PV Inverter

SUNNY BOY 5000-US / 6000-US / 7000-US / 8000-US

Installation Guide

SB50US-80US-eng-IUS112633 | TBUS-SB50_60_70US | Version 3.3

CA US

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IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for the following products:

- Sunny Boy

This manual must be followed during installation and maintenance.

The product is designed and tested according to international safety requirements, but as with all electrical and electronic equipment, certain precautions must be observed when installing and/or operating the product. To reduce the risk of personal injury and to ensure the safe installation and operation of the product, you must carefully read and follow all instructions, cautions and warnings in this manual.

Warnings in this document

A warning describes a hazard to equipment or personnel. It calls attention to a procedure or practice, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the SMA equipment and/or other equipment connected to the SMA equipment or personal injury.

DANGER

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

WARNING

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

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to personal injury.

Other symbols in this document

In addition to the safety and hazard symbols described on the previous pages, the following symbol is also used in this manual:

Information

This symbol accompanies notes that call attention to supplementary information that you must know and use to ensure optimal operation of the system.

Markings on this product

The following symbols are used as product markings with the following meanings.

Warning regarding dangerous voltage

The product works with high voltages. All work on the product must only be performed as described in the documentation of the product.

Electric arc hazards

The product has large electrical potential differences between its conductors. Arc flashes can occur through air when high-voltage current flows. Do not work on the product during operation.

Beware of hot surface

The product can become hot during operation. Do not touch the product during operation.

Observe the operating instructions

Read the documentation of the product before working on it. Follow all safety precautions and instructions as described in the documentation.

This inverter is evaluated to UL 1741, which includes assessment to all of the requirements of IEEE1547 and IEEE1547.1, which are an outgrowth and further development of the IEEE recommended practices and guidelines contained in IEEE Std. 929-2000. IEEE 929-2000 provides recommendations regarding the proper equipment and functionality necessary to ensure compatible operation when power generation is connected to the utility grid. The inverter is additionally evaluated to the *National Electrical Code®* and the *Canadian Electrical Code®* CSA C22.2 No. 107.1-1.

General warnings

General warnings

All electrical installations must be done in accordance with the local and *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1. This document does not and is not intended to replace any local, state, provincial, federal or national laws, regulation or codes applicable to the installation and use of the product, including without limitation applicable electrical safety codes. All installations must conform with the laws, regulations, codes and standards applicable in the jurisdiction of installation. SMA assumes no responsibility for the compliance or noncompliance with such laws or codes in connection with the installation of the product.

The product contains no user-serviceable parts except for the fans on the bottom of the enclosure and the filters behind the fans as well as the handle covers on the sides of the unit. For all repair and maintenance, always return the unit to an authorized SMA Service Center.

Before installing or using the product, read all of the instructions, cautions, and warnings in this manual.

Before connecting the product to the electrical utility grid, contact the local utility company. This connection must be made only by qualified personnel.

Wiring of the product must be made by qualified personnel only.

1 Information on this Guide

1.1 Validity

This guide describes the mounting, installation, commissioning and maintenance of the following SMA inverters:

- Sunny Boy 5000-US (SB 5000US and SB 5000US-11)
- Sunny Boy 6000-US (SB 6000US and SB 6000US-11)
- Sunny Boy 7000-US (SB 7000US and SB 7000US-11)
- Sunny Boy 8000-US (SB 8000US and SB 8000US-11)

This guide does not contain any information on the devices that are connected to the Sunny Boy. Information concerning the connected devices is available from the manufacturers of the devices.

1.2 Target Group

This guide is for qualified personnel. Qualified personnel have received training and have demonstrated skills and knowledge in the construction and operation of this device. Qualified personnel are trained to deal with the dangers and hazards involved in installing electric devices.

1.3 Storing the Documentation

Store all manuals for the Sunny Boy in such a way that they may be accessed at any time.

1.4 Additional Information

Additional information on specific topics can be found in the download area at www.SMA-America.com.

1.5 Nomenclature

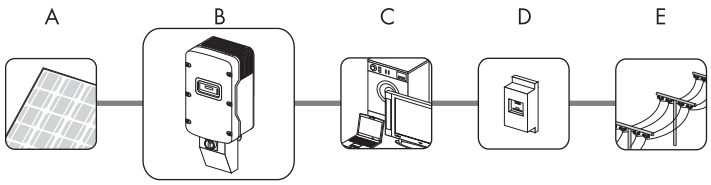
In this document, SMA America Production, LLC and SMA Solar Technology Canada Inc. will be referred to as SMA.

2 Safety

2.1 Appropriate Usage

The Sunny Boy is a PV inverter which converts the DC current of the PV array to AC current and feeds it into the power distribution grid. The Sunny Boy is suitable for use with fuel cells, small wind power plants and other DC current sources. The Sunny Boy takes the current from a DC source and converts it into AC power for the power distribution grid. This power is then supplied to the local consumers (C). Surplus energy is fed into the power distribution grid (E). Due to the power that is consumed by the local devices, the amount of power required from the power distribution grid is reduced. An energy surplus may even result in the energy meter (D) of your plant running backward. This power may also be recorded as power credits by the electric utility company depending on the interconnection agreement.

Principle of a PV Plant with a Sunny Boy



Item	Description
A	PV array
B	Sunny Boy with SMA DC Disconnect
C	Local consumers
D	Energy meter
E	Power distribution grid

Anti-Islanding Protection

A stand-alone grid is a status. It occurs when the power distribution grid is switched off and the Sunny Boy is in operation. For this to happen, the remaining load must be resonant at 60 Hz and exactly match the power of the Sunny Boy. Although the appearance of these conditions is extremely unlikely, the Sunny Boy has an active safety algorithm to protect against islanding. The effect of this is that, in the event of the power distribution grid being switched off, the PV plant does not supply any power to a symmetrical load that is resonant at 60 Hz. In addition, the Sunny Boy regularly feeds leading and lagging reactive currents into the power distribution grid. This procedure is checked by the certification body, in order to destabilize and switch off stand-alone grid status.

Ground Fault Detection and Interruption in the PV Array

The Sunny Boy is equipped with grounding fault detection. If a ground fault current larger than 1 A is flowing, the Sunny Boy switches off and displays the disturbance. As soon as the ground fault has been located and eliminated, the ground fault disturbance must be rectified manually. Following this, the Sunny Boy resumes operation.

PV Series Fusing

Series fusing may be required depending on the type of PV module used in the plant. See *National Electrical Code*® 690.9. For installation in Canada, the installation must be performed according to the applicable Canadian standards.

Operating Temperature

The Sunny Boy delivers full performance in ambient temperatures up to +113 °F (+45 °C). Due to the fan cooling, this level of performance can be achieved in closed rooms. The Sunny Boy does remain operational above +113 °F (+45 °C), but it reduces the level of performance so as to protect the internal component parts from overheating.

Interconnection Code Compliance

The Sunny Boy has been checked by the certification body and certified according to the guidelines in UL 1741 Static Inverters and Charge Controllers for use in Photovoltaic Power Systems, IEEE 929-2000 Recommended Practice for Utility Interface of Photovoltaic Systems, and IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems.

UL 1741 is the standard that is used for the Sunny Boy by the certification body, in order to certify that it complies with the regulations in NEC and IEEE 929-2000. IEEE 929-2000 states recommendations regarding the appropriate equipment and functionality that is required to guarantee fault-free operation when the power generation is connected to the power distribution grid.

The Sunny Boy is also certified according to C22.2 N0. 107.1-01 (General Use Power Supplies).

Prior to setting up and installing your PV plant, contact the on site grid operator or the responsible authority.

FCC Compliance

The Sunny Boy has been tested and shown to conform with all FCC Part 15 A & B EMI/EMC emissions regulations.

2.2 Safety Instructions

DANGER

Danger to life due to high voltages in the inverter.

Risk of death or serious injury due to electric shock.

- Only qualified personnel may perform work on the inverter.

WARNING

During operation, the inverter can become hot.

Risk of burns.

- Do not touch the enclosure during operation.
- Only touch the lid during operation.

2.3 Installation Overview

This section provides a brief overview of the installation process of a Sunny Boy.

Section 3: Unpacking and Inspection

This section provides instructions and information on unpacking the Sunny Boy and inspecting shipping damage.

Section 4: AC Voltage Configuration

This section contains information on removing the cover, determining the position of the fundamental component parts in the inverter and selecting the suitable voltage configuration for the installation.

Section 5: Mounting

This section provides guidelines to help you choose the best mounting location, recommendations for achieving optimal performance, safety measures and warnings to prevent injuries and/or damage to the device, and step-by-step instructions for mounting the Sunny Boy inverter.

Section 6: Wiring the Sunny Boy

This section contains guidelines for selecting the correct line cross-section, safety measures and warnings to prevent injuries and/or damage to the device, and step-by-step instructions for connecting the Sunny Boy to a PV array, to an electric circuit in the home, and to the power distribution grid. Procedures are also included for connecting optional data communication cables.

Section 7: Commissioning

Commissioning comprises applying DC input power to the Sunny Boy, observing the LED and LCD displays and resolving any problems that occur.

Section 8: Displays and Messages

This section provides information on messages that may appear during commissioning and operation.

Section 9: Troubleshooting

This section provides information for troubleshooting and procedures for resolving problems that may occur during commissioning and operation.

Section 10: Maintenance

This section contains the maintenance and cleaning of the Sunny Boy and safety measures and warning for preventing injuries and damage to the device.

Section 11: Technical Data

This section contains the technical data of the Sunny Boy, connection diagrams, and the correct tightening torques for connecting the cables and screws to the Sunny Boy.

3 Unpacking and Inspection

Inspect the packaging for damage prior to commencing installation. If the inverter is damaged, immediately report the damage to your SMA dealer and the delivery company that delivered the Sunny Boy.

If it is necessary to send the Sunny Boy back, use the original packaging.

WARNING

The Sunny Boy may fall over due to its heavy weight.

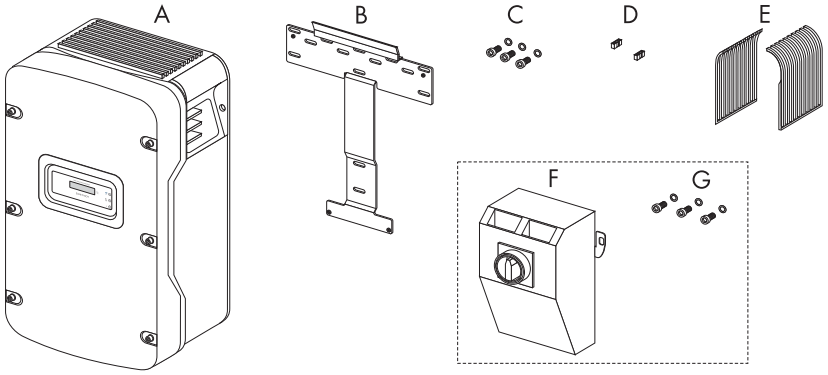
Risk of bruising and broken bones.

- When mounting the Sunny Boy, note that it has a weight of 148 lbs. (67 kg).
- Use suitable lifting techniques or get an additional person to assist.

If you require help with a damaged Sunny Boy, please contact your SMA dealer or SMA.

Contact information is provided in the "Contact" section, page 101.

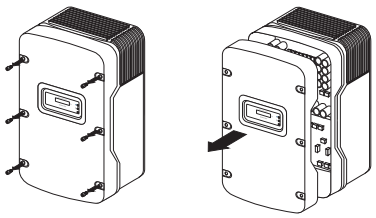
3.1 Scope of Delivery



Item	Quantity	Description
A	1	Sunny Boy
B	1	Wall mounting bracket
C	1	Replacement screw and replacement tooth lock washers for connecting the enclosure lid to the Sunny Boy.
	2	Screws and washers for fastening the Sunny Boy to the wall mounting bracket
D	2	Spare jumpers for fan test
E	2	Handle covers (left and right)
F	1	SMA DC Disconnect
G	1	Screw and washer for connecting the enclosure lid to the DC Disconnect
	2	Screws and washers for fastening the DC Disconnect to the wall mounting bracket

4 AC Voltage Configuration

4.1 Opening the Sunny Boy



1. Remove the six screws and conical spring washers from the enclosure cover. Pull the cover forward smoothly.
2. Put the cover, screws and conical spring washers to one side so that they do not get in the way.

NOTICE

Damage to the enclosure lid may affect the seal between the enclosure lid and the enclosure.

There may be an ingress of moisture.

Potential damage to the Sunny Boy.

- Handle the enclosure lid with care.
- Do not lose the screws and conical spring washers of the enclosure lid.
- When closing the enclosure, no moisture may remain in the enclosure.
- Do not install the Sunny Boy in the event of precipitation or a high level of humidity (> 95 %).

NOTICE

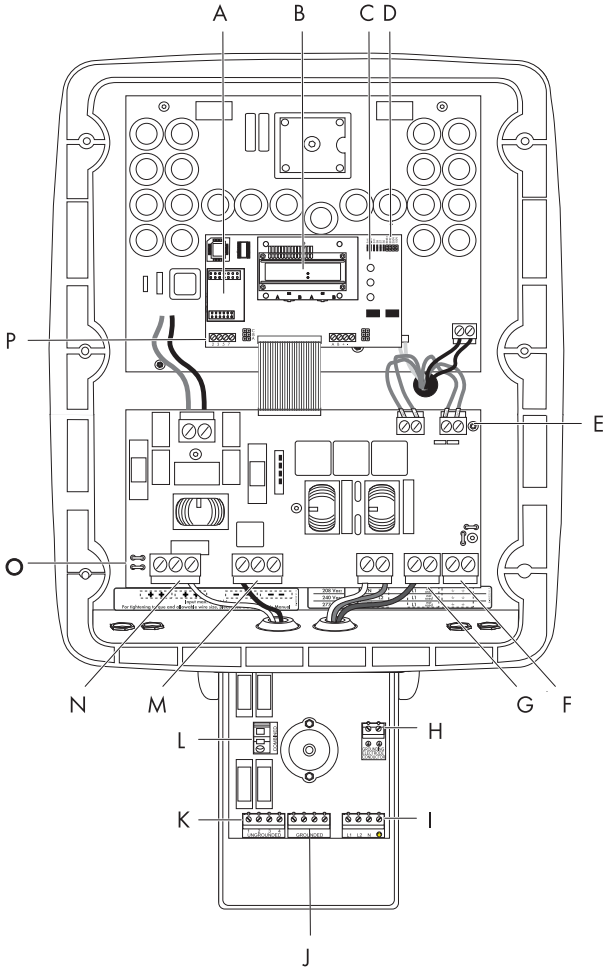
The seal of the enclosure may become frozen shut due to frost.

Potential damage to the seal when opening the Sunny Boy.

There may be an ingress of moisture, damaging the Sunny Boy.

- Do not open the Sunny Boy when the outdoor temperature is below 23 °F (− 5 °C).

4.2 Locating Internal Component Parts



Item	Description
A	Sockets for optional communication Piggy-Back (RS485 or wireless)
B	Display
C	Status LEDs
D	Jumpers for configuring the AC voltage and the fan test
E	Terminal blocks for configuring the AC voltage
F	Ground terminal (PE)

Item	Description
G	Output AC conductor terminals (N, L1 and L2)
H	Terminal block, PV grounding conductor + DC grounding conductor
I	Output AC conductor terminals (L1, L2, N and PE)
J	PV terminal GROUNDED (PV array input)
K	PV terminal UNGROUNDED (PV array input)
L	Combined terminal UNGROUNDED
M	Terminal DC – (PV array input)
N	Terminal DC+ (PV array input)
O	Flat connection for grounding the cable shield for communication
P	Terminal for optional communication (RS485)

4.3 AC Voltage Configuration

The Sunny Boy 8000-US must not be connected to a 208 V grid.

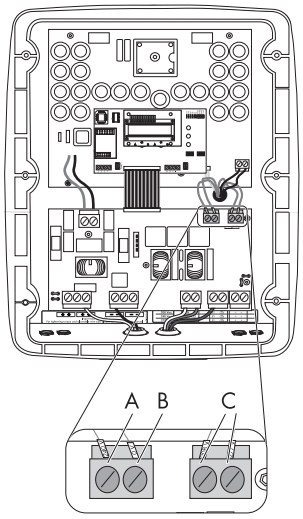
The Sunny Boy is compatible with the following grid types:

- 208 V AC (not Sunny Boy 8000-US)
- 240 V AC
- 277 V AC

The Sunny Boy is configured ex works for connection to the power distribution grid with a voltage of 240 V AC. The Sunny Boy can be configured for other voltages.

4 cables are inserted into the enclosure via a cable support sleeve. Each cable is labeled with its respective voltage.

1. Connect the cable with the correct voltage to the left terminal block (A).
2. To adjust the AC voltage, select the cable with the correct voltage at the right terminal block (C). Connect the selected cable to the left side of the left terminal block (A).
3. Secure all screw terminals. If spring-type terminals are available, close the levers of the terminals by pressing down.



Tightening torque of the screw terminals for the left terminal block:

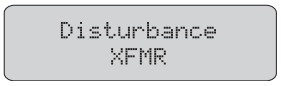
Gray terminal blocks (Weidmüller)	18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	22 in-lbs. (2.5 Nm)

Do not remove the cable in the left terminal block with the marking 0 V (B).
This always remains connected to the right side of the left terminal block.

4. Connect and fasten all cables not being used to the right terminal block (C). Tightening torques of the screw terminals for the right terminal block (cables not being used):

Gray terminal blocks (Weidmüller)	11 in-lbs. (1.2 Nm)
Green terminal blocks (Phoenix)	15 in-lbs. (1.7 Nm)

If the Sunny Boy is configured for the wrong input voltage, this error message appears in the display:



- Check if the configuration of the AC voltage is correct.

Automatic Grid Voltage Detection

The Sunny Boy automatically detects the grid voltage that it must feed in. Depending on the voltage and the phase angle between L1-N and L2-N, the inverter determines whether it is connected to a 208 V, 240 V or 277 V grid. If the Sunny Boy is configured for the wrong grid voltage (for example, the inverter was configured for 240 V and then connected to a 208 V grid), the Sunny Boy displays an error message.

The table below contains the limiting values for voltage and frequency in the AC terminal:

Voltage range for 208 V nominal value, phase-phase (not Sunny Boy 8000-US)	183 V ... 229 V
Voltage range for 240 V nominal value, phase-phase	211 V ... 264 V
Voltage range for 277 V nominal value, phase-neutral conductor	244 V ... 305 V
Frequency range	59.3 Hz ... 60.5 Hz

If the power distribution grid uses a neutral conductor, the responsible authority can demand that a neutral conductor be connected to the inverter.

