Sunny Boy SB 1100LV
Inverter for Photovoltaic Plants

Installation Guide | Version 1.1 | SB1100LV-11:SE2006
IME-SB1100LV

Inhaltsverzeichnis

1 Explanation of the symbols used:

To ensure optimum use of these instructions, please note the following explanation of symbols used.

This symbol identifies an example.

This symbol identifies a notice where failure to follow the advice will make the procedure or operation more difficult.

This symbol indicates a fact that when not observed could result in damage to components or danger to persons. Please read these sections especially carefully.

2 Foreword

The Sunny Boy SB 1100LV contains the SMA grid guard 2. This is a type of independent disconnection device. It ensures that the Sunny Boy SB 1100LV complies with the VDEW (Verband der Elektrizitätswirtschaft – German Electricity Industry Association) regulations for the connection and parallel operation of electrical power units to the low-voltage grid of the electricity supply company and with DIN VDE 0126-1-1, which forms a part of these regulations.

For detailed information on troubleshooting and on how to use the Sunny Boy and the various communications options, please see the operating instructions.

"Sunny Design" helps you design the system and check string size taking the relevant inverter into consideration. Further information on Sunny Design is available at www.SMA.de.

If you require further information, please call the Sunny Boy hotline on the following number:

(0561) 95 22 - 499

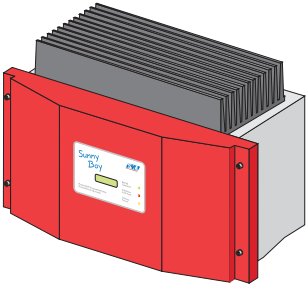
2.1 Target group

Attention!

The Sunny Boy may only be installed by trained specialists. Installers must be approved by the local energy supplier. Please carefully read this installation manual. All prescribed safety regulations, the technical connection requirements of the local energy supplier and all applicable provisions must be adhered to.

This installation manual is intended solely for qualified electricians. Its aim is to help install and set up SMA Sunny Boy SB 1100LV inverters quickly and correctly.

3 Safety instructions



Caution! Overvoltage

Check the system design using the "Sunny Design" design tool (www.SMA.de) or by calling the Sunny Boy Hotline. Overvoltages may lead to the destruction of the Sunny Boy SB 1100LV.

Warning! High voltage!

Work on the Sunny Boy with the cover removed must be carried out by a qualified electrician. High voltages are present in the device. Before working on the Sunny Boy with the cover removed, the AC and DC voltages must be disconnected from the Sunny Boy and the capacitors must be discharged.

The Sunny Boy must be disconnected from the mains grid and precautions must be taken to prevent the grid being reconnected. In addition, the connections to the PV generator must be disconnected.

After isolating the AC and DC voltage, you must wait approx. 30 minutes for the capacitors in the Sunny Boy to discharge. Only then is it safe to open the unit by removing the cover. You must also make sure that no voltage is present in the device.

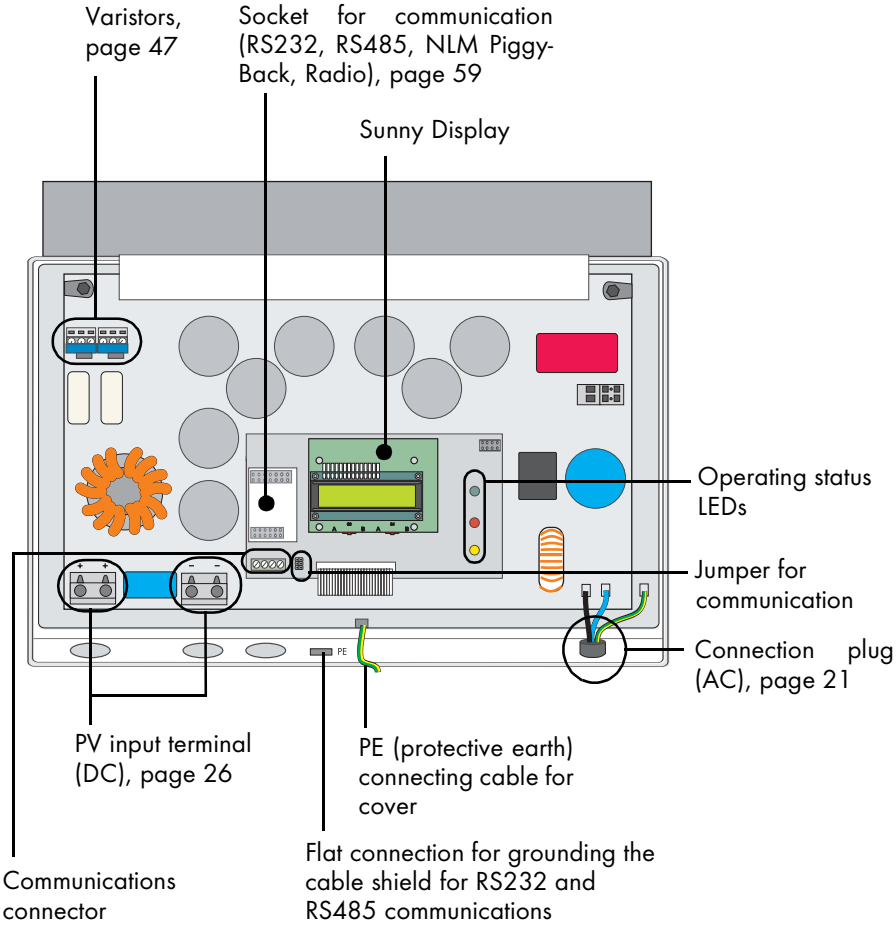
Caution! Electrostatic charge!

When working on the Sunny Boy SB 1100LV and handling the components, remember to observe all ESD safety regulations. Electronic components are susceptible to electrostatic charge. Discharge any electrostatic charge by touching the grounded enclosure before handling any electronic component.

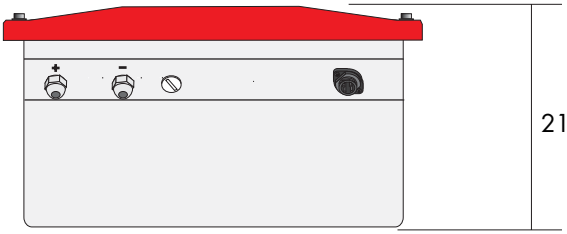
4 Overview

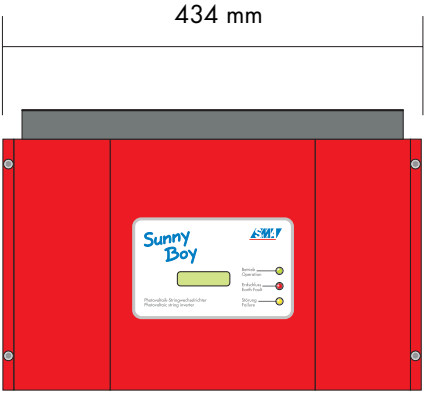
4.1 Unit description

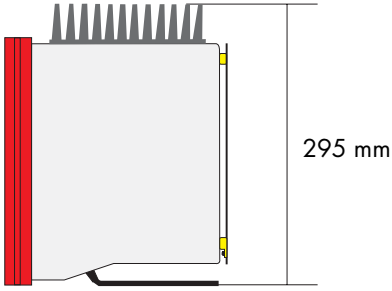
The following diagram gives a schematic overview of the various components and connection points inside the Sunny Boy SB 1100LV with the cover removed:



4.2 External dimensions



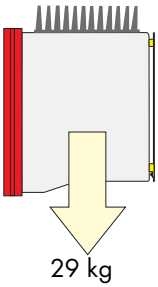




5 Installation requirements

Please check that all of the conditions listed below are met before installing and setting up the Sunny Boy.

5.1 Installation site requirements



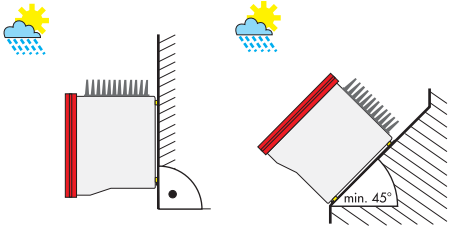
The Sunny Boy SB 1100LV weighs approx. 29 kg. Please take this weight into account when choosing the installation site and method of installation.

The ambient temperature must not be outside the -25 °C to +60 °C range.

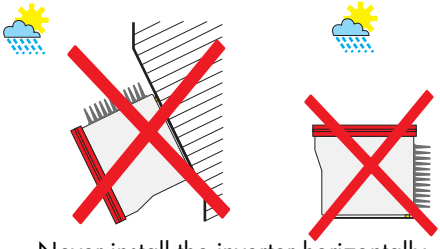
The Sunny Boy SB 1100LV should be installed in a place where it is not exposed to direct sunlight. An increased ambient temperature can reduce the yield of the PV system.

