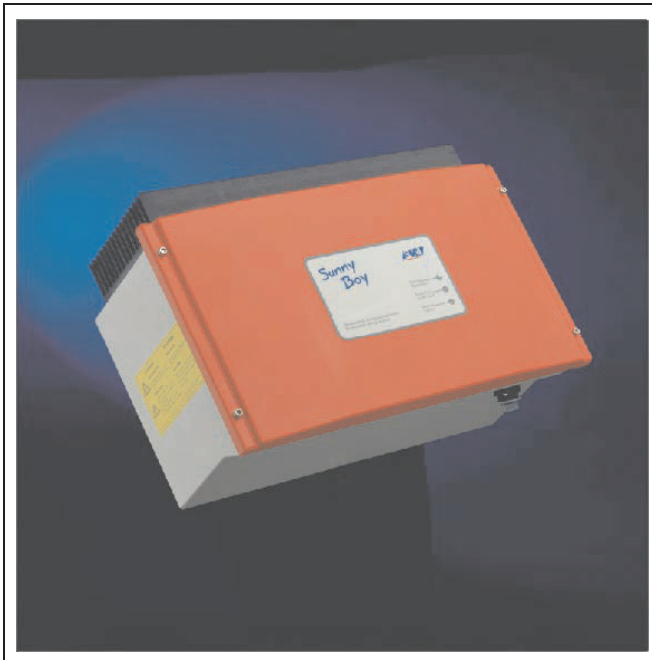




Sunny Boy 2100TL

Transformerless solar inverter



Installation Guide

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Revision History

Document number	Changes	Author
SB2100TL-11:SE0204	First Issue	Siebert

1 Introduction

This document gives short installation instructions for electricians only. It helps to swiftly and correctly install and commission an SMA inverter type „Sunny Boy 2100TL“.

For detailed technical data and operating instructions please see the Operating Instructions.

The „GenAu“ tool will help to dimension and check the size of your strings with respect to the Sunny Boy you intend to use. The „GenAu“ tool is available for download at www.SMA.de.

If you have any further questions please do not hesitate to call the Sunny Boy hotline on the following number:

+49 561 9522-499

All trademarks mentioned in this Installation Guide are accepted.

2 Safety Instructions



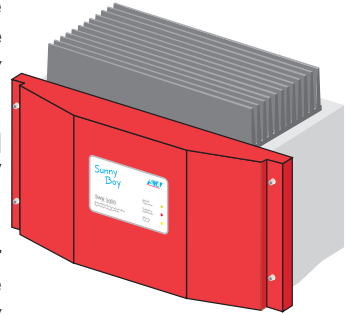
Only a qualified electrician may work on the open Sunny Boy! This work is only permissible if the AC and DC power supply are safely disconnected from the Sunny Boy.

The Sunny Boy must be disconnected from the grid and secured against accidental reconnection. Connections to the PV generator must be disconnected as well.



When this has been done, always wait for approx. 5 minutes so that the capacitors in the Sunny Boy can be discharged. Only then may the lid be opened and the safe isolation from power supply be checked.

The Sunny Boy 2100TL is equipped with the anti-islanding unit „SMA grid guard“. The Sunny Boy 2100TL therefore complies with the VDEW guidelines for grid interactive inverters and the DIN VDE 0126 (4.99) specified in this regulation.



The Sunny Boy is equipped with high voltage capacitors that can contain lethal voltages even when disconnected from supply power for some time.

3 Overview

3.1 Device Description

The following figure shows the different components and connection areas of an open Sunny Boy 2100TL inverter.

