



Sunny Boy Accessories

SUNNY BOY COMBINER BOX TLUS SBCBTL6

Installation Guide



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IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for the Sunny Boy Combiner Box that must be followed during installation and maintenance of the Sunny Boy Combiner Box.

The Sunny Boy Combiner Box 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 Sunny Boy Combiner Box. To reduce the risk of personal injury and to ensure the safe installation and operation of the Sunny Boy Combiner Box, you must carefully read and follow all instructions, cautions and warnings in this installation guide.

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 installation guide:



Information

This symbol accompanies notes that call attention to supplementary information that you should 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 be done as described in its documentation.



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.



Earth Ground



Observe the operating instructions

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



UL1741 is the standard applied by Underwriters Laboratories to the Sunny Boy Combiner Box to certify that it meets the requirements of the *National Electrical Code*®.

General Warnings



General Warnings

All electrical installations must be done in accordance with the local and *National Electrical Code*® ANSI/NFPA 70. For installation in Canada the installations must be done in accordance with applicable Canadian standards.

The Sunny Boy Combiner Box contains no user-serviceable parts. For all repair and maintenance, always return the unit to an authorized SMA Service Center.

Before installing or using the Sunny Boy Combiner Box, read all of the instructions, cautions, and warnings on the Sunny Boy Combiner Box in this installation guide.

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

Wiring of the Sunny Boy Combiner Box must be made by qualified personnel only.

Table of Contents

1 Notes on this manual. 9

1.1 Target group 9

1.2 Validity 9

1.3 Nomenclature 9

2 Security 10

2.1 Appropriate usage 10

2.2 Safety precautions 11

3 Unpacking. 12

3.1 Unpacking and inspection 12

3.2 Scope of delivery 12

3.3 Identifying the Sunny Boy Combiner Box 13

4 Mounting. 14

4.1 Safety 14

4.2 Selecting the mounting location 15

4.2.1 Conditions for installation 15

4.2.2 Dimensions 16

4.3 Wall mounting 17

4.3.1 Stone wall mounting 17

4.3.2 Wood wall mounting 17

4.3.3 Mounting the Sunny Boy Combiner Box 18

5 Inserting the strings 19

6 Electrical connection. 20

6.1 Connection area 20

6.2 Fuse sizing 21

6.3 Connecting equipment ground 22

6.4 Connecting PV modules 23

6.4.1 Inserting the string fuses 23

6.4.2 Connecting the negative strings 24

6.4.3 Connecting the positive strings 24

6.5 Connecting the inverter 25

6.5.1 Connecting DC+ 25

6.5.2 Connecting DC – 26

7 Commissioning 26

8 Opening and closing 27

8.1 Opening the Sunny Boy Combiner Box 27

8.2 Closing the Sunny Boy Combiner Box 28

9 Replacing string fuses 29

10 Maintenance 31

11 Technical Data 32

11.1 Cable requirements. 33

12 Contact 34

1 Notes on this manual

This manual describes the installation and commissioning of the Sunny Boy Combiner Box SBCBTL6. Keep this manual in a convenient place for future reference

1.1 Target group

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

1.2 Validity

This manual is valid for the Sunny Boy Combiner Box TLUS. It does not cover any details concerning connected equipment. Information concerning the connected equipment is provided by the manufacturer.

1.3 Nomenclature

In this document SMA America Production, LLC is referred to in the following as SMA. In this manual the Sunny Boy Combiner Box TLUS is referred to as Sunny Boy Combiner Box.

2 Security

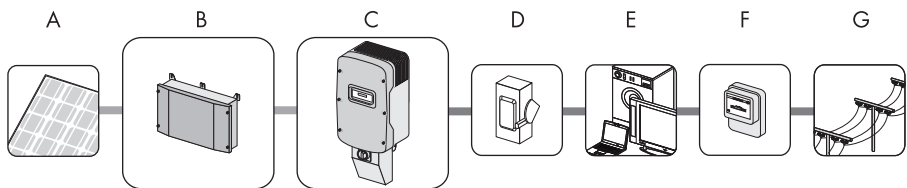
2.1 Appropriate usage

The Sunny Boy Combiner Box is a string combiner connecting up to 6 strings and linking them to the inverter. All inputs must be fused in accordance with *National Electrical Code*® NEC 690. The Combiner Box is designed for the use with transformerless SMA PV inverters.



The Sunny Boy Combiner Box can only be used in ungrounded array installations.

Principle of a PV power system with the Sunny Boy Combiner Box



Position	Description
A	PV modules
B	Sunny Boy Combiner Box
C	Sunny Boy with DC Disconnect
D	AC main circuit breaker
E	Load
F	Meter
G	Grid

Do not use the Sunny Boy Combiner Box for purposes other than those described here. Alternative uses, modifications to the Sunny Boy Combiner Box or the installation of components not expressly recommended or sold by the manufacturer void the warranty claims and operation permission.