The Sunny Boy is designed to be mounted on a vertical wall. If absolutely necessary, however, the Sunny Boy can be installed tilted back at a maximum angle of 45°. For an optimum energy yield and the most convenient operation, vertical installation at eye-level is preferable. If installing the unit outdoors, make sure that it is not slanting forward. The rear panel is designed such that the Sunny Boy SB 1100LV is tilting slightly backward on a perfectly vertical wall.

We advise against installing the unit in a horizontal position outdoors.



Install the inverter vertically or tilting backward.



Never install the inverter horizontally or so that it tilts forward.

When choosing the installation site, be sure to note the following:

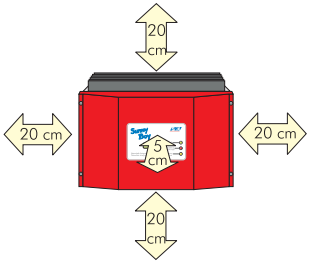
Warning! Risk of burns!

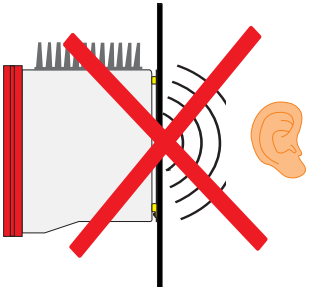
The temperature of individual parts of the case and components within the Sunny Boy can reach more than 60 °C. Touching could result in burns!

Do not install the Sunny Boy on flammable construction materials, in areas where highly inflammable materials are stored or in potentially explosive environments!

When choosing the installation site, ensure there is enough space for heat to dissipate. Under normal conditions, the following guidelines should be applied for the space to be kept clear around the Sunny Boy SB 1100LV:

	Minimum clearance
Sides	20 cm
Top	20 cm
Underneath	20 cm
Front	5 cm





In domestic installations, the unit should not be mounted on plasterboard walls or similar as otherwise audible vibrations are likely to result.

We recommend securing the unit to a solid surface.

The Sunny Boy makes noises when in use which can, in the domestic setting, be seen as a nuisance.

5.2 PV generator requirements

The Sunny Boy SB 1100LV is internally designed to be connected directly to up to two strings (PV modules wired in series) having a homogenous structure (modules of the same type, identical orientation and tilt).

For connecting the PV generators, the unit has two DC terminal blocks, which each have connections for two strings. If you want to connect more than two strings to the Sunny Boy SB 1100LV, you must use a DC distribution box.

The DC side must be equipped with a DC circuit breaker compliant to DIN VDE 0100-712 to allow the PV generator to be disconnected from the Sunny Boy.

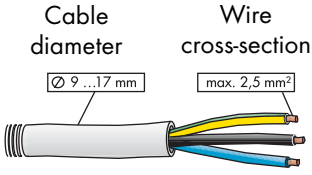
The Sunny Boy SB 1100LV operates with high currents on the DC side. If there is a fault in a string, the current of this string is routed via another string as reverse current. This can irreparably damage the PV generators. See chapter 6.3 "Reverse current" (Page 27) for more information.

"Sunny Design" helps you design the system and check string size taking the relevant inverter into consideration. Further information on "Sunny Design" is available at www.SMA.de.

Limit values for DC input	
Max. voltage	60 V (DC)
Max. input current	62 A (DC)

5.3 Low voltage grid (AC)

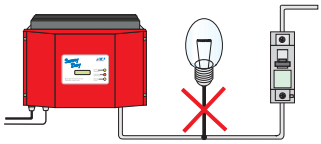
The Sunny Boy must have a three-conductor connection to the mains grid (live (L), neutral (N), protective earth (PE)).



The grid connection terminals on the AC connection socket included in the accessories kit can take wires with a cross-section of up to 2.5 mm². The accessories kit also contains a PG13.5 AC connection socket for connecting cables with a cable diameter between 9 mm and 13.5 mm, while the PG16 connection socket is used for cables with cable diameters from 13.5 mm up to a maximum of 17 mm. For detailed instructions, see chapters "Connecting the AC output with PG13.5" (Page 22) and "Connecting the AC plug with PG16" (Page 24).

Attention!

We recommend using a 16 A line circuit breaker to protect the power circuit. No loads should be connected to this power circuit.



Rating for a line circuit breaker in a photovoltaic electrical power unit operated in parallel with the low-voltage grid

Various factors should be taken into account when selecting line circuit breakers. These include, for example:

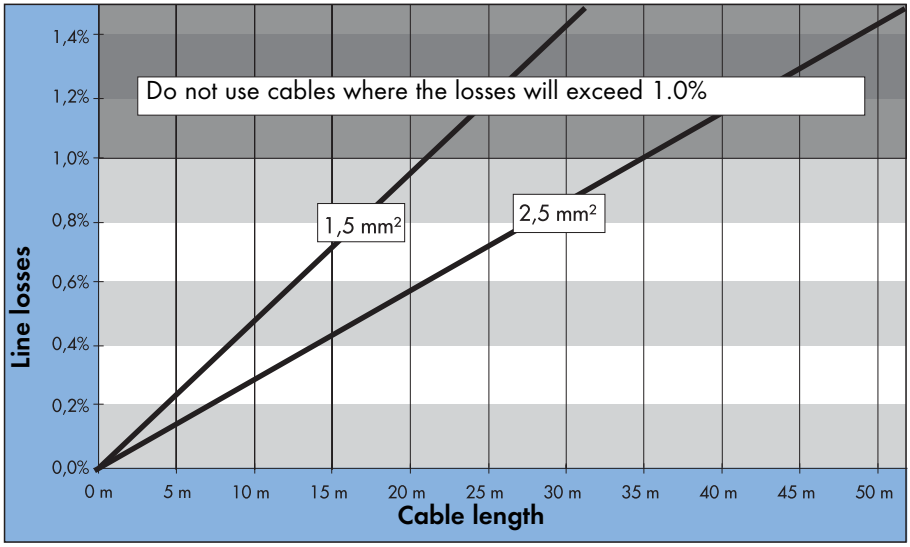
- The type of cable used (conductor material and insulation)
- Ambient temperatures affect the cables (higher temperatures result in a reduced maximum current load)
- Method of routing the cable (reduces the ampacity of the conductor)
- Bundling cables together (reduces the ampacity of the conductor)
- Loop impedance [Z] (in the event of a body contact this limits the current that can flow and therefore determines the response behavior of the circuit breaker)
- Sufficient distance between the circuit breakers so as to avoid undue heating (heat can trigger the circuit breakers early).
- Selectivity
- Protection class of the connected load (VDE 0100, part 410, Protection against electric shock)

Please pay attention to chapter 11 "Rating for a line circuit breaker" (Page 51).

The following standards should be followed in all cases:

- DIN VDE 0298-4 (Cable routing and current-carrying capacity)
- DIN VDE 0100; part 430 (Protective measures; protection of cable and cords against overcurrent)
- DIN VDE 0100; part 410 (Protective measures; protection against electric shock)

AC cable system impedance should not exceed 1 ohm. This is necessary, amongst other things, for the correct operation of impedance observation. In addition, we recommend dimensioning the conductor cross-section so that line losses do not exceed 1% at the nominal power. Line losses depending on the cable length and cross-section are shown in the graph below. Multi-wire cables with copper forward and return conductors are used.



The maximum cable lengths for the different cable cross-sections are as follows:

Conductor cross-section	1.5 mm²	2.5 mm²
Max. length	21 m	35 m

The Sunny Boy SB 1100LV is designed for operation on 220 - 240 V grids with a grid frequency of 50 Hz. When connecting an inverter to the public grid, please adhere to the local connection requirements of your grid operator.

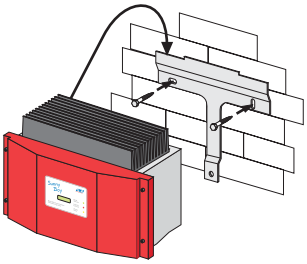
	Limit values for AC output
Voltage range (complying with DIN VDE 0126-1-1)	198 V ... 253 / 260 V [a]
Frequency range (complying with DIN VDE 0126-1-1)	47.55 Hz ... 50.2 Hz
Voltage range (extended operating range)	180 V ... 265 V
Frequency range (extended operating range)	45.5 Hz ... 54.5 Hz

a The Sunny Boy can feed into the public grid at a maximum output voltage of 260 V for brief periods. However, DIN VDE 0126-1-1 stipulates that the average voltage over 10 minutes must not exceed 253 V. I.e., if the grid voltage remains constant at 254 V, the inverter is automatically disconnected from the grid. In this case, contact the local grid operator for assistance.

DIN VDE 0126-1-1 only applies in Germany. See chapter 8.4.3 "Country-specific parameter settings" (Page 42) for the country-specific preset default values of your inverter.

6 Installation

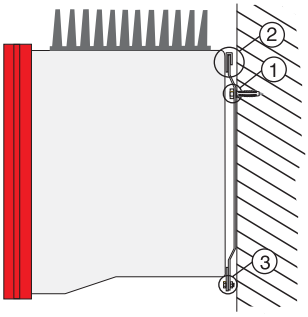
6.1 Mounting the unit



To make the job easier, we recommend you use the supplied wall bracket to mount the Sunny Boy SB 1100LV. For vertical installation on solid concrete or block walls, for example, you can fit the bracket using 8 mm x 50 mm hexagon bolts to DIN 571 standard, stainless steel type, and with wall plugs type SX8.