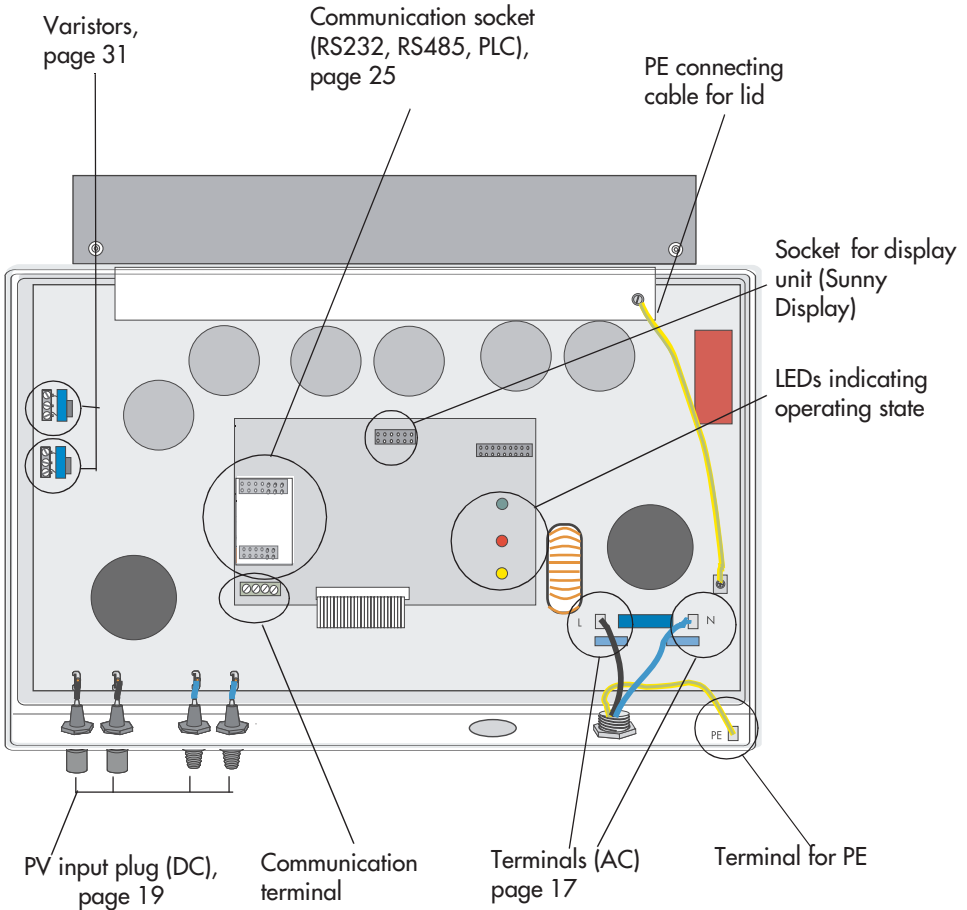


Fig. 3.1: Inside view of the Sunny Boy 2100TL

3.2 External Dimensions

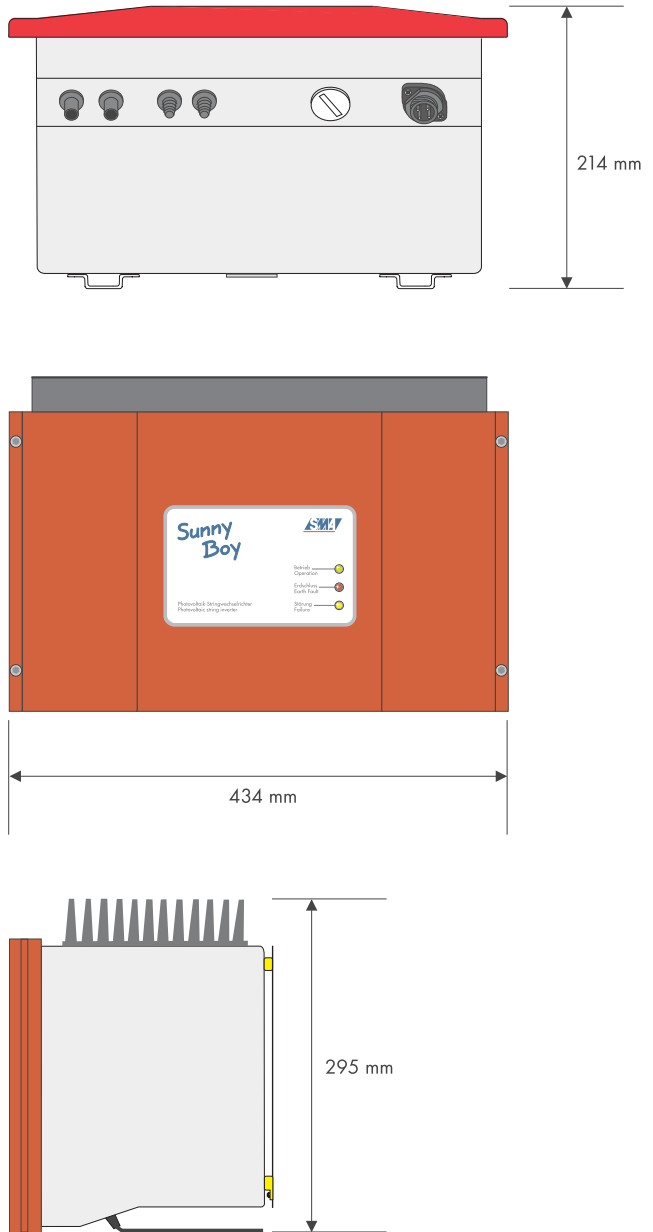


Abb. 3.2: Size of the Sunny Boy 2100TL

4 Requirements for the Installation

Please make sure to fulfill all conditions below before installing and commissioning the Sunny Boy.

4.1 Requirements: Mounting Place

The Sunny Boy 2100TL has a relatively high weight of 16 kg. Please keep this in mind when selecting the place where and how to mount the Sunny Boy.



The ambient temperature should be within $-25\text{ }^{\circ}\text{C}$ and $+60\text{ }^{\circ}\text{C}$.

The Sunny Boy 2100TL should be installed in a place where it is not exposed to direct sunlight - otherwise this may reduce the yield of the PV plant due to the higher temperature.

The inverter may not be mounted in a position tilted to the front if installed outdoors.

It can be mounted straight or to the back. To ensure optimum energy yield and easy operation it should be mounted straight on eye level.

Important for the selection of the location:



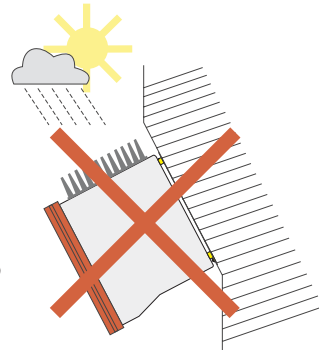
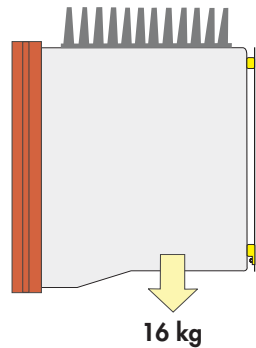
Unintended removal of the Multi-Contact[®] snap-cable connectors can damage the connectors and even result in serious injuries. Install the Sunny Boy in a place where an unintended removal of the Multi-Contact[®] connectors (e. g. by children) is not possible.



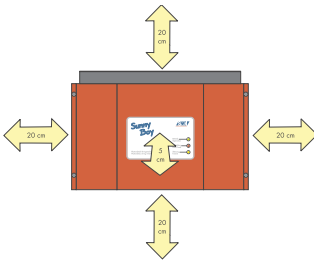
Some parts of the Sunny Boy can reach temperatures over $80\text{ }^{\circ}\text{C}$. Keep a suitable distance to flammable materials!



Never install the Sunny Boy in areas that likely contain explosive atmospheres (battery rooms, fuel storage rooms etc.)!



The Sunny Boy may not be mounted in a position tilted to the front if installed outdoors!