2.2 Safety precautions



DANGER

Risk of electric shock due to high voltages inside the Sunny Boy Combiner Box.

Death or serious injuries will result.

- All work on the Sunny Boy Combiner Box must be carried out by qualified personnel only.
- All work on the Sunny Boy Combiner Box must be done in accordance with this manual only.
- Pay attention to all safety precautions.



WARNING

Risk of electric shock during operation of a damaged Sunny Boy Combiner Box.

Death or serious injuries will result.

- The Sunny Boy Combiner Box may only be used when it is technically faultless.
- Operate the Sunny Boy Combiner Box only if no damage is visibly evident.
- Inspect the Sunny Boy Combiner Box for damage on a regular basis.
- Ensure that all external safety features are freely accessible at all times, and that they are regularly tested for correct functionality.

NOTICE

Electrostatic discharge is possible when components are touched.

Damage to components will result.

- Follow ESD protective provisions.
- Remove existing electrostatic charges by touching a grounded metal surface (e.g. housing).

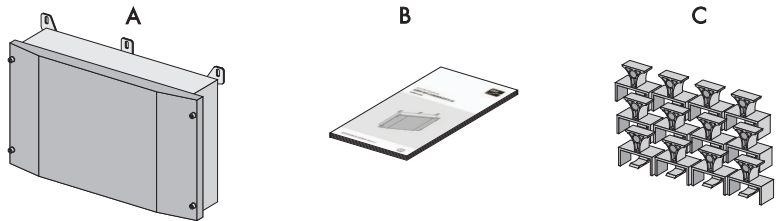
3 Unpacking

3.1 Unpacking and inspection

All SMA Sunny Boy Combiner Boxes are checked before shipping and packaged in sturdy boxes. However the sturdy boxes do not guarantee that damage will not occur during shipping and delivery. It is important to carefully inspect the shipping box and contents prior to installation. If you detect any external damage after unpacking, report the damage immediately to your SMA dealer and to the shipping company that delivered the unit. If it becomes necessary to return the Sunny Boy Combiner Box, use the original packing material.

If you need assistance with a damaged Sunny Boy Combiner Box, contact your SMA dealer or SMA. Contact information for SMA is provided in chapter 12 "Contact" (page 34).

3.2 Scope of delivery



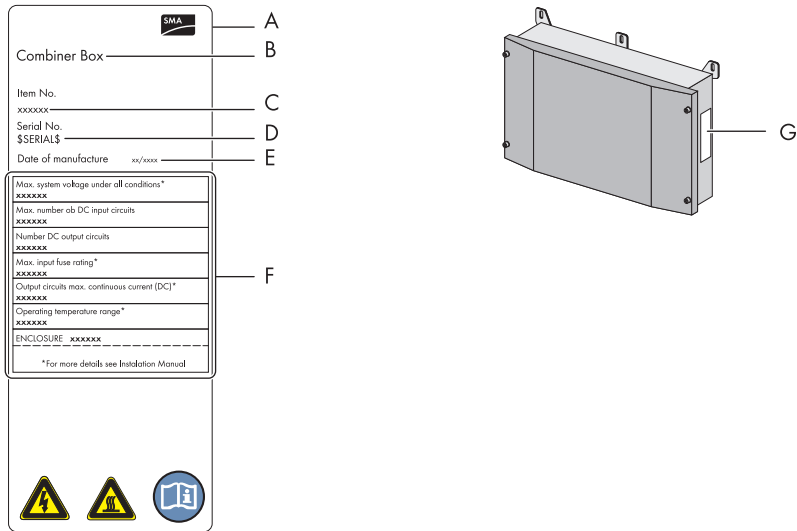
Position	Number	Description
A	1	Sunny Boy Combiner Box
B	1	Installation Guide
C	12	Fuse holder



The Sunny Boy Combiner is shipped without any fuses. For correct operation fuses have to be purchased by the installer.

3.3 Identifying the Sunny Boy Combiner Box

The Sunny Boy Combiner Box can be identified by the type label. The type label (G) is located on the right side of the enclosure.



Position	Description
A	Type plate
B	Product name
C	Item number
D	Serial number
E	Date of manufacture
F	Technical data
G	Position of type label

4 Mounting

4.1 Safety



DANGER

Danger to life due to fire or explosion.

There is always a certain risk with electric devices that a fire can occur, even though greatest attention was paid to avoid this during the development.

