



Sunny Boy 4200TL Multi-String Transformerless Solar Inverter for Two Independent Strings



Explanation of Symbols used in this Document

This symbol indicates information that is essential for a trouble-free and safe operation of the product. Please read these sections carefully in order to avoid any damages of the equipment and for optimal personal protection.



This symbol indicates information that is required for the optimal operation of the product. Read these sections carefully in order to ensure an optimal operation of the product and all its features.



This symbol indicates an example.



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1 Introduction

The installation of the Sunny Boy may only be done by qualified technicians. The installer must be approved by the utility company. Please read the installation guide carefully before you begin with the installation. The installation of utility interactive power sources must be compliant with all applicable regulations of the utility company and with all applicable regulations and standards.



The Sunny Boy 4200TL Multi-String is equipped with the SMA grid guard. This is a type of independent disconnection device. It ensures that the Sunny Boy 4200TL Multi-String 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 (4.99) which is a part of these regulations.



This installation manual is intended solely for qualified electricians. Its aim is to help install and set up SMA Sunny Boy 4200TL Multi-String inverters quickly and correctly.

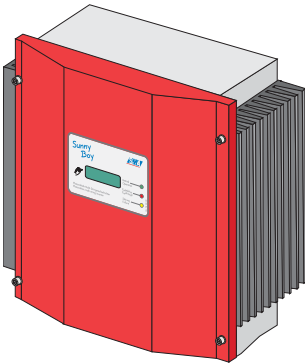
For detailed information on troubleshooting and on how to use the Sunny Boy 4200TL Multi-String, including information about the different communication options, please see the operating instructions.

The „Sunny Design“ tool will help to dimension and check the size of your strings with respect to the inverter you intend to use. Further information about „Sunny Design“ is available at www.SMA.de.

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

+49 561 95 22 - 499

2 Safety Instructions



Check your plant configuration and the string sizing with „Sunny Design“ (available at www.SMA.de) or with the Sunny Boy Hotline before you start with the installation. Exceeding the specifications with the input voltage will destroy the Sunny Boy. Overvoltage on the DC side can even cause dangerous explosions of the Sunny Boys input capacitors and explosions of the electrolytes coming from the exploded capacitors.



Work on the Sunny Boy with the lid removed must be carried out by a qualified electrician. Hazardous and even lethal voltages can be encountered within the enclosure. Before working on the Sunny Boy with the lid removed, the AC and DC voltages **MUST** be disconnected from the Sunny Boy and it must be sure that all capacitors are discharged.



The Sunny Boy must be disconnected from the mains 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 lid. You must also make sure that no voltage is present in the device.

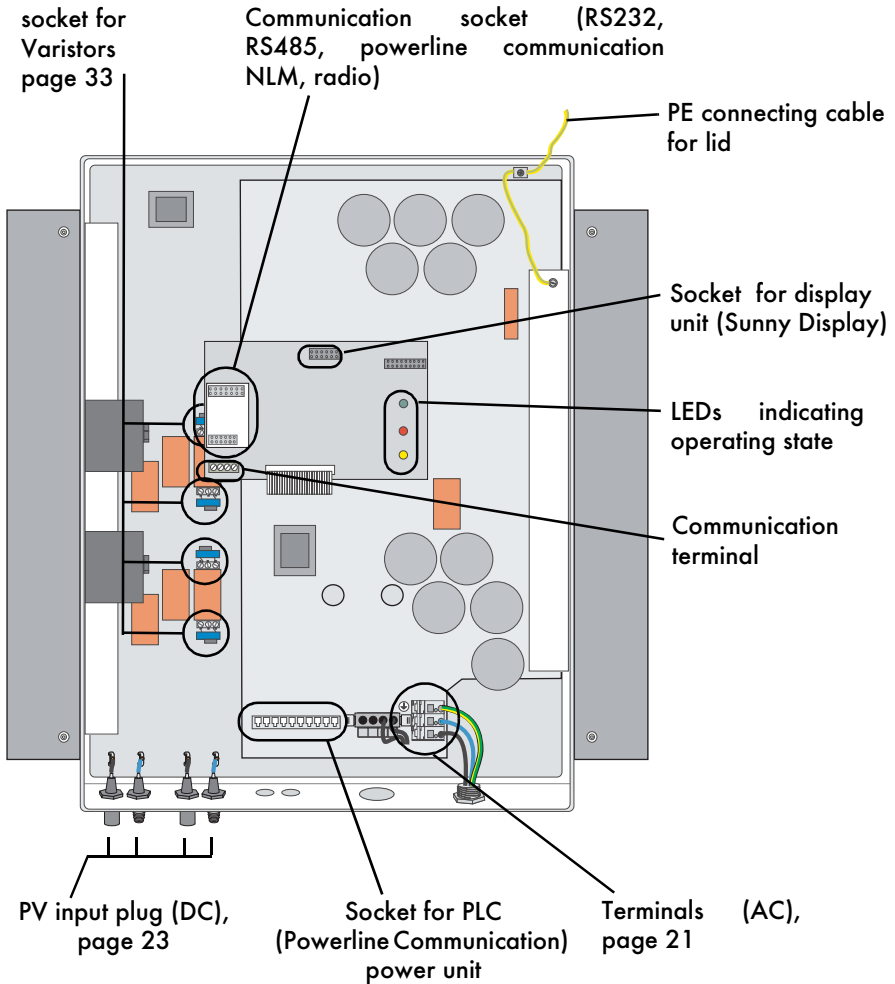
The electronics inside your Sunny Boy 4200TL Multi-String is vulnerable in terms of electrostatic discharge. Be sure to be connected to ground (e.g. the enclosure of the Sunny Boy) before handling anything within the enclosure of the Sunny Boy.