When selecting the mounting materials, be sure to take into account the weight of the Sunny Boy SB 1100LV (29 kg).

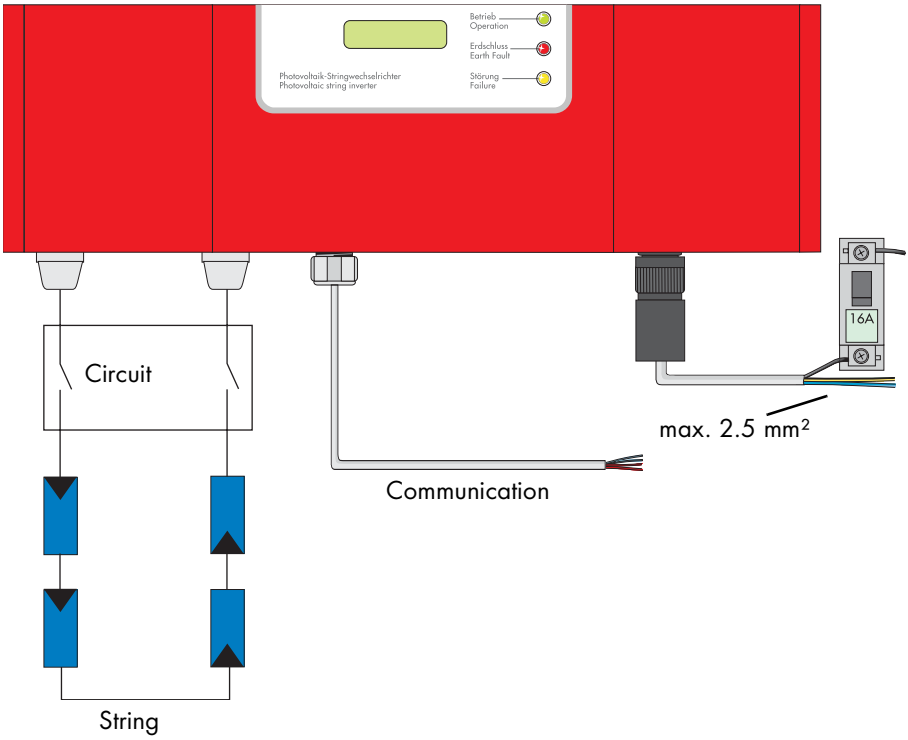
1. Fit the wall bracket (1). To mark the positions to drill the holes, you can use the wall bracket as a drilling template.
2. Now hook the Sunny Boy SB 1100LV onto the wall bracket (2) at its upper mounting plate so that it cannot be moved sideways.
3. Fix the Sunny Boy SB 1100LV onto its bracket by screwing the supplied M6x10 bolt into the central threaded hole at the bottom of the bracket (3).
4. Make sure the Sunny Boy SB 1100LV is positioned securely on the bracket.



6.2 Electrical installation

Attention!
Make sure to check the polarity of the strings before connecting them!

The complete wiring for a Sunny Boy SB 1100LV is shown schematically in the following diagram:



* Circuit breaker according to DIN VDE 0100-712

6.2.1 Connecting the AC output

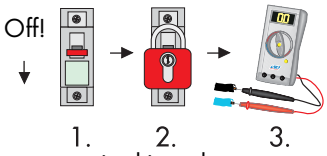
Warning! Voltage!

Before you connect the mains cable to the AC connection socket, make sure that no voltage is present in the cable.

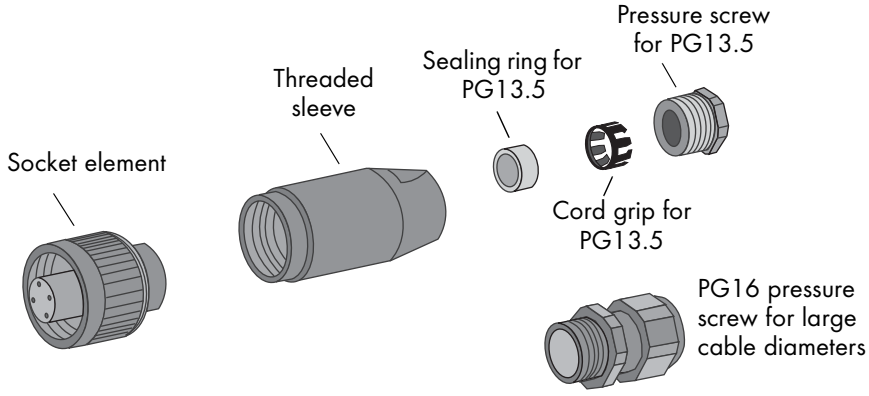
A round plug connector system is used, which allows various cable diameters to be used in the cable outlet. For this reason, the accessories kit includes a PG13.5 pressure screw and a PG16 pressure screw. Check which screw fitting is the right one for your AC cable.

To connect up the AC output, follow these steps:

1. Check the grid voltage. If this is constantly higher than 253 V, the Sunny Boy SB 1100LV will not be fully operational. In this case, contact the local grid operator for assistance. The inverter can feed into the grid at an output voltage of 260 V for brief periods. However, the average output over a 10 minute period may not exceed 253 V.
2. Isolate the grid connection (switch the line circuit breaker to its "off" position), make sure it cannot be switched back on, and test to make sure no voltage is present.



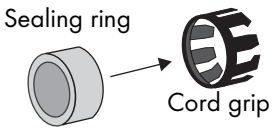
3. Now take the AC connection socket parts from the accessories kit and connect up the cable, with shielding and insulation stripped, as described on the following pages:



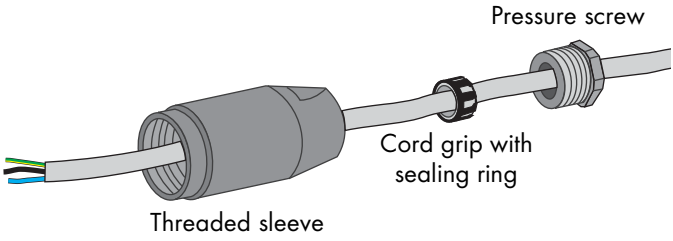
Connecting the AC output with PG13.5

To connect a cable with a maximum cross-section of 13.5 mm², proceed as follows.

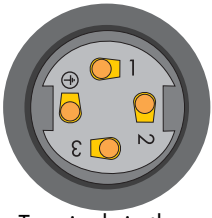
1. Press the sealing ring into the cord grip.



2. Now slide the pressure screw over the cable first of all, followed by the cord grip with the sealing ring in it. Now slide the threaded sleeve over the cable.

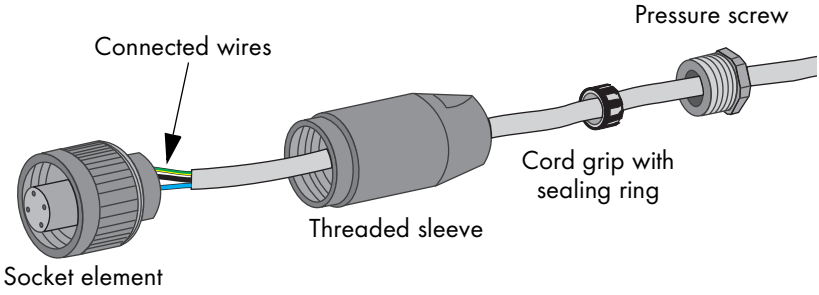


3. Now connect the individual conductors to the socket element in sequence.
   - Protective earth PE (green/yellow) to the screw terminal with the earth sign. Make sure that the PE earth wire is longer than the N and L connected wires.
   - Neutral conductor N (blue) to screw terminal 1.
   - Live L (brown or black) to screw terminal 2.
   - Terminal 3 remains unused.

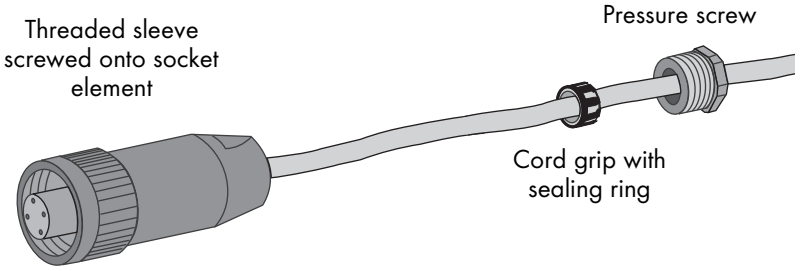


Terminals in the socket element

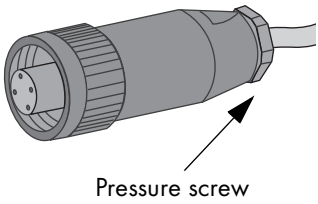
4. Make sure the wires are securely connected.