- Do not install the Sunny Boy Combiner Box on flammable construction material.
- Do not install the Sunny Boy Combiner Box in areas where highly flammable material is stored.
- Do not install the Sunny Boy Combiner Box in potentially explosive areas.



WARNING

The Sunny Boy Combiner Box becomes hot during operation.

Danger of burn injuries.

- Mount the Sunny Boy Combiner Box so that it cannot be touched accidentally.



CAUTION

Falling of the Sunny Boy Combiner Box may cause injuries.

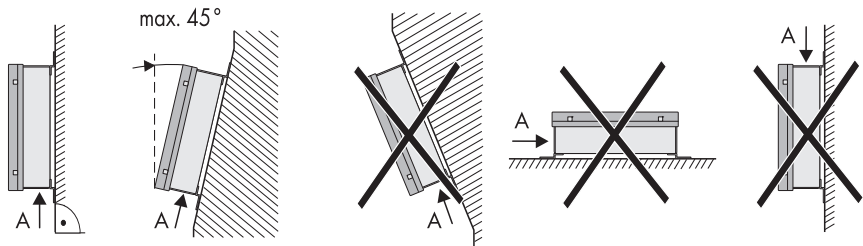
Crushing of body parts will result.

Consider the weight of the Sunny Boy Combiner Box of approx. 8¹/₂ lbs (3.9 kg).

4.2 Selecting the mounting location

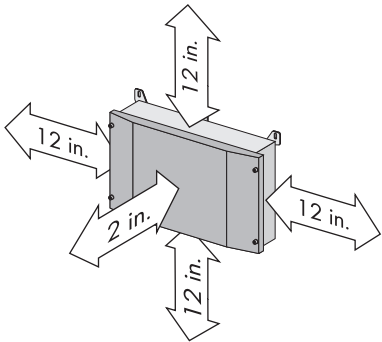
4.2.1 Conditions for installation

- The installation method and mounting location must be suitable for the weight and dimensions of the Sunny Boy Combiner Box (see section 11 “Technical Data” (page 32)).
- Mount on a solid surface.
- The mounting location must be accessible at all times.
- Never install the device with a forward tilt.
- Do not install horizontally.
- The connection area (A) must point downwards.
- Vertical installation or tilted backwards by max. 45°.



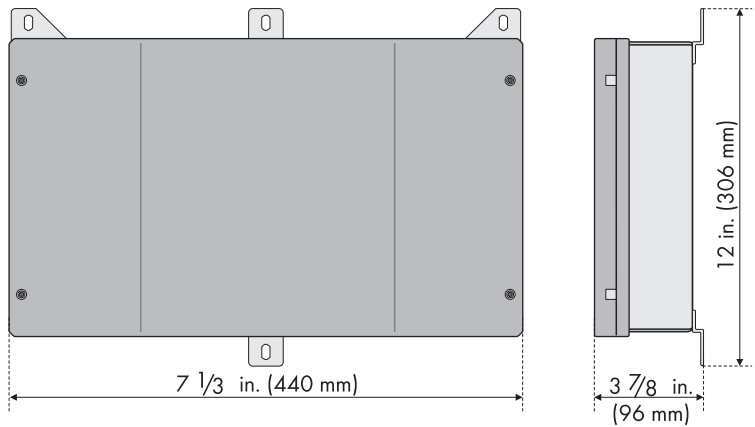
- During installation cover the PV modules with opaque material.
- The ambient temperature must be below 140 °F (60 °C) to ensure optimal operation.
- Do not expose the Sunny Boy Combiner Box to direct sunlight, in order to avoid excessive heating.
- Observe the minimum clearances to walls, other devices or objects in order to guarantee sufficient heat dissipation.

Position	Clearance
Top	12 in. (300 mm)
Bottom	12 in. (300 mm)
Left	12 in. (300 mm)
Right	12 in. (300 mm)
Front	2 in. (50 mm)