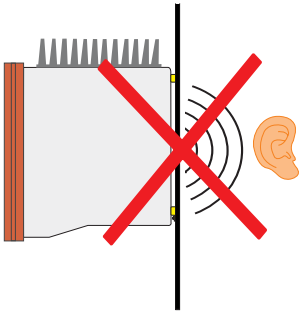


Pay attention to the required minimum clearance for the Sunny Boy 2100TL

Please make sure there is a sufficient space for heat dissipation! In a normal environment the following clearance should be provided for the Sunny Boy 2100TL

	Minimum clearance
Lateral	20 cm
Top	20 cm
Bottom	20 cm
Front	5 cm

Table 4.1: Minimum clearance



Mounting the Sunny Boy on a thin surface may emit a slight noise!

In a living area the Sunny Boy should not be mounted on plaster panels, thin wooden panels etc. in order to avoid noises.

We recommend to install the inverter on a firm and sturdy surface.

4.2 Requirements: PV-Modules

The Sunny Boy 2100TL is designed for the connection of up to two strings (PV modules connected in series).

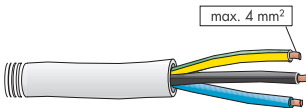
The „GenAu“ tool will help to dimension and check the size of your strings with respect to the Sunny Boy you intend to use. The „GenAu“ tool is available for download at www.SMA.de.

The device has four Multi-Contact plug connectors (two for each string). The connecting cables of the PV panel therefore have to be equipped with such plug connectors as well.

A connection kit for connection of loose cable ends in a string can be purchased as an accessory (SMA order name: „SWR-MC“).

Limits for DC input	
Max. voltage	600 V (DC)

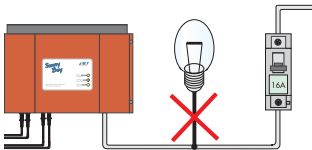
4.3 Requirements: Grid 230 V~ (AC)



The Sunny Boy has to be connected to grid with three wires!

The relevant technical regulations as well as specific requirements defined by the local public utility have to be complied with.

The terminals of the Sunny Boy 2100TL are suitable for cables with a cross-section of up to 4 mm². The Sunny Boy is connected with three wires (L, N, PE).



No additional consumers may be connected between the Sunny Boy and the fuse!



Each connection to a Sunny Boy 2100TL must be equipped with a separate circuit breaker 16 A. No other consumers may be connected to the cable.



Do not equip the AC circuit with a 30 mA GFCI (Ground Fault Current Interruptor) that trips when the residual failure current to the equipment ground (PE) exceeds 30 mA.

The Sunny Boy 2100TL constantly monitors the ground currents of the PV-plant (PV-modules, cables and inverter) and disconnects from the grid when the ground fault current *deviations* exceed 30 mA. The Sunny Boy 2100TL automatically distinguishes between real failure currents and normal capacitive discharge currents.

The Sunny Boy 2100TL does not generate any extraordinary capacitive discharge currents in normal operation. In certain cases (e.g. the internal testing of the safety components within the Sunny Boy 2100TL) discharge currents can occur that can trip a 30 mA GFCI.



Install a 100 mA GFCI in the AC distribution in case an additional GFCI is absolutely necessary.

The impedance at the AC connection point of the Sunny Boy 2100TL must be below 1.2 Ohm in order to ensure a reliable function of the anti-islanding unit. You should furthermore have a suitable cable cross-section in order to keep the losses below 1 % at nominal power. The according losses with respect to cable length and cross-section are illustrated below:

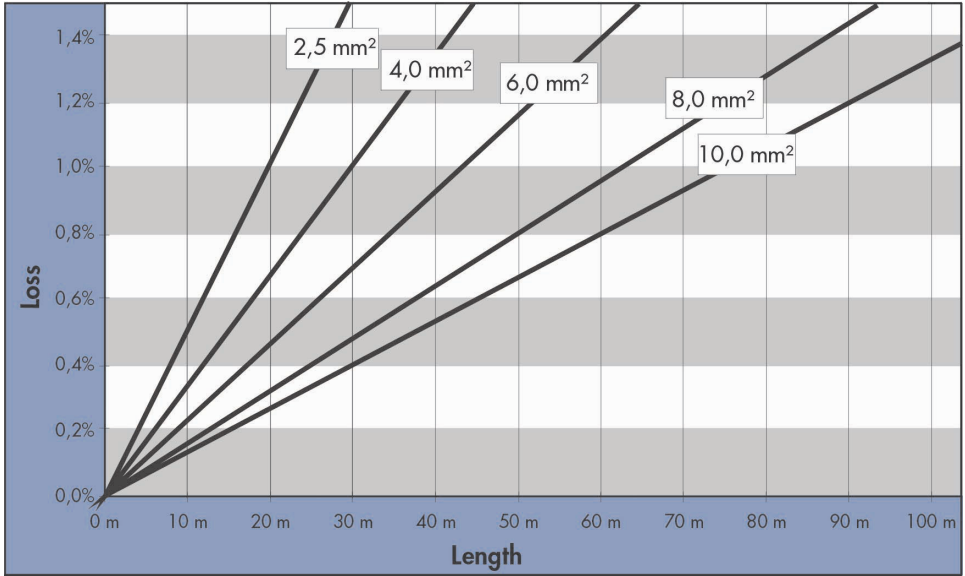


Fig. 4.1: Losses in AC cable

The Sunny Boy 2100TL is designed for 230 V grids. The voltage should be within 198 V and 260 V and the frequency should be within 49.8 Hz and 50.2 Hz.

198 V ... 260 V
49.8 Hz ... 50.2 Hz

Limits for AC output

Limits for AC Output	
Voltage range	198 V ... 260 V
Frequency range	49.8 Hz ... 50.2 Hz
Voltage range (without ENS)	180 V ... 260 V
Frequency range (without ENS)	45.5 Hz ... 54.5 Hz

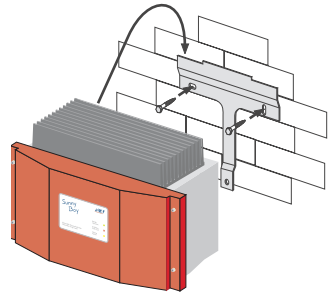
Table 4.2: Limits for AC output of the Sunny Boy 2100TL

5 Installation

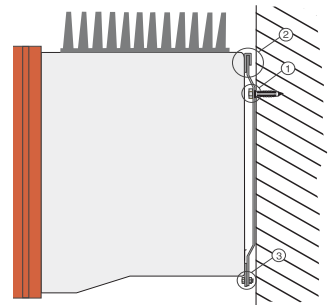
5.1 Mounting

For trouble-free mounting of the Sunny Boy 2100TL we recommend to use the bracket for wall installation included in delivery. You can mount it vertically in firm concrete or stone walls with e. g. stainless steel 8 mm x 50 mm hexagon screws according to DIN 571 and with dowels type SX8.