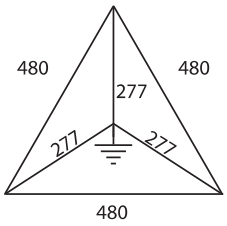
To set the configuration jumpers, observe the procedure in 4.4 "Jumper for System Configuration" (page 23).

To connect a neutral conductor to the Sunny Boy, observe section 6.4.2 "AC Connection without SMA DC Disconnect" (page 41) or section "AC Wiring with SMA DC Disconnect" on page 43.

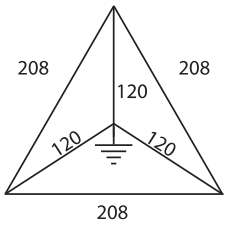
Configuration of Grid Voltage

The figure on the next page illustrates common grid forms. Note that it is not the phase relationship that is important when connecting the Sunny Boy to the power distribution grid, but the voltage compatibility.

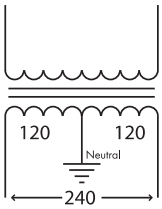
480 Delta: 277 WYE



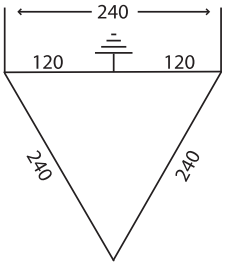
208 Delta: 120 WYE*



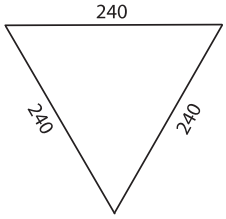
240: 120 Split Phase



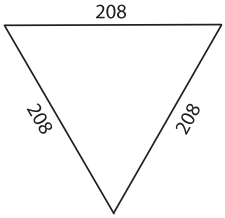
240 Delta: 120 Stinger



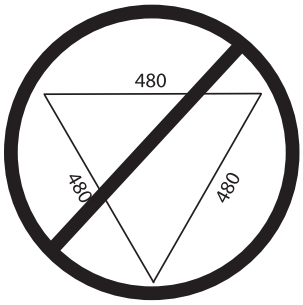
240 Delta



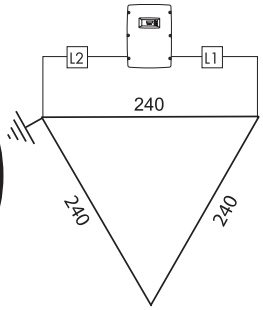
208 Delta*



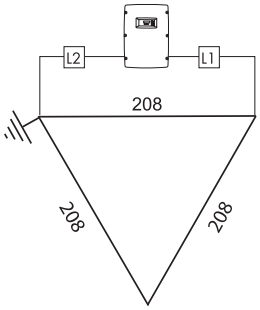
480 Delta
DO NOT USE!



240 Delta:
Corner grounded



208 Delta:*
Corner grounded



*The Sunny Boy 8000-US must not be connected to a 208 V grid.

When using corner grounded 240 V or 208 V Delta grids:

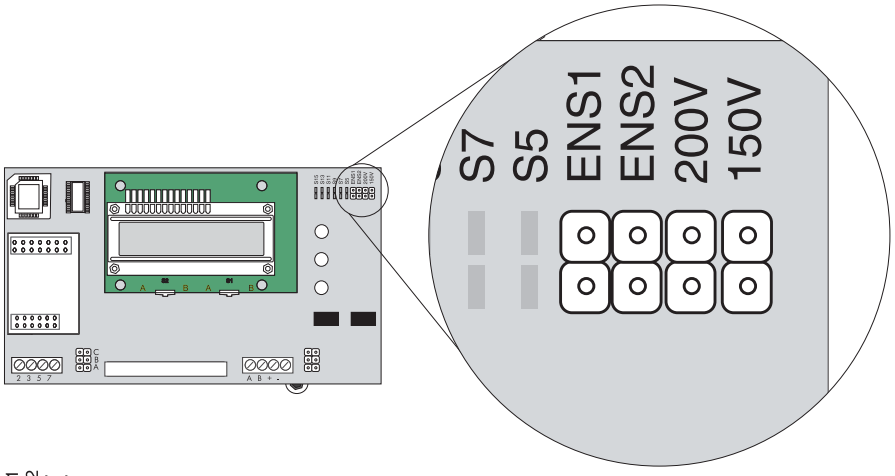
- Connect terminal L2 to the grounded phase.

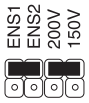
4.4 Jumper for System Configuration

By setting the jumper, you configure the Sunny Boy for different grid topologies. This means that operation in system configurations without neutral conductors, such as 208 V and 240 V Delta, is possible. The following figure provides an overview of the standard settings, the settings for grids without neutral conductors, and the settings for the fan test.

In the event of frost, the fan cannot be inspected.

Below 32 °F (0 °C), the fans are no longer controlled.





208V with neutral conductor 240V with neutral conductor or 277V

208 V Delta, without neutral conductor or *
208 V Delta, grounded *

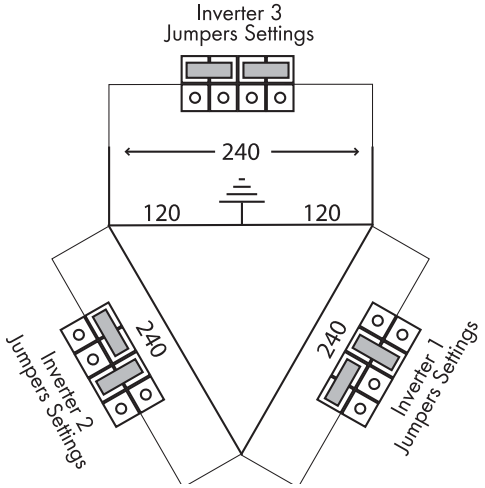
240 V Delta, without neutral conductor or
240 V Delta, grounded

Fan test

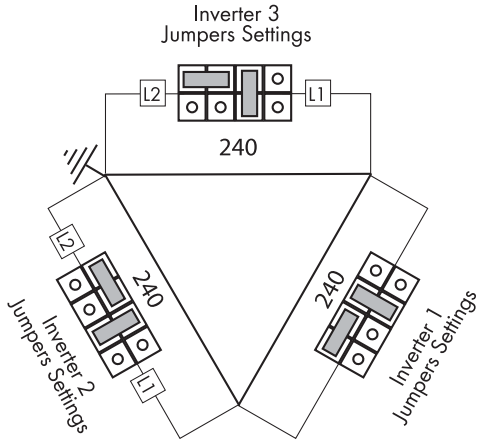
* The Sunny Boy 8000-US must not be connected to a 208 V grid.

The following figures display the correct arrangement of the jumpers for the 240 V Delta system configuration: Note the order in which the inverters are connected to the phases.

Configuration Examples for Jumpers with 240 V Delta, 120 V Stinger



Configuration Examples for Jumpers with 240 V Delta, Grounded



When using grounded 240 V or 208 V Delta grids, connect terminal L2 to the grounded phase.

5 Mounting

5.1 Safety

DANGER

Danger to life due to fire or explosions.

With electrical devices, there is always a certain danger that a fire may break out.

- Do not install the inverter in the vicinity of combustible materials.
- Do not install the inverter in potentially explosive areas.

WARNING

During operation, the inverter can become hot.

Risk of burns.

- Do not touch the enclosure during operation.
- Only touch the lid during operation.
- Install the inverter in such a way that it cannot be touched accidentally.

CAUTION

The Sunny Boy may fall over due to its heavy weight.

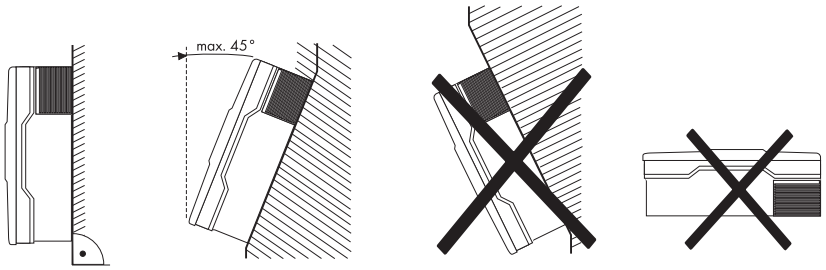
Risk of bruising and broken bones.

- When mounting the Sunny Boy, note that it has a weight of 148 lbs. (67 kg).
- Use suitable lifting techniques or get an additional person to assist.

5.2 Requirements for the Mounting Location

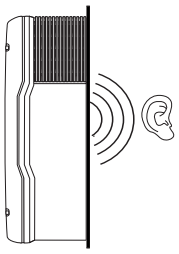
Observe the following conditions during installation:

- The installation method and mounting location must be suitable for the weight and dimensions of the Sunny Boy (see section 11 "Technical Data" (page 88)).
- Note the dimensions of the DC Disconnect (Page 32).
- Mount the inverter on a stable surface.
- The mounting location must be accessible at all times.



- Mount vertically or tilted backward at max. 45°.
- The connection area must point downward.
- Do not install the inverter tilting forward.
- Do not install the inverter horizontally.
- Install the inverter at eye level in order to be able to read out the operating state at any time.
- The ambient temperature must be below +113 °F (+45 °C).
- Do not expose inverter to direct sunlight.
- In the living area, do not install inverters on a plasterboard wall or similar wall.

  The Sunny Boy may emit noises when in use which can be regarded as a nuisance.



- Adhere to the minimum clearance from the ground and walls, and other devices and objects, so as to guarantee sufficient heat dissipation.

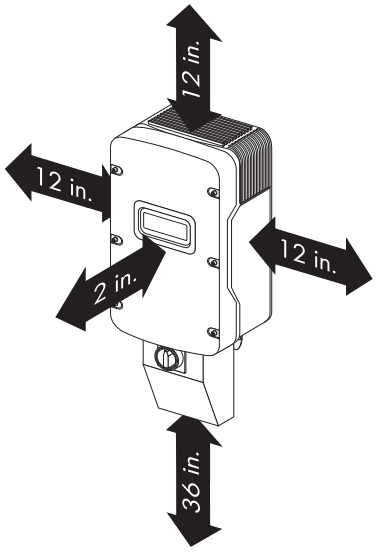
Arrangement of multiple inverters in areas with high ambient temperatures.

The individual inverters must be installed far enough away from each other that they are able to draw in sufficient cooling air.

- For sufficient ventilation, increase the clearances if required.

The *National Electrical Code* may stipulate greater clearances (see *National Electrical Code*, Section 110.26). Installations in Canada must be carried out according to the applicable Canadian standards.

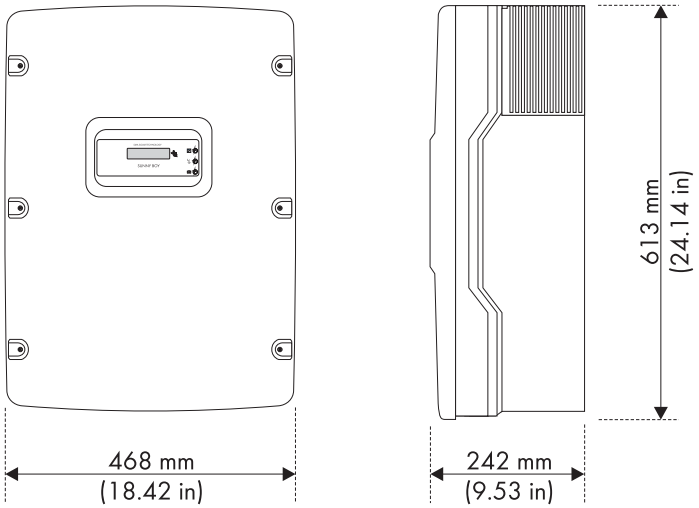
Item	Clearance
Top	12 in. (300 mm)
Bottom	36 in. (900 mm)
Left	12 in. (300 mm)
Right	12 in. (300 mm)
Front	2 in. (50 mm)



If the Sunny Boy is installed outdoors:

- Observe minimum clearance to the ground of 36 in. (900 mm).

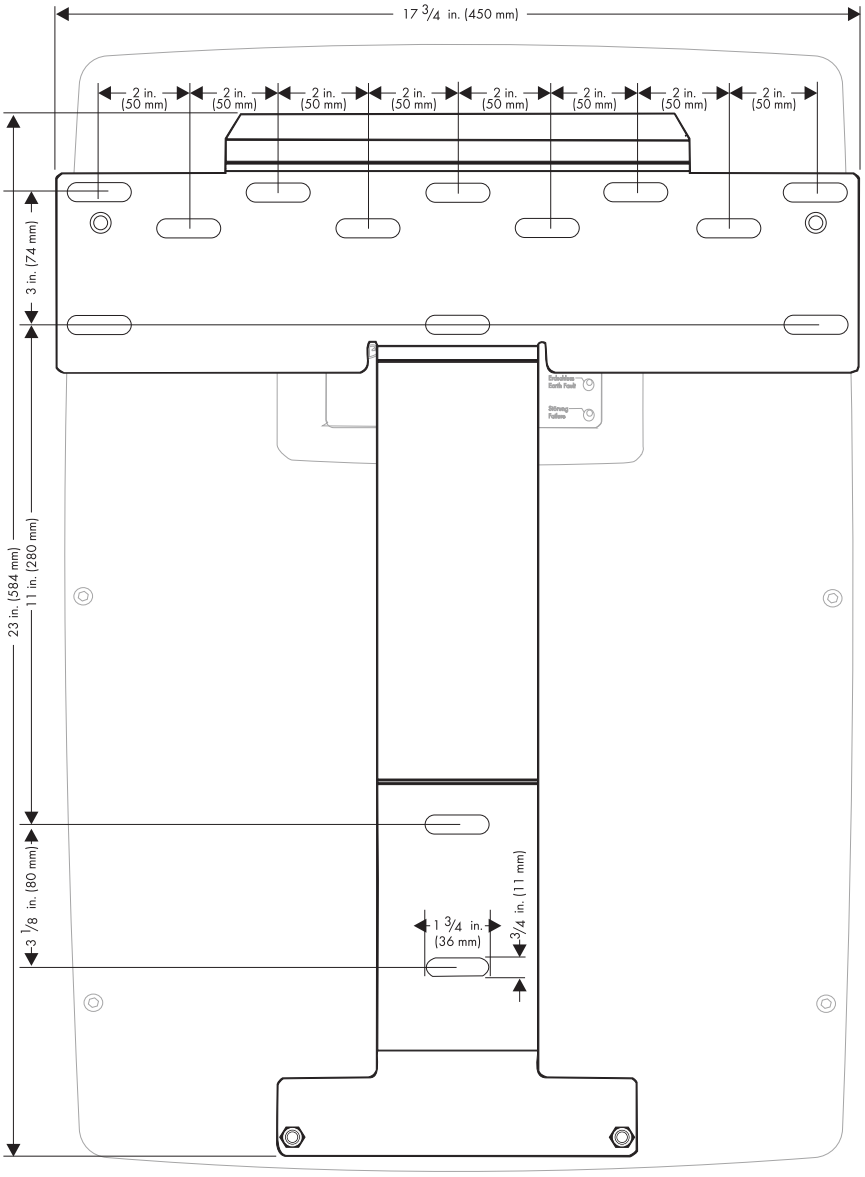
Dimensions of the Sunny Boy



5.3 Mounting with Wall Mounting Bracket

The Sunny Boy is supplied with a T-shaped wall mounting bracket that is suitable for most walls. The wall must be vertical and stable enough to carry a weight of 145 lbs. (67 kg) for a long period of time. For the wall material, use suitable fastening elements no smaller than ¼ in.

Dimensions of the Wall Mounting Bracket



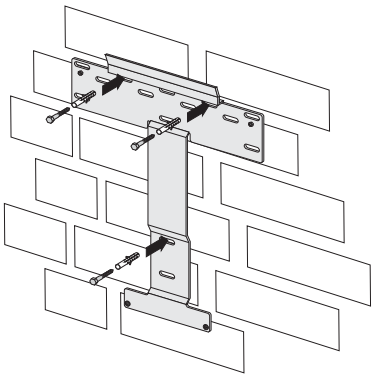
5.3.1 Possibilities for Mounting the Wall Mounting Bracket

Mounting on Stone Wall

Secure wall mounting bracket with at least 3 screws. The position of the screws on the wall mounting bracket is as follows:

- 1 screw on the upper left side.
- 1 screw on the upper right side.
- 1 screw below.

Mount the wall mounting bracket as described in section 5.3.2 "Mounting the Wall Mounting Bracket" (page 31).

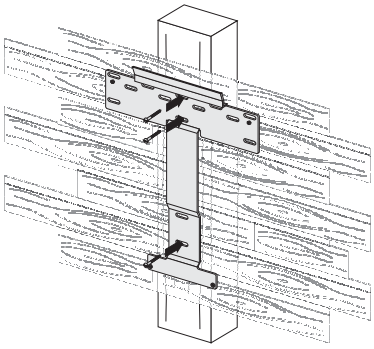


Mounting on a Wooden Wall with a Stud or on a Pillar

Secure the wall mounting bracket with at least 3 screws. The position of the screws on the wall mounting bracket is as follows:

- 2 screws at the upper middle.
- 1 screw below.

Mount the wall mounting bracket as described in section 5.3.2 "Mounting the Wall Mounting Bracket" (page 31).



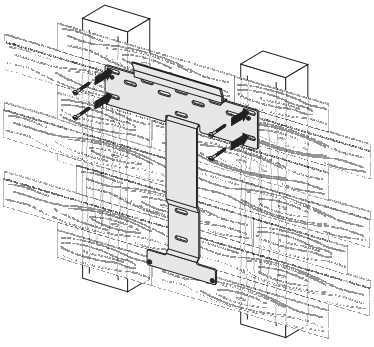
Mounting on a Wooden Wall with two Studs

Secure wall mounting bracket with at least 4 screws. The position of the screws on the wall mounting bracket is as follows:

- 2 screws on the upper left side.
- 2 screws on the upper right side.

Use the four outer mounting holes on the left and right sides of the wall mounting bracket.

Mount the wall mounting bracket as described in section 5.3.2 "Mounting the Wall Mounting Bracket" (page 31).



5.3.2 Mounting the Wall Mounting Bracket

1. Position the wall mounting bracket at the installation location. If possible, select eye level.
2. Align the wall mounting bracket with a spirit level. The bottom end of the wall mounting bracket reaches approximately until the bottom corner of the inverter.

DANGER

Risk of electric shock by drilling into power cables.

Risk of death or serious injury.

- Check mounting location for power cables prior to drilling.

CAUTION

The Sunny Boy may fall over due to its heavy weight.