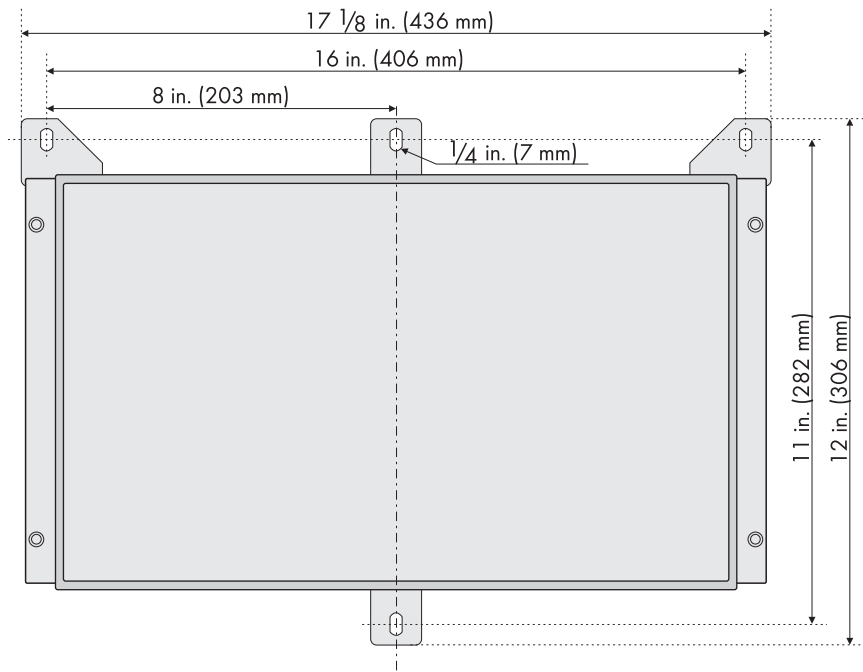


If the Sunny Boy Combiner Box is installed in an outdoor environment: Observe a minimum clearance of 36 in. (900 mm) to the ground.

4.2.2 Dimensions



Mounting holes on backside



4.3 Wall mounting

The Sunny Boy Combiner Box can be mounted on stone, brick, solid walls or wooden walls with poles. Be sure to use appropriate type of mounting hardware for the wall material.

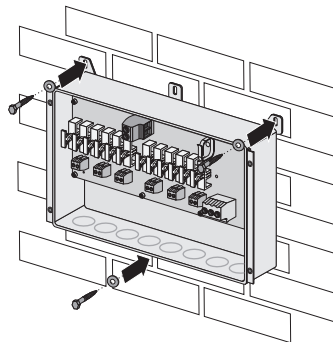
You may use screws of size 10, 12 or 14. The recommended length of the screws is $1\frac{1}{2}$ in. to $1\frac{3}{4}$ in.

4.3.1 Stone wall mounting

Attach the Sunny Boy Combiner Box using 3 screws.

- 1 screw on the upper left side.
- 1 screw on the upper right side.
- 1 screw below.
- Use stainless screws or comparable with fender washers.

Mount the Sunny Boy Combiner Box as described in section 4.3.3 "Mounting the Sunny Boy Combiner Box" (page 18).

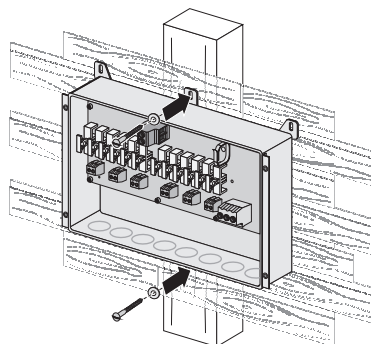


4.3.2 Wood wall mounting

Attach the Sunny Boy Combiner Box to a pole using 2 screws.

- 1 screw on the upper side.
- 1 screw below.
- Use stainless steel screws or comparable and washers.

Mount the Sunny Boy Combiner Box as described in section 4.3.3 "Mounting the Sunny Boy Combiner Box" (page 18).



4.3.3 Mounting the Sunny Boy Combiner Box

When mounting use the Sunny Boy Combiner Box as a template.

1. Place the Sunny Boy Combiner Box at the mounting position on the wall. Level the Sunny Boy Combiner Box.
2. Mark the mounting position through the mounting holes.



DANGER

Risk of electric shock by drilling into power cables.

Death or serious injuries will result.

- Check installation location for power cables.



CAUTION

Falling of the Sunny Boy Combiner Box may cause injuries.

Crushing of body parts will result.

- Ensure that there are studs in the wall at places where you intend to drill holes.

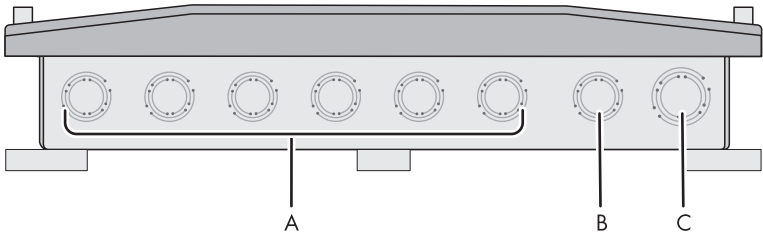
3. Remove the Sunny Boy Combiner Box and drill the marked mounting holes.
 4. Insert the wall anchors.
 5. Place the Sunny Boy Combiner Box on the wall. Align the mounting holes with the drilled holes.
 6. Insert the screws through the mounting holes of the Sunny Boy Combiner Box. Tighten the screws clockwise.
 7. Ensure that the Sunny Boy Combiner Box is attached firmly to the wall.
- ☒ The Sunny Boy Combiner Box is mounted to the wall.

