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

SMA America, LLC
3801 N. Havana Street
Denver, CO 80239 U.S.A.

SMA Solar Technology Canada Inc.
2425 Matheson Blvd. E, 8th Floor
Mississauga, ON L4W 5K5, Canada

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

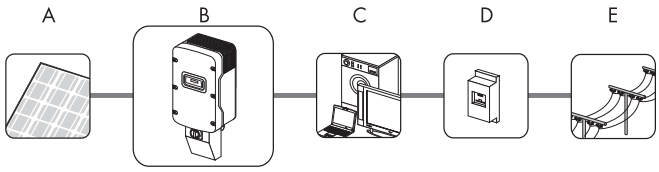
In this document, SMA America Production, LLC and SMA Solar Technology Canada Inc. will be referred to as SMA.

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.

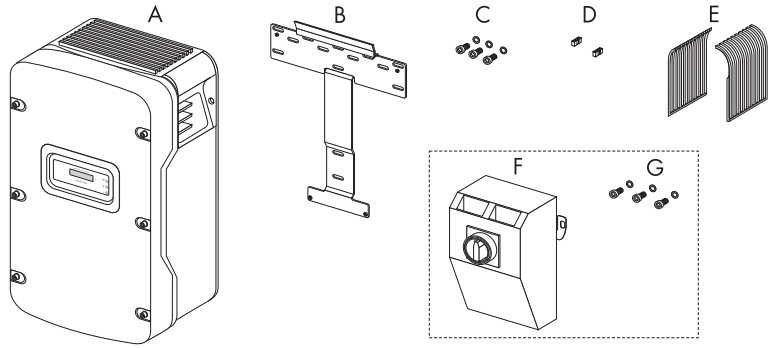
Risk of bruising and broken bones.

- 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.

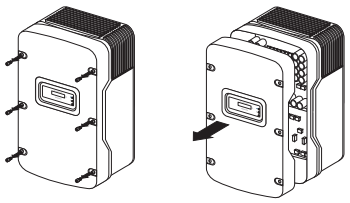
3.1 Scope of Delivery



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

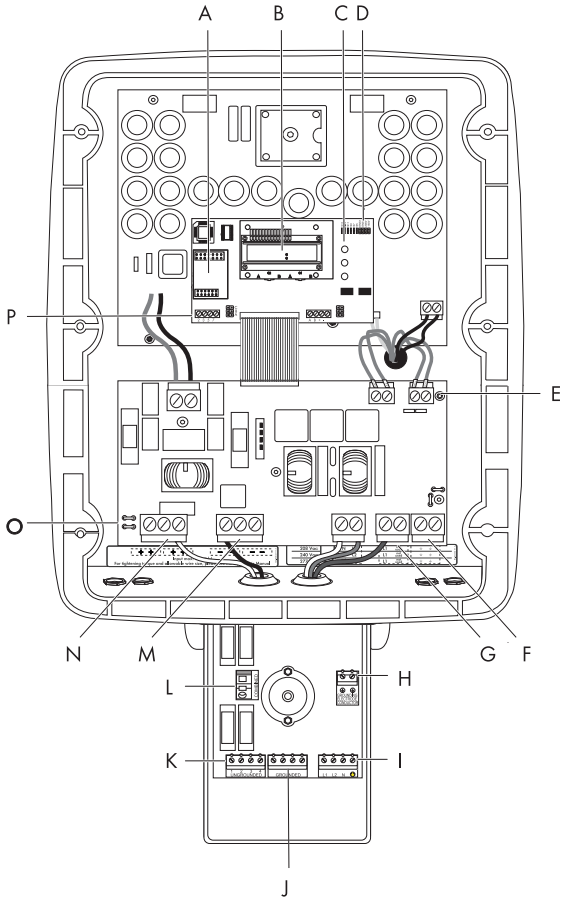
The seal of the enclosure may become frozen shut due to frost.

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.

