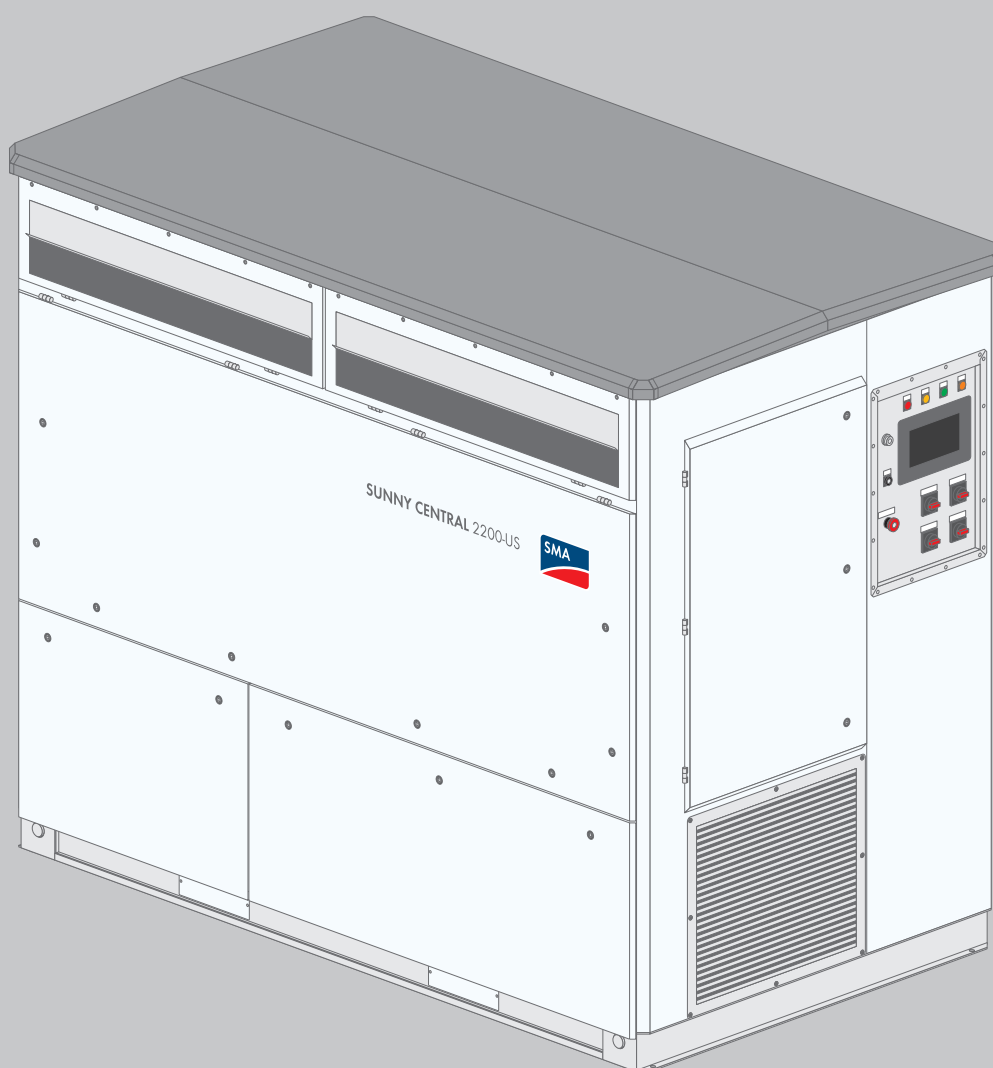




Installation manual

# **SUNNY CENTRAL 2200-US** **SUNNY CENTRAL 1850-US**



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**SMA America, LLC**

3801 N. Havana Street

Denver, CO 80239 U.S.A.

**SMA Solar Technology Canada Inc.**

2425 Matheson Blvd. E

7th Floor

Mississauga, ON L4W 5K4

Canada

## Important Safety Information

### SAVE THESE INSTRUCTIONS

This manual contains important instructions for the following products:





- SC-2200-US-10 (Sunny Central 2200-US)
- SC-1850-US-10 (Sunny Central 1850-US)

This manual must be followed during installation and maintenance.

The product is designed and tested in accordance with 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.

Symbol	Description
	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
	NOTICE is used to address practices not related to personal injury.

### Warnings on this Product

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



#### Beware of dangerous voltage

The product operates at 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.



#### Risk of fire

Improper installation of the product may cause a fire.



#### Beware of hot surface

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



**Use hearing protection**

The product generates loud noises. When working on the product, wear hearing protection.

---



**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.

## General Warnings

### WARNING

#### General Warnings

All electrical installations must be carried out in accordance with the local standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1. This document does not replace and is not intended to replace any local, state, provincial, federal or national laws, regulations 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 non-compliance with such laws or codes in connection with the installation of the product.

- 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.

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# 1 Information on this Document

## 1.1 Validity

This document is valid for the following device types:

Device type	Production version	Firmware version
SC-2200-US-10 (Sunny Central 2200-US)	Q3	1.0
SC-1850-US-10 (Sunny Central 1850-US)	Q3	1.0

The production version of the inverter is indicated on the type label.

The firmware version can be read off from the user interface.

Illustrations in this document are reduced to the essential and may deviate from the real product.

## 1.2 Target Group





The tasks described in this document must only be performed by qualified persons. Qualified persons must have the following skills:

- Knowledge of how the product works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of and adherence to this manual and all safety information
- Training in dealing with dangers and risks in electrical installations according to 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC and NFPA 70E
- Training in risk prevention when working with electrical installations

## 1.3 Additional Information

Links to additional information can be found at [www.SMA-Solar.com](http://www.SMA-Solar.com).

## 1.4 Symbols

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
	Indicates a requirement for meeting a specific goal
	Desired result
	A problem that might occur

## 1.5 Typographies

Typographies	Use	Example
<b>bold</b>	<ul style="list-style-type: none"> <li>• Display messages</li> <li>• Elements on a user interface</li> <li>• Terminals</li> <li>• Slots</li> <li>• Elements to be selected</li> <li>• Elements to be entered</li> </ul>	<ul style="list-style-type: none"> <li>• Set parameter <b>WGra</b> to <b>0.2</b>.</li> </ul>
<b>&gt;</b>	<ul style="list-style-type: none"> <li>• Connects several elements to be selected</li> </ul>	<ul style="list-style-type: none"> <li>• Select <b>PV system &gt; Detect</b>.</li> </ul>
<b>[Button/Key]</b>	<ul style="list-style-type: none"> <li>• Button or key to be selected or pressed</li> </ul>	<ul style="list-style-type: none"> <li>• Select <b>[Start detection]</b>.</li> </ul>

## 1.6 Nomenclature

Complete designation	Designation in this document
Sunny Central 2200-US	Sunny Central or inverter
Sunny Central 1850-US	Sunny Central or inverter

## 2 Safety

### 2.1 Intended Use

The Sunny Central is a PV inverter which converts the direct current generated in the PV modules into grid-compliant alternating current. An external MV transformer fitted downstream feeds the generated alternating current into the utility grid.

The product is designed for outdoor use only.

The inverter is classified under Class 4C2 as per IEC 60721-3-4: 1995 and is suitable for operation in a chemically active environment. The enclosure corresponds to UL 1741 "Type 3R" and can also be operated in rain, sleet and snow.

It is only permitted to use the product in a PV power plant which is designed as a closed electrical operating area as per IEC 61936-1.

The specified minimum clearances must be observed.

The required fresh-air supply must be assured. Ensure that no exhaust air of other devices is sucked in.

The maximum permissible DC input voltage of the inverter must not be exceeded.

The inverter must only be operated in conjunction with a suitable MV transformer.

The MV transformer must be designed for the voltages that arise during the pulsed mode of the inverter.

Do not switch off or adjust settings that affect grid management services without first obtaining approval from the grid operator.

Use this product only in accordance with the information provided in the enclosed documentation and with the locally applicable standards and directives. Any other application may cause personal injury or property damage.

Alterations to the product, e.g. changes or modifications, are only permitted with the express written permission of SMA. Unauthorized alterations will void guarantee and warranty claims and usually void the operating license. SMA shall not be held liable for any damage caused by such changes.

Any use of the product other than that described in the Intended Use section does not qualify as appropriate.

The enclosed documentation is an integral part of this product. Keep the documentation in a convenient place for future reference and observe all instructions contained therein.

Only persons fulfilling all of the skills for the target group are permitted to work on or with the product.

All work on the product must only be performed using appropriate tools and in compliance with the ESD protection regulations.

Suitable personal protective equipment is to be worn by all persons working on or with the product.

Unauthorized persons must not operate the product and must be kept at a safe distance from the product.

The product must not be operated with open covers or doors.

The product must not be opened when it is raining or when humidity exceeds 95%.

The product must not be operated with any technical defects.

The type label must remain permanently attached to the product.

## 2.2 Safety Information

This section contains safety information that must be observed at all times when working on or with the product. To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

### DANGER

#### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

### DANGER

#### **Danger to life from electric shock due to live DC cables**

DC cables connected to PV modules that are exposed to light are live. Touching live cables results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Prior to connecting the DC cables, ensure that the DC cables are voltage-free.

### DANGER

#### **Danger to life from electric shock due to ground fault**

If a ground fault has occurred, parts of the PV power plant that are supposedly grounded may in fact be live. Touching incorrectly grounded parts of the PV power plant results in death or serious injuries from electric shock.

- Before working on the system, ensure that no ground fault is present.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.

**⚠ DANGER****Danger to life from electric shock due to damaged product**

Operating a damaged product can lead to hazardous situations that result in death or serious injuries due to electric shock.

- Only operate the product when it is in a flawless technical condition and safe to operate.
- Check the product regularly for visible damage.
- Make sure that all external safety equipment is freely accessible at all times.
- Make sure that all safety equipment is in good working order.
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.

**⚠ WARNING****Danger to life from electric shock if the product is not locked**

If the product is not locked, unauthorized persons will have access to live components carrying lethal voltages. Touching live components can result in death or serious injury due to electric shock.

- Always close and lock the product.
- Ensure that no unauthorized person has access to the closed electrical operating area.

**⚠ WARNING****Risk of fire due to failure to observe torque specifications on live bolted connections**

Failure to follow the specified torques reduces the ampacity of live bolted connections so that the contact resistances increase. This can cause components to overheat and catch fire.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- When working on the device, use suitable tools only.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

**⚠ WARNING****Danger to life from electric shock when entering the PV field**

The ground-fault monitoring with GFDI, Remote GFDI does not provide protection from personal injury when the ground-fault monitoring is activated. PV modules which are grounded with ground-fault monitoring discharge voltage to ground. Entering the PV field can result in lethal electric shocks.

- Ensure that the insulation resistance of the PV field exceeds the minimum value. The minimum value of the insulation resistance is: 550  $\Omega$ .
- Before entering the PV field, switch the PV modules to insulated operation.
- Configure the PV power plant as a closed electrical operating area.

**⚠ WARNING****Hearing impairment due to high-frequency noises of the inverter**

The inverter generates high-frequency noises when in operation. This can result in hearing impairment.

- Wear personal protective equipment for all work on the product.
- Wear hearing protection.

**⚠ CAUTION****Risk of burns due to hot components**

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- Wear suitable personal protective equipment for all work on the product.

**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**⚠ CAUTION****Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**NOTICE****Property damage due to dust intrusion and moisture penetration**

Dust or moisture intrusion can damage the product and impair its functionality.

- Do not open the enclosure during rainfall or when humidity exceeds the specified thresholds. The humidity thresholds are: 0% to 95%.
- Only perform maintenance work when the environment is dry and free of dust.
- Only operate the product when it is closed.
- If the installation or commissioning process is interrupted, mount all panels.
- Close and lock the enclosure.
- The product must always be closed for storage.
- Store the product in a dry and covered location.
- Temperature at the storage location must be in the specified range. The temperature range is:  $-40^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$  ( $-40^{\circ}\text{F}$  to  $+158^{\circ}\text{F}$ ).

**NOTICE****Damage to electronic components due to electrostatic discharge**

Electrostatic discharge can damage or destroy electronic components.

- Observe the ESD safety regulations when working on the product.
- Wear suitable personal protective equipment for all work on the product.
- Discharge electrostatic charge by touching grounded enclosure parts or other grounded elements. Only then is it safe to touch electronic components.

## 2.3 Personal Protective Equipment

### **i** Always wear suitable protective equipment

When working on the product, always wear the appropriate personal protective equipment for the specific job.

All clothing should be in accordance with NFPA 70E Section 130.7. Appropriately insulated gloves for shock protection in accordance with NFPA 70E Section 130.7(C), rated at least 1,000 V shall be worn as required.

Any other prescribed protective equipment must also be used. When carrying out work on live parts of the inverter, wear protective equipment of the respective Hazard Risk Category in accordance with NEMA NFPA 70 E, table 130.7(C)(16). The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.

### **i** Personal protective equipment required

Appropriate arc flash hazard labels stating the required personal protective equipment (PPE) for exposed, energized interaction with the equipment, are attached. SMA has conducted an electric arc risk analysis in accordance with NFPA 70E. Appropriate arc flash hazard labels are attached. The required personal protective equipment (PPE) for exposed, energized interaction with the equipment is indicated on the labels. PPE is required for all routine maintenance, diagnostics, and commissioning activities as described in the SMA protocols. Areas within the machine also exist that cannot, under any circumstances, be exposed while energized. These areas are marked accordingly on the machine, and can only be made accessible after de-energization of the inverter.

For further information, contact us (see Section 10, page 100).

## 2.4 Warning Labels

### 2.4.1 Warning Labels on the Inverter

Warning labels designate dangers on the product. Warning labels must be observed before and while working on the inverter.

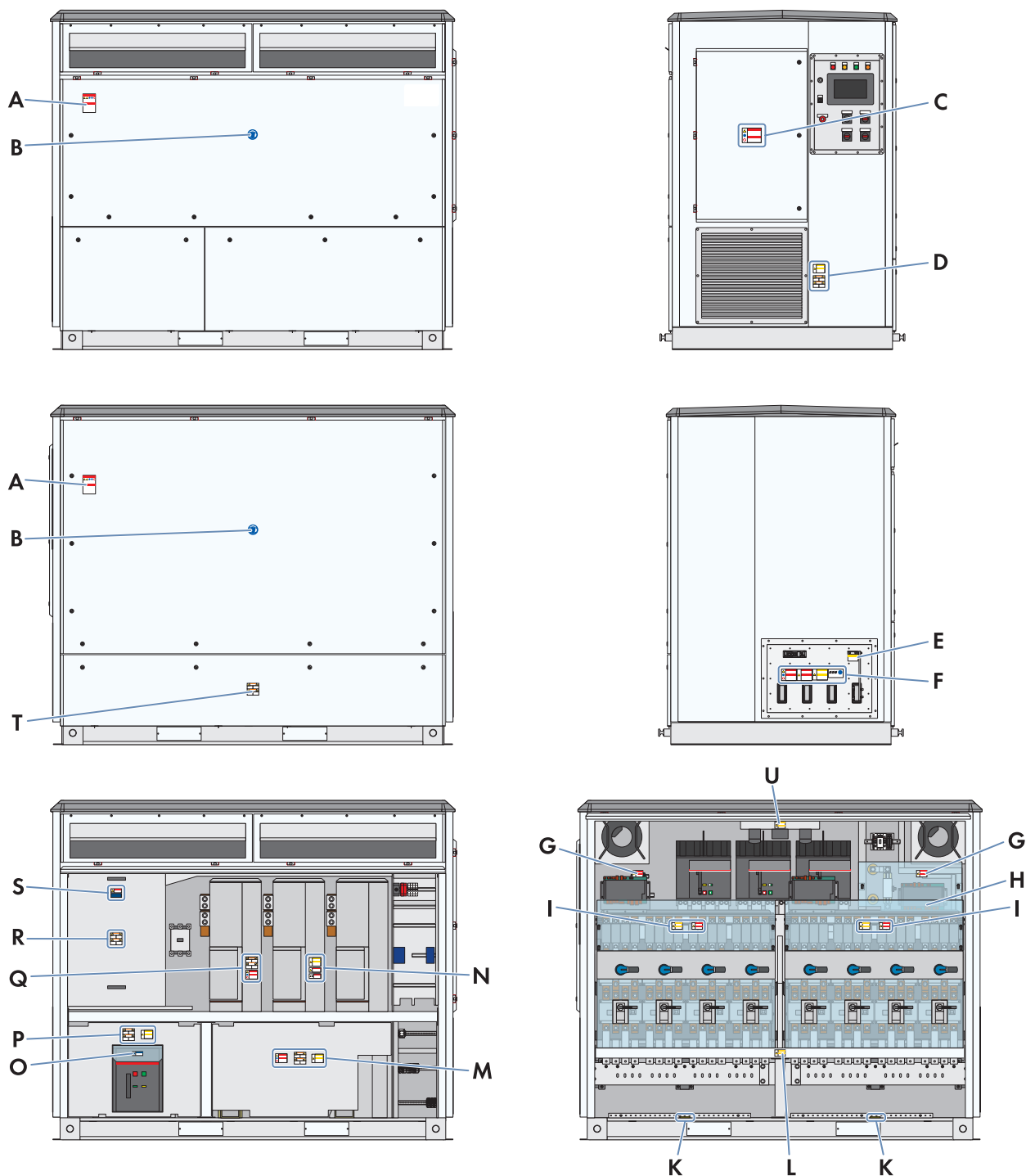


Figure 1: Position of the warning labels

Position	Order number	Position	Order number
A	86-00340132 (en-es)	M	86-114500 (en-es)
	86-00340137 (en-fr)		86-114600 (en-fr)
B	86-029687 (en-es)		86-106100 (en-es)
C	86-106200 (en-fr)		86-106200 (en-fr)
D	86-003314 (en)		86-110600.01 (en)
	86-003315 (es)		86-110700.01 (fr)
	86-003316 (fr)	N	86-110600.01 (en)
	86-114700 (en-es)		86-110700.01 (fr)
	86-114800 (en-fr)		86-10867153 (en)
E	86-0043460		86-10867154 (es)
F	86-106100.01 (en-es)		86-10867155 (fr)
	86-106200.01 (en-fr)		86-003314 (en)
	86-00340138 (en-es)		86-003315 (es)
	86-00340136 (en-fr)		86-003316 (fr)
	86-105300	O	86-004335
	86-0043469 (en-es)	P	86-114700 (en-es)
	86-0043470 (en-fr)		86-114800 (en-fr)
G	86-106500 (en-es)		86-110600.01 (en)
	86-106600 (en-fr)		86-110700.01 (fr)
F	86-00340131 (en-es)	Q	86-114700 (en-es)
	86-79616 (en-fr)		86-114800 (en-fr)
H	86-003307 (en)		86-106100 (en-es)
	86-10867056 (es)		86-106200 (en-fr)
	86-10867066 (fr)	R	86-003314 (en)
I	86-110600.01 (en)		86-003315 (es)
	86-110700.01 (fr)		86-003316 (fr)
	86-105100 (en-es)		86-003307 (en)
	86-105200 (en-fr)		86-10867056 (es)
K	86-0043460		86-10867066 (fr)
L	86-0043469 (en-es)	S	86-114700 (en-es)
	86-0043470 (en-fr)		86-114800 (en-fr)

Position	Order number	Position	Order number
		T	86-114700 (en-es)
			86-114800 (en-fr)
		U	86-110600.01 (en)
			86-110700.01 (fr)

### 3 Product Overview

#### 3.1 Design of the inverter

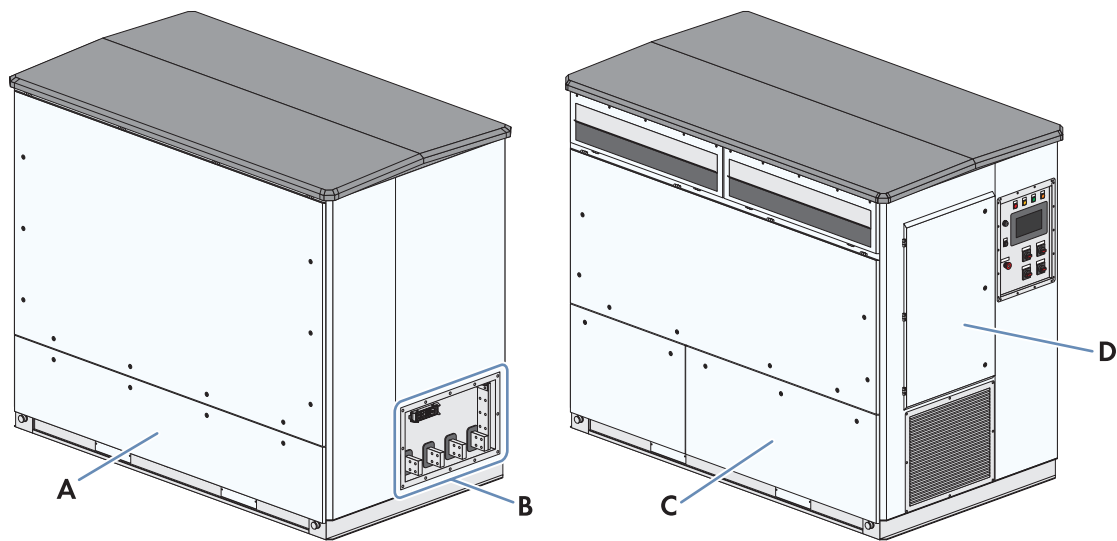


Figure 2: Design of the Inverter

Position	Designation
A	DC connection area and grounding
B	AC connection area and grounding
C	Connection area for electronics
D	Customer installation location

#### 3.2 Devices of the Inverter

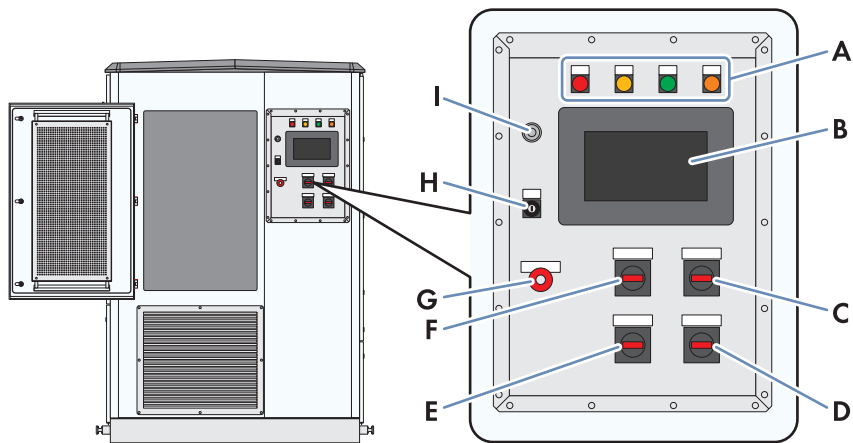


Figure 3: Devices of the inverter







Position	Designation
A	Light repeater -P1, -P2, -P3, -P4
B	Touch display -A60
C	Load-break switch -Q63 for AC disconnection unit

Position	Designation
D	Load-break switch <b>-Q64</b> for auxiliary energy supply *
E	Load-break switch <b>-Q62</b> for supply voltage
F	Load-break switch <b>-Q61</b> for DC switchgear
G	Key switch <b>-S2</b> for fast stop
H	Key switch <b>-S1</b> for start/stop
I	Service interface <b>-X500</b>

\* only for option "Auxiliary supply for external loads: 2.5 kVA/230 V" or "Auxiliary supply for external loads: 2.5 kVA/120 V"

### 3.3 Symbols on the Product

The following gives an explanation of all the symbols found on the inverter and on the type label.

Symbol	Designation	Explanation
	Direct current	-
	Alternating current	-
	Protection class I	All electrical equipment is connected to the grounding conductor system of the product.
	Center of gravity marking	-
	On-setting of the AC disconnection unit	-
	Off-setting of the AC disconnection unit	-

## 4 Transport and Mounting

### 4.1 Safety during Transport and Mounting

#### WARNING

##### **Danger of crushing if raised or suspended loads tip over, fall or sway**

Vibrations or careless or hasty lifting and transportation may cause loads to tip over or fall. This can result in death or serious injury.

- Always transport the load as close to the ground as possible.
- Use all suspension points for transportation.
- Avoid fast or jerky movements during transport.
- Always maintain an adequate safety distance during transport.
- All means of transport and auxiliary equipment used must be designed for the weight of the load.

#### CAUTION

##### **Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

#### CAUTION

##### **Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

#### **NOTICE**

##### **Damage to the frame construction due to uneven support surface**

If the product is set down on uneven surfaces, components may distort. This may lead to moisture and dust penetration into the components.

- Never place the devices on an unstable, uneven surface even for a short period of time.
- The unevenness of the support surface must be less than 0.25%.
- The support surface must be suitable for the weight of the product.

**NOTICE****Damage due to intake of exhaust air or blocked exhaust air outlets**

The supply air is intended to cool the inverter components. Failure to observe the specified minimum clearances can result in warm exhaust air from the inverter being drawn in. This increases the risk of a thermal short circuit. Property damage due to yield loss and damage to the components may result.

- Ensure that no exhaust air can be drawn in through the air inlets.
- Ensure that it is not possible for exhaust air to be drawn into the air intake of other devices.
- Make sure that the exhaust air vents are not obstructed.
- Make sure that the exhaust air vents are accessible for cleaning at all times.
- Ensure that the minimum clearances are complied with.

## 4.2 Requirements for Transport and Mounting

### 4.2.1 Requirements and Ambient Conditions

- ☐ The requirements for the ambient conditions are complied with (see Section 9.1, page 90).
- ☐ The requirements for the foundation are complied with (see Section 9.3, page 92).
- ☐ The cables protruding from the cavities in the foundation are bundled.
- ☐ The minimum clearances are observed (see Section 9.2, page 91).

### 4.2.2 Requirements for Transport

#### **i** Requirements for Transport Routes and Means of Transport

The inverter complies with the requirements of 2M3 in accordance with IEC 60721-3-2. The transport routes and means of transport must be such that they comply with the requirements described in the standard.

#### **Requirements for transport routes in the PV power plant:**

- ☐ The PV power plant must provide a possibility for a truck and a mobile crane to turn.
- ☐ The transport routes in the PV power plant must be designed to handle the maximum gross axle weight rating. The maximum gross axle weight rating is: 5,000 kg (11,025 lb).
- ☐ The transport routes in the PV power plant must be passable year-round.

### 4.3 Center of Gravity Marker

#### 4.3.1 Center of Gravity Marker on the Inverter

The center of gravity of the inverter is not in the middle of the device. Take this into account during transport. The center of gravity of the inverter is marked on the packaging and on the enclosure with the center of gravity symbol.