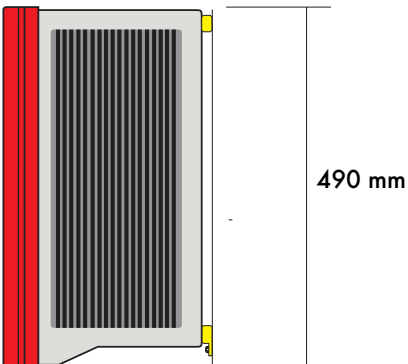
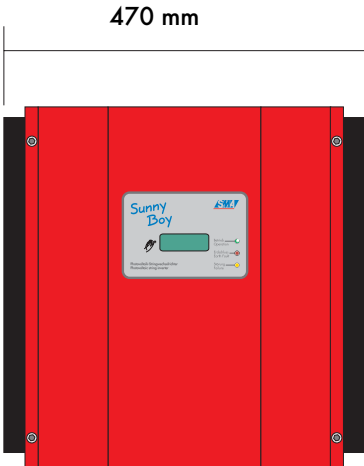
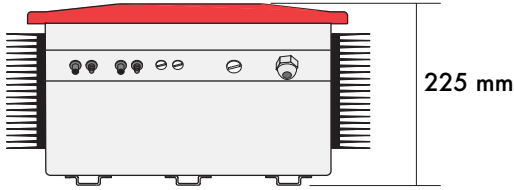
3 Overview

3.1 Device Description

The following figure shows the different components and connection areas of an open Sunny Boy 4200TL Multi-String inverter.



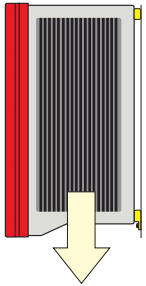
3.2 External Dimensions



4 Requirements for the Installation

Please make sure to fulfill all conditions below before installing and commissioning the Sunny Boy 4200TL Multi-String.

4.1 Requirements: Mounting Place



29 kg

The Sunny Boy 4200TL Multi-String has a weight of 29 kg. Please keep this in mind when selecting the place where and how to mount the Sunny Boy 4200TL Multi-String.

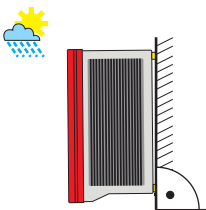
The ambient temperature must be within $-25\text{ }^{\circ}\text{C}$ and $+60\text{ }^{\circ}\text{C}$.



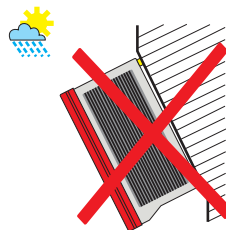
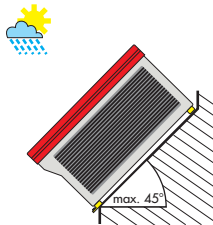
The Sunny Boy 4200TL Multi-String should be installed at a place where it is not exposed to direct sunlight - otherwise this may reduce the yield of the PV plant due to the higher temperature.

The Sunny Boy is designed to be mounted on a vertical wall. For an optimum energy yield and the most convenient operation, vertical installation at eye-level is preferable. In case it is absolutely necessary to tilt the Sunny Boy to the back the maximum angle is 45 ° . If installing the unit outdoors, make sure that it is not slanting forwards. We advise against installing the unit in a horizontal position outdoors.

It is not recommended to install the Sunny Boy lying on the back side with the lid facing upwards.



Mount the Sunny Boy in a vertical position or with a slight angle to the back.



Do not mount the Sunny Boy with an angle to the front or on the back.



Important for the selection of the location:



Unintended removal of the PV plug connectors can damage the connectors and even result in serious injuries. Install the Sunny Boy 4200TL Multi-String at a place where an unintended removal of the PV plug connectors (e. g. by children) is not possible.



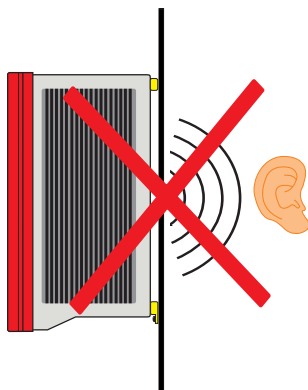
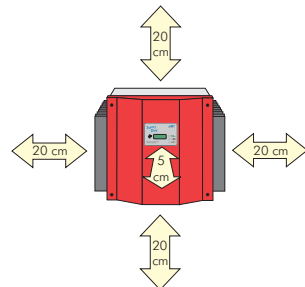
Some parts of the Sunny Boy can reach temperatures over 60 °C.



