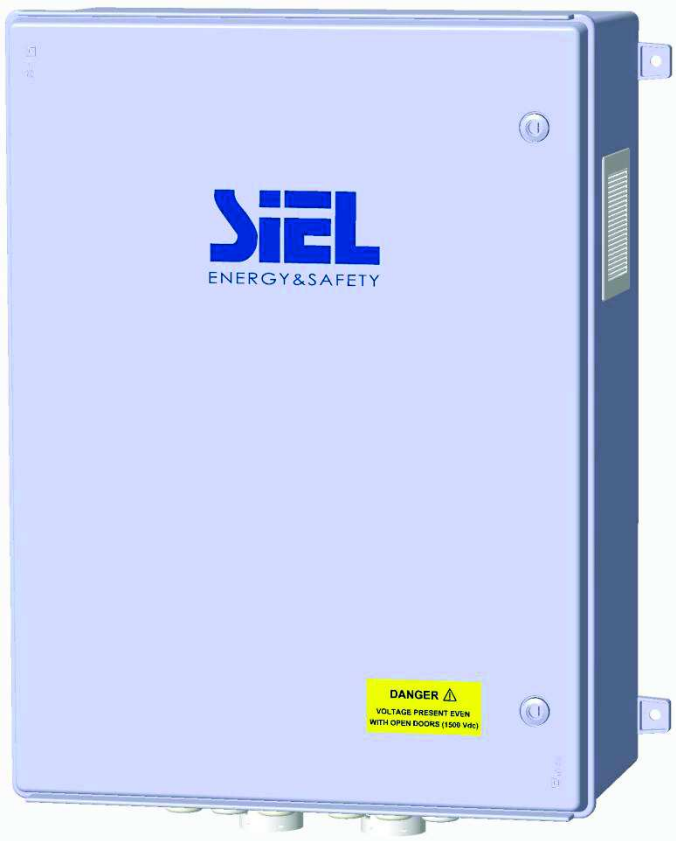
PV STRING BOX-12 1500V

Box for panels series

Operation and Installation Manual



Introduction

The engineers who have contributed to the development of this box for panels series would like to thank you in the first place for choosing the **PV STRING BOX-12 1500V** for your network photovoltaic system.

We believe that owners expect maximum performances and reliability from their SIEL photovoltaic systems. These boxes are designed and manufactured to guarantee long-term efficiency and reliability, and are suitable to be used in large power stations.

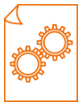
SIEL is always interested in receiving feedback from its customers in order to be able to continuously improve its products.

Operation and Installation Manual

Index

Symbols used in the manual

Graphical symbols have been used in this manual to warn users or draw their attention to different situations of particular importance. The symbols used and their meanings are described below:

LIST OF GRAPHICAL SYMBOLS:	
Symbol:	**Description:**
	**INFORMATION:** Complementary description that must be taken into account. Used to highlight an important note or memo.
	**ATTENTION** Situation that may cause serious damages to equipment or injuries to people.
	**DANGER** Highlights a mandatory instruction. Failure to comply with the instructions highlighted by this symbol may cause accidents with serious damages.
	**INSPECTION UPON RECEIPT** Describes the steps that must be performed upon opening the packaged system.
	**USER** User manual. Instructions on how to use the system, menus and other functions. Installation and start-up.
	**INSTALLER** Maintenance and Supervision Manual. Advanced menu options.

Glossary of technical terms and abbreviations

Term	Description
PV	Photovoltaic field
AC	Alternate current
DC	Direct current
DC line	Line that connects the photovoltaic modules to the box
TT	Ground connection

Compliance with Regulations

(**Note**: for further information on certifications, visit www.sielups.com)

- Direttiva Europea 2006/95/CE in materia di Materiale Elettrico Bassa Tensione
  - EN 62109-1. Safety power converters for use in photovoltaiv power systems – Part 1: General requirements
  - EN 62109-2. Safety power converters for use in photovoltaiv power systems – Part 1: Particular requirements for inverters
- Direttiva Europea 2004/108/CE in materia di Compatibilità Elettromagnetica
  - EN 61000-6-2:2005. Immunità. Ambiente industriale.
  - EN 61000-6-3:2007. Emissione di disturbi EMI. Ambiente industriale.
- Direttiva 93/68/CEE Denominazione CE

Safety instructions

Please read this section carefully, because the operating voltages used inside the box could be dangerous for people.

Dangerous voltages are used in the system. Please read and carefully follow the instructions provided in this manual.

If the equipment is not used as specified in this manual, its protections may not work correctly, causing damages to people, even fatal, due to electrical shock.

- PV STRING BOX-12 1500V must be installed and opened by trained and qualified personnel only, who have been approved by the supplier.
- Do not use the product if one of its many mechanical or electrical components is faulty.
- Before make any operations on the fuses, it is mandatory to place the main switch of the system PV STRING BOX-12 1500V in position OFF.
- Before connecting or disconnecting the DC line cables, it is mandatory to remove the fuses.
- Precaution: always follow the installation instructions provided in this document. Failure to follow the described procedure shall result in the invalidation of any warranty or other claim.
- The working tools used for the installation of the PV box must be suitable for the type of work required because there are dangerous voltages in the system.
- All the electrical conductors used must have a suitable section and fitted with a solid protection, because they are designed to be installed outdoors where they could be exposed directly to sunlight.
- During installation, protect the conductors to prevent accidental contacts with dangerous voltages.

The cable routes must provide mechanical support to the conductors and be fitted therefore with an appropriate protections.

After start-up, the system and wiring should not be moved. The system must be installed in a location where it cannot be accidentally touched by unauthorized people.

Operation and Installation Manual

Packaging checklist

A. Delivery by the carrier

Examine the product packaging before opening it in order to verify that it is not damaged.

If damage is visible, it is necessary to immediately inform the carrier. The supplier of the box will be pleased to provide assistance in case of need.