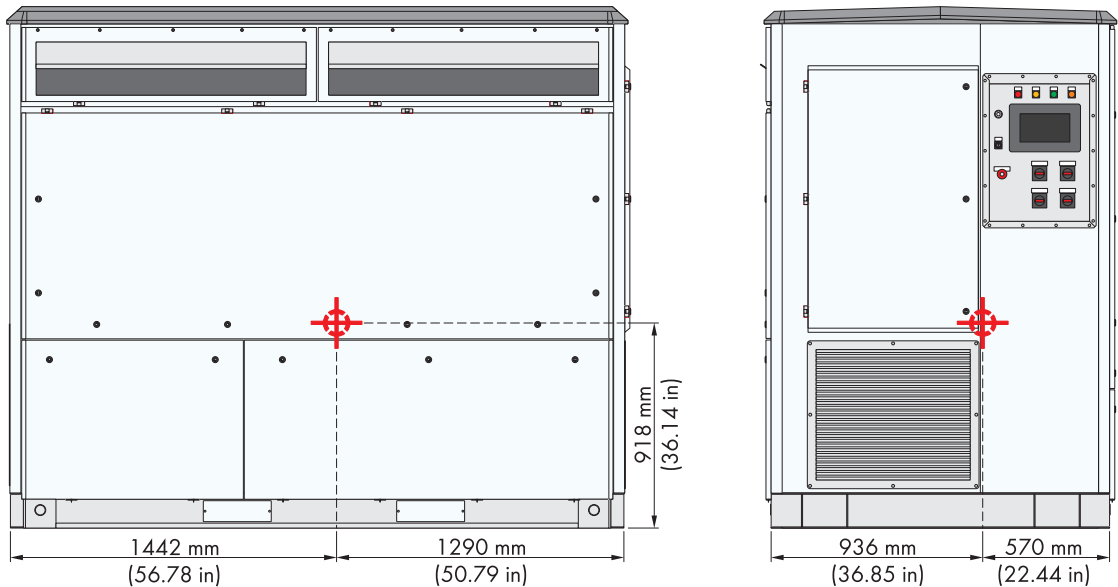


Figure 4: Center of gravity location

### 4.4 Transport Locks

#### 4.4.1 Securing the Inverter for Transport

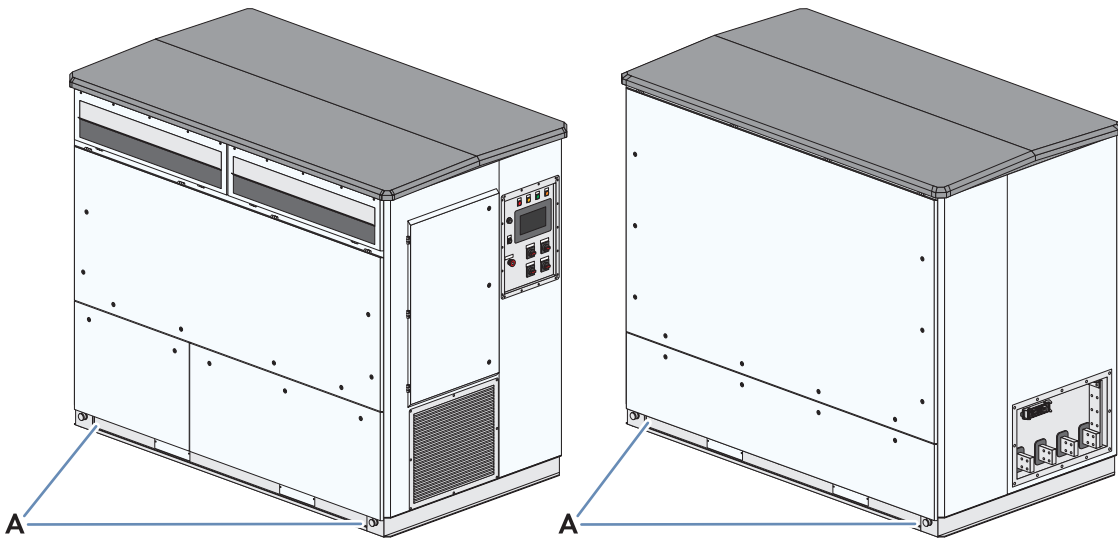
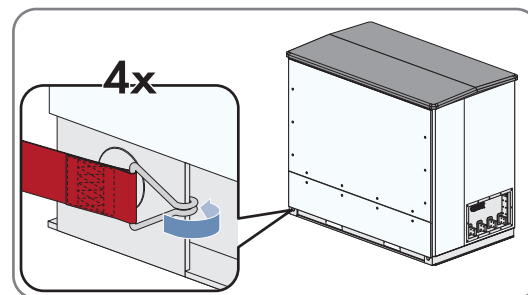


Figure 5: Position of the suspension points for the transport locks

Position	Designation
A	Suspension points for the transport locks

**Procedure:**

- Attach transport locks to the suspension points and to the means of transport.



## 4.5 Loading

### 4.5.1 Loading the Inverter

#### 4.5.1.1 Loading the Inverter with a Forklift

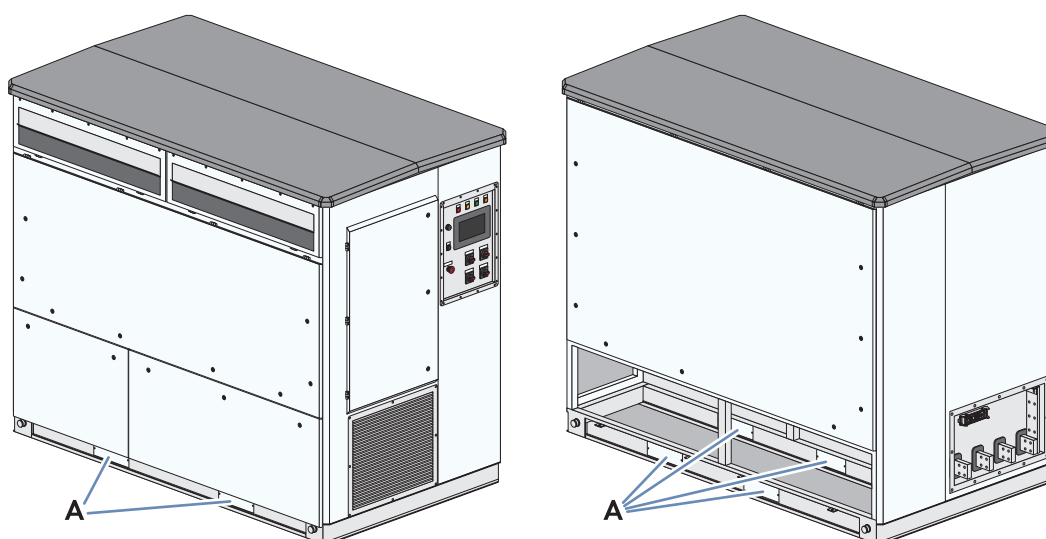


Figure 6: Position of the transport covers

Position	Designation
A	Transport covers

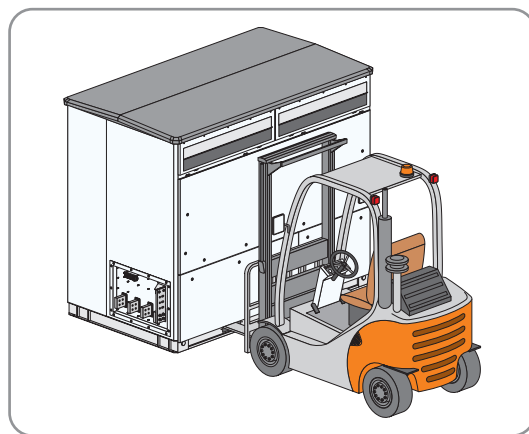
**Requirements:**

- ☐ The forklift is designed for the given weight. Weight: < 4,000 kg (< 8,819 lb).

**Procedure:**

1. Disassemble the panels on the inverter (see Section 7.1.1, page 73).
2. Remove the transport covers. Use a Torx screwdriver.
3. Retain the transport covers and bolts.

4. Move the fork of the floor-bound transportation vehicle under the inverter from the front or the back. The fork prongs must protrude on the other side.



5. Secure the inverter, e.g., with harness, to prevent it from tipping over.
6. Slightly raise the inverter. Take the center of gravity of the inverter into account.
7. Transport the inverter to its final position as close to the ground as possible.
8. Using e.g. a conduit rod, insert DC cables and cables for communication, control and monitoring into the inverter as it is lowered into position.
9. Set the inverter down.
10. Remount the transport covers. Use a Torx screwdriver. This will prevent animals from penetrating the inverter.
11. Mount the panels on the inverter (see Section 7.1.1, page 73).

#### 4.5.1.2 Loading the Inverter by Crane

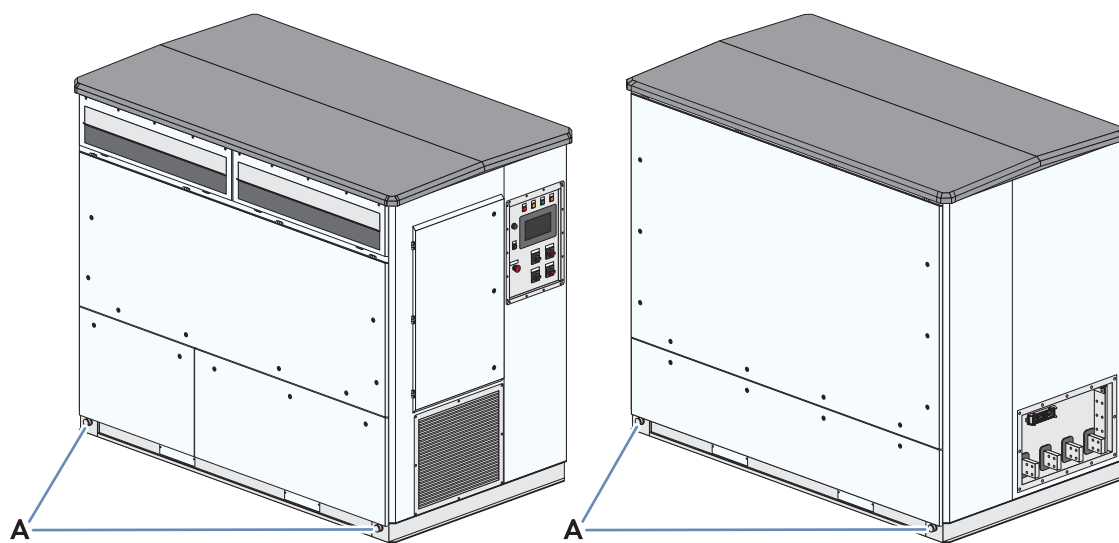


Figure 7: Position of the suspension points

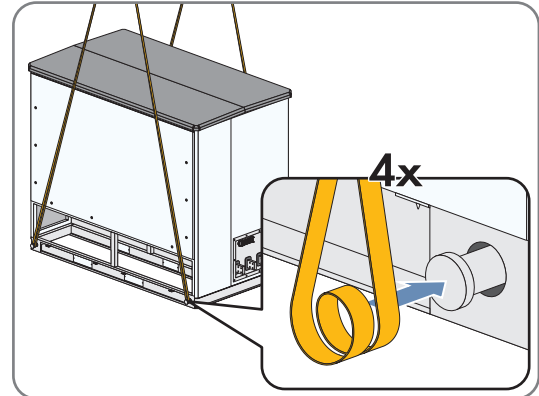
Position	Designation
A	Suspension points

#### Requirements:

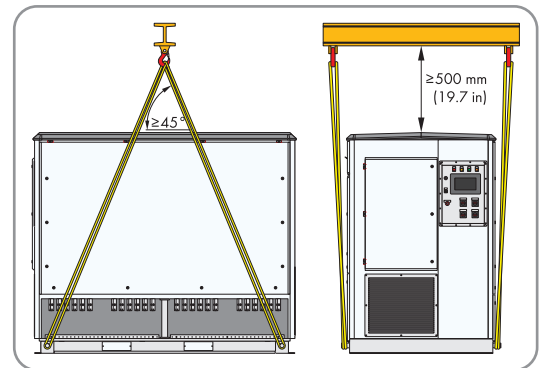
- ☐ Crane and hoist are designed to take the given weight. Weight: < 4,000 kg (< 8,819 lb).
- ☐ Endless loop straps are used.
- ☐ The hoist is properly attached to the crane.
- ☐ A crossbeam is used which is long enough to prevent the sling gear from touching the roof of the inverter during transport.

**Procedure:**

1. Disassemble the panels on the inverter (see Section 7.1.1, page 73).
2. Pull the suspension points out of the enclosure.
3. Attach the endless loop straps to the suspension points. Lead the endless loop straps around the suspension points twice.



4. Tighten the endless loop straps.
5. Ensure that the hoist is attached correctly.
6. Slightly raise the inverter. The angle between the lifting accessories and the ground must be at least  $45^\circ$  and the minimum clearance between cross beam and the inverter roof must be met. The minimum clearance is: 500 mm (19.7 in).



7. Transport the inverter to its final position as close to the ground as possible.
8. Using e.g. a conduit rod, insert DC cables and cables for communication, control and monitoring into the inverter as it is lowered into position.
9. Set the inverter down.
10. Release the sling gear.
11. Reinsert the suspension points in the enclosure.
12. Mount the panels on the inverter (see Section 7.1.1, page 73).

## 4.6 Attaching to the Support Surface

### 4.6.1 Attaching the Inverter to the Foundation

**Requirements:**

- ☐ The holes for attachment must have been drilled (see Section 9.3.3, page 95).

**Additionally required material (not included in the scope of delivery):**

- ☐ 4 screws M20
- ☐ 4 washers
- ☐ Torque wrench with sufficient torque (minimum: 425 Nm (314 ft-lb))

**Procedure:**

- Insert the screws into the mounting holes and tighten (torque: 425 Nm (314 ft-lb)).

## 5 Installation

### 5.1 Safety during Installation

#### DANGER

##### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

#### DANGER

##### **Danger to life from electric shock due to live DC cables**

DC cables connected to PV modules that are exposed to light are live. Touching live cables results in death or serious injury due to electric shock.

- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Prior to connecting the DC cables, ensure that the DC cables are voltage-free.

#### DANGER

##### **Danger to life by electric arc when there is a reverse-poled connection of the DC cables**

A reverse-poled connection of the DC cables can cause an electric arc. Electric arcs can result in death or serious injury.

- Ensure that the polarity of the DC cables is correct prior to connection.

**⚠ WARNING****Risk of fire due to failure to observe torque specifications on live bolted connections**

Failure to follow the specified torques reduces the ampacity of live bolted connections so that the contact resistances increase. This can cause components to overheat and catch fire.

- Ensure that live bolted connections are always tightened with the exact torque specified in this document.
- When working on the device, use suitable tools only.
- Avoid repeated tightening of live bolted connections as this may result in inadmissibly high torques.

**⚠ WARNING****Danger to life from electric shock when entering the PV field**

The ground-fault monitoring with GFDI, Remote GFDI does not provide protection from personal injury when the ground-fault monitoring is activated. PV modules which are grounded with ground-fault monitoring discharge voltage to ground. Entering the PV field can result in lethal electric shocks.

- Ensure that the insulation resistance of the PV field exceeds the minimum value. The minimum value of the insulation resistance is: 550  $\Omega$ .
- Before entering the PV field, switch the PV modules to insulated operation.
- Configure the PV power plant as a closed electrical operating area.

**⚠ WARNING****Danger to life due to arc fault caused by damaged connection busbars**

If excessive force is exerted while connecting the cables, the connection busbars can be bent or damaged. This will lead to reduced clearances and creepage distances. Reduced clearances and creepage distances can lead to arc faults.

- Cut the cables to the correct length and prepare them for connection.
- Position the terminal lugs on the connection busbars ensuring a large contact surface.
- Tighten to the specified torque.

**⚠ WARNING****Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**⚠ CAUTION****Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**i DC-side disconnection**

The DC main distributions and DC subdistributions should be equipped with load-break switches or circuit breakers. Load-break switches or circuit breakers enable trouble-free DC-side disconnection of the inverter.

**i Cable route**

Data cables must be laid separately from the DC cables.

## 5.2 Grounding

### 5.2.1 Foundation Grounding

#### 5.2.1.1 Requirement for the Foundation Grounding

**Cable Requirements for the Grounding Connection:**

- ☐ All cables must be suitable for temperatures of up to +197°F (+90°C) and in accordance with the *National Electrical Code®* ANSI/NFPA 70.
- ☐ Use copper or aluminum cables only.
- ☐ The cable cross-sections of the PE connections depend on the installed overcurrent protective device. Refer to the *National Electrical Code®* ANSI/NFPA 70 Article 250.122 for how to calculate the required cross-sections.
- ☐ The grounding of the PV plant must be designed in accordance with the requirements of sections 690.41 to 690.47 of the *National Electrical Code®* or with the requirements of the *Canadian Electrical Code®* CSA C22.1 No. 107.1-01 section 15.4.2.3 and is the responsibility of the installer.

**Requirements for the Cable Connection with Terminal Lugs:**

- ☐ All used terminal lugs must have a valid UL approval.
- ☐ All terminal lugs used must be UL certified crimp-type terminal lugs.
- ☐ All connections must be made in accordance with the *Canadian Electrical Code®* CSA C22.2, section 14.5.2.3
- ☐ The width of the terminal lugs must exceed the washer diameter. This will ensure that the specified torques are effective over the whole surface.
- ☐ Use only copper terminal lugs or tin-plated aluminum lugs.
- ☐ Connect a maximum of two grounding cables to the grounding connection lug.
- ☐ The specified torques must always be complied with.

**Requirements for the Design of the Foundation Grounding**

- ☐ The recommended grounding of inverter and MV transformer in meshed design reduces leakage current levels as well as the interference in the medium-wave and long-wave band.
- ☐ In order to connect the foundation grounding, all connection points at the inverter and the MV transformer must be used.
- ☐ In case of a concrete foundation, six foundation grounding terminals must be planned for the connection of the inverter.

- ☐ In case of a concrete foundation, two foundation grounding terminals must be planned for the connection of the MV transformer.
- ☐ Unused foundation grounding terminals must be insulated. This will prevent inadvertent touching.

### 5.2.1.2 Connection Area on the Inverter

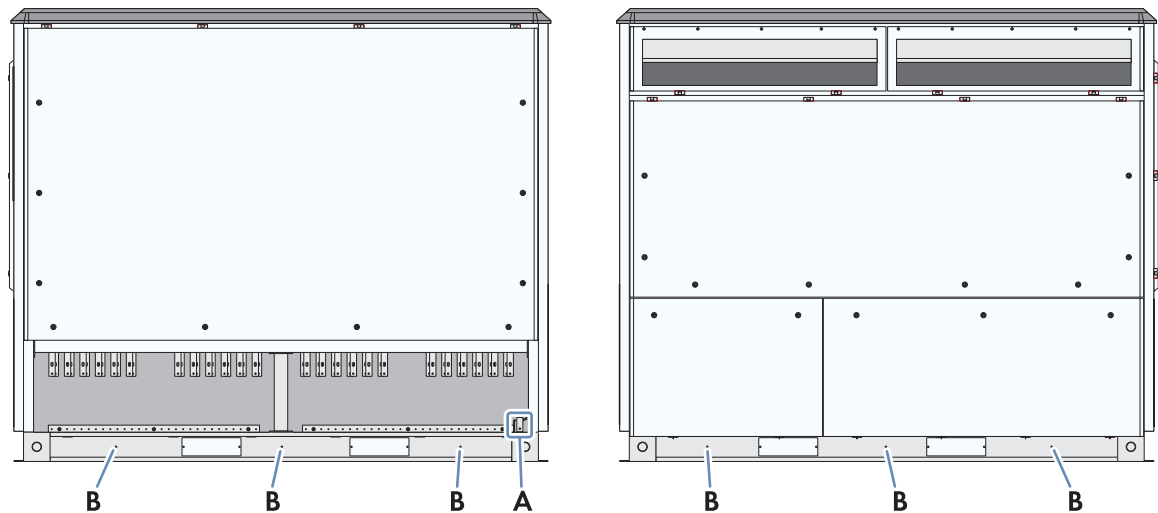


Figure 8: Position of the connection points for the foundation ground electrode

Position	Designation
A	Connection point in the DC connection area
B	Connection points at the base

### 5.2.1.3 Connecting the Foundation Ground Electrode

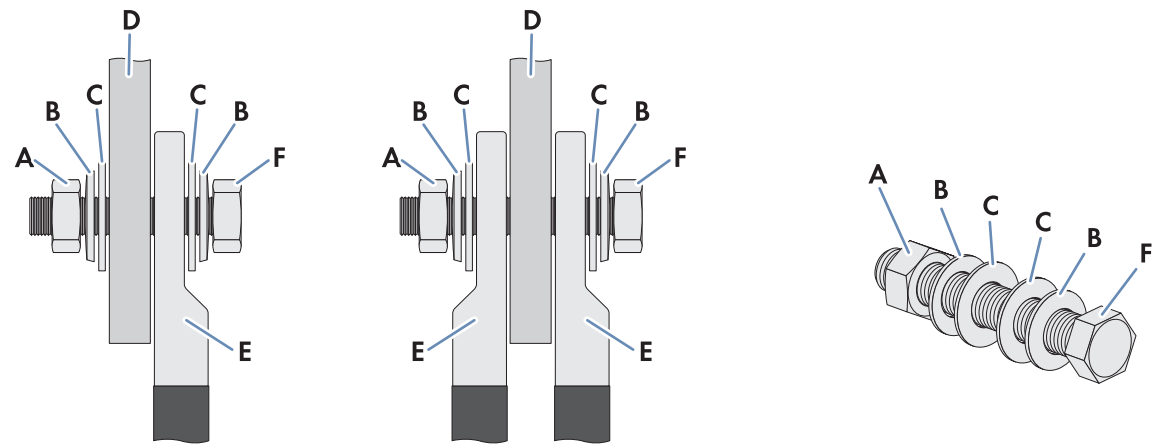


Figure 9: Assembly of the bolted connection

Position	Designation
A	Nut
B	Spring washer
C	Fender washer
D	Connection point of the inverter

Position	Designation
E	One-hole terminal lug
F	Bolt

**Additionally required mounting material (not included in the scope of delivery):**

- ☐ Clean cloth
- ☐ Ethanol cleaning agent
- ☐ 6 x single-hole terminal lug M8
- ☐ 1 x single-hole terminal lug M12 or 2 x single-hole terminal lug M12

**Additionally required mounting material (included in the scope of delivery):**

- ☐ 6 nuts M8
- ☐ 6 screws M8
- ☐ 12 spring washers M8
- ☐ 12 fender washers M8
- ☐ 1 nut M12
- ☐ 1 screw M12
- ☐ 2 spring washers M12
- ☐ 2 fender washers M12

**Procedure:**

1. Ensure that no voltage is present.
2. Strip the cable insulation.
3. Fit the cables with terminal lugs.
4. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect a grounding cable to the connection busbar **-X103** in the DC connection area (torque: 68 Nm to 102 Nm (50.2 ft-lb to 75.2 ft-lb)).
6. Connect one grounding cable each to the six grounding points at the base of the inverter (torque: 68 Nm to 102 Nm (50.2 ft-lb to 75.2 ft-lb)).
7. Connect all grounding cables to the foundation ground electrode.

## 5.2.2 Ground electrode

### 5.2.2.1 Requirement for the Cables and Terminal Lugs for the Ground Electrode

**Cable Requirements for the Grounding Connection:**

- ☐ All cables must be suitable for temperatures of up to +197°F (+90°C) and in accordance with the *National Electrical Code®* ANSI/NFPA 70.
- ☐ Use copper or aluminum cables only.
- ☐ The cable cross-sections of the PE connections depend on the installed overcurrent protective device. Refer to the *National Electrical Code®* ANSI/NFPA 70 Article 250.122 for how to calculate the required cross-sections.
- ☐ The grounding of the PV plant must be designed in accordance with the requirements of sections 690.41 to 690.47 of the *National Electrical Code®* or with the requirements of the *Canadian Electrical Code®* CSA C22.1 No. 107.1-01 section 15.4.2.3 and is the responsibility of the installer.

**Requirements for the Cable Connection with Terminal Lugs:**

- ☐ All used terminal lugs must have a valid UL approval.
- ☐ All terminal lugs used must be UL certified crimp-type terminal lugs.
- ☐ All connections must be made in accordance with the *Canadian Electrical Code*® CSA C22.2, section 14.5.2.3
- ☐ The width of the terminal lugs must exceed the washer diameter. This will ensure that the specified torques are effective over the whole surface.
- ☐ Use only copper terminal lugs or tin-plated aluminum lugs.
- ☐ Connect a maximum of two grounding cables to the grounding connection lug.
- ☐ The specified torques must always be complied with.

**Requirements:**

- ☐ If conduits are used, they must be rain-tight and moisture-proof.
- ☐ If conduits are used, they must meet the requirements of UL 514B.