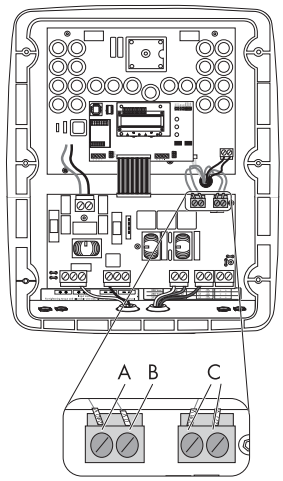
The Sunny Boy is compatible with the following grid types:

- 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:

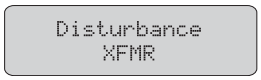
Gray terminal blocks (Weidmüller)	18 in-lbs. (2 Nm)
Green terminal blocks (Phoenix)	22 in-lbs. (2.5 Nm)

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.

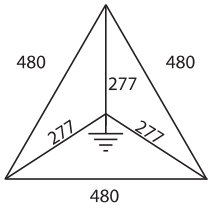
To set the configuration jumpers, observe the procedure in 4.4 "Jumper for System Configuration" (page 23).

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.

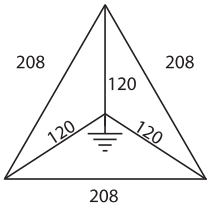
Configuration of Grid Voltage

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.

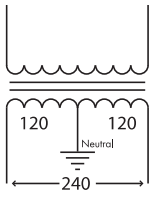
480 Delta: 277 WYE



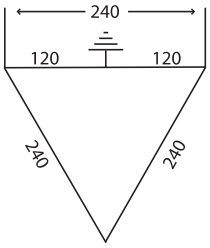
208 Delta: 120 WYE*



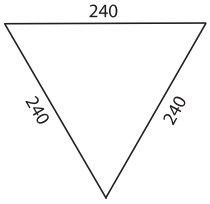
240: 120 Split Phase



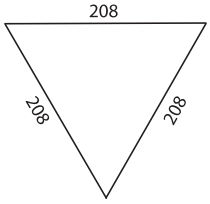
240 Delta: 120 Stinger



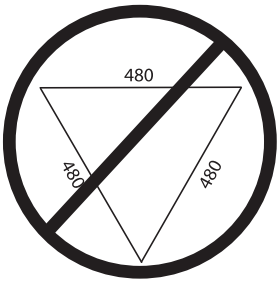
240 Delta



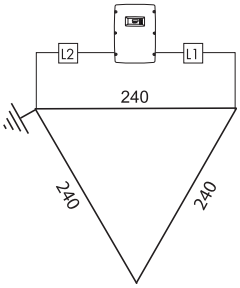
208 Delta*



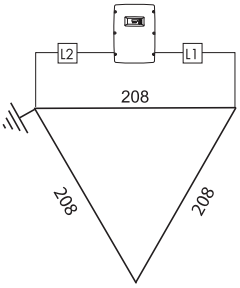
480 Delta
DO NOT USE!



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:

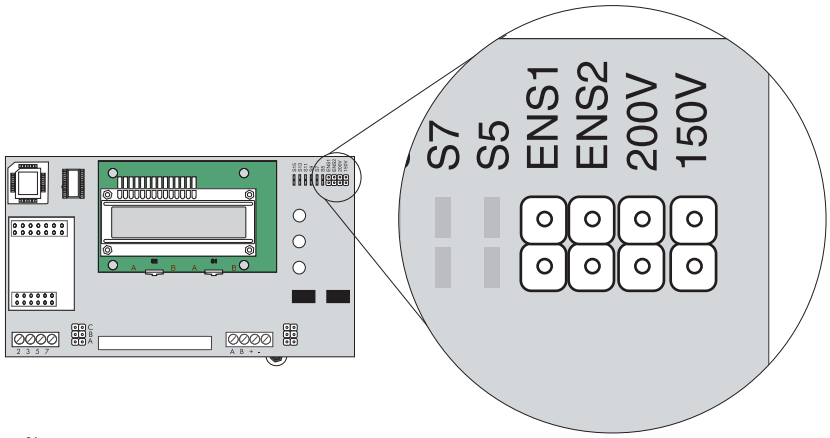
- Connect terminal L2 to the grounded phase.

