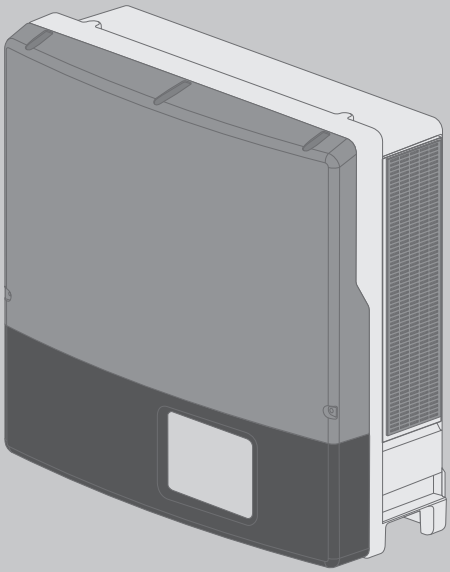
Installation Manual

# SUNNY TRIPOWER 12000TL-US / 15000TL-US / 20000TL-US / 24000TL-US



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# Important Safety Instructions

## SAVE THESE INSTRUCTIONS

This manual contains important instructions for the following products:

- STP 12000TL-US-10 (Sunny Tripower 12000TL-US)
- STP 15000TL-US-10 (Sunny Tripower 15000TL-US)
- STP 20000TL-US-10 (Sunny Tripower 20000TL-US)
- STP 24000TL-US-10 (Sunny Tripower 24000TL-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 | DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury. |
| ⚠ WARNING | WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. |
| ⚠ CAUTION | CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. |
| *NOTICE* | NOTICE is used to address practices not related to personal injury. |

### Warnings on this Product

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

**Warning regarding dangerous voltage**

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

**Beware of hot surface**

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

**Observe the operating instructions**

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

# General Warnings

**⚠ WARNING**

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

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

Before installing or using the 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.

# Table of Contents

# 1 Information on this Document

## 1.1 Validity

This document is valid for the following device types:

- STP 12000TL-US-10 (Sunny Tripower 12000TL-US)
- STP 15000TL-US-10 (Sunny Tripower 15000TL-US)
- STP 20000TL-US-10 (Sunny Tripower 20000TL-US)
- STP 24000TL-US-10 (Sunny Tripower 24000TL-US)

## 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 an inverter 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 the applicable standards and directives
- Knowledge of and compliance with this document and all safety information

## 1.3 Additional Information

Links to additional information can be found at www.SMA-Solar.com:

| Document title | Document type |
|---|---|
| "Sunny Explorer"<br>Software for Visualizing and Administrating a Speedwire System | User Manual |
| "Webconnect Systems in Sunny Portal"<br>Registration in Sunny Portal and setting or changing operating parameters of the inverter | User Manual |
| "Parameter list"<br>Overview of All Inverter Operating Parameters and Their Configuration Options | Technical Information |
| "Efficiency and Derating"<br>Efficiency and Derating Behavior of the Sunny Boy, Sunny Tripower and Sunny Mini Central Inverters | Technical Information |
| "Leading Leakage Currents"<br>Information on the Design of Transformerless Inverters | Technical Information |

| Document title | Document type |
|---|---|
| "Shade Management"<br>Efficient operation of partly shaded PV systems with OptiTrac Global Peak | Technical Information |
| "Module Technology"<br>Use of Thin-Film and Back-Contact Modules | Technical Information |

## 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 Nomenclature

| Complete designation | Designation in this document |
|---|---|
| SMA America Production, LLC | SMA |
| SMA Solar Technology Canada Inc. | SMA |
| SMA Speedwire | Speedwire |
| PV system | PV system |
| Sunny Tripower 12000TL-US / 15000TL-US / 20000TL-US / 24000TL-US | Sunny Tripower, inverter |
| SMA Connection Unit 1000-US | Connection Unit |

# 2 Safety

## 2.1 Intended Use

The Sunny Tripower is a transformerless PV inverter with two MPP trackers which converts the direct current of the PV array to grid-compliant three-phase current and feeds it into the utility grid.

**i No galvanic isolation**

- The product is not equipped with a transformer and therefore has no galvanic isolation. Do not use grounded PV modules with the product. Only ground the mounting frame of the PV modules. If you connect grounded PV modules to the product, the error message **Insulation resistance > Check generator** occurs.
- The AC output/neutral conductor is not bonded to ground inside of the product.

The product is suitable for indoor and outdoor use.

The Sunny Tripower must only be operated with PV arrays (PV modules and cabling) that are approved by the electrical standards applicable on-site and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1. The PV modules used must be suitable for use with the Sunny Tripower.

SMA offers the SMA Connection Unit which is equipped with fuse holders for string fuses for up to eight strings and with a DC load-break switch. The SMA Connection Unit combines up to four strings to each of two output circuits. These two DC electric circuits can be connected to the two MPP tracker inputs of the Sunny Tripower (for further information see the installation manual of the SMA Connection Unit-US at www.SMA-Solar.com).

PV modules with a high capacity to ground may only be used if their coupling capacity does not exceed 3.5 µF.

All components must remain within their permitted operating ranges at all times.

To protect the PV system against excessive reverse currents under fault conditions, the *National Electrical Code*®, Section 690.9, requires overcurrent protection for PV source circuits where possible short-circuit currents exceed the ampacity of source circuit conductors or the maximum series fuse rating of the PV modules. Typically, this requires string fusing where more than two strings are combined in parallel. Where overcurrent protection is required, *National Electrical Code*®, Section 690.35, requires that both positive and negative conductors have overcurrent protection for ungrounded PV arrays.

The product must only be used in countries for which it is approved or released by SMA and the grid operator.

The product is not equipped with a transformer and therefore has no galvanic isolation. Do not use grounded PV modules with the product. Only ground the mounting frame of the PV modules. If you connect grounded PV modules to the product, the error message **Insulation resistance > Check generator** occurs.

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.

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 high voltages of the PV array**

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors and the live components of the inverter. Touching the DC conductors or the live components can lead to lethal electric shocks. If you disconnect the DC connectors from the inverter under load, an electric arc may occur leading to electric shock and burns.

- Do not touch non-insulated cable ends.
- Do not touch the DC conductors.
- Do not touch any live components of the inverter.
- Have the inverter mounted, installed and commissioned only by qualified persons with the appropriate skills.
- If an error occurs, have it rectified by qualified persons only.
- Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document (see Section 9, page 41).

**⚠ DANGER**

**Danger to life due to electric shock in case of a ground fault**

If a ground fault occurs, parts of the system may still be live. Touching live components can lead to lethal electric shocks.

- Ensure that no voltage is present and wait five minutes before touching any parts of the PV system or the inverter.

**⚠ CAUTION**

**Risk of burns from hot surfaces**

The surface of the inverter can get very hot. Touching the surface can result in burns.

- Mount the inverter in such a way that it cannot be touched inadvertently.
- Do not touch hot surfaces.
- Wait 30 minutes for the surface to cool sufficiently.
- Observe the safety messages on the inverter.

***NOTICE***

**Damage to the inverter due to moisture and dust intrusion**

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

- Close all enclosure openings of the inverter tightly.
- Never open the inverter when it is raining or snowing, or the humidity is over 95%.

# 3 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.

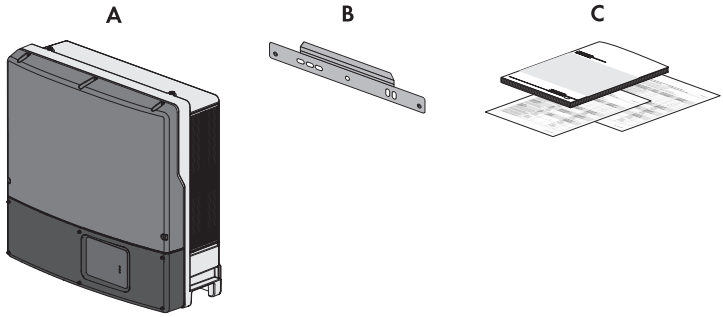



Figure 1: Components included in the scope of delivery

| Position | Quantity | Designation |
|---|---|---|
| A | 1 | Inverter |
| B | 1 | Wall mounting bracket |
| C | 1 | Installation manual, production test report, supplementary sheet with the default settings |

# 4 Product Description

## 4.1 Sunny Tripower

The Sunny Tripower is a transformerless PV inverter with two MPP trackers which converts the direct current of the PV array to grid-compliant three-phase current and feeds it into the utility grid.

**No galvanic isolation**

- The product is not equipped with a transformer and therefore has no galvanic isolation. Do not use grounded PV modules with the product. Only ground the mounting frame of the PV modules. If you connect grounded PV modules to the product, the error message **Insulation resistance > Check generator** occurs.
- The AC output/neutral conductor is not bonded to ground inside of the product.

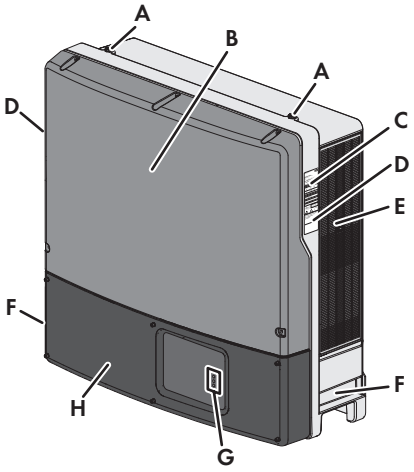



Figure 2: Design of the Sunny Tripower

| Position | Designation |
|---|---|
| A | Thread for screwing in the eye bolts for transport with a crane |
| B | Upper enclosure lid |
| C | Type label<br>The type label uniquely identifies the inverter. You will require the information on the type label to use the product safely and when seeking customer support from the SMA Service Line. You will find the following information on the type label:<br>• Device type (Model)<br>• Serial number (Serial No.)<br>• Date of manufacture<br>• Device-specific characteristics |

| Position | Designation |
|---|---|
| D | Additional label with details for registration in Sunny Portal:<br>• Internet address of the PV System Setup Assistant<br>• Identification key (PIC)<br>• Registration ID (RID) |
| E | Ventilation grid |
| F | Recessed grips |
| G | LEDs<br>The LEDs indicate the operating state of the inverter:<br>• Green LED is glowing: operation<br>• Green LED is flashing: the requirements for the connection to the utility grid have not been met or the inverter has reduced its output power due to excessive temperature.<br>• Red LED is glowing: an error has occurred that must be rectified by a qualified person (see Section 10 "Troubleshooting", page 43). You will find the detailed error message in Sunny Portal or Sunny Explorer.<br>• Blue LED: no function |
| H | Lower enclosure lid |

## Symbols on the Inverter and on the Type Label

| Symbol | Explanation |
|---|---|
|  | Inverter<br>This symbol is located next to the green LED which indicates feed-in operation of the inverter. |
|  | Observe the documentation<br>This symbol is located next to the red LED which indicates a fault or disturbance (see Section 10 "Troubleshooting", page 43). |
|  | Communication<br>This symbol is located next to the blue LED. |
|  | The product does not have a transformer. |
|  | Equipment Grounding Terminal |

| Symbol | Explanation |
|---|---|
|  | Danger to life due to electric shock<br>The product operates at high voltages. All work on the product must be carried out by qualified persons only. |
|  | Risk of burns due to hot surfaces<br>The product can get hot during operation. Avoid contact during operation. Allow the product to cool down sufficiently before carrying out any work. |
|  | Observe the documentation<br>Observe all documentation supplied with the product. |
| FC | FCC designation<br>The product complies with the requirements of the applicable FCC standards. |
| c UL US LISTED | UL certification mark<br>UL1741 is the standard applied by Underwriters Laboratories to the product to certify that it meets the requirements of the *National Electrical Code* ®, the *Canadian Electrical Code*® CSA C22.1 and IEEE-929-2000. IEEE 929-2000 provides recommendations regarding the proper equipment and functionality necessary to ensure compatible operation when power generation is connected to the utility grid. |

## 4.2 Interfaces and Functions

The inverter can be equipped or retrofitted with the following interfaces and functions:

### SMA Speedwire/Webconnect

The inverter is equipped with SMA Speedwire/Webconnect as standard. SMA Speedwire/Webconnect is a type of communication based on the Ethernet standard. This enables inverter-optimized 10/100 Mbit data transmission between Speedwire devices in PV systems and the software Sunny Explorer. The Webconnect function enables direct data transmission between the inverters of a small-scale system and the Internet portal Sunny Portal without any additional communication device and for a maximum of 4 inverters per Sunny Portal system. In large-scale PV power plants, data transmission to the Internet portal Sunny Portal is carried out via the SMA Cluster Controller. You can access your Sunny Portal system from any computer with an Internet connection.

Class 1 wiring methods are to be used for field wiring connection to the terminals of the communication interface.

### RS485 Interface

The inverter can communicate via cables with special SMA communication products via the RS485 interface (information on supported SMA products at www.SMA-Solar.com). The RS485 interface can be retrofitted and can be used in place of the SMA Speedwire/Webconnect interface in the inverter.

Class 1 wiring methods are to be used for field wiring connection to the terminals of the communication interface.

### Grid Management Services

The inverter is equipped with service functions for grid management.

Depending on the requirements of the grid operator, you can activate and configure the functions (e.g. active power limitation) via operating parameters.

### SMA OptiTrac Global Peak

SMA OptiTrac Global Peak is an advancement of SMA OptiTrac and allows the operating point of the inverter to follow the optimal operating point of the PV array (MPP) precisely at all times. In addition, with the aid of SMA OptiTrac Global Peak, the inverter detects several maximum power points in the available operating range, such as may occur particularly with partially shaded strings. You can activate SMA OptiTrac Global Peak via the operating parameters (see Section 8.5 "Setting SMA OptiTrac Global Peak", page 39).