Damages must be notified in writing and the notice must be sent to the carrier within a maximum of six days from receipt of materials.

B. Packaging content

Inspect the PV STRING BOX-12 1500V packaging content. Verify that the following components are present:

- 1 PV STRING BOX-12 1500V for panels series
- Installation Manual
- 1 key
- 24 fuses 30A 1500Vdc

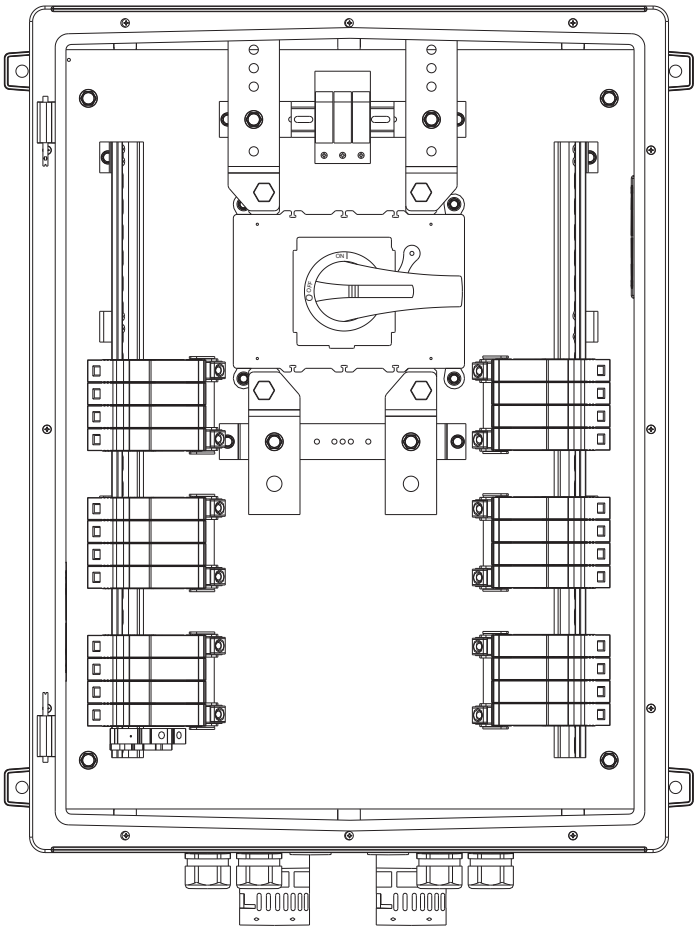


Fig. 1

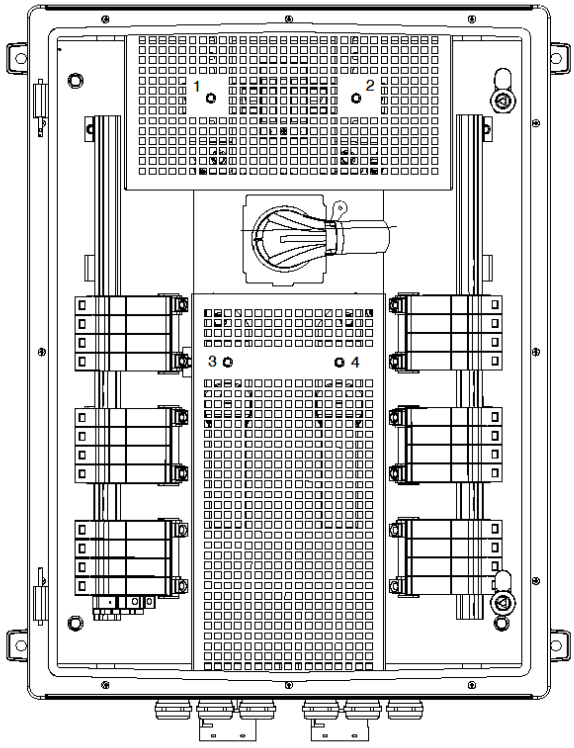
Box description

PV STRING BOX-12 1500V is a connection box that simplifies the grouping of panels series and that is fitted with protection.

The box has inputs for 12 series with a maximum capacity of 17,8A and 1500Vdc.

A. General box description

- Parallel connection of a maximum of 12 series with a capacity of 17,8A per series (*)
- DC output switch for connection to the inverter
- Positive and negative 1500Vdc fuses to protect each panels series
- Overvoltage protection that can be easily replaced in the event of failure
- IP54 grade polycarbonate cabinet for outdoor installations.



Note: the box is designed to be used for a field of panels with a maximum short-circuit current per line of 21,2A. The maximum short-circuit current output from the box is 254A. Therefore, the box is protected by means of fuses with a direct current of 30A and a disconnection capacity of 30KA at the rated voltage of 1500Vdc.

Note: to access the SPD overvoltage protection, remove the plastic protection using screws 1 and 2
To access the exit bars, remove the plastic protection using screws 3 and 4
Warning! replace the protections before carrying out any work

Physical characteristics

The protective box is made up of an IP54 grade polycarbonate cabinet for outdoor installation. The dimensions and total weight of the box are detailed below:

- Dimensions: 620x825x330mm.
- Weight: 33kg

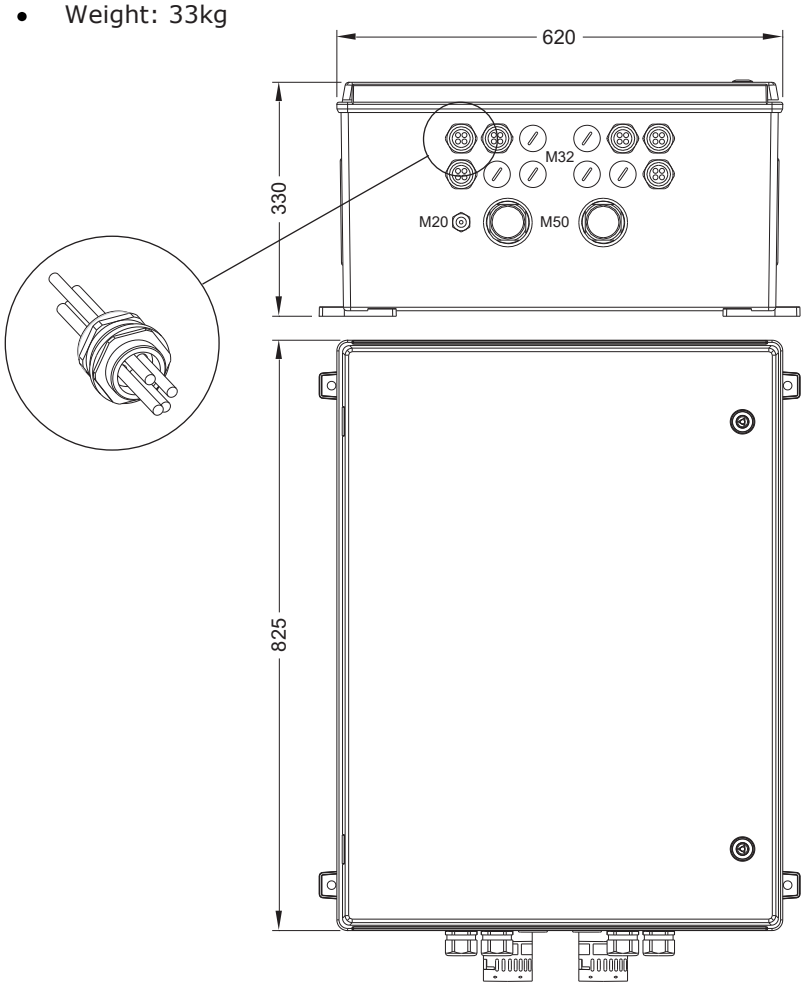


Fig. 2

Inputs and outputs

The inputs and outputs of the cables are situated in the lower section of the box, as described below:

- For the positive and negative inputs of the panels series, cable glands are used for cables from 4 to 7mm of external diameter. Each cable gland can accept n°4 cables.
- For the positive and negative outputs, straight fitting are used for corrugated conduits of 54.5mm of external diameter.
- For the output of the TT cable, cable glands are used for cables from 7 to 13mm of external diameter.

The use of cables with external diameters ranging between these values, that vary according to situations, is an essential requirement to ensure that the box is completely waterproof.

Note: Cover the unused packing glands to ensure full water-proofing and prevent the entrance of undesired animals.

Technical characteristics

Power

The main characteristics are the following:

- Cables section:
  - Input for panels series: from 4 to 6 sqmm
  - Inverter output: from 95 to 300 sqmm, for copper and aluminium cables
  - T.T. cable: from 16 to 35 sqmm
- Rated current per series 17,8A.
- Protection by means of varistors (+); (-); (earth) with a capacity of 25kA 8/20μs.
- Main disconnecting switch: 1500Vdc 400A.

Block diagram

The various parts of the box are illustrated below.

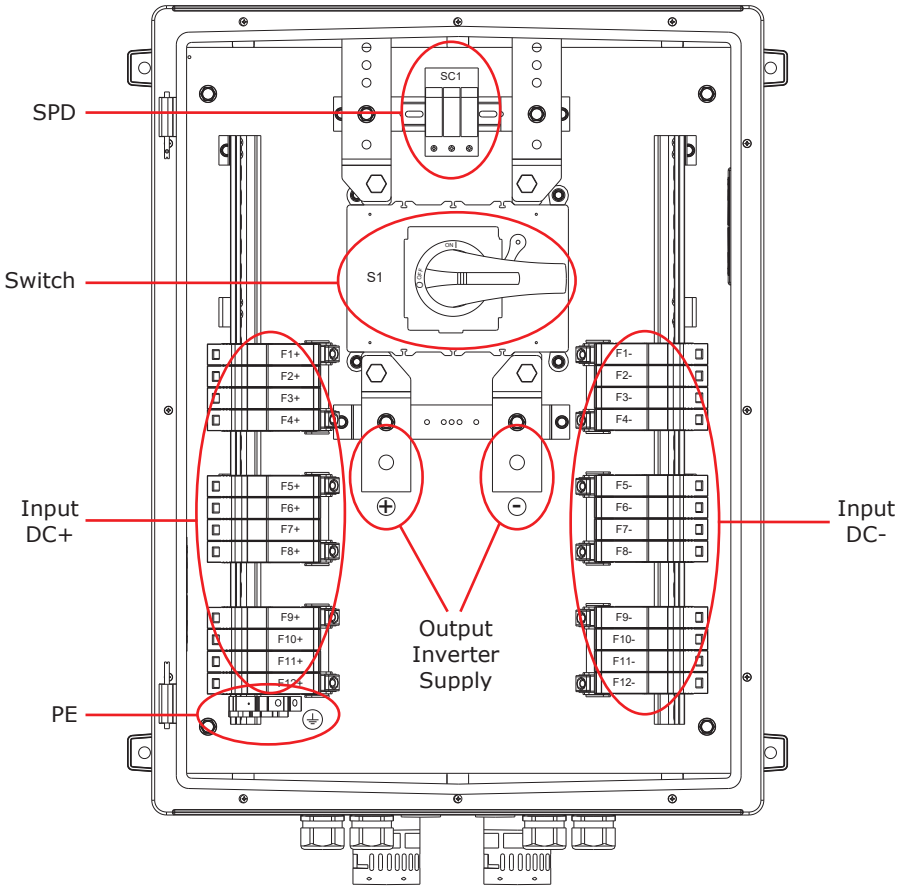


Fig. 3

***Note**: further information on the box is provided in section Technical specifications of PV STRING BOX-12 1500V.*

Operation and Installation Manual

B. System layout

PV STRING BOX-12 1500V receives the electrical power directly from the DC photovoltaic generator (PV). Its purpose is to group the panels series in a single DC series that can be connected to the converter.