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 *

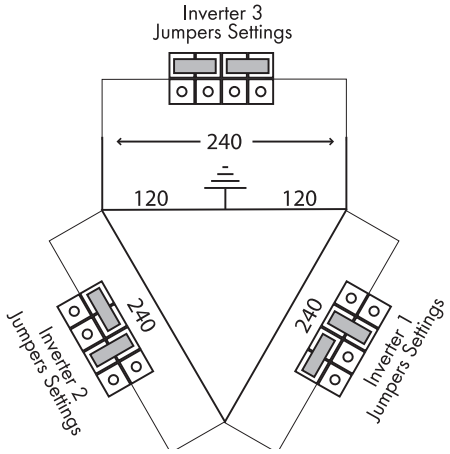
240 V Delta, without neutral conductor or
240 V Delta, grounded

Fan test

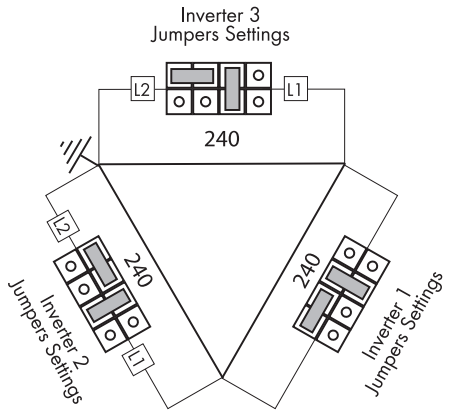
* The Sunny Boy 8000-US must not be connected to a 208 V grid.

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.

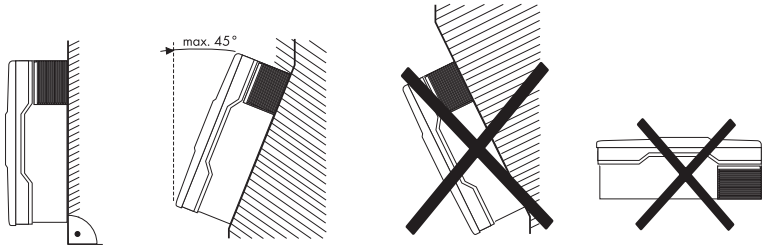
Risk of bruising and broken bones.

- 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

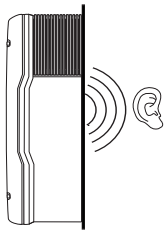
Observe the following conditions during installation:

- 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.

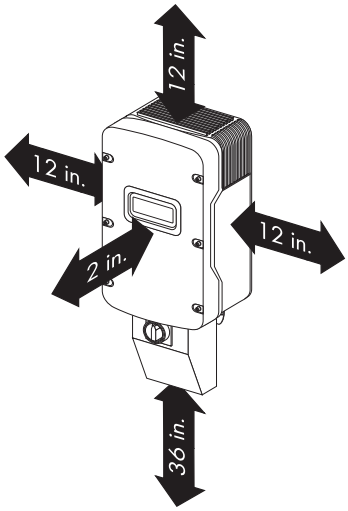
Arrangement of multiple inverters in areas with high ambient temperatures.

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.

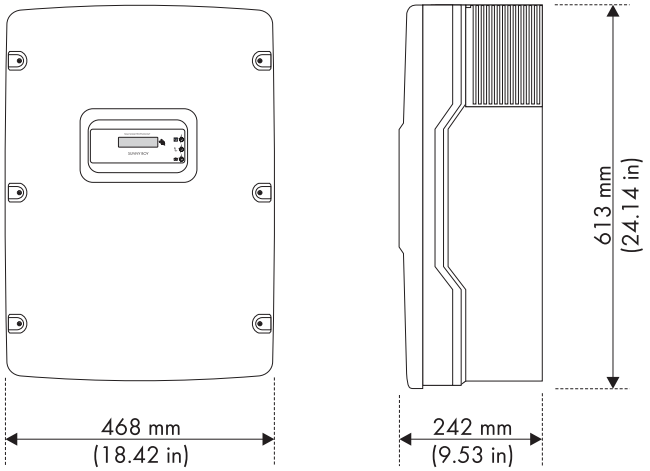
Item	Clearance
Top	12 in. (300 mm)
Bottom	36 in. (900 mm)
Left	12 in. (300 mm)
Right	12 in. (300 mm)
Front	2 in. (50 mm)