Risk of bruising and broken bones.

- For installing the inverter on plasterboard or panels, do not use cavity plugs or toggle plugs.
- Studs must be present behind the installation points on plasterboard or panels.

3. Use the wall mounting bracket as a template. Mark at least 3 holes in the horizontal or vertical position of the wall mounting bracket (see section 5.3.1 "Possibilities for Mounting the Wall Mounting Bracket" (page 30)).
4. Remove mounting bracket and drill the holes at the markings.

Information for the installation

The diameter of the bore holes must correspond to the fastening elements that you use for mounting the inverter.

Mounting on a concrete wall:

- The hole diameter must be the same as the outer diameter of the screw anchors.
- Insert suitable screw anchors into the bore holes.

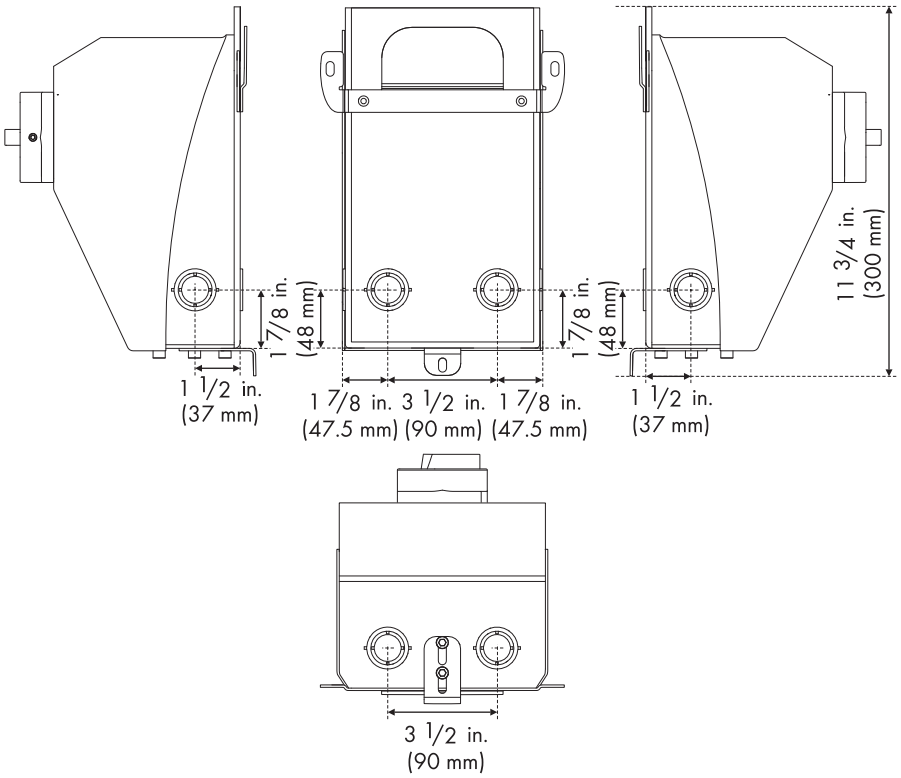
Mounting on a wall with wooden studs:

- The hole diameter must correspond to the screw diameter used. The screws are to be stainless steel. The diameter of the screws must correspond to the diameter of the holes in the wall mounting bracket. The screws must be long enough to reach a depth in the wall of up to 1.5 in.

5. Insert the screws into the bore holes through the holes in the wall mounting bracket.
6. Tighten the screws clockwise until the wall mounting bracket hangs securely on the wall.

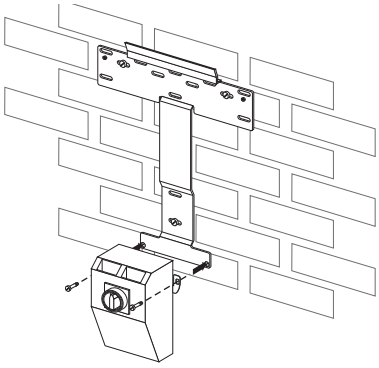
5.3.3 Mounting the SMA DC Disconnect

Dimensions for the DC Disconnect



Attach the SMA DC Disconnect to the two lower holes of the wall mounting bracket, using the two screws and washers provided.

1. Insert screws with washers through the holes of the fastening straps of the DC Disconnect. The teeth of the washers must lie on the fastening straps of the DC Disconnect.
2. Put the SMA DC Disconnect onto the wall mounting bracket.
3. Tighten the screws with a tightening torque of 44 in-lbs. (5 Nm).



5.3.4 Mounting the Sunny Boy on a Wall Mounting Bracket

CAUTION

The Sunny Boy may fall over due to its heavy weight.

Risk of bruising and broken bones.

- When mounting the Sunny Boy, note that it has a weight of 148 lbs. (67 kg).

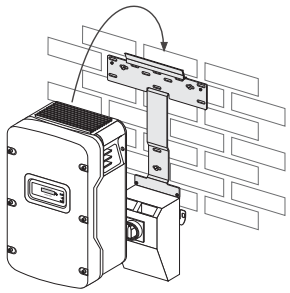
1. Remove the handle covers on the right and left side of the Sunny Boy.

   Move the Sunny Boy up and down onto the side handles (job for 2 people).

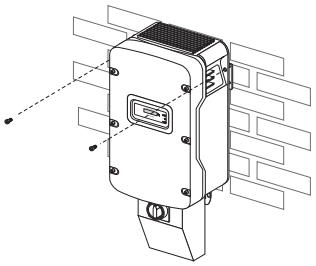
   or

   Feed a steel rod with a maximum diameter of $1\frac{1}{8}$ in. (30 mm) through the enclosure openings at the top. Have two people move the Sunny Boy.

2. Hook the Sunny Boy with the enclosure opening onto the rear panel in the wall mounting bracket. The Sunny Boy must be seated on the middle of the wall mounting bracket.



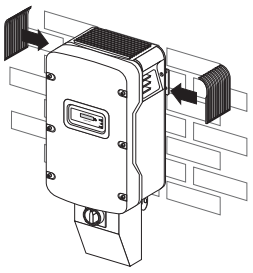
3. Screw the Sunny Boy onto the wall mounting bracket on both sides with the screws supplied.
4. Tighten the screws clockwise with a tightening torque of 44 in-lbs. (5 Nm).



5. Place handle covers on the handles.

   To help you identify the sides, the ventilation grids are labeled "rechts/right" and "links/left" on the inside.

   The ventilation grilles prevent dirt and insects from entering the inverter and can be reordered from SMA if required. See section 12 "Accessories" (page 100).



6 Electrical Connection

DANGER

Danger to life due to high voltages in the DC and AC cables.

Risk of death or serious injury due to electric shock.

- Only qualified personnel may perform work on the inverter.
- Only connect the Sunny Boy in the order stated below.

NOTICE

Ingress of moisture when mounting and installing the Sunny Boy.

Potential damage to the Sunny Boy.

- For the purpose of inserting the cable conduits into the enclosure, use only UL-certified rainproof sleeves or waterproof sleeves that fulfill UL 514B.
- Do not open the Sunny Boy in the event of rain or a high level of humidity (> 95 %).

The seal of the enclosure may become frozen shut due to frost.

Potential damage to the seal when opening the Sunny Boy.

- Do not open the Sunny Boy when the outdoor temperature is below 23 °F (– 5 °C).

NOTICE

Electrostatic discharges from touching component parts.

Potential damage to the Sunny Boy.

- Ground yourself prior to touching a component part.

NOTICE

Ground fault error, unreliable and highly resistive connections due to luster terminals.

Potential damage to or failure of the Sunny Boy.

- Do not use luster terminals.

Electrical Installations

All electrical installations must be carried out according to the applicable electrical standards on site and the *National Electrical Code* ANSI/NFPA 70. Installations in Canada must be carried out according to the applicable Canadian standards.

Before connecting the Sunny Boy to the power distribution grid, contact your local electric utility company. This connection must be made only by qualified personnel.

Inverters that are equipped with a fixed AC output:

The circuits of the AC input and the AC output are isolated from the enclosure. The installer is responsible for grounding the plant according to Section 250 of the *National Electrical Code* ANSI/NFPA 70.

Grounding a PV plant is performed according to the instructions in Sections 690.41 to 690.47 of the National Electrical Code ANSI/NFPA 70 and is the responsibility of the installer. Installation in Canada must be carried out according to the applicable Canadian standards.

AC Grounding

The AC output and the neutral conductor are not bonded to ground (PE).

The Sunny Boy must be connected to the AC ground terminal of the power distribution grid via the ground terminal (PE) (see section 4.2 "Locating Internal Component Parts" (page 19)).

PV Grounding

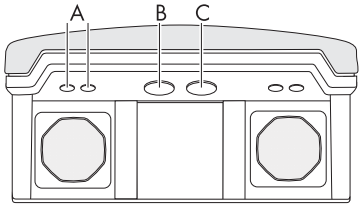
The grounding conductor in the framework of the PV array must be connected to the PV grounding conductor and the DC grounding conductor (see section 4.2 "Locating Internal Component Parts" (page 19)). The cross section of the grounding conductor corresponds to the cross-section of the largest conductor in the DC system.

DC Grounding Conductor

A DC grounding conductor may be required by the Authority Having Jurisdiction (AHJ). Use the terminal block for the PV grounding conductor and DC grounding conductor (see section 4.2 "Locating Internal Component Parts" (page 19)).

6.1 Connection Area of the Sunny Boy

The DC input of the PV array and the output of the AC power distribution grid are connected inside the enclosure. The internal AC and DC terminal blocks are designed for a maximum size of 6 AWG. Suitable enclosure openings are on the underside of the Sunny Boy.



Item	Description
A	$^1/_2$ in. screws for communication cable with filler-plugs
B	$^3/_4$ in. DC opening with double membrane adapter
C	$^3/_4$ in. AC opening with double membrane adapter

NOTICE

Ingress of water due to enclosure openings being too large.

Potential damage to the Sunny Boy.

- Do not increase the size of the enclosure openings. The AC and DC enclosure openings are designed for $^3/_4$ in. cable conduits.

6.1.1 Wiring without SMA DC Disconnect

Procedure and Order

1. Switch off all energy sources. Open all AC and DC disconnect switches and breakers.
2. Wiring from AC breaker to the AC disconnect switch.
3. Wiring from AC disconnect switch to the Sunny Boy.
4. Wiring from the PV lines to the DC Disconnect.
5. Wiring from the DC disconnect switch to the Sunny Boy.
6. Switch on DC switch and breaker.
7. Switch on AC switch and breaker.

Removing Sunny Boy from Wiring

- First, disconnect all AC disconnect switches, then all DC disconnect switches. Disconnect the AC side from the DC side.
- When the Sunny Boy is switched off, remove the wiring in reverse order.

6.1.2 Wiring with SMA DC Disconnect

Procedure and Order

1. Switch off all energy sources. Open all AC and DC disconnect switches and breakers.
2. Wiring from AC breaker to SMA DC Disconnect.
3. AC wiring from SMA DC Disconnect to Sunny Boy.
4. Wiring from PV array to SMA DC Disconnect.
5. DC wiring from SMA DC Disconnect to Sunny Boy.
6. Switch SMA DC Disconnect to position "1".
7. Switch on AC breaker.

Removing Sunny Boy from Wiring

- Disconnect all AC disconnect switches.
- Switch SMA DC Disconnect to position "0".
- Always disconnect the AC side before the DC side.
- When the Sunny Boy is switched off, remove the wiring in reverse order.

6.2 Opening the Sunny Boy

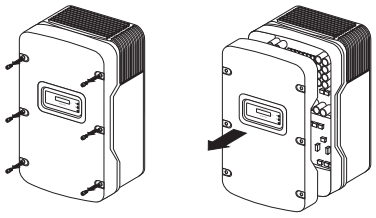
DANGER

High voltages are present in the Sunny Boy during operation.

Death or serious injury due to electric shock.

- Only open the Sunny Boy in the order described as follows.

1. Switch off all AC and DC breakers or switch-disconnectors. Ensure they cannot reconnect accidentally.
2. Wait at least 5 minutes until the residual voltage has been drained.
3. Remove the 6 screws and conical spring washers from the enclosure lid. Pull the lid forward smoothly.



4. Put the cover, screws and washers aside.

NOTICE

There may be an ingress of moisture into the open Sunny Boy.

Potential damage to the Sunny Boy.

- Do not open the Sunny Boy in the event of rain or a high level of humidity (> 95 %).
- Handle the enclosure lid with care.

The seal of the enclosure may become frozen shut due to frost.

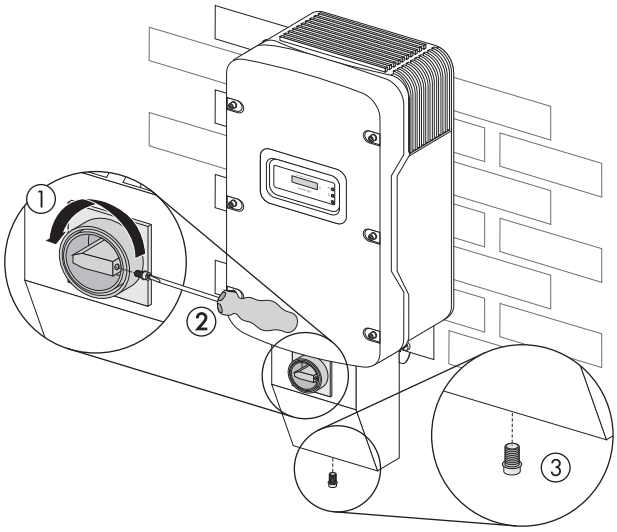
Potential damage to the seal when opening the Sunny Boy.

- Do not open the Sunny Boy when the outdoor temperature is below 23 °F (− 5 °C).

☑ The Sunny Boy is open.

6.3 Opening the SMA DC Disconnect

1. Switch the SMA DC Disconnect to "0".

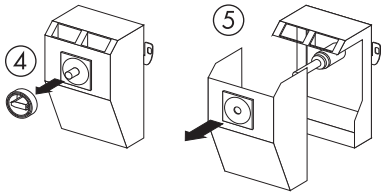


2. Loosen the screws in the right area of the SMA DC Disconnect. Use a cross-head screwdriver (screw used: UNC no. $5x^3/_4$ in., cross-head, flat-head, metal).

Do not fully remove the screws.

- If the knob of the SMA DC Disconnect cannot be removed, loosen the screw further.

3. Remove the screws and the washer of the cover on the underside of the SMA DC Disconnect.
4. Remove the knob.
5. Remove the cover of the SMA DC Disconnect:
   - Pull the cover on the underside forward.
   - In the process, simultaneously remove it from the enclosure.



☑ The SMA DC Disconnect is open.

6.4 AC Connection

CAUTION

Risk of fire

Risk of cable fire due to overcurrent.

- The electrical installation must include overcurrent protection for the AC output circuit.
- Set up the overcurrent protection for 50 A maximum.

Carry out all electrical installations according to all of the applicable on site electrical standards and the *National Electrical Code*® (NE, ANSI/NFPA 70).

See *National Electrical Code*, Section 690-64(b) (2).

For installations in Canada, observe the applicable Canadian standards.

6.4.1 AC Connection Requirements

For all AC cable connections to the Sunny Boy, use a max. 6 AWG copper wire that is designed for +194 °F (+90 °C) – even if voltage drop and other considerations mean that the use of larger cable cross sections is required. Use only cables made of solid wire or rough-wire strands. Do not use fine-wire strands.

6.4.2 AC Connection without SMA DC Disconnect

If you replace an existing inverter

- In the switchbox, disconnect the cables for the AC line on which you are working.

1. Switch off the main switch in the main switchbox.
2. Remove the internal switchboard cover.
3. Install a $^{3}/_{4}$ in. cable gland in the enclosure opening for the AC cables of the Sunny Boy. Observe section 6.2 "Opening the Sunny Boy" (page 38).
4. Between the main switchbox and the breakout opening for the AC cables, install a $^{3}/_{4}$ in. cable conduit.
5. Pull the AC cables from the switchbox through the cable conduit into the Sunny Boy.
6. Connect the AC device grounding conductor to the PE terminal labeled ⏚ in the Sunny Boy.

Do not connect the Sunny Boy 8000-US to a 208 V grid.

208 V and 240 V System Configuration:

7. Connect conductor L1 (AC conductor 1 or UNGROUNDED) to terminal L1.
8. Connect conductor L2 (AC conductor 2) to terminal L2.
9. Connect conductor N (AC conductor N) to terminal N.

When using grounded 240 V or 208 V Delta grids:

- Connect terminal L2 to the grounded phase.

277 V System Configuration:

10. Connect conductor L1 (AC conductor 1 or UNGROUNDED) to terminal L1.
11. Do not use terminal L2.
12. Connect conductor N (AC conductor N) to terminal N.

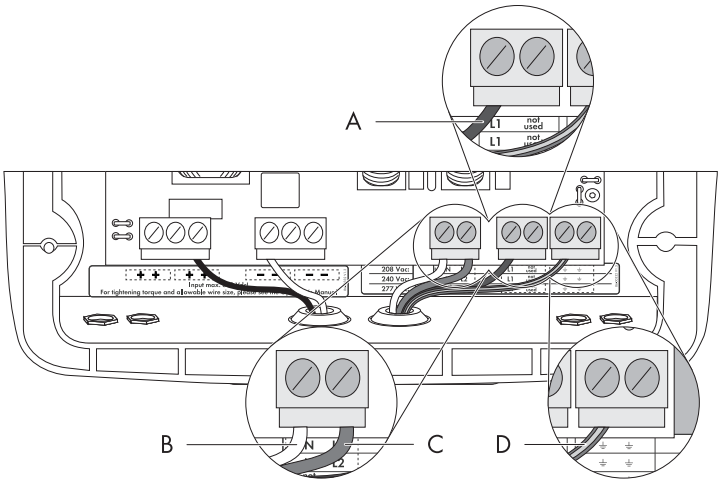
Open terminal fully before feeding through the cables.

