

Installation and User Manual

**for Photovoltaic Smart String Box active (with contactors)
SOLO SSB-A-14-140 and SSB-A-25-250**

Manual 50605
(Revision A1)



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1 Introduction

This high-quality ELECTROINVENT photovoltaic string box is intended to connect up to 25 PV module strings. The box is also used to disconnect the DC from the inverter. The SOLO Smart String Box (SSB) measures the current of each string and sends data to the inverter. This feature is essential for diagnostics and maintenance of PV-panels and cabling.

1.1 Disclaimer

ELECTROINVENT delivers optimized tested equipment such as inverters and string boxes for Photovoltaic Power Plants. The correct integration and interconnection of the equipment must be made according to the manuals and datasheets of ELECTROINVENT and is the responsibility of the System Integrator. ELECTROINVENT does not accept liability for system design, dimensioning of system related parts, installation or the performance of the system.

The content of this manual is regularly reviewed for compliance with the hardware and software operation and any corrections are included in later editions. Every effort is made to ensure the details in this manual are accurate. Warranty claims will not be accepted in case of violation of the installation instructions and we do not accept liability in case of accidents caused by inappropriate handling or work performed by unauthorized personnel which results in personal injury or damage to devices, or any other subsequent damages.

1.2 IMPORTANT SAFETY INSTRUCTIONS

READ AND SAVE THESE INSTRUCTIONS!

This manual contains important safety and operating instructions for SOLO SSB-A-14-140 and SSB-A-25-250 photovoltaic string boxes. Keep it with or near the equipment at all times.

Photovoltaic installations operate with lethal voltages and the work described here should only be performed by authorized personnel familiar with the installation, mounting, commissioning, and the operation of PV installations. This manual must be fully read and understood before installing or commissioning is performed. The SOLO product must only be used for its intended purpose and unauthorized personnel are not allowed to open the SOLO product. The faultless and safe operation of the product assumes appropriate transport, specialized storage, installation and mounting as well as correct operation and maintenance. The relevant regional and country-specific regulations and instructions must be obeyed as well as requirements described in this document including placement and installation instructions (e.g. connection profiles, torque settings, etc.)

Symbols and warning signs used:



WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

NOTICE

NOTICE refers to address practices not related to personal injury. Failure to observe could lead to property damage.

1.3 Scope of Delivery

Table 1.1 Scope of delivery

Quantity	Article
1 pc	Smart String Box (SSB)
2 pcs	Plastic keys (one for the box door and one for transport)
4 pcs	Wall mounting kit
2 pcs	Spare fuses for the strings
2 pcs	Spare fuses for the Power Supply Box (PSB)
1 pc	Spare fuse for the String Box Monitor (SBM)
1 pc	Spare fibre optic connector

1.4 Type Label

The type label with the product identification is located on the right side under the protective cover.



Type	SSB-A-25-250-1-0		1
Circuit diagram no	V2.0 Rev. 0		2
Max PV string voltage U_{PV} : 1000 V _{DC}	Max PV string current I_{PV} : 10 A	Number of string inputs n: 25	<div> <div> <div>Conformity</div> <div>  </div> </div> </div>
Max DC output voltage U_{DC} : 1000 V	Max DC output current I_{DC} : 250 A	Surge protector Type II	
Rated ambient temperature T_{amb} : -20 ... +60 °C	Insulation class 2	Protection class IP 55	
			
Production date 12-2011	Item number ART-07550-116	Serial number 17868968	3

Figure 1.1 SOLO SSB type label

- 1 - Product identification (see also Figure 1.2)
- 2 - Valid electrical circuit diagram
- 3 - Serial number of the string box

The product identification (type code) [Figure 1.1-1] description is shown in Figure 1.2.

Typical Part Number **SSB-A-25-250-1-0**

S_{MART} S_{TRING} B_{OX}

A-SOLO String Box with DC Contactors.

Number of Inputs:

14 - Inputs

25 - Inputs

Nominal Current:

140 Amps

250 Amps

Version:

1-Max PV string voltage: 1000Vdc

2-Max PV string voltage: 1200Vdc

Revision:

Figure 1.2 Product identification description (see Figure 1.1-1)

2 Warnings and Notes



WARNING

The local installation standards must be obeyed.



WARNING

The device must only be installed, operated and maintained by qualified personnel.



WARNING

The device carries lethal voltages. The PV module strings can be live even when the SOLO String Box switch is turned off and the string protections are removed. The DC line toward the inverter can be live even when the SOLO String Box switch is turned off. Consider the inverter capacitors discharge time of **10 minutes!**



WARNING

The SOLO String Box is a part of an entire PV installation. Consider all safety instructions displayed on the SOLO String Box and on all the equipment connected to it and in the installation and user manuals! Beware that an automatic restart can follow a grid or photovoltaic voltage failure.



WARNING

If any information is unclear, please refer to ELECTROINVENT Service Centre.

NOTICE

Loss of warranty.

The box must not be damaged and no holes are allowed to be drilled in the cabinet. Any transport damage must be reported to ELECTROINVENT.