If the Sunny Boy is installed outdoors:

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

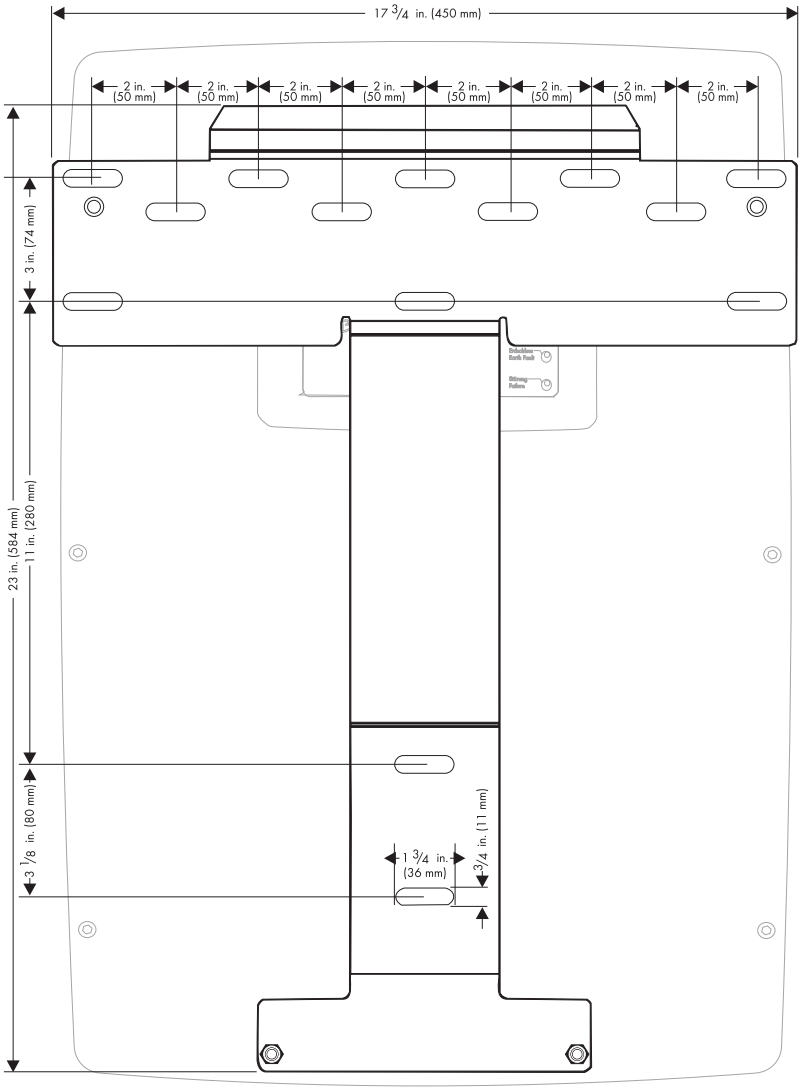
Dimensions of the Sunny Boy



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



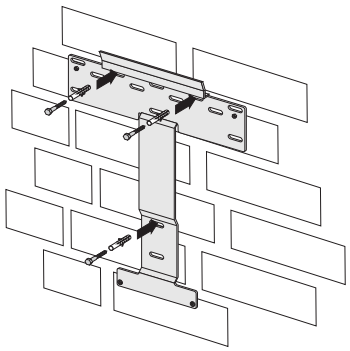
5.3.1 Possibilities for Mounting the Wall Mounting Bracket

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).