5. Now screw the threaded sleeve onto the socket element and tighten it.



6. Screw the pressure screw into the threaded sleeve and tighten it. The cord grip with the sealing ring is pressed into the threaded sleeve and can no longer be seen.



The AC connecting socket is now fully assembled.

If you are not going to connect up the Sunny Boy immediately, close off the socket element using the cap supplied in the accessories kit.

If the Sunny Boy is already installed, you can now connect up the fully assembled AC connection socket to the flange plug on the Sunny Boy. To do this, remove the protective cap from the flange plug on the Sunny Boy. Firmly tighten the threaded ring on the AC connecting socket to the flange plug to seal the connection and secure it.

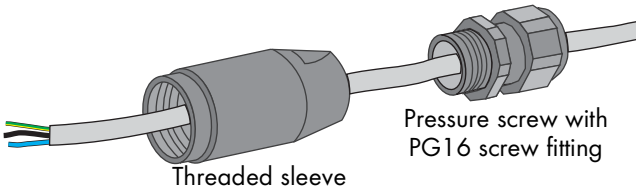
Attention!

Do not switch the line circuit breaker on yet! The Sunny Boy SB 1100LV may only be connected to the AC grid once the PV strings are connected and the device is securely closed.

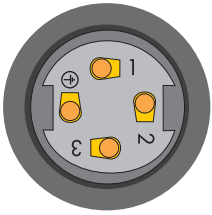
Connecting the AC plug with PG16

To connect a cable with a cross-section between 13.5 mm² and 16 mm², proceed as follows.

1. First of all, slide the pressure screw with the PG16 screw fitting onto the cable. Now slide the threaded sleeve over the cable.

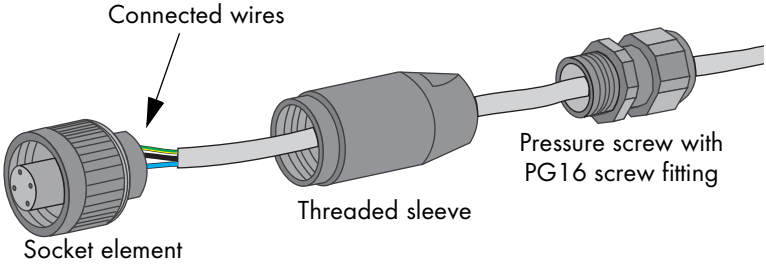


2. Now connect the individual conductors to the socket element in sequence.
   - Protective earth PE (green/yellow) to the screw terminal with the earth sign. Make sure that the PE earth wire is longer than the N and L connected wires.
   - Neutral conductor N (blue) to screw terminal 1.
   - Live L (brown or black) to screw terminal 2.
   - Terminal 3 remains unused.

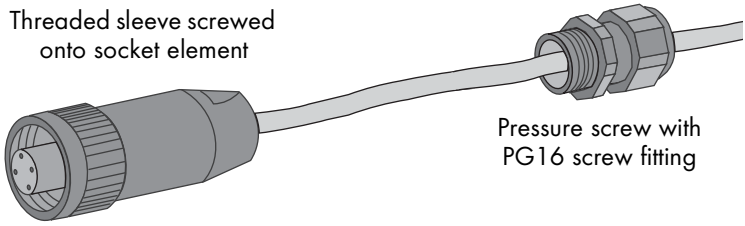


Terminals in the socket element

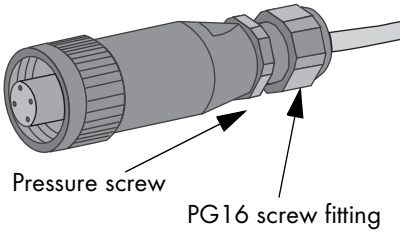
3. Make sure the wires are securely connected.



4. Now screw the threaded sleeve onto the socket element and tighten it.



5. Now screw the pressure screw into the threaded sleeve and tighten it.
6. Firmly tighten the screw fitting against the seal and strain relief.



The AC connecting socket is now fully assembled.

If you are not going to connect up the Sunny Boy immediately, close off the socket element using the cap supplied in the accessories kit.

If the Sunny Boy is already installed, you can now connect up the fully assembled AC connection socket to the flange plug on the Sunny Boy. To do this, remove the protective cap from the flange plug on the Sunny Boy. Firmly tighten the threaded ring on the AC connecting socket to the flange plug to seal the connection and secure it.

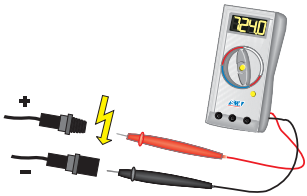
Attention!

Do not switch the line circuit breaker on yet! The Sunny Boy SB 1100LV may only be connected to the AC grid once the PV strings are connected and the device is securely closed.

6.2.2 PV string (DC) connection

To connect up the input, follow these steps:

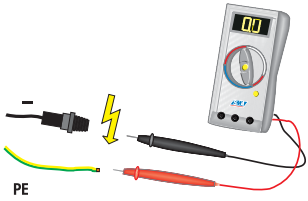
1. Make sure the PV generator connectors have the right polarity and do not exceed the maximum string voltage of 60 V (DC). See also chapter 5.2 "PV generator requirements" (Page 15).



Warning!

Dangerous high voltages may be present. Danger of death!

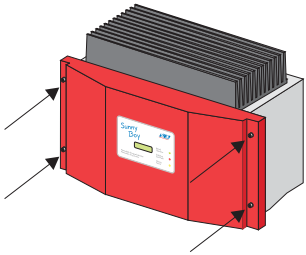
2. Taking one DC plug connector at a time, measure the direct current voltage between one DC connection of a string and earth potential.
3. If the measured voltages are constant and if their total is roughly the same as the open circuit voltage of the string, then there is an ground fault in this string. Its approximate location can be deduced from the relationships between the voltages.



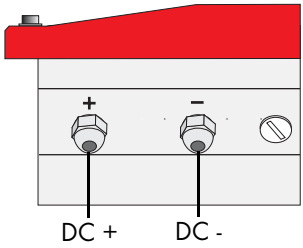
Attention!

Do not connect strings to the Sunny Boy SB 1100LV that contain a ground fault until you have fixed the earth fault in the PV generator.

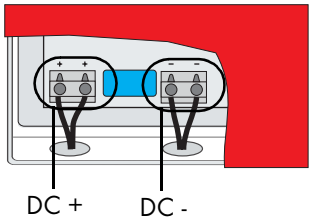
4. Repeat points 2 and 3 for each string.
5. Open the Sunny Boy as described in chapter 7.1 "Opening the Sunny Boy" (Page 33).



6. Pull the cable(s) of the PV generator through the PG screw fitting on the bottom of the inverter. DC + must be pulled through the PG screw fitting on the left; DC - through the one on the right.



7. There are two terminal blocks for DC connection on the left-hand side of the inverter. Connect DC + to the terminal block on the left and DC - to the terminal block on the right. The terminals can hold cables with a cross-section of up to 25 mm². If you are using a core end sleeve, it may not exceed a cross-section of 16 mm².



6.3 Reverse current

Advice on generator configuration for PV systems using the Sunny Boy SB 1100LV

The Sunny Boy SB 1100LV operates with very high input currents. This does not sound particularly spectacular but it has practical consequences because, in such large generators, certain faults which are totally uncritical in string systems must be allowed for. Short circuits cause wrongly directed module current, which can lead to a PV module being subjected to so-called reverse current, which may be several times more than the normal maximum current (short circuit current) of the PV module.

How does reverse current occur?

In principle, reverse current can only occur when modules are connected in parallel and the open circuit terminal voltage (Voc) of the individual parallel strings is different. In normal operation, this is adequately avoided when the strings are of the same length. Since shadowing of the modules has no significant effect on Voc, even in this situation no significant reverse current occurs.

Under fault-free operation of a correctly laid out PV generator, no excessive reverse current can occur!

Reverse current can only occur due to a fault in the solar generator (e.g. short circuit in one or more modules) that causes the open circuit terminal voltage of a module string to be significantly lower than the open circuit terminal voltage of other parallel strings. In the worst case, the voltage on the faulty string may lie within the MPP voltage (VMPP) of the remaining generator elements. The internal diode structure of the solar cells

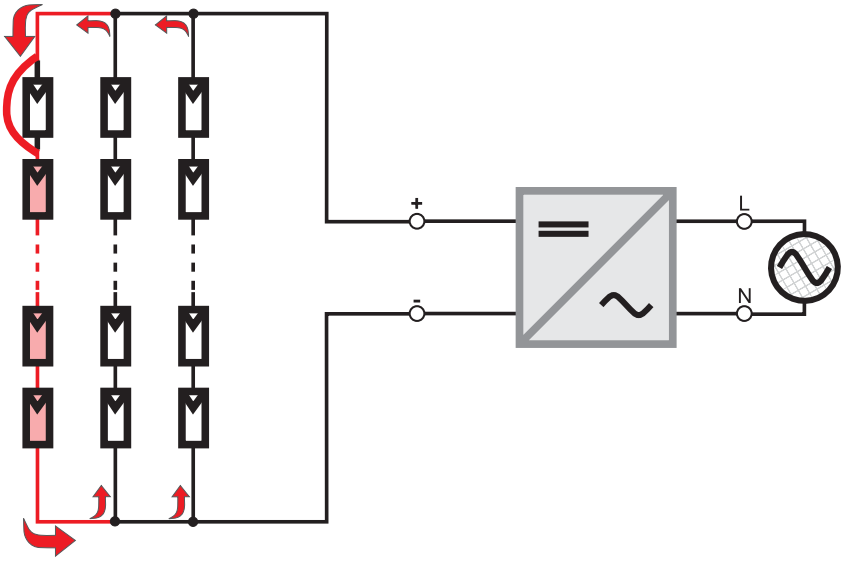
causes reverse current to flow through the faulty generator string that, depending on the amount of current, may lead to excessive heating or destruction of the modules in this string.

