



SUNNY HIGHPOWER PEAK3

SHP 125-US-21 / SHP 150-US-21 / SHP 165-US-41 / SHP 172-US-21 / SHP FLEX-US-21

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1 Information on this Document

1.1 Validity

This document is valid for:

- SHP 125-US-21 (Sunny Highpower PEAK3-US 125)
- SHP 150-US-21 (Sunny Highpower PEAK3-US 150)
- SHP 165-US-21 (Sunny Highpower PEAK3-US 165)
- SHP 172-US-21 (Sunny Highpower PEAK3-US 172)
- SHP FLEX-US-21 (Sunny Highpower FLEX-US)

1.2 Target Group

This document is intended for qualified persons and end users. Only qualified persons are allowed to perform the activities marked in this document with a warning symbol and the caption "Qualified person". Tasks that do not require any particular qualification are not marked and can also be performed by end users. Qualified persons must have the following skills:

- Knowledge of how to safely disconnect SMA inverters
- Knowledge of how an inverter works and is operated
- Training in how to deal with the dangers and risks associated with installing, repairing and using electrical devices and installations
- Training in the installation and commissioning of electrical devices and installations
- Knowledge of all applicable laws, standards and directives
- Knowledge of and compliance with this document and all safety information

1.3 Content and Structure of this Document

This document describes the mounting, installation, commissioning, configuration, operation, troubleshooting and decommissioning of the product as well as the operation of the product user interface.

You will find the latest version of this document and further information on the product in PDF format and as eManual at www.SMA-Solar.com. You can also call up the eManual via the user interface of the product.

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

1.4 Levels of warning messages

The following levels of warning messages may occur when handling the product.

DANGER

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

WARNING

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




CAUTION

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

NOTICE

Indicates a situation which, if not avoided, can result in property damage.

1.5 Symbols in the Document

Icon	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
<input type="checkbox"/>	Indicates a requirement for meeting a specific goal
<input checked="" type="checkbox"/>	Required result
	Example
 QUALIFIED PERSON	Sections describing activities to be performed by qualified persons only

1.6 Typographical Elements in the Document

Typographical element	Use	Example
bold	<ul style="list-style-type: none"> Messages Terminals Elements on a user interface Elements to be selected Elements to be entered 	<ul style="list-style-type: none"> Connect the insulated conductors to the terminals X703:1 to X703:6. Enter 10 in the field Minutes.
>	<ul style="list-style-type: none"> Connects several elements to be selected 	<ul style="list-style-type: none"> Go to Settings > Date.
[Button] [Key]	<ul style="list-style-type: none"> Button or key to be clicked on or pressed down 	<ul style="list-style-type: none"> Select [Enter].
#	<ul style="list-style-type: none"> Placeholder for variable components (e.g., parameter names) 	<ul style="list-style-type: none"> Parameter WCtHz.Hz#

1.7 Designations in the Document

Complete designation	Designation in this document
Sunny Highpower PEAK3	Sunny Highpower, inverter, product

1.8 Additional Information

For more information, please go to www.SMA-Solar.com.

Title and information content	Type of information
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information
"SMA GRID GUARD 10.0 - Grid Management Services via Inverter and System Controller"	Technical Information
"Efficiency and Derating" Efficiency and derating behavior of the SMA inverters	Technical Information
"Parameters and Measured Values" Overview of all inverter operating parameters and their configuration options	Technical Information

Title and information content	Type of information
"SMA MODBUS" Information on the SMA Modbus interface as well as an overview of all SMA Modbus registers	Technical Information
"SUNSPEC MODBUS" Information on the activation of the SunSpec Modbus interface and information on the SunSpec Modbus profiles	Technical Information
"SMA SPEEDWIRE FIELDBUS"	Technical information
"Important Requirements for Medium-Voltage Transformers" Requirements for Medium-Voltage Transformers	Technical Information

2 Safety

2.1 Intended Use

The Sunny Highpower is a transformerless PV inverter. It converts the direct current from the PV modules into grid-compliant three-phase current and feeds it into the utility grid via a separate transformer.

The product is intended for use in commercial, industrial or business sectors.

The product is suitable for operation in a chemically active environment in accordance with IEC 60721-3-4 as per Class 4C2.

The product is suitable for indoor and outdoor use.

When used indoors, the ventilation system at the installation site must be able to dissipate the power loss that occurs.

The product must only be operated with PV modules of protection class II in accordance with IEC 61730, application class A. The PV modules must be compatible with this product.

The product may only be operated in connection with a suitable medium-voltage transformer. The low-voltage side must be configured in a star formation and the neutral point must be grounded (for information about the requirements of the medium-voltage transformer, consult the technical information "Important Requirements for Medium-Voltage Transformers" under www.SMA-Solar.com).

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

Use SMA products only in accordance with the information provided in the enclosed documentation and with the locally applicable laws, regulations, standards and directives. Any other application may cause personal injury or property damage.

Alterations to SMA products, e.g., changes or modifications, are only permitted with the express written permission of and according to the instructions from SMA Solar Technology AG. Unauthorized alterations can be dangerous and lead to personal injury. In addition, an unauthorized alteration will void guarantee and warranty claims and in most cases terminate the operating license. SMA Solar Technology AG 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, dry place for future reference and observe all instructions contained therein.

This document does not replace any regional, state, provincial, federal or national laws, regulations or standards that apply to the installation, electrical safety and use of the product. SMA Solar Technology AG assumes no responsibility for the compliance or non-compliance with such laws or codes in connection with the installation of the product.

The type label must remain permanently attached to the product.

2.2 IMPORTANT SAFETY INSTRUCTIONS

Keep the manual for future reference.

This section contains safety information that must be observed at all times when working.

The product has been designed and tested in accordance with international safety requirements. As with all electrical or electronical devices, there are residual risks despite careful construction. 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 electric shock when live components or DC cables are touched

When exposed to light, the PV modules generate high DC voltage which is present in the DC cables. Touching live DC cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Install external DC load-break switch (e.g., a PV junction box including a load-break switch) between the inverter and PV array.
- Disconnect the PV array from the inverter via an external DC load-break switch (e.g. via a PV junction including a load-break switch). Switch off and secure the DC load-break switch against reconnection.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Wear suitable personal protective equipment for all work on the product.

DANGER

Danger to life due to electric shock from touching an ungrounded PV module or array frame

Touching ungrounded PV modules or array frames results in death or lethal injuries due to electric shock.

- Connect and ground the frame of the PV modules, the array frame and the electrically conductive surfaces so that there is continuous conduction. Observe the applicable local regulations.

DANGER

Danger to life due to electric shock when touching live system components in case of a ground fault

If a ground fault occurs, parts of the system may still be live. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Only touch the cables of the PV modules on their insulation.
- 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.
- Ensure that no voltage is present and wait 5 minutes before touching any parts of the PV system or the product.

⚠ DANGER**Danger to life due to electric shock in case of overvoltages and if surge protection is missing**

Overvoltages (e. g. in the event of a flash of lightning) can be further conducted into the building and to other connected devices in the same network via the network cables or other data cables if there is no surge protection. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Ensure that all devices in the same network are integrated in the existing overvoltage protection.
- When laying the network cable outdoors, ensure that there is suitable surge protection at the network cable transition from the product outdoors to the network inside the building.
- The Ethernet interface of the product is classified as "TNV-1" and offers protection against overvoltages of up to 1.5 kV.