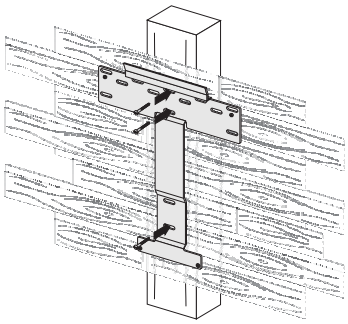


Mounting on a Wooden Wall with a Stud or on a Pillar

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).



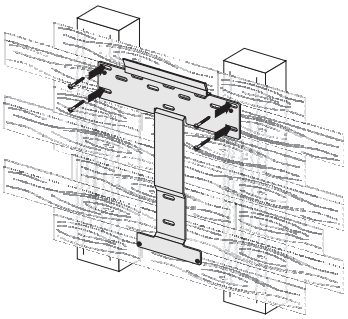
Mounting on a Wooden Wall with two Studs

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.

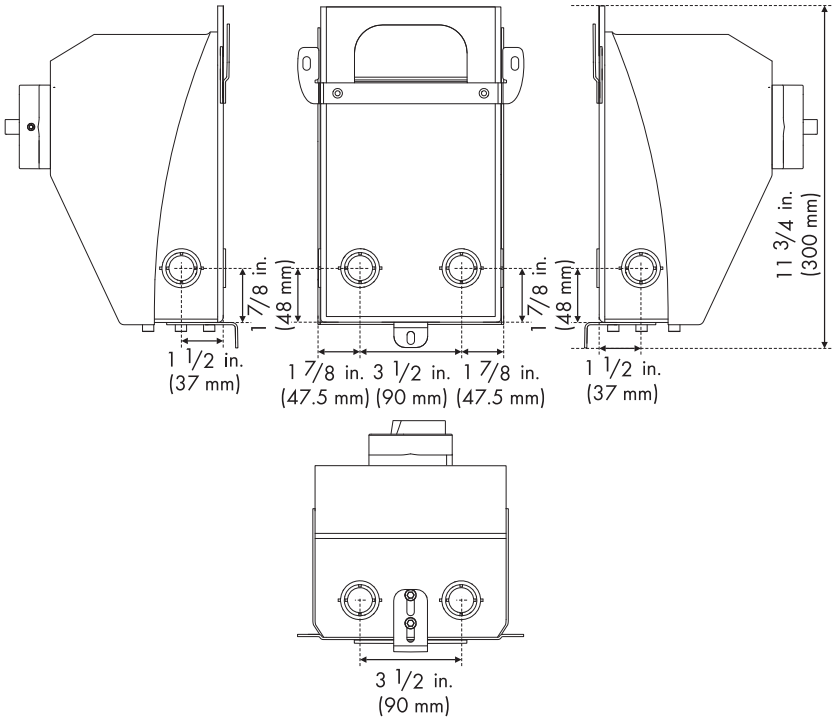
Mounting on a wall with wooden studs:

- 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.

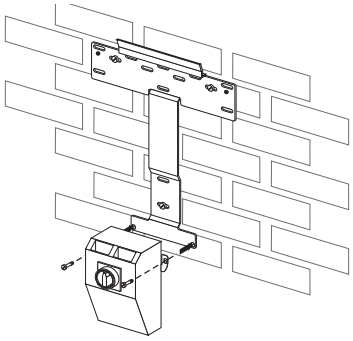
5.3.3 Mounting the SMA DC Disconnect

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).

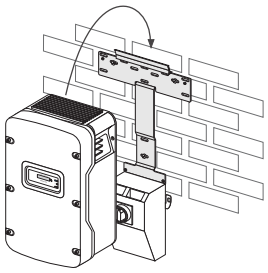
1. Remove the handle covers on the right and left side of the Sunny Boy.

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

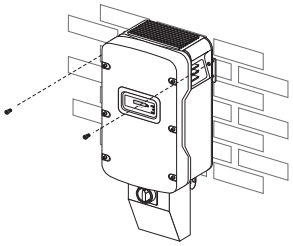
   or

   Feed a steel rod with a maximum diameter of $1\,{}^{1}/_{8}$ 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.