Among other symptoms, the following faults may lead to reduction of the open circuit terminal voltage of a generator string and subsequent reverse current in parallel-connected systems:

- Short circuit in one or more modules,
- Short circuit in one or more cells in a module,
- Double ground fault in a module and/or the cabling.

Despite the fact that these faults are very unlikely, and extremely rare in practice, preventative measures must still be taken. After all, these types of faults carry a high potential for damage and danger, since all modules in the affected string may be damaged and the local heating may also cause secondary damage.

Current in the faulty string =
Total current of the remaining strings



How to avoid reverse current in the modules?

First, we must know that today's state-of-the-art bypass diodes for module construction do not affect reverse current in the module, but only reduce the effects of any shading which may occur.

The following standard methods of preventing or reducing reverse current to the modules exist.

1. String technology

All components in a string (modules, cable cross-section, plug connectors) must be designed for the remaining generator short-circuit current as reverse current. This is always the case if no more than two strings are connected in parallel, as the resulting reverse current of a (defective) string cannot exceed the value of the short-circuit current of the (intact) string.

2. String diodes

String diodes connected in series to the individual strings prevent any form of reverse current in the corresponding string. Disadvantage: The diode is permanently connected in series to the corresponding generator string, which means that the current of the string in question always flows through it, leading to correspondingly high permanent losses. If the diode fails, the protective function may be lost or the entire string may fail.

3. String fuses

The string fuses connected in series to the individual strings allow the reverse current in the corresponding string to be limited to a permitted maximum value. The losses at the string fuses are significantly lower than at the string diodes. The failure of a string fuse can be detected by monitoring the fuse or via "intelligent" fault monitoring of the solar generator.

For cost-effective solutions, only the first option is suitable. The PV input terminals are approved for 62 A per connection. The system planner must ensure that this value is not exceeded.

Design instructions

The following must be tested/ensured in particular:

1. Do all strings have the same number of modules connected in series?
2. How high is the maximum reverse current in a defective string at nominal conditions?

   Example: Generator with 4 strings of modules at 5 A short-circuit current.

   The maximum reverse current is 3 x 5 A = 15 A.
3. Are the modules suited for this reverse current?
4. Are the plug connectors of the modules and the inverters suited for this reverse current?
5. Is the string wiring suited for this reverse current?

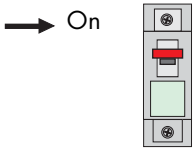
6.4 Commissioning

You can start up the Sunny Boy SB 1100LV when

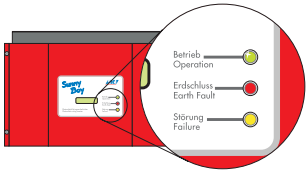
- the lid is securely screwed shut,
- the AC (mains) cable is connected correctly,
- the DC cables (PV strings) are fully connected.

How to start up the inverter

1. First of all, switch the line circuit breaker and the DC circuit breaker to the "on" position.



2. Look at the LED display and consult the table on the following page to check whether the Sunny Boy SB 1100LV is in a fault-free and expedient operating mode. Once the inverter is in a fault-free operating status, start-up has successfully completed.



Attention!

If the bottom yellow LED flashes four times at intervals of one second, the grid voltage and the PV generator must be disconnected from the Sunny Boy SB 1100LV immediately! There is a risk of damage to the inverter resulting from excessive DC input voltage.

Check the string voltages again to make sure they are within the limits stated in chapter 5.2 "PV generator requirements" (Page 15). If the string voltages are too high, the PV generator's planner/installer should be called upon for assistance.

If despite checking the string voltages the LED signal occurs again when the PV generator is connected to the Sunny Boy SB 1100LV, disconnect the PV generator from the Sunny Boy again and contact **SMA** Technologie AG (see chapter 13 "Contact" (Page 59)).

Green	Red	Yellow	Status
Illuminates continuously	Is not illuminated	Is not illuminated	OK (working mode)
	Illuminates continuously	Is not illuminated	Fault
		Illuminates continuously	OK (initialization)
Flashes quickly (3x per second)	Is not illuminated	Is not illuminated	OK (stop)
	Illuminates continuously	Is not illuminated	Fault
Flashes slowly (1x per second)	Is not illuminated	Is not illuminated	OK (waiting, grid monitoring)
	Illuminates continuously	Is not illuminated	Fault
Briefly goes out (approx. 1x per second)	Is not illuminated	Is not illuminated	OK (derating)
	Illuminates continuously	Is not illuminated	Fault
Is not illuminated	Is not illuminated	Is not illuminated	OK (night shutdown)
		Illuminating/ flashing	Fault
	Illuminates continuously	Is not illuminated	Fault
		Illuminating/ flashing	Fault

For a detailed description of the fault messages and their causes, see the operating instructions.

7 Opening and closing the Sunny Boy

Attention!

If you need to open the device for whatever reason, please pay attention to chapter 3 "Safety instructions" (Page 9).

7.1 Opening the Sunny Boy

Attention!

Follow the sequence below under all circumstances.

1. Switch the line circuit breaker to the "off" position.
2. Switch the DC circuit breaker to the "off" position.
3. **Wait 30 minutes!**
4. Remove the four screws from the lid and pull the lid forward smoothly. Remove the PE connection from the lid. Loosen the locking on the PE connectors on the lid when you remove them.

7.2 Closing the Sunny Boy

Attention!

Follow the sequence below under all circumstances.

1. Reconnect the earth wire (PE) to the lid. Now secure the lid to the Sunny Boy SB 1100LV by tightening the four screws evenly.
2. Switch the DC circuit breaker to the "on" position.
3. Switch the line circuit breaker to the "on" position.
4. Now check whether the LED display on the Sunny Boy SB 1100LV indicates that the device is functioning correctly.

8 Technical data

8.1 PV generator connection data

Description	Unit	Setting
Max. input open circuit voltage	$U_{PV\ 0}$	60 V (based on -10°C cell temperature)
Input voltage, MPP range	U_{PV}	21 V ... 60 V
Max. input current	$I_{PV\ max}$	62 A
Max. input power	P_{DC}	1240 W
Recommended total generator power		1380 Wp (for central Europe)
Connection of the DC input side		DC screw terminal
Surge voltage protection		Thermally monitored varistors
Voltage ripple	U_{ss}	< 10% of the input voltage
Insulation protection		Ground fault monitoring (Riso > 1 MΩ)
Operating consumption		< 4 W (standby)
Reverse polarity protection		via short circuit diode

8.2 Grid connection data

Description	Unit	Setting
Nominal output power	P_{ACnom}	1000 W
Continuous output power (at 45 °C)		1000 W
Peak output power	P_{ACmax}	1100 W
Nominal output current	I_{ACnom}	4.4 A
Harmonic distortion of output current (at K_{Ugrid} < 2 %, P_{AC} > 0.5 P_{ACNom})	K_{IAC}	< 4 %
Short-circuit strength		Grid-side via current regulation
Operating range, grid voltage	U_{AC}	180 ... 265 V AC Germany: 198 ... 253 / 260 V AC [a]
Operating range, grid frequency	f_{AC}	45.5 ... 54.5 Hz Germany: 47.55 ... 50.2 Hz
All-pole isolator grid side		Independent disconnection device ("SMA grid guard 2"), double implementation
Phase shift angle (based on the current's fundamental frequency)	cos phi	1
Overvoltage category		III
Test voltage (DC)		1.6 kV (1 s routine testing / 5 s type testing)
Test surge voltage		4 kV (serial interface: 6 kV)
Own consumption in night mode		0.1 W

a The Sunny Boy can feed into the public grid at a maximum output voltage of 260 V for brief periods. However, DIN VDE 0126-1-1 stipulates that the average voltage over 10 minutes must not exceed 253 V. I.e., if the grid voltage remains constant at 254 V, the inverter is automatically disconnected from the grid. In this case, contact the local grid operator for assistance.

DIN VDE 0126-1-1 only applies in Germany. See chapter 8.4.3 "Country-specific parameter settings" (Page 42) for the country-specific preset default values of your inverter.