3 Installation of the SOLO String Box

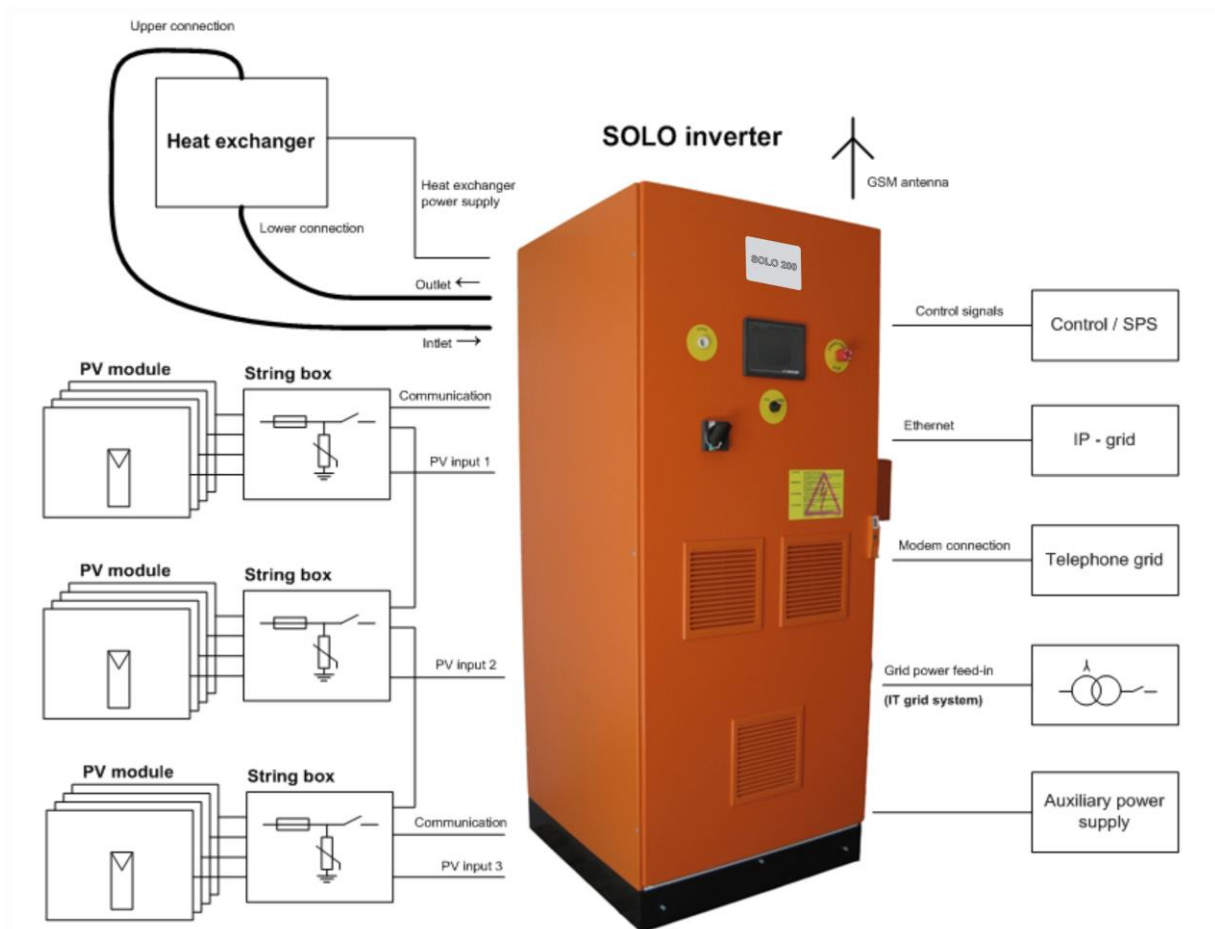


Figure 3.1 Example view of a photovoltaic installation with SOLO inverter, SOLO string boxes and grid transformer

A different number of PV strings can be connected depending on the string box type. The positive poles of the separate power feeds are protected individually, whereas the type of the fuses must correspond to the maximum PV module string current.

The separate string currents are brought together through coupling joints and contactors toward the two DC output terminals. The PV string currents are monitored and the data is sent to the inverter via serial interface (fibre optical or optional RS485).

If an overvoltage occurs the accruing energy is discharged through a surge arrester.

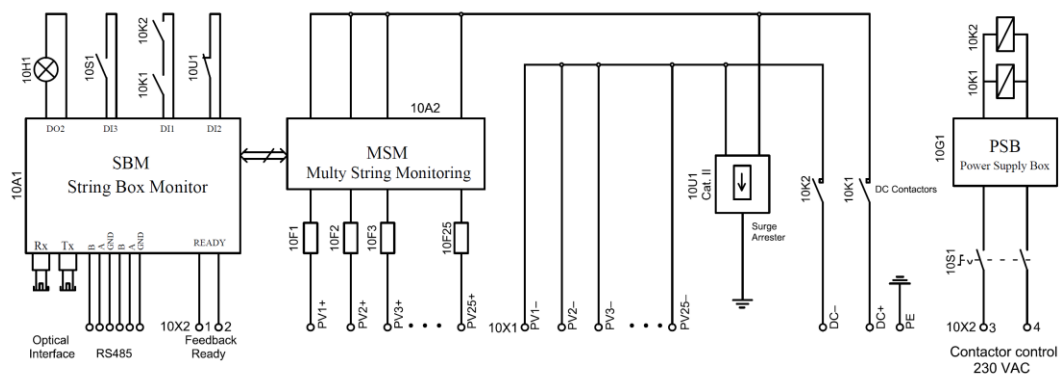


Figure 3.2 Scheme of SOLO Smart String Box with 25 PV strings inputs

3.1 Fuse Selection

The fuse selection must follow the rules below:

- Maximum DC operating voltage of the fuse must be: $1.2 \times$ maximum voltage of string
- Rated current of the fuse must be higher or equal than: $1.6 \times I_{SC}$ at standard conditions (STC) (I_{SC} – short circuit current of panel)

Table 3.1 Fuse selection

I_{SC} : short circuit current of panel at STC [A]	Rated current of the fuse [A]	Size [mm]	Pre-arching Joule integral [A ² s] L/R=2ms	Operating Joule integral [A ² s] L/R=2ms
≤ 2 A	4 A	10x38	3.3	28
≤ 3 A	6 A		5.5	45
≤ 5 A	8 A		8	62
≤ 6 A	10 A		11	88
≤ 8 A	12 A		23	180
≤ 10 A	16 A		35	270

Note: The fuses are factory pre-installed according to the client's requirements (specified current). The fuses have to be selected according to Table 3.1.

3.2 Location Selection

- The SOLO String Box is suitable for outdoor installation.
- The SOLO String Box should be positioned as close as possible to the PV modules.
- The string box must be easily accessible for operation and maintenance.
- A location without direct sun irradiation should be chosen.
- The SOLO String Box should be mounted in a way, minimizing or preventing collection of water and dirt and growth of moss.

3.3 Mechanical Installation

The SOLO String Box must be mounted vertically on a wall or on a stand, with the cable glands [Figure 3.4] on the bottom side, using the supplied fitting materials where possible. No liquid (water, oil, etc.) should ever enter into the cabinet, not even during installation.