5 Inserting the strings

NOTICE

Infiltration of water during mounting and installation of the product.
Damage to the product will result.

- Do not open the Sunny Boy Combiner Box when it is raining or when there is very high humidity > 95 %.
- For conduit hubs, use only UL listed rainproof, or wet location hubs complying with UL 514B for entry into the enclosure.

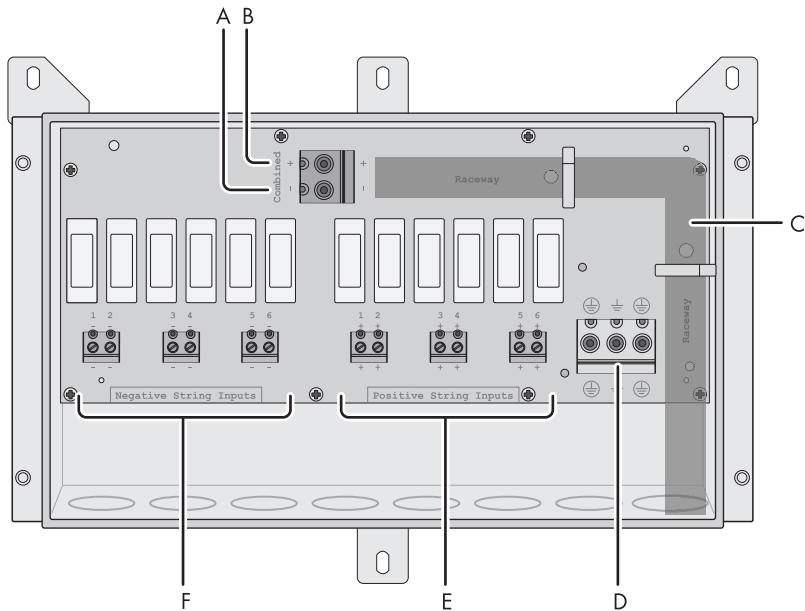


Position	Description
A	DC input
B	Grounding
C	DC combined output

1. Determine the number of the required strings referring to your system calculation.
 2. Open the Sunny Boy Combiner Box (see 8.1 "Opening the Sunny Boy Combiner Box" (page 27)).
 3. Break out the number of knockouts needed for the cable conduits. For each string cable a separate conduit is needed.
 4. Insert the cable conduit fittings into the knockout holes.
 5. Pull the cable conduits into the fittings and tighten them.
 6. Draw the string cables through the cable conduits into the Sunny Boy Combiner Box.
- ☒ The cables are inserted into the Sunny Boy Combiner Box.

6 Electrical connection

6.1 Connection area



Position	Description
A	Combined out negative
B	Combined out positive
C	Raceway
D	Equipment grounding
E	Positive string inputs
F	Negative string inputs

6.2 Fuse sizing

Fuses are used to protect wiring and equipment from excessive currents that can cause damage, heating or in extreme cases even fire. If the fuse rating is too small the fuses can trip during normal operation. If the fuse rating is too large, the fuses cannot provide adequate protection. In PV systems, the minimum and maximum size of the standard fuses are determined by the electrical ratings of the PV module as well as *National Electrical Code*® requirements. Be sure to consult your PV module manufacturer for appropriate fuse ratings.



The maximum string fuse rating for the Sunny Boy Combiner Box is 20 A.

The minimum size of fuses and wiring is calculated by using the Short Circuit Current Rating (Isc) of the PV module. The *National Electrical Code*® requires that all fuses and wiring must be sized for a minimum of 1.56 times of the Isc of the PV module used in the system.

- To determine the proper size of PV string fuses calculate $1.56 \times I_{sc}$ of the PV module and round up to the next standard fuse size.



If the Isc of the PV module equals 6.9 Adc, then the fuse size is determined by $1.56 \times 6.9 = 10.76$. The next standard fuse size would be a 12 A, 600 V DC fuse.

PV string fuses

1. Determine the required number and type of fuses.
 - Use the same number of fuses for negative and positive string input.
2. Determine the required fuse size referring to your system calculation.
 - Place fuses only in positions with corresponding numbers.
 - Insert all fuse holders provided with the Sunny Boy Combiner Box.

The table below shows the string current per number of strings:

Number of strings	Maximum string current	Maximum continuous string current
3	18.70 A	12.00 A
4	14.00 A	9.00 A
5	11.20 A	7.20 A
6	9.40 A	6.00 A

Sunny Boy Combiner Box requirements


NEC 690.15-18 allows the use of fuse holders as a suitable means of disconnecting PV arrays for servicing. Additional external DC disconnects at the inverter may be required by the local authority having jurisdiction.