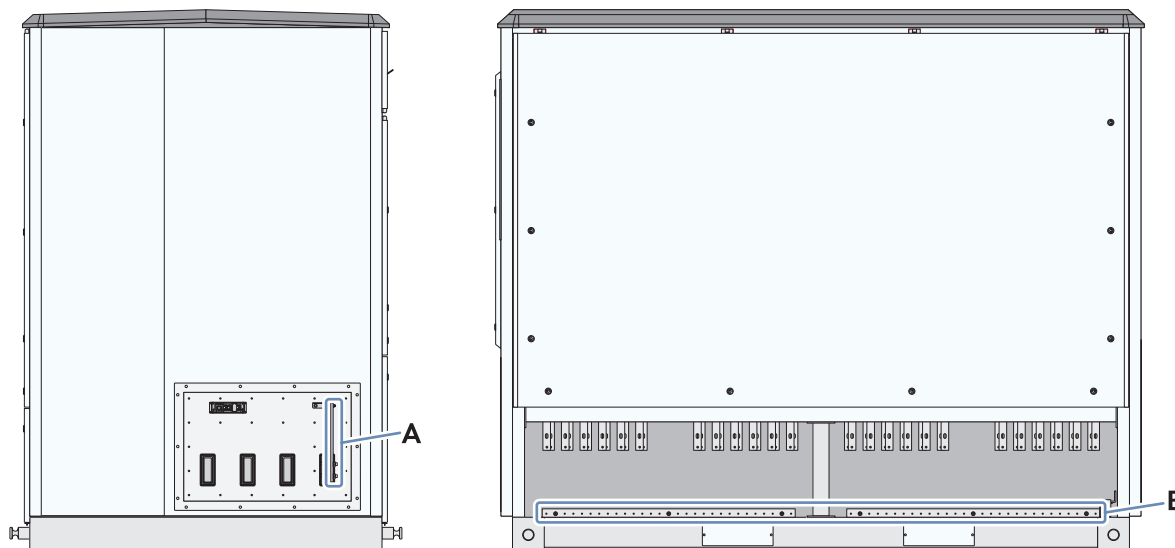
**5.2.2.2 Connection Area on the Inverter****Position of the Connection Points of the Ground Electrodes**

Figure 10: Position of the Connection Points of the Ground Electrodes

Position	Designation
A	Connection points for the ground electrode in the AC connection area Connection point for the grounding of the MV transformer
B	Connection points for the ground electrode in the DC connection area

Dimensions of the Connection Points of the Ground Electrodes in the DC Connection Area

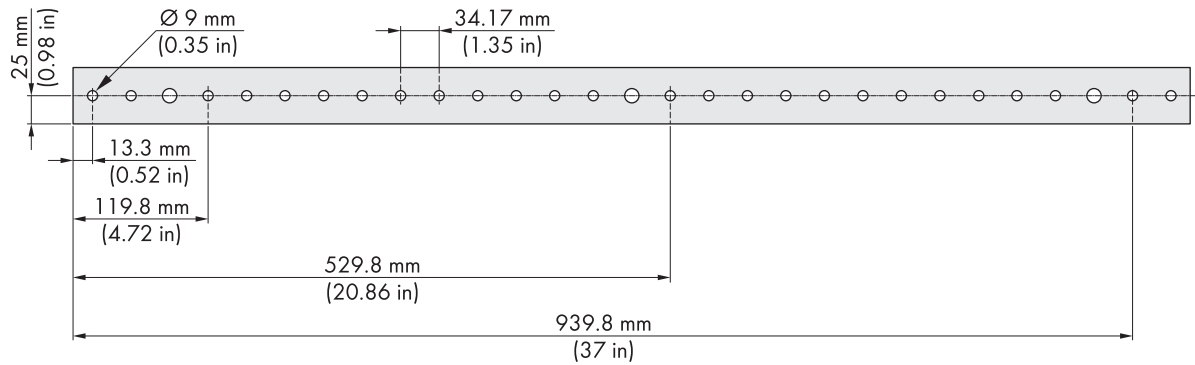


Figure 11: Dimensions of the ground electrodes in the DC connection area

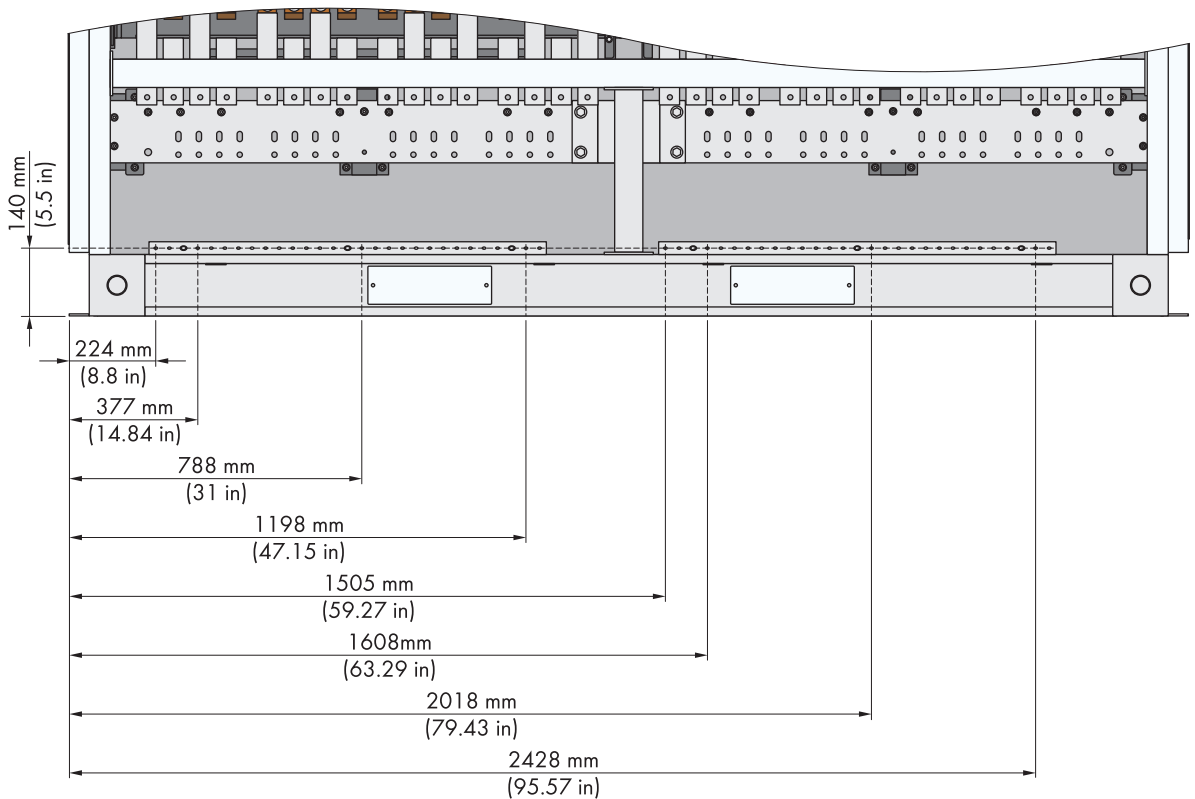


Figure 12: Dimensions of the ground electrodes in the DC connection area

Dimensions of the Connection Points of the Ground Electrodes in the AC Connection Area

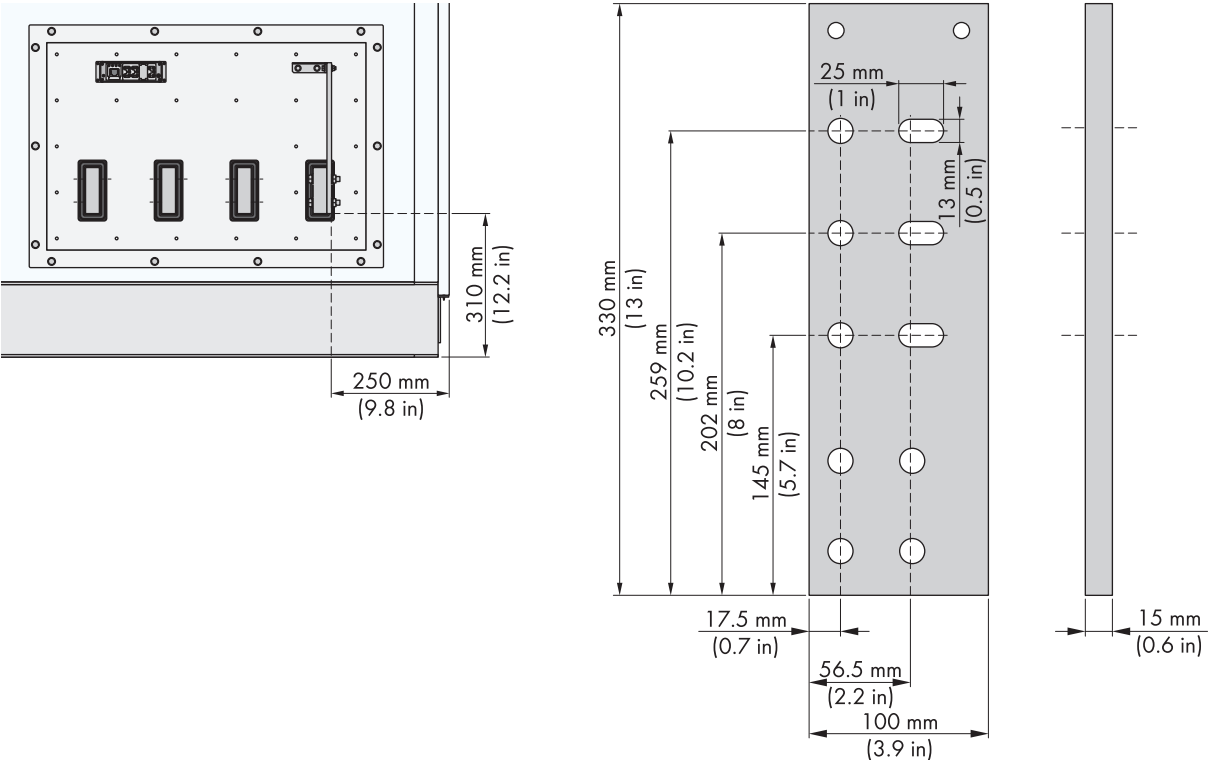


Figure 13: Dimensions of the ground electrodes in the AC connection area

5.2.2.3 Connecting the Ground Electrode

Assembly of the Bolted Connection of the Grounding in the DC Connection Area

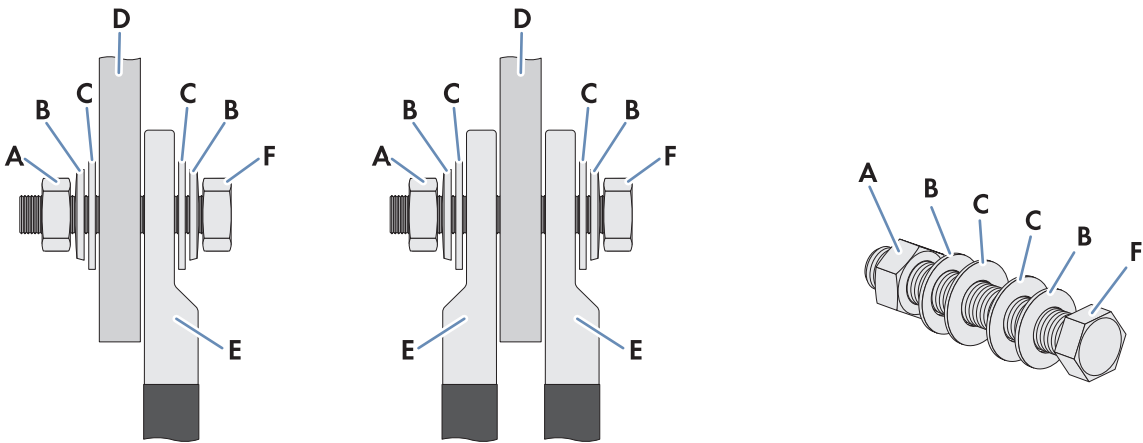


Figure 14: Assembly of the bolted connection

Position	Designation
A	Nut M8
B	Spring washer
C	Fender washer
D	Connection busbar

Position	Designation
E	One-hole terminal lug
F	Screw M8

### Assembly of the Bolted Connection of the Ground Electrodes in the AC Connection Area

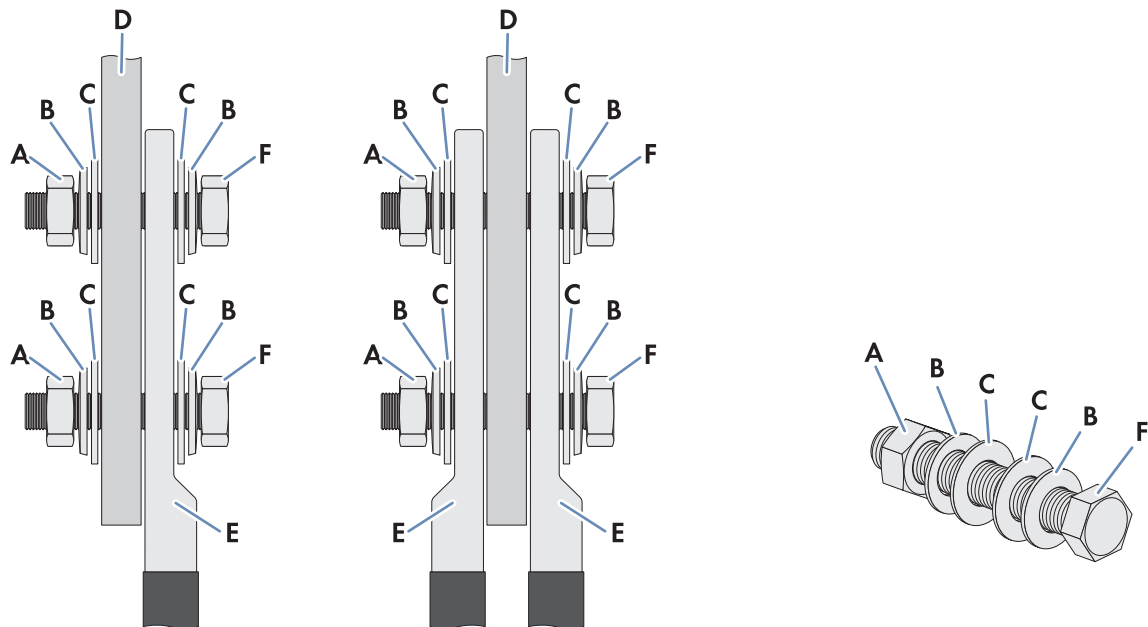


Figure 15: Assembly of the bolted connection

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer
D	Connection busbar
E	Two-hole terminal lug
F	Screw M12

### Additionally required mounting material (included in the scope of delivery):

- ☐ Nuts M8 (quantity depends on option "DC input configuration")
- ☐ Screws M8 (quantity depends on option "DC input configuration")
- ☐ Spring washers M8 (quantity depends on option "DC input configuration")
- ☐ Fender washer M8 (quantity depends on option "DC input configuration")

**Additionally required mounting material (not included in the scope of delivery):**

- ☐ Clean cloth
- ☐ Ethanol cleaning agent
- ☐ One-hole terminal lugs M8 (quantity depends on the number of grounding cables to be connected)
- ☐ Nuts M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Screws M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Spring washers M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Fender washer M12 (quantity depends on the number of grounding cables to be connected)
- ☐ Two-hole terminal lugs M12 (quantity depends on the number of grounding cables to be connected)

**Procedure:**

1. Ensure that no voltage is present.
2. Strip the cable insulation.
3. Fit the cables with terminal lugs.
4. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect the grounding cables of the MV transformer to the connection busbar **-X100** in the AC connection area (torque: 54 Nm to 66 Nm (39.8 ft-lb to 48.6 ft-lb)).
6. Connect the grounding cables of the PV array to the connection busbar **-X101 to -X102** in the DC connection area (torque: 14.4 Nm to 17.6 Nm (10.7 ft-lb to 12.9 ft-lb)).

## 5.3 DC Connection

### 5.3.1 Requirements for the Cables and Terminal Lugs for the DC Connection

**Cable Requirements for the DC Connection**

- ☐ All cables must be suitable for temperatures of up to +197°F (+90°C) and in accordance with the *National Electrical Code®* ANSI/NFPA 70.
- ☐ Use only copper cables or aluminum cables.
- ☐ The wire size has to be based on the ampacities given in Table 310.16 of the *National Electrical Code®*, ANSI/NFPA 70, and the derating factor of no less than 125 percent of the RMS or DC current that the circuit carries during rated conditions.
- ☐ Maximum cable cross-section per DC input: 2 x 400 mm<sup>2</sup> (2 x 800 kcmil).

**Requirements for the Cable Connection with Terminal Lugs:**

- ☐ All used terminal lugs must have a valid UL approval.
- ☐ All terminal lugs used must be UL certified crimp-type terminal lugs with two securement holes (diameter: 0.5 in. (13 mm)). A minimum clearance of 1.75 in. (44 mm) must be maintained between the holes. Both holes have to be utilized in installation.
- ☐ All connections must be made in accordance with the *Canadian Electrical Code®* CSA C22.2, section 14.5.2.3
- ☐ The terminal lug width must be larger than the diameter of the washers 1.25 in (32 mm). This will ensure that the specified torques are effective over the whole surface.
- ☐ Use only copper terminal lugs or tin-plated aluminum lugs.
- ☐ Only use screws, nuts and washers included in the scope of delivery.
- ☐ The specified torques must always be complied with.

**Requirements:**

- ☐ If conduits are used, they must be rain-tight and moisture-proof.
- ☐ If conduits are used, they must meet the requirements of UL 514B.

**5.3.2 DC Connection Area on the Inverter****For inverters with DC switch in front of the input fuses**

Overview of the DC connection area for the following options:

- DC input configuration: 24 fused inputs + disco.
- DC input configuration: 28 fused inputs + disco.
- DC input configuration: 32 fused inputs + disco.

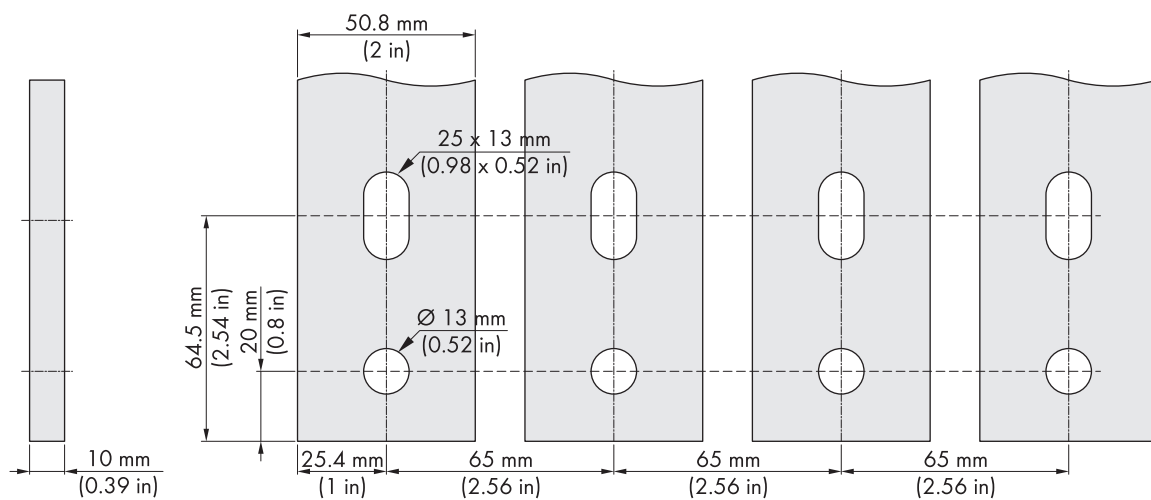
**DC Connection Brackets**

Figure 16: Dimensions of the DC connection brackets

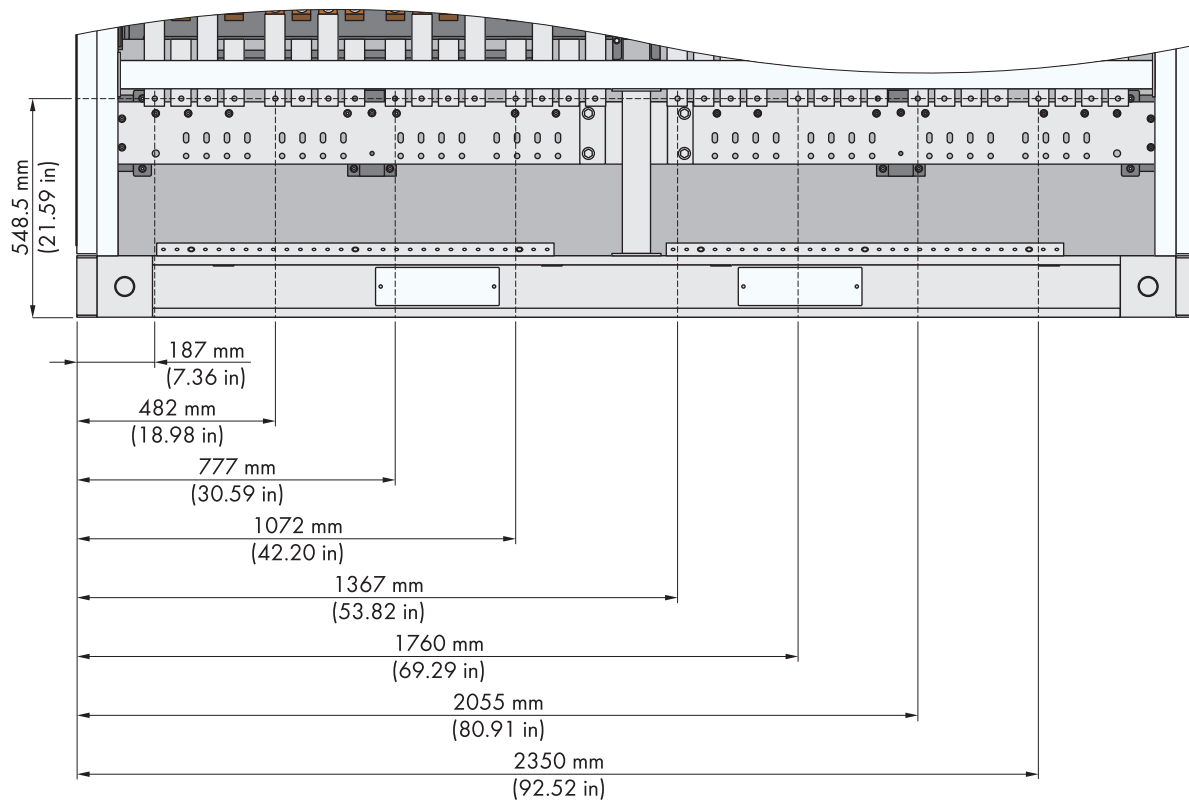


Figure 17: Position and dimension of the DC connection brackets

### DC Connection Busbar

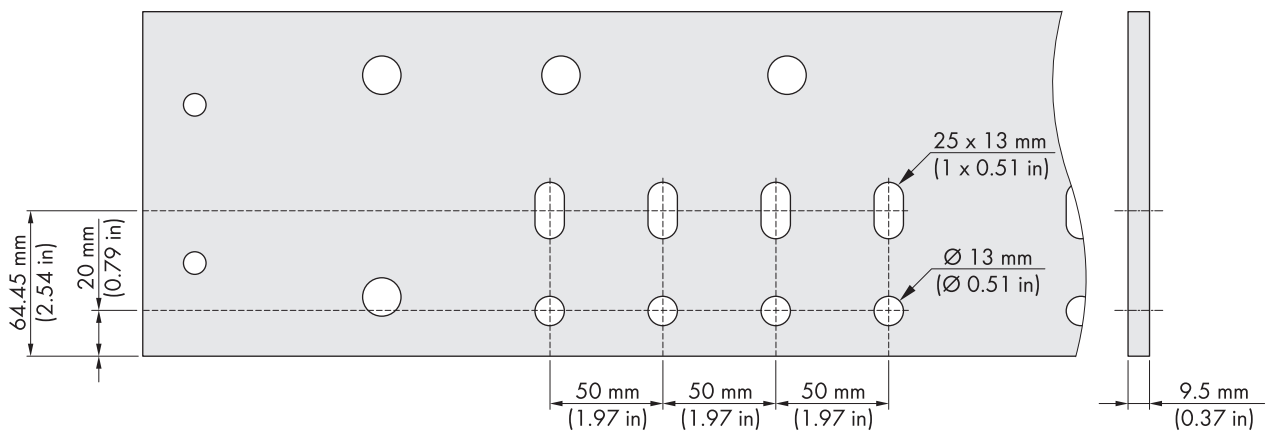


Figure 18: Dimensions of the DC connection busbar

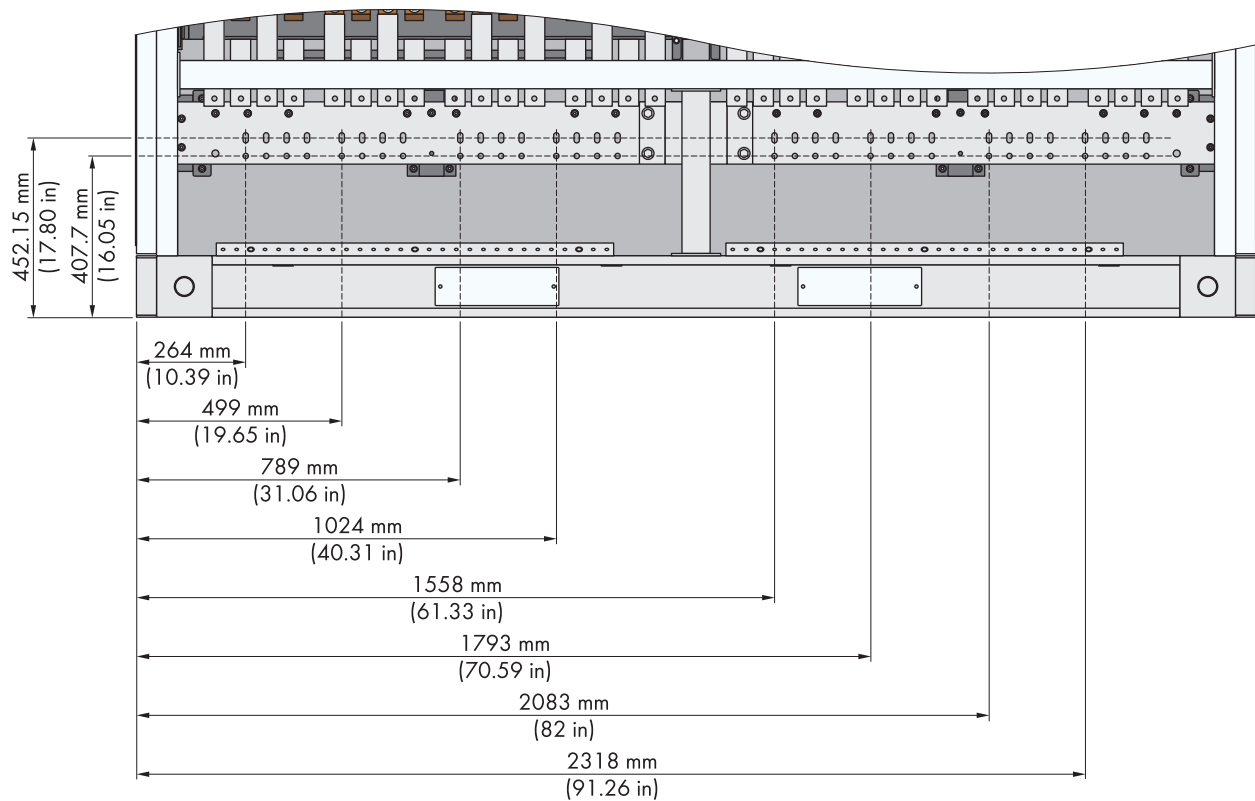


Figure 19: Dimensions and position of the DC connection busbar

### For inverters without DC switch in front of the input fuses

Overview of the DC connection area for the following options:

- DC input configuration: 24 fused inputs

### DC Connection Brackets

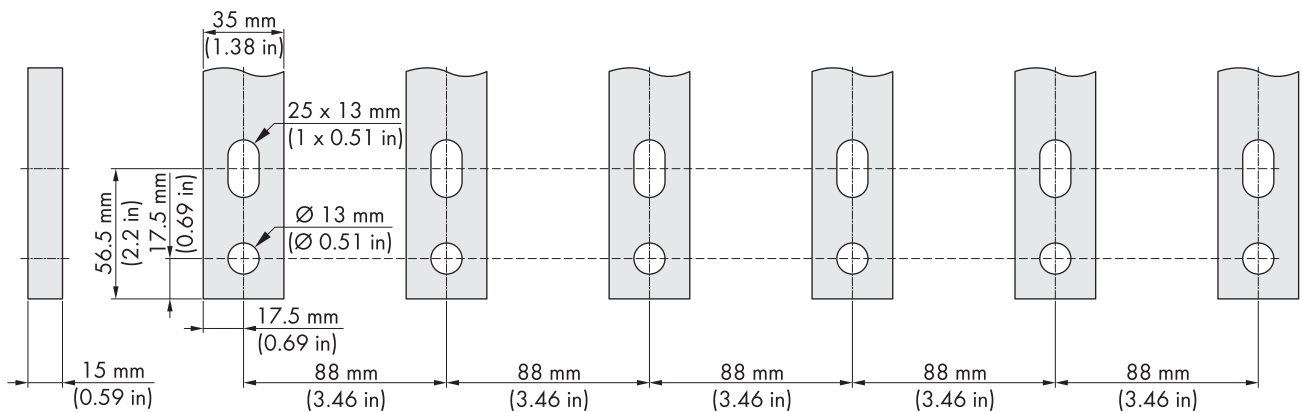


Figure 20: Dimensions of the DC connection brackets

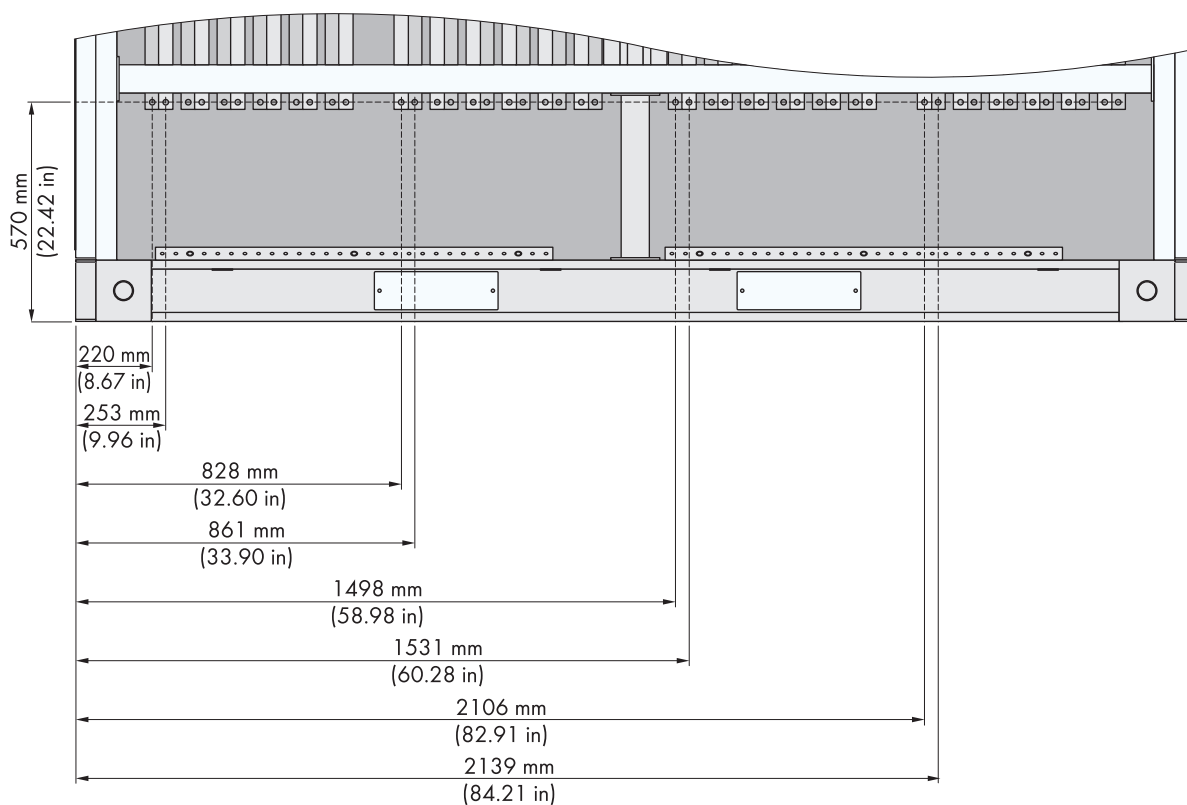


Figure 21: Dimension and position of the DC connection brackets

### 5.3.3 Connecting the DC Cables

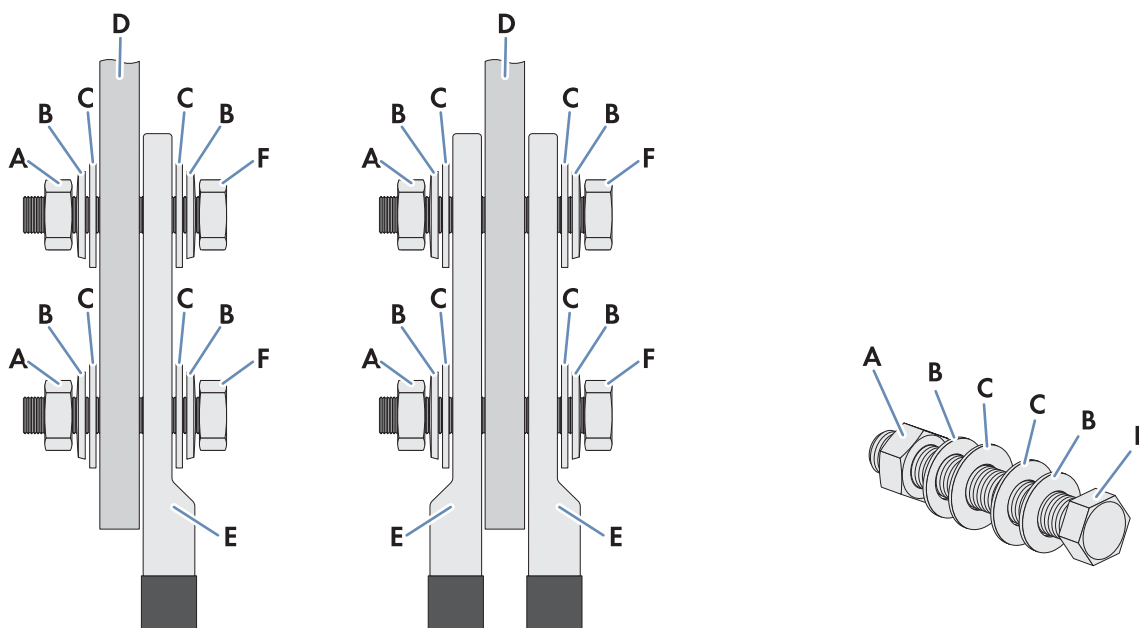


Figure 22: Assembly of the bolted connection

Position	Designation
A	Nut M12
B	Spring washer
C	Fender washer

Position	Designation
D	Connection busbar
E	Two-hole terminal lug
F	Screw M12

### **i** Polarities of the connection points

The polarities of the connection points are marked with labels.

#### **Additionally required mounting material (not included in the scope of delivery):**

- ☐ Clean cloth
- ☐ Ethanol cleaning agent

#### **Additionally required mounting material (included in the scope of delivery):**

Additionally required mounting material	Quantity for option "DC Input Configuration":			
	24 fused in-puts	24 fused in-puts with disco.	28 fused in-puts with disco.	32 fused in-puts with disco.
<input type="checkbox"/> Nut M12	96	96	112	124
<input type="checkbox"/> Screw M12	96	96	112	124
<input type="checkbox"/> Spring washer M12	192	192	224	256
<input type="checkbox"/> Fender washer M12	192	192	224	256

#### **Procedure:**

1. Ensure that no voltage is present.
2. Strip the cable insulation.
3. Fit the cables with terminal lugs.
4. Clean the contact surfaces of the terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect the DC cables to the connection busbars **-X21** to **-X99** (torque: 60 Nm (44.3 ft-lb)). The polarities and connection brackets that must not be assigned are marked with labels.

### **5.3.4 Inserting the DC Fuses**

#### **For inverters with DC switch in front of the input fuses**

Select this procedure if the inverter is equipped with one of the following options:

- DC input configuration: 24 fused inputs + disco.
- DC input configuration: 28 fused inputs + disco.
- DC input configuration: 32 fused inputs + disco.

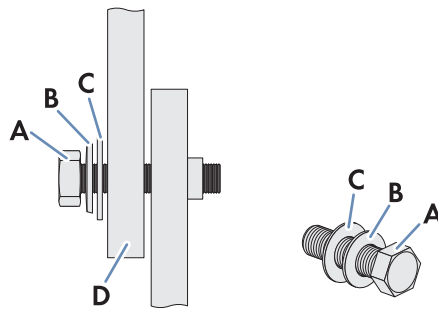


Figure 23: Assembly of the bolted connection

Position	Designation
A	Bolt
B	Spring washer
C	Fender washer
D	DC fuse

**Additionally required installation material (not included in the scope of delivery):**

- ☐ DC fuses in accordance with the PV system design. The DC fuses can be ordered from SMA using the following material number:

Nominal current	Material number
200 A	61-103100.01
250 A	61-103200.01
315 A	61-103300.01
350 A	61-103400.01
400 A	61-103500.01

- ☐ Non-woven abrasive  
☐ Ethanol cleaning agent  
☐ Clean cloth

**Additionally required installation material (included in the scope of delivery):**

Additionally required installation material	Quantity for option "DC Input Configuration":		
	24 fused inputs with disco.	28 fused inputs with disco.	32 fused inputs with disco.
<input type="checkbox"/> Screw M8	48	56	64
<input type="checkbox"/> Spring washer M8	48	56	64
<input type="checkbox"/> Fender washer M8	48	56	64

**Procedure:**

1. Ensure that no voltage is present.
2. Clean the non-tin-plated contact surfaces of the DC fuses and connection busbars with the non-woven abrasive until they have a light metallic sheen.

3. Clean the contact surfaces of the DC fuses and connection busbars with a clean cloth and ethanol cleaning agent. Do not touch the contact surfaces again after cleaning.
4. Connect the DC fuses in accordance with the design of the bolted connection (torque 14.4 Nm to 17.6 Nm (10.7 ft-lb to 12.9 ft-lb)).

### For inverters without DC switch in front of the input fuses

Select this procedure if the inverter is equipped with one of the following options:

- DC input configuration: none (busbar)
- DC input configuration: 9 fused inputs
- DC input configuration: 12 fused inputs
- DC input configuration: 18 fused inputs
- DC input configuration: 21 fused inputs
- DC input configuration: 24 fused inputs

### Additionally required installation material (not included in the scope of delivery):

- ☐ DC fuses in accordance with the PV system design. The DC fuses can be ordered from SMA using the following material number:

Nominal current	Material number
200 A	61-103100.01
250 A	61-103200.01
315 A	61-103300.01
350 A	61-103400.01
400 A	61-103500.01

- ☐ Disconnection blades in accordance with PV system design. The disconnection blades can be ordered from SMA using the following material number: 61-014021.

### Procedure:

1. Ensure that no voltage is present.
2. Insert the LV/HRC fuses. Use an LV/HRC fuse extractor.
3. Insert the disconnection blades. Use an LV/HRC fuse extractor.

## 5.4 AC Connection

### 5.4.1 Requirements for the Power Connection between Inverter and MV Transformer

#### Power connection between inverter and MV transformer

- ☐ The connection busbars used must be made of aluminum or copper.
- ☐ The connection busbars used must have a minimum cross-section per line conductor. The minimum cross-section depends on the material of the connection busbars. Minimum cross-section copper: 2 x 2,000 mm<sup>2</sup> (2 x 4,000 kcmil). Minimum cross-section aluminum: 2 x 3,000 mm<sup>2</sup> (2 x 6,000 kcmil).
- ☐ The connection busbars must meet the requirements of the National Electrical Code®, ANSI/ NFPA 70 part 366.23.
- ☐ All connections must be made in accordance with the *Canadian Electrical Code*® CSA C22.2, section 14.5.2.3

- ☐ The impedance voltage of the MV transformer must be in the permissible range. The permissible range of the impedance voltage is: 5% to 7%.
- ☐ The connection busbars used must be designed for a maximum continuous current. The maximum continuous current depends on the material of the connection busbars. Maximum continuous current copper: 1.55 A/mm<sup>2</sup> (1,000 A/in<sup>2</sup>) Maximum continuous current aluminum: 1.09 A/mm<sup>2</sup> (700 A/in<sup>2</sup>)
- ☐ No vacuum circuit breakers may be used.
- ☐ The enclosure of the MV transformer must be grounded.
- ☐ The power connection used must have suitable insulation resistance since voltages to ground of  $\pm 1,700$  V at the most occur when the inverter is in pulsed mode.

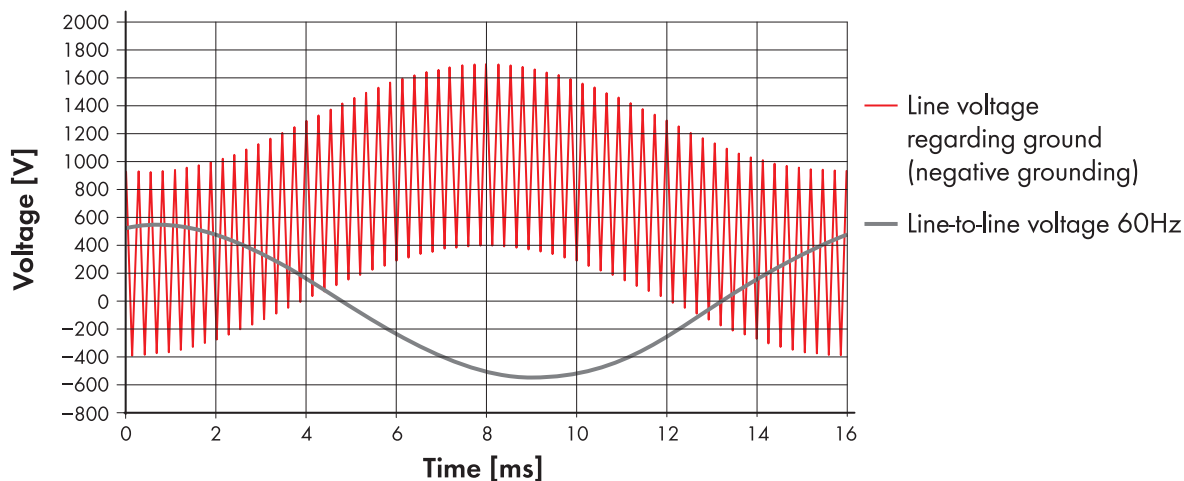


Figure 24: Voltages in pulsed mode

## 5.4.2 AC Connection Area on the Inverter

### Overview of the AC Connection Area

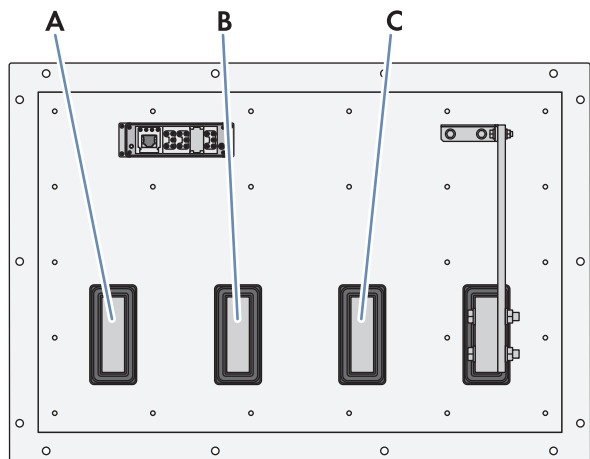


Figure 25: Overview of the AC connection area

Position	Designation
A	Line conductor L1
B	Line conductor L2
C	Line conductor L3

### Dimensions and position of the AC connection busbars

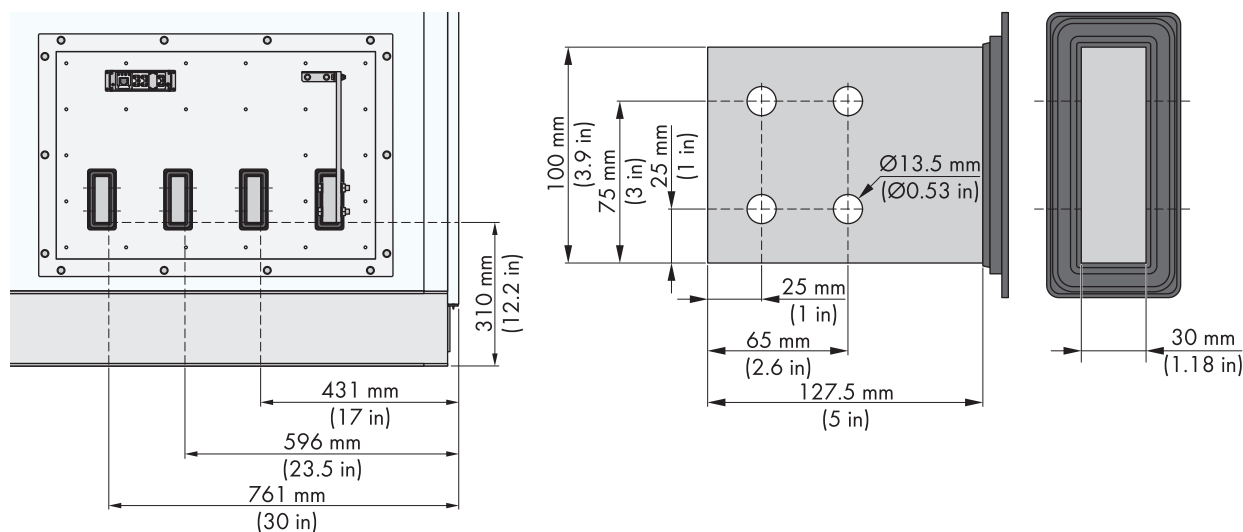


Figure 26: Dimensions and position of the AC connection busbars

The AC outputs are isolated from the enclosure and the system grounding, so that the AC output and neutral are not bonded to ground. If required by section 250 of the National Electrical Code®, ANSI/NFPA 70, the installer is responsible for this grounding.

### 5.4.3 Installing the AC Connection

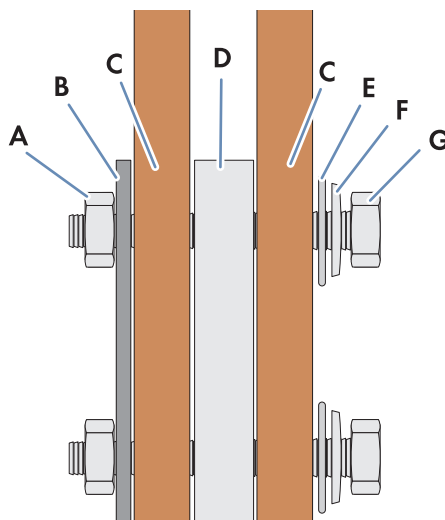


Figure 27: Assembly of the bolted connection

Position	Designation
A	Nut
B	Connecting plate
C	Flexible connection busbars
D	Connection busbar of inverter
E	Fender washer
F	Spring washer
G	Screws

**⚠ WARNING****Risk of fire due to the impedance voltage of the MV transformer being too low**

An insufficient impedance voltage results in an increased short-circuit current in case of a short circuit. An increased short-circuit current can cause a fire. This can result in death or serious injury.

- Ensure that the impedance voltage of the MV transformer is in the permissible range. The permissible range of the impedance voltage is:  $v_{sc}$ : 5% to 7%.

**Additionally required mounting material (not included in the scope of delivery):**

- ☐ Clean cloth
- ☐ Ethanol cleaning agent

**Procedure:**

1. Ensure that no voltage is present.
2. Clean the contact surfaces of the connection busbars with a clean cloth and ethanol cleaning agent.
3. Clean the non-tin-plated contact surfaces of the connection busbars with the non-woven abrasive until they have a light metallic sheen. Ensure that the coated contact surfaces are not damaged.
4. Remove metal dust using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces again after cleaning.
5. Connect the AC connection busbars to the connection busbars on the inverter in accordance with the design of the bolted connection (torque: 60 Nm (44.3 ft-lb)).
  - L1 to -X1
  - L2 to -X2
  - L3 to -X3

## 5.5 Connecting the Cables for Communication, Control, Supply Voltage and Monitoring

### 5.5.1 Connecting Cables for Feedback of the DC Switch

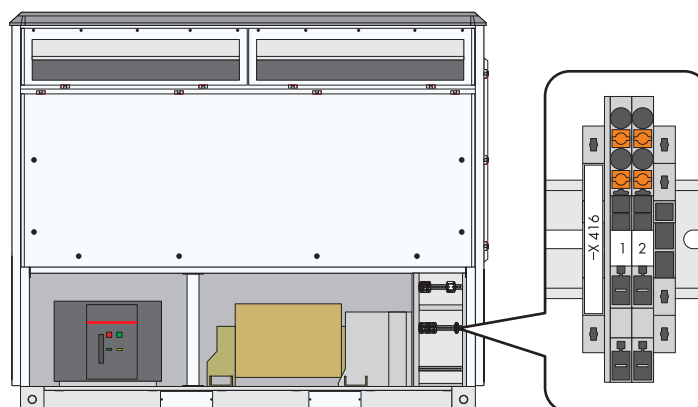


Figure 28: Position of the connecting terminal plate for the switching-state light repeater of the DC switch

**Cable requirements:**

- ☐ Multi-wire cable with bootlace ferrules: 14 AWG
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 2

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Connect the cable to the female connector **-X416** (see Section 7.2.2, page 78):
4. Plug the female connector into the terminals **1** and **2** in the connecting terminal plate **-X416**.
5. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 7.1.1, page 73).

### 5.5.2 Connecting the Cable for External Fast-Stop Function

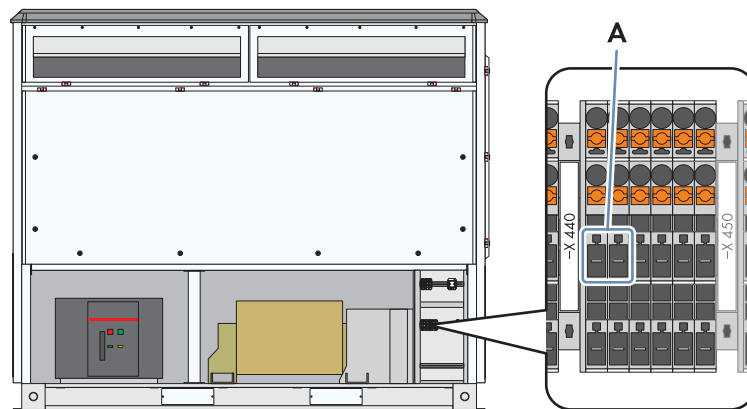


Figure 29: Position of the connecting terminal plate for external fast stop function

Position	Designation
A	Connecting terminal plate

The inverter is equipped with a change-over function and thus meets the anti-islanding requirements in accordance with IEEE 1547, paragraph 4.4.1, section 12-4. An external signal is required from the grid operator so that the inverter will stop feeding into the utility grid in case a grid failure occurs.

**Cable requirements:**

- ☐ Multi-wire cable with bootlace ferrules: 14 AWG
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 2

**Requirements:**

- ☐ A single-pole switch (break contact) is used.

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Remove the bridge from the female connector **-X441**.
4. Connect the cable to the female connector **-X441** (see Section 7.2.2, page 78).
5. Plug the female connector **-X441** into the terminals **1** and **3** in the connecting terminal plate **-X440**.
6. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
7. Mount the panels (see Section 7.1.1, page 73).

8. Connect the first insulated conductor of the cable to the input side of the switch.
9. Connect the second insulated conductor of the cable to the output side of the switch.

### 5.5.3 Connecting the Cable for External Standby

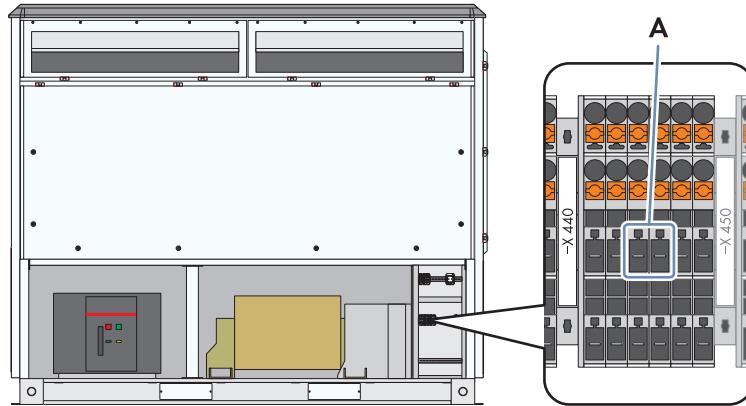


Figure 30: Position of the connecting terminal plate for external standby

Position	Designation
A	Connecting terminal plate

#### Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 14 AWG
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 2

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Connect the cable to the female connector **-X442** (see Section 7.2.2, page 78).
4. Plug the female connector **-X442** into the terminals **5** and **7** in the connecting terminal plate **-X440**.
5. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 7.1.1, page 73).

### 5.5.4 Connecting the Cable for External Active Power Setpoint

If the setpoints for active power limitation and reactive power control are not transmitted via the network, there are terminals in the inverter for connecting external setpoints. The inverter processes standard analog signals from 4.0 mA to 20.0 mA.

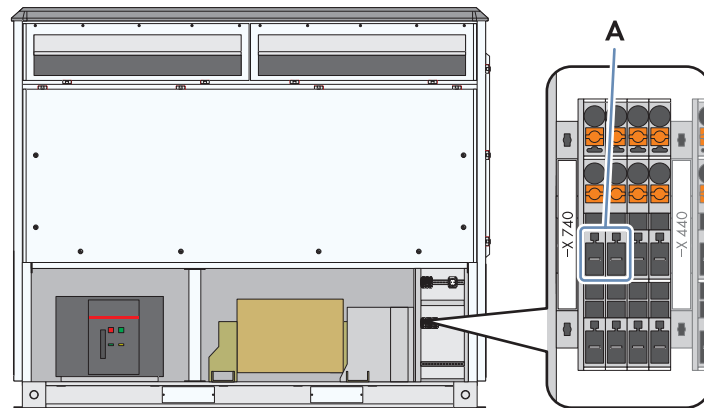


Figure 31: Position of the connecting terminal plate for external setpoint of active power limitation

Position	Designation
A	Connecting terminal plate

#### Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 14 AWG
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 2

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Connect the cable to the female connector **-X741** (see Section 7.2.2, page 78).
4. Plug the female connector **-X741** into the terminals **1** and **3** in the connecting terminal plate **-X740**.
5. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 7.1.1, page 73).

### 5.5.5 Connecting the Cable for External Reactive Power Setpoint

If the setpoints for active power limitation and reactive power control are not transmitted via the network, there are terminals in the inverter for connecting external setpoints. The inverter processes standard analog signals from 4.0 mA to 20.0 mA.

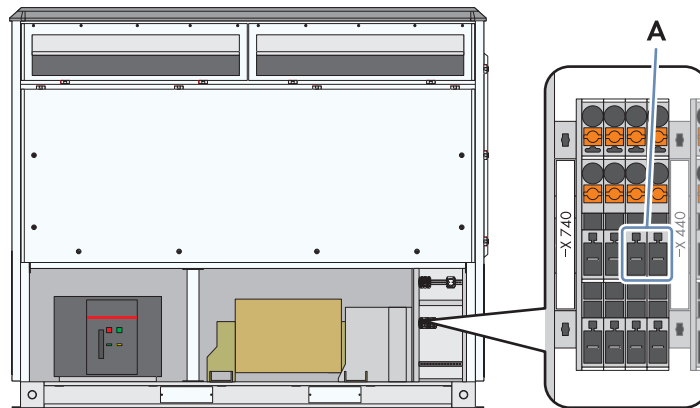


Figure 32: Position of the connecting terminal plate for external setpoint of reactive power control

Position	Designation
A	Connecting terminal plate

#### Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 14 AWG
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 2

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Connect the cable to the female connector **-X742** (see Section 7.2.2, page 78).
4. Plug the female connector **-X742** into the terminals **5** and **7** in the connecting terminal plate **-X740**.
5. Attach the cable to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 7.1.1, page 73).