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

Make sure there is a sufficient space for heat dissipation! In a normal environment the following clearances should be provided for the Sunny Boy 4200TL Multi-String:

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



In a living area the Sunny Boy 4200TL Multi-String should not be mounted on plaster panels etc. in order to avoid noises.

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

The Sunny Boy 4200TL Multi-String will emit a slight noise during operation. This noise can be annoying when the Sunny Boy is installed within a living area.

4.2 Requirements: PV-Modules

The Sunny Boy 4200TL Multi-String is designed for the connection of up to two strings (PV modules connected in series). The two strings may be different in terms of type, module number and orientation due to the fact that each input string is processed by a separate MPP-tracker.

The „Sunny Design“ tool will help to dimension and check the size of your string with respect to the inverter you intend to use. Information about the „Sunny Design“ tool is available at www.SMA.de.

The device has four PV 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 the connection of loose cable ends in a string can be purchased as an accessory. In the following you find the SMA order numbers for the different PV plug connectors:

- Multi-Contact 3 mm: „SWR-MC“
- Multi-Contact 4 mm: „MC-SET“
- Tyco: „TYCO-SET“

Limits for DC input	
max. voltage per string	750 V (DC)
max. input current per string	7,5 A (DC)

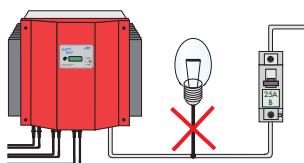
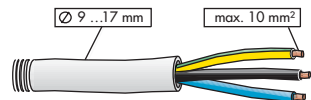
Caution: A parallel connection of the DC input is not possible!



4.3 Requirements: Grid 230 V (AC)

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 4200TL Multi-String are suitable for cables with a cross-section of up to 10 mm². Their outer diameter should be between 9 mm and 17 mm. The Sunny Boy 4200TL Multi-String is connected with three wires (L, N, PE).



Each connection to a Sunny Boy 4200TL Multi-String must be equipped with a separate automatic circuit breaker 25 A type B. No other consumers may be connected to the cable.



Sizing of a circuit breaker for the AC line of a photovoltaic inverter for utility interaction

Several factors have to be considered when you define the size of the circuit breaker for your PV-plant:

- cable type (material and isolation)
- ambient temperature surrounding the cable (higher temperatures reduce the conducting capacity of the cable)
- type of installation for the cable (can reduce the conducting capacity of the cable)
- bundling of cables (can reduce the conducting capacity of the cable)
- loop impedance [Z] (reduces the current that flows in case of a ground fault current through a body and has influence on the tripping characteristics of the circuit breaker)
- Adequate clearance between the circuit breakers in order to avoid excessive heating (automatic circuit breakers trip earlier when they are warmer).
- fuse selectivity
- protection class of the connected consumer (VDE 0100 Part 410 "Protection against electric shock"¹ and/or the international standard IEC 364-4-41:1992)

The following standards have to be complied with:



- DIN VDE 0298-4¹ ("Types of cable installation and conducting capacity")
- DIN VDE 0100 Part 430¹ ("Protection measures for protection of cables and conductors in terms of overcurrent") and/or the international standard IEC 364-4-43:1977 and IEC 364-4-473:1977
- VDE 0100 Part 410¹ ("Protection against electric shock") and/or the international standard IEC 60364-4-41:1992

An example for determining the rating of the AC circuit breaker is specified in detail in chapter 9 „Sizing of a Circuit Breaker“ (page 37).



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 4200TL Multi-String 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 inverter automatically distinguishes between real failure currents and normal capacitive discharge currents.

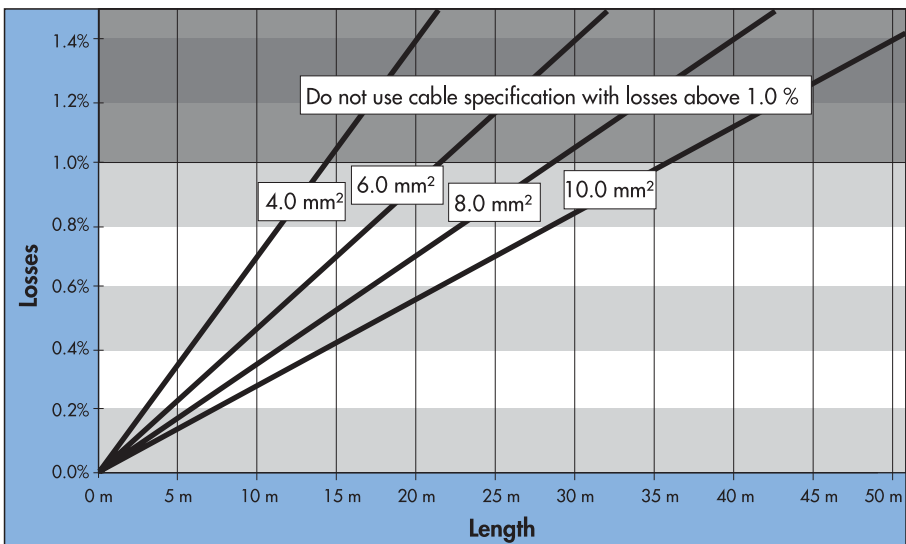
1. The standards mentioned above are to be only used as a guideline for your installation. They apply for installations in Germany. Please note that other standards will apply for different countries throughout the world.