6.3 Connecting equipment ground

The PV system grounding must be installed in accordance with the requirements of sections 690.43 through 690.47 of the *National Electrical Code*®, ANSI/NFPA 70. In Canada, wiring methods shall be in accordance to the Canadian Electrical Code Part II.

The installer bears the responsibility for correct installation.

Use only 194 °F (90 °C) rated copper wire for wiring connections to the Sunny Boy Combiner Box.


DANGER

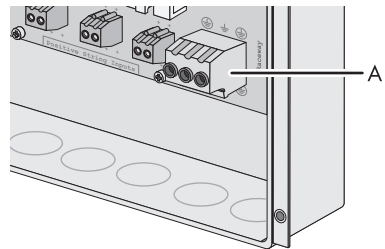
Risk of electric shock when touching the DC cable attached to the PV module.
 Death or serious injuries will result.
 Voltage is present in PV modules exposed to light.

- Cover the PV modules with opaque material during installation and maintenance.
- Follow all safety precautions of the module manufacturer.

The grounding terminal block (A) is located at the bottom right corner of the Sunny Boy Combiner Box. Following components may be connected to the grounding terminals:

- AC equipment-grounding
- DC equipment-grounding

1 terminal of the block remains unused.



Consider the required cable sizes and torques. Refer to 11.1 "Cable requirements" (page 33).

NOTICE

Danger of fire

The cable cross-section of the equipment grounding must not be smaller than the one of Combined-Out.

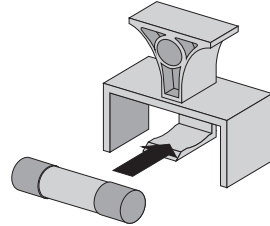
1. Strip the cable by approx. 0.3 in. (8 mm).
 2. Open the screw terminals completely by turning them counterclockwise with a flat-head screwdriver.
 3. Plug the stripped cable into the screw terminal.
 4. Tighten the screw terminal clockwise.
- ☒ The components are grounded.



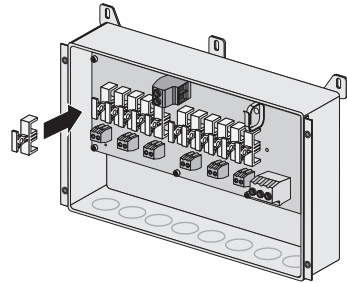
6.4 Connecting PV modules

6.4.1 Inserting the string fuses

1. Open the Sunny Boy Combiner Box as described in section 8.1 "Opening the Sunny Boy Combiner Box" (page 27).
2. Insert fuses into the fuse holders.



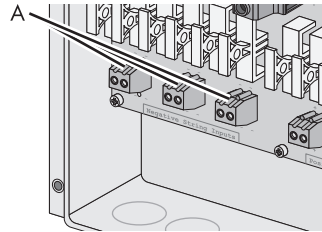
3. Insert all fuse holders provided with the Sunny Boy Combiner Box.



4. Close the Sunny Boy Combiner Box as described in section 8.2 "Closing the Sunny Boy Combiner Box" (page 28).
- ☒ The string fuses are inserted.

6.4.2 Connecting the negative strings

Use the "Negative String Inputs" screw terminals(A).

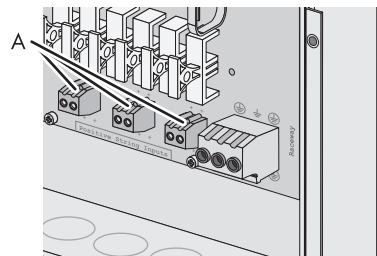


1. Strip the cable by approx. 0.3 in. (8 mm).
 2. Open the screw terminals completely by turning them counterclockwise with a flat-head screwdriver.
 3. Plug the stripped cable into the screw terminal.
 4. Tighten the screw terminal clockwise.
- ☒ The negative strings of the PV modules are connected.



6.4.3 Connecting the positive strings

Use the "Positive String Inputs" screw terminals (A).



1. Strip the cable by approx. 0.3 in. (8 mm)
 2. Open the screw terminals completely by turning them counterclockwise with a flat-head screwdriver.
 3. Plug the stripped cable into the screw terminal.
 4. Tighten the screw terminal clockwise.
- ☒ The positive strings of the PV modules are connected.



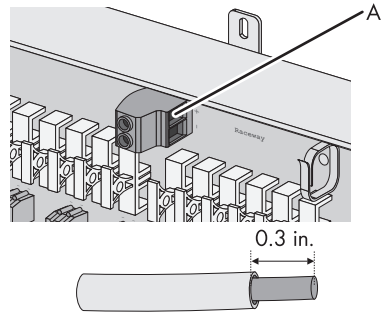
6.5 Connecting the inverter

Route the cables of the combined screw terminal to the inverter along the raceway printed on the board (see figure on page 20).