### Arc-Fault Circuit Interrupter (AFCI)

In accordance with the *National Electrical Code®*, Article 690.11, the inverter has a system for arc fault detection and interruption.

An electric arc with a power of 300 W or greater must be interrupted by the AFCI in the time specified by UL 699B. A tripped AFCI can only be reset manually. The 2011 edition of the *National Electrical Code®*, Section 690.11, stipulates that newly installed PV systems attached to a building must be fitted with a means of detecting and disconnecting serial electric arcs on the DC side. If you prefer not to have that function, you can deactivate the arc-fault circuit interrupter via a communication product (see Section 8.4, page 39).

### Q on Demand 24/7

The inverter can supply reactive power by means of Q on Demand 24/7 covering the entire unit circle around the clock (for details on the configuration refer to the Technical Information "Integrated Plant Control and Q on Demand 24/7" at www.SMA-Solar.com).

### Integrated Plant Control

The inverter can display the Q(V) characteristic curve specified by the grid operator by means of Integrated Plant Control without measuring on the grid-connection point. The inverter can automatically compensate equipment installed between the inverter and the grid-connection point after having activated the function (for information on the system configuration refer to the Technical Information "Integrated Plant Control and Q on Demand 24/7" at www.SMA-Solar.com).

# 5 Mounting

## 5.1 Requirements for Mounting

### Requirements for the mounting location:

**⚠ WARNING**

**Danger to life due to fire or explosion**

Despite careful construction, electrical devices can cause fires.

- Do not mount the inverter in areas containing highly flammable materials or gases.
- Do not mount the inverter in a potentially explosive atmosphere.

- ☐ Do not mount the inverter on a pillar.
- ☐ The inverter must be mounted on a solid support surface (e.g. concrete, brickwork, free-standing constructions).
- ☐ Do not install the inverter in a living area.
- ☐ The mounting location must be suitable for the weight and dimensions of the inverter (see Section 14 "Technical Data", page 69).
- ☐ To ensure optimum operation, the ambient temperature should be between -25°C (-13°F) and 60°C (140°F).
- ☐ The inverter can be mounted in a position that is directly exposed to solar irradiation. However, it is possible that the inverter may become overheated and its power be reduced as a result.
- ☐ Climatic conditions must be met (see Section 14 "Technical Data", page 69).
- ☐ The mounting location should be freely and safely accessible at all times without the need for any auxiliary equipment (such as scaffolding or lifting platforms). Non-fulfillment of these criteria may restrict servicing.

## Dimensions for mounting:

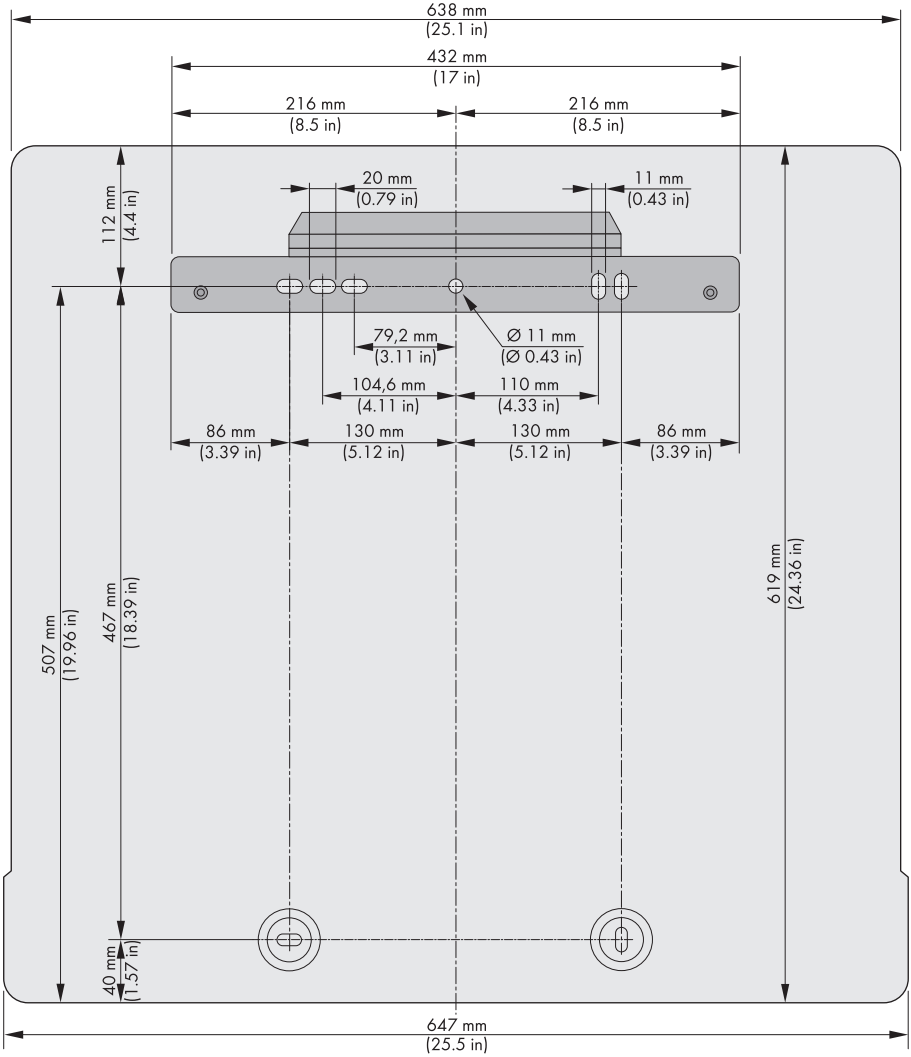



Figure 3: Position of the anchoring points

## Recommended clearances:

To guarantee optimal operation and adequate heat dissipation for the inverter, the following requirements for clearances should be observed. This will prevent the inverter power output from being reduced due to excessive temperatures. However, smaller clearances are permitted without causing any risk.

**Prescribed clearances in accordance with the *National Electrical Code*®**

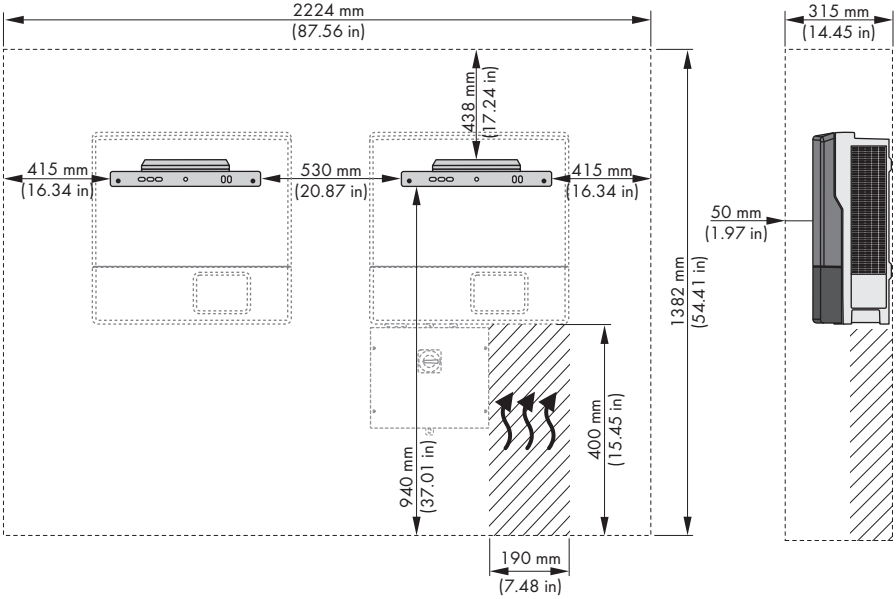
Under certain conditions, *the National Electrical Code*® specifies greater clearances.

- Ensure that the prescribed clearances in accordance with the *National Electrical Code*®, paragraph 110.26 and *Canadian Electrical Code*® CSA C22.1 are adhered to.

☐ Observe the recommended clearances to walls as well as to other inverters or objects.

☐ Ensure adequate clearance on the right-hand side of the inverter below the fan.

☐ If multiple inverters are mounted in areas with high ambient temperatures, increase the clearances between the inverters and ensure an adequate fresh-air supply, if possible.




**Permitted and prohibited mounting positions:**

☐ The inverter must only be mounted in one of the permitted positions. This will ensure that no moisture can penetrate the inverter.

☐ The inverter should be mounted in such a way that LED signals can be read without difficulty.

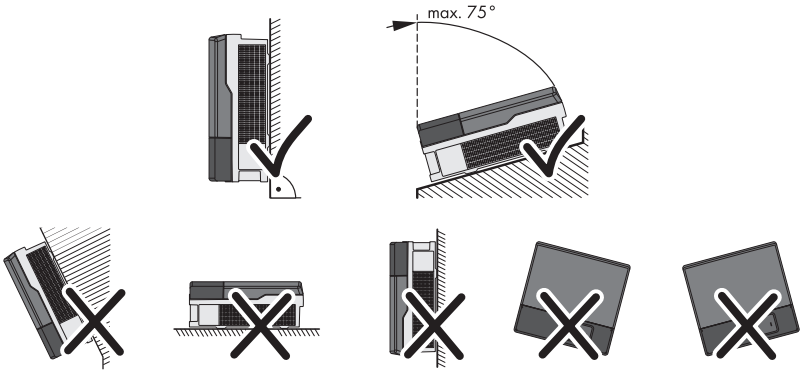



Figure 4: Permitted and prohibited mounting positions:

## 5.2 Mounting the Inverter

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

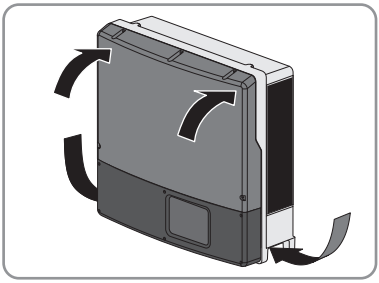
- ☐ At least two screws suitable for the support surface (diameter: 10 mm at maximum)
- ☐ At least two washers that are suitable for the screws (diameter: 30 mm (1.8 in) at maximum)
- ☐ If necessary, two screw anchors suitable for the support surface and the screws
- ☐ For transporting the inverter with a crane: two eye bolts suitable for the weight of the inverter (size: M10)
- ☐ To secure the inverter from being lifted off: two screws, washers and screw anchors that are suitable for the support surface

**⚠ CAUTION**

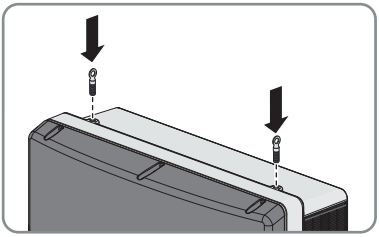
**Risk of injury when lifting the inverter, or if it is dropped**

The inverter weighs 55 kg (121 lb). There is risk of injury if the inverter is lifted incorrectly or dropped while being transported or when attaching it to or removing it from the wall mounting bracket.

- Carry and lift the inverter in an upright position with several people without tilting it. With one hand grasp the recessed grip, and with the other hand support the top part of the enclosure. This will prevent the inverter tipping forward.



- If the inverter is to be transported and lifted with a crane, remove the filler plugs on the top of the inverter and screw the eye bolts into the threads.



**⚠ CAUTION**

**Risk of burns due to hot enclosure parts**

Some parts of the enclosure can get hot during operation.

- Mount the inverter in such a way that it cannot be touched inadvertently during operation.

**Procedure:**

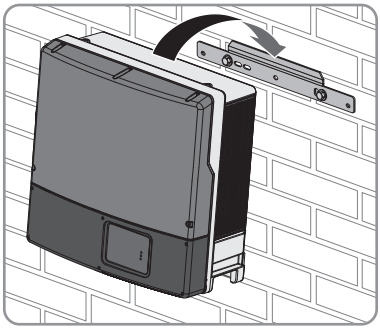
1. **⚠ CAUTION**

   **Risk of injury due to damaged cables**

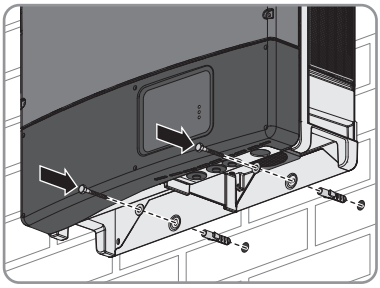
   There may be power cables or other supply lines (e.g. gas or water) routed in the wall.

   - Ensure that no lines are laid in the wall which could be damaged when drilling holes.
2. Align the wall mounting bracket horizontally on the wall and use it to mark the position of the drill holes. Use at least one hole on the right-hand and left-hand side in the wall mounting bracket.
3. If the inverter is to be secured from being lifted off of the wall mounting bracket, mark the position of the drill holes for the screw that attaches the inverter to the wall mounting bracket. Observe the dimensions of the two anchoring points at the bottom of the inverter rear panel.
4. Set the wall mounting bracket aside and drill the marked holes.

5. Insert screw anchors into the drill holes if the support surface requires them.
6. Secure the wall mounting bracket horizontally using screws and washers.
7. Hook the inverter into the wall mounting bracket.



8. If the inverter has been transported with a crane, remove the eye bolts from the threads on the top of the inverter and reinsert the filler plugs.
9. In order to secure the inverter from being lifted off the wall accidentally, attach it to the wall with suitable mounting material. Use both of the lower drill holes on the rear panel of the inverter.