## 5.5.6 Transformer Protection

### 5.5.6.1 Terminal Assignment of the Transformer Protection

#### Position of the Transformer Protection

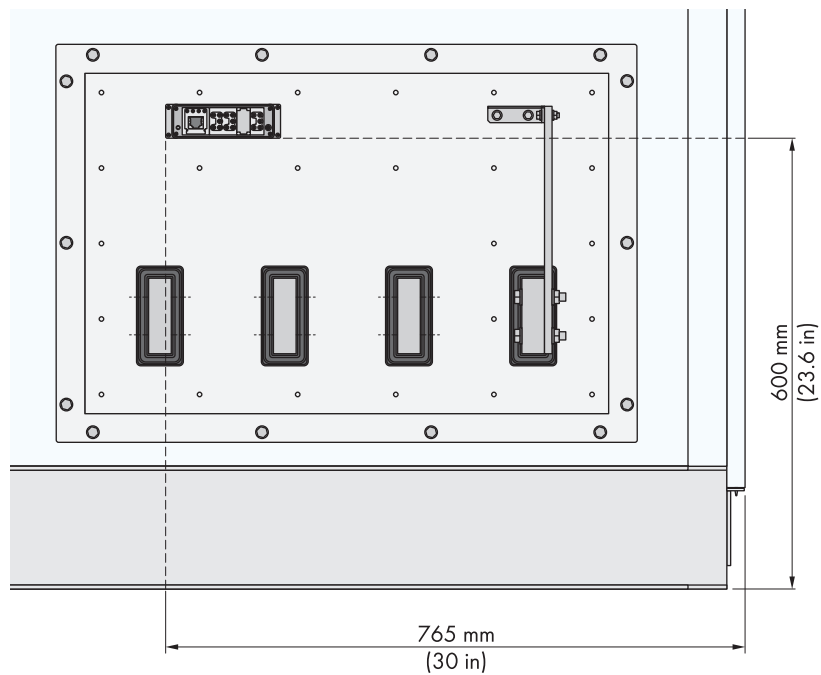


Figure 33: Position of the transformer protection

Part number	Quantity	Description
MHV 24.32	1	Coupling housing, cable outlet: M32
CX 06 TM	1	Supporting frame for modular inserts
CX 05 SM	2	Modular insert for pin contacts
CX FM	4	Dummy module for unused module locations

### Terminal assignment of the transformer protection

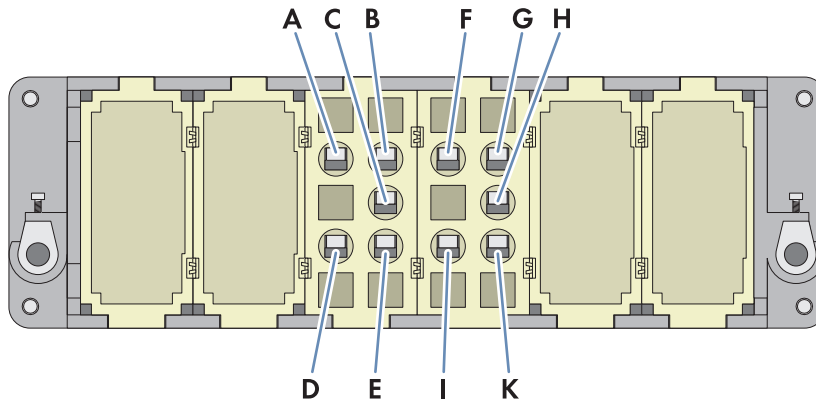


Figure 34: Plug assignment

Position	Reference designation	Designation at the plug	Description
A	-X4:1	Module insert 4: Connection designation: 1	Input: Disconnection of temperature monitoring via change-over contact
B	-X4:2	Module insert 4: Connection designation: 2	Input: Alarm of temperature monitoring via change-over contact
C	-X4:3	Module insert 4: Connection designation: 3	Output: 24 V voltage supply
D	-X4:4	Module insert 4: Connection designation: 4	Input: Pressure monitoring
E	-X4:5	Module insert 4: Connection designation: 5	Input: Gas fill level
F	-X3:1	Module insert 3: Connection designation: 1	Output: +24 V voltage supply for the analog temperature monitoring
G	-X3:2	Module insert 3: Connection designation: 2	Input: GND for analog temperature monitoring
H	-X3:3	Module insert 3: Connection designation: 3	unassigned
I	-X3:5	Module insert 3: Connection designation: 5	Output: SIGN– of the analog temperature sensor
K	-X3:4	Module insert 3: Connection designation: 4	Input: SIGN+ of the analog temperature sensor

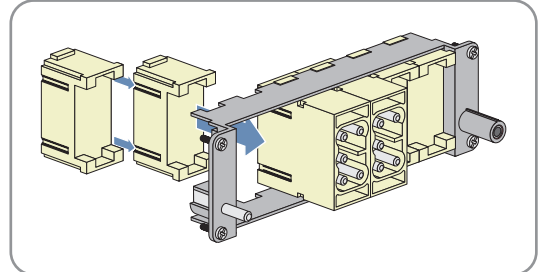
### 5.5.6.2 Connecting the Transformer Protection

**Additionally required mounting material (not included in the scope of delivery):**

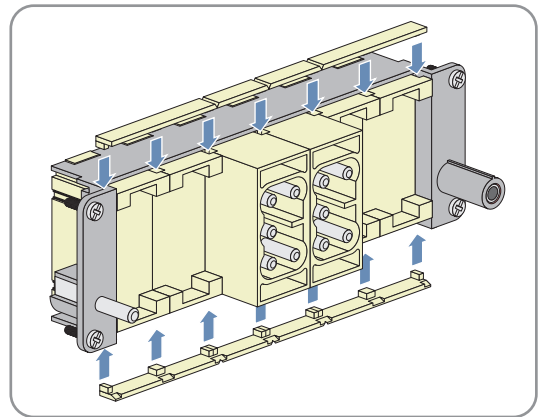
- ☐ Cable gland M32

**Procedure:**

1. Ensure that no voltage is present.
2. Insert the dummy modules and the module inserts into the supporting frame.

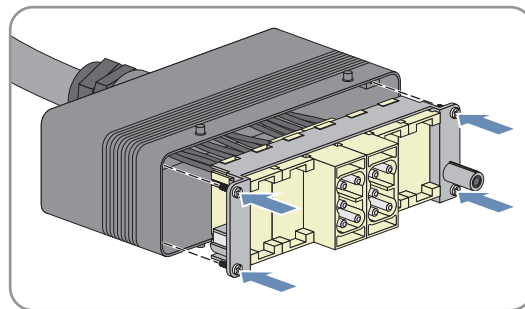


3. Secure the dummy modules and the module inserts with the brackets to the supporting frame.



4. Lead the cable through the cable gland and the coupling housing.
5. Dismantle the cable.
6. Strip the insulation off the wires. The insulation stripping length is: 9 mm to 11 mm (0.36 in to 0.43 in).
7. Connect the cable. Insert the screwdriver in the opening of the module insert. This will release the opening for the insulated conductors in the module insert.
  - Connect the input of the inverter disconnection by means of temperature monitoring with change-over contact to module insert **4:1**.
  - Connect the input of the alarm of the temperature monitoring with change-over contact to module insert **4:2**.
  - Connect the output of the 24 V voltage supply to module insert **4:3**.
  - Connect the input of the pressure monitoring to module insert **4:4**.
  - Connect the input of the gas fill level monitoring to module insert **4:5**.
  - Connect the output of the +24 V voltage supply for the analog temperature monitoring to module insert **3:1**.
  - Connect the input of the GND for analog temperature monitoring to module insert **3:2**.
  - Module insert **3:3** is unassigned.
  - Connect the output SIGN– of the analog temperature sensor to module insert **3:4**.
  - Connect the input SIGN+ of the analog temperature sensor to module insert **3:5**.

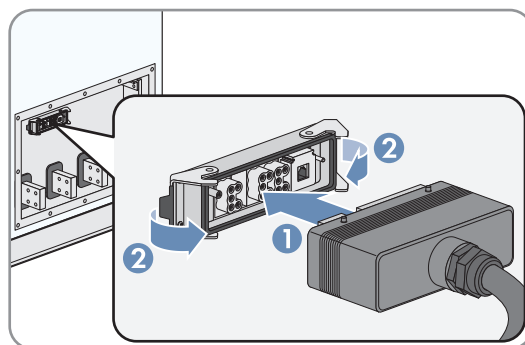
8. Mount the supporting frame on the coupling housing.



9. Tighten the cable gland.

10. Disassemble the transport cover of the transformer protection. Cut through the captive washer with diagonal cutting pliers.

11. Insert the plug into the pin connector on the inverter. Close the clamping brackets.



## 5.5.7 Connection of the Communication in the PV Power Plant

### 5.5.7.1 Organizing the Communication in the PV Power Plant

Depending on the selected option, the connection of the communication must be made in different ways.

Option code	Explanation	see Section
16_0	Customer communication system	Section 5.6.1.2, page 58
16_1	Managed switch for multi-mode cluster ring	Section 5.5.7.2, page 54
17_2	Managed switch for single-mode backbone ring	Section 5.5.7.3, page 55

### 5.5.7.2 Connecting the Cable for Communication via Optical Fiber Cluster Ring

The following contents are only part of the product if the following option was selected:

- Communication System A: Managed Switch MMF

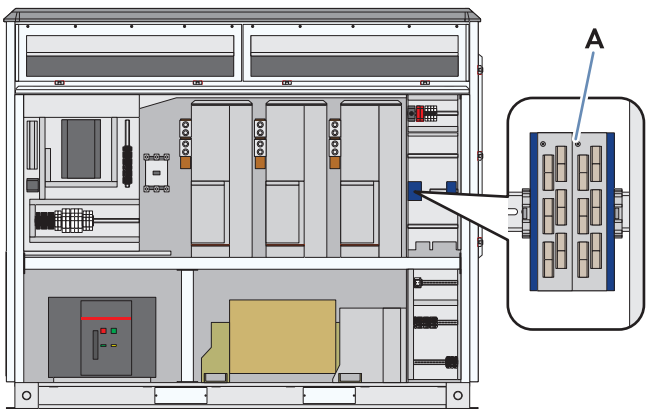


Figure 35: Position of the splice box of communication via optical fiber ring

Position	Designation
A	Splice box

**Optical fiber requirements in multi mode:**

- ☐ 50/125  $\mu\text{m}$
- ☐ Category: OM2
- ☐ Plug: SC MMF

**NOTICE**

**Damage to optical fibers due to too tight bend radii**

Excessive bending or kinking will damage the optical fibers.

- Observe the minimum permissible bend radii of the optical fibers.

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Insert the cables Inserting the Cables.
4. Splice the subscriber connectors with the optical fibers.
5. Plug the subscriber connectors into the SC-P plugs -**X502** in the splice box.
6. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.
7. Mount the panels (see Section 7.1.1, page 73).

**5.5.7.3 Connecting the Cable for Communication via Optical Fiber Backbone Ring**

The following contents are only part of the product if the following option was selected:

- Communication System B: Managed Switch SMF Backbone

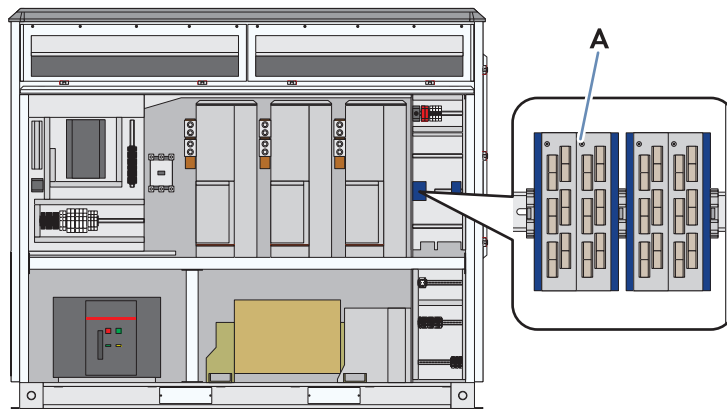


Figure 36: Position of the splice box of communication via optical fiber backbone ring

Position	Designation
A	Splice box

#### Optical fiber requirements in single mode:

- ☐ 9/125  $\mu\text{m}$
- ☐ Category: OS2
- ☐ Plug: SC SMF

#### NOTICE

##### Damage to optical fibers due to too tight bend radii

Excessive bending or kinking will damage the optical fibers.

- Observe the minimum permissible bend radii of the optical fibers.

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Insert the cables Inserting the Cables.
4. Splice the subscriber connectors with the optical fibers.
5. Plug the subscriber connectors into the SC-P plugs **-X503** in the splice box.
6. Attach the optical fibers to the cable support rail using a cable tie. This ensures that the optical fibers cannot be pulled out inadvertently.
7. Mount the panels (see Section 7.1.1, page 73).

5.6 Customer Devices

5.6.1 Customer Installation Location

5.6.1.1 Connecting the Cable for Supply Voltage to Customer Installation Location

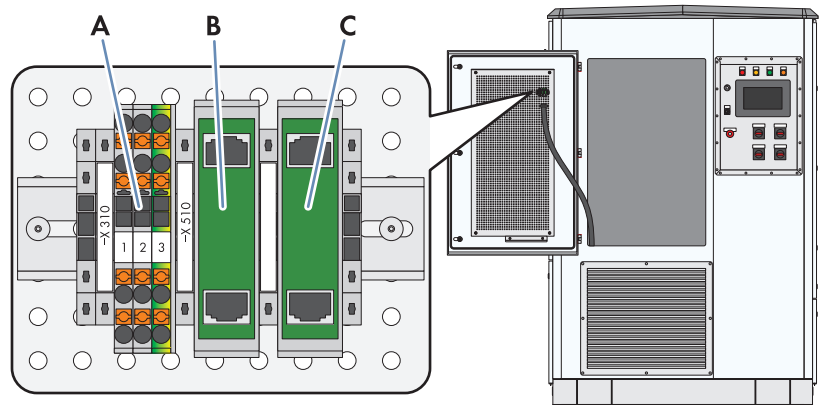


Figure 37: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location <b>-X310</b>
B	Ethernet interface for connecting customer communication devices <b>-X510*</b>
C	Internal Ethernet interface

\* Only for option: Communication System A: Customer Communication

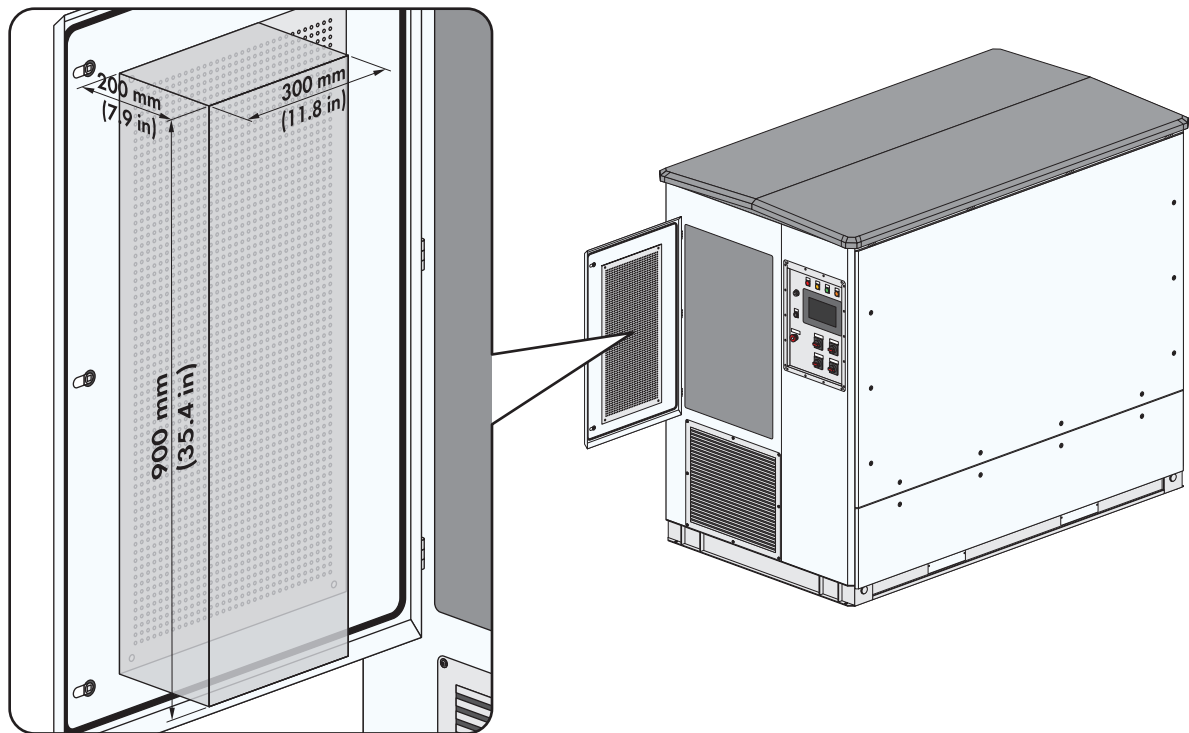


Figure 38: Area for customer devices in the customer installation location

### Requirements for the Connection of Customer Devices:

- ☐ The total maximum power consumption of all customer devices at connecting terminal plate **-X310** must not be exceeded. The maximum continuous power consumption is: 300 VA.
- ☐ The customer devices must be designed for the permissible voltage. The permissible voltage is: 230 V.
- ☐ Voltage fluctuations that occur at the grid-connection point are transmitted to connecting terminal plate **-X310** in the same proportion. The customer devices must be designed for these voltage fluctuations.
- ☐ The total weight of all customer devices may not be exceeded. The total weight is: 20 kg (44 lb).
- ☐ Customer devices may be mounted on the mounting plate. An area of W x H x D: 300 mm x 900 mm x 200 mm (11.8 in x 35.4 in x 7.8 in) is available for this. The area may not be exceeded.
- ☐ The customer devices must be designed for a temperature of 60°C (140°F) in normal operation.

### Requirements for cable routing:

- ☐ Data cables must be laid in a conduit or cable channel. This reduces EMC disturbances.

### Cable requirements:

- ☐ Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup> (AWG 14)
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 3

### Procedure:

1. Ensure that no voltage is present.
2. Connect the cable to the connecting terminal plate **-X310** (see Section 7.2.1, page 77).

### 5.6.1.2 Cable for Option Communication System A: Connecting Customer Communication:

The Ethernet interface may only be used if the following option was selected:

- Communication System A: Customer Communication

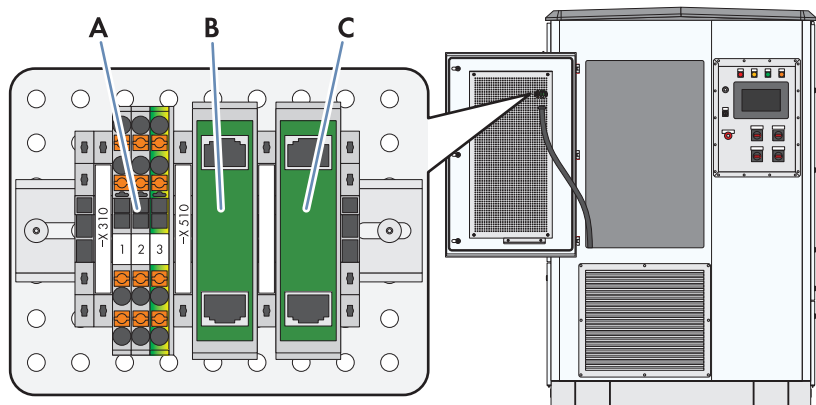


Figure 39: Position of the connections at the customer installation location

Position	Designation
A	Connecting terminal plate for voltage supply at customer installation location <b>-X310</b>
B	Ethernet interface for connecting customer communication devices <b>-X510*</b>
C	Internal Ethernet interface

\* Only for option: Communication System A: Customer Communication

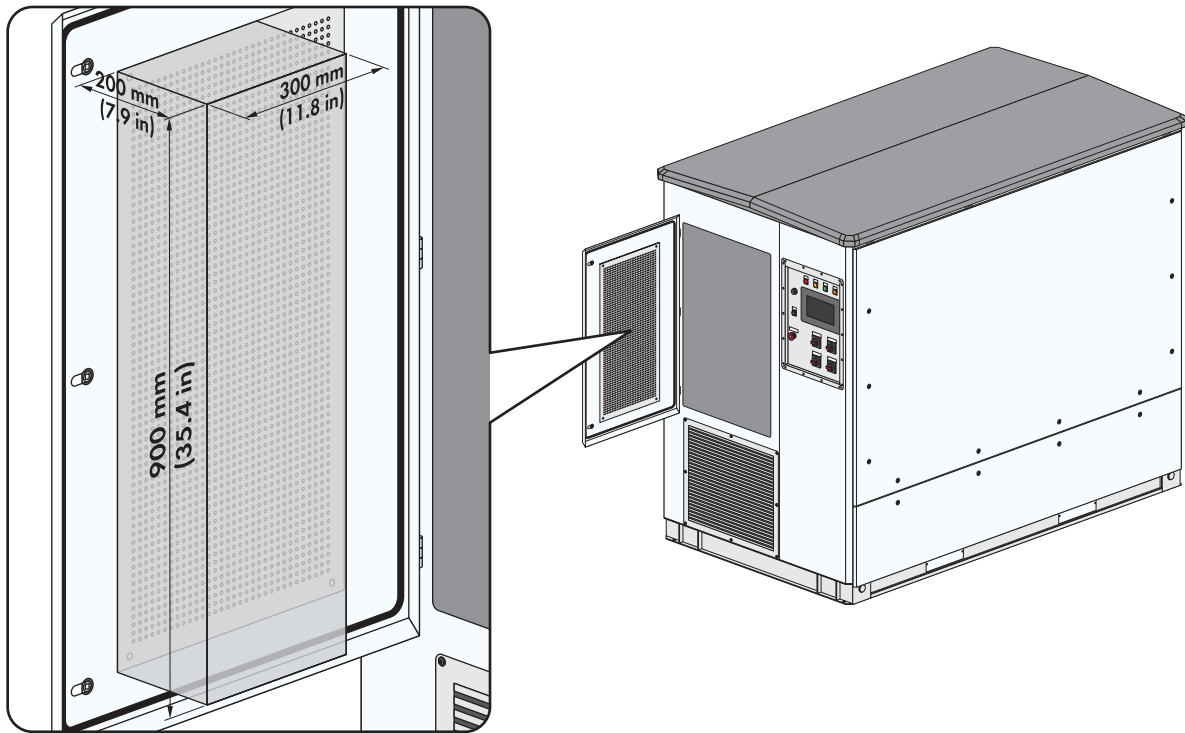


Figure 40: Area for customer devices in the customer installation location

#### Requirements for cable routing:

- ☐ Data cables must be laid in a conduit or cable channel. This reduces EMC disturbances.

#### Ethernet cable requirements:

- ☐ The cable must be shielded.
- ☐ The insulated conductors must be pair-twisted.
- ☐ The cable must be at least of category 5 (CAT 5).

#### Requirements for wired communication:

- ☐ In case of wired communication, an overvoltage protection for the data cables must be provided.

#### Procedure:

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Insert the cables Inserting the Cables.
4. Plug the cable into the network port **-X510**.
5. Attach the cables to the cable support rail using a cable tie. This will prevent the cables from being pulled out inadvertently.
6. Mount the panels (see Section 7.1.1, page 73).

## 5.6.2 Auxiliary Voltage Supply for External Loads

### 5.6.2.1 Connecting the Cables for External Loads to the Auxiliary Voltage Supply

The following contents are only part of the product if one of the following options was selected:

- Additional supply for external loads: 2.5 kVA/230 V
- Additional supply for external loads: 2.5 kVA/120 V

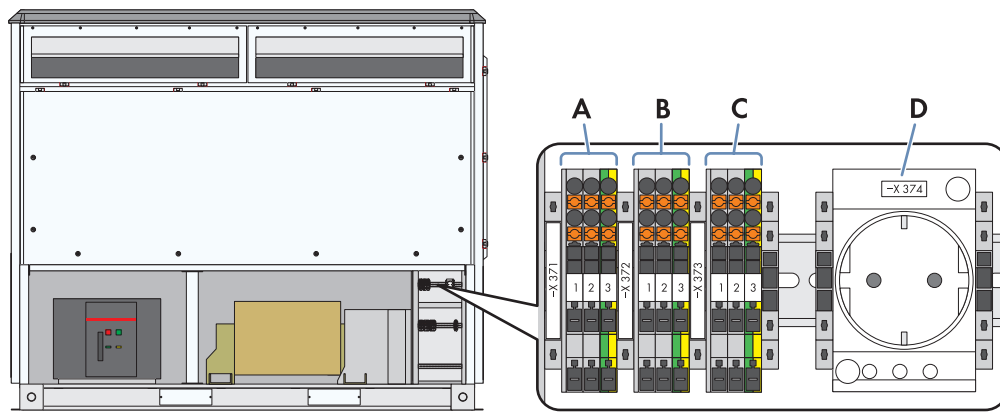


Figure 41: Position of the connecting terminal plates and the outlet for external loads

Position	Designation
A	Connecting terminal plate <b>-X371</b>
B	Connecting terminal plate <b>-X372</b>
C	Connecting terminal plate <b>-X373</b>
D	Outlet <b>-X374</b>

**Requirements for the connection of customer devices to the outlet -X374:**

- ☐ The total maximum power consumption of all customer devices at the outlet must not be exceeded. The maximum continuous power consumption is: 1,440 VA.
- ☐ The customer devices must be designed for the permissible voltage. The permissible voltage is: 120 V.
- ☐ The customer devices must be suitable for the connection to the circuit breaker. The type of the circuit breaker is: B20 A.

**Requirements for the connection of customer devices to the connecting terminal plate -X371 to -X373:**

- ☐ The total maximum power consumption of all customer devices at the connecting terminal plates must not be exceeded. The maximum continuous power consumption for every single connecting terminal plate is: 350 VA.
- ☐ The customer devices must be designed for the permissible voltage. The permissible voltage is: 120 V.
- ☐ The customer devices must be suitable for the connection to the circuit breaker. The type of the circuit breaker is: B20 A.

**Requirements for cable routing:**

- ☐ Data cables must be laid in a conduit or cable channel. This reduces EMC disturbances.

**Cable requirements:**

- ☐ Multi-wire cable with bootlace ferrules: 2.5 mm<sup>2</sup> (AWG 14)
- ☐ Single-wire cable: 4 mm<sup>2</sup> (AWG 12)
- ☐ Number of conductors: 3

**Procedure:**

1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Connect the cable to the female connector **-X371** (see Section 7.2.2, page 78).
4. Plug the female connector into the terminals **1**, **2** and **3** in the connecting terminal plate **-X371**.

5. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
6. Connect the cable to the female connector **-X372** (see Section 7.2.2, page 78).
7. Plug the female connector into the terminals **1, 2** and **3** in the connecting terminal plate **-X372**.
8. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
9. Connect the cable to the female connector **-X373** (see Section 7.2.2, page 78).
10. Plug the female connector into the terminals **1, 2** and **3** in the connecting terminal plate **-X373**.
11. Attach the cable to the cable support rail using cable ties. This will prevent the cables from being pulled out inadvertently.
12. Mount the panels (see Section 7.1.1, page 73).

## 5.7 Mounting the Protective Cover

### **DANGER**

#### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Observe the safety information when disconnecting and reconnecting voltage sources (see Section 6.1, page 64).
- Disconnect the inverter from the control path (see Section 6.3.4, page 68).
- Disconnect the inverter from the power transmission path on the AC side (see Section 6.3.2, page 66).
- Disconnect the inverter from the power transmission path on the DC side (see Section 6.3.3, page 67).
- Switch off the MV transformer (see Section 6.4, page 69).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely.

### **DANGER**

#### **Danger to life due to electric shock when live components are touched if the protective cover was incorrectly mounted**

The connection busbars are live when in operation. If no protective cover has been mounted, the connection busbars are not protected against contact. Touching live components results in death or serious injury.

- Mount the protective cover between the MV transformer and the inverter.
- The clearance between the connection busbars and the protective cover must always be at least 12.7 mm (0.5 in). Take the thermal expansion of the connection busbars into account.
- The protective cover must prevent inadvertent touching.
- The protective cover must not form a conductive connection to the connection busbars.
- The installer is responsible for constructing and mounting the protective cover.

## Types of Protective Covers

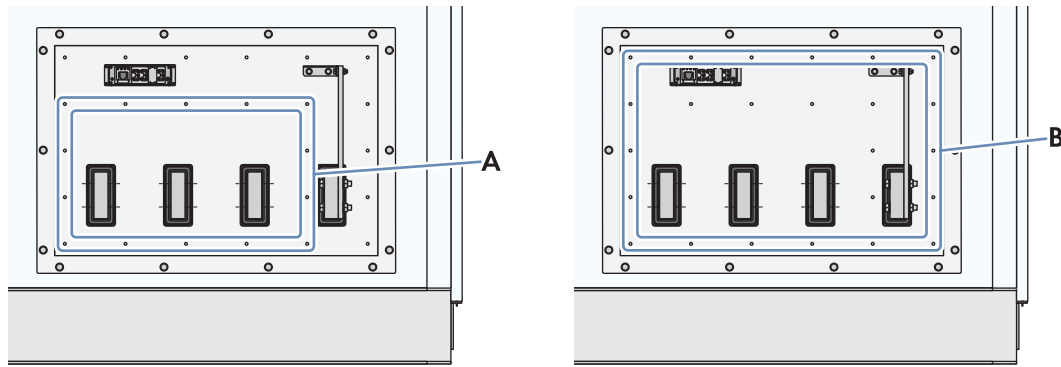


Figure 42: Bolts to be used for mounting the protective cover

Position	Designation
A	Bolts for mounting the protective cover when only the AC connection busbars should be covered
B	Bolts for mounting the protective cover when the AC connection busbars, the protective cover, the foundation ground electrode and the transformer protection should be covered

### Position of the Bolts for Mounting the Protective Cover

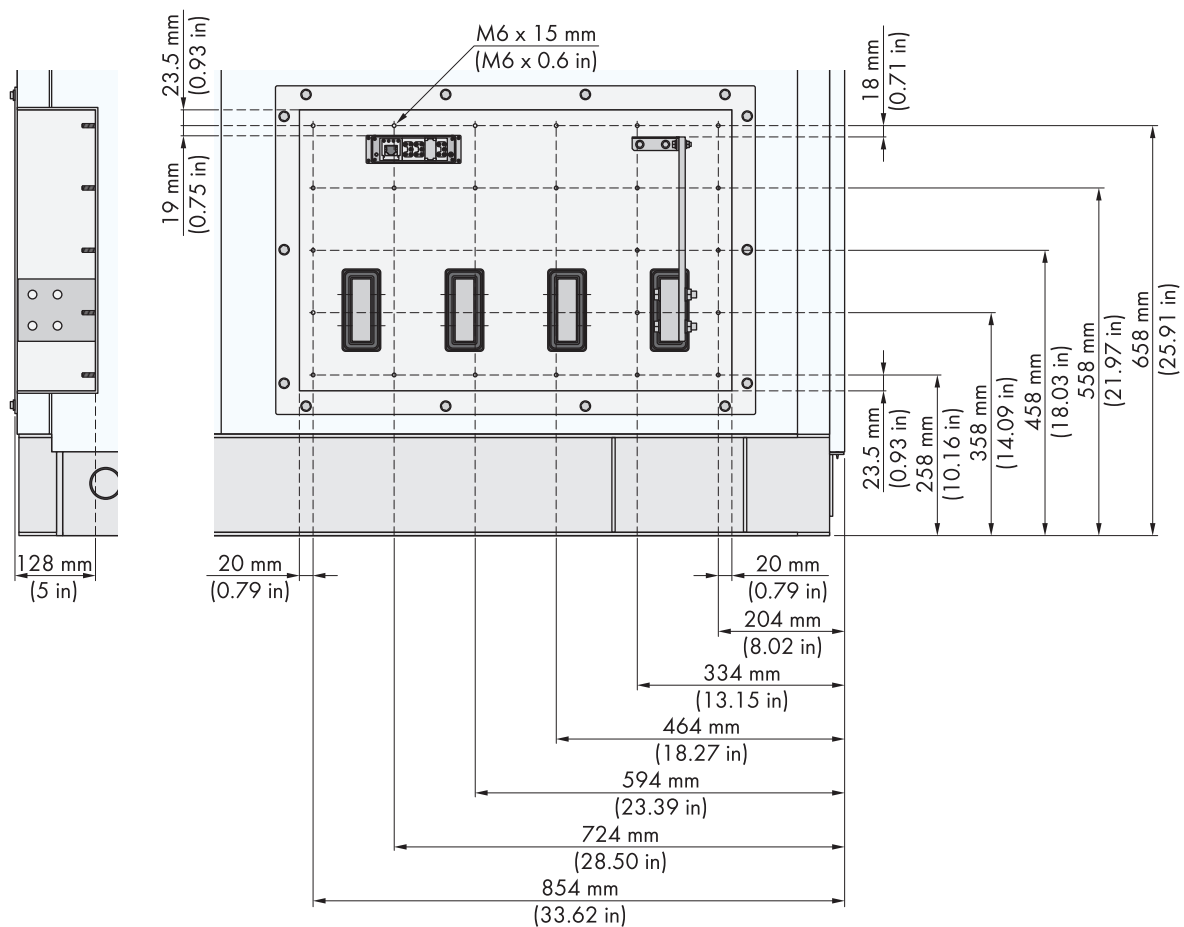


Figure 43: Position of the bolts for mounting the protective cover

**Additionally required mounting material (not included in the scope of delivery):**

- ☐ Protective cover with the following properties:

- The protective cover prevents that the connection busbars are touched inadvertently.
- The protective cover does not have a conductive connection to the connection busbars.
- The protective cover must be flush with the inverter.
- The protective cover must be mounted to all bolts on the inverter.
- The clearance between the connection busbars and the protective cover must be at least 12.7 mm (0.5 in). Take the thermal expansion of the connection busbars into account.
- The creeping distance between the connection busbars and the protective cover must be at least 25.4 mm (1.0 in). Take the thermal expansion of the connection busbars into account.
- The protective cover must form a conductive connection between the inverter enclosure and the MV transformer.

## 5.8 Covering the Cable Insertion Area

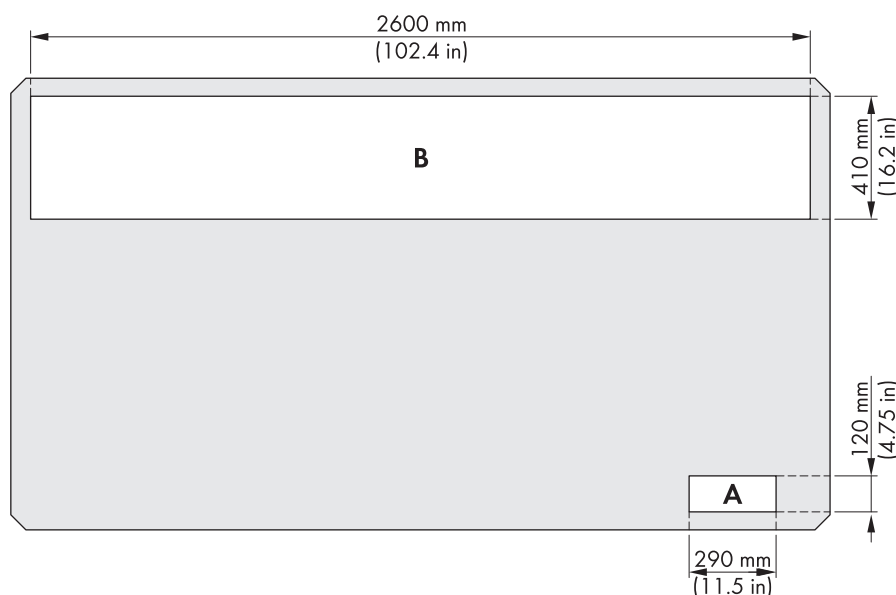


Figure 44: Cavity in the base area of the inverter

Position	Designation
A	Cable insertion area of the cables for communication, control, supply voltage and monitoring
B	Cable insertion area of the DC cables and grounding cables

### **i** Construction and mounting of the cover

The installer is responsible for constructing and mounting the cover for the cable insertion areas.

#### Requirements for the cover of the cable insertion areas:

- ☐ The connection area of the inverter must be protected against solid foreign objects from a diameter of 12.5 mm (0.49 in).
- ☐ The connection area of the inverter must be protected against vertically falling spray water up to 60°.

#### Procedure:

- Cover the cable insertion areas.

## 6 Disconnecting and Reconnecting

### 6.1 Safety When Disconnecting and Reconnecting Voltage Sources

#### DANGER

##### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

#### DANGER

##### **Danger to life due to electric arcs if measuring device is not connected correctly**

If the measurement points are incorrectly contacted, this can cause an electric arc. Electric arcs can result in death or serious injury.

- Select the appropriate measurement range on the measuring device.
- Wear suitable personal protective equipment for all work on the device.
- Select correct measurement points.

#### WARNING

##### **Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

#### WARNING

##### **Hearing impairment due to high-frequency noises of the inverter**

The inverter generates high-frequency noises when in operation. This can result in hearing impairment.

- Wear personal protective equipment for all work on the product.
- Wear hearing protection.

**⚠ CAUTION****Risk of burns due to hot components**

Some components of the product can get very hot during operation. Touching these components can cause burns.

- Observe the warnings on all components.
- During operation, do not touch any components marked with such warnings.
- Wear suitable personal protective equipment for all work on the product.

## 6.2 Disconnecting Procedures

Components that are in contact with the voltage of the PV array or with the AC voltage generated by the inverter up to the medium-voltage grid, are called "power transmission path".

Components that are in contact with supply voltages and control signals are called "control path".

### Areas on the inverter

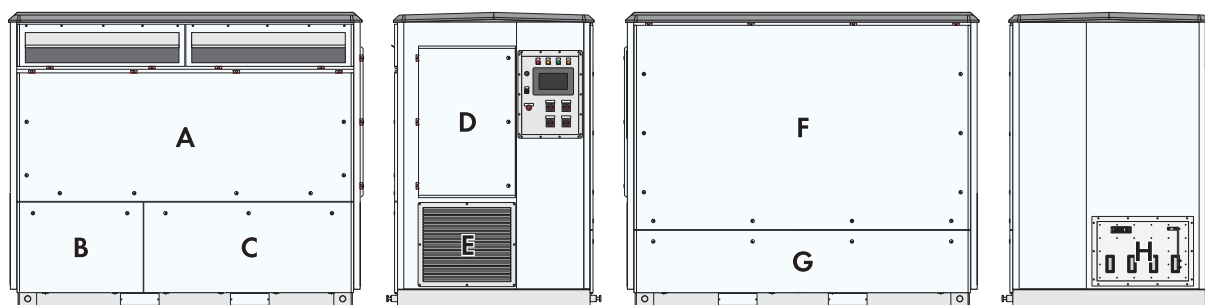


Figure 45: Areas on the inverter

Areas on the inverter	Disconnecting the power transmission path, see Section	Disconnecting the control path, see Section
A	Section 6.3.2, page 66	Section 6.3.4, page 68
B	Section 6.4, page 69	Section 6.4, page 69
C	Section 6.3.2, page 66	Section 6.3.4, page 68
D	There is no power transmission path in this area	Section 6.3.4, page 68
E	Section 6.3.2, page 66	Section 6.3.4, page 68
F	Section 6.3.3, page 67	Section 6.3.4, page 68
G	Section 6.3.3, page 67	There is no control path in this area
H	Section 6.4, page 69	Section 6.4, page 69

### **i** Hazard risk category after disconnecting the power transmission path

After disconnecting the power transmission path, the hazard risk category decreases for the respective area in the inverter. The hazard risk category is 0 after proper disconnection.

## 6.3 Disconnecting the Inverter

### 6.3.1 Switching off the Inverter

1. Turn the key switch **-S1** to **Stop**.
2. Remove the key. This will protect the inverter from inadvertent reconnection.

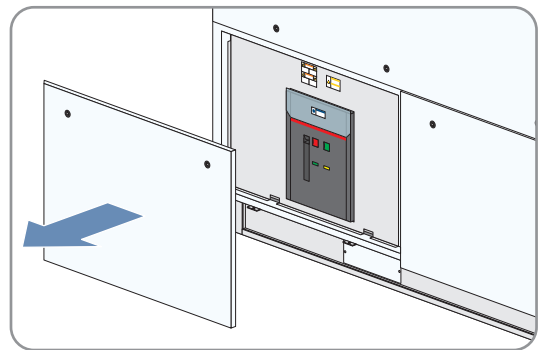
### 6.3.2 Disconnecting the Inverter from the Power Transmission Path on the AC Side

**Additionally required material (not included in the scope of delivery):**

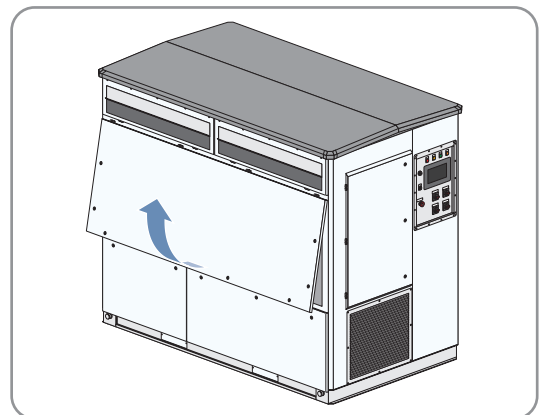
- 1 padlock. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in).

**Procedure:**

1. Make sure that the panels on the inverter are mounted correctly (see Section 7.1.1, page 73).
2. Make sure that the protective cover of the AC connection busbars is mounted correctly.
3. Switch off the inverter (see Section 6.3.1, page 66).
4. Turn the load-break switch of the AC disconnection unit and of the precharge unit **-Q63** to the **OFF** position.
5. Pull the brackets out of the switch levers.
6. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
7. Disassemble the outer panel of the AC switch module (see Section 7.1.1, page 73).



8. Verify that the switch state display of the AC disconnection unit is in the **OPEN** position.
9. Mount the outer panel of the AC switch module (see Section 7.1.1, page 73).
10. Open the hatch (see Section 7.3, page 79).



11. Remove the protective cover situated above the **-X9510** terminals (see Section 7.1.2, page 75).
12. Ensure that no voltage is present on the **-X9510** terminals.

### 6.3.3 Disconnecting the Inverter from the Power Transmission Path on the DC Side

#### For inverters without DC switch in front of the input fuses

Select this procedure if the inverter is equipped with one of the following options:

- DC input configuration: none (busbar)
- DC input configuration: 9 fused inputs
- DC input configuration: 12 fused inputs
- DC input configuration: 18 fused inputs
- DC input configuration: 21 fused inputs
- DC input configuration: 24 fused inputs

#### Additionally required material (not included in the scope of delivery):

- ☐ 1 padlock. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in).

#### Procedure:

1. Switch off the inverter (see Section 6.3.1, page 66).
2. Turn the DC load-break switch **-Q61** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
5. Actuate upstream switchpoint. Remove the fuses from the String-Combiners or switch off the circuit breakers of the String-Combiners.
6. Check whether the switch on the touch display between the DC side and the inverter is open and the voltage display shows 0 V.  
If the switch between the DC side and the inverter is closed or the voltage display does not show 0 V, make sure that all switch points upstream the String-Combiners have been activated. Remove the fuses from the String-Combiners or switch off the circuit breakers of the String-Combiners.
7. Open the hatch (see Section 7.3, page 79).
8. Ensure that no voltage is present for each DC input. Use the measuring points on the bottom of the fuse holders.  
Tip: There are drill holes in the protective covers over the fuse holders. Through these drill holes you can determine the voltage-free status with suitable test probes without having to disassemble the protective covers.

#### For inverters with DC switch in front of the input fuses

Select this procedure if the inverter is equipped with one of the following options:

- DC input configuration: 24 fused inputs + disco.
- DC input configuration: 28 fused inputs + disco.
- DC input configuration: 32 fused inputs + disco.

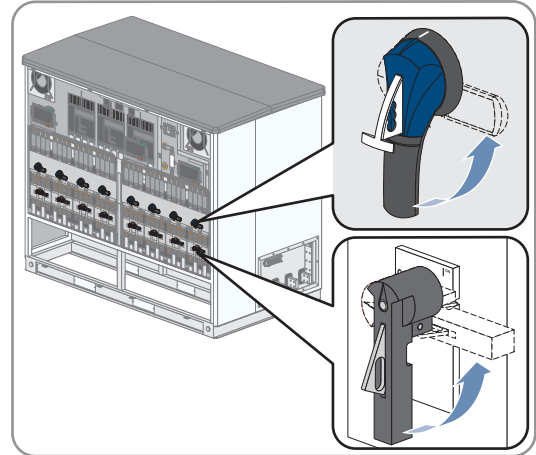
#### Additionally required material (not included in the scope of delivery):

- ☐ 17 padlocks. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in)

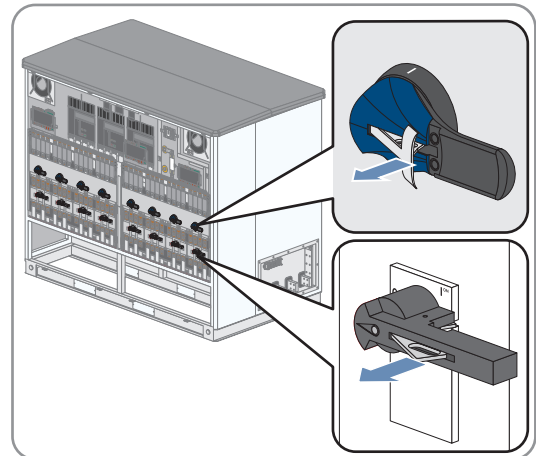
#### Procedure:

1. Switch off the inverter (see Section 6.3.1, page 66).
2. Turn the DC load-break switch **-Q61** to the **OFF** position. Note that the cable to the load-break switch is still energized.

3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
5. Open the hatch (see Section 7.3, page 79).
6. Switch all switch levers of the DC switches **-Q111 to -Q114, -Q121 to -Q124, -Q211 to -Q214, -Q221 to -Q224** to the **OFF** position.



7. Pull the brackets out of the switch levers.



8. Hook the padlocks in the brackets and lock them. This will ensure that the switch levers cannot reconnect inadvertently.
  - ☒ The ungrounded pole of the DC inputs is activated starting at the DC switches.
9. If the ungrounded pole, the DC switches and the DC connection area should also be activated, operate the switch-point positioned in front. Remove the fuses from the String-Combiners or switch off the circuit breakers of the String-Combiners.
10. Check whether the switch between the DC side and the inverter is open on the touch display.
 

If the switch between the DC side and the inverter is closed, ensure that all switch-points upstream the String-Combiners have been activated. Remove the fuses from the String-Combiners or switch off the circuit breakers of the String-Combiners.
11. Ensure that no voltage is present for each DC input. Use the measuring points on the bottom of the fuse holders.
 

Tip: There are drill holes in the protective covers over the fuse holders. Through these drill holes you can determine the voltage-free status with suitable test probes without having to disassemble the protective covers.

### 6.3.4 Disconnecting the Supply Voltage and External Voltages

**Additionally required material (not included in the scope of delivery):**

- ☐ 4 padlocks. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in)

### Switching Off the Supply Voltage

1. Switch off the inverter (see Section 6.3.1, page 66)
2. Turn the DC load-break switch **-Q62** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

### Switching Off the Auxiliary Energy Supply

1. Turn the DC load-break switch **-Q64** to the **OFF** position. Note that the cable to the load-break switch is still energized.
2. Pull the bracket out of the switch lever.
3. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

### Switching Off the Precharge Unit and the AC Circuit Breaker

1. Switch off the inverter (see Section 6.3.1, page 66)
2. Turn the DC load-break switch **-Q63** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

### Switching off the Fans, Heating Elements, String Monitoring and DC Load-Break Switch

1. Switch off the inverter (see Section 6.3.1, page 66)
2. Turn the DC load-break switch **-Q61** to the **OFF** position. Note that the cable to the load-break switch is still energized.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.

## 6.4 Switching Off the MV Transformer

### Connecting and disconnecting the AC voltage

Only a duly authorized person trained in electrical safety is allowed to connect and disconnect the AC voltage.

#### Additionally required material (not included in the scope of delivery):

- ☐ 1 padlock. Diameter of the shackle: 5 mm to 8 mm (0.2 in to 0.3 in)

#### Procedure:

1. Switch off the inverter (see Section 6.3.1, page 66).
2. Turn the DC load-break switch **-Q63** on the inverter to the **OFF** position.
3. Pull the bracket out of the switch lever.
4. Hook a suitable padlock into the bracket and lock it. This will ensure that the switch lever cannot reconnect inadvertently.
5. Open the load-break switch of the circuit-breaker panel of the medium-voltage switchgear.
6. Close the grounding switch of the circuit breaker panel of the medium-voltage switchgear.
7. Attach magnetic signs indicating the name of the duly authorized person to the circuit breaker panel.

## 6.5 Reconnecting the Inverter

### 6.5.1 Reconnecting the Supply Voltage and External Voltages

#### DANGER

##### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Before reconnecting, make sure that the panels are mounted (see Section 7.1.1, page 73).
- Before reconnecting, make sure that the protective covers are mounted (see Section 7.1.2, page 75).
- Before reconnecting, make sure that the hatches are closed (see Section 7.3, page 79).

#### **Switching On the Supply Voltage**

1. Remove the padlock from the bracket of the load-break switch -**Q62**.
2. Turn the DC load-break switch -**Q62** to the **ON** position.

#### **Switching On the Auxiliary Energy Supply**

1. Remove the padlock from the bracket of the load-break switch -**Q64**.
2. Turn the DC load-break switch -**Q64** to the **ON** position.

#### **Switching On the Precharge Unit and the AC Circuit Breaker**

1. Remove the padlock from the bracket of the load-break switch -**Q63**.
2. Turn the DC load-break switch -**Q63** to the **ON** position.

#### **Switching on the Fans, Heating Elements, String Monitoring and DC Load-Break Switch**

1. Remove the padlock from the bracket of the load-break switch -**Q61**.
2. Turn the DC load-break switch -**Q61** to the **ON** position.

### 6.5.2 Reconnecting the DC Side

#### **For inverters with DC switch in front of the input fuses**

#### DANGER

##### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Before reconnecting, make sure that the panels are mounted (see Section 7.1.1, page 73).
- Before reconnecting, make sure that the protective covers are mounted (see Section 7.1.2, page 75).
- Before reconnecting, make sure that the hatches are closed (see Section 7.3, page 79).

Select this procedure if the inverter is equipped with one of the following options:

- DC input configuration: 24 fused inputs + disco.
- DC input configuration: 28 fused inputs + disco.
- DC input configuration: 32 fused inputs + disco.

**Procedure:**

1. Remove the padlock from the brackets of the DC switches.
2. Turn all switch levers of the DC switches **-Q111 to -Q114, -Q121 to -Q124, -Q211 to -Q214, -Q221 to -Q224** to the **ON** position.
3. If the grounded pole, the DC switches **-Q111 to -Q114, -Q121 to -Q124, -Q211 to -Q214, -Q221 to -Q224** and the DC connection area were disconnected, operate the upstream switch point. Remove the fuses from the String-Combiners or switch on the circuit breakers of the String-Combiners.
4. Remove the padlock from the bracket of the load-break switch **-Q61**.
5. Turn the DC load-break switch **-Q61** to the **ON** position.

**For inverters without DC switch in front of the input fuses****⚠ DANGER****Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Before reconnecting, make sure that the panels are mounted (see Section 7.1.1, page 73).
- Before reconnecting, make sure that the protective covers are mounted (see Section 7.1.2, page 75).
- Before reconnecting, make sure that the hatches are closed (see Section 7.3, page 79).

Select this procedure if the inverter is equipped with one of the following options:

- DC input configuration: none (busbar)
- DC input configuration: 9 fused inputs
- DC input configuration: 12 fused inputs
- DC input configuration: 18 fused inputs
- DC input configuration: 21 fused inputs
- DC input configuration: 24 fused inputs

**Procedure:**

1. Actuate upstream switchpoint. Insert fuses in the String-Combiners or switch on the circuit breakers of the String-Combiners.
2. Remove the padlock from the bracket of the load-break switch **-Q61**.
3. Turn the DC load-break switch **-Q61** to the **ON** position.

**6.5.3 Reconnecting the AC Side****⚠ DANGER****Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Before reconnecting, make sure that the panels are mounted (see Section 7.1.1, page 73).
- Before reconnecting, make sure that the protective covers are mounted (see Section 7.1.2, page 75).
- Before reconnecting, make sure that the hatches are closed (see Section 7.3, page 79).

1. Make sure that the panels of the AC connection are mounted correctly.
2. Remove the padlock from the bracket of the load-break switch **-Q63**.
3. Turn the DC load-break switch **-Q63** to the **ON** position.

#### 6.5.4 Restarting the Inverter

##### **DANGER**

##### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Before reconnecting, make sure that the panels are mounted (see Section 7.1.1, page 73).
- Before reconnecting, make sure that the protective covers are mounted (see Section 7.1.2, page 75).
- Before reconnecting, make sure that the hatches are closed (see Section 7.3, page 79).

##### **Procedure:**

- Turn the key switch **-S1** to **Start**.

### 6.6 Reconnecting the MV Transformer

#### **Connecting and disconnecting the AC voltage**

Only a duly authorized person trained in electrical safety is allowed to connect and disconnect the AC voltage.