8.3 Device description

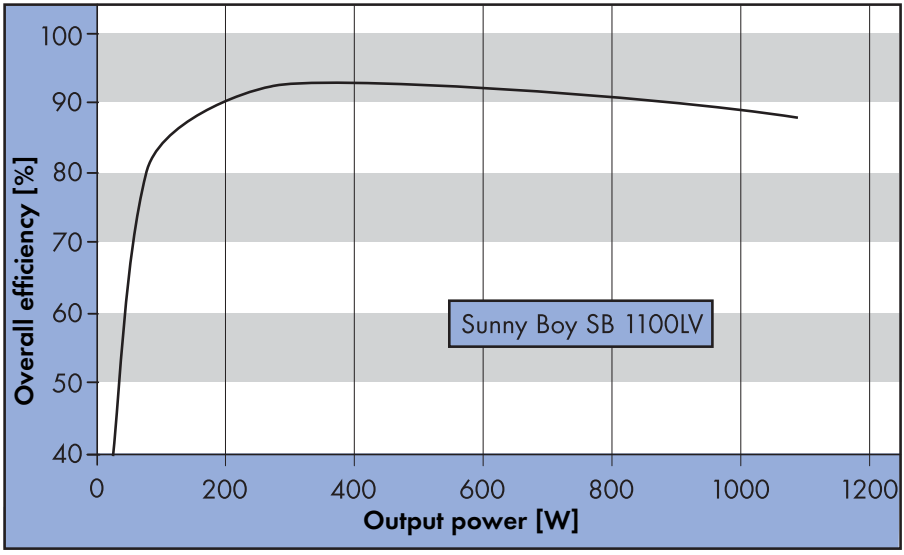
For a detailed description of the devices, see the operating instructions.

General data	
Protection category per DIN EN 60529	IP65
Dimensions (w x h x d)	434 mm x 295 mm x 214 mm (approx.)
Weight	29 kg (approx.)

External interfaces	
Data transmission over mains power line	optional
Data transmission over separate data cable	optional, RS232 / RS485, electrically separated
Wireless data transmission	optional

Efficiency		
Max. efficiency	ηmax	92 %
European standard efficiency	ηeuro	90.4 %

The efficiency of the Sunny Boy SB 1100LV depends mainly on the input voltage of the connected PV strings. The lower the input voltage, the higher the efficiency.



8.4 Operating parameters

Warning!

Unauthorised changes to the operating parameters may result in:

- **injury or accidents as a result of changing the internal safety routines in the Sunny Boy,**
- **voiding the Sunny Boy's operating approval certificate,**
- **voiding the Sunny Boy's guarantee.**

Never change the parameters of your Sunny Boy without express authorization and instructions.

8.4.1 Explanation of the operating parameters

Name	Explanation
ACVtgRPro	Surge voltage protection (only relevant for Germany). Sunny Boys can feed into the public grid with up to 260 V AC. However, DIN VDE 0126-1-1 stipulates that the average AC voltage over 10 minutes must not exceed 253 V. If the average over 10 minutes exceeds the threshold value of 253 V, the inverter disconnects itself from the grid. Once the average over 10 minutes returns to a value of less than 253 V, the inverter returns to "Working" mode. If surge voltage protection is not required in the relevant grid area (outside Germany), it can be deactivated by means of presetting the LDVtgC parameter. In this event, only the fast cut-off via the Uac-Max parameter intervenes.
AntiIsland-Ampl	Amplification of the AntiIsland process (deactivated for GER by setting AntiIsland-Ampl = 0)
AntiIsland-Freq	Repetition rate of the AntiIsland process (deactivated for GER by setting AntiIsland-Ampl = 0)
Default	Used for setting the country-specific information. GER/VDE0126-1-1: country-specific parameter settings for Germany in accordance with DIN VDE 0126-1-1 SP/RD1663: country-specific parameter settings for Spain GB/G83: country-specific parameter settings for Great Britain Other: here, parameter settings can be defined for countries for which no predefined setting exists. Trimmed: if country-specific parameters have been changed, "trimmed" is shown in the display.

Name	Explanation
dFac-Max	Maximum "grid frequency change" before the grid monitoring system disconnects the device from the grid.
dZac-Max	Maximum "grid impedance change" before the grid monitoring system disconnects the device from the grid.
E_Total	Total energy yield for the inverter. This change may be necessary when you exchange the Sunny Boy and want to use the data from the old device.
Fac-delta- Fac-delta+	Maximum frequency, above (Fac-delta+) and below (Fac-delta-) the mains frequency, before the mains monitoring system disconnects the device from the mains supply.
Fac-Pderating	Frequency-dependent output limitation
Fac-Tavg	Averaging time of grid frequency gaging
h_Total	Total hours of operation for the inverter. This change may be necessary when you exchange the Sunny Boy and want to use the data from the old device.
I-Ni-Test	Setting the impulse for impedance monitoring. This parameter only functions when the Sunny Boy is deactivated (disconnected on the AC side) or in "Stopp" mode.
Inst.-Code	Parameters for self contained power system recognition can only be changed after entering the "SMA grid guard" password.
LDVtgC	Compensation for the voltage drop in the cabling. With this parameter, the voltage drop between the inverter and the grid connection point is taken into account. The average voltage over 10 minutes at the inverter connection must not exceed the sum of ACVtgRPro plus LDVtgC. The parameter LDVtgC is preset to 0 V for Germany. In grid areas in which the additional surge voltage protection (see parameter ACVtgRPro) is not required, the parameter LDVtgC is preset to 50 V. Thus, the surge voltage protection is deactivated for these grid areas (253 V + 50 V = 303 V) and only the fast cut-off via the Uac-Max parameter intervenes.

Name	Explanation
Operating mode	Operating mode of the Sunny Boy: MPP: Maximum Power Point UKonst: Constant voltage mode (desired voltage is defined in "Usoll-Konst") IKonst: Operating mode for test purposes Stopp: Disconnection from mains network, no operation Turbine Mode: Operating mode for wind energy systems. Off Grid: Operating mode for Sunny Boys in a stand-alone grid.
Plimit	Upper limit for AC output power
SMA-SN	Serial number of the Sunny Boy
Software-BFR	Firmware version of the operation control unit (BFR)
Software-SRR	Firmware version of the current control unit (SRR)
Storage function	Default parameter: Returns all parameter values to the factory setting. Reset Betriebsdaten: Returns all user level parameter values to the factory setting. Reset Fehler: Resets a permanent fault.
Speicher/Storage	Permanent: Modified parameters are stored in the EEPROM and can be used even when the Sunny Boy has been restarted. Volatil: Prevents the parameters from being stored in the EEPROM, the parameters are only stored until the next restart.
T-Start	The period the Sunny Boy waits after the Upv-Start value has been reached.
T-Stop	The period the Sunny Boy waits before disconnecting from the mains supply when Pac drops below the set value.
Uac-Min Uac-Max	Lower (Uac-Min) and upper (Uac-Max) limits of the allowable AC voltage (self contained power system recognition), before the grid monitoring system disconnects the device from the grid.
Uac-Tavg	Averaging time of grid frequency gaging
Upv-Start	The DC voltage required before the Sunny Boy begins feeding power into the mains supply.
Usoll-Konst	PV desired voltage for constant operational voltage. These parameters are only important when the "Operating mode" parameter is set to U-konst.

8.4.2 Parameter settings for Germany

Grayed out parameters are only displayed in installer mode. The table below contains the parameters that are applicable in Germany.

Name	Unit	Value range	Factory setting
ACVtgRPro	V	230 ... 300	253
AntiIsland-Ampl *	grd	0 ... 10	0
AntiIsland-Freq *	mHz	0 ... 2000	500
Default *		GER/VDE0126-1-1, GB/G83, SP/RD1663, Off_Grid, Other, trimmed	GER/VDE0126-1-1
dFac-Max *	Hz/s	0.1 ... 4.0	0.25
dZac-Max *	mOhm	0 ... 20000	750
E_Total	kWh	0 ... 200000	
Fac-delta- *	Hz	0.1 ... 4.5	2.45
Fac-delta+ *	Hz	0.1 ... 4.5	0.19
h_Total	h	0 ... 200000	
I-NiTest *	mA	0 ... 7500	6000
Operating mode		MPP, UKonst, Stopp, Turbine Mode, Off Grid	MPP
Storage function		Default Parameter, Reset Operating Data, Reset Fault	None
Speicher/ Storage		Permanent, volatile	Permanent
T-Start *	s	5 ... 300	10
T-Stop	s	1 ... 3600	2
Uac-Min *	V	160 ... 230	198
Uac-Max *	V	230 ... 300	260
Upv-Start	V	20 ... 60	25
Usoll-Konst	V	26 ... 63	63

*Parameters designated with * are safety-related grid monitoring parameters. To change the SMA grid guard parameters, you must enter you personal SMA grid guard password (Inst.-Code). Please call the Sunny Boy Hotline to obtain your personal SMA grid guard password.*

8.4.3 Country-specific parameter settings

The parameters listed below represent country-specific settings and are only displayed in installer mode. All other parameters are international and can be viewed in the table in chapter 8.4.2.