⚠ WARNING**Danger to life due to fire and explosion**

In rare cases, an explosive gas mixture can be generated inside the product under fault conditions. In this state, switching operations can cause a fire inside the product or explosion. Death or lethal injuries due to hot or flying debris can result.

- In the event of a fault, do not perform any direct actions on the product.
- Ensure that unauthorized persons have no access to the product.
- Disconnect the PV array from the inverter via an external disconnection device. If there is no disconnecting device present, wait until no more DC power is applied to the inverter.
- Disconnect the AC circuit breaker, or keep it disconnected in case it has already tripped, and secure it against reconnection.
- Only perform work on the product (e.g., troubleshooting, repair work) when wearing personal protective equipment for handling of hazardous substances (e.g., safety gloves, eye and face protection, respiratory protection).

⚠ WARNING**Risk of injury due to toxic substances, gases and dusts.**

In rare cases, damages to electronic components can result in the formation of toxic substances, gases or dusts inside the product. Touching toxic substances and inhaling toxic gases and dusts can cause skin irritation, burns or poisoning, trouble breathing and nausea.

- Only perform work on the product (e.g., troubleshooting, repair work) when wearing personal protective equipment for handling of hazardous substances (e.g., safety gloves, eye and face protection, respiratory protection).
- Ensure that unauthorized persons have no access to the product.

⚠ WARNING**Danger to life due to fire when failing to observe torque specifications on live bolted connections**

Failure to follow the specified torques reduces the ampacity of live bolted connections and the contact resistances increase. This can cause components to overheat and catch fire. Death or lethal injuries can result.

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

⚠ WARNING**Danger to life due to electric shock from destruction of the measuring device due to overvoltage**

Overvoltage can damage a measuring device and result in voltage being present in the enclosure of the measuring device. Touching the live enclosure of the measuring device results in death or lethal injuries due to electric shock.

- Only use measuring devices with a measurement ranges designed for the maximum AC and DC voltage of the inverter.

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

Some parts of the enclosure can get hot during operation. Touching hot enclosure parts can result in burn injuries.

- During operation, do not touch any parts other than the enclosure lid of the inverter.
- Wait until the inverter has cooled down before touching the enclosure.

⚠ CAUTION**Risk of injury due to weight of product**

Injuries may result if the product is lifted incorrectly or dropped while being transported or mounted.

- Transport and lift the product carefully. Take the weight of the product into account.
- Wear suitable personal protective equipment for all work on the product.
- Transport the product using the carrying handles or hoist. Take the weight of the product into account.
- Use all carrying handles provided during transport with carrying handles.
- Do not use the carrying handles as attachment points for hoist equipment (e.g. straps, ropes, chains). Insert eye bolts into threads provided on top of the product to attach the hoist system.

NOTICE**Damage to the enclosure seal in subfreezing conditions**

If you open the product when temperatures are below freezing, the enclosure seals can be damaged. Moisture can penetrate the product and damage it.

- Only open the product if the ambient temperature is not below -5°C (23°F).
- If a layer of ice has formed on the enclosure seal when temperatures are below freezing, remove it prior to opening the product (e.g. by melting the ice with warm air).

NOTICE**Damage to the product due to sand, dust and moisture ingress**

Sand, dust and moisture penetration can damage the product and impair its functionality.

- Only open the product if the humidity is within the thresholds and the environment is free of sand and dust.
- Do not open the product during a dust storm or precipitation.
- Close tightly all enclosure openings.

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 switching operations on the transformer**

If voltages are present in the inverter, switching operations on the transformer can lead to large fluctuations in the voltage in the inverter. Large fluctuations in voltage can damage components in the inverter.

- Disconnect the inverter from voltage sources before performing any switching operations on the transformer.

NOTICE**Damage to the product due to cleaning agents**

The use of cleaning agents may cause damage to the product and its components.

- Clean the product and all its components only with a cloth moistened with clear water.

i The country data set must be set correctly.

If you select a country data set which is not valid for your country and purpose, it can cause a disturbance in the PV system and lead to problems with the grid operator. When selecting the country data set, you must always observe the locally applicable standards and directives as well as the properties of the PV system (e.g. PV system size, grid-connection point).

- If you are not sure which standards and directives are valid for your country or purpose, contact the grid operator.

i When the utility grid is disconnected, the parameter settings are not applied

If you have made parameter settings and subsequently disconnected the utility grid without having first disconnected the DC side from the inverter, the settings cannot be saved. Proceed as follows if you would like to disconnect the utility grid after you have made parameter settings:

- Disconnect the DC side from the inverter.
- Wait 5 minutes.
- Disconnect the utility grid.

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.