Consider the required cable sizes and torques. Refer to 11.1 "Cable requirements" (page 33).

6.5.1 Connecting DC+

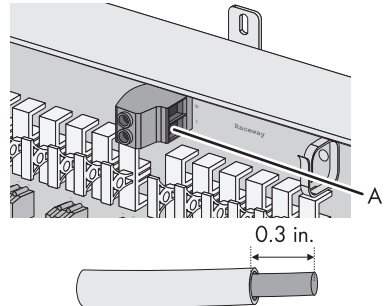
Connect the DC+ conductors of the DC inverter/ disconnect at the inverter to the "Combined Out+" screw terminals (A).



1. Strip the cable by approx. 0.3 in. (8 mm)
 2. Open the screw terminals completely by turning them counterclockwise with a flat-head screwdriver.
 3. Plug the stripped cable into the screw terminal.
 4. Tighten the screw terminal clockwise.
- ☒ DC+ of the inverter is connected.

6.5.2 Connecting DC –

Connect the DC – conductors of the DC Disconnect at the inverter/disconnect to the "Combined Out –" screw terminals (A).



1. Strip the cable by approx. 0.3 in. (8 mm).
 2. Open the screw terminals completely by turning them counterclockwise with a flat-head screwdriver.
 3. Plug the stripped cable into the screw terminal.
 4. Tighten the screw terminal clockwise.
 5. Close the Sunny Boy Combiner Box as described in section 8.2 "Closing the Sunny Boy Combiner Box" (page 28).
- ☒ DC – of the inverter is connected.


7 Commissioning

The Sunny Boy Combiner Box is only one part of the whole PV system. Therefore the commissioning of the Sunny Boy Combiner Box can not be performed separately.

All parts of the PV power system must be installed and set up prior to commissioning.


8 Opening and closing

8.1 Opening the Sunny Boy Combiner Box

**DANGER**

Risk of electric shock when opening the Sunny Boy Combiner Box under load.
Death or serious injuries will result.

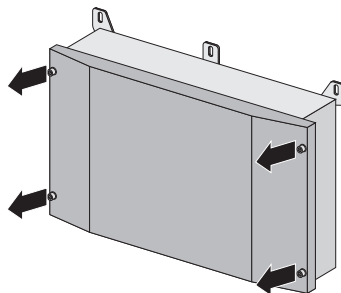
- Cover the PV modules with an opaque material during installation.

**DANGER**

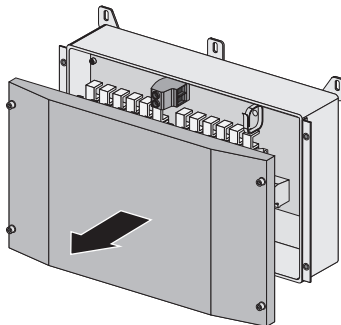
High voltages are present in the Sunny Boy Combiner Box.
Death or serious injury due to electric shock will result.

- Switch off the inverter as described in the installation guide of the inverter.

1. Untighten the four screws of the enclosure lid. Pull the lid forward smoothly.



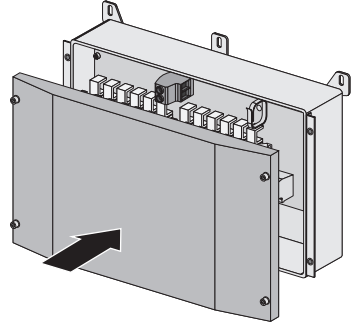
2. Place the lid aside. There it will be out of your way while you are connecting wires and cables to the Sunny Boy Combiner Box.



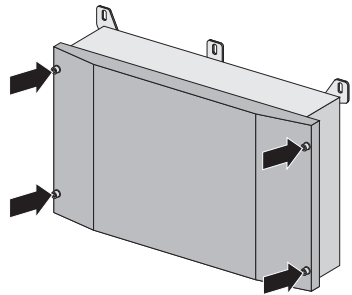
- ☒ The Sunny Boy Combiner Box is opened.

8.2 Closing the Sunny Boy Combiner Box

1. Check wire routing to ensure that no wires can interfere with the seal of the lid.
2. Check the seal on the inside of the lid to ensure it is undamaged and in correct position.
3. Carefully position the lid on the front of the Sunny Boy Combiner Box. Ensure that no pressure is exerted on the connections when the lid is attached.



4. While holding the lid in place turn the four screws until they are snug tight. Be careful not to cross-thread any of the screws.
5. Tighten the screws clockwise with a torque of 35 in-lbs. (4 Nm).