10. Ensure that the inverter is securely in place.

# 6 Electrical Connection

## 6.1 Safety during Electrical Connection

**⚠ DANGER**

**Danger to life due to high voltages of the PV array**

When exposed to sunlight, the PV array generates dangerous DC voltage which is present in the DC conductors and the live components of the inverter. Touching the DC conductors or the live components can lead to lethal electric shocks. If you disconnect the DC connectors from the inverter under load, an electric arc may occur leading to electric shock and burns.

- Do not touch non-insulated cable ends.
- Do not touch the DC conductors.
- Do not touch any live components of the inverter.
- Have the inverter mounted, installed and commissioned only by qualified persons with the appropriate skills.
- If an error occurs, have it rectified by qualified persons only.
- Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document (see Section 9 "Disconnecting the Inverter from Voltage Sources", page 41).

**⚠ CAUTION**

**Risk of fire**

- To reduce the risk of fire, connect only to a circuit provided with 50 A maximum branch-circuit overcurrent protection in accordance with the *National Electrical Code®* (NE, ANSI/NFPA 70).

***NOTICE***

**Damage to seals on the enclosure lids in subfreezing conditions**

If you open the upper and lower enclosure lids when temperatures are below freezing, the enclosure seals can be damaged. This can lead to moisture entering the inverter.

- Do not open the inverter at ambient temperatures lower than -5°C (23°F).
- If a layer of ice has formed on the seal of the lid when temperatures are below freezing, remove it prior to opening the enclosure lids of the inverter (e.g. by melting the ice with warm air). Observe the applicable safety regulations.

***NOTICE***

**Damage to the inverter due to electrostatic discharge**

Touching electronic components can cause damage to or destroy the inverter through electrostatic discharge.

- Ground yourself before touching any component.

*NOTICE*

**Damage to the inverter due to moisture ingress during electrical installation**

- Never open the inverter when it is raining or snowing, or the humidity is over 95%.
- For attaching the conduits to the enclosure, only use UL-listed rain-tight conduit fittings or UL-listed conduit fittings for wet locations complying with UL514B.
- Seal all unused openings tightly.

*NOTICE*

**Ground faults, unreliable and highly resistive connections due to *Wire Nuts*®**

Potential damage to or failure of the inverter.

- Do not use *Wire Nuts*®.

**Electrical installations**

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.

- Before connecting the inverter to the utility grid, contact your local grid operator. The electrical connection of the inverter must be carried out by qualified persons only.
- Ensure that no cables used for electrical connection are damaged.

## 6.2 Overview of the Connection Area

### 6.2.1 View from Below

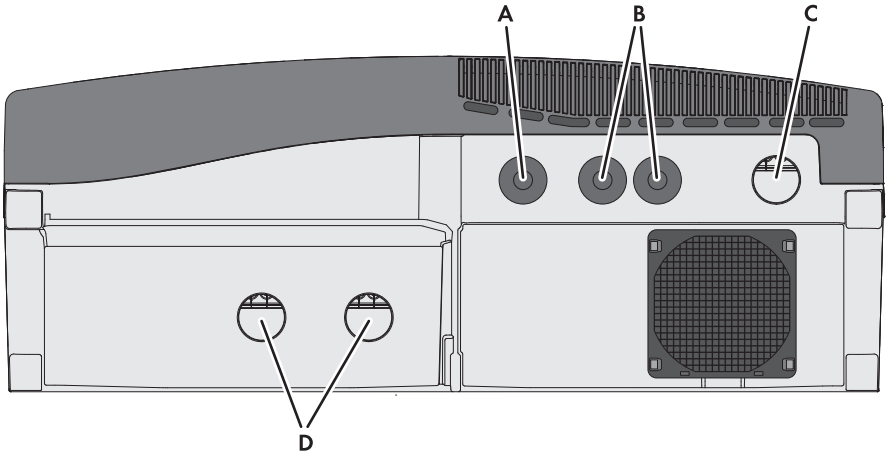



Figure 5: Enclosure openings at the bottom of the inverter

| Position | Designation |
|---|---|
| A | Enclosure opening with filler plug for communication connection (diameter: 27.8 mm to 28.0 mm (1.09 in to 1.1 in)) |
| B | Enclosure opening with filler plug for Ethernet connection (diameter: 27.8 mm to 28.0 mm (1.09 in to 1.1 in)) |
| C | Enclosure opening for AC connection (diameter: 34.5 mm to 34.7 mm (1.36 in to 1.37 in)) |
| D | Enclosure openings for DC connection (diameter: 34.5 mm to 34.7 mm (1.36 in to 1.37 in)) |

### 6.2.2 Interior View

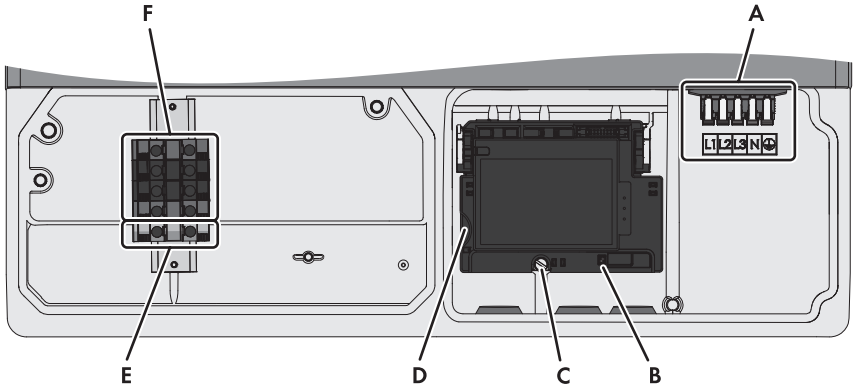



Figure 6: Connection areas in the interior of the inverter

| Position | Designation |
|---|---|
| A | Connecting terminal plate for AC connection |
| B | Switch for changing the language to English for service purposes |
| C | Screw to release and attach the communication board |
| D | Slot for the SD memory card, for service purposes only |
| E | Terminal for equipment grounding and grounding electrode conductor |
| F | Connecting terminal plate for DC connection |

## 6.3 AC Connection

### 6.3.1 Requirements for the AC Connection

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

- ☐ 1 metal conduit: 25.4 mm (1 in)
- ☐ 1 UL-listed rain-tight conduit fitting for wet locations: 25.4 mm (1 in)

**Cable requirements:**

- ☐ The AC cable must be approved for temperatures of over +90°C (+194°F).
- ☐ The AC cable must be designed in accordance with the local installation requirements.
- ☐ The AC cable must be made of solid wire or stranded wires.
- ☐ Conductor cross-section: 10 mm² to 16 mm² (8 AWG to 6 AWG)
- ☐ Cable type: copper wire
- ☐ The maximum cable length subject to conductor cross-section must be observed.

**Load-break switch and cable protection:**

*NOTICE*

**Damage to the inverter through the use of fuses as disconnecting units in the output circuit of the inverter**

Fuses must not be used as disconnecting units, even if they are installed in a fuse holder listed as being a load-break switch.

- If fuses are installed as overcurrent protection in the output circuit of the inverter, a disconnection switch or another load-break switch suitable for the load must be installed as a disconnecting unit in the output circuit of the inverter.
- Use a circuit breaker as load-break switch, for example. These can be used both as overcurrent protection and as disconnecting unit.

☐ In PV systems with multiple inverters, protect each inverter with a separate three-phase circuit breaker. Observe the maximum permissible fuse protection (see Section 14 "Technical Data", page 69). This will prevent residual voltage from being present at the corresponding cable after disconnection.

☐ The load-break switch or circuit breaker must be listed (see *National Electrical Code®*, ANSI/NFPA 70)

☐ Loads installed between the inverter and the circuit breaker must be fused separately.

☐ The overcurrent protection for the AC output circuit is to be provided by others.

## 6.3.2 Connecting the Inverter to the Utility Grid

**Requirements:**

☐ 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.

☐ The AC and DC electric circuits are isolated from the enclosure. If required by section 250 of the *National Electrical Code®*, ANSI/NFPA 70, the installer is responsible for grounding the system.

☐ The connection requirements of the grid operator must be met.

☐ The grid voltage must be within the permissible range. The exact operating range of the inverter is specified in the operating parameters.

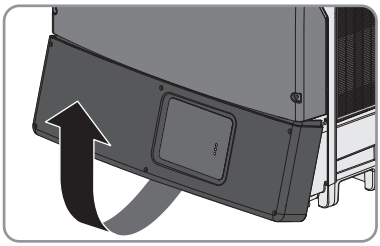
**Procedure:**

1. ⚠ DANGER

   **Danger to life due to electric shock**

   - Ensure that the three-pole circuit breaker is switched off and cannot be reconnected.

2. Release all screws of the lower enclosure lid using an Allen key (AF 3).
3. Lift and remove the lower enclosure lid from below.



4. Remove the adhesive tape from the enclosure opening for the AC connection.
5. **NOTICE**

   **Damage to the inverter due to moisture and dust intrusion**

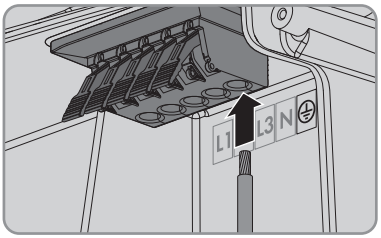
   Electronic components in the inverter can be destroyed or damaged as a result of dust or moisture intrusion.

   - Do not enlarge the enclosure opening.
6. Insert the conduit fitting into the opening and tighten from the inside using the counter nut.
7. Attach the conduit to the enclosure opening.
8. Insert the AC cable through the conduit into the inverter.
9. Strip the cable insulation by 12 mm to 13 mm (0.5 in).
10. Open all locking levers of the connecting terminal plate right up to the stop.
11. **⚠ CAUTION**

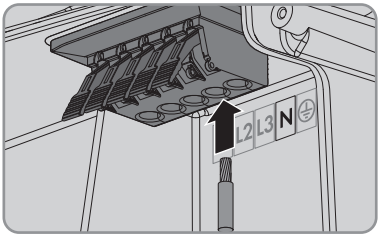
    **Risk of fire if two conductors are connected to one terminal**

    If you connect two conductors to a terminal, a fire can occur due to a bad electrical connection.

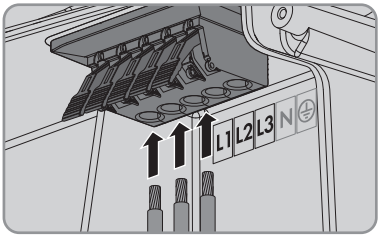
    - Never connect more than one conductor per terminal.
12. Connect the equipment grounding conductor to the terminal ⏚ .



13. Connect the conductor N to the terminal **N**.




14. Connect the conductors L1, L2 and L3 to the terminals **L1**, **L2** and **L3** according to the label. Ensure that the assignment is correct.




15. **⚠ CAUTION**

    **Danger of crushing when locking levers snap shut**

    The locking levers close by snapping down fast and hard.

    - Press the locking levers of the connecting terminal plate for the AC cable down with your thumb only. Do not grip the entire connecting terminal plate for the AC cable between finger and thumb and keep fingers out from under the locking levers.

16. Ensure that the correct conductors are assigned to all the terminals.
17. Ensure that all locking levers of the connecting terminal plate are closed and all conductors are tightly connected.

## 6.3.3 Connecting Additional Grounding

The inverter is equipped with a grounding terminal with two connection points on the DC side for additional grounding (e.g. use of a grounding electrode).

The grounding terminal is yellow/green and identified as follows:

- Equipment grounding terminal: symbol ⏚
- Grounding electrode conductor: labeling **GEC**

**Cable requirements:**

☐ The cable must be designed in accordance with the local installation requirements and for temperatures of over +90°C (+194°F).

☐ Cable type: copper wire

☐ Conductor cross-section: 10 mm² to 35 mm² (8 AWG to 2 AWG)

**Requirement:**

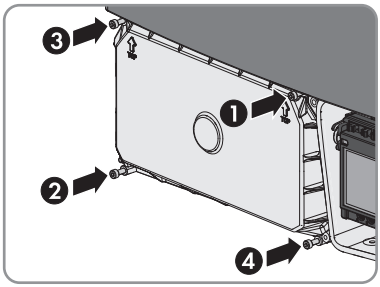
☐ The conduits must be correctly connected to the inverter.

**Procedure:**

1. **⚠ DANGER**

   **Danger to life due to electric shock**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).
2. If the protective cover is mounted, loosen the screws of the DC protective cover using an Allen key (AF 3) and remove the DC protective cover.
3. Lead the equipment grounding conductor or the cable of the grounding electrode through the installed conduit into the inside of the inverter.
4. Strip the equipment grounding conductor or the cable of the grounding electrode by 18 mm (0.71 in).
5. Connect the equipment grounding conductor to the connection point with the symbol ⏚ and tighten with a screwdriver (blade width: 6 mm (0.24 in)) (torque: 5.8 Nm (51 in-lb)).
6. Connect the grounding electrode cable to the connection point **GEC** and tighten with a screwdriver (blade width: 6 mm (0.24 in)) (torque: 5.8 Nm (51 in-lb)).
7. Make sure the equipment grounding conductor or the grounding electrode cable is firmly in place.
8. Reattach the DC protective cover. Tighten all four screws with an Allen key (AF 3) in the order 1 to 4 (torque: 3.5 Nm (31 in-lb)).