Keep the weight of the Sunny Boy 2100TL (16 kg) in mind.

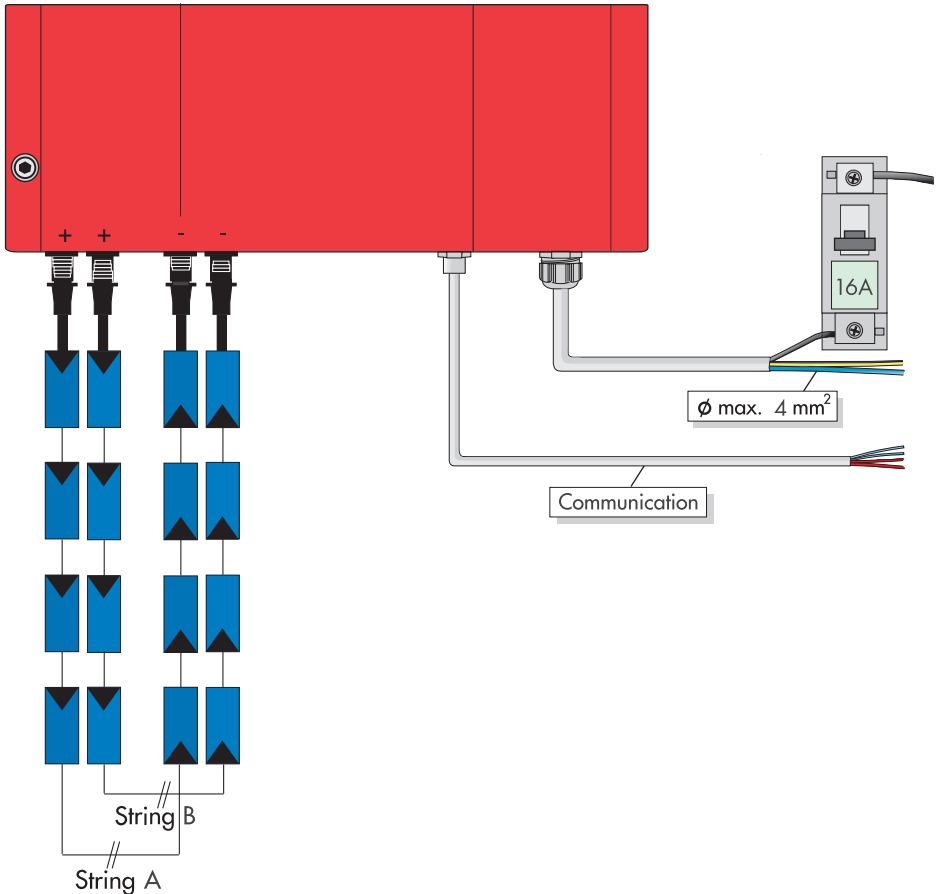


1. Mount the bracket. To mark the positions for drill holes you can also use the bracket as a drilling template.
2. Hang the upper fixing straps on the Sunny Boy 2100TL into the bracket (2) so that it cannot be shifted sideways any more.
3. Secure the Sunny Boy 2100TL against lifting off by screwing the M6x10 screw (included in delivery) into the lower middle fixing strap (3).
4. Ensure the Sunny Boy 2100TL has been tightly fastened.



5.2 Electrical Installation

The following figure shows the complete cabling of a Sunny Boy 2100TL:



Depending on the type of PV module used, it is reasonable to connect only one String or to use two parallel Strings. Thus, the module has two plus poles and two minus poles. These poles are simply connected in parallel within the module.



In case only one String terminal is used, please absolutely cover the two plug-in contacts not used with the seals enclosed.

Connecting of AC output

Please follow the steps below:

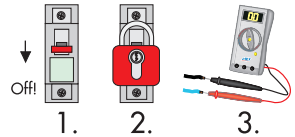
1. Check the grid voltage. If it is above 260 V, the Sunny Boy 2100TL can only operate to a limited extent. The local public utility company should solve this problem.



max. 260 V!

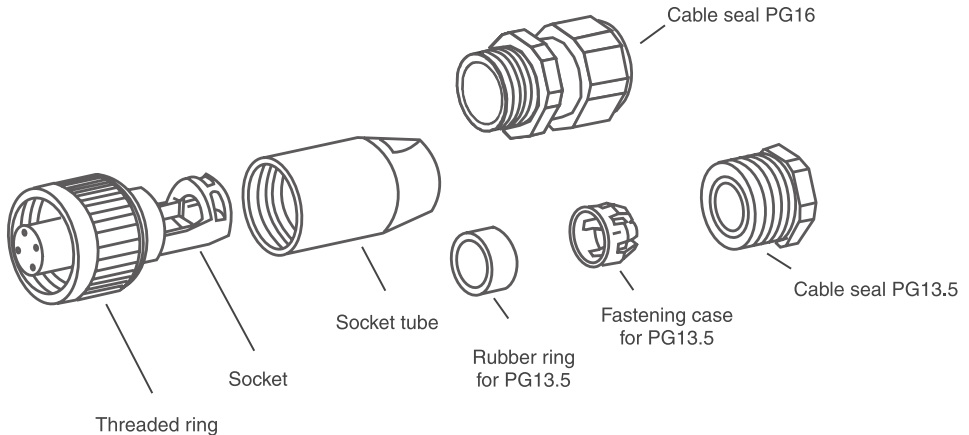
The maximum grid voltage for feeding operation is 260 V!