13. Tighten the AC terminal blocks in the inverter with the following torques:

Gray terminal blocks (Weidmüller)	10 ... 6 AWG: 18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	8 ... 6 AWG: 40 in-lbs. (4.5 Nm)
	10 AWG: 2 in-lbs. (2.5 Nm)

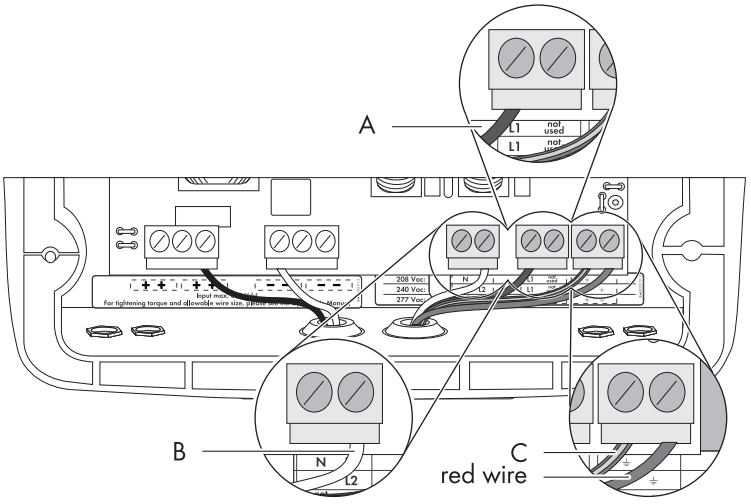
14. Check that all terminals have the correct wiring and that the cables are secure.

AC Connection Terminals for 208 V (not for Sunny Boy 8000-US) and 240 V



Item	Description
A	Conductor L1 connected to terminal L1
B	Conductor N connected to terminal N
C	Conductor L2 connected to terminal L2
D	Device grounding conductor connected to PE terminal

AC Connection Terminals for 277 V



Item	Description
A	Conductor L1 connected to terminal L1
B	Conductor N connected to terminal N
C	Device grounding conductor connected to PE terminal

6.4.3 AC Wiring with SMA DC Disconnect

If you replace an existing inverter

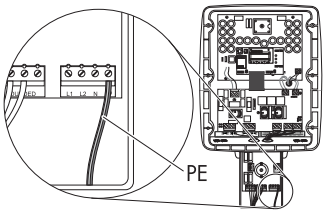
- In the switchbox, disconnect the cables for the AC line on which you are working.

Connecting the AC cables in the DC Disconnect

1. Switch off the main switch in the main switchbox.
2. Remove the internal switchboard cover.
3. Install a $^{3}/_{4}$ in. cable gland in the breakout opening for the AC cables of the SMA DC Disconnect.
4. Between the main switchbox and the breakout opening for the AC cables of the SMA DC Disconnect, install a $^{3}/_{4}$ in. cable conduit.
5. Pull the AC cables from the switchbox through the cable conduit into the SMA DC Disconnect.

Open terminals fully before feeding through the cables.

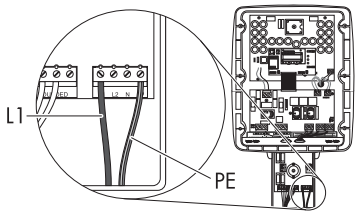
6. Connect the AC device grounding conductor to the PE terminal labeled ⏚ in the SMA DC Disconnect.



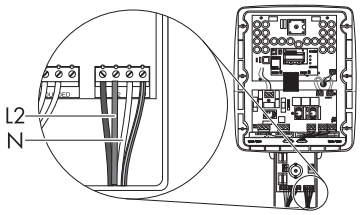
208 V and 240 V System Configuration:

Do not connect the Sunny Boy 8000-US to a 208 V grid.

7. Connect conductor L1 (AC conductor 1 or UNGROUNDED) to terminal L1.



8. Connect conductor L2 (AC conductor 2) to terminal L2.
9. Connect conductor N (AC conductor N) to terminal N.

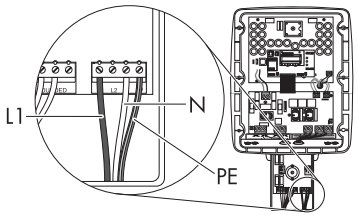


When using grounded 240 V or 208 V Delta grids:

- Connect terminal L2 to the grounded phase.

277 V System Configuration:

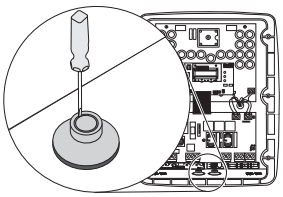
10. Connect L1 (AC conductor 1 or UNGROUNDED) to terminal L1. Do not use terminal L2.
11. Connect conductor N (AC conductor N) to terminal N.



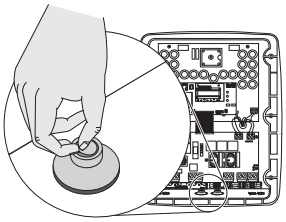
12. Tighten the cables with a torque of 15 in-lbs. (1.7 Nm).
13. Check that all terminals have the correct wiring and that the cables are secure.

Connecting the AC Cables in the Sunny Boy

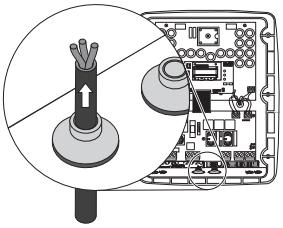
14. Using a screwdriver, make a hole in the rubber grommet in the inverter.



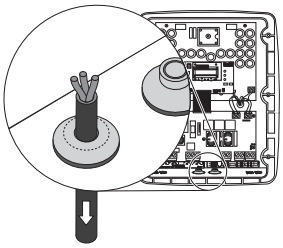
15. Remove the rubber membrane.



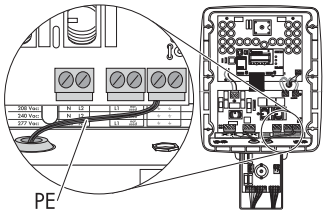
16. Feed the cable through the rubber grommet into the inverter.



17. Pull the cable back slightly so as to seal the rubber grommet.



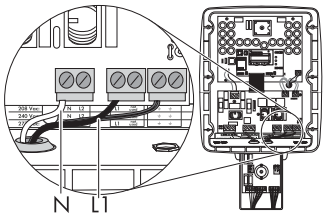
18. Connect the green-yellow cable of the SMA DC Disconnect to the terminal labeled ⏚.



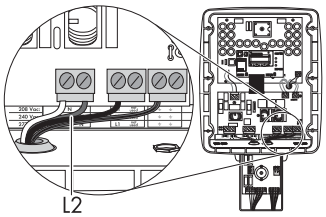
208 V and 240 V System Configuration

Do not connect the Sunny Boy 8000-US to a 208 V grid.

19. Connect the white cable of the SMA DC Disconnect to the terminal labeled N. Connect the black cable of the SMA DC Disconnect to the terminal labeled L1.

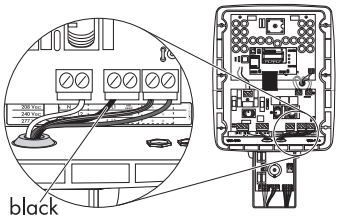


20. Connect the red insulated conductor to the terminal labeled L2.



277 V System Configuration

21. Connect the white cable of the SMA DC Disconnect to the terminal labeled N. Connect the black insulated conductor of the SMA DC Disconnect to the terminal labeled L1.
22. Connect the red insulated conductor to the terminal labeled ⏚.



23. Tighten the AC terminal blocks in the inverter with the following torques:

Gray terminal blocks (Weidmüller)	10 ... 6 AWG: 18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	8 ... 6 AWG: 40 in-lbs. (4.5 Nm)
	10 AWG: 2 in-lbs. (2.5 Nm)

24. Check that all terminals have the correct wiring and that the cables are secure.

6.5 DC Wiring

DANGER

High voltages in PV modules exposed to light.

Risk of death due to electric shock from touching a DC conductor.

- During installation, cover the PV modules with opaque material.

DANGER

High voltages in the DC cables.

Risk of death or serious injury from touching a DC cable.

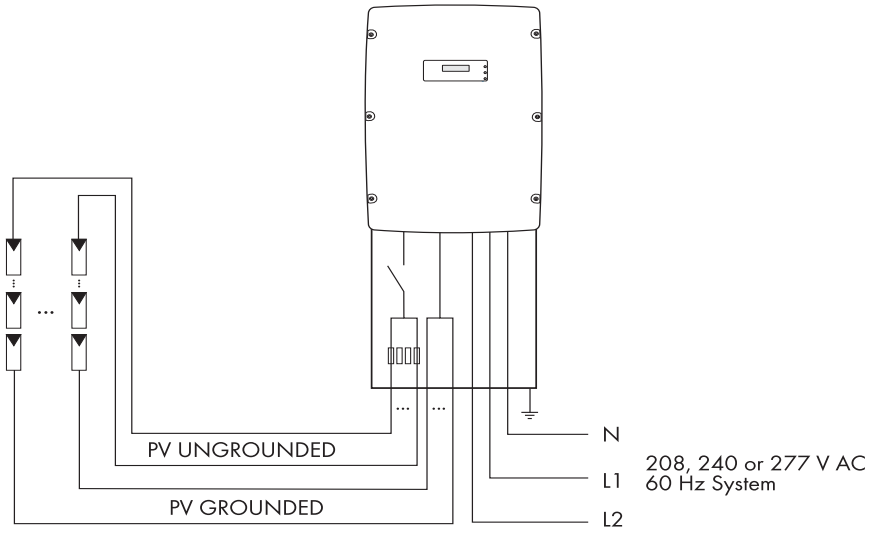
- Only connect the DC cable from the PV module to the inverter as described in this manual.

NOTICE

Potential damage to the inverter due to overvoltage.

- The DC input voltage of the PV modules must not exceed the maximum values of the inverter. Observe the information on the type label.
- Check the polarity and the open-circuit voltage of the PV strings before connecting the DC cables to the inverter.
- Configure the DC input voltage range accordingly before connecting the PV modules to the inverter.Use "Sunny Design" on www.SMA-America.com for string configuration.

Simplified Circuit Diagram of a PV Plant



6.5.1 DC Connection Requirements

Line Sizing

All electrical installations must be carried out according to all of the applicable on site electrical standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1 and the applicable standards in Canada.

When selecting the cable type and the line cross section, observe the following requirements depending on the type of installation:

- For all DC copper wire cable connections, use size 10 ... 6 AWG (6 ... 16 mm²), which is designed for +194 °F (+90 °C).
- Use only solid wire or rough wire strands. Do not use fine-wire strands.

Correct String Configuration

- Use "Sunny Design" on www.SMA-America.com for string configuration.

Fuses

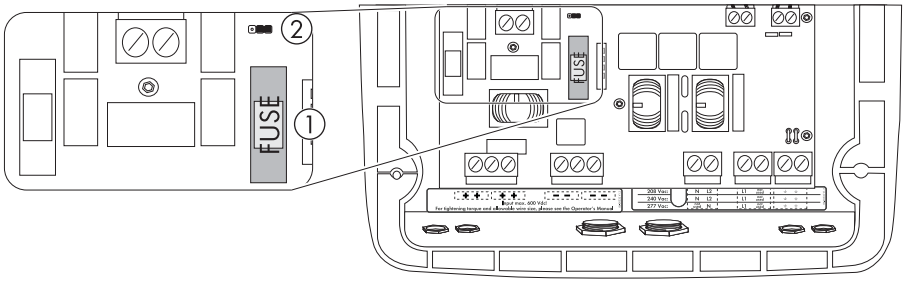
The DC disconnect for the inverter must have a minimum rating of 600 V DC and 36 A continuous. The SMA DC Disconnect is supplied with 4 fuses (one fuse per string) designed for 15 A and 600 V DC. The 4 fuses of the SMA DC Disconnect may be used for a maximum of 20 A and 600 V DC.

Depending on the type of the PV module and its interconnection in the plant, fuses connected in series may be required. When dimensioning the fuses, observe the *National Electrical Code*® 690.8 and 690.9.

6.5.2 DC Input Grounding

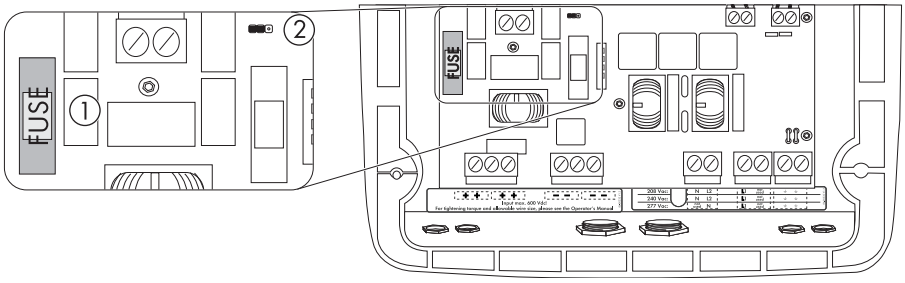
The Sunny Boy configured ex works for plants with negative generator grounding. Certain types of PV modules may make it necessary to ground the negative pole rather than the positive pole.

Position of the GFDI Fuse and the Jumper During Negative Grounding



1. Insert the fuse in position (1).
2. Insert the jumper in position (2).

Position of the GFDI Fuse and the Jumpers During Positive Grounding

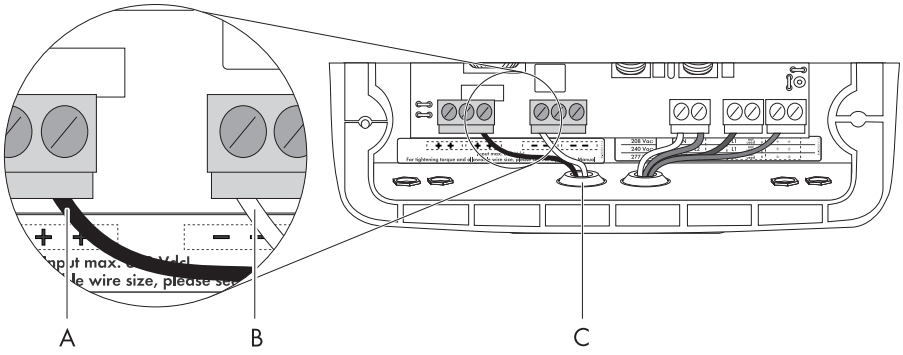


1. Insert the fuse in position (1).
2. Insert the jumper in position (2).

6.5.3 DC Wiring without SMA DC Disconnect

Use the following procedure to connect the DC cables to the Sunny Boy without SMA DC Disconnect:

1. Open the AC breaker and secure against turning on again.
2. Open the DC disconnect switch and secure against turning on again.
3. Install a $^{3}/_{4}$ in. cable gland in the opening for the DC cables. Observe section 6.2 "Opening the Sunny Boy" (page 38) and the following figure. Secure the cable gland to the inner side of the Sunny Boy with the matching locknut.
4. Install a $^{3}/_{4}$ in. cable conduit between the enclosure of the DC disconnect switch and the breakout opening for DC cables on the Sunny Boy.
5. For steps 6 to 8, note the following figure.



Item	Description
A	Positive DC cable connected to DC+
B	Negative DC cable connected to DC–
C	DC enclosure opening

6. Pull the DC cables from the DC disconnect switch through the cable conduit and inside the Sunny Boy.
7. Connect the positive DC cable to the terminal in the Sunny Boy labeled DC+.
8. Connect the negative DC cable to the terminal in the Sunny Boy labeled DC − .

The Sunny Boy has provisions for up to 3 PV strings. The positive and negative terminal blocks each have 3 connection points. This means that 3 pairs of DC input cables can be connected in parallel.

Fully open the terminal before feeding through the cables.

9. Connect the positive and negative DC cables to the terminals provided in the enclosure of the DC disconnect switch.

10. Connect the DC device grounding conductor to the PE terminal labeled ⏚ in the Sunny Boy.
11. Tighten all cables in the AC and DC terminal blocks in the Sunny Boy:

Gray terminal blocks (Weidmüller)	10 ... 6 AWG: 18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	8 ... 6 AWG: 40 in-lbs. (4.5 Nm)
	10 AWG: 2 in-lbs. (2.5 Nm)

12. Check whether all connections are correctly wired. Carry out a tensile test to see whether all cables are tight.

6.5.4 DC Wiring with SMA DC Disconnect

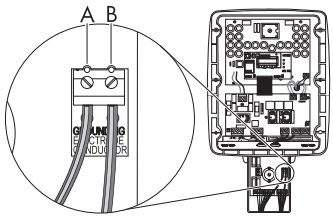
Fully open the terminal before feeding through the cables.

Observe the following procedure to connect the DC cables to the Sunny Boy with SMA DC Disconnect:

1. Open the AC breaker and secure against turning on again.
2. Install a $^{3}/_{4}$ in. cable gland in the breakout opening for the DC cables of the SMA DC Disconnect. The breakout opening is on the left side of the SMA DC Disconnect. Secure the cable gland to the inner side of the SMA DC Disconnect with the matching locknut.
3. Install a $^{3}/_{4}$ in. cable conduit between the enclosure of the DC disconnect switch and the breakout opening for DC cables on the SMA DC Disconnect.
4. Pull the DC cables, the grounding cables of the PV array and the grounding conductor through the cable conduit and inside the SMA DC Disconnect.

The SMA DC Disconnect has provisions for up to 4 PV strings. The terminal blocks PV UNGROUNDED and PV GROUNDED each have 4 connection points. This means that 4 pairs of DC input cables can be connected in parallel.

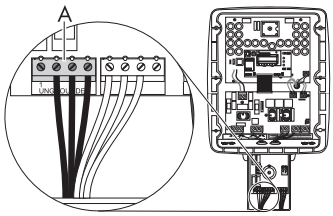
5. Connect the grounding cable of the PV array to the terminal (A) for the grounding conductor.
6. Connect the grounding conductor to the terminal (B) for the grounding conductor.



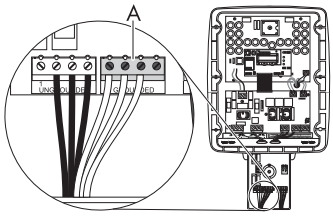
Negative Grounding

In order to check whether your inverter is grounded as intended, please observe section 6.5.2 "DC Input Grounding" (page 49).

7. Connect the positive DC cables to the terminal (A) labeled PV UNGROUNDED in the SMA DC Disconnect.

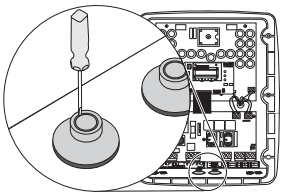


8. Connect the negative DC cables to the terminal (A) labeled PV GROUNDED in the SMA DC Disconnect.

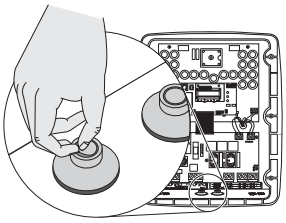


9. Tighten all cables in the terminal blocks in the SMA DC Disconnect with a torque of 15 in-. . . (1.7 Nm).

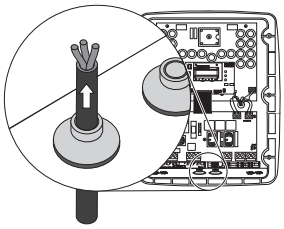
10. Using a screwdriver, make a hole in the left sealing grommet.