The following chart provides a general overview of the system.

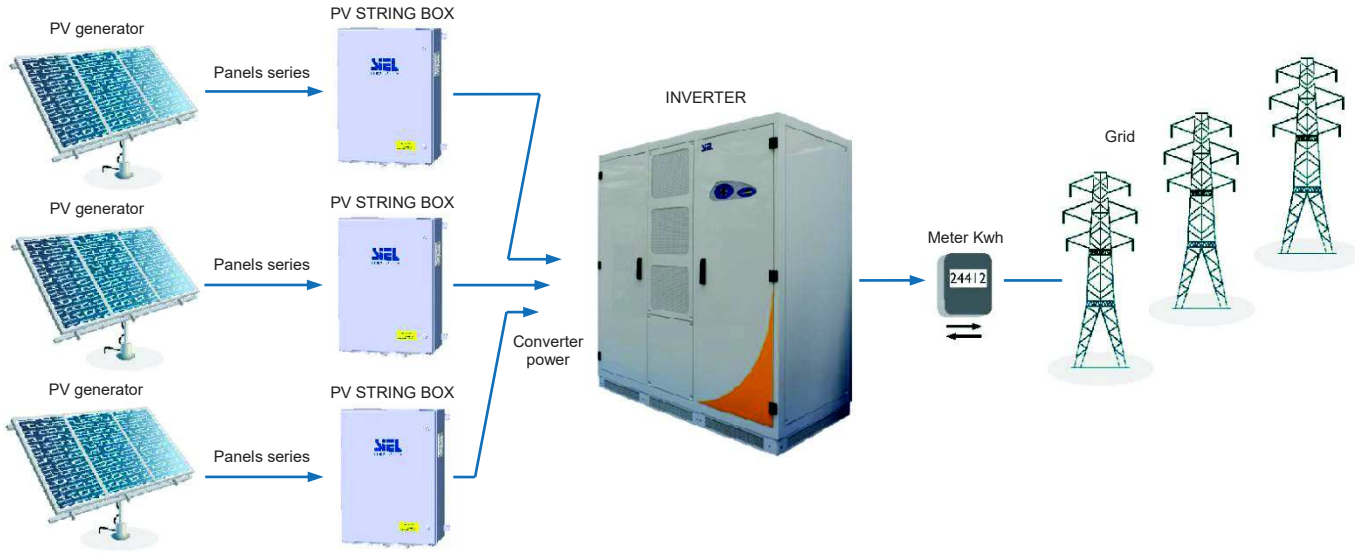


Fig. 4

Box installation

PV STRING BOX-12 1500V must be installed by trained and qualified personnel only. Special tools that are generally available to specialised technicians only are required.

Before starting the box installation process, it is very important to plan and organise the work that needs to be performed. The steps required to install the box are the following:

A. Photovoltaic generator
B. Grounding sockets of the system
C. Box location
D. Box fixing
E. Cabling route
F. Electrical connections
G. System start-up
H. Uninstallation of the box

A. Photovoltaic generator

Warning: Electric shock

When photovoltaic modules are exposed to light, the voltage present in electrical connections could pose risks due to the fact that the modules are connected in series.

Important: Shaded areas

The PV generator must not be shaded in any way. Partially shaded areas like chimneys, trees and small obstacles could cause significant power losses.

B. Grounding connections

Warning: Electric shock

PV STRING BOX-12 1500V must be permanently connected to appropriate grounding connections to maximise the protection of people.

The grounding connection system must be compliant with the current standards applicable in the relevant countries.

Atmospheric overvoltage

The grounding connection must be constituted by a single point. Therefore, it will be necessary to group all grounding conductors in a single point in order to reduce the risks of damaged caused by the overvoltage produced by atmospheric discharges.

Operation and Installation Manual

C. Box location

The main criteria to use to select the installation of the box should include the conditions of the surrounding environment and the easiness of connection of the lines of the panels series.

The box is designed to work appropriately in industrial environments (type B environments).

Note: this product is designed to be used in industrial environments. If it is installed in domestic environments, it can cause radio interferences that must be corrected with appropriate measures (consult the manufacturer for assistance).

Elements to consider

Mechanical considerations

- Install the box on a stable and resistant surface that is able to support a weight of approximately 33kg.
- Install the box vertically. Do not leave any object on the box.

Thermal considerations

- The surface on which the box is installed must not be made of inflammable material. In case this cannot be avoided (for example if the system has to be installed on a wooden surface), it will be necessary to coat it with a layer of heat and non inflammable material.
- If the box is installed indoors in a closed location, it will be necessary to verify that it is adequately ventilated. The air temperature directly influences the performance and life of the box.
- Do not install the box inside a cabinet or in a closed location.
- Although the box is designed to be installed outdoors, it must be protected from the direct exposure to sunlight.
- The recommended installation height should not exceed 1000 meters.

Safety

- Do not store the box close to inflammable liquids and materials, because the high temperature produced by the box could cause the ignition of these materials, with the consequent risk of fires.
- Protect the wiring from rodents that could damage the electrical insulation, causing dangerous situations for people along with the risk of fires.
- To avoid direct and indirect contact, make sure the box is fully closed.
- Indirect contact has been prevented through the ground connection of all metal parts and the insertion of all active parts in the cabinet.
- The installation and maintenance of the box must always be performed with suitable working tools in order to ensure full compliance with precautions regarding direct and indirect contact (industrial boots, gloves resistant to a maximum operating voltage of 1500V...).

Electrical considerations

- PV STRING BOX-12 1500V must be installed in the shortest point of the route between the PV generator and inverter in order to minimise conductor losses.
- Electrical cables must not be overstretched and fixed to masonry work.