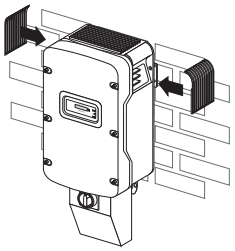
3. Screw the Sunny Boy onto the wall mounting bracket on both sides with the screws supplied.
4. Tighten the screws clockwise with a tightening torque of 44 in-lbs. (5 Nm).



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

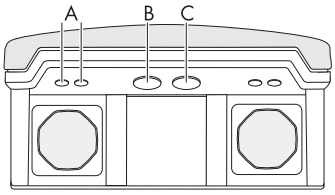
The grounding conductor in the framework of the PV array must be connected to the PV grounding conductor and the DC grounding conductor (see section 4.2 "Locating Internal Component Parts" (page 19)). The cross section of the grounding conductor corresponds to the cross-section of the largest conductor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

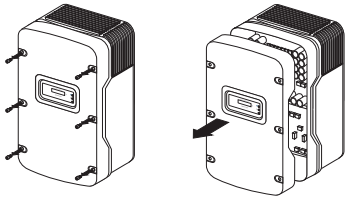
DANGER

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.

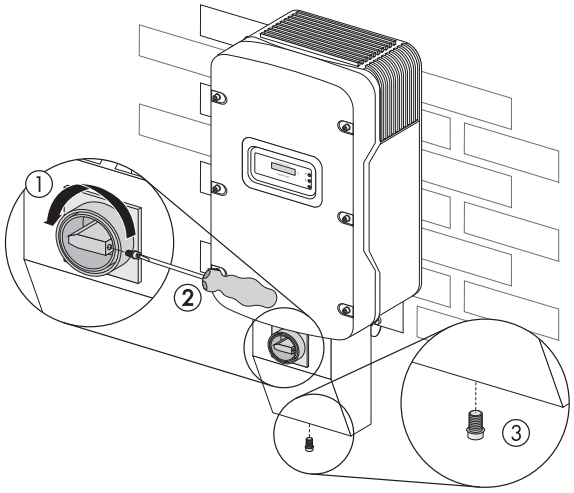
Potential damage to the seal when opening the Sunny Boy.

- 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".

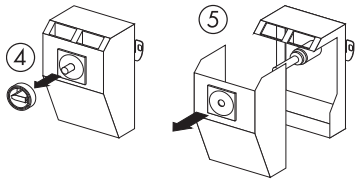


2. Loosen the screws in the right area of the SMA DC Disconnect. Use a cross-head screwdriver (screw used: UNC no. $5x^{3}/_{4}$ in., cross-head, flat-head, metal).

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.

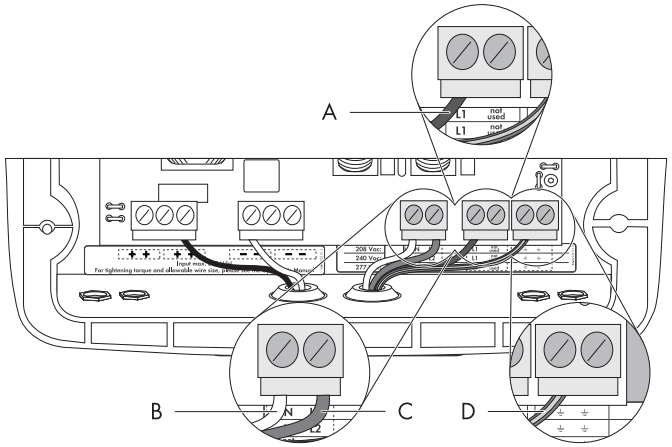
Open terminal fully before feeding through the cables.