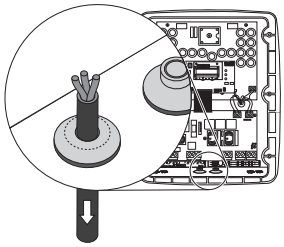
11. Remove the rubber membrane.



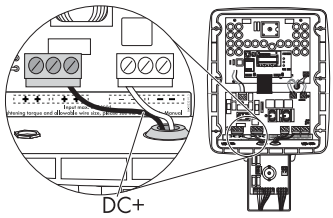
12. Pull the DC cables from the SMA DC Disconnect inside the Sunny Boy.



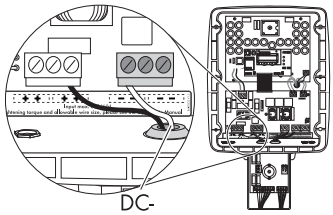
13. Pull the cable back slightly so as to seal the sealing grommet.



14. Connect the black cable (PV UNGROUNDED) to the terminal labeled DC+ in the Sunny Boy.



15. Connect the white cable (PV GROUNDED) to the terminal labeled DC − in the Sunny Boy.



16. Tighten all cables in the AC and DC terminal blocks in the Sunny Boy:

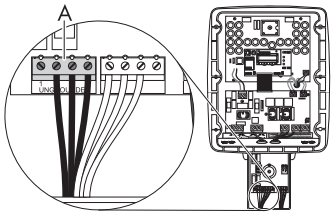
Gray terminal blocks (Weidmüller)	10 ... 6 AWG: 18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	8 ... 6 AWG: 40 in-lbs. (4.5 Nm)
	10 AWG: 2 in-lbs. (2.5 Nm)

17. Check whether all connections are correctly wired. Carry out a tensile test to see whether all cables are tight.

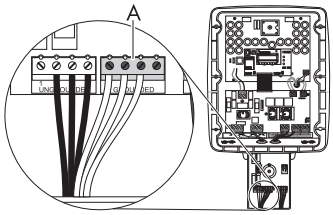
Positive grounding

In order to check whether your inverter is grounded as intended, please observe section 6.5.2 "DC Input Grounding" (page 49).

1. Connect the negative DC cable to the terminal labeled PV UNGROUNDED (A) in the SMA DC Disconnect.

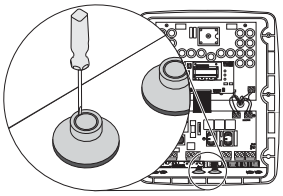


2. Connect the positive DC cable to the terminal labeled PV GROUNDED (A) in the SMA DC Disconnect.

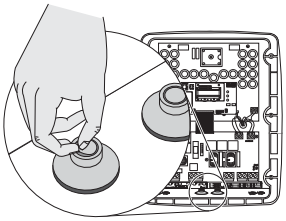


3. Tighten all cables in the terminal blocks in the SMA DC Disconnect with a torque of 15 in-. . (1.7 Nm).

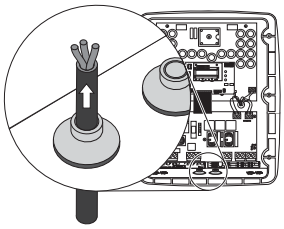
4. Using a screwdriver, make a hole in the left sealing grommet.



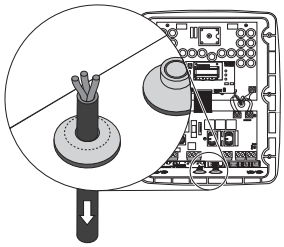
5. Remove the rubber membrane.



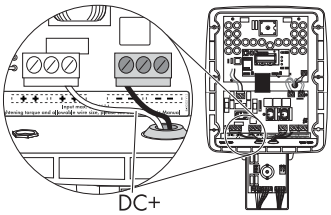
6. Pull the DC cables from the SMA DC Disconnect inside the Sunny Boy.



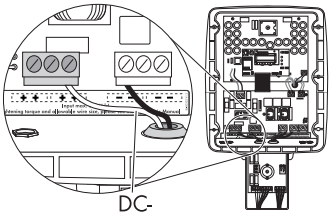
7. Pull the cable back slightly so as to seal the sealing grommet.



8. Connect the white cable (PV GROUNDED) to the terminal labeled DC+ in the Sunny Boy.



9. Connect the black cable (PV UNGROUNDED) to the terminal labeled DC – in the Sunny Boy.



10. Tighten all cables in the AC and DC terminal blocks in the SMA DC Disconnect:

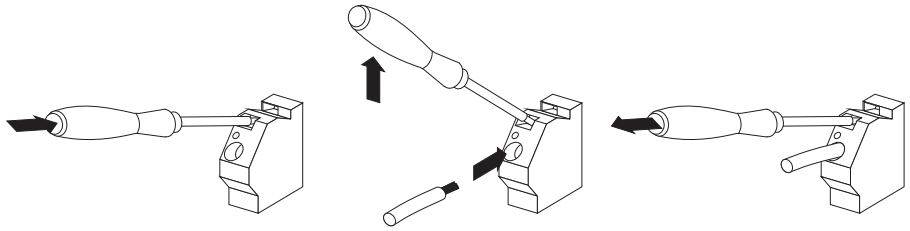
Gray terminal blocks (Weidmüller)	10 ... 6 AWG: 18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	8 ... 6 AWG: 40 in-lbs. (4.5 Nm)
	10 AWG: 2 in-lbs. (2.5 Nm)

11. Check whether all connections are correctly wired. Carry out a tensile test to see whether all cables are tight.

6.5.5 DC Connection with Additional DC Distribution

For a parallel connection of more than 1 string in front of the integrated DC Disconnect, use the COMBINED terminal on the non-grounded side.

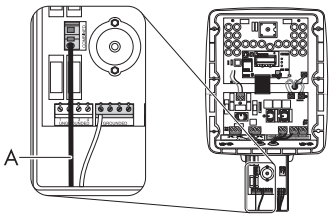
Using the Spring Terminal Labeled COMBINED



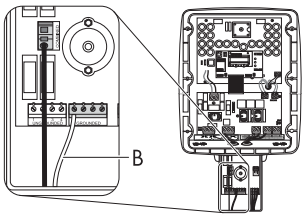
1. Insert an insulated screwdriver into the slot in the spring terminal provided.
2. Press the screwdriver upward.
   ☑ The spring clamp terminal is open.
3. Feed the stripped cable into the spring clamp terminal.
4. Pull the screwdriver back into its original position.
5. Remove the screwdriver.
   ☑ The spring clamp terminal is closed and the cable is fixed.
6. Pull on the cable to check whether it is secure.

DC Connection with Additional DC Distribution, Negative Grounding

1. Connect the positive DC cable to the terminal (A) labeled COMBINED in the SMA DC Disconnect.



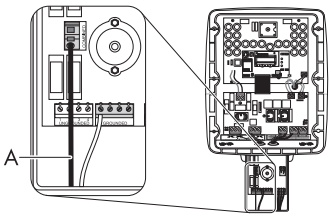
2. Connect the negative DC cable (B) to the terminal labeled PV GROUNDED in the SMA DC Disconnect.



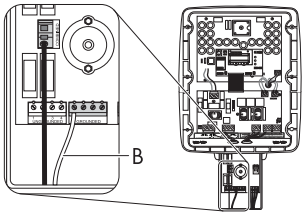
3. Tighten all cables in the terminal blocks in the SMA DC Disconnect with a torque of 15 in-lbs (1.7 Nm).

DC Connection with Additional DC Distribution, Positive Grounding

1. Connect the negative DC cable to the terminal (A) labeled COMBINED in the SMA DC Disconnect.



2. Connect the positive DC cable to the terminal (B) labeled PV GROUNDED in the SMA DC Disconnect.



3. Tighten all cables in the terminal blocks in the SMA DC Disconnect with a torque of 15 in-. . (1.7 Nm).

6.6 Communication

The Sunny Boy can be retrofitted with a communication interface (for slot, see section 4.2 "Locating Internal Component Parts" (page 19)). As a result of this, the Sunny Boy can communicate with special data capture devices (e.g. Sunny WebBox) or a PC with corresponding software (e.g. Sunny Data).

You can find a complete list of all applicable options for communication at www.SMA-America.com or in the product catalog.

In the documentation of the communication interface, you can find a detailed electrical circuit diagram and information on usage.

6.7 Closing the Sunny Boy

Observe the following procedures for mounting the enclosure lid onto the Sunny Boy:

DANGER

Electric shock from touching the non-grounded enclosure lid.

Risk of death or serious injury.

- For the grounding of the enclosure lid, the toothing of the tooth lock washers must point toward the enclosure lid.
- Use all 6 screws with conical spring washers to secure the enclosure lid.

CAUTION

Damage to the enclosure lid may affect the seal between the enclosure lid and the enclosure.

There may be an ingress of moisture.

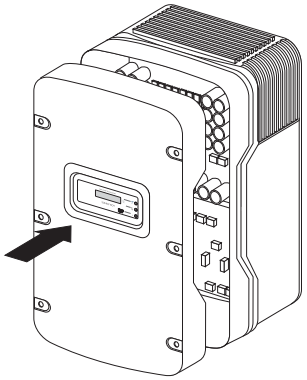
Potential damage to the Sunny Boy.

- Handle the enclosure lid with care.
- Check the seal on the inner side of the enclosure lid for damage.
- When closing, no moisture may remain in the enclosure.

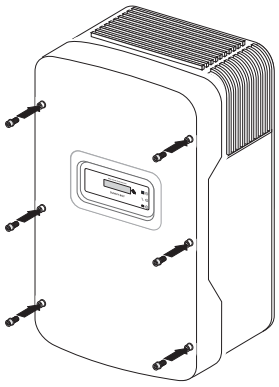
1. Mount the enclosure lid onto the Sunny Boy. The 6 holes in the cover must flow into the enclosure with the 6 thread bores.

Check the line routing.

Cables must not obstruct the seal of the enclosure lid. The enclosure lid must not exert any pressure on the connections.



2. Hold the enclosure lid. Tighten the 6 screws with the conical spring washers through the holes in the enclosure lid into the threaded bores of the enclosure.



The toothing of the conical spring washers must point toward the enclosure lid.

Do not damage the thread of the screws.

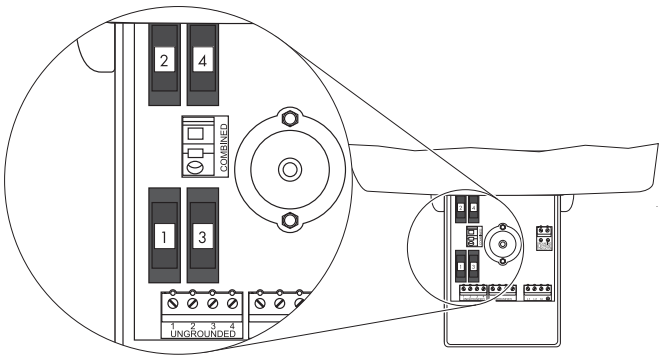
Do not use electric tools to tighten the screws.

3. Check whether the enclosure lid is laying evenly on the enclosure.
4. Tighten the 6 screws with 53 in-lbs. (6 Nm).

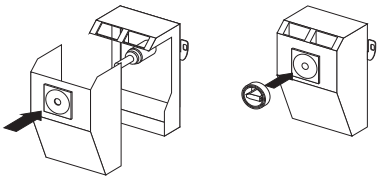
All fastening elements are required for the grounding and weatherproof sealing of the Sunny Boy. To fasten the enclosure lid, use all 6 screws with conical spring washers.

6.8 Closing the SMA DC Disconnect

All string fuses must be securely mounted.

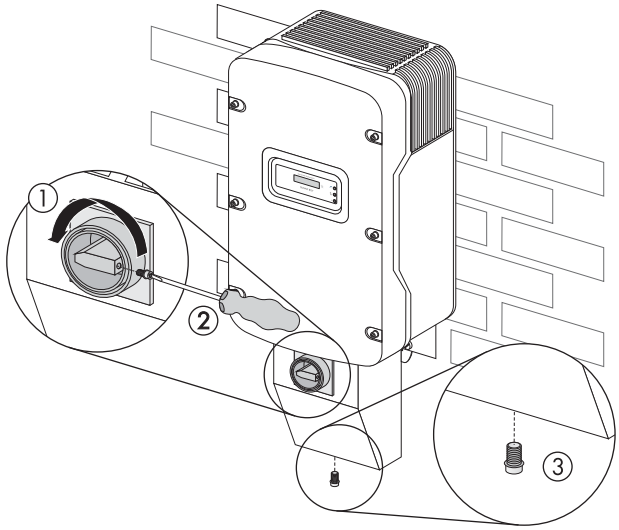


1. Mount the cover onto the SMA DC Disconnect and insert the rotary handle.
2. Turn the rotary handle to position "0". Tighten the screw on the right side of the rotary handle. Use a cross-head screwdriver (screw used: UNC no. 5x$^{3}/_{4}$ in. cross-head, flat-head).



3. Insert the screw and conical spring washer of the SMA DC Disconnect into the underside. Tighten the screw with a torque of 44 in-lbs. (5 Nm).

The toothing of the conical spring washer must point toward the cover for the SMA DC Disconnect to be grounded.



7 Commissioning

All Sunny Boy inverters have a system for detecting ground fault errors in the PV array (GFDI) according to the *National Electrical Code* 690.5.

The PV array is operated in a grounded configuration. Depending on the plant type, the negative or positive conductor of the PV array is connected to the grounding system in the Sunny Boy. According to UL 1741, the GFDI protection is always active when sufficient DC voltage is present to switch on the LC display in the Sunny Boy.

DANGER

High voltages in the PV plant when exposed to sunlight.

Risk of death or serious injuries due to incorrect commissioning.

- Only commission the Sunny Boy in the following order described.
- Never insert the GFDI fuse into the Sunny Boy without a fuse holder.

1. Remove all covers from the PV array.
2. Switch on the AC main conductor breaker.
3. Turn the SMA DC Disconnect to position "1" **or** switch on the external DC disconnect switch.

☑ If there is sufficient sunlight: The Sunny Boy goes into "Wait" mode and the green LED flashes. "Wait" mode ends after 10 seconds. The green LED lights up permanently and the Sunny Boy feeds into the power distribution grid. **or**

☑ The Sunny Boy waits for 5 minutes before feeding into the power distribution grid.

If the feed-in to the power distribution grid was interrupted and then resumed, the inverter always waits 5 minutes before feeding in.

If the inverter is not able to feed into power distribution grid three times in a row, it waits 10 minutes before the next attempt.

This interruption can be caused not only by an AC fault being detected, but it can also be caused manually.

In the event of inverter inspection:

- First, disconnect the DC side.
- Switch off the Sunny Boy, then disconnect the AC side.

The Sunny Boy automatically begins feeding power into the power distribution grid if there is sufficient solar irradiation and the resulting PV input voltage is larger than 300 V DC (for the Sunny Boy 8000-US 365 V DC).

If the Sunny Boy does not begin operation:

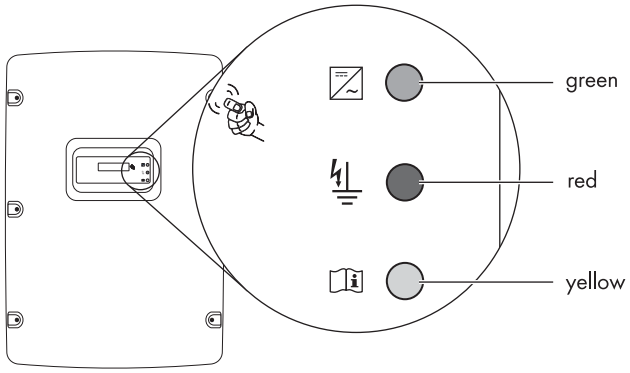
Observe section 8 "Displays and Messages" (page 62) and section 9 "Troubleshooting" (page 77).

If there is a ground fault in the PV array, the message "EarthCurrentMax" will be displayed and the GFDI fuse will clear.

- If this message is displayed, switch off the DC and AC disconnect switches to the inverter and troubleshoot the PV array.

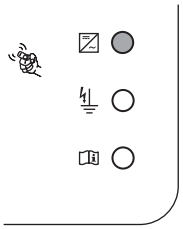
8 Displays and Messages

The Sunny Boy LED Status Indicators



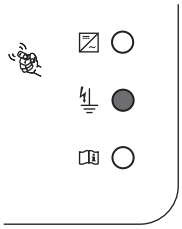
Each Sunny Boy inverter is equipped with three LED status indicators that display the operating mode of the inverter.

The green LED indicates standard operation of the inverter.



The red LED indicates the status of the GFDI fuse, located inside the Sunny Boy. If this LED lights up, the GFDI fuse has cleared or is not present.

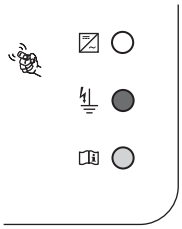
The inverter does not feed into the power distribution grid.



The yellow LED indicates that there is a fault in either the inverter or the PV plant. The inverter will not operate until the fault has been corrected.

The possible error messages and causes are explained later in this section and in section 9 "Troubleshooting" (page 77).

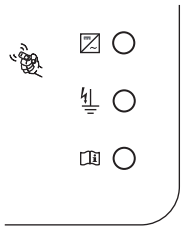
The red and yellow LEDs combined indicate that the inverter has detected a ground fault. The ground fault must be located and cleared and the inverter reset manually. The inverter will not restart automatically after detecting a ground fault. The ground fault may also trip the GFDI fuse.



In turbine mode, all GFDI fuses are suspended.

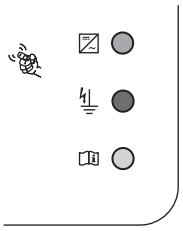
8.1 LED Operation Indicators

Standby (night)



The inverter is in standby mode. The input voltage is too low for operation.

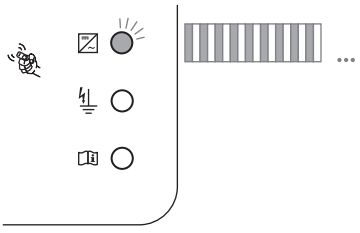
Initialization



The inverter initializes. The power from the PV array is sufficient to initialize the control current. However, it is not sufficient for standard operation. Data transmission is not possible during initialization.