## 6.4 DC Connection

### 6.4.1 Requirements for the DC Connection

**Requirements for the PV modules per input:**

- ☐ All PV modules must be of the same type.
- ☐ All PV modules must be aligned and tilted identically.
- ☐ On the coldest day based on statistical records, the open-circuit voltage of the PV array must never exceed the maximum input voltage of the inverter.
- ☐ The same number of series-connected PV modules must be connected to each string.
- ☐ The thresholds for the input voltage and the input current of the inverter must be adhered to (see Section 14 "Technical Data", page 69).
- ☐ The maximum input current per string must be maintained (see Section 14 "Technical Data", page 69).

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

- ☐ Depending on the number of strings, one or two conduits made of metal: 25.4 mm (1 in)
- ☐ Depending on the number of conduits, one or two UL-listed rain-tight conduit fittings for wet locations complying with UL514B: 25.4 mm (1 in)
- ☐ For closing unused enclosure openings for the DC connection: UL-listed type 3R filler plugs

**Cable requirements:**

- ☐ The DC cables must be approved for temperatures of over +90°C (+194°F).
- ☐ The maximum cable length subject to conductor cross-section must be observed.
- ☐ Cable type: copper wire
- ☐ Only use solid wire or stranded wires.
- ☐ Conductor cross-section: 10 mm² to 35 mm² (8 AWG to 2 AWG)
- ☐ The DC cables must be sized in accordance with the installation requirements applicable on site.

## 6.4.2 Connecting the PV Array

**Requirements:**

- ☐ A means of disconnecting the inverter from the PV array must be present.
- ☐ The grounding of the PV system must be executed as per the specifications of Paragraph 690.41 to 690.47 of the *National Electrical Code®* ANSI/NFPA 70 and is the responsibility of the installer.
- ☐ 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.

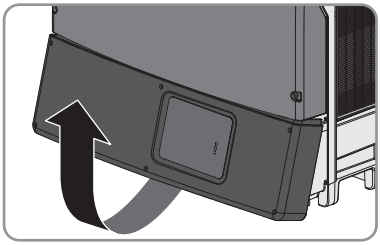
**Procedure:**

1. **⚠ WARNING**

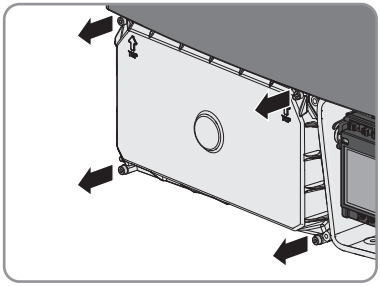
   **Danger to life due to electric shock**

   - Disconnect the inverter from the utility grid and ensure that it cannot be reconnected.
   - Disconnect the inverter from the PV array and ensure that it cannot be reconnected.

2. If the lower enclosure lid is mounted, loosen all screws of the lower enclosure lid using an Allen key (AF 3) and lift the enclosure lid from below and remove it.



3. Release the screws of the DC protective cover using an Allen key (AF 3) and remove the DC protective cover.



4. ***NOTICE***

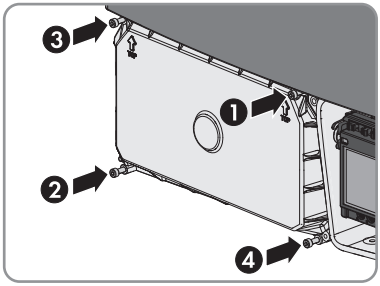
   **Damage to the inverter due to moisture and dust intrusion**

   Electronic components in the inverter can be destroyed or damaged as a result of dust or moisture intrusion. The enclosure openings are suitable for conduits of 25.4 mm (1 in).

   - Only use one opening per string.
   - Do not enlarge the enclosure openings.

5. Remove the adhesive tape from both openings.
6. Insert one conduit fitting for each string into the opening and tighten from the inside using the counter nut.
7. Attach one conduit for each string to the opening.
8. Insert the DC cables through the conduit into the interior of the inverter.
9. Strip the insulation of the DC cables by 18 mm (0.71 in).
10. For connecting the string to **INPUT A**, connect the DC cables to the connecting terminal plate for the DC connection:
    - Connect the positive DC cable to the red terminal **A+** and tighten with a screwdriver (torque: 5.8 Nm (51 in-lb)).
    - Connect the negative DC cable to the black terminal **A-** and tighten with a screwdriver (torque: 5.8 Nm (51 in-lb)).
11. For connecting the string to **INPUT B**, connect the DC cables to the connecting terminal plate for the DC connection:
    - Connect the positive DC cable to the red terminal **B+** and tighten with a screwdriver (torque: 5.8 Nm (51 in-lb)).
    - Connect the negative DC cable to the black terminal **B-** and tighten with a screwdriver (torque: 5.8 Nm (51 in-lb)).
12. Ensure that all DC cables are securely in place.
13. Close unused enclosure openings with UL-listed type 3R filler plugs.
14. If required, you must connect additional grounding or equipotential bonding (see Section 6.3.3, page 31).

15. If no additional grounding is to be connected, reattach the DC protective cover. Tighten all four screws with an Allen key (AF 3) in the order 1 to 4 (torque: 3.5 Nm (31 in-lb)).




## 6.5 Connecting the Inverter to the Network

**Cable requirements:**

The cable length and quality affect the quality of the signal. Observe the following cable requirements.

- ☐ Cable type: 100BaseTx
  SMA recommends cable type "SMA COMCAB-OUTxxx" for outdoor use and cable type "SMA COMCAB-INxxx" for indoor use, available in lengths xxx = 100 m (328 ft), 200 m (656 ft), 500 m (1,640 ft), 1,000 m (3,281 ft)
- ☐ Cable category: Cat5, Cat5e, Cat6, Cat6a or Cat7
- ☐ Plug type: RJ45 of Cat5, Cat5e, Cat6 or Cat6a
- ☐ Shielding: SF/UTP, S/UTP, SF/FTP or S/FTP
- ☐ Number of insulated conductor pairs and insulated conductor cross-section: at least 2 x 2 x 0.22 mm² (2 x 2 x 24 AWG)
- ☐ Maximum cable length between two nodes when using patch cables: 50 m (164 ft)
- ☐ Maximum cable length between two nodes when using installation cables: 100 m (328 ft)
- ☐ UV-resistant for outdoor use

**Procedure:**

1. **⚠ DANGER**

   **Danger to life due to electric shock**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).
2. Connect one end of the network cable to the inverter:
   - Remove the filler plugs from the network connection opening on the inverter.
   - Attach the conduit to the opening.
   - Lead the network cable through the conduit into the interior of the inverter.
   - Release the screw of the display far enough to allow the display to be flipped up.
   - Flip the display up until it snaps into place.
   - Insert the network cable into one of the network jacks of the Webconnect Data Module.
   - Flip the display down and fasten the display screw hand-tight.

3. Connect the other end of the network cable directly to the computer or router or connect it to another node. You can only connect the inverter to other nodes via star topology.
4. Commission the inverter (see Section 7, page 37).

# 7 Commissioning the Inverter

**Requirements:**

☐ The circuit breaker must be correctly rated.

☐ A means of disconnecting the inverter from the PV array must be present.

☐ The inverter must be correctly mounted and closed.

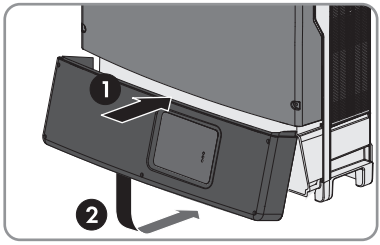
☐ All cables must be correctly connected to the terminals.

☐ Unused openings for the DC connection in the inverter enclosure must be closed with UL-listed type 3R filler plugs.

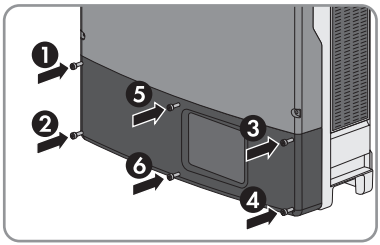
☐ Unused openings for the Ethernet connection or the communication connection in the inverter enclosure must be sealed tightly. The factory-mounted filler plugs can be used for that purpose.

**Procedure:**

1. Make sure that the AC cable is routed so that it cannot be damaged by the partition in the lower enclosure lid.
2. Insert the lower enclosure lid from above and flip it down. The screws must protrude from the lower enclosure lid.




3. Tighten all six screws with an Allen key (AF 3) in the order 1 to 6 (torque: 2.0 Nm (17.7 in-lb)).




4. Switch on all DC disconnectors between the inverter and the PV array.
5. Switch on the circuit breaker and all AC disconnectors.
   - ☑ The green LED is glowing. Feed-in operation begins.
   - ✖ Green LED is flashing?
     The DC input voltage is still too low.
     - Once the DC input voltage is sufficiently high, feed-in operation begins.
   - ✖ The red LED is glowing?
     There is probably an error.
     - Rectify the error (see Section 10 "Troubleshooting", page 43).

# 8 Configuration

## 8.1 Integrating the Inverter into the Network

If the router supports DHCP and DHCP is enabled, the inverter will automatically be integrated into the network. You will not need to carry out network configuration.

If the router does not support DHCP, automatic network configuration will not be possible and you will need to use the SMA Connection Assist to integrate the inverter into the network.

**Requirements:**

☐ The inverter must be in operation.

☐ There must be a router with Internet connection in the local network of the system.

☐ The inverter must be connected to the router.

**Procedure:**

- Integrate the inverter into the network by means of the SMA Connection Assist. Download the SMA Connection Assist and install it on the computer (see www.SMA-Solar.com).

## 8.2 Changing Operating Parameters

This section describes the basic procedure for changing operating parameters. Always change operating parameters as described in this section. Some parameters that have sensitive functions can only be viewed and changed by qualified persons (for further information on changing parameters, refer to the manual of the communication product).

The operating parameters of the inverter are set to certain values by default. To optimize inverter operation, you can change the operating parameters using a communication product.

**Requirements:**

☐ Depending on the type of communication, a computer with Ethernet interface must be available.

☐ A communication product corresponding to the type of communication used must be available.

☐ The inverter must be registered in the communication product.

☐ The changes to the grid-relevant parameters must be approved by the responsible grid operator.

☐ When changing grid-relevant parameters, the SMA Grid Guard code must be available (see "Application for SMA Grid Guard Code" at www.SMA-Solar.com).

**Procedure:**

1. Call up the user interface of the communication product or software and log in as **Installer** or **User**.
2. If required, enter the SMA Grid Guard code.
3. Select and set the required parameter.
4. Save settings.

## 8.3 Setting the Active Power Limitation in case of PV System Control Failure

You will need to set the active power limitation in case of PV system control failure if the active power limitation of the inverter is controlled by a communication product. By setting the active power limitation in case of PV system control failure, you ensure that the inverter will still feed the maximum permissible PV power into the utility grid, even if communication between inverter and communication product has failed. The default setting of the inverter is 100%.

The basic procedure for changing operating parameters is explained in another section (see Section 8.2 "Changing Operating Parameters", page 38).

## 8.4 Deactivating the Arc-Fault Circuit Interrupter (AFCI)

The basic procedure for changing operating parameters is explained in another section (see Section 8.2 "Changing Operating Parameters", page 38).

**Procedure:**

- Select the parameter **AFCI switched on** or **AfciIsOn** and set to **No**.

## 8.5 Setting SMA OptiTrac Global Peak

For partially shaded PV modules, activate SMA OptiTrac Global Peak and set the interval at which the inverter is to optimize the MPP of the PV system.

The basic procedure for changing operating parameters is explained in another section (see Section 8.2 "Changing Operating Parameters", page 38).

**Procedure:**

1. Select the parameter **OptiTrac Global Peak switched on** or **MPPShdw.IsOn** and set to **On**.
2. Select the parameter **Cycle time of the OptiTrac Global Peak algorithm** or **MPPShdw.CycTms** and set the required time interval. The ideal time interval is usually six minutes. This value should only be increased if the shading situation changes extremely slowly.
   ☑ The inverter optimizes the MPP of the PV system at the predetermined time interval.

## 8.6 Adjustable Parameters

You can change the following parameters for voltage and frequency monitoring with a communication product (e.g. Sunny Explorer) (see Section 8.2 "Changing Operating Parameters", page 38).

| Name | Value/range | Default value |
|---|---|---|
| **Voltage monitoring median maximum threshold** (Overvoltage/Fast) | 277.0 V to 332.4 V | 332.4 V |
| **Voltage monitoring lower maximum threshold** (Overvoltage/Slow) | 277.0 V to 332.4 V | 304.7 V |

| Name | Value/range | Default value |
|---|---|---|
| **Voltage monitoring upper minimum threshold** (Undervoltage/Slow) | 138.5 V to 277.0 V | 243.8 V |
| **Voltage monitoring of median minimum threshold** (Undervoltage/Fast) | 138.5 V to 277.0 V | 138.5 V |
| **Voltage monitoring median max. threshold trip.time** (Overvoltage/Fast, maximum time) | 0.1 s to 6,000 s | 0.16 s |
| **Voltage monitoring lower max. threshold trip. time** (Overvoltage/Slow, maximum time) | 0.1 s to 6,000 s | 1.0 s |
| **Voltage monitoring upper min. threshold trip. time** (Undervoltage/Slow, maximum time) | 0.1 s to 1,000 s | 2.0 s |
| **Voltage monitoring median min. threshold trip.time** (Undervoltage/Fast, maximum time) | 0.1 s to 1,000 s | 0.16 s |
| **Frequency monitoring lower maximum threshold** (Overfrequency) | 50 Hz to 65 Hz | 60.5 Hz |
| **Frequency monitoring upper minimum threshold** (Underfrequency) | 44 Hz to 60 Hz | 59.3 Hz |
| **Frq. monitoring lower max. threshold trip. time** (Overfrequency, maximum time) | 0.1 s to 9,000 s | 0.16 s |
| **Frq. monitoring upper min. threshold trip. time** (Underfrequency, maximum time) | 0.1 s to 30,000 s | 0.16 s |

# 9 Disconnecting the Inverter from Voltage Sources

Prior to performing any work on the inverter, always disconnect it from all voltage sources as described in this section. Always adhere to the prescribed sequence.