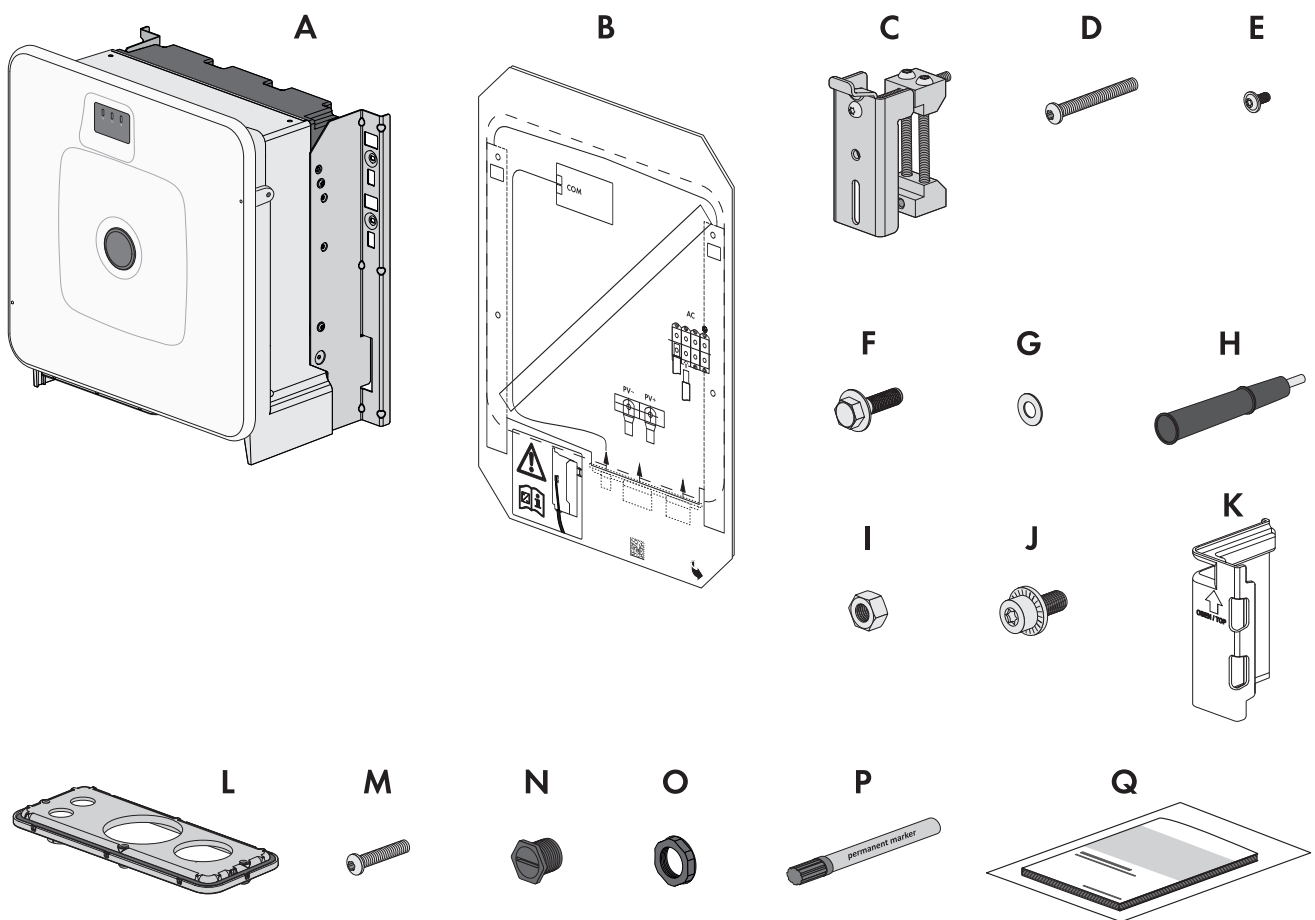


Figure 1: Components included in scope of delivery

Position	Quantity	Designation
A	1	Inverters
B	1	Mounting template
C	2	Mounting bracket
D	2	Button head screw M8x105
E	2	Button head screw M8x16
F	2	M10x40 combination hexagon head screw
G	2	Washer M10
H	4	Carry handle
I	2	Hex nut M10
J	2	M6x16 combined screw
K	4	Touch protection for DC connection

Position	Quantity	Designation
L	1	Connecting plate
M	3	Button head screw M8x70
N	1	Sealing plug (21 mm (0.75 in))
O	1	Counter nut for sealing plug (21 mm (0.75 in))
P	1	Permanent marker (only included with SHP FLEX-US-21)
Q	1	Quick reference guide, production test report, supplementary sheet with the default settings

4 Additionally Required Materials and Equipment

Material or equipment	Quantity	Explanation
Profile rail (length: min. 770 mm (30.3 in), depth: 40 mm to 60 mm (1.6 in to 2.4 in), height: 50 mm to 83 mm (1.5 in to 2.4 in))	2	For mounting the product
Conduit (trade size: 76.2 mm (3 in) or smaller with suitable reducer bush) for the DC connection	1	Only necessary if DC cables must be laid in one conduit
Rain-tight conduit fitting or conduit fitting for wet locations (trade size: 76.2 mm (3 in) or smaller with suitable reducer bush) for DC connection	1	Only necessary if DC cables must be laid in one conduit
Conduit (trade size: 63.5 mm (2.5 in) or smaller with suitable reducer bush) for AC connection	1	Only necessary if AC cables must be laid in one conduit
Rain-tight conduit fitting or conduit fitting for wet locations (trade size: 63.5 mm (2.5 in) or smaller with suitable reducer bush) for AC connection	1	Only necessary if AC cables must be laid in one conduit
Conduit (trade size: 19.05 mm (0.75 in) or smaller with suitable reducer bush) for network connection	1	Only necessary if network cables must be laid in one conduit
Rain-tight conduit fitting or conduit fitting for wet locations (trade size: 19.05 mm (0.75 in) or smaller with suitable reducer bush) for network connection	1	Only necessary if network cables must be laid in one conduit
Terminal lugs (flange hole: M10)	2	Used for positive and negative DC cable
Terminal lugs (flange hole: M6)	1	Used for equipment grounding conductor
Field-assembly RJ45 connector with metal enclosure	1-2	Only required if the network cables are not equipped with RJ45 plugs
Means of transport (e.g. pallet truck)	1	Used to transport packed product to mounting location

Material or equipment	Quantity	Explanation
Eye bolt (M10)	2	Only required if the product is to be transported with a hoist
Hoist	1	Only required if the product is to be transported with a hoist
Utility knife	1	Used to unpack the product
Torx screwdriver (TX25)	1	Used to attach and remove transport handles
Torx screwdriver (TX40)	1	Used to attach mounting brackets, inverters to mounting brackets, connecting plate to inverter; used to connect equipment grounding conductor of PV array
Allen key (AF5)	1	Used for connecting grounding conductor
Allen key (AF8)	1	To attach and remove the enclosure lid and to connect L1, L2 and L3
Allen key (AF16)	1	To connect the DC cables
Measuring device with a measurement range designed for the maximum AC and DC voltage of the inverter	1	For verifying that no voltage is present
Current clamp	1	For verifying that no voltage is present
Press tool	1	Used to attach terminal lugs to DC cables
Clean cloth	1	Used to clean terminal lugs
Ethanol cleaning agent	1	Used to clean terminal lugs
Brush	1	Used to clean aluminum conductor (only necessary if cable is made of aluminum)
Protective grease	1	Used to apply to aluminum conductor (only necessary if cable is made of aluminum)

5 Product Overview

5.1 Product Description

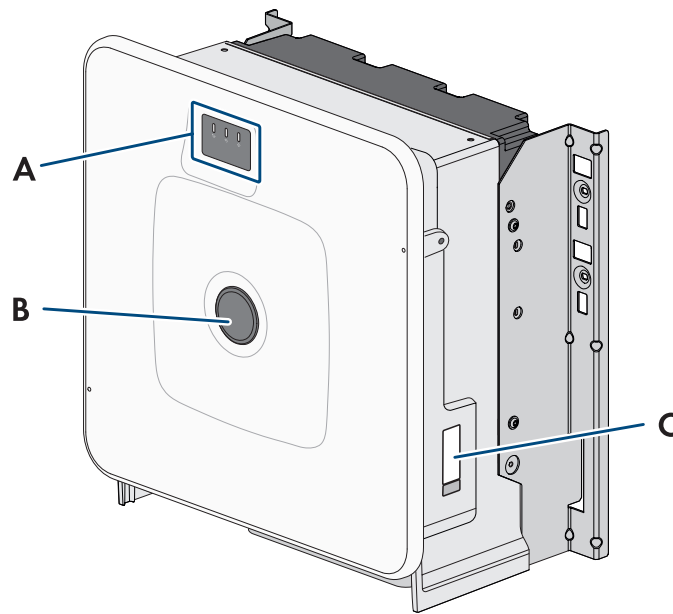










Figure 2: Design of the product

Position	Designation
A	LEDs The LEDs indicate the operating state of the product.
B	Cover
C	Type label The type label clearly identifies the product. The type label must remain permanently attached to the product. You will find the following information on the type label: <ul style="list-style-type: none"> • Device type (Model) • Serial number (Serial No. or S/N) • Date of manufacture • Device-specific characteristics

5.2 Symbols on the Product

Icon	Explanation
	Beware of electrical voltage The product operates at high voltages.
	Beware of hot surface The product can get hot during operation.