The Sunny Boy 4200TL Multi-String 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 4200TL Multi-String) 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 system impedance at the installation site of the Sunny Boy 4200TL Multi-String must be less than 1 Ohms for the islanding detection and the fuses to work properly. Furthermore you should 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. It shows a multi-conduit cable with all conduits made of copper.



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

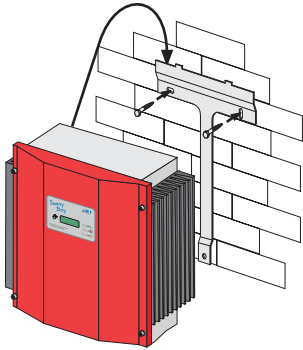
Conductor cross-section	4.0 mm ²	6.0 mm ²	8.0 mm ²	10.0 mm ²
Max. length	14,5 m	22 m	29 m	37 m

The Sunny Boy 4200TL Multi-String 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. All settings shown below are based on the German standard DIN VDE 0126. You are also able to use other settings.

	Limits for AC output
Voltage range	198 V ... 260 V
Frequency range	49.8 Hz ... 50.2 Hz
Voltage range (without anti-islanding)	180 V ... 260 V
Frequency range (without anti-islanding)	45.5 Hz ... 54.5 Hz

5 Installation

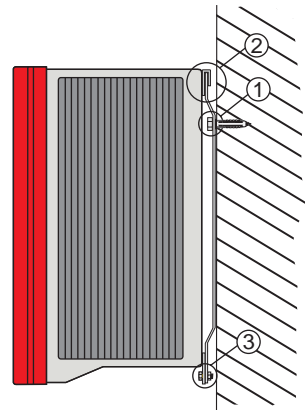
5.1 Mounting



For trouble-free mounting of the Sunny Boy 4200TL Multi-String 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, an apertaining washer and with an 8 mm dowel.

Keep the weight of the Sunny Boy 4200TL Multi-String (29 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 of the Sunny Boy 4200TL Multi-String into the bracket (2) so that it cannot be shifted sideways any more.
3. Secure the Sunny Boy 4200TL Multi-String against lifting off by screwing the M6x10 screw (included in delivery) into the lower middle fixing strap (3).
4. Ensure the Sunny Boy 4200TL Multi-String has been tightly fastened.

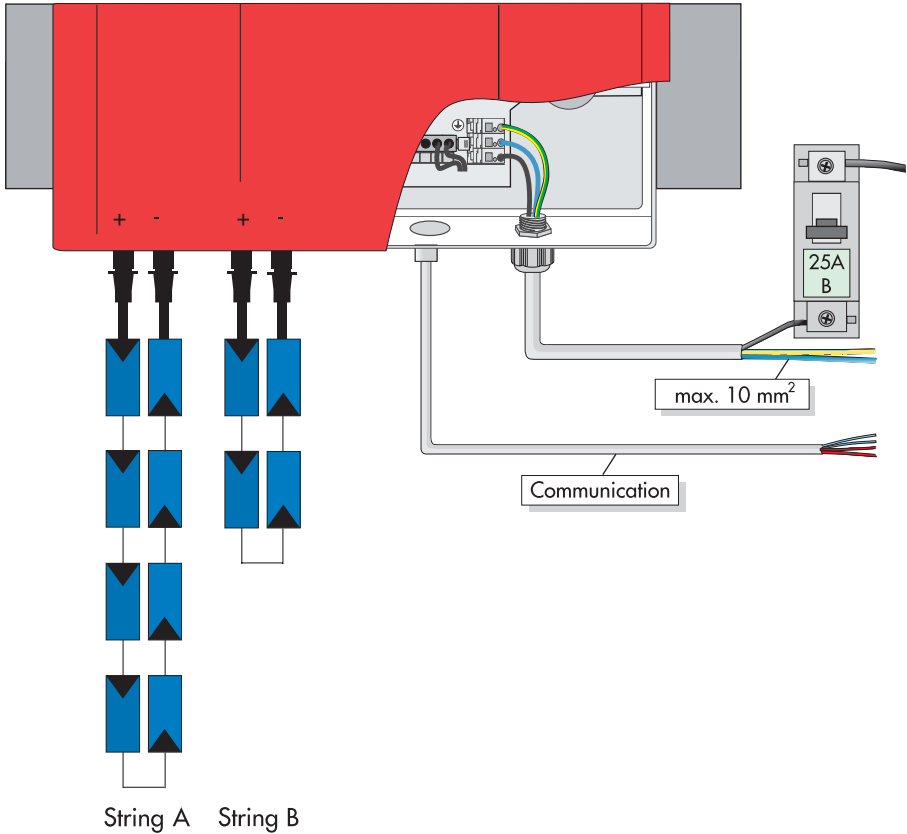


5.2 Electrical Installation

The following figure shows the complete cabling of a Sunny Boy 4200TL Multi-String:



Check the correct polarity before you connect the PV strings!