2. Disconnect the grid (switch off the circuit breaker), secure it against accidental reactivation and ensure that it is disconnected.



Before opening the Sunny Boy check whether the AC output is safely isolated from supply!

3. The AC connector is a round socket that is suitable to take different cable diameters. A PG13.5 and a PG16 cable seal are included with the AC connection socket. Check which size is suitable for your AC connection cable.
4. Strip the insulation off the ends of the cable and connect the cable to the AC socket as shown below.



5. Push the rubber ring into the fastening case.
6. Put the cable through the PG13.5 or 16 cable seal. Put the cable through the fastening case with the rubber ring and through the socket tube.

7. Connect the wires of the AC cable as follows:
 - Protective Earth (PE) to the terminal with the „ground“ symbol.
 - Neutral wire to the terminal marked with „1“
 - Phase L to the terminal marked with „2“
 - The terminal marked with „3“ is not used.
8. Make sure that all wires are firmly connected.
9. Push the socket tube firmly onto the socket.
10. For cables that require the PG16 gland: Tighten the bolt of the PB16 gland.
11. The AC connector socket is now ready to use.
12. Seal the AC connector socket in case you do not insert it into the Sunny Boy.
13. The AC connector socket can be inserted into the Sunny Boy in case the Sunny Boy is already mounted in the correct position. Remove the seal from the AC connector on the Sunny Boy, insert the AC connector plug and tighten the seal.

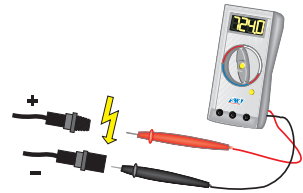


Do not switch on the circuit breaker yet! The Sunny Boy 2100TL may only be connected to the AC grid when the PV strings have been connected and the device is tightly closed.

PV string (DC) connection

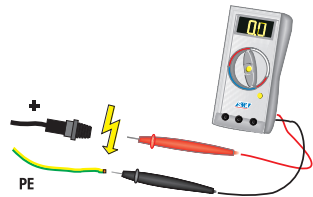
Connect the PV strings as follows:

1. Check the PV generator connections on their correct polarity and compliance with the maximum string voltage of 600 V DC, see chapter 4.2 "Requirements: PV-Modules" (p. 11).



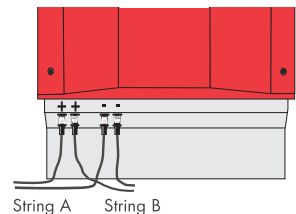
The voltage from the strings is very dangerous! Be very careful and pay attention to all applicable safety regulations!

2. Measure the DC voltages between each Multi Contact plug connector of a string and ground potential. Follow the safety instructions!
3. If the voltages measured are constant and their total approximately corresponds to the open-circuit voltage of the string, a ground fault has occurred in this string. The ratios of voltages approximately indicate where the ground fault can be found.

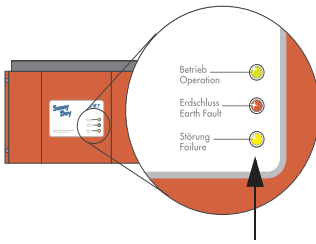


When you have found a ground fault in a string, only connect it to the Sunny Boy 2100TL after you have removed the cause for the ground fault in the PV generator.

4. Repeat steps 2 and 3 for each string.
5. Connect the trouble-free PV strings to the Sunny Boy. Make sure to connect them to the correct terminals and with correct polarization.



When connecting the plus and minus poles of a string make sure to choose the correct connection!



If the lower yellow LED repeatedly blinks once a second for four times, immediately disconnect the grid voltage and the PV generator from the Sunny Boy 2100TL. The input voltage is too high. The inverter might be damaged!

Check whether string voltages comply with limiting values stated in chapter 4.2 "Requirements: PV-Modules" (p. 11). If the values are too high, the planner / installer of the PV generator must modify the strings.

If the LED blinks again when the PV plant is reconnected to the inverter although string voltages have been checked to be ok, disconnect the PV panel again and contact SMA Regelsysteme GmbH (see chapter 9 "Contact" (p. 35)).

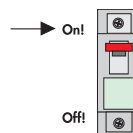
5.3 Activation

You can activate the Sunny Boy 2100TL when:

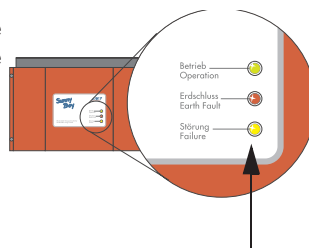
- The AC (grid) cable has been correctly connected.
- All the DC (PV) strings have been connected and all unused DC plug connectors on the underside of the inverter have been closed with the protecting caps.
- The lid has been tightly screwed on.

Proceedings for activation

1. Switch the circuit breaker on.



2. Check whether the LEDs indicate trouble-free operation of the Sunny Boy 2100TL based on the following table. If this is the case commissioning has been successfully completed.



Green	Red	Yellow	Status
permanently on	off	off	OK (feeding)
	permanently on	off	failure
		permanently on	OK (initialization)
blinking fast (3 x per second)	off	off	OK (stop)
	permanently on	off	failure
blinking slowly (1 x per second)	off	off	OK (waiting, grid monitoring)
	permanently on	off	failure
shortly turns off (approx. 1 x per second)	off	off	OK (derating)
	permanently on	off	failure
off	off	off	OK (stand-by)
		on/blinking	failure
	permanently on	off	failure
		on/blinking	failure

Table 5.1: LED blinking codes

You will find a detailed description of failure messages and their causes in the „Operating Instructions“.