D. Box fixing

The box fixing must be made using the 4 holes of 12mm diameter of the supports.

The box is designed for mounting the supports on the back externally without adding any holes.

Fixing is recommended vertically on a flat wall. Take the following measurements into account during installation:

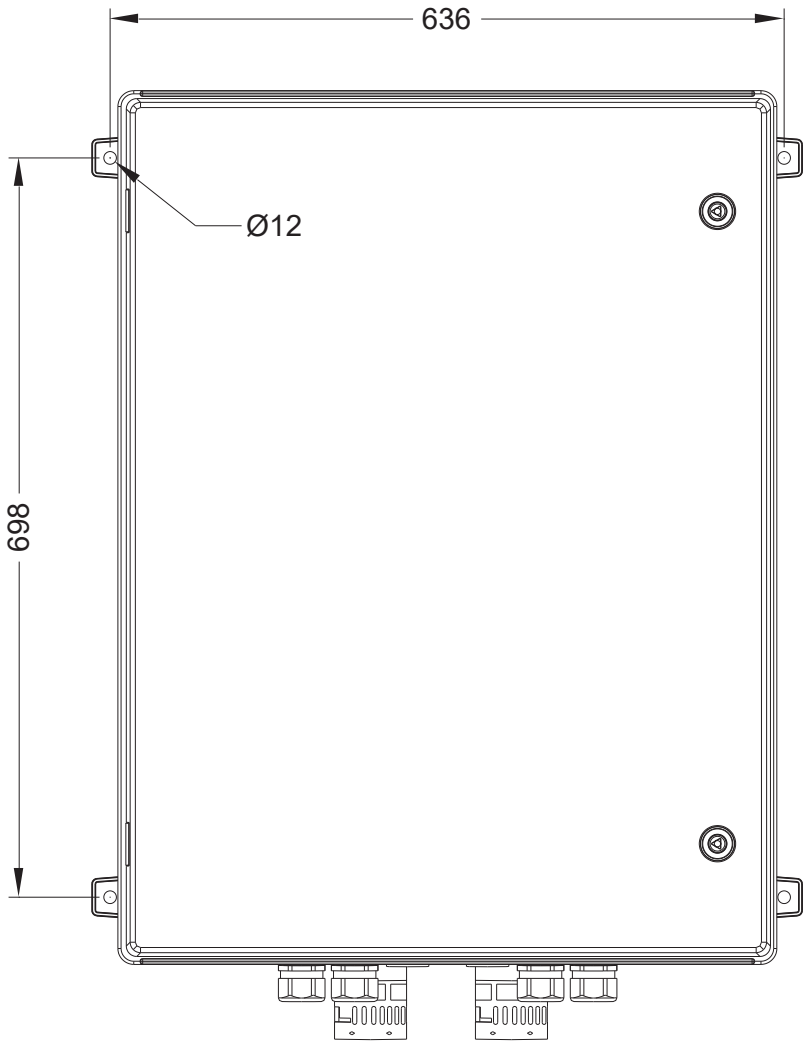


Fig. 5

E. Cabling route

The preparation of the conductor routes simplifies installation.

Warning: Electric shock

Before drilling holes, verify that there are no pipes or electrical systems that could cause dangerous electrical discharges.

It is advisable to carefully protect conductors in order to extend their life cycle.

F. Electrical connections

Before connecting the box, observe the following precautions:

- Adopt the necessary safety precautions to handle maximum voltages of 1500 V inside the cabinet.
- Verify that all the metal parts of the system are grounded.
- Verify that the main disconnecting switch is in position **OFF** before making any electrical connection.

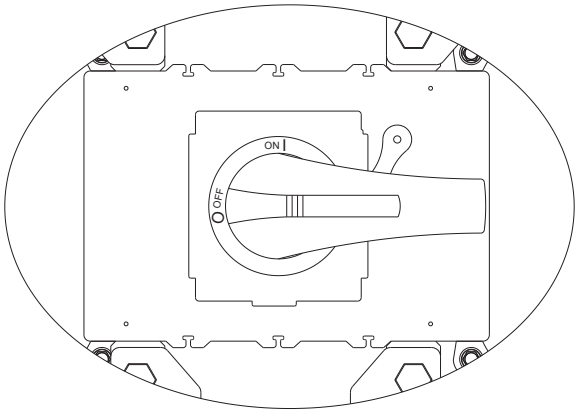


Fig. 6

- Verify that there are NO fuses in the fuseholder and remove them if present.
- Do not reverse polarity.

Inputs and outputs cables

The inputs and outputs of the cables are situated in the lower section of the box; as described below:

- **TT output:** output for TT with IP68 cable glands for cables from 7 to 13mm of external diameter
- **DC output:** positive and negative output with IP66 straight fitting for corrugated conduits of 54.5mm of external diameter
- **Inputs of DC panels series:** positive and negative inputs with IP68 cable glands for cables from 4 to 7mm of external diameter. Each cable gland can accept n°4 cables.

The following figure shows the layout of the box cable glands.