Icon	Explanation
	Observe the documentations Observe all documentations supplied with the product.
	Inverter Together with the green LED, this symbol indicates the operating state of the inverter.
	Observe the documentations Together with the red LED, this symbol indicates an error.
	Data transmission Together with the blue LED, this symbol indicates the status of the network connection.
	FCC designation The product complies with the requirements of the applicable FCC standards.
	UL 62109-1 and CAN/CSA-C22.2 No. 62109-1:16 are the standards applied by Underwriters Laboratories to the product to certify that it meets the requirements of the <i>National Electrical Code</i> [®] , the <i>Canadian Electrical Code</i> [®] and IEEE 1547.

5.3 Interfaces and Functions

5.3.1 User Interface

The product is equipped as standard with an integrated webserver, which provides a user interface for configuring and monitoring the product.

Once the connection has been established to the smart device, use a terminal (e.g. smartphone, tablet or laptop) to connect to the product's user interface using a web browser.

5.3.2 Smart Inverter Screen

The Smart Inverter Screen enables you to view the status display and to display the current power and consumption on the user interface login page. This gives you an overview of the most important product data without having to log into the user interface.

The Smart Inverter Screen is deactivated by default. The Smart Inverter Screen can be activated via the user interface once the product has been commissioned.

5.3.3 SMA Speedwire

The product is equipped with SMA Speedwire as standard. SMA Speedwire is a type of communication based on the Ethernet standard. SMA Speedwire is designed for a data transfer rate of 100 Mbps and enables optimum communication between Speedwire devices within systems.

The products supports the encrypted system communication with SMA Speedwire Encrypted Communication. In order to be able to use the Speedwire encryption in the system, all Speedwire devices, except for the energy meter (e.g. SMA Energy Meter) must support the function SMA Speedwire Encrypted Communication.

5.3.4 Modbus

The product is equipped with a Modbus interface. The Modbus interface is deactivated by default and must be configured as needed.

The Modbus interface of the supported SMA products is designed for industrial use – via SCADA systems, for example – and has the following tasks:

- Remote query of measured values

- Remote setting of operating parameters
- Setpoint specifications for system control

5.3.5 Grid Management Services

For connecting the inverter to the utility grid, no additional grid monitoring equipment is necessary. A description of the tested functions and instructions on the activation and setting of functions can be found in the technical information "Grid Support Utility Interactive Inverters" at www.SMA-Solar.com.

5.3.6 SMA Smart Connected

SMA Smart Connected is the free monitoring of the product via the SMA Sunny Portal. Thanks to SMA Smart Connected, the operator and qualified person will be informed automatically and proactively about product events that occur.

SMA Smart Connected is activated during registration in Sunny Portal. In order to use SMA Smart Connected, it is necessary that the product is permanently connected to Sunny Portal and the data of the operator and qualified person is stored in Sunny Portal and up-to-date.

5.3.7 SMA PUK2.0

SMA PUK2.0 replaces for products with firmware version $\geq 4.00.00.R$ the previous procedure for logging in to the user interface if you have forgotten the password for your product. Whether your product supports PUK2.0 is shown on the login page of the user interface via the information button.

To improve security for your product, SMA Solar Technology AG recommends generating a product key. With the product key, the product can be unlocked directly on the user interface and does not require a chargeable order of a PUK via SMA Solar Technology AG. If you have lost the product key, you can generate a new one by physically accessing the product.

5.4 LED Signals

The LEDs indicate the operating state of the product.

LED signal	Explanation
The green LED is flashing (2 s on and 2 s off)	Waiting for feed-in conditions The conditions for feed-in operation are not yet met. As soon as the conditions are met, the product will start feed-in operation.
The green LED flashes quickly	Update of central processing unit The central processing unit of the product is being updated.
The green LED is glowing	Feed-in operation The product feeds in with a power of at least 90%.
The green LED is pulsing	Feed-in operation The product is equipped with a dynamic power display via the green LED. Depending on the power, the green LED pulses fast or slow. If necessary, you can switch off the dynamic power display via the green LED.
The green LED is off	The product is not feeding into the utility grid.
The red LED is glowing	Event occurred If an event occurs, a distinct event message and the corresponding event number will be displayed in addition on the product user interface or in the communication product (e.g. SMA Data Manager).

LED signal	Explanation
The blue LED flashes slowly for approx. 1 minute	Communication connection is being established The product is establishing a connection to a local network or is establishing a direct connection to a smart device via Ethernet (e.g. smartphone, tablet or laptop).
The blue LED is glowing	Communication active There is an active connection with a local network or there is a direct connection via Ethernet with a smart end device (e.g. smartphone, tablet or laptop).

Also see:

- [Dynamic power display \(green LED\) ⇒ page 53](#)

6 Mounting and Preparing the Connection

6.1 Requirements for Mounting

6.1.1 Requirements for the Mounting Location

WARNING

Danger to life due to fire or explosion

Despite careful construction, electrical devices can cause fires. This can result in death or serious injury.

- Do not mount the product in areas containing highly flammable materials or gases.
- Do not mount the product in potentially explosive atmospheres.

- Do not mount the inverter in living areas
- The installation site can be exposed to direct solar irradiation. There is, however, the possibility that the product reduces its power output to avoid overheating due to high temperatures.
- All ambient conditions must be met.
- At least 2 profile rails must be available for mounting.
- The support surface of the frame to which the profile rails are attached should be firm and level (e.g. concrete). Non-fulfillment of these criteria may restrict servicing.

6.1.2 Requirements for the profile rails

- The profile rails must be designed for the load capacity and orientation of the products in the system. The profile rails might need to be reinforced.
- The spacing of the profile rails must be designed for the spacing of the holes in the bracket parts for the mounting bracket.
- The profile rails must be designed for the clamping range of the mounting bracket.