Connection of AC output

Please follow the steps below:

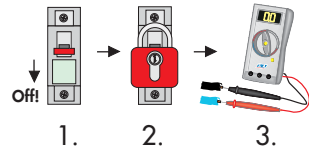
1. Check the grid voltage. If it is above 260 V (German standard), the Sunny Boy 4200TL Multi-String stops operation. The local public utility company should solve this problem.



max. 260 V!

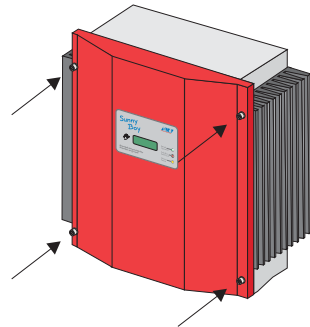
The maximum grid voltage for feeding operation is 260 V!

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



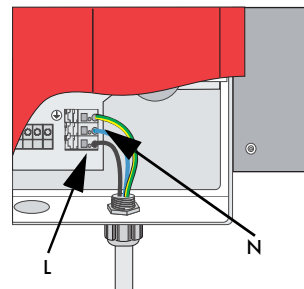
Before opening the Sunny Boy 4200TL Multi-String check whether the AC output is safely isolated from supply!

3. Unscrew the lid from the enclosure of the Sunny Boy 4200TL Multi-String and carefully remove the lid. Then pull the PE cable off the inside of the lid.



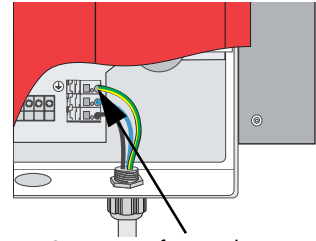
Make sure that you pull off the green yellow PE cable from the inside of the Sunny Boy when you open it!

4. Connect the AC cable as illustrated in the figure on the side. Use the cable gland that is included in the delivery of your Sunny Boy 4200TL Multi-String. Phase (L) and Neutral (N) may not be mixed up.



Connection of „L“ and „N“

5. Connect the earth wire (PE) of the mains lead to the top terminal of the three-terminal block on the circuit board.



6. Fix the PE conductor on the lid again. Fasten the lid to the enclosure of the Sunny Boy 4200TL Multi-String by tightening the four screws.

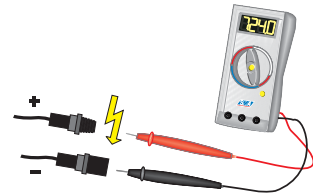


Do not switch on the circuit breaker yet! The Sunny Boy 4200TL Multi-String may only be connected to the AC grid when the PV strings have been connected and the device is tightly closed.

PV String (DC) Connection

Connect the PV strings as follows:

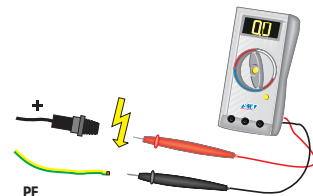
1. Check the PV generator connections on their correct polarity and compliance with the maximum string voltage of 750 V DC, see chapter 4.2 „Requirements: PV-Modules“ (page 15).



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



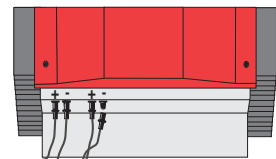
2. Measure the DC voltages between each PV plug connector of a string and ground potential. Follow the safety instructions!
3. If the measured voltages are constant and their total approximately corresponds to the open-circuit voltage of the string, a ground fault has occurred in this string. The ratios 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 4200TL Multi-String after you have removed the cause for the ground fault in the PV generator.



4. Repeat steps 2 and 3 for the other string.
5. Connect the trouble-free PV strings to the Sunny Boy 4200TL Multi-String. Make sure to connect them with correct polarization.
6. Close off the unneeded DC input sockets using the protective caps supplied in the accessories kit.



String A String B

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

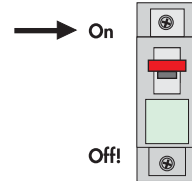
5.3 Activation

You can activate the Sunny Boy 4200TL Multi-String when:

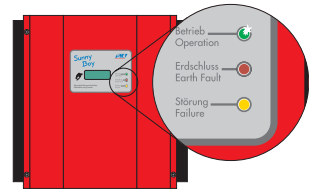
- The AC (grid) cable has been correctly connected.
- All the DC (PV) strings have been connected and all unused PV plug connectors on the underside of the inverter have been closed with the protecting caps.
- The lid has been tightly screwed on.

Proceedings for Activation

1. Switch the circuit breaker on.



2. Check whether the LEDs indicate trouble-free operation of the Sunny Boy 4200TL Multi-String based on the next page. If this is the case commissioning has been successfully completed.



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 4200TL Multi-String. 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“ (page 15). 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 Technologie AG** (see chapter 10 „Contact“ (page 39)).

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	permanently on	failure
shortly turns off (approx. 1 x per second)	off	off	OK (derating)
	permanently on	off	failure
off	off	off	OK (stand-by)
		off / blinking	failure
	permanently on	off	failure
		off / blinking	failure

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

6 Opening and Closing the Sunny Boy 4200TL

If the inverter has to be opened, always follow the safety instructions given in chapter 2 „Safety Instructions“ (page 9).