Name	Unit	Country settings		
		Germany	**Great Britain**	**Spain**
Default		GER/ VDE0126-1-1	GB/G83	SP/RD1663
dFac-Max	Hz/s	0.25	0.2	2
dZac-Max	mOhm	750	350	350
Fac-delta-	Hz	2.45	0.5	0.98
Fac-delta+	Hz	0.19	0.5	0.98
I-Ni-Test	mA	6000	0	0
T-Start	s	10	180	10
Uac-Min	V	198	209	199
Uac-Max	V	260	261	250

8.4.4 Non-modifiable parameters

Grayed out parameters are only displayed in installer mode. The following parameters are displayed in the parameter list but cannot be changed:

Name	Unit	Factory setting
Fac-Pderating		
Fac-Tavg	ms	160
Plimit	W	1100
SMA-SN		
Software-BFR		
Software-SRR		
Uac-Tavg	ms	80

9 Certificates

9.1 CE declaration of conformity

CE Declaration of Conformity

for utility interactive inverters

Product: **Sunny Boy**
Type: **SB 700, SB 1100, SB 1100LV, SB 1700, SB 2100TL, SB 2500, SB 2800i, SB 3000, SB 3300TL, SB 3300TL HC**

We declare that the above specified devices are compliant with the regulations of the European Community, in terms of the design and the version fabricated by SMA. This especially applies for the EMC Regulation defined in 89/336/EWG and the LV- regulation defined in 73/23/EWG.

The devices are compliant with the following standards:

EMC:	
Emission:	DIN EN 61000-6-3: 2002-08
	DIN EN 61000-6-4: 2002-08
	DIN EN 55022: 2003-09, Class B
Utility Interference:	DIN EN 61000-3-3: 2002-05
	DIN EN 61000-3-2: 2001-12
Immunity:	DIN EN 61000-6-1: 2002-08
	DIN EN 61000-6-2: 2002-08
Safety:	DIN EN 50178: 1998-04
Semiconductor-Converter:	DIN EN 60146-1-1: 1994-03

The above mentioned devices are therefore marked with a CE sign.

Note:
This declaration of conformity becomes invalid in case without explicit written confirmation by SMA, when
- the product is modified, complemented or changed,
- and/or components, other than those belonging to the SMA accessories, are installed in the product,
- as well as in case of incorrect connection or inproper usage

Niestetal, 13.03.2006
SMA Technologie AG

i.V. Frank Greizer
(Head of Development Department Solar Technology)

SMA Technologie AG
Hannoversche Strasse 1-5
34266 Niestetal
Tel. +49 561 9522 - 0
Fax +49 561 9522 - 100
www.SMA.de
info@SMA.de

SBK16A-CE-12:BE1706

9.2 SMA grid guard certificate

The Sunny Boy SB 1100LV is equipped with the "SMA grid guard 2" independent disconnection device and it is covered by the industrial trade association "SMA grid guard 2" certificate.

Fachausschuss Elektrotechnik
der Berufsgenossenschaftlichen Zentrale
für Sicherheit und Gesundheit – BGZ
des Hauptverbandes der gewerblichen Berufsgenossenschaften

BG
Federführung:
Berufsgenossenschaft
der Feinmechanik
und Elektrotechnik

Fachausschuss Elektrotechnik, Postfach 51 05 80, 50941 Köln

SMA Technologie AG
Hannoversche Straße 1-5
34266 Niestetal

Ihre Zeichen/Nachricht vom	Unser Zeichen (Bitte stets angeben)	Bearbeiter	☎ (02 21) 37 78-	Datum
	UB.010.17	PI/Ow	6312	25.01.2006

Unbedenklichkeitsbescheinigung

Erzeugnis:	Selbsttätig wirkende Schaltstelle (ENS)
Typ:	SMA grid guard Version 2
Bestimmungsgemäße Verwendung:	Selbsttätig wirkende, dem VNB unzugängliche Schaltstelle als Sicherheitsschnittstelle zwischen einer Eigenerzeugungsanlage und dem Niederspannungsnetz. Gleichwertiger Ersatz für eine jederzeit dem VNB zugängliche Schaltstelle mit Trennfunktion.
Prüfgrundlage:	
DIN V VDE V 0126-1-1 (2006-02)	"Selbsttätige Schaltstelle zwischen einer netzparallelen Erzeugungsanlage und dem öffentlichen Niederspannungsnetz"

Das Sicherheitskonzept des o.g. Erzeugnisses, entspricht den zum Zeitpunkt der Ausstellung dieser Bescheinigung geltenden sicherheitstechnischen Anforderungen für die aufgeführte bestimmungsgemäße Verwendung.

Die Unbedenklichkeitsbescheinigung wird spätestens

31.12.2010

ungültig.

- Mehlem -
Leiter der Prüf- und
Zertifizierungsstelle

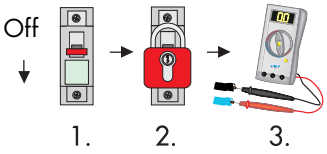
Hausadresse: Gustav-Heinemann-Ufer 130 50968 Köln Tel. (02 21) 37 78-63 01 Fax (02 21) 37 78-63 22

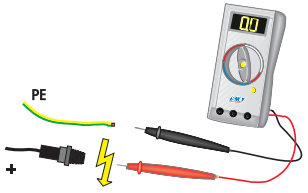
10 Replacing the varistors

The Sunny Boy SB 1100LV is a complex high-technology device. As a result, the possibilities for fixing faults on site are limited to just a few items. Please don't try to carry out repairs other than those described here. Use the **SMA** Technologie AG 24-hour exchange service and repair service instead.

If the red LED on the status display glows continuously during operation, you should first of all make sure that there is no ground fault in the PV generator.

1. Disconnect the Sunny Boy SB 1100LV from the low voltage grid (switch the line circuit breaker to its "off" position). Make sure the grid cannot be inadvertently reconnected and that no voltage is present.
2. Switch off the DC circuit breaker.
3. Open the Sunny Boy SB 1100LV as described in chapter 7.1. Taking one DC plug connector at a time, measure the voltages between one DC plug connector of a string and earth potential. Pay attention to the safety instructions!





Warning!

Dangerous high voltages may be present. Danger of death!

4. If the measured voltages are constant and if their total is roughly the same as the open circuit voltage of the string, then there is an ground fault in this string. Its approximate location can be deduced from the relationships between the voltages.
5. Repeat points 3 and 4 for each string.

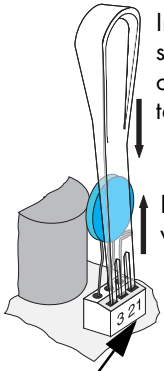
   If you found a ground fault, it is probably not necessary to replace the varistors. Instead, make sure the ground fault is fixed. Generally the PV generator's installation engineer should be hired for this job. In this case continue as described under point 10, but without reconnecting the faulty string. Instead of reconnecting the string, protect its DC plug against accidental touch contact (e.g. by fitting the protective caps or using sufficient high-voltage insulating tape).

   If you did not find any ground fault in the PV generator, it is likely that one of the thermally monitored varistors has lost its protective function. These components are wearing parts. Their functioning diminishes with age or following repeated

responses as a result of overvoltages. You can now check these varistors in the following way, paying attention to the safety instructions in chapter 3 "Safety instructions" (Page 9):

6. Using a continuity tester, check all the varistors to see if there is a conducting connection between connectors 2 and 3. If there is not, then that varistor is not working. The positions of the varistors in the Sunny Boy SB 1100LV can be seen in the diagram in chapter 4.1 "Unit description" (Page 11).

7. Replace the varistor concerned with a new one as shown in the drawing to the right. Ensure the varistor is installed the right way round! If you do not receive a special tool for operating the terminal clamps with your replacement varistors, please contact SMA. As an alternative, the terminal contacts can be operated using a suitable screwdriver. Since the failure of one varistor is generally due to factors that affect all varistors in a similar way (temperature, age, inductive overvoltages), it is highly recommended that you replace both varistors, not just the one that is obviously defective. The varistors are specially manufactured for use in the Sunny Boy SB 1100LV and are not commercially available. They must be ordered directly from **SMA** Technologie AG (SMA order code: "SB-TV3").

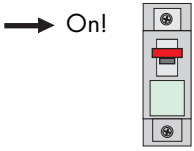


The pole with the small loop (crimp) must be fitted to terminal 1 when replacing the varistor.

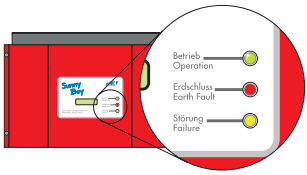
Attention!

If no spare varistors are available on site, the Sunny Boy SB 1100LV can once again feed into the grid. The input is no longer protected against overvoltages! Replacement varistors should be obtained as soon as possible. In systems with a high risk of overvoltages, the Sunny Boy SB 1100LV should not be operated with defective varistors!

8. Connect up the faultless PV generator strings to the inverter.
9. Reconnect the PE connection on the lid and close the Sunny Boy SB 1100LV.
10. Switch on the DC circuit breaker.
11. Switch the line circuit breaker to the "on" position.