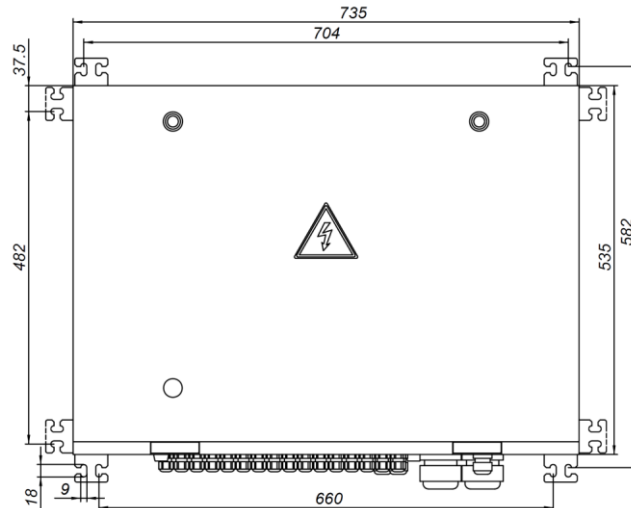


Figure 3.3 Dimensions drawing SSB-A-14, SSB-A-25

Note: The two climate valves [Figure 3.4] must not be covered. They ensure the air circulation inside the SOLO SSB.



Figure 3.4 SSB bottom view (exterior view)

- 1 - Climate valve - 1
- 2 - Climate valve - 2

3.4 Opening the SOLO Smart String Box

3.4.1 Opening the SOLO Smart String Box door



Figure 3.5 SOLO SSB door

- 1 - Locking/Unlocking using the plastic key
2 - Status signal lamp

The SOLO String Box door is closed with the use of the supplied plastic key.

Opening (unlocking) the door is done by turning the supplied plastic key clockwise (see Figure 3.5-1).

3.4.2 Removing the SOLO Smart String Box protective cover



WARNING

Potentially Lethal Voltage!

Even if the main switch is turned off the PV lines and the DC side might have lethal voltage.



WARNING

Removing the protective cover of the SOLO String Box must only be performed by authorized personnel. The absence of voltages (PV lines and DC side) must be ensured at all times.

The protective cover of the SOLO String Box **cannot** be dismantled when the main switch [Figure 3.6-2] is in position "ON". In order to remove the protective cover, first the main switch has to be set to position "OFF". Then the screws [Figure 3.6-1] have to be unlocked using a slotted screw driver (1/4 revolution).



Figure 3.6 SOLO SSB protective cover

- 1 - Screw
- 2 - Main switch
- 3 - SSB address indicators

3.5 Electrical Installation



WARNING

The installation of the string box must only be performed by authorized personnel. The absence of voltages (PV and DC lines) must be ensured at all times.



WARNING

The PV module strings and the DC line toward the inverter might be live even when the main switches of the SOLO String Box and the inverter are turned off and the string protections are removed. Consider the inverter capacitors discharge time of **10 minutes**.

NOTICE

The power supply lines must be mounted in a way that won't allow them to be damaged by rodents.

NOTICE

The electrical lines must not come in contact with flammable materials.

3.5.1 Overview of the Electrical Connections

The locations of the electrical connections in the SOLO Smart String Box are shown in Figure 3.7.

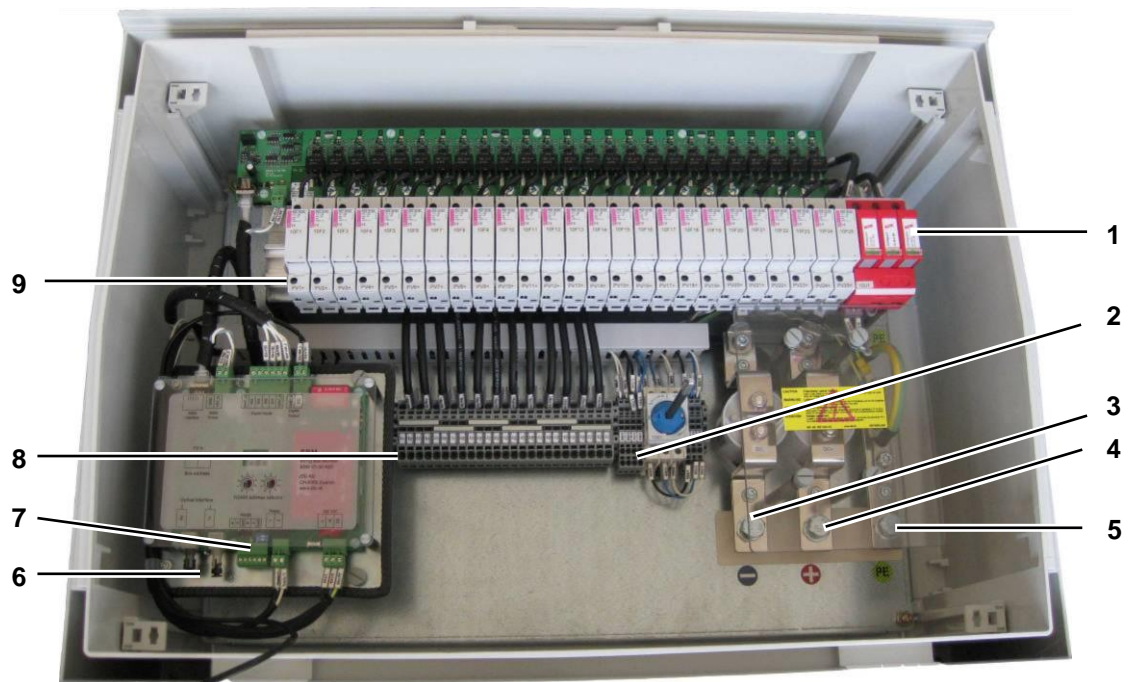


Figure 3.7 Location of the electrical connections in the SSB

- 1 - Overvoltage protection
- 2 - Control and feedback terminals
- 3 - DC- output busbar
- 4 - DC+ output busbar
- 5 - PE
- 6 - Fibre optic communication interface
- 7 - RS485 communication interfaces
- 8 - PV- string input terminals with common (-)
- 9 - PV+ string input terminals