*NOTICE*

**Damage to seals on the enclosure lids in subfreezing conditions**

If you open the upper and lower enclosure lids when temperatures are below freezing, the enclosure seals can be damaged. This can lead to moisture entering the inverter.

- Do not open the inverter at ambient temperatures lower than -5°C (23°F).
- If a layer of ice has formed on the seal of the lid when temperatures are below freezing, remove it prior to opening the enclosure lids of the inverter (e.g. by melting the ice with warm air). Observe the applicable safety regulations.

*NOTICE*

**Destruction of the measuring device due to overvoltage**

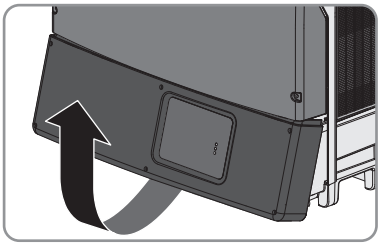
- Only use measuring devices with a DC input voltage range of 1,000 V or higher.

**Procedure:**

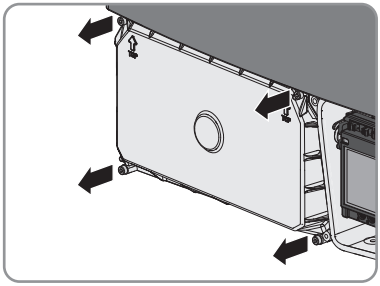
1. ⚠ DANGER

   **Danger to life due to electric shock**

   - Disconnect the inverter from the utility grid and ensure that it cannot be reconnected.
   - Disconnect the inverter from the PV array and ensure that it cannot be reconnected.
2. Wait five minutes until the LEDs on the inverter switch off.
3. Release all screws of the lower enclosure lid using an Allen key (AF 3).
4. Lift and remove the lower enclosure lid from below.



5. Loosen the screws of the DC protective cover using an Allen key (AF 3) and remove the DC protective cover.



6. Use a suitable measuring device to ensure that no voltage is present at the DC terminals.
7. Use a suitable measuring device to ensure that no voltage is present at the AC terminals.

# 10 Troubleshooting

## 10.1 Cleaning the Inverter

*NOTICE*

**Damage to the inverter due to the use of cleaning agents**

- If the inverter is dirty, clean the enclosure, the enclosure lid, the type label and the LEDs using only clean water and a cloth.

- Ensure that the inverter is free of dust, foliage and other dirt.

## 10.2 Event Messages

| Event number | Message, cause and corrective measures |
|---|---|
| 101 to 103 | **Grid fault**<br>The grid voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid.<br>**Corrective measures:**<br>• Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.<br>If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.<br>If the grid voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line. |
| 202 to 203 | **Grid fault**<br>The utility grid has been disconnected, the AC cable is damaged or the grid voltage at the connection point of the inverter is too low. The inverter has disconnected from the utility grid.<br>**Corrective measures:**<br>1. Make sure that the circuit breaker is switched on.<br>2. Make sure that the AC cable is not damaged.<br>3. Make sure that the AC cable is correctly connected.<br>4. Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.<br>If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.<br>If the grid voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line. |

| Event number | Message, cause and corrective measures |
|---|---|
| 301 | **Grid fault**<br>The ten-minute average value of the grid voltage is no longer within the permissible range. The grid voltage or grid impedance at the connection point is too high. The inverter disconnects from the utility grid to maintain power quality.<br>**Corrective measures:**<br>• Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.<br>If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.<br>If the grid voltage is permanently within the permissible range and this message is still displayed, contact the SMA Service Line. |
| 401 | **Grid fault**<br>The inverter is no longer in grid-parallel operation. The inverter has stopped feeding into the utility grid.<br>**Corrective measures:**<br>• Check the grid connection for significant short-term frequency fluctuations. |
| 404 | **Grid fault**<br>The inverter is no longer in grid-parallel operation. The inverter has stopped feeding into the utility grid.<br>**Corrective measures:**<br>• Check the grid connection for significant short-term frequency fluctuations. |
| 501 | **Grid fault**<br>The power frequency is not within the permissible range. The inverter has disconnected from the utility grid.<br>**Corrective measures:**<br>• If possible, check the power frequency and observe how often fluctuations occur.<br>If fluctuations occur frequently and this message is displayed often, contact the grid operator. The grid operator must approve changes to the operating parameters of the inverter.<br>If the grid operator gives its approval, discuss any changes to the operating parameters with the SMA Service Line. |

| Event number | Message, cause and corrective measures |
|---|---|
| 601 | **Grid fault**<br>The inverter has detected an excessively high proportion of direct current in the grid current.<br>**Corrective measures:**<br>1. Check the grid connection for direct current.<br>2. If this message is displayed frequently, contact the grid operator and check whether the monitoring threshold on the inverter can be raised. |
| 701 | **Frq. not permitted > Check parameter**<br>The power frequency is not within the permissible range. The inverter has disconnected from the utility grid.<br>**Corrective measures:**<br>• If possible, check the power frequency and observe how often fluctuations occur.<br>If fluctuations occur frequently and this message is displayed often, contact the grid operator. The grid operator must approve changes to the operating parameters of the inverter.<br>If the grid operator gives its approval, discuss any changes to the operating parameters with the SMA Service Line. |
| 901 | **PE conn. missing > Check connection**<br>The grounding conductor is not correctly connected.<br>**Corrective measures:**<br>• Ensure that the grounding conductor is correctly connected (see Section 6.3 "AC Connection", page 28). |
| 1302 | **Waiting for grid voltage > Installation failure grid connection > Check grid and fuses**<br>The inverter has detected an error in the AC cabling. The inverter cannot connect to the utility grid.<br>**Corrective measures:**<br>1. Ensure that the AC connection is correct (see Section 6.3 "AC Connection", page 28).<br>2. Ensure that the country data set has been configured correctly. Select the parameter **Set country standard** or **CntrySet** and check its value. |
| 1501 | **Reconnection fault grid**<br>The changed country data set or the value of a parameter you have set does not correspond to the local requirements. The inverter cannot connect to the utility grid.<br>**Corrective measures:**<br>• Ensure that the country data set has been configured correctly. Select the parameter **Set country standard** or **CntrySet** and check its value. |

| Event number | Message, cause and corrective measures |
|---|---|
| 3301 | **Unstable operation > Generator output too low**<br>There is not enough power at the DC input of the inverter for stable operation. This may be caused by snow on the PV modules or insufficient irradiation. The inverter interrupts feed-in operation and can no longer connect to the utility grid.<br>**Corrective measures:**<br>1. Wait for higher irradiation.<br>2. If this message is displayed frequently, ensure that the PV array has been correctly rated and wired. |
| 3302 | **Unstable operation > Abort self-test**<br>There is not enough power at the DC input of the inverter for stable operation. This may be caused by snow on the PV modules or insufficient irradiation. The inverter interrupts feed-in operation and can no longer connect to the utility grid.<br>**Corrective measures:**<br>1. If irradiation is too low, wait for it to increase.<br>2. If this message is displayed frequently, ensure that the PV array has been correctly rated and wired. |
| 3303 | **Unstable operation > Data storage blocked**<br>There is not enough power at the DC input of the inverter for stable operation. This may be caused by snow on the PV modules or insufficient irradiation. The inverter interrupts feed-in operation and can no longer connect to the utility grid.<br>**Corrective measures:**<br>1. Wait for higher irradiation.<br>2. If this message is displayed frequently, ensure that the PV array has been correctly rated and wired. |

| Event number | Message, cause and corrective measures |
|---|---|
| 3401 to 3402 | **DC overvoltage > Disconnect generator**<br>Overvoltage at the DC input. This can destroy the inverter.<br>**Corrective measures:**<br>1. Immediately disconnect the inverter from all voltage sources (see Section 9, page 41).<br>2. Check whether the DC voltage is below the maximum input voltage of the inverter.<br>If the DC voltage is below the maximum input voltage of the inverter, reconnect the DC connectors to the inverter.<br>If the DC voltage is above the maximum input voltage of the inverter, ensure that the PV array has been correctly rated or contact the installer of the PV array.<br>3. If this message is repeated frequently, contact the SMA Service Line. |
| 3501 | **Insulation resistance > Check generator**<br>The inverter has detected a ground fault in the PV array.<br>**Corrective measures:**<br>• Check the PV system for ground faults (see Section 10.5, page 57). |
| 3601 | **High discharge curr. > Check generator**<br>The leakage currents of the inverter and the PV array are too high. There is a ground fault, a residual current or a malfunction.<br>The inverter interrupts feed-in operation immediately after exceeding a threshold and then automatically reconnects to the utility grid. If this process happens five times a day, the inverter disconnects from the utility grid and terminates feed-in.<br>**Corrective measures:**<br>• Check the PV system for ground faults (see Section 10.5, page 57). |
| 3701 | **Resid.curr.too.high > Check generator**<br>The inverter has detected a residual current due to temporary grounding of the PV array.<br>**Corrective measures:**<br>• Check the PV system for ground faults (see Section 10.5, page 57). |
| 3801 to 3802 | **DC overcurrent > Check generator**<br>Overcurrent at the DC input. The inverter briefly interrupts feed-in operation.<br>**Corrective measures:**<br>• If this message is displayed frequently, ensure that the PV array has been correctly rated and wired. |

| Event number | Message, cause and corrective measures |
|---|---|
| 3901 to 3902 | **Waiting for DC start conditions > Start cond. not met**<br>The feed-in conditions for the utility grid are not yet fulfilled.<br>**Corrective measures:**<br>1. Wait for higher irradiation.<br>2. If this message is displayed frequently in the morning, increase the voltage limit for starting grid feed-in. Change the parameter **Minimum voltage input** or **A.VStr, B.VStr**.<br>3. If this message is displayed frequently with medium irradiation, ensure that the PV array is correctly rated. |
| 4301 | **Serial el.arc in String detected by AFCI mod.**<br>The inverter has detected an electric arc. The inverter interrupts grid feed-in and cannot connect to the utility grid.<br>**Corrective measures:**<br>• Reset the operation inhibition (see Section 10.6, page 60). |
| 6001 to 6438 | **Self diagnosis > Interference device**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 6501 to 6511 | **Self diagnosis > Interference device**<br>The inverter has switched off due to excessive temperature.<br>**Corrective measures:**<br>1. Clean the fans (see Section 10.3, page 54).<br>2. Ensure that the inverter has sufficient ventilation. |
| 6512 | **Minimum operating temperature not reached**<br>The inverter will only recommence grid feed-in once the temperature has reached at least −25°C (−13°F). |
| 6603 to 6604 | **Self-diagnosis > Overload**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 6606 | **Interference device**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |

| Event number | Message, cause and corrective measures |
|---|---|
| 6701 to 6702 | **Communication disturbed**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 6801 to 6802 | **Self-diagnosis > Input A defective**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 6901 to 6902 | **Self-diagnosis > Input B defective**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 7001 to 7002 | **Sensor fault fan permanently on**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 7101 | **SD card defective**<br>The SD memory card is not formatted.<br>**Corrective measures:**<br>• Re-format the SD memory card.<br>• Re-save the files to the SD memory card. |
| 7105 | **Param. setting failed**<br>Parameters could not be set using the memory card. The inverter continues feeding power into the grid.<br>**Corrective measures:**<br>• Ensure that the parameters are set correctly.<br>• Ensure that the SMA Grid Guard code is available. |
| 7106 | **Update file defect.**<br>Update file on the memory card is defective.<br>**Corrective measures:**<br>• Reformat the memory card.<br>• Re-save the files to the memory card. |

| Event number | Message, cause and corrective measures |
|---|---|
| 7102 | **Parameter file not found or defective**<br>The parameter file was not found or is defective. The update failed. The inverter continues feeding power into the grid.<br>**Corrective measures:**<br>• Copy the parameter file to the correct folder again. |
| 7110 | **No update file found**<br>No update file has been found.<br>**Corrective measures:**<br>• Copy the update file to the memory card folder. Select the folder **\UPDATE**. |
| 7201 to 7202 | **Data stor. not poss.**<br>Internal error. The inverter continues to feed into the utility grid.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 7303 | **Update main CPU failed**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 7305 | **Update RS485I module failed**<br>Update of RS485i module failed.<br>**Corrective measures:**<br>• Retry update.<br>• If the error recurs, contact the SMA Service Line. |
| 7311 | **Update language table failed**<br>Updating the language table failed.<br>**Corrective measures:**<br>• Retry update.<br>• If the error recurs, contact the SMA Service Line. |
| 7316 | **Update Speedwire module failed**<br>Updating the Speedwire module failed.<br>**Corrective measures:**<br>• Retry update.<br>• If the error recurs, contact the SMA Service Line. |
| 7324 | **Wait for update conditions**<br>The inverter has successfully completed the update and is waiting for sufficient DC irradiation. |