6 Opening and closing the Sunny Boy



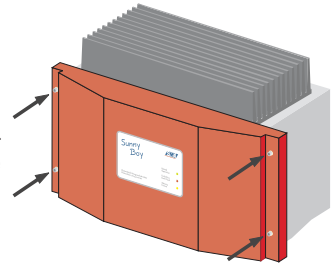
When the inverter has to be opened always follow the safety instructions given in chapter 2 "Safety Instructions" (p. 5).

6.1 Opening the Sunny Boy



Caution: Stick to the order specified below!

1. Switch off the AC connection.
2. Disconnect the PV generator from the Sunny Boy 2100TL, by pulling off all the connectors.
3. **Wait 5 minutes! (This is necessary to let the internal capacitors discharge.)**
4. Unscrew the lid from the enclosure of the Sunny Boy 2100TL and carefully remove the lid. Then pull the PE cable off the inside of the lid.



Make sure that you pull off the green-yellow PE cable from the inside of the Sunny Boy when you open it!

6.2 Closing the Sunny Boy



Caution: Stick to the order specified below!

1. Connect the PE conductor to the lid. Then attach the lid to the enclosure of the Sunny Boy 2100TL by tightening the four screws.
2. Connect the PV generator. Make sure to connect each plug to the correct terminal.
3. Switch on the circuit breaker. This activates the Sunny Boy 2100TL.
4. Check whether the LEDs of the Sunny Boy 2100TL indicate trouble-free operation.

7 Communication

The upgrading of your Sunny Boy 2100TL with communication Piggy-Backs is described in the manuals delivered with the communication Piggy-Backs.

The connection of the data cables for RS232 and RS485 communication is described in the following.

You can see whether the Sunny Boy 2100TL has already been equipped with a communication interface in the factory by checking the order name on the delivery note.

„-0xx“	without interface
„-1xx“	PLC modem (Powerline Communication)
„-2xx“	RS232 interface
„-3xx“	RS485 interface

7.1 Powerline Communication

The following conditions must be fulfilled for Powerline Communication:

- The Sunny Boy 2100TL has to be equipped with the „PLC signal unit“ (see chapter 3.1 "Device Description" (p. 7)).

The Sunny Boy 2100TL can be upgraded for powerline communication. The ordering code for the powerline upgrade kit for the Sunny Boy 2100TL inverter is „NLMPB-NR“.

7.2 RS232 Communication

RS232 is a communication standard for transmission paths up to 15 m to one single Sunny Boy 2100TL. The following conditions must be fulfilled for RS232 communication.

- The Sunny Boy 2100TL has to be equipped with a second cable gland (included in delivery) between the PV input plugs and the cable opening for AC output on its underside.
- The Sunny Boy 2100TL has to be equipped with an RS232 Piggy-Back. The ordering code for the RS232 is 232PB-MS-NR
- A cable with a minimum of three wires and common shield, such as LiYCY, 0.25 mm² cross-section and a maximum 15 m length has to be used.

To provide for an RS232 interface the Sunny Boy 2100TL has to be equipped with the second cable gland included in delivery. The RS232 cable enters the inverter through this gland and is connected to the communication terminal within the Sunny Boy 2100TL (see chapter 3.1 "Device Description" (p. 7)). Its other end is usually connected to a serial interface of a PC. The following table specifies the pin designation for standard PC terminals.

Terminal	Signal	D-SUB 9 plug (PC)	D-SUB 25 plug (PC)
Enclosure	Shielding	Enclosure	Enclosure
2	RxD (Sunny Boy output port)	2	3
3	TxD (Sunny Boy input port)	3	2
5	GND	5	7

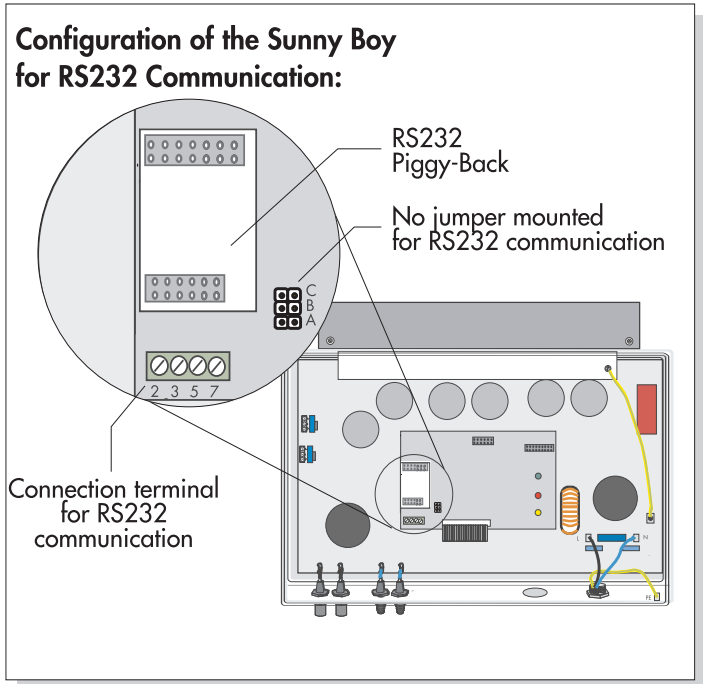
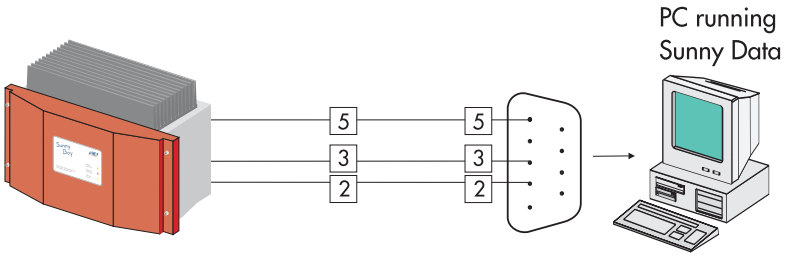


Abb. 7.1: Sunny Boy connected to a PC via RS232

7.3 RS485 Communication

RS485 is a communication standard for up to 50 Sunny Boy inverters with a total cable length of up to 1200 m. The following conditions must be fulfilled for RS485 communication:

- All Sunny Boys have to be equipped with the second cable gland (included in delivery) on their underside.
- All Sunny Boys have to be equipped with an RS485 Piggy-Back.
- A cable with common shield (such as LiYCY) with two twisted pair with a line impedance of 100 ohm.
- The first and the last participant of the RS485 bus have to be equipped with a termination resistor.