12. Now check whether the LED display on the Sunny Boy SB 1100LV indicates that the device is functioning correctly.

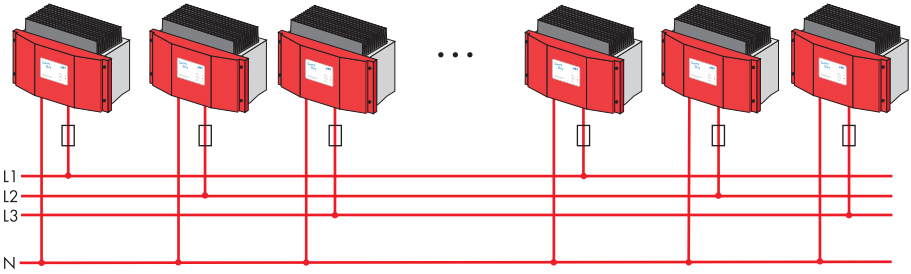


If no ground fault and no defective varistor were found, there is probably a fault in the Sunny Boy. In this case, contact the SMA hotline to discuss what to do next.

11 Rating for a line circuit breaker

Example for the thermal rating for a line circuit breaker in a photovoltaic electrical power unit operated in parallel with the low-voltage grid.

We assume a PV system with 9 Sunny Boy SB 1100LV inverters, with three inverters per phase.



Required technical information for the inverters used

- Maximum output current = 5 A
- Maximum permissible fuse protection for the inverter = 16 A

The choice of cable together with the way it is routed, ambient temperatures and other underlying conditions limit the maximum fuse protection for the cable.

- In our example we assume that the chosen cable (2.5 mm²) is ideally routed and can take a nominal current of 11 A.

Selecting a line circuit breaker:

- The maximum possible nominal current for the cable used and the maximum possible fuse protection for the inverter now limit the maximum possible nominal current for the line circuit breaker.
- In our example, 10 A is possible.

However, the thermal suitability of the line circuit breaker still needs to be checked.

When selecting line circuit breakers, a number of load factors need to be taken into account. These can be found in the respective data sheets.

Example for the thermal selection of a 10 A line circuit breaker with B sensitivity with no gap between the circuit breakers:

For example, one manufacturer's circuit breaker may be designed for an ambient temperature of 50 °C.

Load factors according to data sheet specifications:

- Reduction through permanent load >1h = 0.9 [a]
- Reduction when 9 circuit breakers are arranged side-by-side without gaps = 0.77 [b]
- Increase in nominal current as a result of ambient temperatures of 40 °C in the circuit breaker panel = 1.07 [c]

Result:

The nominal load current for the line circuit breaker is calculated as:

Ibn = 10 A x 0.9 x 0.77 x 1.07 = 7.4 A

a. Permanent loads of longer than 1 hour are possible in photovoltaics.

b. When only one circuit breaker is used, this factor = 1

c. Because the circuit breakers are rated for 50 °C

Summary:

The selected line circuit breaker can be used in our example case since the maximum current-carrying capacity for fault-free operation is higher than the maximum output current of the inverter used. **It will not trigger under rated operating conditions!**

If the calculated current-carrying capacity of the circuit breaker had been lower than the maximum output current from the inverter, the following solution might have been used:

By spacing the circuit breakers at an interval of 8 mm, the reduction factor would be 0.98 instead of 0.77. As a result, the maximum current-carrying capacity would be 9.4 A.

In addition to the thermal rating of the circuit breakers, the boundary conditions as laid out in section "Rating for a line circuit breaker in a photovoltaic electrical power unit operated in parallel with the low-voltage grid" (Page 16) and the applicable DIN VDE standards also need to be taken into account, of course. The main ones that apply here are:

- DIN VDE 0100; part 410
- DIN VDE 0100; part 430
- DIN VDE 0298; part 4

In special applications the relevant standards must be followed.

12 The communications interface

Attention!

Installation or replacement of the communications interface is only to be carried out by a trained electrician.

The communications interface is used to communicate with SMA communication devices (e. g. Sunny Boy Control, Sunny WebBox) or a PC with appropriate software (e. g. Sunny Data Control). Depending on the selected communications interface, up to 2500 inverters can be interconnected. Detailed information on this topic can be found in the communication device manual, the software, or on the Internet at www.SMA.de.

The detailed wiring diagram for the individual communications interfaces can be found in the communication device manual. This wiring diagram includes:

- Specifications of the necessary cable type
- Which of the inverter's connections are used
- Whether jumpers need to be mounted, and if so, which jumpers
- Whether the PE needs to be connected to the cable shield

The next pages will describe the following:

- The enclosure feed-throughs for the communications interface
- The permitted cable route in the Sunny Boy
- The location of the PE connector
- The location of the screw terminals for connection of communication wires
- The location of the jumper slots
- The location of the interface port

12.1 Connection of the interface

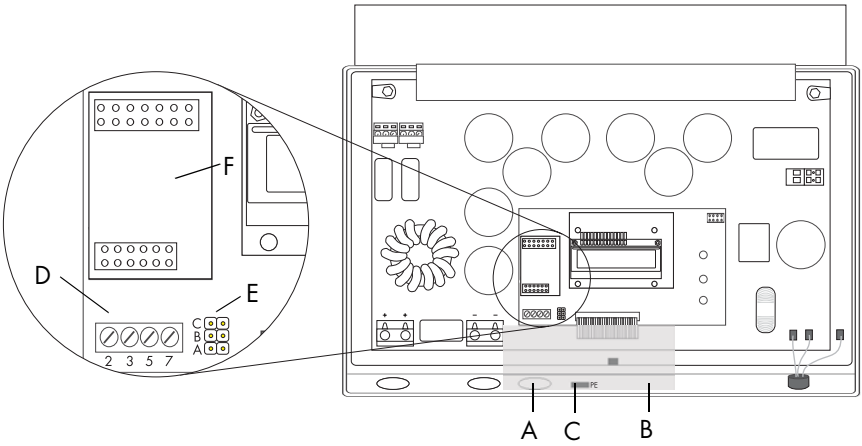
Attention!

When opening the Sunny Boy, follow all the safety instructions as described in section 3.

Electrostatic discharges are an acute danger to the Sunny Boy and to the communications interface. Ground yourself by touching PE before removing the communications interface from the packaging, and before touching any components within the Sunny Boy.

Read the communication device manual before beginning installation work. Further wiring details can be found there.

1. Open the inverter as described in section 7.1.
2. Guide the PG screw fitting over the communication cable.
3. Thread the cable through the cable feed-throughs (A) on the Sunny Boy.
4. Screw the PG screw fitting onto the Sunny Boy.
5. Sheathe the cable inside the Sunny Boy using the silicon tube provided. The silicon tube is imperative for safety reasons. The interface may not be commissioned without this silicon tube (with the exception of the Sunny Beam Piggy-Back).
6. Lay the cable in area (B) as shown in the figure to the right.
7. Ground the cable shield at the PE connector (C) if the terminal connection diagram of the communication device indicates this as necessary.
8. Connect the communication wires to the screw terminal strip (D) as described in the terminal connection diagram of the communication device. Note down the connector color coding for the respective pin numbers. Connecting the receiver incorrectly can cause the devices to be damaged.
   - Pin 2 color: _____
   - Pin 3 color: _____
   - Pin 5 color: _____
   - Pin 7 color: _____
9. Connect the jumpers (E) if the terminal connection diagram of the communication device indicates this as necessary. The table shown to the right provides an overview of the jumper functions.
10. Plug the communications interface into the board (F).
11. Close the Sunny Boy as described in chapter 7.2.



A Enclosure feed-throughs in the base of the Sunny Boy

B Cable route (gray surface)

C PE connector

D Screw terminals for connection of the communication wires

E Jumper slot

F Interface port

12.1.1 Jumper functions

	Jumper A	Jumper B	Jumper C
RS232	-	-	-
RS485	Termination	Bias 1	Bias 2
NLM	-	-	-
Sunny Beam	-	-	-

A detailed description of the jumper functions can be found in the communication device manual.

13 Contact

If you have any questions or technical problems concerning the Sunny Boy SB 1100LV, please contact our hotline. Have the following information available when you contact SMA:

- Inverter type
- Type and number of modules connected
- Communication method
- Serial number of the Sunny Boy
- Blink code or display of the Sunny Boy

Address:
SMA Technologie AG
Hannoversche Strasse 1 - 5
D-34266 Niestetal
Germany
Tel.: +49 (561) 95 22 - 499
Fax: +49 (561) 95 22 - 4699
hotline@SMA.de
www.SMA.de

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SMA Technologie AG

Hannoversche Straße 1-5

34266 Niestetal

Germany

Tel. +49 561 9522-0

Fax +49 561 9522-100

www.SMA.de

E-mail: info@SMA.de

Sales
Solar Technology

www.SMA.de

SMA Technologie AG
Hannoversche Strasse 1–5
34266 Niestetal, Germany
Tel.: +49 561 9522 4000
Fax: +49 561 9522 4040
E-Mail: Info@SMA.de
Freecall: +800 SUNNYBOY
Freecall: +800 78669269

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