| Event number | Message, cause and corrective measures |
|---|---|
| 7326 | **Webconnect update failed**<br>Update of Webconnect module failed.<br>**Corrective measures:**<br>• Retry update.<br>• If the error recurs, contact the SMA Service Line. |
| 7508 | **External fan fault > Replace fan**<br>One of the fans is blocked.<br>**Corrective measures:**<br>• Clean the fans (see Section 10.3, page 54).<br>• If the message continues to be displayed, replace the fan (see Section 15 "Spare Parts and Accessories", page 75). |
| 7701 to 7703 | **Self diagnosis > Interference device**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 8001 | **Derating occurred**<br>The inverter has reduced its power output for more than ten minutes due to excessive temperature.<br>**Corrective measures:**<br>• Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush.<br>• Clean the fans (see Section 10.3, page 54).<br>• Ensure that the inverter has sufficient ventilation. |
| 8101 to 8104 | **Communication disturbed**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |
| 8204 | **AFCI self-test failed**<br>The cause must be determined by the SMA Service Line.<br>**Corrective measures:**<br>• Contact the SMA Service Line. |

| Event number | Message, cause and corrective measures |
|---|---|
| 8206 | **Electr. arc detected > Please confirm by tapping**<br>The inverter has detected an electric arc and was recommissioned after a disconnection. By tapping, you are confirming that you have repaired any possible damage to PV modules, cables or plugs in the PV system.<br>**Corrective measures:**<br>• Tap on the enclosure lid within ten seconds of the message appearing in order to recommission the inverter. |
| 8708 | **Timeout in communication for active power limitation**<br>Communication to the system control absent. Depending on the fall-back setting, either the last received values will be retained or the active power will be limited to the set percentage value of the inverter nominal power.<br>**Corrective measures:**<br>• Ensure that the connection to the system manager (e.g. Sunny Home Manager) is intact and that no cables are damaged or that no plugs have been pulled. |
| 8709 | **Timeout in communication for reactive power spec.**<br>Communication to the system control absent. Depending on the fall-back setting, either the last received values will be retained or the reactive power will be set to the set value.<br>**Corrective measures:**<br>• Ensure that the connection to the system manager (e.g. Sunny Home Manager) is intact and that no cables are damaged or that no plugs have been pulled. |
| 8710 | **Timeout in communication for cos-Phi spec.**<br>Communication to the system control absent. Depending on the fall-back setting, either the last received values will be retained or the displacement power factor will be set to the set value.<br>**Corrective measures:**<br>• Ensure that the connection to the system manager (e.g. Sunny Home Manager) is intact and that no cables are damaged or that no plugs have been pulled. |
| 9002 | **SMA Grid Guard code invalid**<br>The SMA Grid Guard code entered is incorrect. The operating parameters are still protected and cannot be changed.<br>**Corrective measures:**<br>• Enter the correct SMA Grid Guard code. |

| Event number | Message, cause and corrective measures |
|---|---|
| 9003 | **Grid parameter locked**<br>The parameters are now locked. You cannot change the parameters.<br>**Corrective measures:**<br>• Unlock the parameters with the SMA Grid Guard code. |
| 9005 | **Changing of grid parameters not possible > Ensure DC supply.**<br>PV power is too low for setting the country data set. As soon as sufficient irradiation is available, the inverter assumes the setting automatically. |
| 27301 | **Update communication**<br>The inverter is updating the communication component. |
| 27302 | **Update main CPU**<br>The inverter is updating the inverter component. |
| 27312 | **Update completed**<br>The inverter has successfully completed the update. |
| 27103 | **Set parameter**<br>The inverter is setting the parameters. |
| 27104 | **Parameters set successfully**<br>The inverter is setting the parameters. |
| 27107 | **Update file OK**<br>The update file found is valid. |
| 27108 | **SD card is read**<br>The inverter is currently reading the SD memory card. |
| 27109 | **No new update SDcard**<br>There are no update files relevant for this inverter on the SD memory card or the available update has already been carried out. |
| 27304 | **Update RS485i module**<br>The inverter is updating the 485 Data Module. |
| 27317 | **Update Speedwire**<br>The inverter is updating the Speedwire data module. |
| 27325 | **Webconnect update**<br>The inverter is updating the Webconnect Data Module. |
| 27310 | **Upd. language table**<br>The inverter is updating the Webconnect Data Module. |
| 28205 | **AFCI self-test successful**<br>The inverter has successfully performed the arc fault detection self-test. |

| Event number | Message, cause and corrective measures |
|---|---|
| 29001 | **Grid Guard code valid**<br>The entered SMA Grid Guard code is valid. Protected parameters have now been unlocked and you can adjust the parameters. The parameters will be automatically locked again after ten feed-in hours. |
| 29004 | **Grid param. unchanged**<br>Changing the grid parameters is not possible. |

## 10.3 Cleaning the Fans

### 10.3.1 Cleaning the Fan at the Bottom

First clean the fan at the bottom of the inverter and then clean the fan on the left-hand side of the enclosure.

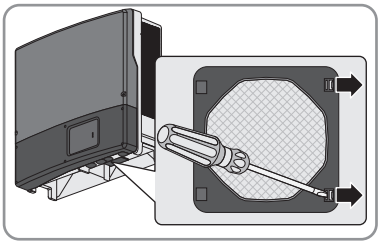
**Procedure:**

1. **⚠ DANGER**

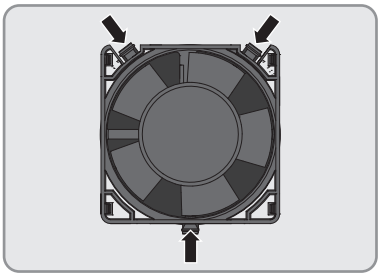
   **Danger to life due to electric shock**

   - Disconnect the inverter from all voltage sources (see Section 9 "Disconnecting the Inverter from Voltage Sources", page 41).

2. Wait for the fan to stop rotating.
3. Remove the fan guard and clean it:
   - Use a screwdriver to push the two locking tabs at the right-hand edge of the fan guard to the right-hand side and remove them from the retainer.

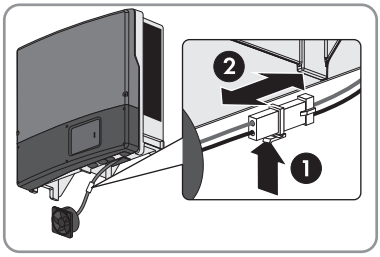


   - Carefully remove the fan guard.
   - Clean the fan guard with a soft brush, a paint brush, a cloth or compressed air.
4. Press the locking tabs on the fan toward the center of the fan.



5. Carefully remove the fan from the inverter.

6. Release and remove the fan plug.

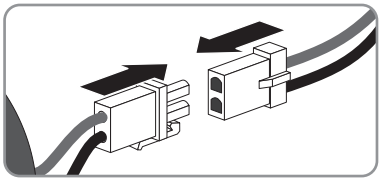



7. *NOTICE*

**Damage to the fan due to compressed air**

- Clean the fan only with a soft brush, a paint brush, or a damp cloth.

8. After cleaning, insert the fan plug back into the pin connector until it snaps into place.



9. Insert the fan into the inverter until it snaps into place.
10. Push the fan guard into the retainer until it snaps into place.
11. Clean the fan on the left-hand side of the enclosure (see Section 10.3.2 "Cleaning the Fan on the Left-Hand Side of the Enclosure", page 55).

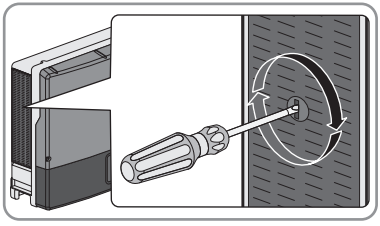
## 10.3.2 Cleaning the Fan on the Left-Hand Side of the Enclosure

1. **⚠ DANGER**

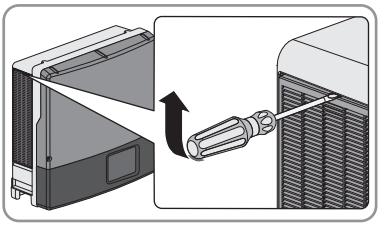
**Danger to life due to electric shock**

- Ensure that the inverter is disconnected from all voltage sources (see Section 9 "Disconnecting the Inverter from Voltage Sources", page 41).

2. Remove the ventilation grids on the left-hand and right-hand sides and clean them:
   - Turn the rotary fastener of the ventilation grid with a flat-blade screwdriver until the notch is in a vertical position.



- Remove the ventilation grid. Use a screwdriver to gently lever open the ventilation grid.



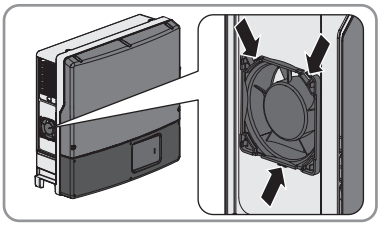
- Clean the ventilation grid with a soft brush, a paint brush, or compressed air.

3. *NOTICE*

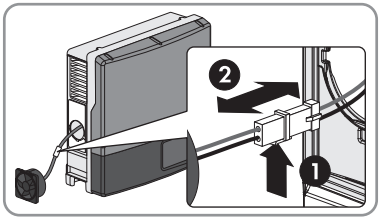
   **Damage to the inverter due to foreign bodies**

   - Do not remove the ventilation grids permanently, otherwise foreign bodies could penetrate the enclosure.

4. Wait for the fan to stop rotating.
5. Press the locking tabs on the fan toward the center of the fan.



6. Carefully remove the fan from the inverter.
7. Release and remove the fan plug.

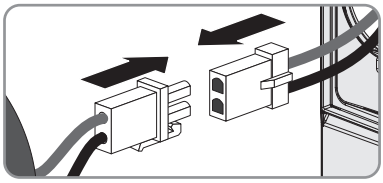



8. *NOTICE*

   **Damage to the fan due to compressed air**

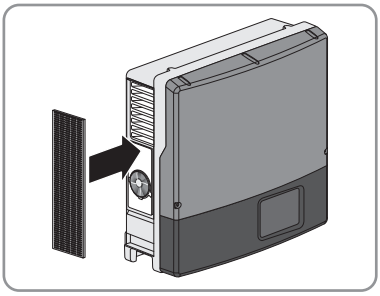
   - Clean the fan only with a soft brush, a paint brush, or a damp cloth.

9. After cleaning, insert the fan plug into the pin connector until it snaps into place.

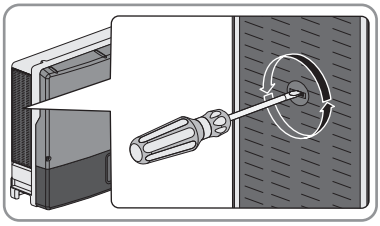


10. Insert the fan into the inverter until it snaps into place.
11. Attach the ventilation grids on the right-hand and left-hand side of the inverter:

- Reinsert the ventilation grid until it snaps into place.



- Turn the rotary lock of the ventilation grid with a flat-blade screwdriver until the slot is in a horizontal position and the arrows point to the right.



- Ensure that the ventilation grid is securely in place.

12. Recommission the inverter (see Section 11, page 61).
13. Check the fans to ensure that they are working properly (see Section 10.4, page 57).

## 10.4 Checking the Function of the Fans

You can check the function of the fans by setting a parameter.

The basic procedure for changing operating parameters is described in the manual of the inverter or the communication product (see the operating manual of the inverter or communication product).

**Procedure:**

1. Select the parameter **Fan test** or **FanTst** and set to **On.**
2. Save settings.
3. Check whether air is being drawn in through the bottom and is coming out of the upper ventilation grids and whether the fans are making any unusual noises.

   If no air is being drawn in through the bottom, no air is coming out of the ventilation grids, or the fans are making unusual noises, then the fans were presumably installed improperly. Check whether the fans have been installed correctly.

   If the fans were installed correctly, contact Service (see Section 17, page 77).
4. Select the parameter **Fan test** or **FanTst** and set to **Off**.
5. Save settings.

## 10.5 Checking the PV System for Ground Faults

If the red LED is glowing and the and the event number **3501**, **3601** or **3701** is displayed in the comunication product (e.g. Sunny Portal), this could indicate a ground fault. The electrical insulation from the PV system to ground is defective or insufficient.

**⚠ WARNING**

**Danger to life due to electric shock**

In the event of a ground fault, high voltages can be present.

- Touch the cables of the PV array on the insulation only.
- Do not touch any parts of the substructure or frame of the PV array.
- Do not connect PV strings with ground faults to the inverter.

***NOTICE***

**Destruction of the measuring device due to overvoltage**

- Only use measuring devices with a DC input voltage range of 1,000 V or higher.

**Procedure:**

In order to check the PV system for ground faults, perform the following actions in the prescribed order. The exact procedure is described in the following sections.

- Check the PV system for ground faults by measuring the voltage.
- If the voltage measurement was not successful, check the PV system via insulation resistance measurement for ground faults.

## Test by Measuring the Voltage

Proceed as follows to check each string in the PV system for ground faults.

**Procedure:**

1. **⚠ DANGER**

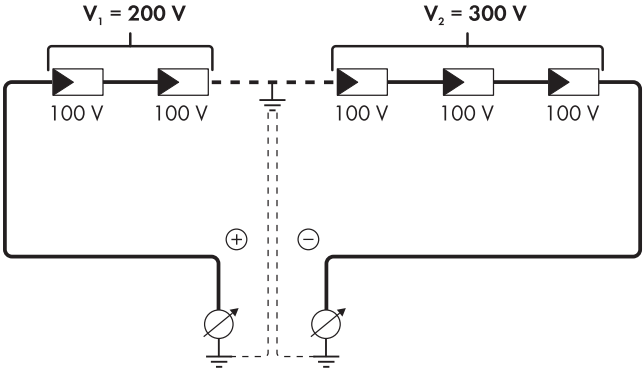
   **Danger to life due to high voltages**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).