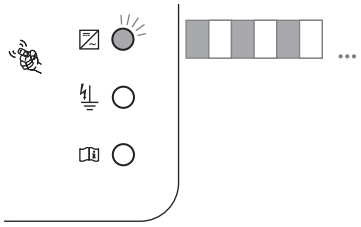
In the event of inclement weather or low solar irradiation, all LEDs may simultaneously light up and then go out again. This is not a disturbance. The inverter is attempting to initialize. The power available from the PV array is not sufficient for standard operation.

Start



The inverter calibrates the internal systems. The power available from the PV array is not sufficient for standard operation. The calibration lasts 10 seconds and the inverter records standard operation. The inverter also displays this status if it has manually been set to STOP mode. For the duration of the parameter setting, the actual PV voltage P-Start must be lower than the set PV-Start voltage (see section 9 "Troubleshooting" (page 77)).

Waiting

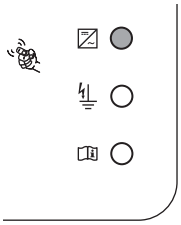


The inverter checks the grid requirements and whether enough voltage from the generator is available to feed into the power distribution grid.

If the feed-in to the power distribution grid was interrupted and then resumed, the inverter always waits 5 minutes before feeding in.

If the inverter is not able to feed into power distribution grid three times in a row, it waits 10 minutes before the next attempt.

Standard Operation



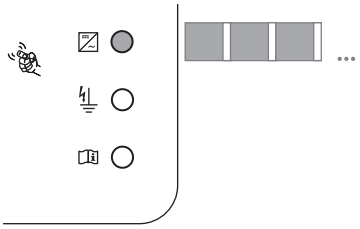
The inverter feeds into the power distribution grid in either "MPP", "Constant Voltage" or "Turbine" mode.

"MPP" mode: The Sunny Boy adjusts the voltage and the power from the PV array in order to receive the highest possible PV output power.

"Constant Voltage" mode: The generator voltage is set to a fixed value by the user. This value is set using the Sunny Boy Control or the Sunny Data Software. The parameter designation is "V- . . . . . mode is suitable for using the inverter with fuel cells or small hydroelectric power plants.

"Turbine" mode: This mode is suitable for using the inverter with a rectified DC generator and dynamic power characteristic curve. The inverter can be adjusted to the form and the increase of the power characteristic curve of a specific generator. A small wind power plant is a suitable generator for this.

Derating



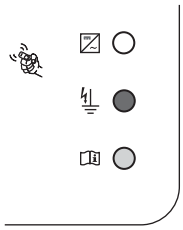
The Sunny Boy can be operated with rated output power at an ambient temperature of up to +113 °F (+45 °C). The Sunny Boy does remain operational at temperatures above +113 °F (+45 °C), but it reduces the level of performance so as to protect the internal component parts from overheating.

Unwanted derating due to blocked fan inlets.

Clean the fan inlets regularly.

8.2 LED Fault Indicators

Ground Fault

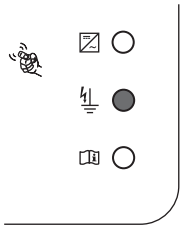


There is a ground fault in the PV plant. The inverter has disconnected from the grid. The ground fault must be located and rectified before inverter operation can be resumed. The inverter will not restart automatically.

Observe section 9 "Troubleshooting" (page 77) for information on rectifying ground fault errors in the PV array.

In "Turbine" mode, all GFDI fuses are deactivated.

Cleared GFDI Fuse



The GFDI fuse was cleared or is not present. This fuse protects the PV plant if a ground fault is present in the PV array.

Check the PV array for ground fault errors before replacing this fuse. It is located in the fuse holder on the inverter board.

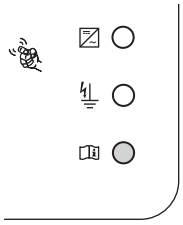
CAUTION

Risk of fire due to incorrectly dimensioned fuse.

Risk of injury due to fire.

- Only replace faulty fuses with fuses of the same type and size.
- The Sunny Boy is shipped with a Littelfuse KLKD 1 Amp, 600 V AC/DC type fuse.

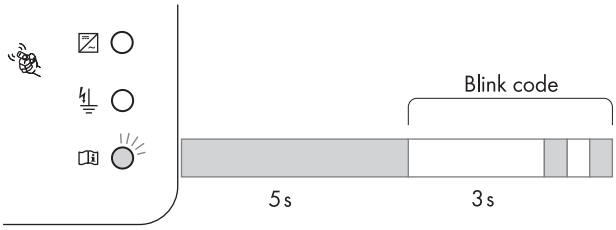
Control System Fault



The yellow LED is continuously lit up. The Sunny Boy has detected a fault within the internal monitoring system.

If the inverter detects this kind of fault, it will no longer feed into the power distribution grid. The inverter must be maintained by a qualified service technician. Contact SMA.

Grid Failure



The yellow LED lights up for 5 seconds, goes out for 3 seconds, then flashes 2 times. This sequence is repeated 3 times. As long as a grid failure continues to be present, this flashing code will repeat itself.

The flashing code can be caused by one of the following conditions:

- Grid undervoltage (< Vac Min).
- Grid overvoltage (> Vac Max).
- Grid underfrequency (< fac Min).
- Grid overfrequency (> fac Max).
- Sudden change in the power frequency or the grid voltage.

DANGER

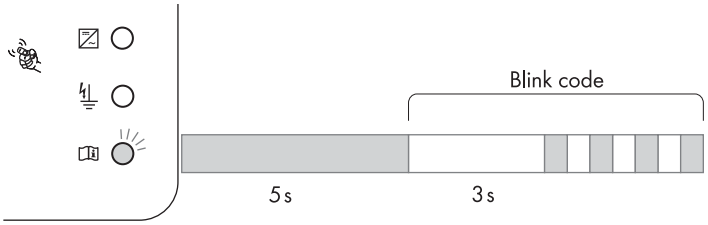
Danger to life due to high voltages in the inverter.

Risk of death or serious injury due to electric shock.

- Only qualified personnel may perform work on the inverter.

Monitor the status of the power distribution grid at the AC terminal blocks in the Sunny Boy and the AC disconnect switch between the Sunny Boy and the power distribution grid.

High DC Input Voltage



The yellow LED lights up for 5 seconds, goes out for 3 seconds, then flashes 4 times. This sequence is repeated 3 times. If the status does not change, the flashing code repeats itself.

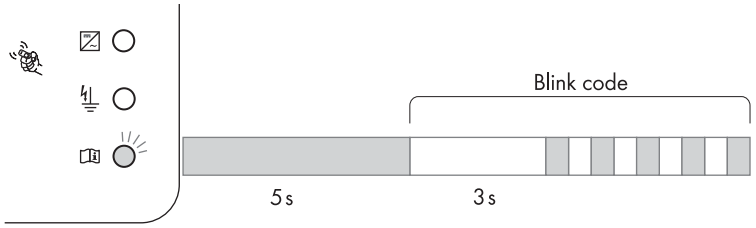
The inverter has detected a DC input voltage that is too high for safe operation.

NOTICE

Damage to the inverter due to high DC input voltage.

- Disconnect the inverter from the PV array immediately.
- Test the DC voltage at the DC disconnect switch before switching on the inverter.

Inverter Disturbance

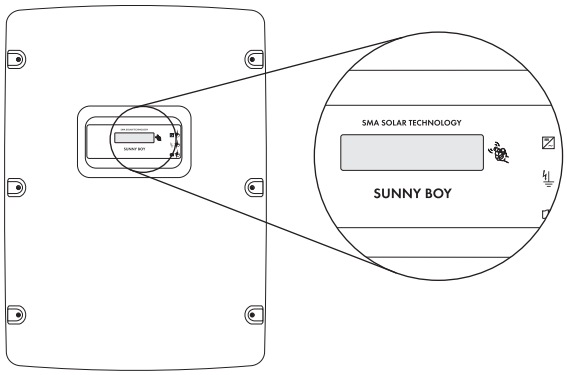


The yellow LED lights up for 5 seconds, goes out for 3 seconds, then flashes 5 times. The message is repeated 3 times. If the status does not change, the flashing code repeats itself.

The inverter has detected an internal fault that interrupts standard operation. The inverter must be maintained by a qualified service technician. Contact SMA.

8.3 Status Messages on the LCD Display

The Sunny Boy is equipped with the LCD "Sunny Display" in the enclosure lid as standard.



Activation of the Background Illumination

Tapping on the enclosure lid activates the background illumination. Additional taps will scroll through the display messages.

The backlight shuts off automatically after 2 minutes.

INIT Messages

The inverter displays the following messages during initialization:

After 6 seconds, the installed firmware versions of the sequential control system (BFR) and the current control system (SRR) are displayed.

Operation Messages

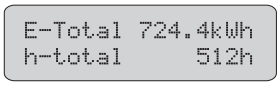
The LCD scrolls consecutively through all operation messages. Every message is displayed for 5 seconds. After all messages have been displayed, the LCD repeats them from the start.

Message 1 "E-Today": Total energy generated today. The current operating mode is displayed under this.

Message 2 "Gridtype": system configuration of the inverter and measured values of the voltage between the conductor and the neutral conductor.

Message 3: current AC power and current DC input voltage.

Message 4: energy output accrued since the installation of the inverter and the total operating hours.



Knocking on the lid of the inverter takes you to the next display message.

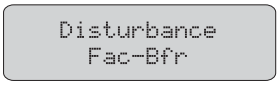
Error Messages

If a fault occurs, the LCD switches into "Fault" mode and the background illumination is activated.

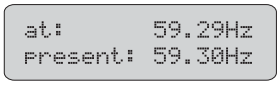
The upper line of the display shows one of the following fault types:

- Disturbance

  The Sunny Boy has detected a problem with the frequency of the power distribution grid. The message ends automatically as soon as the fault is rectified. Disturbances are caused if a measured value exceeds a preset limit.

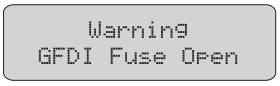
  

  The display shows the value of the fault (at:) as well as the current value for the corresponding parameter (present:).

- Warning

  The GFDI fuse is cleared. Warning messages display a plant status that must be investigated. The inverter may be operational despite a warning message.

- Fault

  The inverter has detected a problem with the internal ROM. A fault status prevents a restart of the inverter until the fault is rectified.

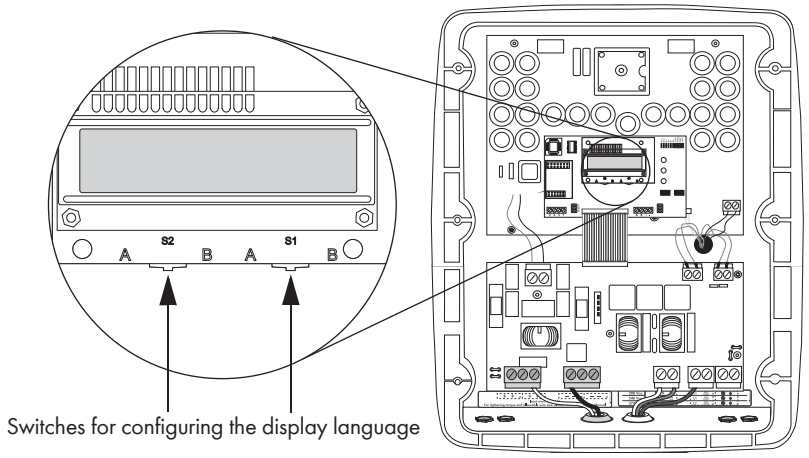
Each error message is displayed for 5 seconds. After 5 seconds, the LCD scrolls through the regular operation messages.

The error message will be displayed in the display sequence until the fault is rectified.

8.3.1 LCD Display Language Selection

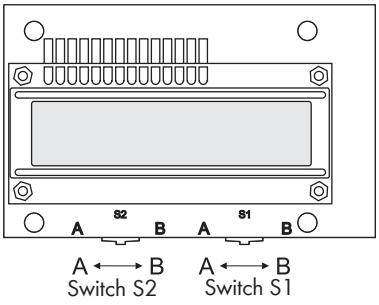
The LCD can display information in one of 4 different languages. The language is configured via two slide switches that are located on the lower edge of the display board.

The language choices are: German, English, French, and Spanish.



Language Selection Switches for the LCD Display

Language	Switch S2	Switch S1
German	B	B
English	B	A
French	A	B
Spanish	A	A



8.4 Measuring Channels and Parameters

The communication options support a number of measuring channels and messages from the Sunny Boy inverters.

The following abbreviations are used:

BFR Sequential Control System (Betriebsführungsrechner)

SRR Current Control System (Stromregelungsrechner)

The BFR and SRR are redundant processor control systems for the utility protection functions.

8.4.1 Measuring Channels

Vpv:	PV input voltage
Vpv Setpoint:	MPPT DC target voltage
Iac:	Grid current
Vac:	Grid voltage L1 - L2
Vac L1:	Grid voltage L1 - N
Vac L2:	Grid voltage L2 - N
Fac:	Power frequency
Pac:	Power fed to grid
Vpv-PE:	PV voltage to earth (for troubleshooting PV ground faults)
Temperature:	Temperature measured at IGBT module
Ipv:	PV current
Max Temperature:	Max temperature measured at IGBT
Max Vpv:	Max. PV input voltage
I-dif:	Fault current
Vfan:	Fan voltage
E-Total:	Total energy yield
h-Total:	Total operating hours
h-on:	h-on displays how long sufficient DC voltage has been applied at the Sunny Boy and how long the Sunny Boy has been in operation. The displayed value contains the time when the Sunny Boy was unable to feed into the power distribution grid due to the DC voltage being too low or due to "STOP" mode.
Power On:	Total number of system starts
Event-Cnt:	Event counter
Serial Number:	Serial number of the Sunny Boy
CO2 saved:	Amount of CO2 saved during the operating time
Mode:	Current operating mode
Grid Type:	Type of grid the Sunny Boy is connected to
Error:	Description of fault

8.4.2 Operating Mode

Stop:	Manual system stop
Offset:	Offset calibration of the electronics (at start-up)
Waiting:	PV voltage is not high enough to start
Grid monitoring:	Synchronizing to grid (at start-up)
MPP-Search:	MPPT range test (at start-up)
MPP:	Sunny Boy is in MPP mode (standard operation)
V-Const:	Sunny Boy is in MPP mode with constant voltage
Derating:	Reduction of the power fed into the grid due to increased cooling element temperatures
Disturbance:	Fault status relating to the grid. As soon as the cause of the fault is no longer present, this fault will be reset automatically.
Error:	Inverter fault, user interaction required
Warning:	System warning advising further investigation

8.4.3 Operating Parameters of the Sunny Boy

Changes to the preset parameters can negatively influence the operation and the performance of the inverter.

- Changes to the operating parameters must be made by trained qualified personnel.

Changes to the parameters labeled with * can lead to changes regarding conformity with IEEE 1547 and must be approved by the on site electric utility company and/or the responsible authority.

8.4.4 Operating Parameters of the Sunny Boy

Name	Unit	Range	Standard	Password Level	Description
AntiIsland-Ampl*	deg	0 ... 10	0	Installer	Amplification of the anti-island process
AntiIsland-Freq*	mHz	0 ... 2000	500	Installer	Repetition rate of the anti-island process
CO2-Fact	lbs./ kWh	0 ... 2	1.7	Installer	The Sunny Boy evaluates the yield and displays the approximate amount of CO2 that the Sunny Boy has saved. This CO2 amount is calculated by multiplying the generated kWh (E-total) by the factor defined in the parameter "CO2".
Default		USA/UL1741/ 2005, OFF_Grid, NON IEEE1547	USA/ UL1741/ 2005	Installer	Used for adjusting the parameters country specific settings. Note: After changing one of the parameters marked with "*", the parameter "default" changes to "adjusted" automatically.

Name	Unit	Range	Standard	Password Level	Description
dFac-MAX*	Hz/s	0.005 ... 4	0.5 (for country setting USA/ UL1741/ 2005)	Installer	Maximum "number of frequency changes" before the anti-islanding protection switches on
E_total	kWh	0 ... 200000	0	Installer	Total energy yield of the inverter. Changing the value may be necessary if a Sunny Boy is replaced and you wish to compare the data obtained previously.
Fac-delta– *	Hz	0.2 ... 3	0.69 (for country setting USA/ UL1741/ 2005)	Installer	Maximum permissible operating frequency above and below 60 Hz. Standard value is optimal for plants < 30 kW.
Fac-delta+*	Hz	0 ... 4.5	0.49 (for country setting USA/ UL1741/ 2005)	Installer	
Fac-MinTripTime*	s	0.16 ... 300	0.16	Installer	Switch-off time having fallen below power frequency. The standard value is optimal for plants < 30 kW.
Fan-Test		1 / 0	0	Installer	By setting this parameter to "1" you can check the function of the fans. This test turns the fans at maximum speed.
h_Total	h	0 ... 200000	0	Installer	Total operating hours of the inverter. Changing the value may be necessary if a Sunny Boy is replaced and you wish to compare the data obtained previously.
Memory Function		no function, Default param., Reset Op.Data, Reset errors	no function	Installer	Default param.: Sets all parameters to the standard value. Reset Op.Data: Sets all parameters to the standard values that are displayed on the user level. Reset errors: Resets all permanent errors that lead to device disconnection.
Operating Mode		MPP-Operation, Turbine, V-const, Stop	MPP	Installer	Operating modes of the Sunny Boy: MPP-Operation: Sets the Sunny Boy in Maximum Power Point Tracking Mode V-const: Constant Voltage Mode (target value defined in "Vconst-Setval") Turbine: Operating mode for wind power plants Stop: Disconnection from grid, no operation

Name	Unit	Range	Standard	Password Level	Description
V-Const Setval	V	**SB 5000-US - SB 7000-US:** 250 ... 600 **SB 8000-US:** 300 ... 600	600	Installer	PV target voltage for constant voltage operation. These parameters only are important in the event that the parameter "Operating Mode" is set to "V-const".
Vac-Min*	%	0 ... 50	12	Installer	Values are used to calculate the lower limit of permissible AC voltage. Standard value is optimal for plants < 30 kW. Standard value 12 results in a trip value of 88 %, as the list of the trip limits shows.
Vac-Max*	%	0 ... 20	10	Installer	Values are used to calculate the upper limit of permissible AC voltage. Standard value is optimal for plants < 30 kW. Standard value 10 results in a trip value of 110 %, as the list of trip limits shows.
Vac-Min-Fast*	%	0 ... 50	50	Installer	Values are used to calculate the lower limit of allowable AC voltage for fast disconnection. Standard value is optimal for plants < 30 kW. Standard value 50 results in a trip value of 50 %, as the list of trip limits shows.
Vac-Max-Fast*	%	0 ... 20	20	Installer	Values are used to calculate the upper limit of allowable AC voltage for fast disconnection. Standard value is optimal for plants < 30 kW. Standard value 20 results in a trip value of 120 %, as the list of trip limits shows.
Vac-Min-Recnet	%	0 ... 50	11.7	Installer	Values are used to calculate the lower and upper limits to reconnect to the grid after a grid failure.
Vac-Max-Recnet	%	0 ... 20	5.83	Installer	
Vpv-Start	V	**SB 5000-US - SB 7000-US:** 250 ... 600 **SB 8000-US:** 300 ... 600	**SB 5000-US - SB 7000-US:** 300 **SB 8000-US:** 365	Installer	Minimum DC voltage for the Sunny Boy to connect to the grid.