6.1 Opening the Sunny Boy 4200TL

Caution: Stick to the order specified below!



1. Switch off the AC connection.
2. Prevent accidental reconnection!
3. Disconnect the PV generator from the Sunny Boy 4200TL Multi-String by pulling off all the connectors.
4. **Wait 30 minutes! (This is necessary to let the internal capacitors discharge.)**
5. Remove the four screws on the lid and pull the lid slightly forward. Unlock the green-yellow PE connection and remove it from the lid and take the lid off.

6.2 Closing the Sunny Boy 4200TL

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 4200TL Multi-String by tightening the four screws.
2. Connect the PV generator. Make sure to connect each plug to the correct terminal.
3. Switch on the AC circuit breaker. This activates the Sunny Boy 4200TL Multi-String.
4. Check whether the LEDs of the Sunny Boy 4200TL Multi-String indicate trouble-free operation.

7 Technical Documentation

7.1 Data PV Generator Connection

Max. input open-circuit voltage	U_{PV0}	750 V (at -10 °C module temperature)
Input voltage, MPP operation	U_{PV}	125 V ... 750 V DC
Max. input current	I_{PVmax}	7,5 A per input port
Max. input power	P_{PV}	3800 W per String
Recommended generator power		4400 Wp
All-pole disconnector on DC input side		Multi-Contact® plug connector (standard - other snap cable connectors optional)
Surge voltage protection		thermally monitored varistors
Voltage ripple	U_{PP}	< 10 % of input voltage
Personnel protection		Ground Fault monitoring (Riso > 1 MΩ)
Internal consumption in operation		< 10 W (stand-by)
Pole confusion prevention		by short-circuit diode

7.2 Data Grid Connection

Nominal output power	P_{ACnom}	4000 W
Peak output power	P_{ACmax}	4200 W
Nominal output current	I_{ACnom}	17.5 A
Harmonic distortion of output (with $K_{U_{nom}}$ < 2 %, $P_{AC} > 0,5 P_{ACnom}$)	THD _{AC}	4 %
Short-circuit resistance		$I_{max} = 30$ A
Operating range, grid voltage	U_{AC}	198 ... 260 V AC
Operating range, grid frequency	f_{AC}	49.8 ... 50.2 Hz
All-pole disconnector on grid side		independent disconnection device (MSD), (2 independant systems)
Phase difference (related to basic wave of current)	cos Phi	1
Overvoltage category		III
Test voltage (50 Hz)		1.65 kV (5 s unit / type test)
Surge voltage test		4 kV (1.2/50 ms) (serial interface: 6 kV)
Internal consumption in stand-by		0.25 W

7.3 Description of Device

You will find a detailed device description in the Operating Instructions.

General Data

Protection Degree according to DIN EN 60529	IP65
Dimensions (width x height x depth)	approx. 470 mm x 490 mm x 225 mm
Weight	approx. 29 kg

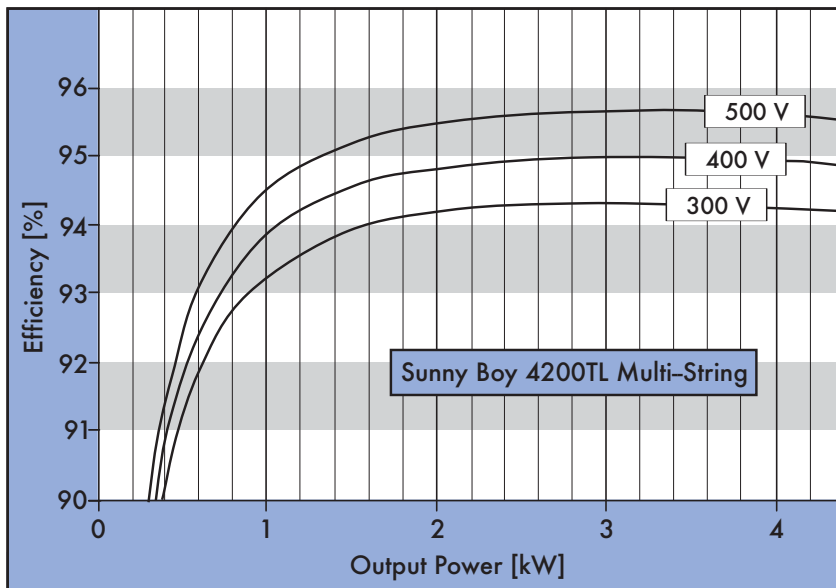
External interfaces

Data transmission via Powerline	optional
Data transmission via separate data cable	optional, RS232 / RS485, electrically separated
Data transmission via radio	optional

Efficiency

Max. Efficiency at nominal voltage	$\eta_{m\ max}$	95.6 %
European weighted efficiency	η_{EURO}	94.9 %

The efficiency of the Sunny Boy 4200TL Multi-String depends on the DC input voltage coming from the PV modules. The higher the voltage the higher is the efficiency of the Sunny Boy 4200TL Multi-String.