2. Measure the voltages:
   - Measure the voltage between the positive terminal and the ground potential (PE).
   - Measure the voltage between the negative terminal and the ground potential (PE).
   - Measure the voltage between the positive and negative terminals.
     If the following results are present at the same time, there is a ground fault in the PV system:
     - ☑ All measured voltages are stable.
     - ☑ The sum of the two voltages to ground potential is approximately equal to the voltage between the positive and negative terminals.
   - If a ground fault is present, determine the location of the ground fault via the ratio of the two measured voltages and eliminate the ground fault.

### Example: Location of the ground fault

The example shows a ground fault between the second and third PV module.




3. If a definite ground fault cannot be measured and the message is still displayed, measure the insulation resistance.
4. Reconnect the strings without ground faults to the inverter and recommission the inverter (see Section 11, page 61).

## Test by Measuring the Insulation Resistance

If the voltage measurement does not provide sufficient evidence of a ground fault, the insulation resistance measurement can provide more exact results.

**Required devices:**

☐ Suitable device for safe disconnection and short-circuiting

☐ Measuring device for insulation resistance

**Procedure:**

1. Calculate the expected insulation resistance per string.
2. **⚠ DANGER**

   **Danger to life due to high voltages**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).
3. Install the short circuit device.
4. Connect the measuring device for insulation resistance.
5. Short-circuit the first string.
6. Set the test voltage. The test voltage should be as close as possible to the maximum system voltage of the PV modules but must not exceed it (see datasheet of the PV modules).
7. Measure the insulation resistance.
8. Eliminate the short circuit.
9. Measure the remaining strings in the same manner.

   ☑ If the insulation resistance of a string deviates considerably from the theoretically calculated value, there is a ground fault present in that string.

10. Reconnect to the inverter only those strings from which the ground fault has been eliminated.
11. Reconnect all other strings to the inverter.
12. Recommission the inverter (see Section 11, page 61).
13. If the inverter still displays an insulation error, contact the Service (see Section 17 "Contact", page 77). The PV modules might not be suitable for the inverter in the present quantity.

## 10.6 Resetting the Operation Inhibition after Detection of an Arc Fault

If the red LED is glowing and the event number **4301** is displayed in the communication product (e.g. Sunny Portal), the inverter has detected an electric arc and interrupts feed-in operation.

**Requirement:**

☐ A communication product corresponding to the type of communication used must be available.

**Procedure:**

1. **⚠ DANGER**

   **Danger to life due to electric shock**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).
2. Ensure that the PV modules, the connected cables and plugs are not defective.

   Repair or replace defective PV modules, cables or plugs.
3. Recommission the inverter (see Section 7, page 37).
4. Access the user interface of the communication product.
5. Reset the operation inhibition by setting one of the following parameters:
   - Select the parameter **Reset operating data** or **Op.FncSetIstl** and set to **Reset operation inhibition** or **RSPermStopOp**. This effects resetting of the operation inhibition and the inverter will start feeding in again.

     **or**
   - Select the parameter **AFCI switched on** or **AfciIsOn** and set to **No** and then back to **Yes**. This effects resetting of the operation inhibition and the inverter will start feeding in again.

# 11 Recommissioning the Inverter

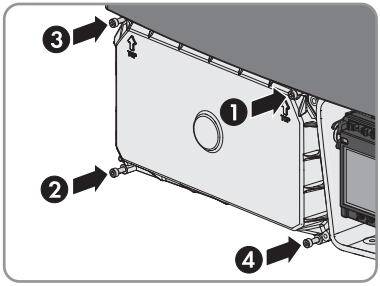
If you have disconnected the inverter from all voltage sources (e.g. for configuration purposes) and want to recommission it, proceed as follows.

**Requirements:**

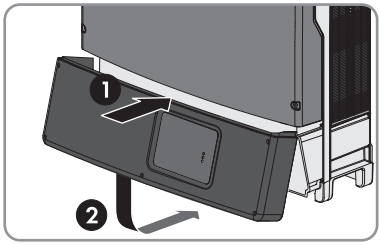
- ☐ The inverter must be correctly mounted.
- ☐ All cables must be correctly connected to the terminals.
- ☐ Unused openings for the DC connection in the inverter enclosure must be closed with UL-listed type 3R filler plugs.
- ☐ Unused openings for the Ethernet connection or the communication connection in the inverter enclosure must be sealed tightly. The factory-mounted filler plugs can be used for that purpose.

**Procedure:**

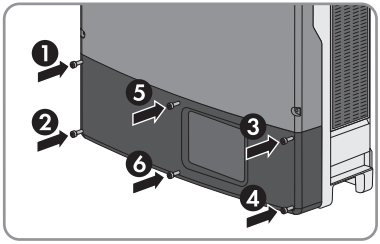
1. Ensure that all DC cables are securely in place.
2. Reattach the DC protective cover. Tighten all four screws with an Allen key (AF 3) in the order 1 to 4 (torque: 3.5 Nm (31 in-lb)).




3. Make sure that the AC cable is routed so that it cannot be damaged by the partition in the lower enclosure lid.
4. Insert the lower enclosure lid from above and flip it down. The screws must protrude from the lower enclosure lid.




5. Tighten all six screws with an Allen key (AF 3) in the order 1 to 6 (torque: 2.0 Nm (17.7 in-lb)).



6. Switch on all DC disconnectors between the inverter and the PV array.
7. Switch on the circuit breaker and all AC disconnectors.
   ☑ The green LED is glowing. Feed-in operation begins.
   ✖ Green LED is flashing?
   The DC input voltage is still too low.
   - Once the DC input voltage is sufficiently high, feed-in operation begins.

   ✖ The red LED is glowing?
   There is probably an error.
   - Rectify the error (see Section 10 "Troubleshooting", page 43).

# 12 Decommissioning the Inverter

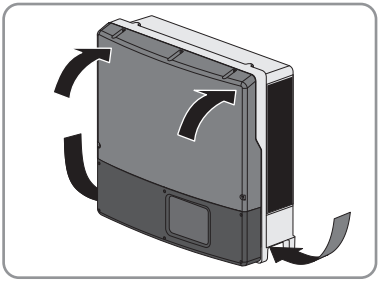
To decommission the inverter completely upon completion of its service life, proceed as described in this Section. If the inverter is defective and you have received a replacement device, observe the information on how to proceed when receiving a replacement device (see Section 13 "Procedure for Receiving a Replacement Device", page 65).

**⚠ CAUTION**

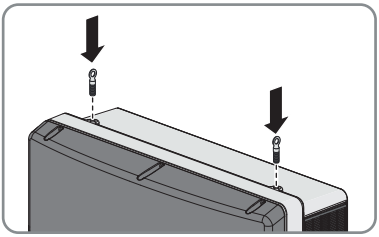
**Risk of injury when lifting the inverter, or if it is dropped**

The inverter weighs 55 kg (121 lb). There is risk of injury if the inverter is lifted incorrectly or dropped while being transported or when attaching it to or removing it from the wall mounting bracket.

- Carry and lift the inverter in an upright position with several people without tilting it. With one hand grasp the recessed grip, and with the other hand support the top part of the enclosure. This will prevent the inverter tipping forward.



- If the inverter is to be transported and lifted with a crane, remove the filler plugs on the top of the inverter and screw the eye bolts into the threads.



**Procedure:**

1. **⚠ DANGER**

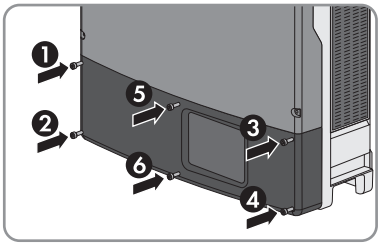
   **Danger to life due to electric shock**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).
2. Disconnect the DC cables from the connecting terminal plate for the DC connection using a screwdriver.
3. Remove the AC cable from the inverter. Press the locking levers all the way upward and pull the conductors out of the connecting terminal plate for the AC cable.
4. Press down the locking levers of the connecting terminal plate for the AC cable.
5. Remove all connected grounding cables from the grounding terminal.
6. If the multi-function relay or the SMA Power Control Module are used, remove the connection cable from the inverter.

7. If other cables (e.g. data cables or network cables) are connected, remove them from the inverter.
8. Remove all conduits with cables from the inverter.
9. Close all enclosure openings.
10. **⚠ CAUTION**

    **Risk of burns due to hot enclosure parts**

    - Wait 30 minutes before disassembling the inverter. This will allow the enclosure to cool down and thus prevent burn injuries.
11. Remove the inverter by lifting it vertically up and off the wall mounting bracket.
12. Place the lower enclosure lid on the inverter from above and flip down. The screws must protrude from the lower enclosure lid.
13. Tighten all six screws in the lower enclosure lid with an Allen key (AF 3) in the order 1 to 6 (torque: 2 Nm ± 0.3 Nm). By tightening the screws in the prescribed order, you avoid warping the lid, which would keep it from sealing correctly.
    Useful hint: If the screws fall out of the lower enclosure lid, insert the long screw into the lower middle hole and the five short screws into the other holes.




14. Release the screws from the wall mounting bracket and take the bracket off the wall.
15. If the inverter is to be stored or shipped, pack the inverter and the wall mounting bracket. Use the original packaging or packaging that is suitable for the weight and dimensions of the inverter and secure with tension belts if necessary.
16. Dispose of the inverter in accordance with the locally applicable disposal regulations for electronic waste.

# 13 Procedure for Receiving a Replacement Device

Under fault conditions, the inverter may need to be replaced. If this is the case, you will receive a replacement device from SMA. If you received a replacement device, replace the defective inverter with the replacement device as described in this section.

**Procedure:**

- Decommission the defective inverter.
- Commission the replacement device.
- Ship the defective inverter.

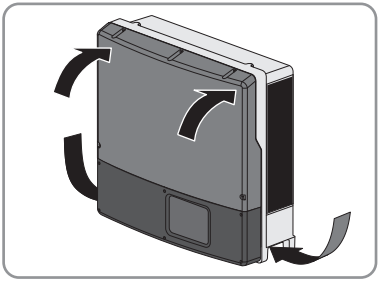
## Decommissioning the Defective Inverter

**⚠ CAUTION**

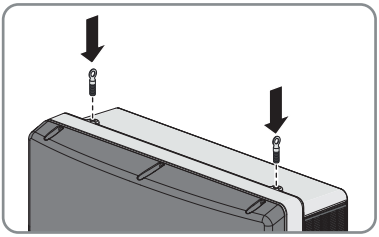
**Risk of injury when lifting the inverter, or if it is dropped**

The inverter weighs 55 kg (121 lb). There is risk of injury if the inverter is lifted incorrectly or dropped while being transported or when attaching it to or removing it from the wall mounting bracket.

- Carry and lift the inverter in an upright position with several people without tilting it. With one hand grasp the recessed grip, and with the other hand support the top part of the enclosure. This will prevent the inverter tipping forward.



- If the inverter is to be transported and lifted with a crane, remove the filler plugs on the top of the inverter and screw the eye bolts into the threads.



1. **⚠ DANGER**

   **Danger to life due to electric shock**

   - Disconnect the inverter from all voltage sources (see Section 9, page 41).
2. Disconnect the DC cables from the connecting terminal plate for the DC connection using a screwdriver.
3. Remove the AC cable from the inverter. Press the locking levers all the way upward and pull the conductors out of the connecting terminal plate for the AC cable.

4. Press down the locking levers of the connecting terminal plate for the AC cable.
5. Remove all connected grounding cables from the grounding terminal.
6. If the multi-function relay or the SMA Power Control Module are used, remove the connection cable from the inverter.
7. If other cables (e.g. data cables or network cables) are connected, remove them from the inverter.
8. Remove any installed interfaces from the inverter (see the manual for the communication interface).
9. Remove all conduits with cables from the inverter.
10. Close all enclosure openings.
11. Keep the DC load-break switch in a safe place as the replacement device will be delivered without the DC load-break switch.
12. **⚠ CAUTION**

    **Risk of burns due to hot enclosure parts**

    - Wait 30 minutes before disassembling the inverter. This will allow the enclosure to cool down and thus prevent burn injuries.
13. Remove the inverter by lifting it vertically up and off the wall mounting bracket.

## Commissioning the Replacement Device

***NOTICE***

**Damage to seals on the enclosure lids in subfreezing conditions**

If you open the upper and lower enclosure lids when temperatures are below freezing, the enclosure seals can be damaged. This can lead to moisture entering the inverter.

- Do not open the inverter at ambient temperatures lower than -5°C (23°F).
- If a layer of ice has formed on the seal of the lid when temperatures are below freezing, remove it prior to opening the enclosure lids of the inverter (e.g. by melting the ice with warm air). Observe the applicable safety regulations.

***NOTICE***

**Damage to the inverter due to moisture and dust intrusion**

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

- Close all enclosure openings of the inverter tightly.
- Never open the inverter when it is raining or snowing, or the humidity is over 95%.

***NOTICE***

**Damage to the inverter due to electrostatic discharge**

Touching electronic components can cause damage to or destroy the inverter through electrostatic discharge.

- Ground yourself before touching any component.

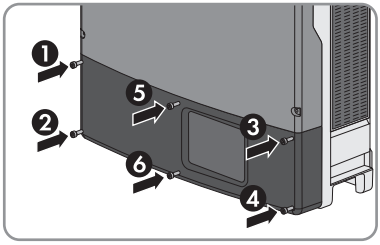
1. Mount the replacement device (see Section 5, page 19) and make the electrical connections (see Section 6, page 25).
2. If needed, install interfaces in the replacement device and connect the interfaces (see the interface manual).
3. If there is a label with "transport lid" affixed to the upper lid of the replacement device, replace the upper enclosure lid of the replacement device with the upper enclosure lid of the defective inverter.