8.4.5 Fixed Operating Parameters of the Sunny Boy

Name	Unit	Range	Standard	Description
Plimit	W	fixed	**SB 5000-US:** 5100 **SB 6000-US:** 6100 **SB 7000-US:** 7100 **SB 8000-US:** 8100	Upper limit of AC output power
SMA-SN				Serial number of the Sunny Boy
Software-BFR				Firmware version of the sequential control system (BFR)
Software-SRR				Firmware version of the current control system (SRR)

9 Troubleshooting

9.1 General

Every inverter is checked prior to leaving the plant. If there are faults in the operation of the inverter, perform the following steps to rectify the faults.

- Pay attention to Sunny Boy flashing codes. Look up the meaning of the flashing code being displayed in section 7 "Commissioning" (page 61).
- Monitor operating modes and error messages on the LCD of the Sunny Boy or via connected PV plant monitoring. Look up the meaning of messages being displayed in section 8 "Displays and Messages" (page 62).
- Monitor the DC and AC voltage at the terminals in the inverter. Please observe all safety precautions listed in the course of this manual.
- If the fault cannot be rectified, contact SMA Serviceline. For contact data, see section 13 "Contact" (page 101).

If it is necessary to return the Sunny Boy for maintenance, use the original box in order to prevent shipping damage.

9.2 Error Messages

Fault Type	Fault Code	Description
Disturbance	Bfr-Srr	Communication between micro-controllers is interrupted.
Warning	Derating	The inverter reduces the output power due to high internal temperatures.
Fault	EarthCurMax-B	The ground current of the BFR between PV+ and GND is outside of the tolerable range.
Fault	EarthCurMax-S	The ground current of the SRR between PV+ and GND is outside of the tolerable range.

Fault Type	Fault Code	Description
Disturbance	EEPROM	Transfer fault whilst reading or writing data from the EEPROM. This data is not essential for safe operation. This fault does not have any influence on performance.
Fault	EEPROM p	Data from the EEPROM are defective. The operation of the inverter is permanently inhibited as the data loss affects important functions of the inverter. Contact SMA.
Disturbance	EeRestore	Internal disturbance.
Disturbance	Fac-Bfr, Fac-Srr	The AC power frequency is exceeding the permissible range. To prevent islanding, the Sunny Boy disconnects itself from the power distribution grid. If the power frequency is within the tolerable range and the error message "Fac-Bfr" or "Fac-Srr" continues to be displayed, contact SMA.
Warning	GFDI Fuse Open	The GFDI fuse is cleared. Before replacing the fuse, check the PV array for a ground fault error.
Disturbance	Grid-Timeout, Grid-Fault-S	The system configuration cannot be detected (208 V/240 V/277 V). If a 277 V grid is configured: Check whether the cables for L1 and N are located in the correct connection terminals.
Disturbance	Imax	Overcurrent on the AC side. The current to the AC grid exceeds the guidelines. The reason for this may be a severe system incidents. If "Imax" appears frequently, check the AC grid. If you require help, contact SMA.
Disturbance	K1-Close	Relay test failed. Contact SMA.
Fault	K1-Open, K2-Open	
Disturbance	MSD-FAC, MSD-Idif	Internal measurement comparison fault: The BFR and SRR values measured by the Sunny Boy differ too strongly from one another. Contact SMA.
Fault	MSD-VAC	
Disturbance	OFFSET	Grid monitoring self-test failed.
Fault	ROM	The internal test of the Sunny Boy control system firmware failed. If this fault occurs frequently, contact SMA.
Disturbance	Shut-Down	Continuous internal overcurrent.

Fault Type	Fault Code	Description
Disturbance	Vac-Bfr, Vac-Srr	The AC grid voltage is exceeding the permissible range. The cause may be disconnection from the power distribution grid or from an AC cable. To prevent islanding, the Sunny Boy disconnects itself from the power distribution grid. If the error message "Vac-Bfr" or "Vac-Srr" is displayed despite the grid voltage being within the tolerable range, contact SMA.
Disturbance	VacL1-Bfr, VacL2-Bfr, VacL1-Srr, VacL2-Srr	Voltage is too high or too low on the indicated branch.
Disturbance	VpvMax !PV Overvoltage! !Disconnect DC!	The DC input voltage is exceeding the maximum tolerable value. Disconnect the DC line immediately.
Disturbance	Watchdog	Watchdog for operation control triggered.
Disturbance	XFMR	The transformer is connected to the wrong grid. Check the connection of the transformer. For grounded Delta grids: monitor whether the grid grounding conductor is connected to terminal L2. In the event of unbalanced load in 200 V and 240 V grids, swapping L1 and L2 may rectify the fault.
Disturbance	XFMR_TEMP_F	High transformer temperature. The Sunny Boy stops and the fans run at maximum speed.
Warning	XFMR_TEMP_W	After the reduction of the high transformer temperatures, the Sunny Boy restarts. Monitor the function of the fans.

10 Maintenance

Regular maintenance ensures a long operating life and optimal efficiency of the entire PV plant.

10.1 Cleaning the Fans

The Sunny Boy is fitted with two fans on its underside.

The fan intakes and handle covers should be cleaned periodically with a vacuum cleaner. For more thorough cleaning, completely remove the fans.

NOTICE

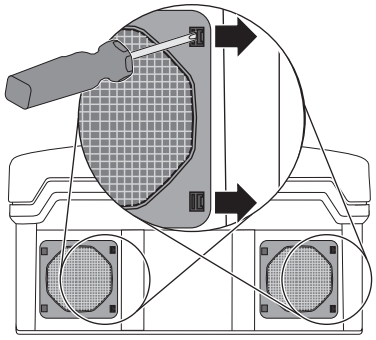
Potential damage to the fans due to compressed air.

- Do not use compressed air for cleaning.
- Use a soft brush or a cloth for cleaning.
- Always remove the fans for cleaning.

1. Disconnect the Sunny Boy on the AC and DC sides.
2. Wait 5 minutes until the residual voltage has been drained and the fans are no longer turning.

Cleaning the Ventilation Grid

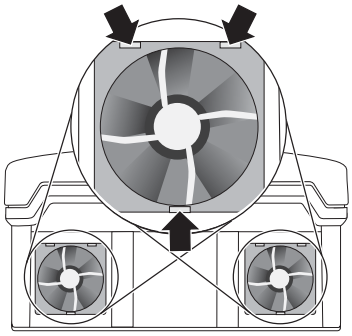
3. Remove the ventilation grids.
   - Press both latches on the right of the fan screen to the right using a screwdriver and loosen from the bracket.
   - Carefully remove the ventilation grid.



4. Clean the ventilation grid with a soft brush, a paint brush, a cloth, or compressed air.

Cleaning the Fans

5. Press the front latches backward and the rear latch forward.



6. Remove the fan by pulling it slowly and carefully downward.
7. Unlock and remove the plug.
   The cables of the fans are long enough to disconnect the plug in the inside of the Sunny Boy.
8. Remove the fan.
9. Clean the fans with a soft brush, a paintbrush, or a cloth.
10. After cleaning, mount the fans and the ventilation grids in reverse order.
11. Check the function of the fans as described in section "Checking the Fans" on page 83.

10.2 Cleaning the Handle Covers

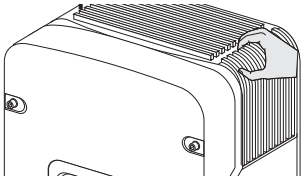
For optimal heat dissipation of the device, the handle covers must be clean. Clean the handle covers regularly.

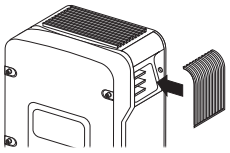
NOTICE

Insects entering the Sunny Boy can damage the device.

- The handle covers must not be removed permanently, because otherwise the device is not protected against the entrance of insects!

1. Remove the handle covers. To do this, put your finger up into the space between the handle covers and the enclosure and pull the handle covers to the side
2. Clean the handle covers with a soft brush or a paintbrush.
3. Re-secure the handle covers on the inverter. The side on which they are to be mounted is stated on the inside of the handle covers ("links/left" and "rechts/right").





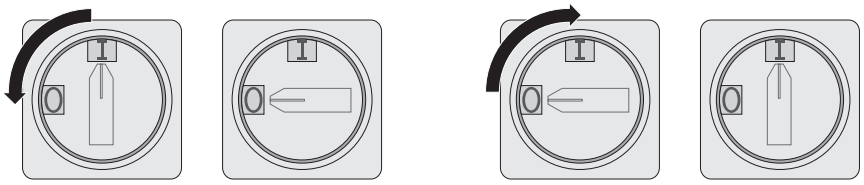
10.3 Checking the DC Disconnect

In the case of normal use, the DC Disconnect does not require any maintenance.

It is recommended, though not compulsory, to:

- Check the DC Disconnect regularly.
- Activate the DC Disconnect 10 times in a row once a year.

Operating the switch will clean the contacts and will extend the life of the DC Disconnect.



10.4 Checking the Fans

In the event of frost, the fan cannot be inspected.

Below 32 °F (0 °C), the fans are no longer controlled.

You can check the operation of the fans in 2 ways:

- Set the parameter "Fan Test" in installer mode to "1". To do this, use the Sunny Data, Sunny Data Control, Sunny Boy Control, or the Sunny WebBox.

  or

- Set the jumper on the sequential control board. The jumper for checking the fans is included in the scope of supply of the Sunny Boy.

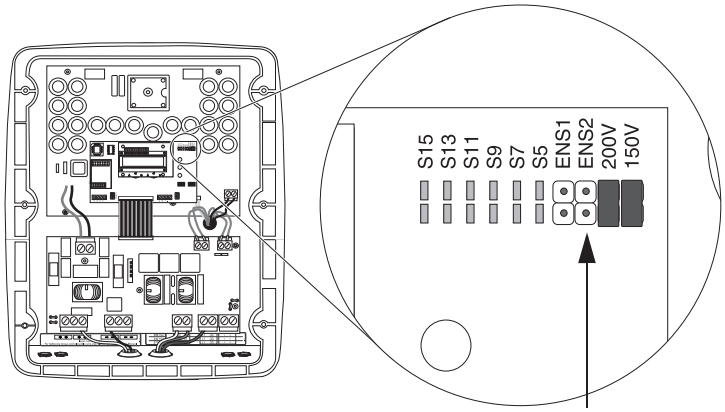
Setting the Parameter

1. Ask for the installer password from SMA Serviceline. See "Contact" on page 101.
2. Set the "Fan Test" parameter to "1" in the installer mode.
3. Check the air flow of the fans.
   - The Sunny Boy draws in cold air through the fans and lets it out again through the handle covers.
   - Pay attention to unusual sounds.
4. After checking the fans, set the parameter "Fan Test" back to "0".

Setting the Jumper

The Sunny Boy only detects the jumper after it is restarted. All LEDs must go out prior to a restart.

1. Disconnect the Sunny Boy on the AC and DC sides. Wait 5 minutes until the residual voltage has been drained.
2. Open the Sunny Boy as described in section 6.2 "Opening the Sunny Boy" (page 38).
3. Insert the jumper supplied into the slot on the sequential control board shown below.



Jumper position for checking the fans

4. Close the Sunny Boy as described in section 6.7 "Closing the Sunny Boy" (page 58).
5. Check the air flow of the fans.
   - The Sunny Boy draws in cold air through the fans and lets it out again through the handle covers.
   - Pay attention to unusual sounds.
6. After checking the fans, remove the jumper.

10.5 Exchanging the Fuses

CAUTION

Danger of fire due to incorrectly designed fuse.

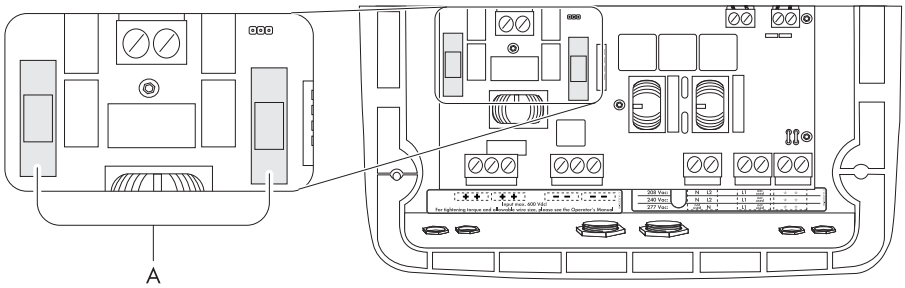
Risk of injury due to fire.

- Only replace faulty fuses with fuses of the same type and size.

10.5.1 Exchanging the GFDI Fuse within the Sunny Boy

1. Disconnect the Sunny Boy on the AC and DC sides.
2. Wait 5 minutes until the residual voltage has been drained and the fans are no longer turning.
1. Open the Sunny Boy as described in section 6.2 "Opening the Sunny Boy" (page 38).
2. Replace the fuse (A).

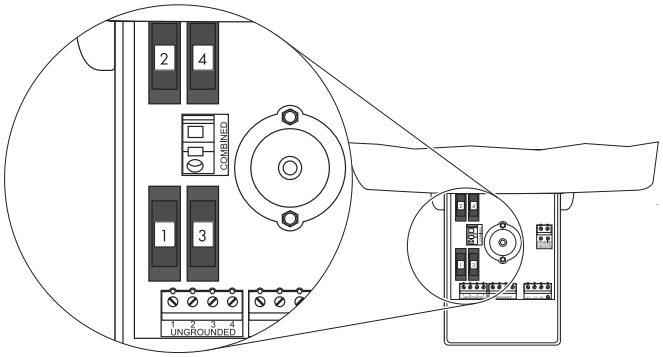
   For the correct position of the fuse, observe section "DC Input Grounding" on page 49.



3. Completely insert the fuse into the terminal.
4. Close the Sunny Boy as described in section 6.7 "Closing the Sunny Boy" (page 58).
5. Switch the AC and DC disconnect switches back on.

10.5.2 Exchanging PV String Fuses within the SMA DC Disconnect

1. Disconnect the Sunny Boy on the AC and DC sides.
2. Wait 5 minutes until the residual voltage has been drained.
3. Open the SMA DC Disconnect as described in section 6.3 "Opening the SMA DC Disconnect" (page 39).
4. Replace the fuse (1, 2, 3, or 4).



5. Close the SMA DC Disconnect as described in section 6.8 "Closing the SMA DC Disconnect" (page 59).
6. Switch the AC and DC disconnect switches back on.

PV String Fuse Sizing

If the fuses are designed too small, they may open too early and cause disturbances. If fuses are designed too large, they do not provide the required protection as they open too late.

For PV plants, the minimum and maximum size of a fuse connected in series is specified by the electrical nominal sizes of a PV module and by UL and the *National Electrical Code*. Contact the manufacturer of the PV modules in order to obtain the corresponding nominal sizes of the PV string fuses.

The minimum sizes of fuses and wiring are calculated using the Short Circuit Current Rating (Isc) of the PV module. The *National Electrical Code stipulates* that all fuses and cables are designed to be at least 1.56x as large as the Isc of the PV module being used in the plant.

The correct size of the PV string fuse is specified by calculating 1.56x the Isc (of the PV module) and then rounding this up to the nearest standard size for fuses.

For example, if the Isc of the PV module is 6.9 Adc, then the size of the PV string fuses is determined as follows: 1.56 x 6.9 = 10.76

The nearest standard size for fuses would be a 12 A and 600 Vdc fuse.

The size of a string fuse may not be greater than the maximum nominal value of a PV module fuse. Observe the data sheet of the PV module. If no maximum size for fuses is stated, contact the manufacturer of the PV module.

DC Disconnect Requirements

National Electrical Code 690.15-18 enables the use of fuse holders as a suitable medium for disconnecting PV arrays for maintenance. Additional DC disconnects external to the inverter may be required by the local authority having jurisdiction.

WARNING

Electric arc and electric shock when removing the fuses under load.

Risk of death or serious injury.

- Do not remove any fuses when the inverter is under load.

PV String Fuses

The SMA DC Disconnect is shipped with 15 A, 600 V DC fuses in the fuse holders. The maximum nominal size for string fuses in the SMA DC Disconnect is 20 A at 600 V DC.

When dimensioning the fuses, observe the *National Electrical Code*® 690.8 and 690.9.

11 Technical Data

11.1 FCC Compliance Information

Interactive Grid-Connected Inverter, Sunny Boy Model

This device complies with Part 15 of the FCC Rules. Operation is subject to the following conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received, including interference that may cause undesired operation.

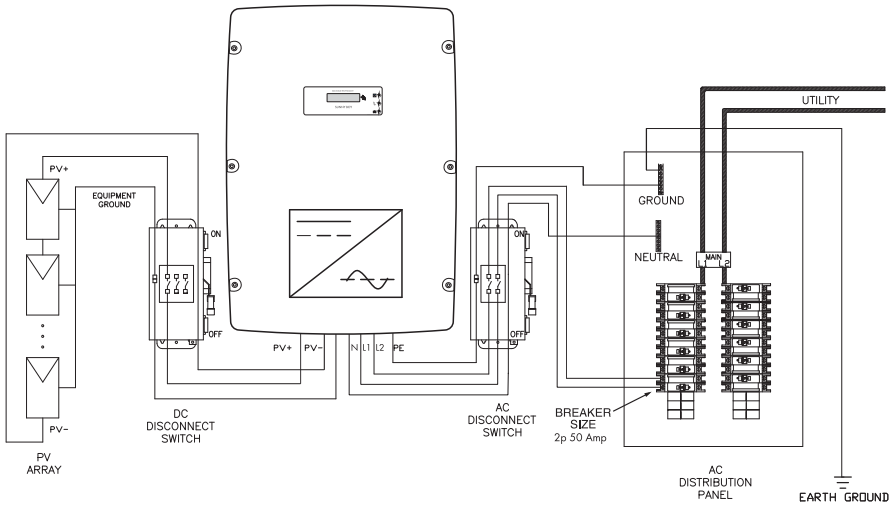
NOTE: This device has been checked and fulfils the limiting values for digital devices of classes A & B according to Part 15 of the FCC Rules. These limiting values have been designed in such a way that appropriate protection against serious disturbances is provided for installations in houses. This device generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular plant. If this device causes serious disturbances to radio or TV reception that can be identified by switching the device on and off, the user will be required to rectify the disturbance using one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the device and the receiver.
- Connect the device to an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
- The user is cautioned that changes or modifications not expressly approved by SMA America, Inc. could void the user's authority to operate this device.