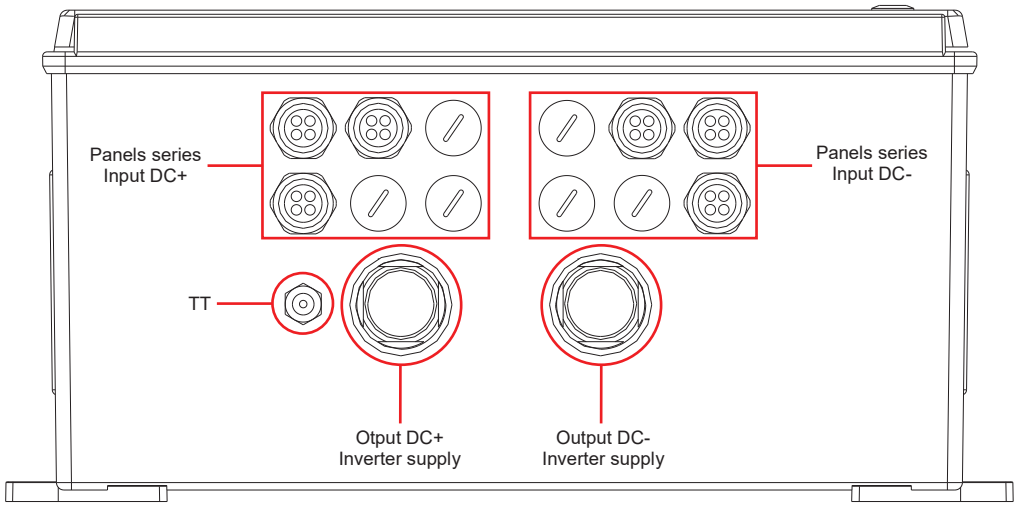


Fig. 7

Connection cables

INPUT / OUTPUT	CABLES SECTION	TERMINALS
Input for Strings	4÷6sqmm	Stripped cables or Insulated end sleeves
DC Output	95÷300sqmm	Ring terminal hole Ø14
GND	16÷35sqmm	Stripped cables or Insulated end sleeves

Location of the internal connection terminals

DC outputs connections and grounding connection

The terminals used to connect the DC output are situated under the main DC switch. The terminal used to connect the TT is situated on a DIN guide lower left. The following figures show what has been described.

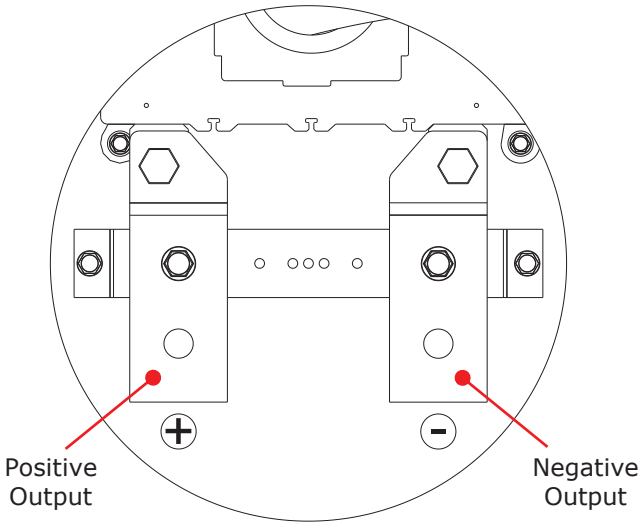


Fig. 8

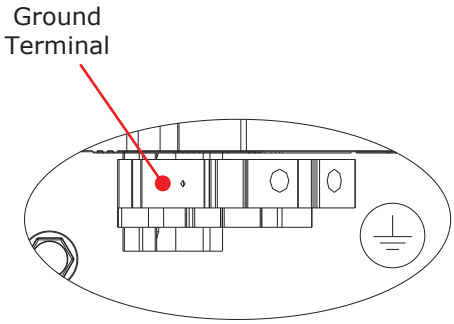


Fig. 9

Connection of panels series inputs

Panel line connection terminals are the fuse boxes mounted on the DIN guide; the positives to the left and the negative to the right, as shown below.

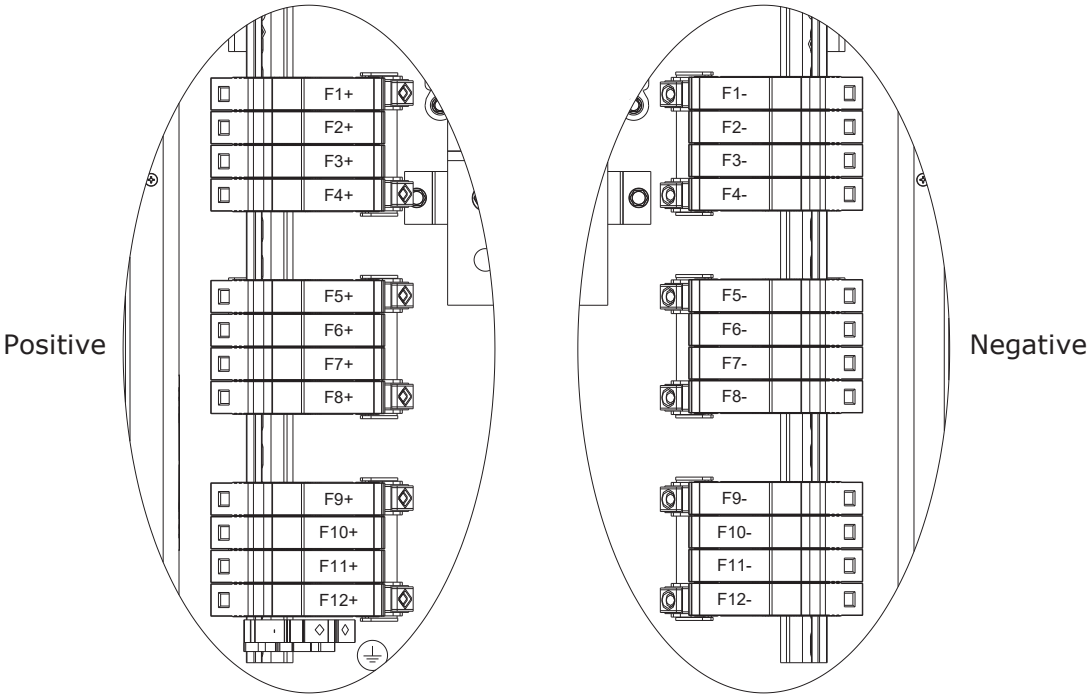


Fig. 10

Electrical connections

The steps to follow to electrically connect the system are the following:

1. Connection of the DC output and grounding

- Connect the grounding connector cable to the box. Insert the cable in the dedicated TT cable gland. Use a suitable tool to connect the cable to the TT terminal.
- Connect the DC output lines to the power bars inside the box. Insert the cables in the dedicated DC straight fitting. Use a suitable tool to connect the cables to the DC bars.
- Check that the connections correctly tightened to prevent the cables voltage from being transmitted to the terminals.