3.5.2 Overview of the Cable Glands

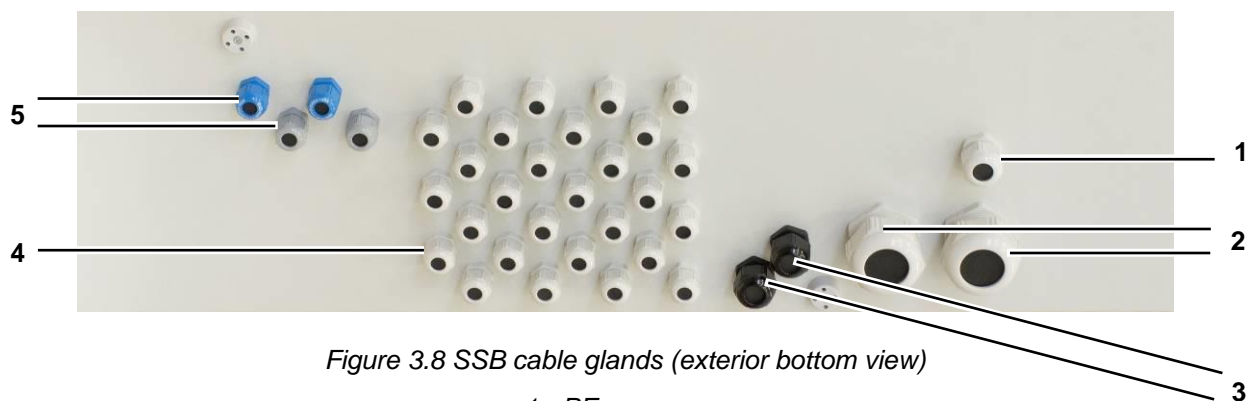


Figure 3.8 SSB cable glands (exterior bottom view)

- 1 - PE
- 2 - DC outputs (+ and -)
- 3 - Control and feedback (in and out)
- 4 - PV strings inputs
- 5 - Serial interfaces

3.5.3 Schematic Example of a PV installation with Smart String Boxes

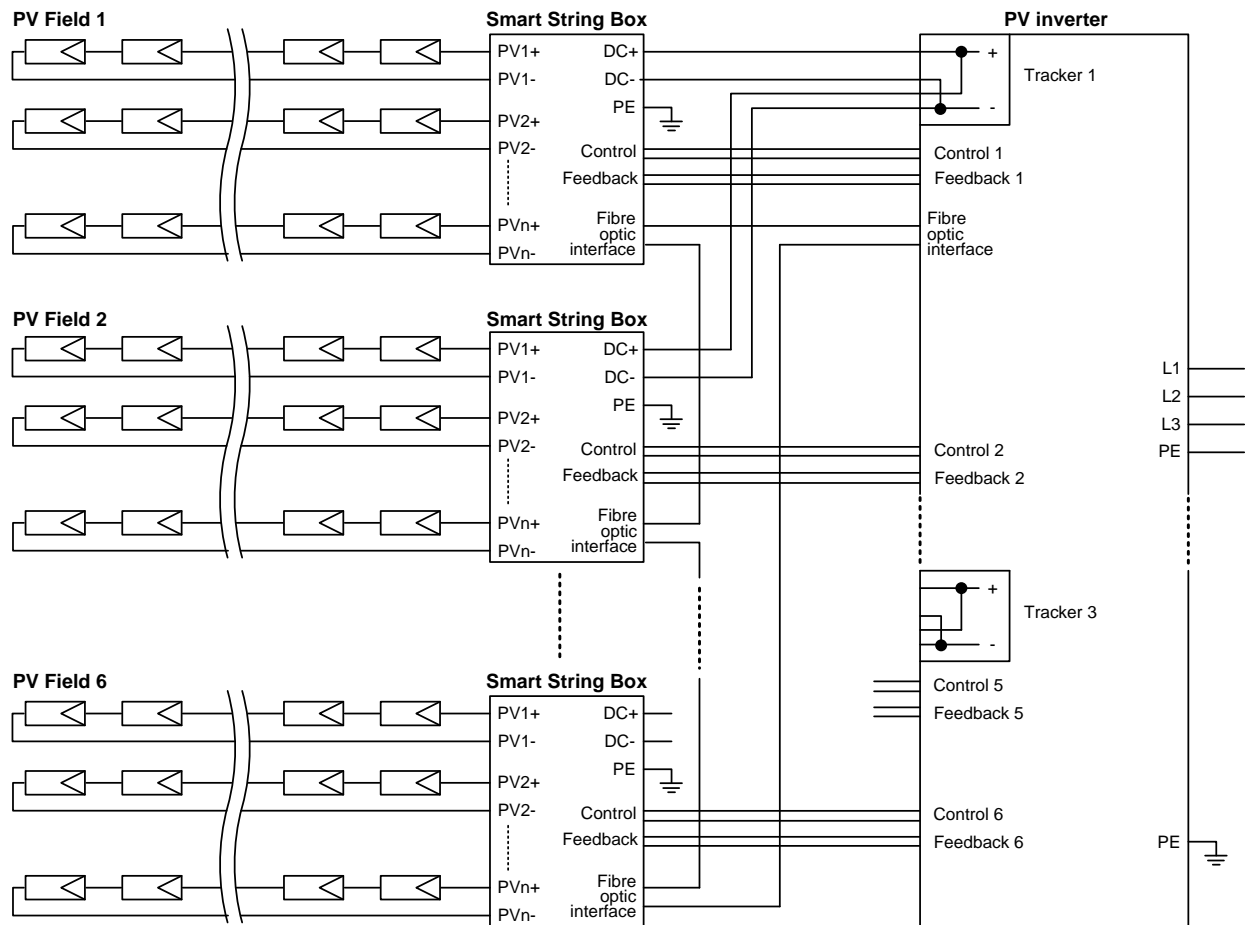


Figure 3.9 Schematic example of a PV installation with Smart String Boxes

3.5.4 PV strings connections

NOTICE

Respect the correct PV polarity. Wrong polarity of the PV inputs might cause damage to the SOLO String Box and the PV modules.

NOTICE

Never feed a DC inlet with voltages higher than 1000V (or 1200V if the relevant option is used). Higher voltages lead to box damage. Improper operation of the SOLO String Box may lead to the warranty being void, and no liability for consequential damages will be undertaken.