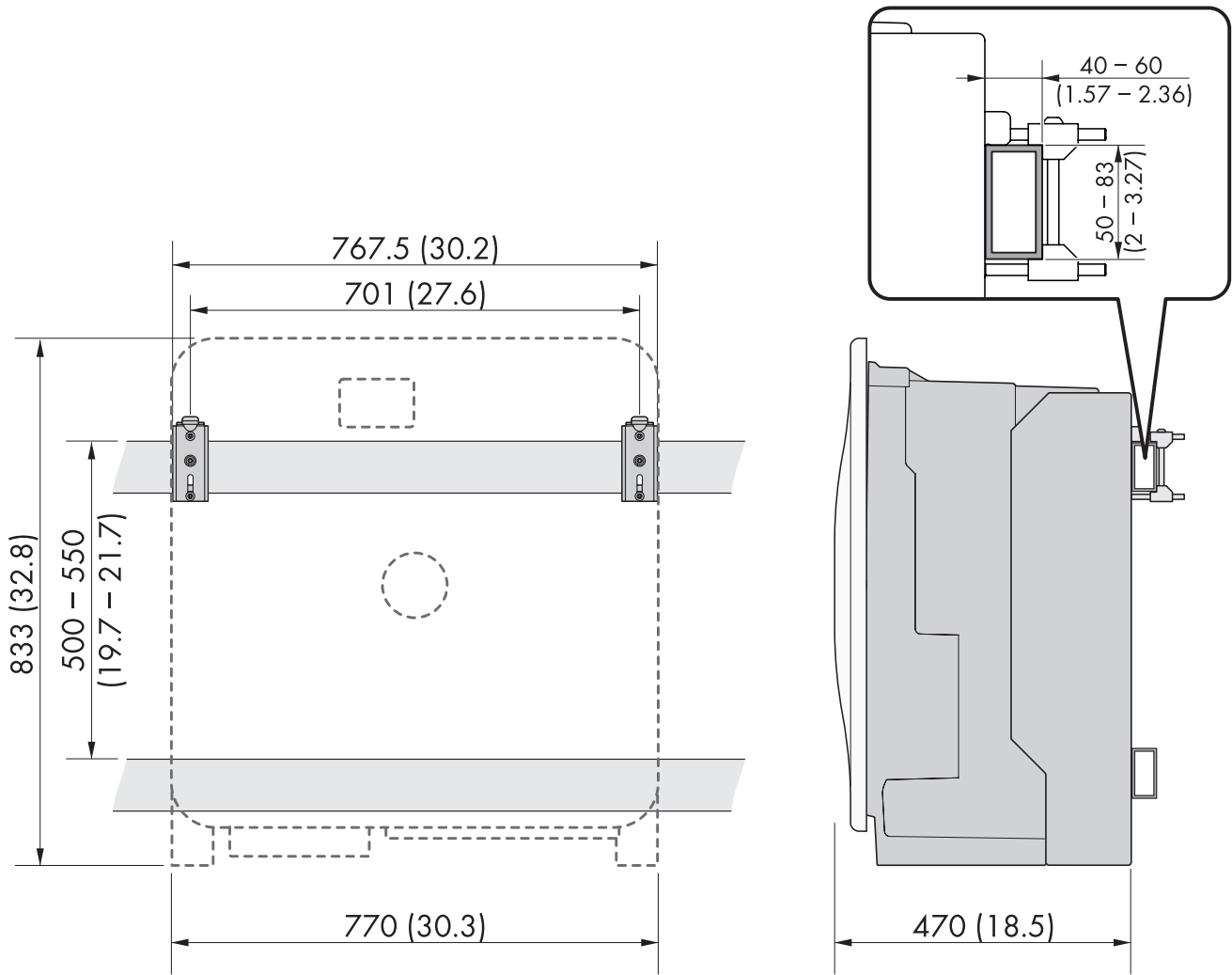


Figure 3: Dimensions of the profile rails and the clamping range of the mounting bracket (dimensions in mm (in))

6.1.3 Permitted and prohibited mounting positions

- The product may only be mounted in a permitted position. This will ensure that no moisture can penetrate the product.
- The product should be mounted such that the LED signals can be read off without difficulty.

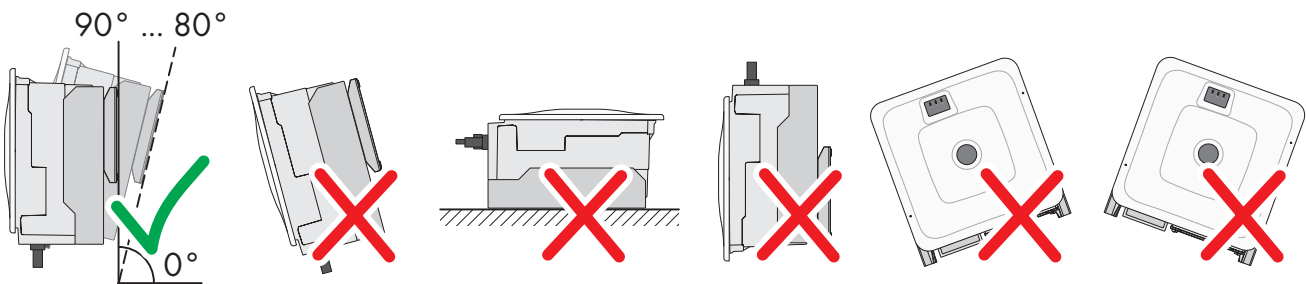


Figure 4: Permitted and prohibited mounting positions

6.1.4 Recommended clearances for mounting

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.

i Prescribed clearances in accordance with the **National Electrical Code®** or **Canadian Electrical Code® CSA C22.1**

Under certain conditions, the *National Electrical Code®* or the *Canadian Electrical Code®* CSA C22.1 specify greater clearances.

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

□ Recommended distances to walls, other devices and objects should be maintained.

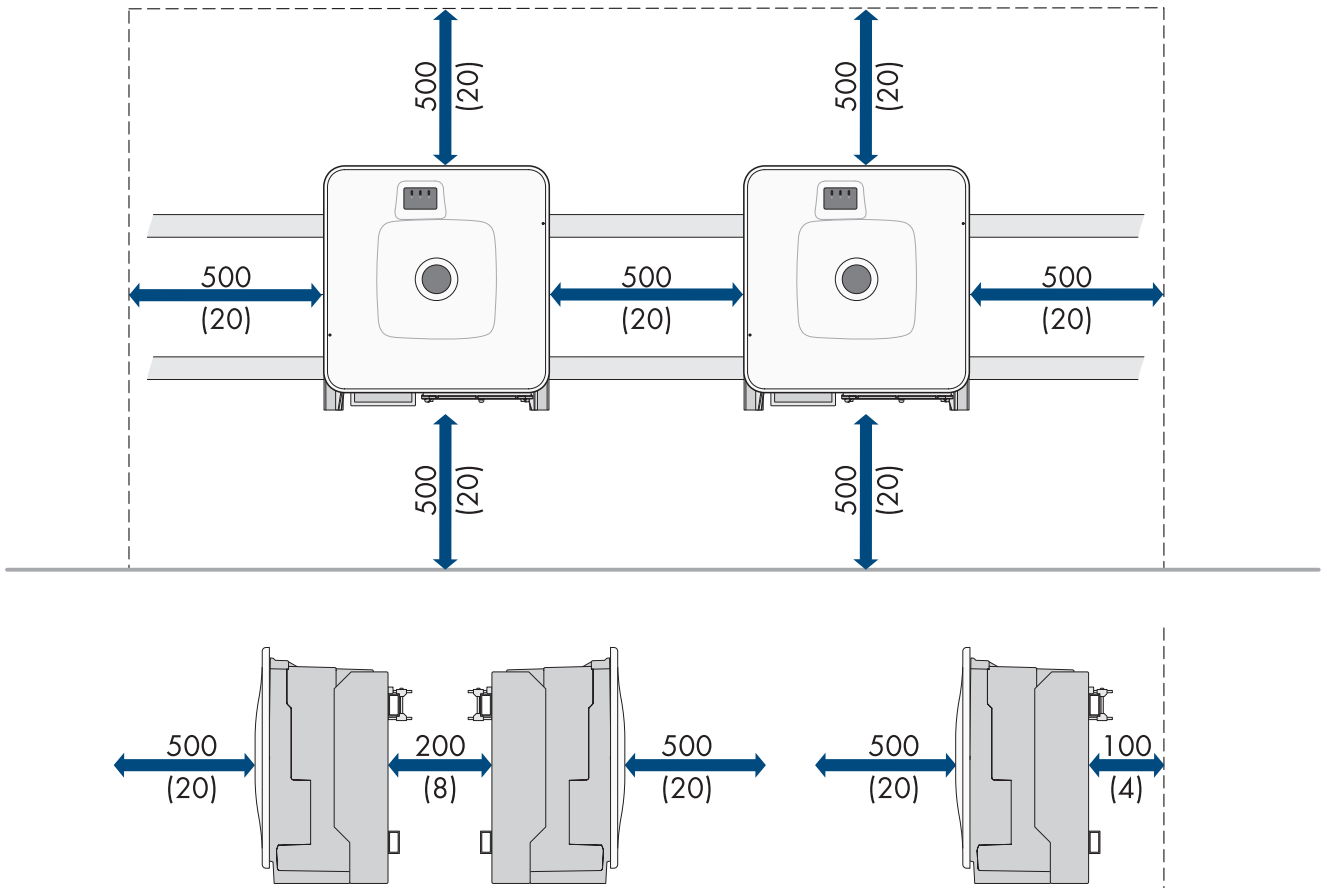


Figure 5: Recommended clearances (dimensions in mm (in))