2. Connection of the panels series inputs

- Identify the lines of the panels and number them from 1 to 12. Do not reverse the polarity and observe the numbering. An incorrect connection may cause faults in the system.
- Insert the cable in the dedicated panels series cable glands. Use a suitable tool to connect the cables to the fuseholders. The torque required for a correct connection must be max 2,5 Nm.
- Perform the connections in this sequence:
    - Open the fuseholders.
    - Connect cable 1 + (positive cable of series 1).
    - Connect cable 1 - (negatives cable of series 1).
    - Use a voltmeter to check that the polarity and voltage of the series are correct.
    - Follow the same procedure for the rest of the series.

- Check that the connections correctly tightened to prevent the cables voltage from being transmitted to the terminals.

Operation and Installation Manual

G. System start-up

Warning.

Data may be subject to temporary variations during cloudy days or due to rapid radiation changes. Therefore, it will be necessary to validate the data for all the panels being monitored for at least 10 seconds when radiation is stable.

Fuses mounting

1. Make sure that there is no fuse inserted in the fuseholder. In this case, it will be necessary to open the fuseholder and remove it.

2. Make sure the PV STRING BOX-12 1500V output DC switch is **OFF**.

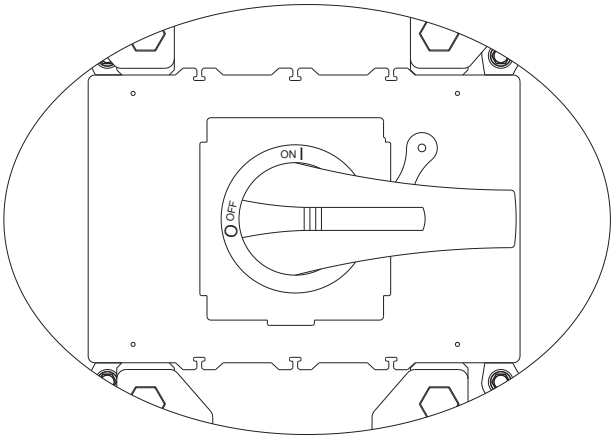
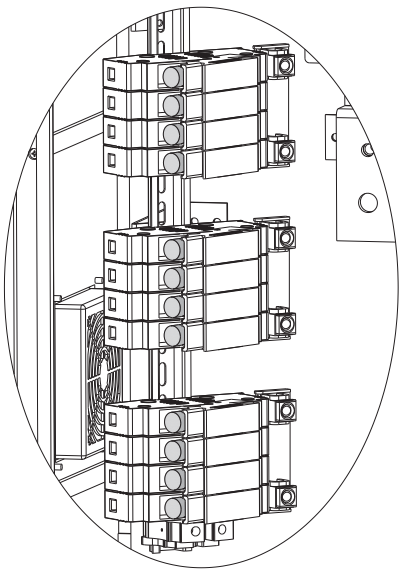
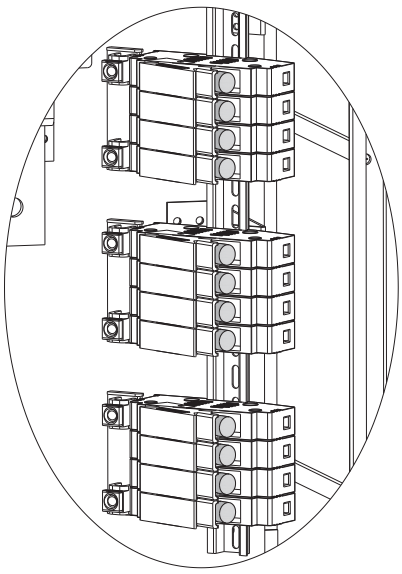


Fig. 11

3. Place all the positive and negative fuses in the fuseholders and close them.

Positive





Negative

Fig. 12

4. Turn the output DC switch ON

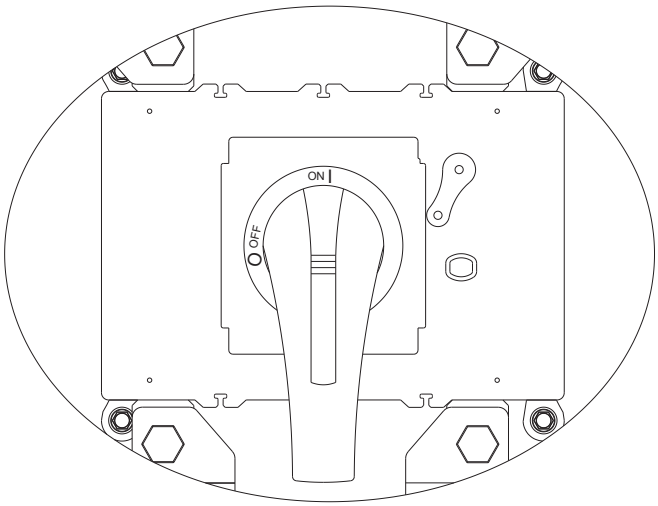


Fig. 13

To check whether the PV STRING BOX-12 1500V is operating correctly, a panels series and an inverter must be connected so that current circulates throughout the series connected to the box.

H. Uninstallation

Perform the installation steps in reverse order.

1. Move the output DC switch to position OFF.
2. Open the fuseholders and remove all the fuses
3. Disconnect the series, cable by cable, insulating the active parts.
4. Disconnect the general DC output.
5. Disconnect the ground connection.