**⚠ DANGER**

**Danger to life due to high voltages**

Wait 20 minutes before removing the upper enclosure lid to allow residual voltages to discharge.

   - Loosen the screws of the upper enclosure lid using an Allen key (AF 4) and remove the enclosure lid.
   - Position the upper enclosure lid with the six screws and conical spring washers on the enclosure and tighten it using an Allen key (AF 4) in the order 1 to 6 (torque: 6 Nm ± 0.3 Nm).
4. Insert the lower enclosure lid from above and flip it down. Use the enclosure lid of the defective inverter for this if there is a label with "transport lid" affixed to the enclosure lid of the replacement device. The screws must protrude from the lower enclosure lid.
5. Tighten all six screws in the lower enclosure lid with an Allen key (AF 3) in the order 1 to 6 (torque: 2 Nm ± 0.3 Nm). By tightening the screws in the prescribed order, you avoid warping the lid, which would keep it from sealing correctly.
   Useful hint: If the screws fall out of the lower enclosure lid, insert the long screw into the lower middle hole and the five short screws into the other holes.

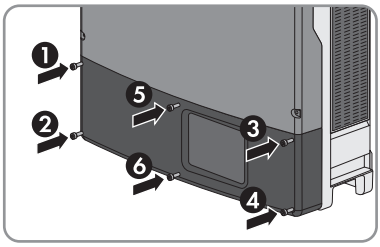



6. Commission the replacement device (see Section 7, page 37). Remount the DC load-break switch of the defective inverter to the replacement device.
7. Configure the replacement device (see Section 8, page 38).
8. Replace the replacement device in the communication product.

## Shipping the Defective Inverter

1. If necessary, position the upper enclosure lid with the six screws and conical spring washers on the enclosure and tighten it using an Allen key (AF 4) in the order 1 to 6 (torque: 6 Nm ± 0.3 Nm).
2. Insert the lower enclosure lid from above and flip it down. The screws must protrude from the lower enclosure lid.

3. Tighten all six screws in the lower enclosure lid with an Allen key (AF 3) in the order 1 to 6 (torque: 2 Nm ± 0.3 Nm). By tightening the screws in the prescribed order, you avoid warping the lid, which would keep it from sealing correctly.
   Useful hint: If the screws fall out of the lower enclosure lid, insert the long screw into the lower middle hole and the five short screws into the other holes.




4. Pack the defective inverter in the packaging of the replacement device and arrange with SMA for it to be picked up.

# 14 Technical Data

## 14.1 DC/AC

### 14.1.1 Sunny Tripower 12000TL-US / 15000TL-US / 20000TL-US

#### DC Input

| | STP 12000TL-US-10 | STP 15000TL-US-10 | STP 20000TL-US-10 |
|---|---|---|---|
| Maximum DC power at cos φ = 1 | 12,250 W | 15,300 W | 20,400 W |
| Maximum input voltage | 1,000 V | 1,000 V | 1,000 V |
| MPP voltage range | 300 V to 800 V | 300 V to 800 V | 380 V to 800 V |
| Rated input voltage | 675 V | 675 V | 695 V |
| Minimum input voltage | 150 V | 150 V | 150 V |
| Initial input voltage | 188 V | 188 V | 188 V |
| Maximum input current input A | 33 A | 33 A | 33 A |
| Maximum input current input B | 33 A | 33 A | 33 A |
| Maximum short-circuit current per string | 43 A | 43 A | 43 A |
| Maximum residual input current | 1,187 $A_{pk}$ | 1,187 $A_{pk}$ | 1,187 $A_{pk}$ |
| Duration of the maximum residual input current | 0.0072 s | 0.0072 s | 0.0072 s |
| Number of independent MPP inputs | 2 | 2 | 2 |
| Strings per MPP input | 1 | 1 | 1 |

#### AC Output

| | STP 12000TL-US-10 | STP 15000TL-US-10 | STP 20000TL-US-10 |
|---|---|---|---|
| Rated power at 277 V, 60 Hz | 12,000 W | 15,000 W | 20,000 W |
| Maximum apparent AC power | 12,000 VA | 15,000 VA | 20,000 VA |
| Rated grid voltage | 480 / 277 WYE | 480 / 277 WYE | 480 V / 277 V WYE |
| AC voltage range | 243.7 V to 304.7 V | 243.7 V to 304.7 V | 243.7 V to 304.7 V |
| Nominal AC current at 277 V | 14.5 A | 18.1 A | 24.1 A |
| Maximum output current | 14.5 A | 18.1 A | 24.1 A |

| | STP 12000TL-US-10 | STP 15000TL-US-10 | STP 20000TL-US-10 |
|---|---|---|---|
| Total harmonic distortion of the output current with total harmonic distortion of the AC voltage < 2%, and AC power > 50% of the rated power | ≤ 3% | ≤ 3% | ≤ 3% |
| Maximum residual output current | 142.5 $A_{pk}$ | 142.5 $A_{pk}$ | 142.5 $A_{pk}$ |
| Duration of the maximum residual output current | 0.0131 s | 0.0131 s | 0.0131 s |
| Line synchronization characteristics / In-rush current | Method 2 | Method 2 | Method 2 |
| Rated power frequency | 60 Hz | 60 Hz | 60 Hz |
| Operating range at AC power frequency 60 Hz | 59.3 Hz to 60.5 Hz | 59.3 Hz to 60.5 Hz | 59.3 Hz to 60.5 Hz |
| Maximum utility backfeed current to utility | – | – | – |
| Limits of accuracy of voltage measurement | 2% | 2% | 2% |
| Limits of accuracy of frequency measurement | ±0.1 Hz | ±0.1 Hz | ±0.1 Hz |
| Limits of accuracy of time measurement at nominal trip time | ±0.1% | ±0.1% | ±0.1% |
| Output power at +60°C (+140°F) | 12,000 W | 15,000 W | 17,000 W |
| Maximum power operating ambient temperature | +45°C (+113°F) | +45°C (+113°F) | +45°C (+113°F) |
| Power factor at rated power | 1 | 1 | 1 |
| Displacement power factor, adjustable | $0_{overexcited}$ to $0_{underexcited}$ | $0_{overexcited}$ to $0_{underexcited}$ | $0_{overexcited}$ to $0_{underexcited}$ |
| Feed-in phases | 3 | 3 | 3 |
| Connection phases | 3 | 3 | 3 |
| Overvoltage category in accordance with UL1741 | IV | IV | IV |

### Efficiency

| | STP 12000TL-US-10 | STP 15000TL-US-10 | STP 20000TL-US-10 |
|---|---|---|---|
| Maximum efficiency, $\eta_{max}$ | 98.2% | 98.2% | 98.5% |
| CEC efficiency, $\eta_{CEC}$ | 97.5% | 97.5% | 97.5% |

## 14.1.2 Sunny Tripower 24000TL-US

### DC Input

| | STP 24000TL-US-10 |
|---|---|
| Maximum DC power at cos φ = 1 | 24,500 W |
| Maximum input voltage | 1,000 V |
| MPP voltage range | 450 V to 800 V |
| Rated input voltage | 712 V |
| Minimum input voltage | 150 V |
| Initial input voltage | 188 V |
| Maximum input current input A | 33 A |
| Maximum input current input B | 33 A |
| Maximum short-circuit current per string | 43 A |
| Maximum residual input current | 1,187 $A_{pk}$ |
| Duration of the maximum residual input current | 0.0072 s |
| Number of independent MPP inputs | 2 |
| Strings per MPP input | 1 |

### AC Output

| | STP 24000TL-US-10 |
|---|---|
| Rated power at 277 V, 60 Hz | 24,000 W |
| Maximum apparent AC power | 24,000 VA |
| Rated grid voltage | 480 V / 277 V WYE |
| AC voltage range | 243.7 V to 304.7 V |
| Nominal AC current at 277 V | 29 A |
| Maximum output current | 29 A |
| Total harmonic distortion of the output current with total harmonic distortion of the AC voltage < 2%, and AC power > 50% of the rated power | ≤ 3% |

| | STP 24000TL-US-10 |
|---|---|
| Maximum residual output current | 142.5 $A_{pk}$ |
| Duration of the maximum residual output current | 0.0131 s |
| Line synchronization characteristics / In-rush current | Method 2 |
| Rated power frequency | 60 Hz |
| Operating range at AC power frequency 60 Hz | 59.3 Hz to 60.5 Hz |
| Maximum utility backfeed current to utility | – |
| Limits of accuracy of voltage measurement | 2% |
| Limits of accuracy of frequency measurement | ±0.1 Hz |
| Limits of accuracy of time measurement at nominal trip time | ±0.1% |
| Output power at +60°C (+140°F) | 17,000 W |
| Maximum power operating ambient temperature | +45°C (+113°F) |
| Power factor at rated power | 1 |
| Displacement power factor, adjustable | $0_{overexcited}$ to $0_{underexcited}$ |
| Feed-in phases | 3 |
| Connection phases | 3 |
| Overvoltage category in accordance with UL1741 | IV |

### Efficiency

| | STP 24000TL-US-10 |
|---|---|
| Maximum efficiency, $\eta_{max}$ | 98.5% |
| CEC efficiency, $\eta_{CEC}$ | 98.0% |

## 14.2 General Data

| | |
|---|---|
| Width x height x depth | 665 mm x 650 mm x 265 mm (26.18 in x 25.59 in x 10.43 in) |
| Weight | 55 kg (121 lb) |
| Length x width x height of the packaging | 780 mm x 380 mm x 790 mm (30.71 in x 14.96 in x 31.10 in) |
| Transport weight | 61 kg (134.5 lb) |
| Operating temperature range | –25°C to +60°C (–13°F to +140°F) |

| | |
|---|---|
| Storage temperature | −40°C to +60°C<br>(−40°F to +140°F) |
| Maximum permissible value for relative humidity, non-condensing | 100% |
| Maximum operating altitude above mean sea level | 2,000 m (6,562 ft) |
| Typical noise emission | ≤ 51 dB(A) |
| Power loss in night mode | < 1.8 W |
| Maximum data volume per inverter with Speedwire/Webconnect | 550 MB/month |
| Additional data volume when using the Sunny Portal live interface | 600 kB/hour |
| Topology | Transformerless |
| Cooling method | OptiCool: temperature-controlled fan |
| Enclosure type rating in accordance with UL50 | Type 3R |
| Protection class | I |
| Grid configurations | 480 V / 277 V WYE |
| Approvals and national standards, as per 05/2013 | UL1741<br>CAN/CSA C22.2 No. 107.1-01 |

## 14.3 Protective Devices

| | |
|---|---|
| DC reverse polarity protection | Short-circuit diode |
| AC short-circuit current capability | Current control |
| Grid monitoring | SMA Grid Guard 3 |
| Maximum permissible fuse protection | 50 A |
| Ground-fault monitoring STP 12000TL-US-10 | Insulation monitoring: $R_{iso}$ > 417 kΩ |
| Ground-fault monitoring STP 15000TL-US-10 | Insulation monitoring: $R_{iso}$ > 333 kΩ |
| Ground-fault monitoring STP 20000TL-US-10 | Insulation monitoring: $R_{iso}$ > 250 kΩ |
| Ground-fault monitoring STP 24000TL-US-10 | Insulation monitoring: $R_{iso}$ > 208 kΩ |
| All-pole sensitive residual-current monitoring unit | Available |
| Arc fault detection AFCI, type 1, listed according to UL1699B | Available |

## 14.4 Climatic Conditions

| | |
|---|---|
| Extended temperature range | −25°C to +60°C<br>(−13°F to +140°F) |
| Extended humidity range | 0% to 100% |
| Extended air pressure range | 79.5 kPa to 106 kPa |

## 14.5 Equipment

| | |
|---|---|
| DC connection | Screw terminals |
| AC connection | Spring-cage terminal |
| SMA Webconnect Data Module | RJ45, as standard |

## 14.6 Torques

| | |
|---|---|
| Upper enclosure lid screws | 6.0 Nm (53 in-lb) |
| Lower enclosure lid screws | 2.0 Nm (17.7 in-lb) |
| Screws for DC protective cover | 3.5 Nm (31 in-lb) |
| Screw for grounding | 5,8 Nm (51 in-lb) |
| Screw terminal DC input | 5.0 Nm (44 in-lb) |

## 14.7 Data Storage Capacity

| | |
|---|---|
| Energy yields in the course of the day | 63 days |
| Daily yields | 30 years |
| Event messages for users | 250 events |
| Event messages for installers | 250 events |

# 15 Spare Parts and Accessories

You will find the corresponding accessories and spare parts for your product in the following overview. If required, these can be ordered from SMA or your distributor.

| Designation | Brief description | SMA order number |
|---|---|---|
| RS485 data module | Retrofit kit RS485 communication interface | DM-485CB-US-10 |
| SMA Connection Unit 1000-US | String-Combiner with DC load-break switch for connecting eight strings, up to 1,000 V | CU1000-US-10 |
| Ventilation grid | Ventilation grid set (right and left) as spare part | 45-10899080 |

# 16 Compliance Information

## FCC Compliance

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

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The user is cautioned that changes or modifications not expressly approved by SMA America, LLC could void the user's authority to operate this equipment.

## IC Compliance

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

# 17 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:

- Inverter device type
- Inverter serial number
- Inverter firmware version
- Special country-specific settings of the inverter (if applicable)
- Type and quantity of PV modules connected
- Mounting location and altitude of the inverter
- Inverter message
- Optional equipment, e.g. communication products

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

SMA Solar Technology

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