WARNING

In case of wrong poled strings never break the current flow by removing the fuses from the fuse holders.



WARNING

A fuse holder must only be opened if no current is flowing.

The PV strings connections have to be done according to the following sequence:

1. Remove the fuses out of the fuse holders [Figure 3.10-3].
2. Connect the PV string cables according to Table 3.3 and Table 3.2.

NOTICE

The connection points of user contact spring-cage terminals (Table 3.2) are opened with a standard screwdriver.

After the conductor has been inserted into the terminal compartment, the screwdriver is removed and the conductor automatically makes contact.

3. Measure the string voltage and check the polarity.
4. Insert the fuses again.

Table 3.2 PV- strings connections (see Figure 3.7-8)

Terminal	Function	Specifications
10X1 PV1- ... 10X1 PV25-	PV1- ... 25- (negative pole)	Spring-cage terminals: 0.5 ...10 mm ² Cable gland: 4.5...10 mm

Table 3.3 PV+ strings connections (see Figure 3.7-9)

Terminal	Function	Specifications
PV1+ ... PV25+	PV1+ ... PV25+ (positive pole)	Fastening torque nominal/maximal: 1.5/1.8 Nm Cu-cross section: 0.5 ...10 mm ² Cable gland: 4.5...10 mm

The String Box Monitor [Figure 3.10-1] inside the Smart String Box with 25 inputs (SSB-A-25) is mounted on a swivelling plate, which can be opened to install the PV+ strings cables. For this purpose, the two plastic screws on the right side of the plate [Figure 3.10-2] have to be loosened completely. The plate with the monitoring can be swivelled to the left until it is kept magnetically [Figure 3.11]. The PV+ terminals are now accessible.

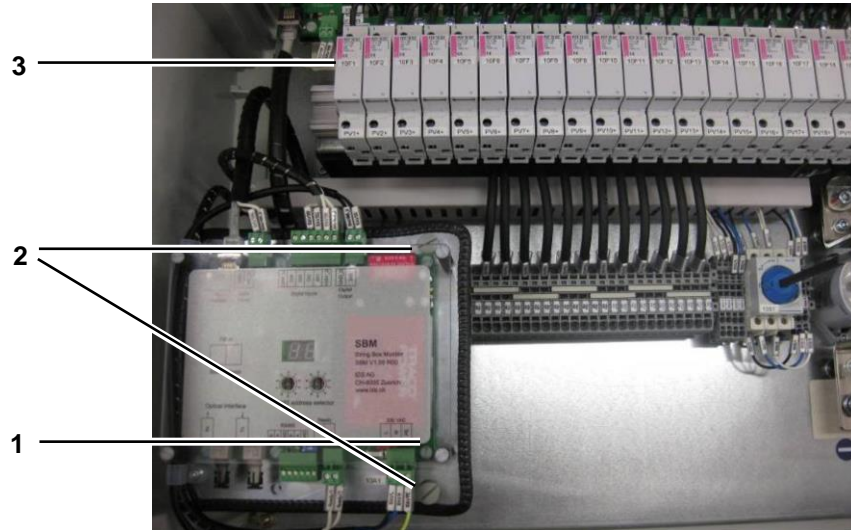


Figure 3.10 Smart String Box SSB-A-25

- 1 - String box monitor
- 2 - Slotted cylinder-head screws
- 3 - Fuse holders

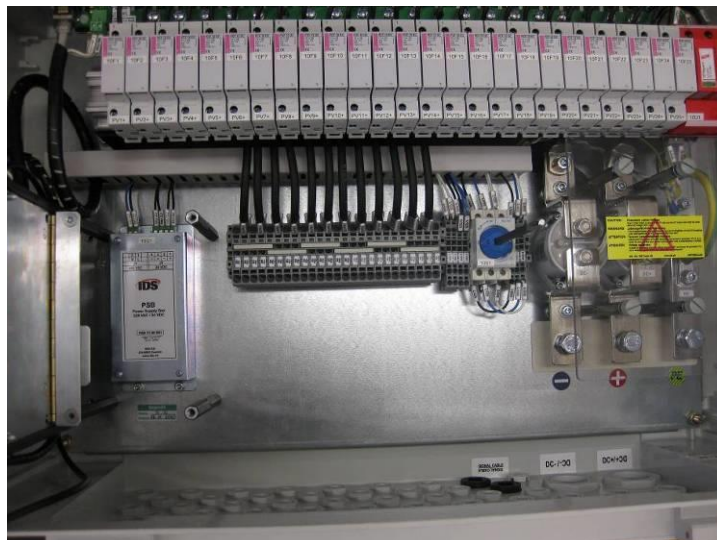


Figure 3.11 String box monitor swivelled

3.5.5 Power connections to the inverter

The power connections have to be performed according to *Table 3.4* in the following sequence:

1. Before installation, the protective transparent plate must be unscrewed and removed from the box.
2. First, the grounding cable (PE) must be connected using a cable lug to the corresponding screw terminal.
3. Then, the DC cables to the inverter are connected with cable lugs to the corresponding screw terminals. The correct polarity must be observed!
4. The protective transparent plate must be mounted back and screwed!

Table 3.4 Power connections to the inverter (see Figure 3.12)

Terminal	Function	Specifications
PE	Grounding	Connection type: M12 Fastening torque: 25 Nm Cable gland: 7...13 mm
DC-	Negative pole	Connection type: M12 Fastening torque: 25 Nm Cable gland: 22...32 mm
DC+	Positive pole	