7.4 Sunny Boy 4200TL Operating Parameters

Any unauthorized modifications of the operating parameters can

- Result in serious injuries or casualties due to altered internal safety precautions within the Sunny Boy
- Void the operating permission of the Sunny Boy
- Void the warranty of the Sunny Boy.



Never change the operating parameters without explicit permission and instructions!

The parameters with a grey background are only visible when in installer mode.

Name	Unit	Range	Default
Betriebsart/ Operating Mode		MPP/ Ikonst/ UKonst/ Stop	MPP
Default			GER/ENS
dFac-MAX	Hz/s	0.005 ... 4.0	0.25
dZac-MAX	mOhm	0 ... 2000	350
E_Total	kWh	0 ... 200000	
Fac-Delta-	Hz	0 ... 4.5 (0.19)	0.19
Fac-Delta+	Hz	0 ... 4.5	0.19
h_Total	h	0 ... 200000	
Inst.-Code			
NiTest/ impedance test		0 / 1	1
Riso-Min	kOhm	1000 ... 30000	1000
Speicherfunktion/ Memory Function		Default parameter/ Reset Operating Data/ Reset Failure	none
Speicher / Storage		permanent/ volatile	permanent
Uac-Min / Vac-Min	V	180 ... 300	198
Uac-Max / Vac-Max	V	180 ... 300	260
Usoll-Konst A/ Vconst-SetpointA	V	0 ... 750	290
Usoll-Konst B/ Vconst-SetpointB	V	0 ... 750	290

The following parameters appear in the parameter list but cannot be modified:

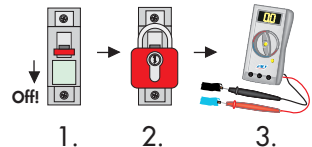
Name	Unit	Range	Description
Plimit	W	5100	Upper limit of AC output power
SMA-SN			Serial Number of the Sunny Boy
Software-BFR / Firmware-BFR			Firmware version of the operation control unit (BFR)
Software-SRR/ Firmware SRR			Firmware version of the current control unit (SRR)
Hardware-DC- BFR			Hardware version of the DC converter control unit (DC-BFR)
Firmware-DC-BFR			Firmware version of the DC converter control unit (DC-BFR)

8 Exchanging Varistors

The Sunny Boy 4200TL Multi-String 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 otherwise than described in this document. Make use of our exchange service and the repair service of **SMA** Technologie AG.

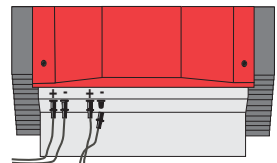
If the red status LED is permanently on during operation please first make sure that there is no ground fault in the PV generator. Only if the green LED is permanently on at the same time, you can skip points 3 to 5 below.

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



1. 2. 3.
Ensure that the AC voltage is off before you open the Sunny Boy 4200TL Multi-String!

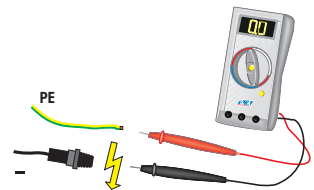
2. Disconnect the DC plug connectors of all strings. Make sure that their allocation to the different inverter input ports can still be recognized!



String A String B

Disconnect the PV strings!

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



Measure voltages between PV plug connectors and the ground potential.

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

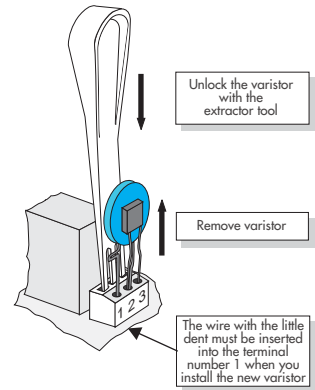


4. If the voltages measured are constant and their total is approximately equal to the open-circuit voltage of the string, there is a ground fault in this string. Its approximate position can be deducted from the ratios of voltages.

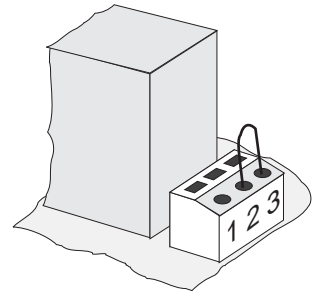
5. Repeat points 3 and 4 for the other string.
If you have found a ground fault it is probably unnecessary to exchange the varistors. Make sure to remove the ground fault instead. This should normally be done by the installer of the PV plant. In this case proceed with point 10, but without reconnecting the faulty string! Protect its PV 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“ (page 9).

6. Unscrew the lid of the Sunny Boy 4200TL Multi-String 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 4200TL Multi-String can be seen in chapter 3.1 „Device Description“ (page 11).
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 four. These varistors are specially manufactured for use in the Sunny Boy 4200TL Multi-String and are not commercially available. They have to be purchased from **SMA Technologie AG** direct (SMA order name: “MSWR-TV6”).



9. If no replacement varistors are available on site the Sunny Boy 4200TL Multi-String 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 4200TL Multi-String is then not protected against surge voltages!