At the moment the Sunny Boy Control and the Sunny Boy Control Plus can communicate with PV-plants with up to 5 different types and all in all 50 Sunny Boy inverters in total. The Sunny Boy Control Light can communicate with 5 different Sunny Boy types and all in all 20 Sunny Boy inverters in total.

To provide for an RS485 interface the Sunny Boy 2100TL has to be equipped with the second cable gland included in delivery. The delivery includes two different gland fittings (a fitting with one hole for one cable and a f with two holes for two cables).

Best start with the last Sunny Boy 2100TL in the communication chain (i. e. the one at the end of the RS485 cable):

1. Use the gland fitting with **one** hole.
2. Now attach one of the two plug connectors delivered to the data cable. Connect the wires of one twisted pair to terminals 2 and 7 on the communication slot (see Fig. 7.2: "One or several Sunny Boys connected with an RS485 cable to a PC with interface converter." (p. 30)). **Write down which wire is connected to which terminal!**
3. Connect one (or both) wires of the second twisted pair to terminal 5 on the communication slot. **Write down which wire(s) you have used!**
4. If no other inverters have to be connected, continue with point 8.
5. Now connect the next inverter. Use the contact units with **two** holes.

6. Connect the wires of a cable to the terminals on the communication slot with the same allocation as written down for the first inverter. This applies both to the wires in the cable coming from the last inverter and in the one running to the next inverter. **Proceed with special care! Finding wiring failures can be very frustrating!**
7. Repeat points 5 and 6 for each Sunny Boy to be connected.
8. To be able to connect them to a Sunny Boy Control or a PC with an interface converter later, label the wires at the end of the cable as follows.

Terminal	D-SUB 9 plug	Labeling of wire	Your wire labeling
Enclosure	Enclosure	Shielding	
2	3	Data +	
7	8	Data -	
5	5	GND	

The connection of one or several Sunny Boy inverters to a Sunny Boy Control is described in detail in the manual of the Sunny Boy Control.

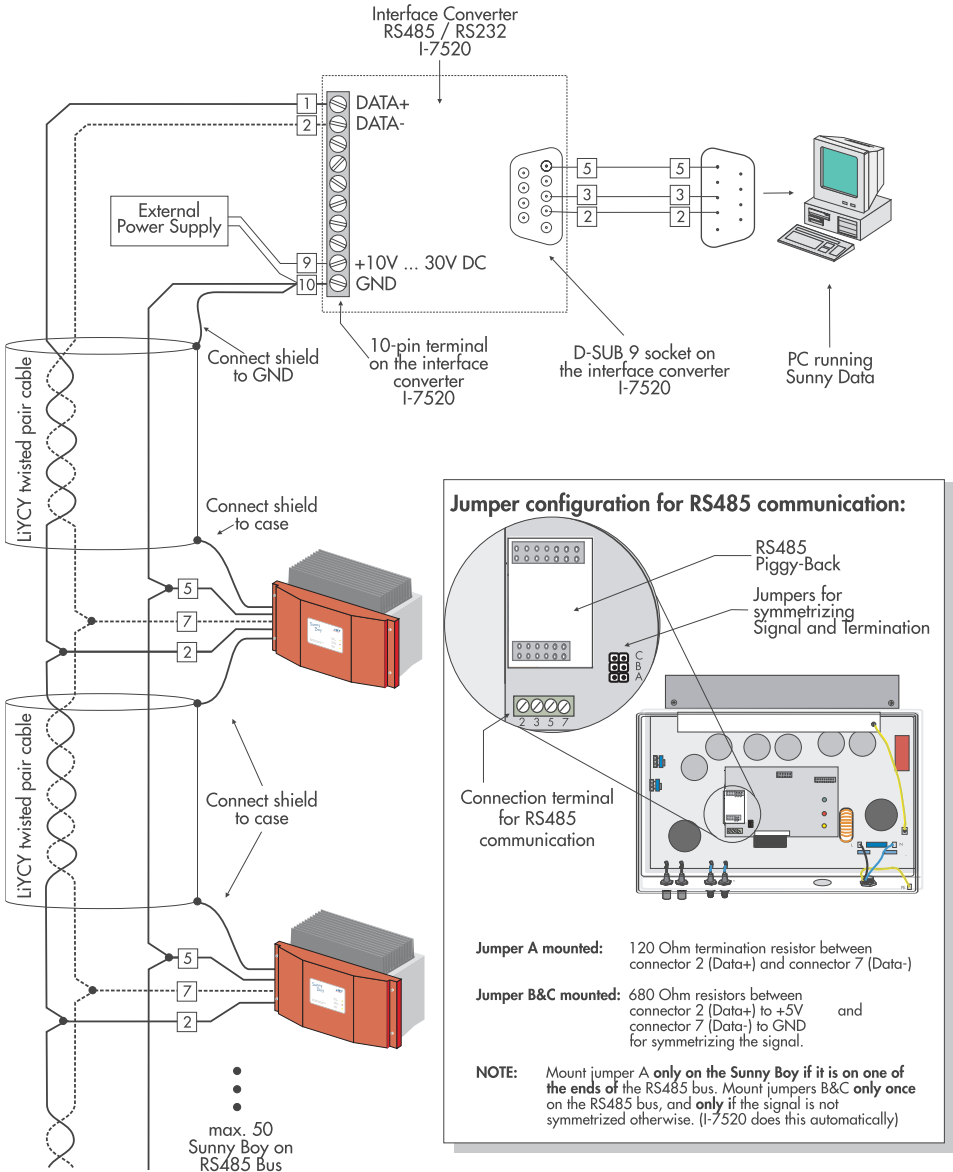


Fig. 7.2: One or several Sunny Boys connected with an RS485 cable to a PC with interface converter.