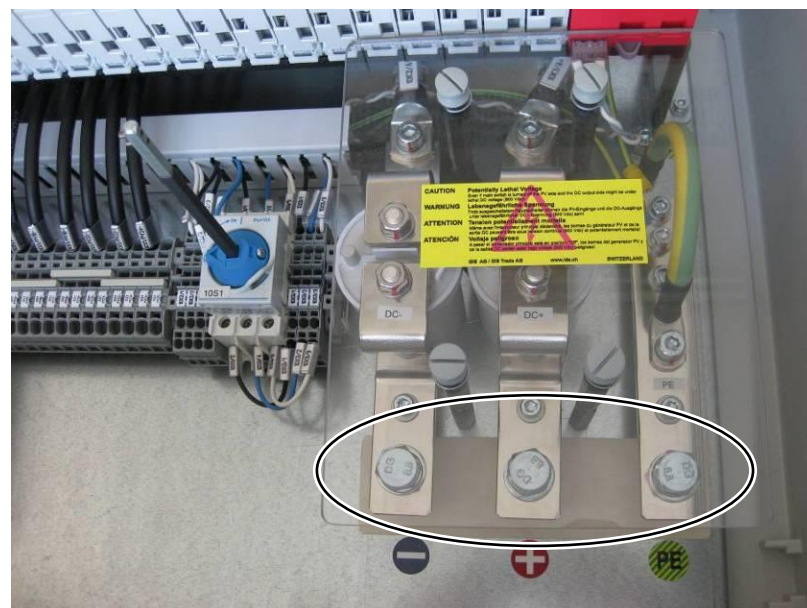


Figure 3.12 PE, DC- and DC+ connections to the inverter (see also Figure 3.7 -3, -4 and -5)

3.5.6 String Box Power Supply, Control and Feedback Connections to the Inverter

The connection of DC+ and DC- terminals to PV+ and PV- string joints is done by two contactors (10K1 and 10K2). They are switched on by 230V_{AC} control line from the inverter connected according to *Table 3.5*.

Table 3.5 String box power supply and control (see Figure 3.13)

Terminal	Function	Specifications
10X2/3	SSB supply and control (L)	230 V _{AC} Spring cage: 0.25...4 mm ² Cu-cross section: 3x1.5 mm ² Cable gland: 4.5...10 mm
10X2/4	SSB supply and control (N)	

The connections for ready feedback signal to the SOLO inverter are shown in *Table 3.6*. If the string box is not ready, despite the actuation of the contactors, the SOLO inverter will report a warning. In case of a warning, the modules of the surge arresters have to be checked (green/red indicator), and if needed exchanged (see *Chapter 5.1.2*). If a warning stays despite of intact surge arrester modules, the DC contactors have to be checked, and if needed exchanged.

Table 3.6 String box feedback to the inverter (see Figure 3.13)

Terminal	Function	Specifications
10X2/1 10X2/2	Ready feedback	24 V _{DC} Closed dry contact when ready Spring cage: 0.25...4 mm ² Cu-cross section: 2x1 mm ² Cable gland: 4.5...10 mm

NOTICE

The connection points of user contact spring-cage terminals (*Table 3.5 and Table 3.6*) are opened with a standard screwdriver.

After the conductor has been inserted into the terminal compartment, the screwdriver is removed and the conductor automatically makes contact.

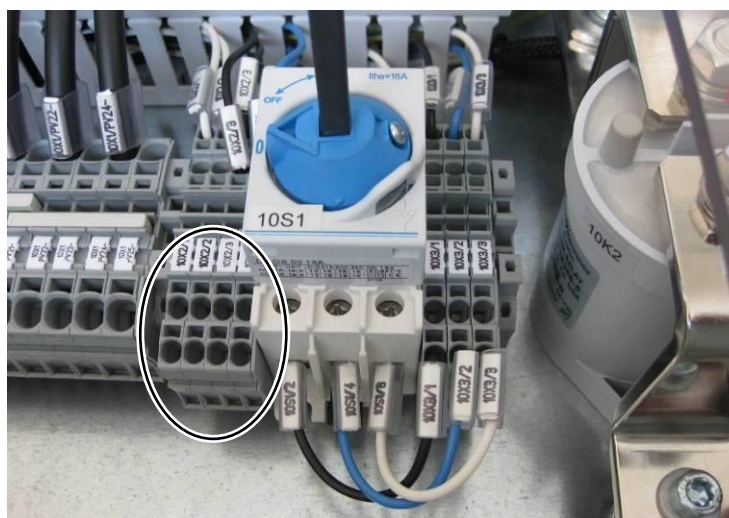


Figure 3.13 Contactor control and feedback (see also Figure 3.7-2)

3.5.7 Serial Interface Connections For String Box Monitoring

The string box monitoring communication can be done using the fibre optic interface (standard), or the RS485 interface (optional).

The fibre optic interface [Figure 3.14-3] requires a ring topology between the inverter and the string boxes. Starting from the inverter the ring has to be connected from string box to string box with increasing address numbering and ending back to the inverter.

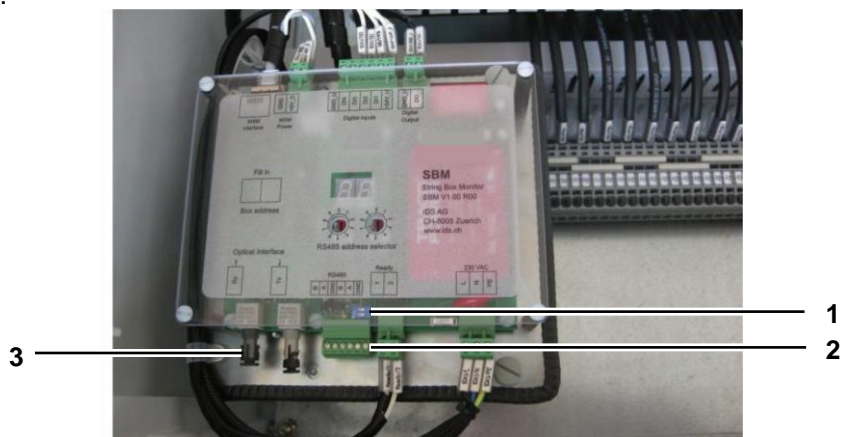


Figure 3.14 String box monitoring connections

- 1 - On/Off termination resistance activation
- 2 - RS485 interfaces
- 3 - Glass fibre transmitter and receiver

Table 3.7 SSB serial glass fibre optic interface

Terminal	Function	Specification
TX	Fibre optic Transmit data	Cable type: Outdoor, UV light resistant, armoured
RX	Fibre optic Receive data	Fibre type: Multimode 62,5/125 or 50/125 Cable end port ST type Recommended: A-VQ(BN)H 1x4, Corning Cable Systems Cable gland: 4.5...10 mm

Note: SSB RS485 [Figure 3.14-2] interface is available on request.