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)

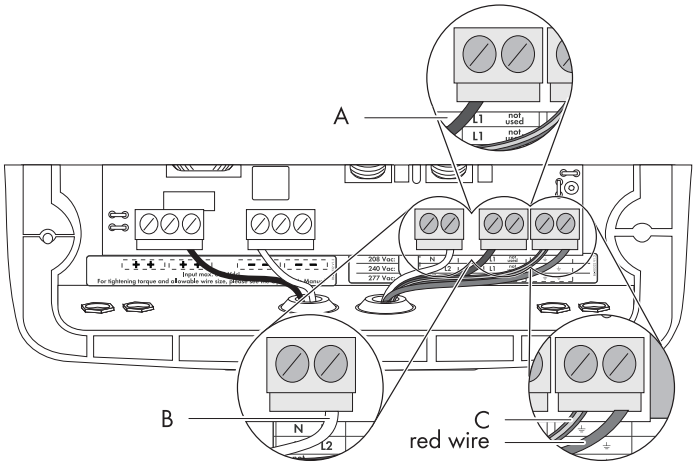
14. Check that all terminals have the correct wiring and that the cables are secure.

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

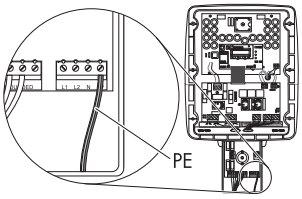
- In the switchbox, disconnect the cables for the AC line on which you are working.

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.

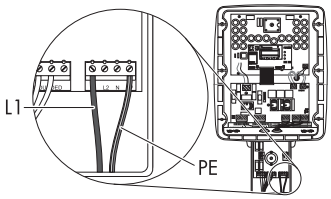
6. Connect the AC device grounding conductor to the PE terminal labeled ⏚ in the SMA DC Disconnect.



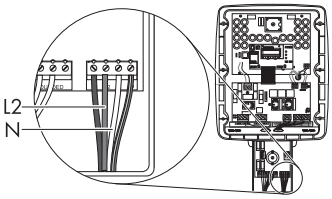
208 V and 240 V System Configuration:

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.

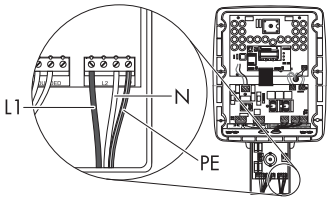


When using grounded 240 V or 208 V Delta grids:

- Connect terminal L2 to the grounded phase.

277 V System Configuration:

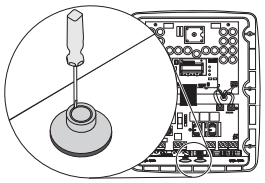
10. Connect L1 (AC conductor 1 or UNGROUNDED) to terminal L1. Do not use terminal L2.
11. Connect conductor N (AC conductor N) to terminal N.



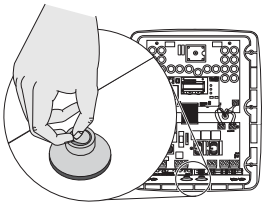
12. Tighten the cables with a torque of 15 in-lbs. (1.7 Nm).
13. Check that all terminals have the correct wiring and that the cables are secure.

Connecting the AC Cables in the Sunny Boy

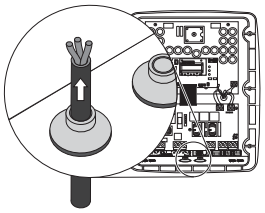
14. Using a screwdriver, make a hole in the rubber grommet in the inverter.



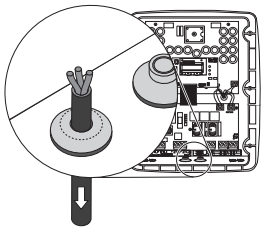
15. Remove the rubber membrane.



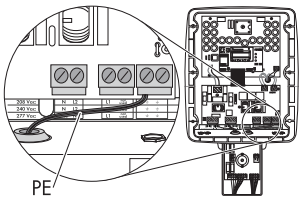
16. Feed the cable through the rubber grommet into the inverter.



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



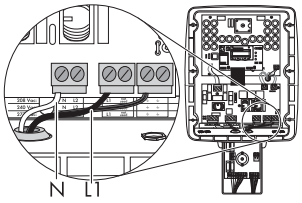
18. Connect the green-yellow cable of the SMA DC Disconnect to the terminal labeled ⏚.