6.2 Overview of Connecting Plate

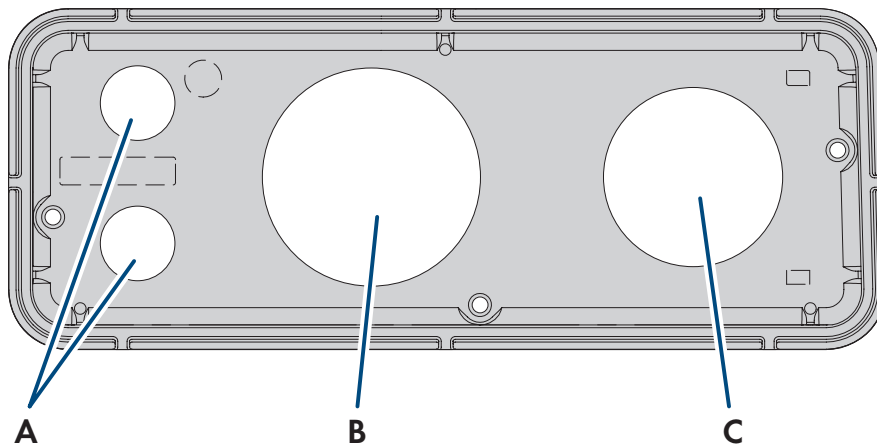


Figure 6: Overview of the connecting plate (included in the scope of delivery)

Position	Designation
A	Entry for the network cables (for 19.05 mm (0.75 in) trade size conduits)
B	Entry for the DC cables (for 76.2 mm (3 in) trade size conduits)
C	Entry for the AC cables (for 63.5 mm (2.5 in) trade size conduits)

6.3 Center of gravity

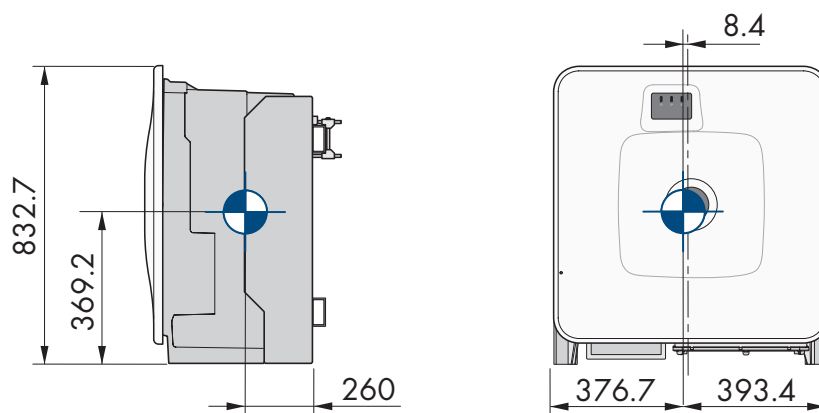


Figure 7: Dimensions of the center of gravity of the product (dimensions in mm (in))

6.4 Preparing for mounting and connection

⚠ QUALIFIED PERSON

⚠ DANGER

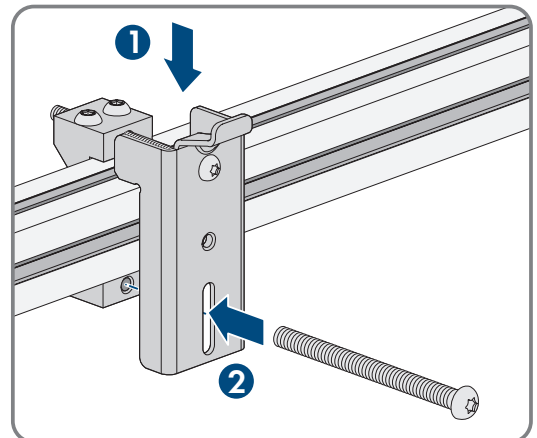
Danger to life due to electric shock when live cables are touched

High voltages are present on the AC and DC cables. Touching live cables results in death or lethal injuries due to electric shock.

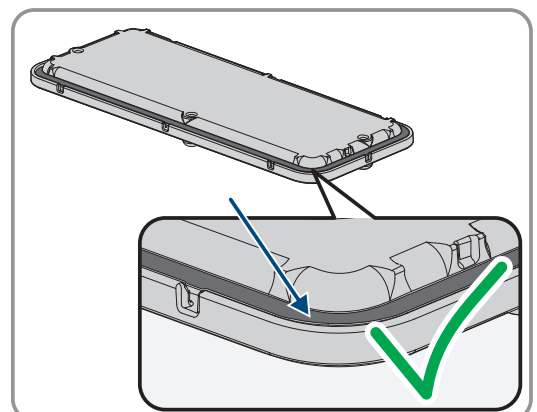
- Do not touch non-insulated parts or cables.
- Disconnect the AC circuit breaker and secure it against reconnection.
- Disconnect the PV array from the inverter via an external DC load-break switch (e.g. via a PV junction including a load-break switch). Switch off and secure the DC load-break switch against reconnection.
- Ensure that all cables to be connected are de-energized.
- Wear suitable personal protective equipment for all work on the product.

Procedure:

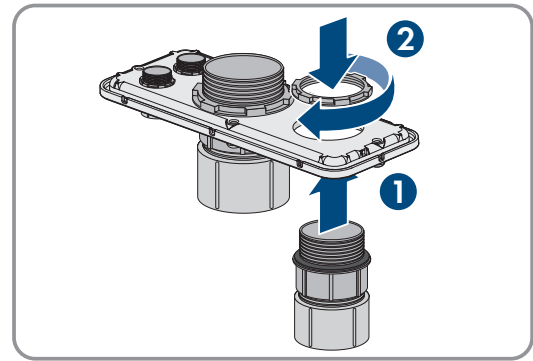
1. Mark the position for the mounting brackets.
2. Hook each mounting bracket onto the profile rail and insert the screw (M8x105).



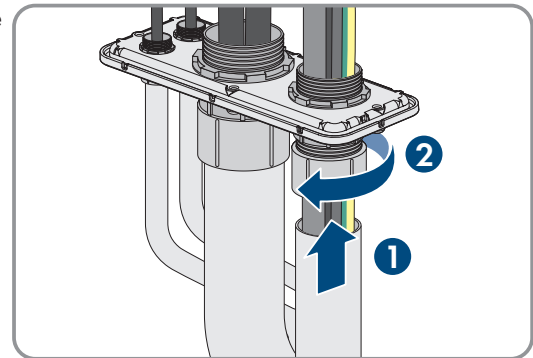
3. Fasten all four screws of each mounting bracket hand-tight (TX40).
4. Ensure the correct position of the mounting brackets by hooking in the mounting template. If the position is incorrect, move the mounting brackets to the correct position.
5. Tighten all four screws of each mounting bracket (TX40, torque: 12 Nm \pm 2 Nm (106 in-lb \pm 17.7 in-lb)).
6. Clip the mounting template into the mounting brackets.
7. Align the cable conduits by means of the mounting template and shorten if necessary. Take the product depth of 400 mm (15.8 in) into account.
8. Ensure on the connection plate that the seal is present and undamaged.