RS485 has to be realized as a bus and terminated in the last string box with the termination resistance (shift the white switches [Figure 3.14-1] to position "ON").

Table 3.8 SSB RS485 serial interface

Terminal	Function	Specification
RS485	B, A, GND	Cable type: Outdoor, UV light resistant Separable screw terminals Cu-cross section: 0.5 ... 1 mm ² Recommended: UNITRONIC® Li2YCYv(TP) 2x2x0,5 or 3x2x0,5, Lapp Kabel Cable gland: 4.5...10 mm

4 Commissioning

4.1 String Box Address Selection

All string boxes connected to a common serial interface should have unique addresses. Up to 100 string boxes can be addressed in one bus using the two address selection keys [Figure 4.1-2]. The address number is selected with the help of a screwdriver and is indicated on the LED seven segment indicators [Figure 4.1-1]. The two empty rectangular fields [Figure 4.1-3] are dedicated to put a handwritten string box address by a permanent marker.

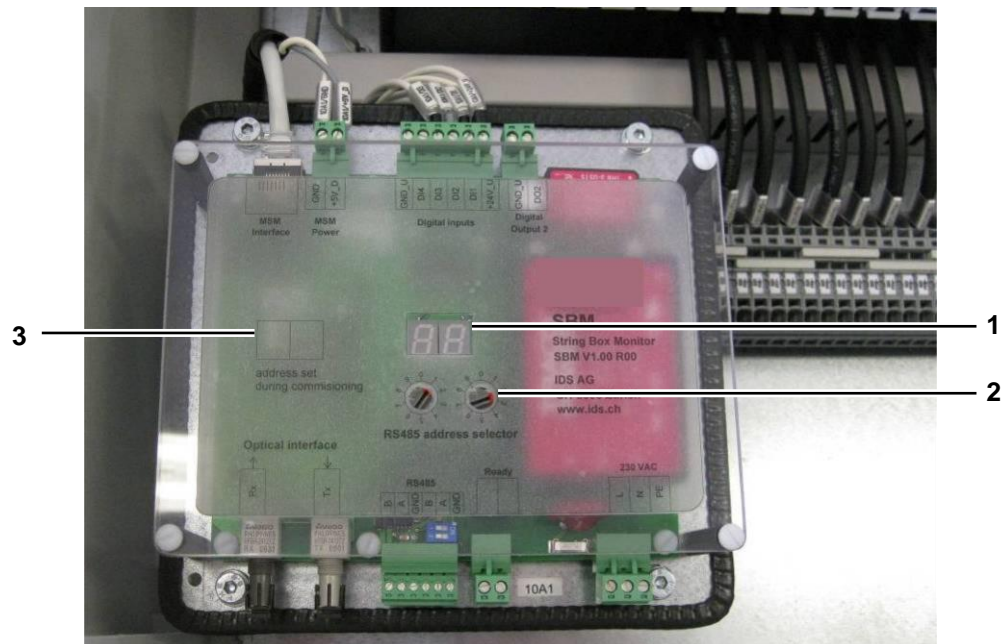


Figure 4.1 Setting the address of the string box monitor unit

- 1 - LED seven segment indicators
- 2 - Keys for address selection
- 3 - Field for writing the address

4.2 Turning the SOLO String Box On

Make sure that the PV strings, DC+, DC-, signal and PE cables are installed correctly.

Check if the fuse links are rated for the correct current. The fuse rating must comply with the rules defined in *Chapter 3.1*.

NOTICE

Wrong rated fuse link can lead to damages both to the SOLO String Box and the PV strings.



WARNING

Potentially Lethal Voltage!

Mount the plastic protective cover for protection against direct contact before proceeding with the commissioning.

The protective cover of the SOLO String Box can be dismantled or mounted only when the main switch is turned off (see *Figure 3.6-2*).

The screws of the SOLO String Box protective cover can be locked with the use of a slotted screwdriver, with a quarter of a revolution clockwise.

When the PV modules, power cables, ground and communication lines in the PV installation are connected correctly, the SOLO String Box is ready for operation.

NOTICE

Observe the instructions supplied in the user manual accompanying your photovoltaic inverter.

To connect the PV modules to the photovoltaic inverter, turn the main switch on.

Close and lock the SOLO String Box door.

The indication lamp on the door (see *Figure 3.5-2*) should glow in red. If the lamp is blinking this is an indication for a surge arrester or contactors or monitor electronic fault.

NOTICE

The door must be closed properly in order to prevent the penetration of dust and humidity.

NOTICE

Contaminations on the rubber seal must be avoided. Damaged rubber seals must be replaced immediately.



WARNING

If the signal lamp is off, this may be due to a light defect. The box could still be in operation and live.

4.3 Turning the SOLO String Box Off

In order to separate the PV modules from the inverter, turn the main switch off.

NOTICE

Observe the instructions supplied in the user manual accompanying your photovoltaic inverter.

5 Replacing defective fuse links and surge arresters



WARNING

The works described below must only be performed by electricians trained for PV installation.



WARNING

The PV module strings and the DC line toward the inverter might be live even when the main switches of the SOLO String Box and the inverter are turned off and the string protections are removed. Consider the inverter capacitors discharge time of **10 minutes**.

NOTICE

Use only fuses intended for use in photovoltaic applications. Otherwise, the protection of the installation will no longer be secured.

5.1.1 Replacing a Fuse

NOTICE

Observe the instructions in the user manual accompanying your photovoltaic inverter.

1. Check on the inverter VCU or in the Web portal which string is not producing current. This can be an indication of a damaged fuse.
2. Open the string box door.
3. Turn the main switch off.
4. Unscrew and remove the protective cover of the SOLO String Box.
5. Pull the string fuse holder out.



Figure 5.1 Fuse link opened

6. Replace the fuse link with the correct rated one complying with the rules defined in *Chapter 3.1*.

NOTICE

A wrong rated fuse link can lead to damages both to the SOLO String Box and the PV strings.

7. Close the string fuse holder.
8. Mount the protective cover back.
9. Turn the main switch on. The string is in operation again.
10. Close and lock the string box door.

5.1.2 Changing a Surge Arrester

The green indicator of the surge arrester (10U1) changes its colour to red when it is tripped.

