-STRINGCOMB(-S) is not warped. b) Tighten all cable glands and make sure that the internal rubber protection is present and intact. Unused cable glands must be sealed with appropriate caps or silicon. c) Contact the supplier
Inverter		
The inverter is not getting DC from the panels	a) The switch on the PVI-STRINGCOMB-S is open. b) Interruption on the DC line	a) Close the DC switch inside the PVI-STRINGCOMB-S. b) Are the DC output wires connected? Are the string fuses inserted?
The inverter signals a generic fault on a stringcomb.	Check the cause on the inverter display	Check whether the following points cover this case. Otherwise contact the supplier.

13.1 Before contacting the technician (Questionnaire)

In the case of problems which can not be solved directly, and in any case when it is necessary to contact the supplier for assistance, take note of the following information:

(A) Type of problem

(B) How many PVI-STRINGCOMB(-S) there are in the system.

(C) How many PVI-STRINGCOMB(-S) show a problem.

(D) Where they are installed. (Roof, ground, etc.)

(E) Is the last PVI-STRINGCOMB(-S) of the serial chain correctly terminated?

(F) How many input strings are there to the PVI-STRINGCOMB(-S)?

(G) The string composition

a. How many panels are connected in series?

b. Type of panels (Constructor and Model)

c. Any other information (e.g: presence of diodes)

(H) Is the photovoltaic field insulated by earth?

14 APPENDIXES

14.1 Appendix A: Technical Data

Table 14-1: Technical Data

CHARACTERISTICS	PVI-STRINGCOMB(-S)
INPUT	
Rated input voltage range [Vdc]	250 - 850
Maximum input voltage [Vdc]	1000
Measurement channels	10
Max. IDC current for each channel [A]	20
Number of DC fuses	20 tot [10 (+), 10 (-)]
Number of strings per fuse	Max 2
Section of each string wire [mm^2]	6
Maximum number of strings (in parallel)	20
Excess input voltage protection	YES (with replaceable cartridges)
OUTPUT	
Maximum output current [ADC]	125
Type of connection for direct current	M10 [max 120mm^2]
Type of earth connection	M8 [35mm^2]
Rating of the DC disconnection switch (Only PVI-STRINGCOMB–S version)	125A / 1000V
SIGNAL INPUT/OUTPUT	
Digital Inputs	no.2 [clean contacts] or n.1 [clean contact] if DC isolating switch status check is enabled
Analogue inputs	no.4 [0-10v] or no.3 [0-10v] if PT100 sensor is enabled
PT100 sensor input	no. 1
24V built-in power supply for sensors	24Vdc / 150mA max
Auxiliary status contact for DC isolating switch	Clean contact [240Vac/6A or 125Vdc/1.1A]
Auxiliary contact for antitheft system	Clean contact [50Vdc/1A max]
Built-in cord-type antitheft device	YES (second class rating antitheft device)

CHARACTERISTICS		PVI-STRINGCOMB(-S)
Auxiliary voltage input		24V / 3A from external source
MECHANICAL and ENVIRONMENTAL DATA		
Dimensions (h x w x d) (without PG) [mm]		560 x 760 x 250
Weight [kg]		25
Degree of environmental protection		IP65
Environmental temperature for normal functioning [℃]		-25 ÷ +55
Storage temperature [℃]		-25 ÷ +65
Relative humidity		from 0 to 95%
Pollution Degree		As per CEI EN 50178 Pollution degree 2 (usually there is only non-conductive pollution)
COMMUNICATIONS		RS485
AVAILABLE DATA	➲ String current ➲ State of string fuses	➲ Internal temperature ➲ Reading of external sensors ➲ Overvoltage protection ➲ Field voltage

Some data can vary without prior warning.

14.2 Appendix B: Declaration of Conformity

power-one
Changing the Shape of Power

PVI-STRINGCOMB Europe (CE Declaration)

Declaration of Conformity

CE MARKING

We, **Power-One, Inc., 740 Calle Plano, Camarillo, CA. 93012 USA** declare under our sole responsibility that the products

Product: Photo-Voltaic String Combiner
Trade Mark: Power-One
Type: Aurora Series
Models : PVI-STRINGCOMB, PVI-STRINGCOMB-S,
PVI-STRINGCOMB-MC & PVI-STRINGCOMB-S-MC

to which this declaration relates, is in compliance with the essential requirements of the following European Directives :

2006/95/EC Council Directive 2006/95/EC of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.
Conformity was proved by the application of the following standard:

EN 50178: 1997

2004/108/EC Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.
Conformity was proved by the application of the following standards:

EN 61000-6-2: 2005
EN 61000-6-4: 2007

The subject products are developed and manufactured in an ISO 9001: 2000 certified factory and are 100% tested on functioning and safety during manufacturing.

Based on the above, the products are eligible to be CE marked.

. / .

Power-One Italy, S.p.A.
52028 Terranuova Bracciolini (Ar) – Via S.Giorgio, 642 – Tel. +39 055.9195.1 – Fax +39 055.9195.248 – Fax +39 055.9195.263 (purch. dept.)
Capitale Sociale € 22.000.000 int. vers. – C.C.I.A.A. Arezzo n. 101220 – Reg. Imp. E Cod. Fisc. 09286180154 – Partita I.V.A. 01574720510
Società soggetta alla direzione e controllo della Power-One Inc.

PVI-STRINGCOMB Europe (CE Declaration)

Note this Declaration of Conformity is not valid any longer, in case, without any written authorization by Power-One, Inc. .
- the product is modified, supplemented or changed in any other way ;
- components, which are not part of the accessories kit, if any, are integrated in the product ;
- the product is used or installed improperly.

(Manufacturer)	Camarillo, CA (Place)	2009 September 25 (Date)

Robert P. White Jr.
(Director of Safety)