9. Attach the conduit fittings for attachment of the conduits to the connecting plate.



10. Lead the cables through the conduit fittings in the connecting plate and align the connecting plate using the mounting template.



11. Remove the mounting template.
12. Mount the product .

Also see:

- Permitted and prohibited mounting positions ⇒ page 20
- Recommended clearances for mounting ⇒ page 20
- Center of gravity ⇒ page 22

6.5 Mount the product.

⚠ QUALIFIED PERSON

⚠ DANGER

Danger to life due to electric shock when live cables are touched

High voltages are present on the AC and DC cables. Touching live cables results in death or lethal injuries due to electric shock.

- Do not touch non-insulated parts or cables.
- Disconnect the AC circuit breaker and secure it against reconnection.
- Disconnect the PV array from the inverter via an external DC load-break switch (e.g. via a PV junction including a load-break switch). Switch off and secure the DC load-break switch against reconnection.
- Ensure that all cables to be connected are de-energized.
- Wear suitable personal protective equipment for all work on the product.

⚠ CAUTION

Risk of injury due to weight of product

Injuries may result if the product is lifted incorrectly or dropped while being transported or mounted.

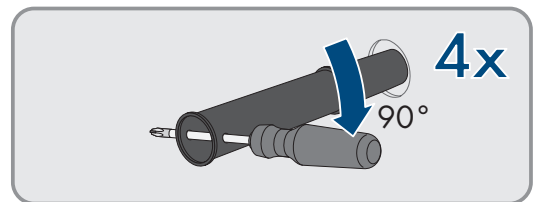
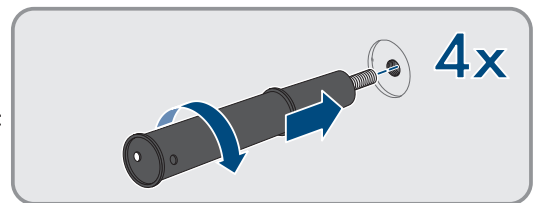
- Transport and lift the product carefully. Take the weight of the product into account.
- Wear suitable personal protective equipment for all work on the product.
- Transport the product using the carrying handles or hoist. Take the weight of the product into account.
- Use all carrying handles provided during transport with carrying handles.
- Do not use the carrying handles as attachment points for hoist equipment (e.g. straps, ropes, chains). Insert eye bolts into threads provided on top of the product to attach the hoist system.

Requirement:

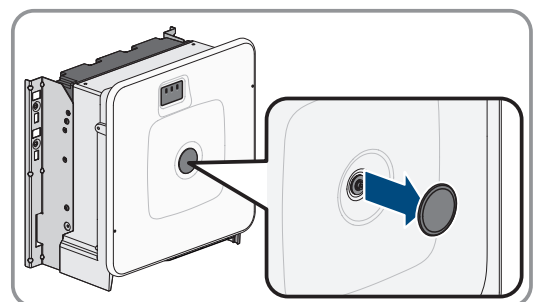
- Mounting and connection are prepared .

Procedure:

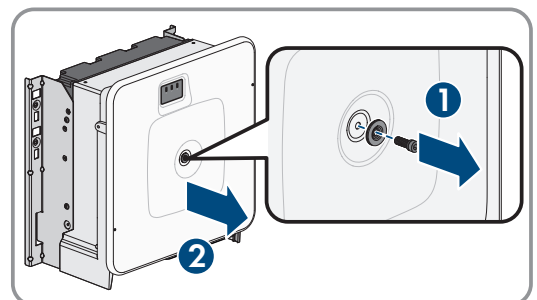
1. Screw the transport handles as far as they will go into the tapped holes on the right- and left-hand side until they lie flush with the enclosure. When doing so, ensure that the transport handles are screwed into the tapped holes so that they are perfectly straight. If the transport handles are not screwed in straight, this can make it more difficult or even impossible to unscrew them later on and can damage the tapped holes to the extent that transport handles can no longer be screwed into them.
2. Insert a screwdriver into the holes in the transport handle and turn the screwdriver through 90°. This ensures that the transport handles are securely tightened.



3. If the product should be hung into the mounting bracket with the help of a hoist, screw the eye bolts into the threads on the top of the product and attach the hoist to them. The hoist must be suitable for the weight of the product.
4. Remove the cover from the enclosure lid.

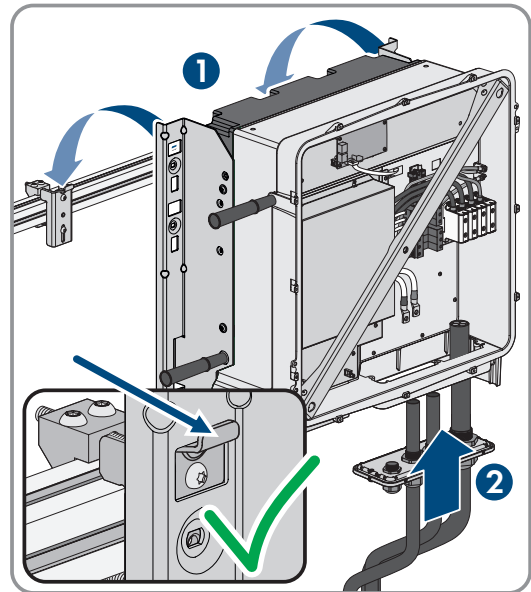


5. Unscrew the screw on the enclosure lid (hex socket, AF8) and remove the enclosure lid.

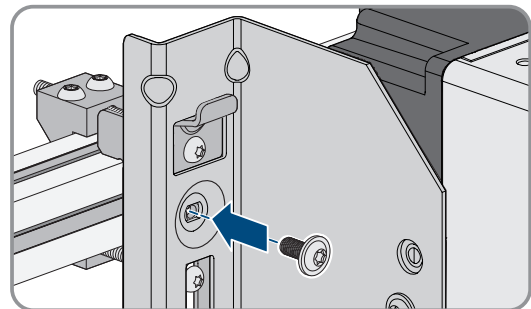


6. Set the cover, screw with seal, washer with seal and enclosure lid aside and store safely.

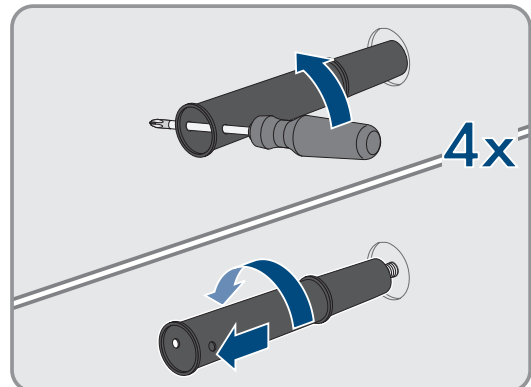
7. Hook the product into the mounting brackets. To do this, guide the product over the cables and the connecting plate so that the cables protrude through the opening into the product and the connecting plate sits under the opening. The bracket must protrude through the upper opening.