##### **Procedure:**

1. Remove the magnetic signs indicating the name of the duly authorized person from the circuit breaker panel.
2. Open the grounding switch at the circuit breaker panel of the medium-voltage switchgear.
3. Close the load-break switch on the circuit breaker panel of the medium-voltage switchgear.
4. Remove the padlock from the bracket of the load-break switch **-Q63**.
5. Turn the DC load-break switch **-Q63** to the **ON** position.
6. Restart the inverter (see Section 6.5.4, page 72).

7 Periodic Actions

7.1 Mounting and Disassembly Work

7.1.1 Disassembling and Mounting the Panels

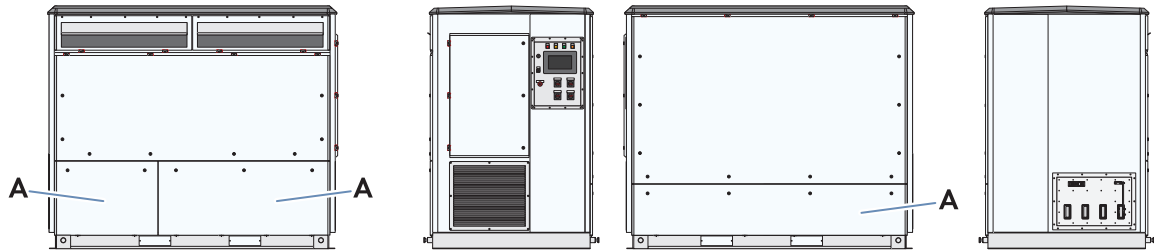


Figure 46: Overview of the panels

Position	Designation
A	Panel

**⚠ DANGER**

**Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

**⚠ WARNING**

**Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**⚠ CAUTION****Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**NOTICE****Property damage due to rupture of grounding conductors**

The components are connected to the inverter via the grounding conductor. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Take care not to damage the grounding conductors during disassembly.

**Disassembling the panels**

1. Open the locks with a square key wrench.
2. Detach the grounding straps from the panels.
3. Slightly raise and remove the panels.

**Mounting the panels****Requirement:**

- ☐ The protective covers in the connection area must be mounted.

**Procedure:**

1. Attach the grounding straps to the panels (torque: 8 Nm to 10 Nm (70.8 in-lb to 88.5 in-lb)).
2. Ensure that the grounding straps are firmly in place.
3. Mount the panels.
4. Close the locks with a square key wrench.

7.1.2 Disassembling and Mounting the Protective Covers on the Inverter

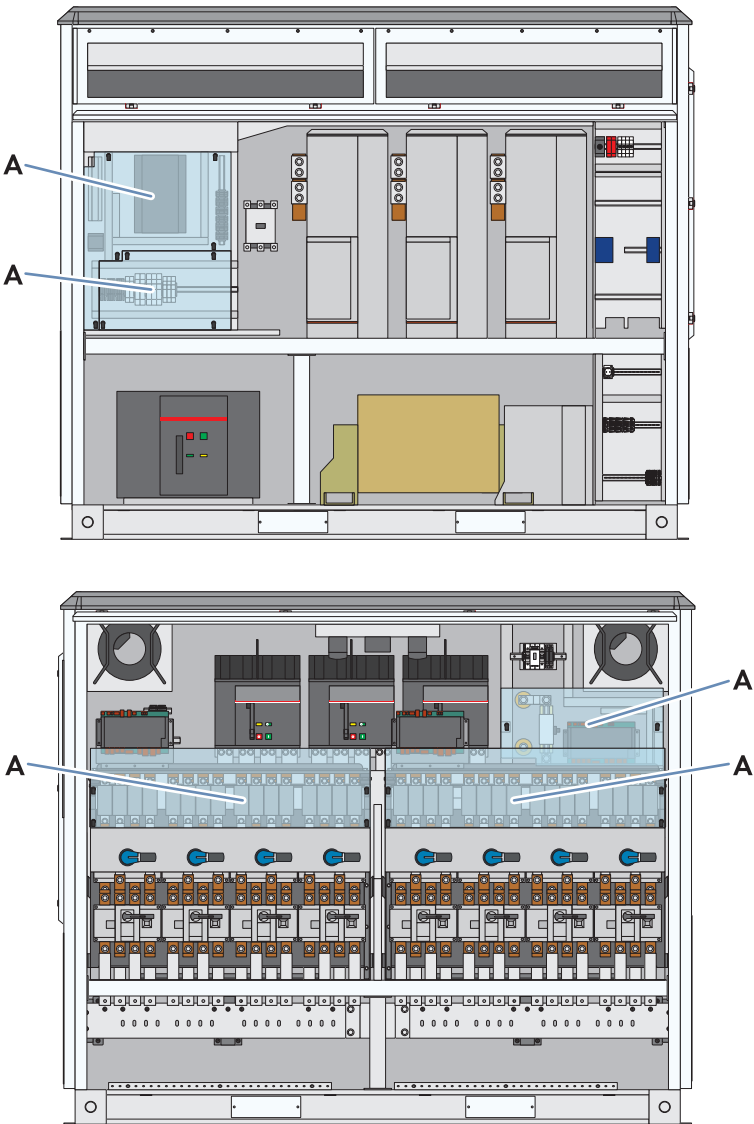


Figure 47: Position of the protective covers

Position	Designation
A	Protective cover

**⚠ DANGER****Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

**⚠ WARNING****Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

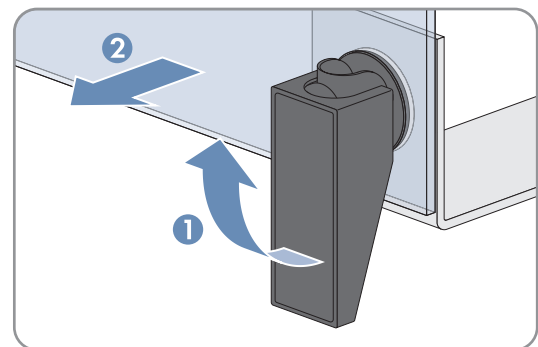
**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**Disassembling the protective covers**

1. Ensure that no voltage is present.
2. Open the clamping brackets.



3. Remove the protective cover forwards. The clamping brackets remain in the protective cover.

### Mounting the protective covers

1. Mount the protective cover to the bracket. The clamping brackets must be located over the holes in the bracket.
2. Close the clamping brackets.

## 7.2 Clamp Connections

### 7.2.1 Connecting Cables to the Connecting Terminal Plates

#### DANGER

##### **Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

#### WARNING

##### **Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

#### CAUTION

##### **Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

#### CAUTION

##### **Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**Procedure:**

1. Ensure that no voltage is present.
2. Dismantle the cable.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 6 mm to 7 mm (0.236 in to 0.275 in).
4. Connect the cable in accordance with the circuit diagram.
  - Insert the screwdriver into the square-shaped opening of the connecting terminal plate. This will release the opening for the insulated conductors.
5. Pull the screwdriver out of the connecting terminal plate.

**7.2.2 Connecting Cables to the Female Connectors****⚠ DANGER****Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

**⚠ WARNING****Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**⚠ CAUTION**

**Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**Procedure:**

1. Ensure that no voltage is present.
2. Dismantle the cable.
3. Strip the insulation of the insulated conductors. Insulation stripping length: 8 mm to 9 mm (0.315 in to 0.354 in).
4. Connect the cable in accordance with the circuit diagram.
  - Remove the female connector from the connecting terminal plate.
  - Insert the screwdriver into the square-shaped opening of the female connector. This will release the opening for the insulated conductors of the female connector.
  - Insert the insulated conductors of the cable into the female connector in accordance with the circuit diagram.
  - Pull the screwdriver out of the female connector.

**7.3 Opening and Closing the Hatches**

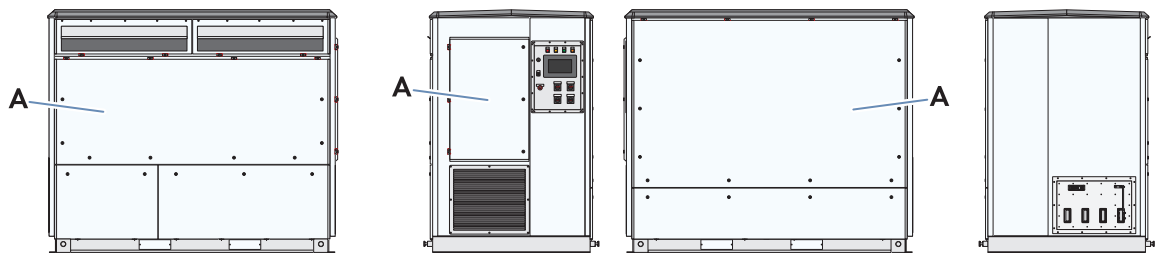


Figure 48: Overview of the hatches

Position	Designation
A	Hatch

**⚠ DANGER****Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

**⚠ WARNING****Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**⚠ CAUTION****Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**Opening hatches**

- Open the locks with a square key wrench. Lightly press against the hatch.

**Closing hatches****Requirement:**

- ☐ Protective covers must be mounted (see Section 7.1.2, page 75).

**Procedure:**

1. Press the hatch down.
2. Close the locks with a square key wrench. Lightly press against the hatch.

## 7.4 Inserting the Cables

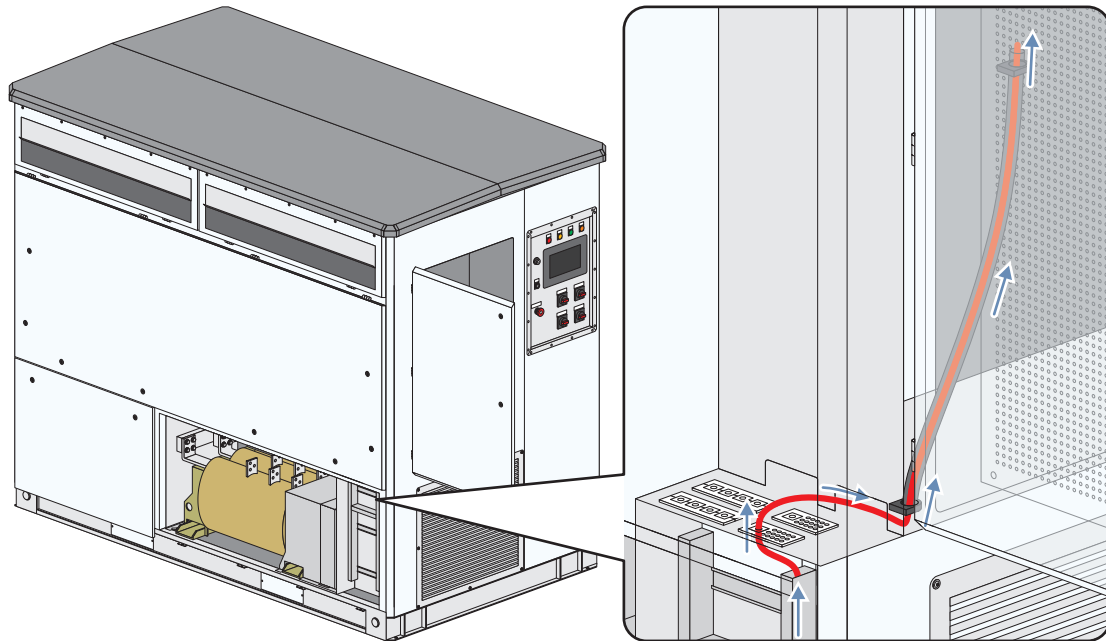


Figure 49: Cable route from the base to the customer installation location

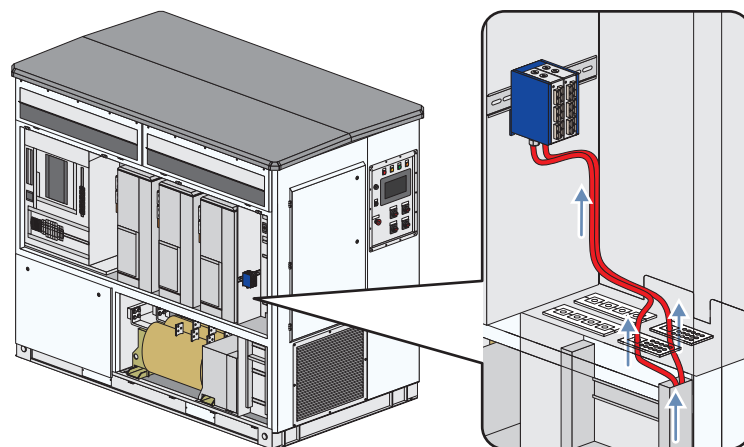


Figure 50: Cable route from the base to the splice box

**⚠ DANGER****Danger to life due to applied voltages**

High voltages are present in the live components of the product. Touching live components results in death or serious injury due to electric shock.

- Always disconnect the inverter from the power transmission path and from the control path if no voltage is required for working on the product (see Section 6.3, page 66).
- After switching off the inverter, wait at least 15 minutes before opening it to allow the capacitors to discharge completely (see Section 6.3, page 66).
- Wear suitable personal protective equipment of the corresponding hazard risk category for all work when the power transmission path is connected. The hazard risk category of the various areas of the inverter are different. The areas are identified with warning labels.
- Wear suitable personal protective equipment for all work when the control path is connected.
- Always perform all work on the product in compliance with the regulations specified in 29 CFR, Chapter XVII, Part 1910 (OSHA), NEC, and NFPA 70E.
- Do not touch any live components.
- Observe all warning messages on the product and in the documentation.
- Observe all safety information of the module manufacturer.
- The product must not be operated with open covers or doors.

**⚠ WARNING****Danger to life due to electric arc if there are tools inside the product**

When reconnecting or during operation, an electric arc can occur if there are tools in the product creating a conductive connection between the live components. This can result in death or serious injury.

- Before commissioning or reconnection, verify that no tools are inside the product.

**⚠ CAUTION****Danger of crushing and collision when carelessly working on the product**

Carelessly working on the product could result in crushing injuries or collisions with edges.

- Wear personal protective equipment for all work on the product.

**⚠ CAUTION****Risk of injury when using unsuitable tools**

Using unsuitable tools can result in injuries.

- Ensure that the tools are suitable for the work to be carried out.
- Wear personal protective equipment for all work on the product.

**NOTICE****Property damage due to rupture of grounding conductors**

The components are connected to the inverter via the grounding conductor. If the roof is not disassembled correctly, the grounding conductors may be pulled out.

- Take care not to damage the grounding conductors during disassembly.

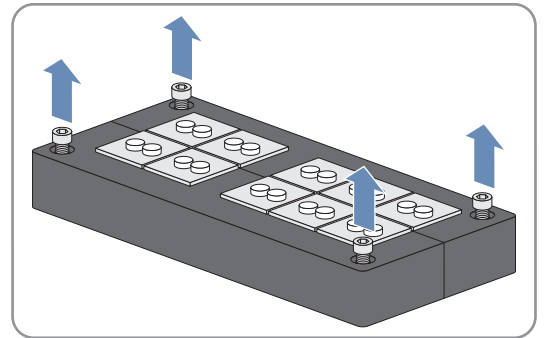
**NOTICE****Damage to optical fibers due to too tight bend radii**

Excessive bending or kinking will damage the optical fibers.

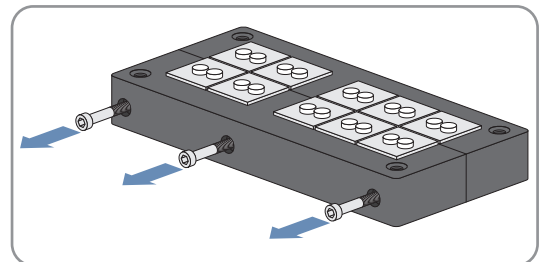
- Observe the minimum permissible bend radii of the optical fibers.

**Procedure:**

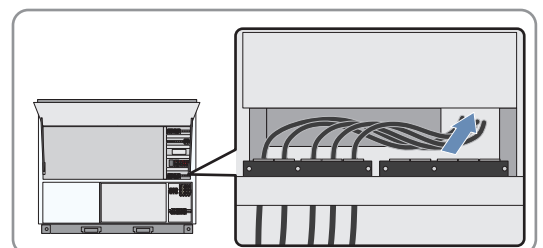
1. Ensure that no voltage is present.
2. Disassemble the panels (see Section 7.1.1, page 73).
3. Open the hatches (see Section 7.3, page 79).
4. Open the cable channels.
5. Remove the screws at the top of the sealing plate.



6. Remove the sealing plate.
7. Loosen the screws at the side of the sealing plate.



8. Remove the required number of rubber seals from the sealing plate. Make sure that the diameter of the rubber seals corresponds to the diameter of the cables to be inserted.
9. Remove the sealing plugs from those rubber seals through which the cables are to be led.
10. Lead the cables through the rubber seals.
11. Insert the rubber seals in the sealing plate avoiding any distortion. This will ensure the tightness of the seal.
12. Tighten the screws at the side of the sealing plate.
13. Lay the cables in the cable channel.
14. Close the cable channel.
15. For cables to the customer installation location:
  - Lead the cables through the opening to the door.



- Lead the cables through the conduit to the customer installation location.
16. For cables to the splice box:

- Loosen the two outer screws on the front of the splice box. There is no need to remove the screws as they are being held by plastic washers.
- Remove the gray insert.
- Unscrew the filler plug and nut.
- Mount the enclosed cable gland and the previously removed nut.
- Lead the cables to the splice box.
- Lead the cable gland over the cable.
- Lead the cable through the cable gland into the splice box.
- Tighten the cable gland.

17. Mount the panels (see Section 7.1.1, page 73).

18. Close the hatches (see Section 7.3, page 79).

## 8 Technical Data

### 8.1 Sunny Central 2200-US

DC Input	
MPP voltage range	570 V to 950 V
Maximum DC Voltage	1,000 V
Maximum DC current at 25°C (+77°F)	4,110 A
Maximum DC current at 50°C (+122°F)	3,960 A
Number of DC inputs	24* / 28 / 32
Maximum number of DC cables per DC input for each polarity	2 x 400 mm <sup>2</sup> (2 x 800 kcmil)
Integrated zone monitoring	optional
Available DC fuse sizes (per input)	200 A / 250 A / 315 A / 350 A / 400 A
* For ungrounded systems the number of DC inputs is 24	
AC Output	
Nominal AC power at $\cos \varphi = 1$ and 25°C (+77°F)	2,200 kVA / 2,200 kW
Nominal AC power at $\cos \varphi = 1$ and 40°C (+104°F)	2,080 kVA / 2,080 kW
Nominal AC power at $\cos \varphi = 1$ and 50°C (+122°F)	2,000 kVA / 2,000 kW
Nominal AC power at $\cos \varphi = 0.9$ and 25°C (+77°F)	2,200 kVA / 1,980 kW
Nominal AC power at $\cos \varphi = 0.9$ and 40°C (+104°F)	2,080 kVA / 1,872 kW
Nominal AC power at $\cos \varphi = 0.9$ and 50°C (+122°F)	2,000 kVA / 1,800 kW
Maximum output current $I_{AC, max}$	3,300 A
Nominal AC current $I_{AC, nom}$	3,000 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range	385 V / 308 V to 462 V
AC power frequency	50 Hz / 60 Hz
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited
Efficiency	
Maximum efficiency	98.4%
European weighted efficiency	98.3%
CEC weighted efficiency	98.0%

**Protective Devices**

Input-side disconnection point	DC Load-Break Switch
AC disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type II
Ground-fault monitoring / remote ground-fault monitoring	Optional / Optional
Insulation monitoring	Optional
Degree of protection (in accordance with IEC 60529)	IP54
Degree of protection (as per NEMA)	3R

**General Data**

Width x height x depth	2,780 mm x 2,318 mm x 1,588 mm (109.4 in x 91.3 in x 62.5 in)
Weight	< 4,000 kg (< 8,819 lb)
Maximum self-consumption (operation*) / self-consumption (standby)	< 8,100 W / < 300 W
Internal auxiliary power supply	Integrated 8.4 kVA transformer
Operating temperature range	-25 °C to +60 °C (-13 °F to +140 °F)
Extended operating temperature range**	40 °C to +60 °C (40 °F to +140 °F)
Temperature range (stand-by)	40 °C to +60 °C (40 °F to +140 °F)
Temperature range (storage)	-40 °C to +70 °C (-40 °F to +158 °F)
Maximum permissible value for relative humidity (non-condensing)	0% to 95%
Maximum permissible value for relative humidity (condensing)	>95% to 100% (up to two months per year)
Maximum operating altitude above MSL 2,000 m / 4,000 m	Standard features / Optional
Fresh air consumption	6,500 m³/h

\* Self-consumption during rated operation

\*\* Optional

**Features**

DC connection	Terminal lug at each input
AC connection	Track system
Communication	Ethernet, Ethernet/IP, Modbus TCP/IP
Color enclosure / roof	RAL 9016 / RAL 7004
Display	HMI touch display (10.1")

**Features**

Supply transformer for external loads	optional 2.5 kVA
Certificates and approvals	UL 1741, UL 1998, UL 840 Category IV, EMC FCC Part 15 Class A, IEEE 1547, BDEW (German Association of Energy and Water Industries)

**8.2 Sunny Central 1850-US****DC Input**

MPP voltage range	570 V to 950 V
Maximum DC Voltage	1,000 V
Maximum DC current at +77°F	4,110 A
Maximum DC current at +122°F	3,960 A
Number of DC inputs	24* / 28 / 32
Maximum number of DC cables per DC input for each polarity	2 x 400 mm <sup>2</sup> (2 x 800 kcmil)
Integrated zone monitoring	optional
Available DC fuse sizes (per input)	200 A / 250 A / 315 A / 350 A / 400 A

\* For ungrounded systems the number of DC inputs is 24

**AC Output**

Nominal AC power at $\cos \varphi = 1$ and 25°C (+77°F)	1,666 kVA / 1,666 kW
Nominal AC power at $\cos \varphi = 1$ and 40°C (+104°F)	1,666 kVA / 1,666 kW
Nominal AC power at $\cos \varphi = 1$ and 50°C (+122°F)	1,666 kVA / 1,666 kW
Nominal AC power at $\cos \varphi = 0.9$ and 25°C (+77°F)	1,850 kVA / 1,666 kW
Nominal AC power at $\cos \varphi = 0.9$ and 40°C (+104°F)	1,850 kVA / 1,666 kW
Nominal AC power at $\cos \varphi = 0.9$ and 50°C (+122°F)	1,850 kVA / 1,666 kW
Maximum output current $I_{AC, max}$	3,300 A
Nominal AC current $I_{AC, nom}$ (1,850 kVA / 1,666 kW)	2,774 A / 2,498 A
Maximum total harmonic distortion	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range	385 V / 308 V to 462 V
AC power frequency	50 Hz / 60 Hz
Power factor at rated power/displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited

**Efficiency**

Maximum efficiency	98.4%
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**Efficiency**

European weighted efficiency	98.3%
CEC weighted efficiency	98.0%

**Protective Devices**

Input-side disconnection point	DC Load-Break Switch
AC disconnection point	AC circuit breaker
DC overvoltage protection	Surge arrester, type II
Ground-fault monitoring / remote ground-fault monitoring	Optional / Optional
Insulation monitoring	Optional
Degree of protection (in accordance with IEC 60529)	IP54
Degree of protection (as per NEMA)	3R

**General Data**

Width x height x depth	2,780 mm x 2,318 mm x 1,588 mm (109.4 in x 91.3 in x 62.5 in)
Weight	< 4,000 kg (< 8,819 lb)
Maximum self-consumption (operation*) / self-consumption (standby)	< 8,100 W / < 300 W
Internal auxiliary power supply	Integrated 8.4 kVA transformer
Operating temperature range	-25 °C to +60 °C (-13 °F to +140 °F)
Extended operating temperature range **	40 °C to +60 °C (40 °F to +140 °F)
Temperature range (stand-by)	40 °C to +60 °C (40 °F to +140 °F)
Temperature range (storage)	-40 °C to +70 °C (-40 °F to +158 °F)
Maximum permissible value for relative humidity (condensing)	0% to 95%
Maximum permissible value for relative humidity (condensing)	>95% to 100% (up to two months per year)
Maximum operating altitude above MSL 2,000 m / 4,000 m	Standard features / Optional
Fresh air consumption	6,500 m³/h

\* Self-consumption during rated operation  
 \*\* Optional

**Features**

DC connection	Terminal lug at each input
AC connection	Track system

**Features**

Communication	Ethernet, Ethernet/IP, Modbus TCP/IP
Color enclosure / roof	RAL 9016 / RAL 7004
Display	HMI touch display (10.1")
Supply transformer for external loads	optional 2.5 kVA
Certificates and approvals	UL 1741, UL 1998, UL 840 Category IV, EMC FCC Part 15 Class A, IEEE 1547, BDEW (German Association of Energy and Water Industries)

## 9 Appendix

### 9.1 Ambient Conditions

#### Requirements for the mounting location:

- ☐ The mounting location must be freely accessible at all times.
- ☐ The permissible maximum value for non-condensing relative humidity must not be exceeded. The maximum value is: 0% to 95%.
- ☐ The permissible maximum value for condensing relative humidity must not be exceeded. The maximum value is: >95% to 100% (up to two months per year).
- ☐ The fresh air requirement of the inverter must be assured. Fresh air consumption: 6,500 m<sup>3</sup>/h.
- ☐ The mounting location must be below the maximum installation altitude.
- ☐ The PV power plant must have a minimum clearance of 100 ft to radio equipment.
- ☐ The ambient temperature must be within the operating temperature range.
- ☐ The air quality for mechanically active substances in accordance with IEC 60721-3-4: 1995 must be observed.

#### The air quality must comply with the following classification of air quality for mechanically active substances:

Ambient conditions for stationary application	Class 4S2
a) Sand in air [mg/m <sup>3</sup> ]	300
b) Dust (suspended matter) [mg/m <sup>3</sup> ]	5.0
c) Dust (precipitation) [mg/m <sup>3</sup> ]	20
Installation sites where appropriate measures are taken to keep dust levels to a minimum	x
Installation sites where no special measures have been taken to reduce the sand or dust levels and which are not located in the vicinity of sand or dust sources	x

- ☐ The air quality for chemically active substances in accordance with IEC 60721-3-4: 1995 must be observed.

#### The air quality must comply with the following classification of air quality for chemically active substances:

Ambient conditions for stationary application	Class 4C2	
	Mean value	Limiting value
a) Sea salt	Occurrence of salt spray	
b) Sulfur dioxide [mg/m <sup>3</sup> ]	0.3	1.0
c) Hydrogen sulfide [mg/m <sup>3</sup> ]	0.1	0.5
d) Chlorine [mg/m <sup>3</sup> ]	0.1	0.3
e) Hydrogen chloride [mg/m <sup>3</sup> ]	0.1	0.5
f) Hydrogen fluoride [mg/m <sup>3</sup> ]	0.01	0.03
g) Ammonia [mg/m <sup>3</sup> ]	1.0	3.0
h) Ozone [mg/m <sup>3</sup> ]	0.05	0.1

Ambient conditions for stationary application	Class 4C2	
	Mean value	Limiting value
i) Nitrogen oxides [mg/m <sup>3</sup> ]	0.5	1.0
Installation sites in rural or densely populated areas with little industry and moderate traffic volume		x
Installation sites in densely populated areas with industry and high traffic volume		x

## 9.2 Minimum Clearances and Free Spaces

It is only permitted to use the product in a PV power plant which is designed as a closed electrical operating area. The locally applicable standards and directives must be complied with. The minimum clearances defined in the applicable standards and directives must be complied with.