- ☒ The Sunny Boy Combiner Box is closed.

9 Replacing string fuses



DANGER

Danger to life due to high voltages on exposed contacts.

- All fuse holders must be plugged in, even if the fuse holder is blank.



DANGER

Danger to life due to high voltages within the device.

- Do not touch power cables and screw terminals.

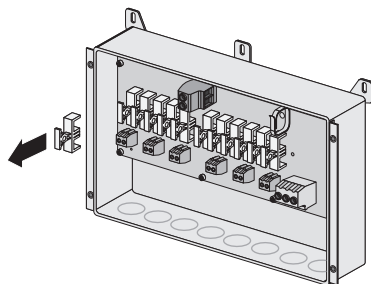
NOTICE

Risk of fire due to incorrectly dimensioned fuse.

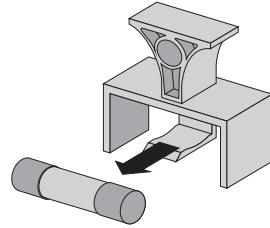
Injuries due to fire.

- For continuous protection, only replace fuses with fuses of the same type and size.
- Place the new fuses at exactly the same locations as the previous fuses.

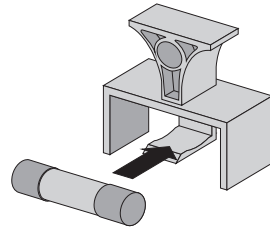
1. Open the Sunny Boy Combiner Box as described in section 8.1 "Opening the Sunny Boy Combiner Box" (page 27).
2. Remove all fuse holders.



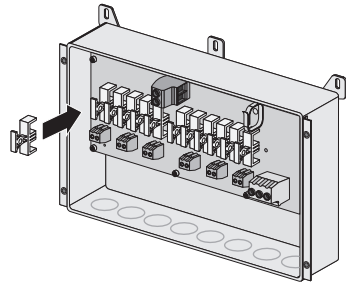
3. Pull the fuses out of the fuse holders.



4. Insert the new fuses into the fuse holders.



5. Insert all fuse holders provided with the Sunny Boy Combiner Box.



6. Close the Sunny Boy Combiner Box as described in section 8.2 "Closing the Sunny Boy Combiner Box" (page 28).
- ☒ The string fuses are replaced.

10 Maintenance

The Sunny Boy Combiner Box is designed to provide many years of trouble-free service. Performing regular maintenance will help to ensure long life and high efficiency of your PV system.

Maintenance may include:

- Inspection of mounting.
- Inspection of electrical connections and components.
- Cleaning of housing and interior if necessary.



The inspection intervals depend on the location and the ambient conditions.

A device installed in an environment with very dusty ambient air requires more frequent inspection and cleaning.

11 Technical Data



Specifications subject to change without notice.
 Values at nominal conditions.

Connection data

Input voltage range	0 V ... 600 V DC
Maximum current per string	20 A
Nominal DC output current	36 A
Maximum DC output current	56.16 A
Maximum number of strings	6
Maximum number of fuses	12

General data

Dimençons W x H x D	17.2 in. x 12.1 in. x 3.8 in. (437 mm x 306 mm x 96 mm)
Weight	8.6 lbs. (3.9 kg)
Ambient temperature range	– 13 °F ... +140 °F (–25 °C ... +60 °C)
Mounting location	indoor/outdoor (NEMA 3R)
Rel. humidity	< 95 %, condensation possible
Maximum height above sea level (NHN)	9,840 ft. (3,000 m)
Type of housing	Aluminium

11.1 Cable requirements

Use only 194 °F (90 °C) copper wire for all DC wiring connections to the screw terminals between

- PV modules and Sunny Boy Combiner Box
- Sunny Boy Combiner Box and Sunny Boy

Connection - Sunny Boy Combiner Box

The conductor cross-section must be adjusted to the maximum current.

Terminal	Torque	Wire Size
String Inputs*	15 in-lbs. (1.7 Nm)	14 AWG ... 6 AWG (2.5 mm ² ... 16 mm ²)
Combined Out*	40 in-lbs. (4.5 Nm)	6 AWG ... 2 AWG (16 mm ² ... 35 mm ²)
Equipment grounding*	40 in-lbs. (4.5 Nm)	8 AWG ... 2 AWG (10 mm ² ... 35 mm ²)

*The listed terminals are rated to a temperature of +221 °F (+105 °C).

12 Contact

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

- Type of inverter, if applicable
- Type and number of modules connected, if applicable
- Communication method, where necessary
- Serial number of the Sunny Boy Combiner Box
- Sunny Boy failure or warning number
- Display message of the Sunny Boy

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