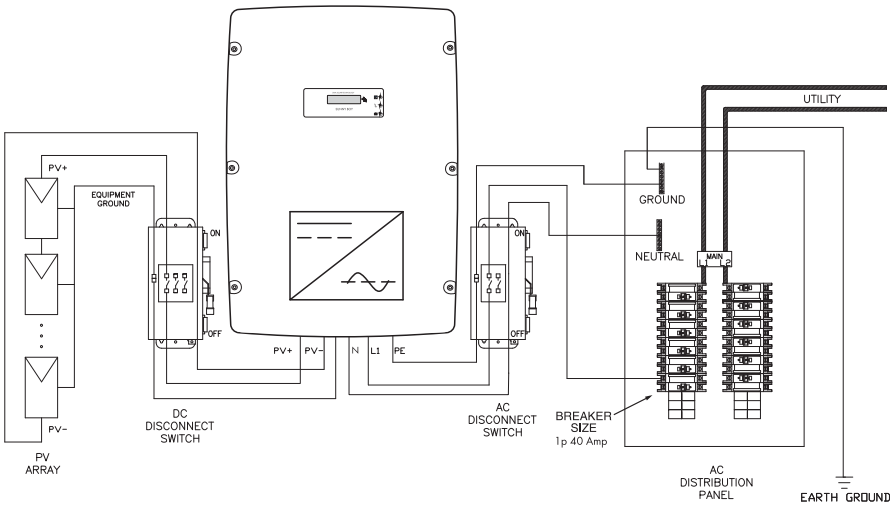
11.2 Sunny Boy Circuit Diagrams

11.2.1 Without SMA DC Disconnect

Sunny Boy Connections for 208 V and 240 V AC Grids

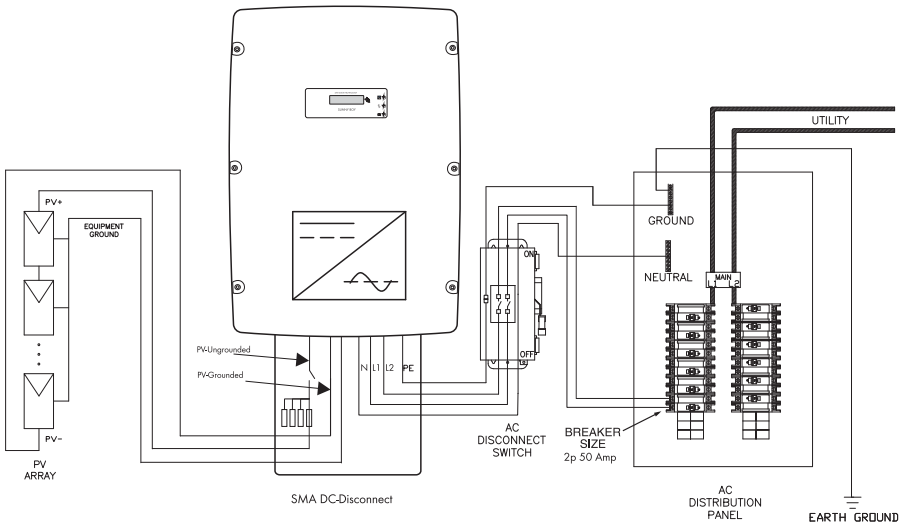


Sunny Boy Connections for 277 V AC Grids

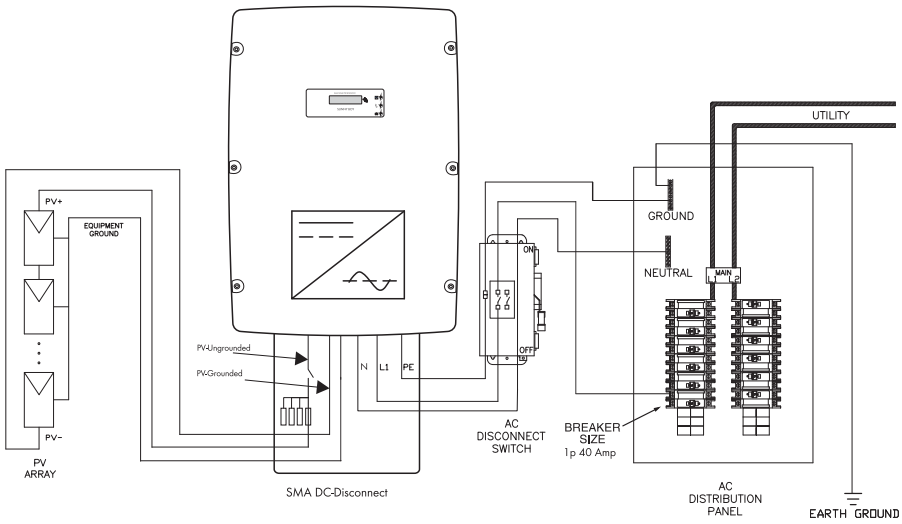


11.2.2 With SMA DC Disconnect

Sunny Boy Connections for 208 V and 240 V AC Grids



Sunny Boy Connections for 277 V AC Grids



11.3 Specifications

11.4 Sunny Boy 5000-US (SB 5000US and SB 5000US-11)

PV Array Connection

Maximum MPP voltage	250 V ... 480 V
Range of input operating voltage	250 V ... 600 V
Maximum generator input power	6,250 W
Maximum DC power	5,300 W
PV start voltage	300 V
Maximum DC input current	21 A
Maximum input short-circuit current	36 A
Maximum utility backfeed current to PV array	50 A AC
DC voltage ripple	< 10 %

Grid Connection

AC operating voltage range at 208 V nominal value	183 V ... 229 V
AC operating voltage range at 240 V nominal value	211 V ... 264 V
AC operating voltage range at 277 V nominal value	244 V ... 305 V
AC operating frequency range	59.3 Hz ... 60.5 Hz
AC frequency, nominal value	60 Hz
Maximum continuous AC output power	5,000 W
Current THD	< 4 %
Maximum continuous AC output current at 208 V	24 A
Maximum continuous AC output current at 240 V	20.8 A
Maximum continuous AC output current at 277 V	18 A
Maximum output failure current	57.6 A
Maximum output overcurrent protection	50 A
Synchronization of inrush current	9.23 A
Trip limit accuracy	±2 %
Trip time accuracy	±0.1 %
Power consumption at night	0.1 W
Power consumption in operation	< 7 W

Efficiency

Range of output power factor	0.95 ... 1.0
Output power factor, nominal value	0.99
Peak inverter efficiency	96.8 %
CEC weighted efficiency	95.5 %

Ambient Conditions

Ambient temperature range **SB 5000US**	– 13 °F ... +113 °F (– 25 °C ... +45 °C)
Ambient temperature range **SB 5000US-11**	– 40 °F ... +113 °F (– 40 °C ... +45 °C)

Mechanical Data

Width x height x depth	$18\frac{3}{8}$ in. x $24\frac{1}{8}$ in. x $9\frac{1}{16}$ in. (468 mm x 613 mm x 242 mm)
Weight	147 lbs. (67 kg)
Noise emission	44 dB(A)

General Data

Inverter technology	True sine, low-frequency transformer
Cooling concept	OptiCool

11.5 Sunny Boy 6000-US (SB 6000US and SB 6000US-11)

PV Array Connection

Maximum MPP voltage	250 V ... 480 V
Range of input operating voltage	250 V ... 600 V
Maximum generator input power	7,500 W
Maximum DC power	6,400 W
PV start voltage	300 V
Maximum DC input current	25 A
Maximum input short-circuit current	36 A
Maximum utility backfeed current to PV array	50 A AC
DC voltage ripple	< 10 %

Grid Connection

AC operating voltage range at 208 V nominal value	183 V ... 229 V
AC operating voltage range at 240 V nominal value	211 V ... 264 V
AC operating voltage range at 277 V nominal value	244 V ... 305 V
AC operating frequency range	59.3 Hz ... 60.5 Hz
AC frequency, nominal value	60 Hz
Maximum continuous AC output power	6,000 W
Current THD	< 4 %
Maximum continuous AC output current at 208 V	29 A
Maximum continuous AC output current at 240 V	25 A
Maximum continuous AC output current at 277 V	21.6 A
Maximum output failure current	57.6 A
Maximum output overcurrent protection	50 A
Synchronization of inrush current	9.23 A
Trip limit accuracy	±2 %
Trip time accuracy	±0.1 %
Power consumption at night	0.1 W
Power consumption in operation	< 7 W

Efficiency

Range of output power factor	0.95 ... 1.0
Output power factor, nominal value	0.99
Peak inverter efficiency	97.0 %
CEC weighted efficiency at 208 V AC	95.5 %
CEC weighted efficiency at 240 V AC	95.5 %
CEC weighted efficiency at 277 V AC	96.0 %

Ambient Conditions

Ambient temperature range **SB 6000US**	– 13 °F ... +113 °F (– 25 °C ... +45 °C)
Ambient temperature range **SB 6000US-11**	– 40 °F ... +113 °F (– 40 °C ... +45 °C)

Mechanical Data

Width x height x depth	$18\frac{3}{8}$ in. x $24\frac{1}{8}$ in. x $9\frac{1}{16}$ in. (468 mm x 613 mm x 242 mm)
Weight	147 lbs. (67 kg)
Noise emission	44 dB(A)

General Data

Inverter technology	True sine, low-frequency transformer
Cooling concept	OptiCool

11.6 Sunny Boy SB 7000-US (SB 7000US and SB 7000US-11)

PV Array Connection

Maximum MPP voltage	250 V ... 480 V
Range of input operating voltage	250 V ... 600 V
Maximum generator input power	8,750 W
Maximum DC power	7,500 W
PV start voltage	300 V
Maximum DC input current	30 A
Maximum input short-circuit current	36 A
Maximum utility backfeed current to PV array	50 A AC
DC voltage ripple	< 10 %

Grid Connection

AC operating voltage range at 208 V nominal value	183 V ... 229 V
AC operating voltage range at 240 V nominal value	211 V ... 264 V
AC operating voltage range at 277 V nominal value	244 V ... 305 V
AC operating frequency range	59.3 Hz ... 60.5 Hz
AC frequency, nominal value	60 Hz
Maximum continuous AC output power	7,000 W
Current THD	< 4 %
Maximum continuous AC output current at 208 V	34 A
Maximum continuous AC output current at 240 V	29 A
Maximum continuous AC output current at 277 V	25.3 A
Maximum output failure current	57.6 A
Maximum output overcurrent protection	50 A
Synchronization of inrush current	9.23 A
Trip limit accuracy	±2 %
Trip time accuracy	±0.1 %
Power consumption at night	0.1 W
Power consumption in operation	< 7 W

Efficiency

Range of output power factor	0.95 ... 1.0
Output power factor, nominal value	0.99
Peak inverter efficiency	97.1 %
CEC weighted efficiency at 208 V AC	95.5 %
CEC weighted efficiency at 240 V AC	96.0 %
CEC weighted efficiency at 277 V AC	96.0 %

Ambient Conditions

Ambient temperature range **SB 7000US**	– 13 °F ... +113 °F (– 25 °C ... +45 °C)
Ambient temperature range **SB 7000US-11**	– 40 °F ... +113 °F (– 40 °C ... +45 °C)

Mechanical Data

Width x height x depth	$18\frac{3}{8}$ in. x $24\frac{1}{8}$ in. x $9\frac{1}{16}$ in. (468 mm x 613 mm x 242 mm)
Weight	141 lbs. (64 kg)
Noise emission	46 dB(A)

General Data

Inverter technology	True sine, low-frequency transformer
Cooling concept	OptiCool

11.7 Sunny Boy SB 8000-US (SB 8000US and SB 8000US-11)

PV Array Connection

Maximum MPP voltage	300 V ... 480 V
Range of input operating voltage	300 V ... 600 V
Maximum generator input power	10,000 W
Maximum DC power	8,600 W
PV start voltage	365 V
Maximum DC input current	30 A
Maximum input short-circuit current	36 A
Maximum utility backfeed current to PV array	50 A AC
DC voltage ripple	< 10 %

Grid Connection

AC operating voltage range at 240 V nominal value	211 V ... 264 V
AC operating voltage range at 277 V nominal value	244 V ... 305 V
AC operating frequency range	59.3 Hz ... 60.5 Hz
AC frequency, nominal value	60 Hz
AC Maximum Continuous Output Power at 240 V	7,680 W
AC Maximum Continuous Output Power at 277 V	8,000 W
Current THD	< 4 %
Maximum continuous AC output current at 240 V	32 A
Maximum continuous AC output current at 277 V	29 A
Maximum output failure current	61.7 A
Maximum output overcurrent protection	50 A
Synchronization of inrush current	14.32 A
Trip limit accuracy	±2 %
Trip time accuracy	±0.1 %
Power consumption at night	0.1 W
Power consumption in operation	< 7 W

Efficiency

Range of output power factor	0.95 ... 1.0
Output power factor, nominal value	0.99
Peak inverter efficiency	96.5 %
CEC weighted efficiency at 240 V AC	96.0 %
CEC weighted efficiency at 277 V AC	96.0 %

Ambient Conditions

Ambient temperature range **SB 8000US**	− 13 °F ... +113 °F (− 25 °C ... +45 °C)
Ambient temperature range **SB 8000US-11**	− 40 °F ... +113 °F (− 40 °C ... +45 °C)

Mechanical Data

Width x height x depth	$18\frac{3}{8}$ in. x $24\frac{1}{8}$ in. x $9\frac{1}{16}$ in. (468 mm x 613 mm x 242 mm)
Weight	147 lbs. (67 kg)
Noise emission	49 dB(A)

General Data

Inverter technology	True sine, low-frequency transformer
Cooling concept	OptiCool

Specifications subject to change without notice.

Values at nominal conditions.

11.7.1 SMA DC Disconnect

Maximum DC input current	36 A DC
Maximum system voltage	600 V DC
Maximum string fuse rating	20 A DC
Maximum AC operating current	40 A AC
Enclosure	NEMA 3R

Specifications subject to change without notice.

11.8 Trip Limits/Trip Times

Nominal Frequency	Trip Limit	Trip Frequencies	Trip Times
60 Hz	> 60.5 Hz	60.45 Hz ... 60.55 Hz	max. 0.1602 s
	< 57.0 Hz ... 59.8 Hz (standard 59.3 Hz)	56.95 Hz ... 59.85 Hz (standard 59.25 Hz ... 59.35 Hz)	adjustable, 0.16 s ... 300 s (standard max. 0.1602 s)
	< 57.0 Hz	56.95 Hz ... 57.05 Hz	max. 0.1602 s

Nominal Voltage	Trip Limit	Trip Voltages Conductor-Neutral Conductor*	Trip Voltages Conductor-Conductor*	Trip Times
208 V	50 %	57.6 V ... 62.4 V	99.8 V ... 108.2 V	max. 0.1602 s
	88 %	103.2 V ... 108.0 V	178.9 ... 187.2 V	max. 2.002 s
	110 %	129.6 V ... 134.4 V	224.6 V ... 233.0 V	max. 1.001 s
	120 %	141.6 V ... 146.4 V	245.4 V ... 253.8 V	max. 0.1602 s
240 V	50 %	57.6 V ... 62.4 V	115.2 V ... 124.8 V	max. 0.1602 s
	88 %	103.2 V ... 108.0 V	206.4 V ... 216.0 V	max. 2.002 s
	110 %	129.6 V ... 134.4 V	259.2 V ... 268.8 V	max. 1.001 s
	120 %	141.6 V ... 146.4 V	283.2 V ... 292.8 V	max. 0.1602 s
277 V	50 %	133.0 V ... 144.0 V	not applicable	max. 0.1602 s
	88 %	238.2 V ... 249.3 V		max. 2.002 s
	110 %	299.2 V ... 310.2 V		max. 1.001 s
	120 %	326.9 V ... 337.9 V		max. 0.1602 s

* The intervals result from the measuring accuracies listed below.

Manufacturer's Accuracies:

Trip limit accuracy: ±2 % of nominal grid voltage

Trip time accuracy: ±0.1 % of nominal trip time

Trip frequency accuracy: ±0.1 % of nominal frequency

11.9 Torque Values and Cable Sizes

Terminal	Torque	Cable Size
Grey AC & DC terminal blocks (Weidmüller), inverter	18 in-lbs. (2 Nm)	10 ... 6 AWG
Green AC & DC terminal blocks (Phoenix), inverter	40 in-lbs. (4.5 Nm)	8 ... 6 AWG
	22 in-	10 AWG
Gray terminal blocks for wires not used in the configuration of the AC voltage (Weidmüller)	22 in-lbs. (2.5 Nm)	–
Green terminal blocks for wires not used in the configuration of the AC voltage (Phoenix)	15 in-lbs. (1.7 Nm)	–
AC & DC terminal blocks, SMA DC Disconnect	15 in-lbs. (1.7 Nm)	10 ... 6 AWG
Combined terminal block, SMA DC Disconnect	Spring terminal	10 ... 6 AWG
Grounding conductor terminal block, SMA DC Disconnect	15 in-lbs. (1.7 Nm)	10 ... 6 AWG
Screws for fastening the Sunny Boy and the SMA DC Disconnect to the wall mounting bracket and closing the SMA DC Disconnect cover	44 in-lbs. (5 Nm)	–
Cover screws	53 in-lbs. (6 Nm)	–

12 Accessories

You will find the corresponding accessories and replacement parts for your product in the following overview. If needed, you can order these from SMA or your SMA dealer.

Name	Brief Description	SMA Order Number
Power Balancer set	Upgrade kit for the Power Balancer function	PBL-SBUS-10-NR
RS485 upgrade kit	RS485 interface	485USPB-NR
Bluetooth retrofit kit	*Bluetooth* communication interface	BTPBINV-NR
Ventilation grid	"Right and left" ventilation grid set as a replacement part	45-7202

13 Contact

If you experience technical problems with our products, please contact SMA Serviceline. We require the following information in order to provide you with the necessary assistance:

- Inverter type
- Type and number of modules connected
- Type of communication
- Sunny Boy disturbance or warning number
- Sunny Boy display message

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