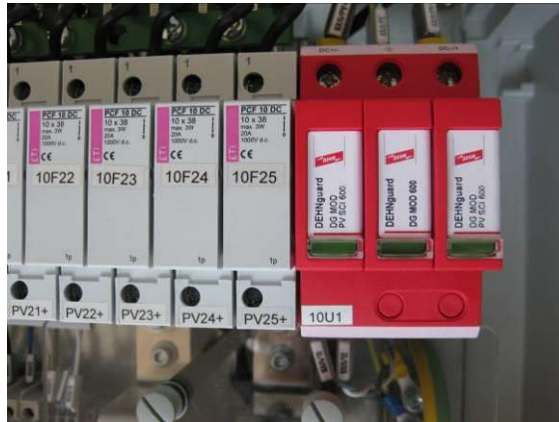


Figure 5.2 Surge arrester (see also Figure 3.7-1)

The surge arrester is monitored by auxiliary potential free contacts.

1. Open the SOLO String Box door.
2. Turn the main switch off.
3. Unscrew and remove the protective cover of the SOLO String Box.
4. Remove the defective surge arrester(s) through pulling it out of the fuse holder and place a new one (see Figure 5.3).



Figure 5.3 Removing of a damaged surge arrester

5. Put the protective cover back.
6. Turn the main switch on.
7. Close and lock the string box door.

6 EC – Declaration of Conformity

EC – Declaration of Conformity

Manufacturer

Electroinvent LTD
43, Cherny Vrah Blvd.
1407 Sofia
Bulgaria

This declaration of conformity relates to string boxes:

SSB-A-14-140
SSB-A-25-250

The above described product is constructed and manufactured according to the good engineering practice in safety matters in compliance with the essential requirements of:

Directive 2006/95/EC of the European Parliament and of The Council of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits

and regarding electromagnetic compatibility in compliance with the essential applicable requirements of:

Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility
meeting accordingly the requirements of the following harmonized European standards:

EN 61000-6-2	Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity for industrial environments (IEC 61000-6-2:2005)
EN 61000-6-4	Electromagnetic compatibility (EMC) Part 6-4: Generic standards - Emission standard for industrial environments (IEC 61000-6-4:2006)
EN 50178	Electronic equipment for use in power installations; EN 50178:1997

Issued by

J. Torchanov, CEO, Electroinvent LTD

This declaration confirms the compliance with the quoted directive, but it does not constitute any warranty as to properties.
The safety information contained in the product documentation supplied must be adhered to.

Sofia, 09.04.2015

.....
J. Torchanov, Electroinvent LTD

EI / jt

CE Conformity SSB –A

Figure 6.1 EC – Declaration of Conformity

7 Data Sheet SOLO Smart String Box

Type	SSB-A-14-140	SSB-A-25-250
------	--------------	--------------

Electrical Data

Maximum operating voltage	U_{DC}	1000 V _{DC} or 1200 V _{DC}	
Maximum output current DC	I_{DCmax}	140 A	250 A
Maximum number PV inputs (strings)		14	25
Maximal input current DC per string	I_{STRmax}	10 A	
String current measurement range	I_{STR}	0.5 – 15 A	
Reverse string current measuring	$I_{STR rev}$	Yes	
Surge arrester		Type II	
State indication lamp on the door		Yes	
Test voltage		2.5 kV, 50 Hz, 1 min	
Surge arrester fault indication		Yes (auxiliary dry contacts)	

Mechanical Data

Dimensions in mm	W x D x H	735 x 270 x 535	
Weight	m	26 kg	29 kg
Colour		RAL 7035 (light grey)	
Enclosure material		Glass-fibre-reinforced and halogen-free polyester	
Protection class according to EN 60529		IP55 (outdoor)	
Impact strength according to EN 50102		IK10	
Max air humidity		95 %	
Ambient temperature range	T_{amb}	-20 °C ... +60 °C	
UV proof		Yes	

String Box Interface

DC contactor control input	230 V _{AC} +10%/-15%, 50 Hz ± 10 %, P _{max} = 40W
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String Box Monitor Interface

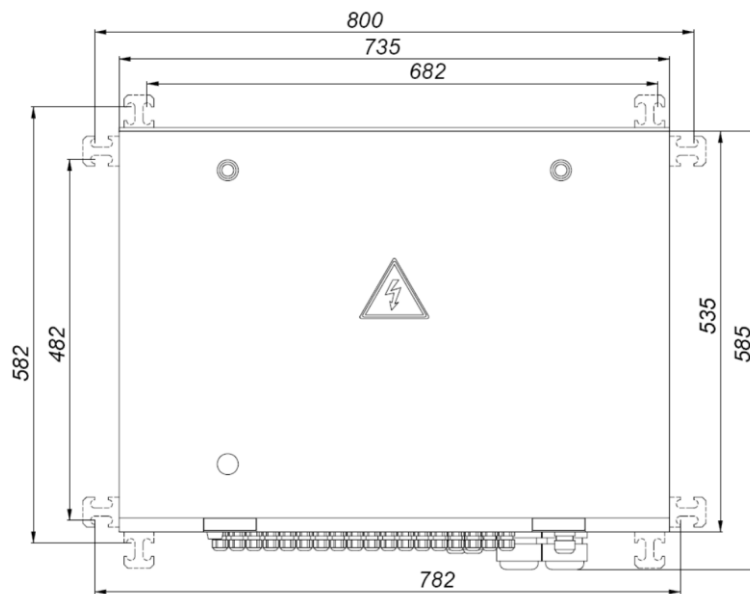
Ready feedback	Separate feedback for each Smart String Box; Closed dry contact when ready
Ready feedback output	24 V _{AC/DC} (18 – 36 V), 2 A at 30 V _{DC}
Fibre optical interface (standard)	Ring type serial interface connection
RS 485 serial interface (optional)	Separable screw terminal with. 6 pins for easy bus wiring. Galvanically isolated from monitoring electronic.

Options

Stainless steel enclosure
Fuses with visual indication when tripped
PV(–) disconnect type terminals

Standards

CE conformity / EMC	Yes / EN 61000-6-2, EN 61000-6-4 / EN 50178
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Ordering Information

For technical or commercial information please contact the ELECTROINVENT sales office (see Contacts on last page of this user manual).

Contacts

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