Operation and Installation Manual

PV STRING BOX-12 technical specifications 1500V

Description	
Nominal input current	12 x 17,8A
Maximum input current	12 x 21,2A
Maximum input voltage	1500V_{DC}
Nominal output current	214A
Maximum output current	254A
Input terminals connector	Screw-type
Protection class of the housing	IP54
Operating temperature	-5ºC ... +45ºC
Relative humidity	0÷90%
Environment category	Non-conditioned outdoor
Use in humid ambient	Yes
Maximum altitude	1000 m a.s.l.
Pollution class	3

Protection devices	
Overvoltages between + and -	25kA varistors
Overvoltages between + and TT	25kA varistors
Overvoltages between - and TT	25kA varistors
Overload on the varistors between + and TT	Thermal disconnection of the discharger
Overload on the varistors between - and TT	Thermal disconnection of the discharger
Overvoltages on the varistors between + and -	Thermal disconnection of the discharger
Overvoltages in each series of lines +	Fuses gPV 30A 1500Vdc
Overvoltages in each series of lines -	Fuses gPV 30A 1500Vdc
General disconnecting switch	400A 1500Vdc

Maintenance

The box must be maintained by trained and qualified personnel only, Special tools that are generally available to specialised technicians only are required.

To unsure the functionality of the box, it is necessary to carry out the following check:

- Check and eventually replace the ventilation clothes filter. – Every 2 months
- Verify that all the mechanical connections of the box are firmly seated and, if necessary, tighten them with suitable tools. – Annual
- Verify that all the electric connections of the box are firmly seated and, if necessary, tighten them with suitable tools. – Annual
- Verify that there are no animals or insects inside box. – Annual

During maintenance operations the box must be switched off and secured: it is necessary to disconnect the incoming DC source from the photovoltaic field and open the DC circuit towards the inverter so that the DC voltage coming from the parallel systems does not return to the box. Before opetating inside the box, check with an suitable tool that there are no dangerous voltages and open the DC switch.

Replacement ventilation clothes filter

- To replace the ventilation clothes filter, remove the cover with a screwdriver levering the lower part as shown in the figure below. Once replaced, close the cover with a slight pressure.

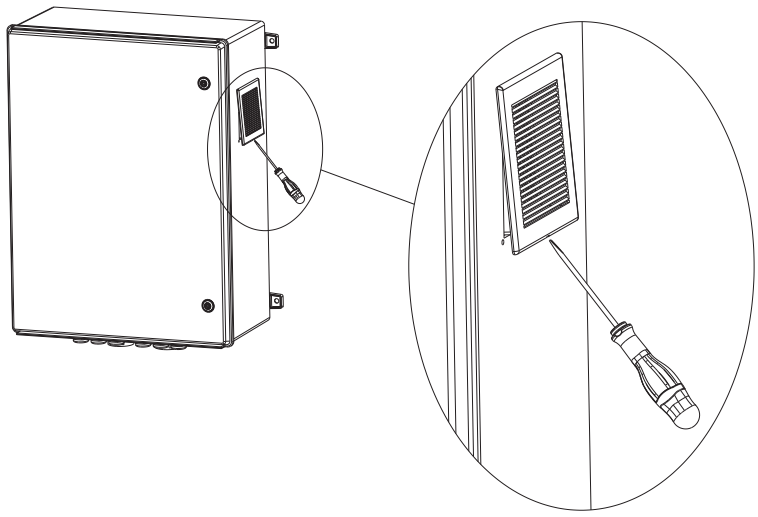


Fig. 14

Quick troubleshooting guide

The section that follows illustrates the corrective actions that can be implemented to correct some of the problems that may occur during the operation of the system.

1. Fuse fault	Identify the cause, correct the problem and replace the fuse.
2. Insulation fault	Disconnect the DC switch. • If the fault persists, it is probably originates from another box or from the inverter. • If the fault continues to be displayed, it is originates from the box. Remove the fuses from each of the series, one by one. When the fault disappears, it means that the series with the insulation fault has been identified. Inspect the cables and panels of the series where the fault has been detected.

Operation and Installation Manual

Warranty terms and conditions

Validity of the warranty

The warranty period covers 2 years from the date of purchase of the system. It is however possible to optionally extend the warranty to 3 or 5 years.

Warranty conditions

It will be necessary to supply the original invoice showing the purchase date for warranty claims.

During the period of validity of the warranty, the manufacturer will repair the box without charging the customer for the cost of materials and labour. The warranty does not include assembly and transportation costs.

The box must be returned to SIEL only after receiving its authorization. The claim must be presented in writing to SIEL along with information like the name, address, telephone number and other contact details. SIEL will authorize the return of the system as soon as it receives the error form that contains detailed information on the fault and applicable warranty. SIEL will not accept systems that have been returned without previously sending the claim in writing.

The customer must wait for the reparation to be completed.

It is important to keep the original packaging even after the expiry of the warranty period, because, for protection during transport, carriers are only authorised to accept boxes that are packaged in the original box. If the original packaging has been discarded, it is necessary to contact SIEL before returning the system. SIEL will provide the customer with a new packaging that will have to be paid by the customer.

Disclaimer

SIEL will not accept claims and declines any responsibility in the following cases:

- Damages caused by an incorrect use of the box
- Continuous use of loads with powers above the maximum rated power
- Use of the system in inadequate environmental conditions (see section Location)
- Damages of boxes subject to impacts or that have been disassembled or repaired by unauthorized technicians
- Damages caused by atmospheric discharges, accidents, water, fire and other circumstances that are out of the manufacturer's control.

The manufacturer declines any responsibility for additional and further claims, in addition of direct or indirect damages, including the cancellation of the contract, unless these are required by law.

Changes

The content of this document may be changed without warning. SIEL has undertaken all possible measures to verify the accuracy of the information contained in this manual. However, it cannot guarantee the absence of errors or omissions or exclude damages that may derive from the incorrect interpretation of the information contained in this manual.

SIEL reserves the right to change the product, at its discretion, without giving prior warning to users.