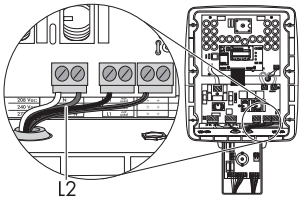
208 V and 240 V System Configuration

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.

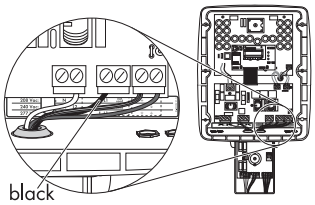


20. Connect the red insulated conductor to the terminal labeled L2.



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.

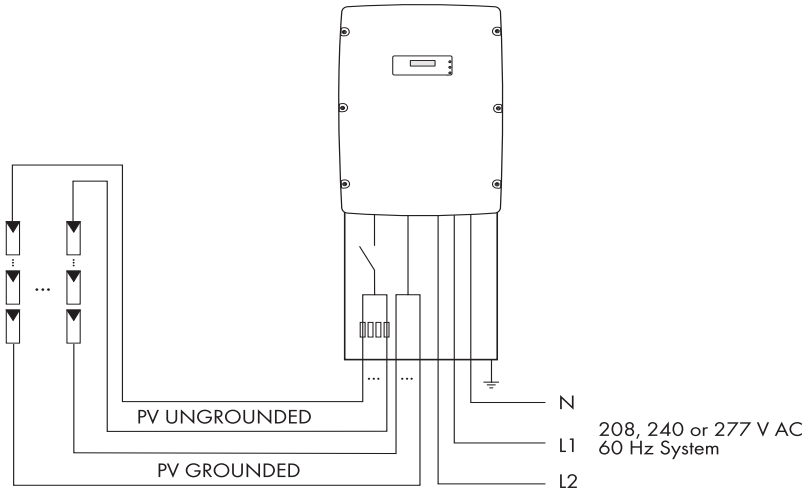
- Only connect the DC cable from the PV module to the inverter as described in this manual.

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

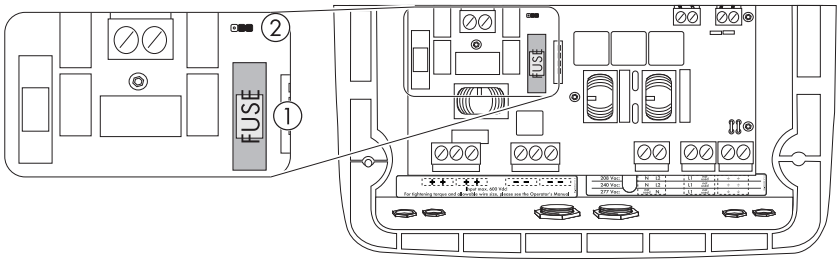
The DC disconnect for the inverter must have a minimum rating of 600 V DC and 36 A continuous. The SMA DC Disconnect is supplied with 4 fuses (one fuse per string) designed for 15 A and 600 V DC. The 4 fuses of the SMA DC Disconnect may be used for a maximum of 20 A and 600 V DC.

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

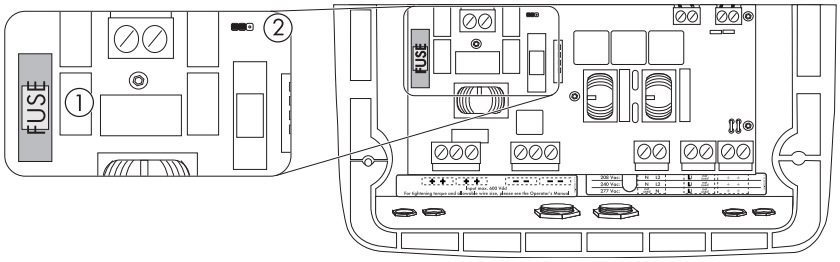
The Sunny Boy configured ex works for plants with negative generator grounding. Certain types of PV modules may make it necessary to ground the negative pole rather than the positive pole.

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).