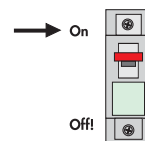
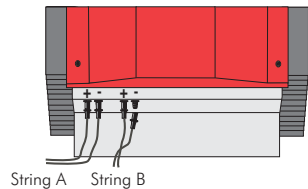


For a limited period of time a defective varistor can be replaced by a wire between terminal 2 and 3.

The input port thus modified is no longer protected against surge voltages! Equip the inverter with varistors again as soon as possible. The Sunny Boy 4200TL Multi-String should not be operated without varistors in plants where is a high risk of surge voltages!



10. Reconnect the PE plug to the lid and close the Sunny Boy 4200TL Multi-String again.
11. Connect the faultless strings of the PV panel. Ensure correct allocation to strings.
12. Close off the unneeded DC input sockets using the protective caps supplied in the accessories kit.
13. Switch on the circuit breaker.
14. Check whether the LEDs of the Sunny Boy 4200TL Multi-String show trouble-free operation.

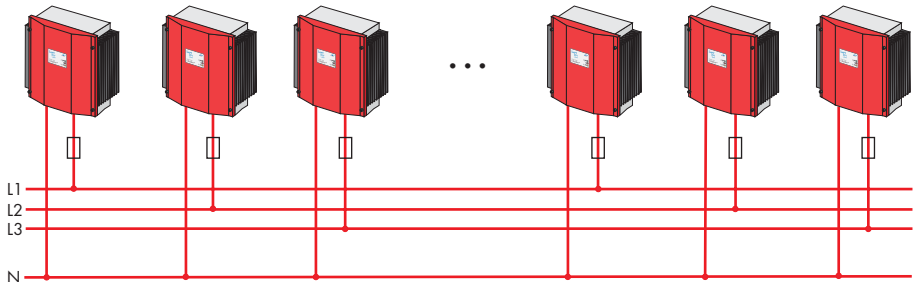


If you have found neither a ground fault nor a defective varistor there probably is a fault in the Sunny Boy 4200TL Multi-String. Please contact the SMA hotline in this case to discuss further proceedings.

9 Sizing of a Circuit Breaker

Example for the sizing of a circuit breaker for the AC line of a photovoltaic inverter for utility interaction in terms of temperature.

Photovoltaic plant with 9 inverters type Sunny Boy 4200TL with 3 inverters per phase



Required data of the used inverters:

- max. output current: 19 A
- max. permissible rating of the circuit breaker for one inverter: 25 A

The type of cable as well as the type of cable installation and several other conditions have influence on the maximum rating of the circuit breaker for the inverter.

- In this example we assume that the cable used (4 mm^2) can be used for nominal currents up to 25.2 A in this example.

Selection of the circuit breakers:

- The maximum possible nominal current of the cable used and the maximum possible rating for the inverter now define the maximum possible nominal current of the circuit breakers.
- 25 A are possible in our example for one inverter.

The circuit breakers must also be selected according to their thermal characteristics.

Several aspects that have affect on the load must be considered when you select a circuit breaker. These aspects are specified in the data sheets of the circuit breakers.



Example for the sizing of a 25 A circuit breaker with B characteristics for the AC line of a photovoltaic inverter for utility interaction while the circuit breakers are installed right next to each other without gap (with respect to the thermal conditions).

One vendor of circuit breakers for example specifies the ratings for an ambient temperature of 50 °C.

Aspects that have an affect on the load specified in the data sheets:

- Reduction of the tolerable current because of continuous load $> 1 \text{ h} = 0.9$ ¹
- Reduction of the tolerable current due to installation of 9 circuit breakers right next to each other without gap $= 0.77$ ²
- Increase of the tolerable current resulting from ambient temperatures of 40 °C in the distribution box $= 1.07$ ³

Result:

The nominal current of the circuit breaker is

$$I_{nr} = 25 \text{ A} \times 0.9 \times 0.77 \times 1.07 = 18.5 \text{ A}$$

The circuit breaker selected for this installation is not suitable due to the fact that the maximum tolerable current of the circuit breaker is below the maximum current of the used inverter. **It will trip in normal operation.**

A solution for this plant would be the installation of the circuit breakers with an 8 mm gap between each unit. This would result in a reduction coefficient of 0.98 instead of 0.77. This would result in a maximum current of 23.6 A.

Beside the sizing of the circuit breakers in terms of thermal characteristics it is necessary to comply with all other applicable standards⁴. These are especially:

- DIN VDE 0100 Part 410 and/or the international standard IEC 60364-4-41:1992
- DIN VDE 0100 Part 430 and/or the international standard IEC 364-4-43:1977 and IEC 364-4-473:1977
- DIN VDE 0298 Part 4

-
1. In photovoltaic applications continuous loads of over 1 h are possible.
 2. The coefficient is 1 in case there is only one single circuit breaker.
 3. Resulting from the sizing of the circuit breakers for ambient temperatures of 50 °C.
 4. The standards listed here are standards that apply in Germany. Please note that other standards apply in other countries. Beside the standards above other standards may be applicable in special installations.

10 Contact

If you have any questions or technical problems with the Sunny Boy 4200TL Multi-String our hotline will be glad to help you. Please keep the following data ready when calling SMA:

- Type of inverter used
- Connected modules and number of modules
- Communication
- Serial number of the Sunny Boy



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