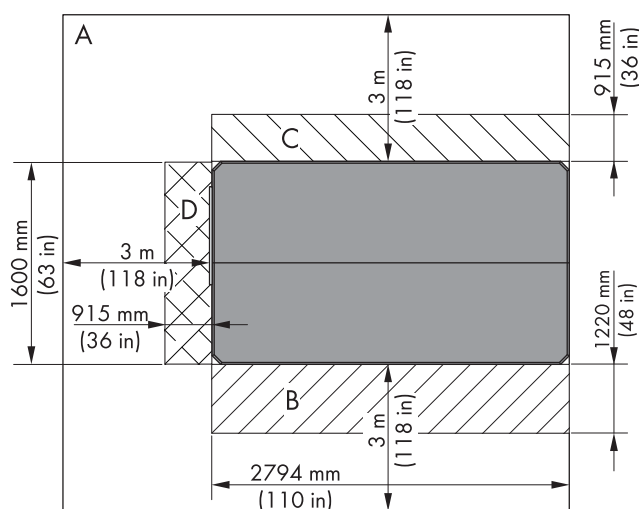


Figure 51: Free Spaces

Position	Designation
A	Clearances for servicing
B	Free space DC side*
C	Free space inverter bridge side*
D	Free space operating side*

\* All free spaces must be flat and the minimum clearances are to be determined in accordance with the National Electrical Code® and in consultation with the responsible authorities. It depends on each individual project if functional clearances need to be maintained in addition.

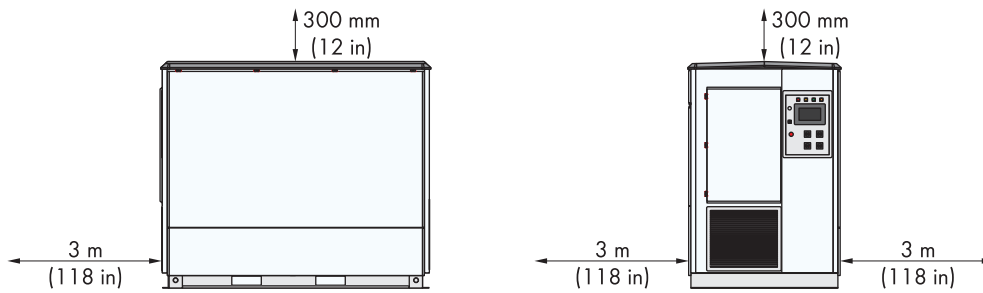


Figure 52: Minimum clearances

**Requirements for the minimum clearance areas for servicing:****i A stable service area is required**

The minimum clearances depicted above are required to allow for future servicing of the equipment.

The product access clearances must be flat, and in accordance with the *Local and National Electrical Code®*.

- ☐ The area must be permanently vehicle accessible.
- ☐ The area must be constructed of well-compacted earth, gravel, tar, concrete, or similar material.
- ☐ The area must be suitable for use with lifting aids, truck mounted cranes, and forklift trucks.
- ☐ The area surrounding the product must be free of obstacles such as fences and barriers.
- ☐ The area must have a maximum grade of 3%
- ☐ The area must be even with the foundation.
- ☐ The area must be compliant with local, state and federal Occupational Health & Safety legislation.
- ☐ The specific surface material can be agreed upon between the plant owner and SMA.

## 9.3 Foundation

### 9.3.1 Foundation Requirements

**Requirements for the support surface:**

- ☐ The support surface must be a dry and solid foundation, e.g. gravel.
- ☐ In areas subject to strong precipitation or high groundwater levels, a drainage system must be implemented.

**Requirements for the subgrade:**

- ☐ The level of compaction must be at least 98%.
- ☐ The soil pressure must be 150 kN/m<sup>2</sup>.
- ☐ The unevenness at a distance of 100 mm (4 in) must not exceed 5 mm (0.2 in).
- ☐ The unevenness at a distance of 1,000 mm (39.5 in) must not exceed 8 mm (0.3 in).
- ☐ The unevenness at a distance of 3,000 mm (119 in) must not exceed 10 mm (0.39 in).

**Possible foundation types**

The product can be mounted on different types of foundation. Possible foundation types include:

- Foundation slabs or platforms
- Strip foundations
- Pile-driven steel pillars

**General requirements for foundations and platforms:**

- ☐ The foundation must be suitable for the weight of the product.
- ☐ The unevenness at a distance of 100 mm (4 in) must not exceed 5 mm (0.2 in).

- ☐ The unevenness at a distance of 1,000 mm (39.5 in) must not exceed 8 mm (0.3 in).
- ☐ The unevenness at a distance of 3,000 mm (119 in) must not exceed 10 mm (0.39 in).
- ☐ In flood areas it is recommended to install the product on a raised position.
- ☐ The inclination must not exceed 1.5%. This will allow rain water to drain from underneath the product.
- ☐ Prescribed safety measures such as railings or similar items must be installable or removable within ten minutes.
- ☐ It must be possible to use a manual pallet truck on the entire foundation area.

### 9.3.2 Dimensions and Openings in the Foundation

#### Variant: Foundation or platform

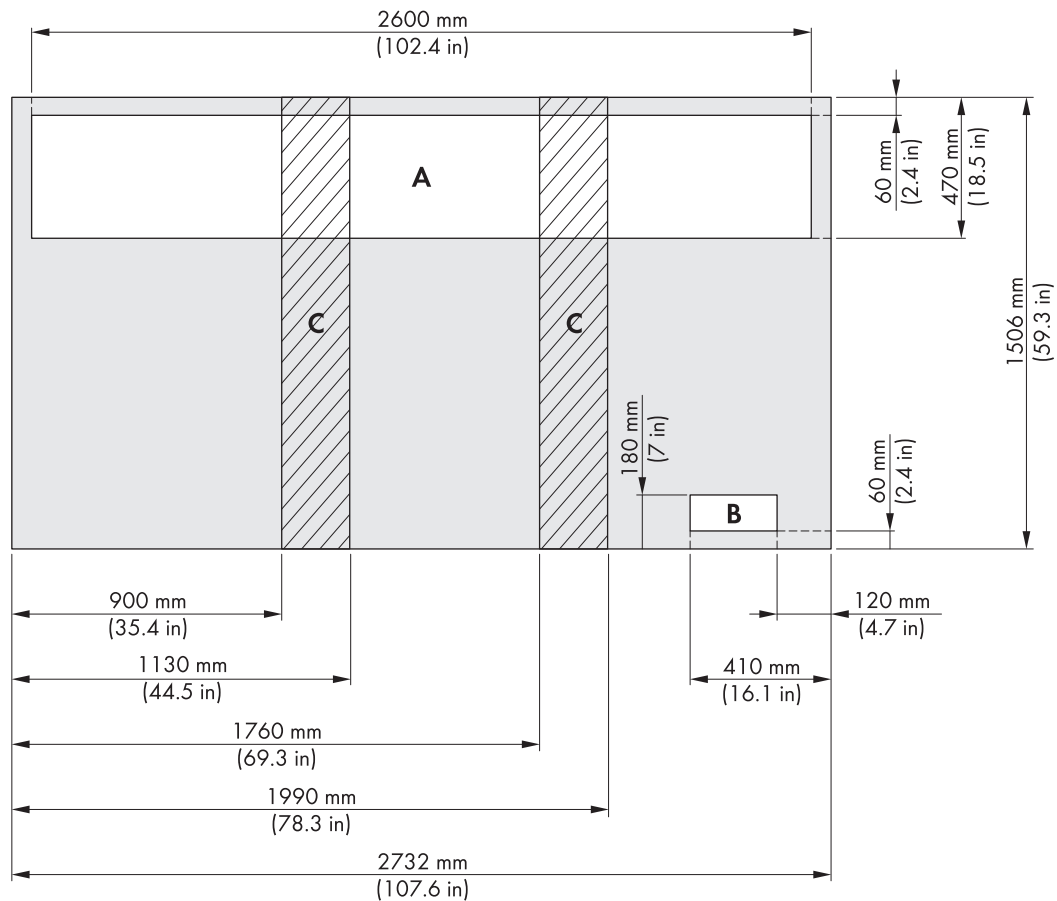


Figure 53: Minimum size of the foundation and position of the openings in the floor area for introduction of the cables

Position	Designation
A	Opening for introduction of the DC cable and the grounding cable
B	Opening for introduction of the cables for communication, control, supply voltage and monitoring
C	Pick-up area for the crane fork of material handling equipment. There must be no conduits or cables in the area where the material-handling equipment is used for transportation.

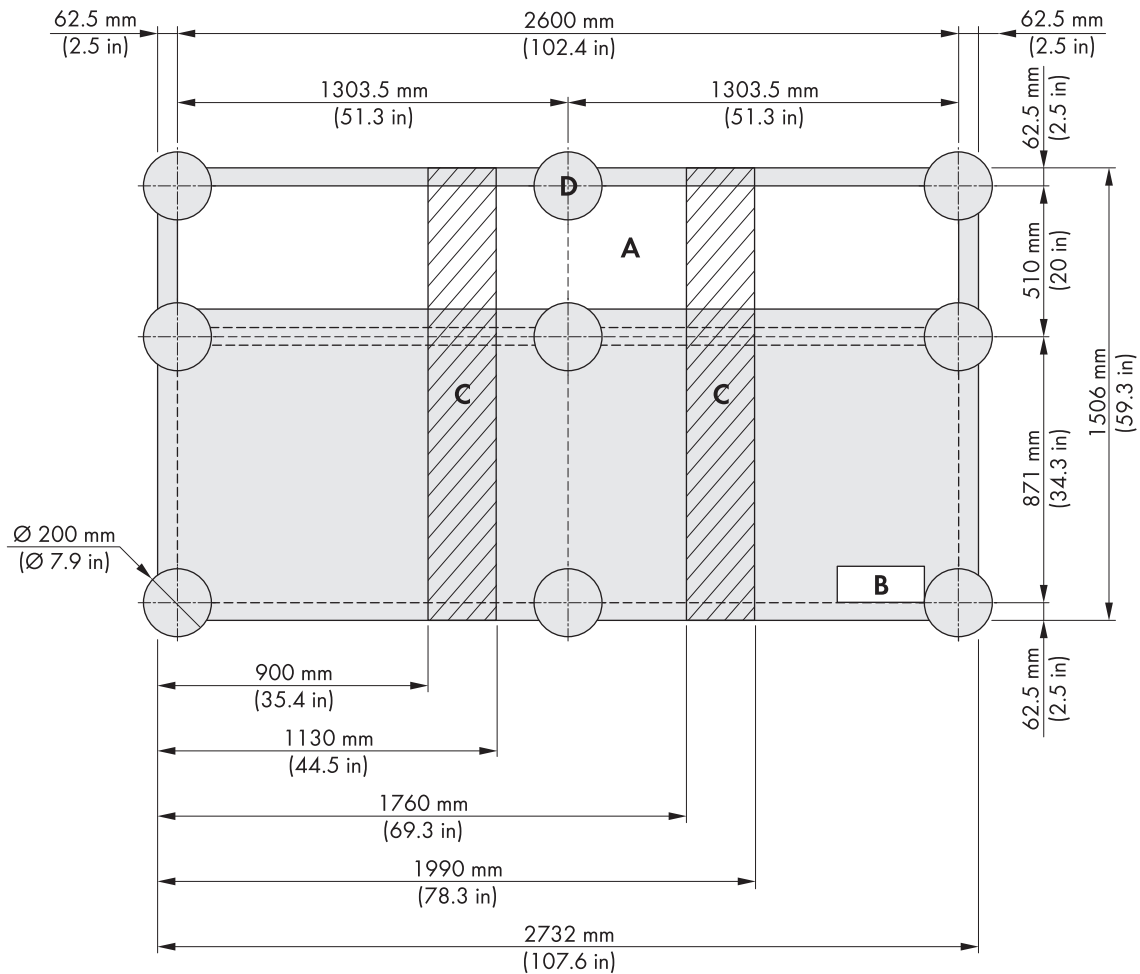
**Variant: Pile-driven steel pillars**

Figure 54: Arrangement of the pile-driven steel pillars and position of the openings in the floor area for introduction of the cables

Position	Designation
A	Openings in the floor area of the inverter for introduction of the DC cable and grounding cable
B	Openings in the floor area of the inverter for introduction of the cables for communication, control, supply voltage and monitoring
C	Pick-up area for the crane fork of material handling equipment. There must be no conduits or cables in the area where the material-handling equipment is used for transportation.
D	Optional pile-driven steel pillar

### 9.3.3 Anchoring Points at the Foundation

#### Anchoring points of the inverter

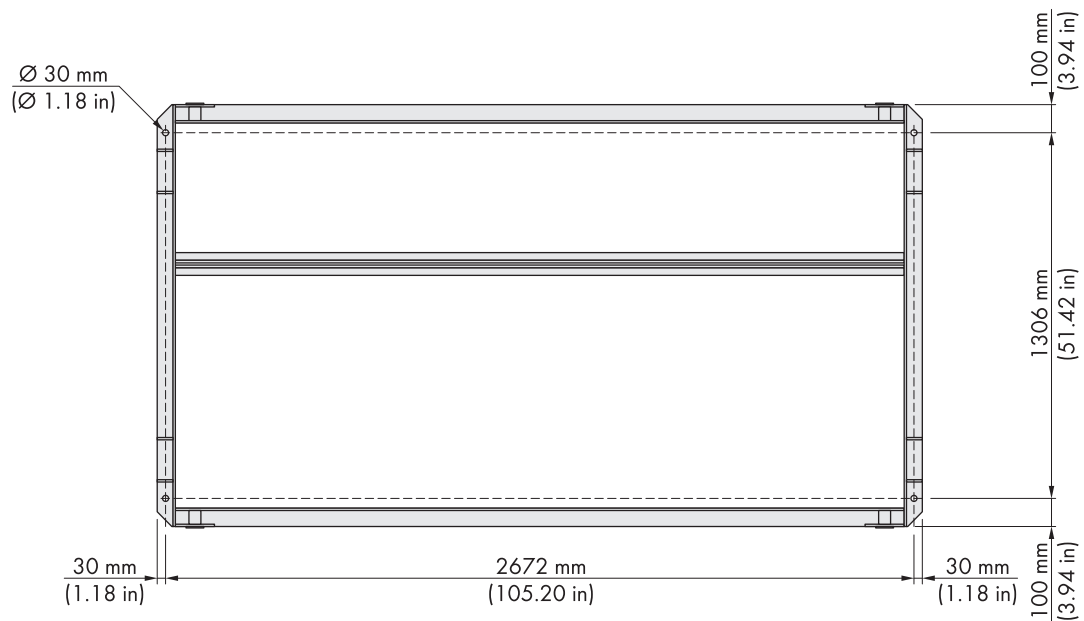


Figure 55: Position of the anchoring points

#### Requirements:

- ☐ The holes for attachment must be drilled before the product can be placed on the foundation.

9.4 Permitted Mounting Options

Mounting options: foundation or platform and minimum clearances



Figure 56: Mounting options: foundation and minimum clearances

Position	Designation
A	Free spaces
B	Foundation or platform

Mounting options: pile-driven steel pillars and minimum clearances

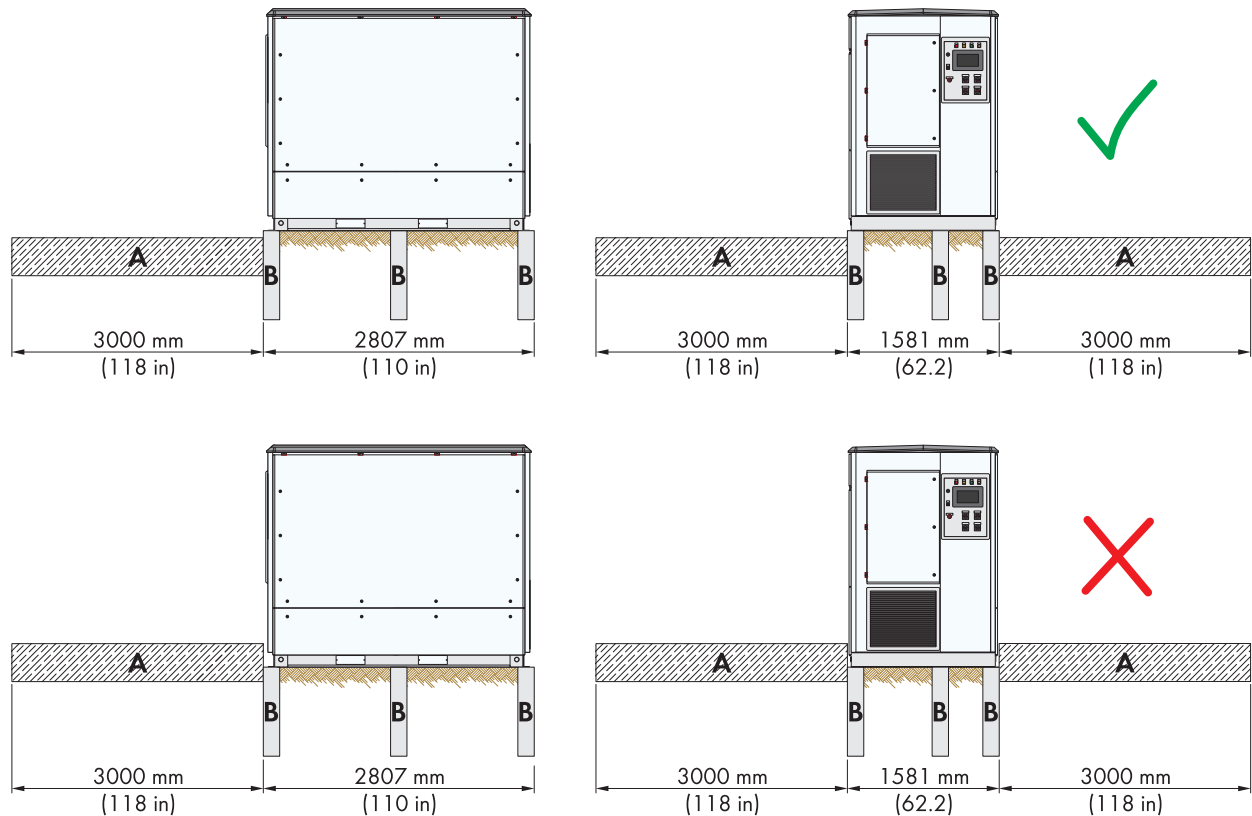


Figure 57: Mounting options: pile-driven steel pillars and minimum clearances

Position	Designation
A	Free spaces
B	Pile-driven steel pillars

9.5 Dimensions of the Inverter

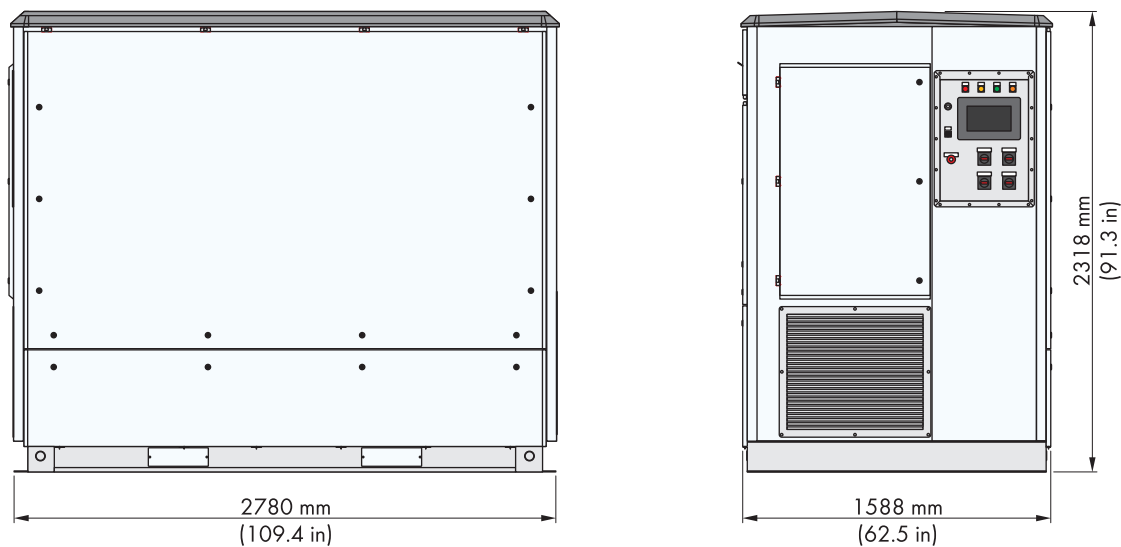


Figure 58: Dimensions of the Inverter

# 9.6 Measurement accuracy

The inverter is not equipped with a calibrated meter. The display values may deviate from the actual values and must not be used as a basis for invoicing. The inverter's measured values are required for the system management and to control the current to be fed to the grid.

## Deviation:

- Voltage measurement:  $\pm 5 \text{ V}$
- Frequency measurement:  $\pm 0.06 \text{ Hz}$
- Disconnect time:  $\pm 0.1\%$

# 9.7 Scope of Delivery

Check the scope of delivery for completeness and any externally visible damage. Contact your distributor if the scope of delivery is incomplete or damaged.

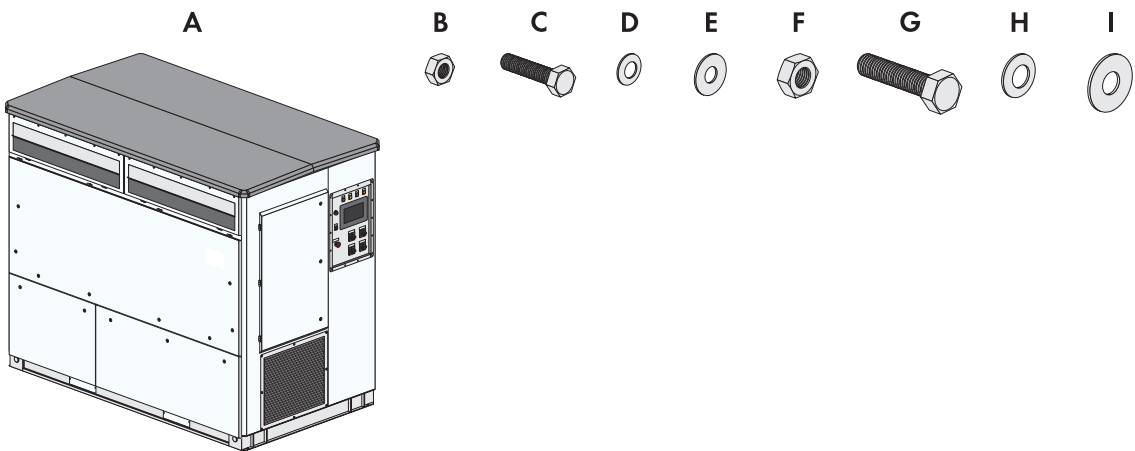


Figure 59: Standard scope of delivery of the inverter

Position	Quantity	Designation	Use
A	1	Inverter	-
B	6	Nut M8	Foundation ground electrode
C	6	Screw M8	
D	12	Spring washer M8	
E	12	Fender washer M8	
F	1	Nut M12	
G	1	Screw M12	
H	2	Spring washer M12	
I	2	Fender washer M12	

## Optional scope of delivery

### For option "Device combination: Inverter only"

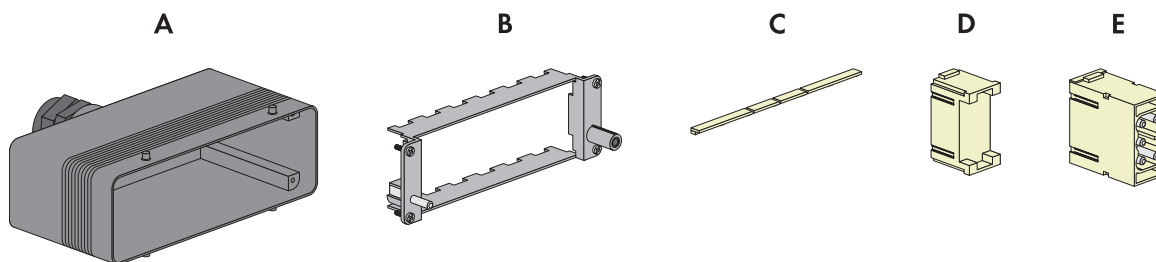


Figure 60: Scope of delivery for option "Device combination: Inverter only"

Position	Quantity	Designation
A	1	Coupling housing, cable outlet: M32
B	1	Supporting frame for modular inserts
C	2	Brackets
D	4	Dummy module for unused module locations
E	2	Modular insert for pin contacts

### For option "DC Input Configuration"

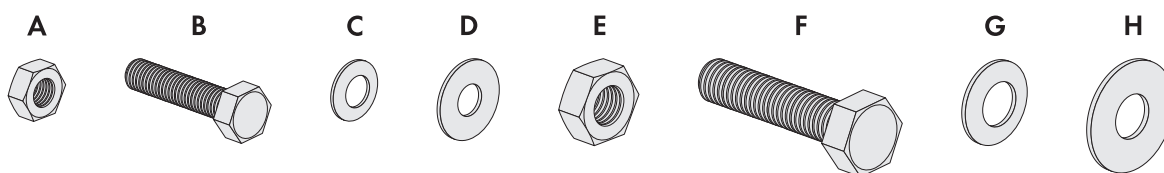


Figure 61: Scope of delivery for option "DC Input Configuration"

Position	Quantity for option "DC Input Configuration":				Designation
	24 fused in-puts	24 fused in-puts with disco.	28 fused in-puts with disco.	32 fused in-puts with disco.	
A	24	24	28	32	Nut M8
B	24	72	84	96	Screw M8
C	48	96	112	128	Spring washer M8
D	48	96	112	128	Fender washer M8
E	96	96	112	124	Nut M12
F	96	96	112	124	Screw M12
G	192	192	224	256	Spring washer M12
H	192	192	224	256	Fender washer M12

# 10 Contact

If you have technical problems with our products, please contact the SMA Service Line. We need the following information in order to provide you with the necessary assistance:

- Device type
- Serial number
- Type and number of PV modules connected
- Type of communication
- Error number and error message

United States/ Estados Unidos	SMA America, LLC Rocklin, CA	Toll free for USA, Canada and Puerto Rico / Llamada gratuita en EE. UU., Canadá y Puerto Rico: +1 877-MY-SMATech (+1 877-697-6283) International / Internacional: +1 916 625-0870
Canada/ Canadá	SMA Canada, Inc. Toronto	Toll free for Canada / gratuit pour le Canada: +1 877-MY-SMATech (+1 877-697-6283)



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