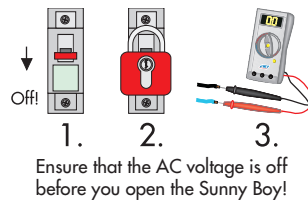
SMA recommends the usage of a I-7520 interface converter for the connection of an RS485 bus to a PC. SMA does not support any other types.

8 Exchanging varistors

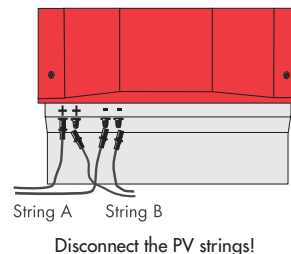
The Sunny Boy 2100TL is a very complex technical device. Therefore there are only a few possibilities to repair failures on site. Please do not try to make repairs other than described in this document. Make use of our 24-hour exchange service and the repair service of SMA Regelsysteme GmbH.

If the red status LED is permanently on during operation please first make sure that there is no ground fault in the PV generator. Only if the green LED is **permanently** on at the same time, you can skip points 3 to 5 below.

1. Disconnect the grid (switch off the circuit breaker), secure it against accidental reactivation and ensure that it is disconnected.



2. Disconnect the Multi-Contact plug connectors of all strings. Make sure that their allocation to the different inverter input ports can still be recognized!



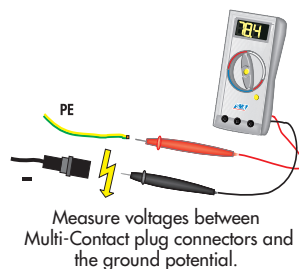
3. Measure voltages between one Multi-Contact plug connector of each string and the ground potential. Follow all applicable safety instructions!



The voltage from the strings is very dangerous! Be very careful and pay attention to all applicable safety regulations!

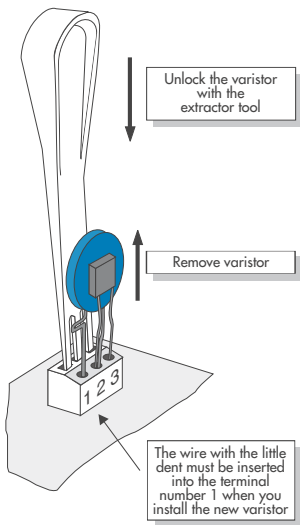
4. If the voltages measured are constant and their total is approximately equal to the open-circuit voltage of the string, there is a ground fault in this string. Its approximate position can be deducted from the ratios of voltages.

5. Repeat points 3 and 4 for each string.
If you have found a ground fault it is probably unnecessary to exchange the varistors. Make sure to remove the ground

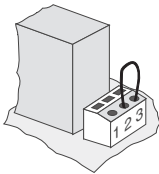


fault instead. This should normally be done by the installer of the PV panel. In this case proceed with point 10, but without reconnecting the faulty string! Protect its Multi-Contact plug connectors against touching (e. g. by protective caps or insulation strip with sufficient electric strength).

If you have not found any ground fault in the PV generators, probably one of the thermally monitored varistors has lost its protective function. The varistors are subject to wear and tear and their function is reduced in the course of their aging or in case of repeated strain placed on them by surge voltages. You can now check the varistors as described below while following the safety instructions given in chapter 2 "Safety Instructions" (p. 5).



6. Unscrew the lid of the Sunny Boy 2100TL and remove it. Disconnect the PE plug inside the lid. Test safe isolation from supply.
7. Test all varistors for an electric connection between terminals 2 and 3. If there is no electric connection the varistor is useless. The position of varistors in the Sunny Boy 2100TL can be seen in the figure in chapter 3.1 "Device Description" (p. 7).
8. Replace the defective varistor by a new one as shown in the figure on the left. Ensure correct orientation of the varistor! Please contact SMA if you have not received special tools to move the terminals (included in delivery of replacement varistors). However, the terminal contacts can also provisionally be released one by one with a suitable screwdriver. The failure of a varistor is normally due to circumstances that apply to all varistors in a similar manner (temperature, age, induced surge voltages). We therefore strongly recommend not only to exchange the defective one, but all two. These varistors are specially manufactured for use in the Sunny Boy 2100TL and are not commercially available. They have to be purchased from SMA Regelsysteme GmbH direct (SMA order name: "SB-TV4" (2 varistors)).



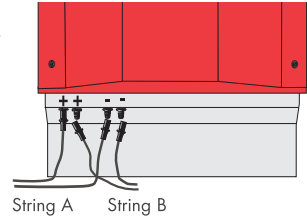
For a limited period of time a defective varistor can be replaced by a wire between terminal 2 and 3.

9. If no replacement varistors are available on site the Sunny Boy 2100TL can also be operated without them for a limited period of time. To this end remove the varistors you have found to be defective and equip the terminals with a wire jumper between terminals 2 and 3 instead. The Sunny Boy 2100TL is then not protected against surge voltages!



The input port thus modified is no longer protected against surge voltages! Equip the inverter with varistors again as soon as possible. The inverter should not be operated without varistors in plants where there is a high risk of surge voltages!

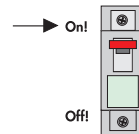
10. Reconnect the PE plug to the lid and close the Sunny Boy 2100TL again.



11. Connect the faultless strings of the PV panel. Ensure correct allocation to strings.

12. Switch on the circuit breaker.

13. Check whether the LEDs of the Sunny Boy 2100TL show trouble-free operation.



If you have found neither a ground fault nor a defective varistor there probably is a fault in the inverter. Please contact the SMA hotline in this case to discuss further proceedings.

9 Contact

If you have any questions or technical problems with the Sunny Boy 2100TL our hotline will be happy to help you. Please keep the following data ready when calling SMA:

- Type of inverter used
- Connected modules
- Communication
- Serial number of device



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