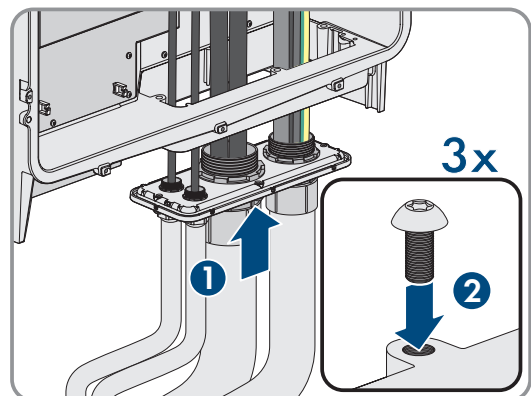
8. Align the cables according to the corresponding terminals and shorten the cables if necessary.
 9. Secure the product with one screw each on the right and left on the mounting bracket (M8x16, TX40, 12 Nm \pm 2 Nm (106 in-lb \pm 17.7 in-lb)).



10. Remove all 4 transport handles from the tapped holes. If necessary, insert a screwdriver into the holes on the transport handle and use the screwdriver to remove the transport handle.



11. Fasten the connecting plate to the enclosure using three screws (M8x70, TX40, torque: 8 Nm \pm 0.5 Nm (71 in-lb \pm 4 in-lb)).



Also see:

- [Center of gravity](#) ⇒ page 22

7 Electrical Connection

7.1 Requirements for the electrical connection

7.1.1 Residual-current monitoring unit (RCMU)

The product is equipped with an all-pole sensitive residual-current monitoring unit in accordance with IEC/EN 62109-2 and VDE 0126-1-1. The all-pole sensitive residual-current monitoring unit monitors AC and DC residual currents and redundantly disconnects the product from the utility grid if residual current jumps of > 30 mA occur. If the residual-current monitoring unit malfunctions, all poles of the product are immediately disconnected from the utility grid. If the protection provided by automatic disconnection of the power supply in accordance with DIN VDE 0100-410 is fulfilled by an appropriate overcurrent protective device, the product does not require an external residual-current device to operate safely. If local regulations require the use of a residual-current device, the following must be observed:

- The inverter is compatible with type B residual-current devices. For SHP 125-US-21 the rated residual current must be 1250 mA and for SHP 150-US-21 / SHP 165-US-21 / SHP 172-US-21 / SHP FLEX-US-21 the rated residual current must be 1500 mA or higher (for information on selecting a residual-current device, see Technical Information "Criteria for Selecting a Residual-Current Device" under www.SMA-Solar.com). Each inverter in the system must be connected to the utility grid via a separate residual-current device.
- When using residual-current device with a lower rated residual current, there is a risk of false tripping of the residual-current device, depending on the system design.

7.1.2 Overvoltage category

The product can be used in grids of overvoltage category III or lower in accordance with IEC 60664-1. That means that the product can be permanently connected to the grid-connection point of a building. In case of installations with long outdoor cabling routes, additional measures to reduce overvoltage category IV to overvoltage category III are required (see the Technical Information "Overvoltage Protection" at www.SMA-Solar.com).

7.1.3 AC cable requirements

- Aluminum or copper cables must be used.
- The conductors must be solid, stranded or fine-stranded. When using fine-stranded wire, bootlace ferrules must be used.
- The maximum permitted temperature for the terminal block of the AC connection of 90°C must be observed.
- Cable cross-section L1, L2, L3: 50 mm² to 150 mm² (300 kcmil to 1 AWG)
- Cable cross-section grounding conductor when using copper cable: 10 mm² to 50 mm² (1/0 AWG to 6 AWG)
- Cable cross section grounding conductor when using aluminum cable: 25 mm² to 50 mm² (1/0 AWG to 4 AWG)
- Maximum permissible temperature: 90°C

Also see:

- [Connecting the AC Cable](#) ⇒ page 31

7.1.4 Network cable requirements

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

- Cable type: 100BaseTx
- Cable category: minimum CAT5e
- Plug type: RJ45 of Cat5, Cat5e or higher with metal enclosure
- Shielding: SF/UTP, S/UTP, SF/FTP or S/FTP

- Number of insulated conductor pairs and insulated conductor cross-section: at least $2 \times 2 \times 0.22 \text{ mm}^2$ (2 x 2 x 24 AWG)
- Maximum cable length between 2 nodes when using patch cables: 50 m (164 ft)
- Maximum cable length between 2 nodes when using installation cables: 100 m (328 ft)
- UV-resistant for outdoor use.

7.1.5 Laying plan for network cables

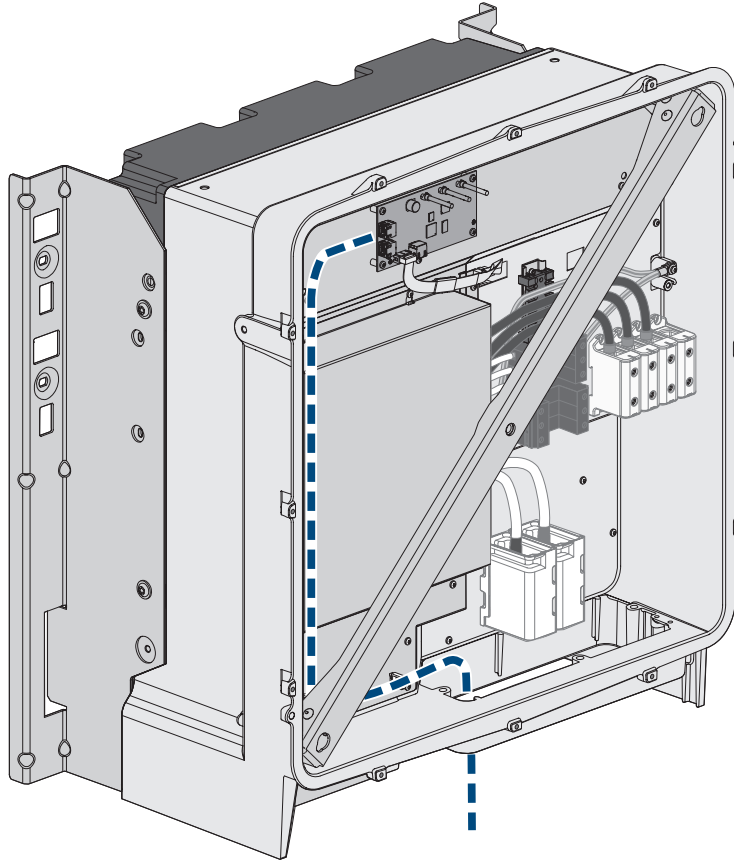


Figure 8: Interior view of the product with laying plan for network cables

7.1.6 DC cable requirements

- Aluminum or copper wires must be used.
- Cable cross-section: 95 mm^2 to 300 mm^2 (600 kcmil to 3/0 AWG)
- The cables must be equipped with suitable cable lugs for the DC connection in the product. The DC cables in the product are equipped with cable lugs made of tin-plated copper.

Also see:

- [Connecting the DC Cables](#) ⇒ page 32

7.2 Overview of the Connection Area

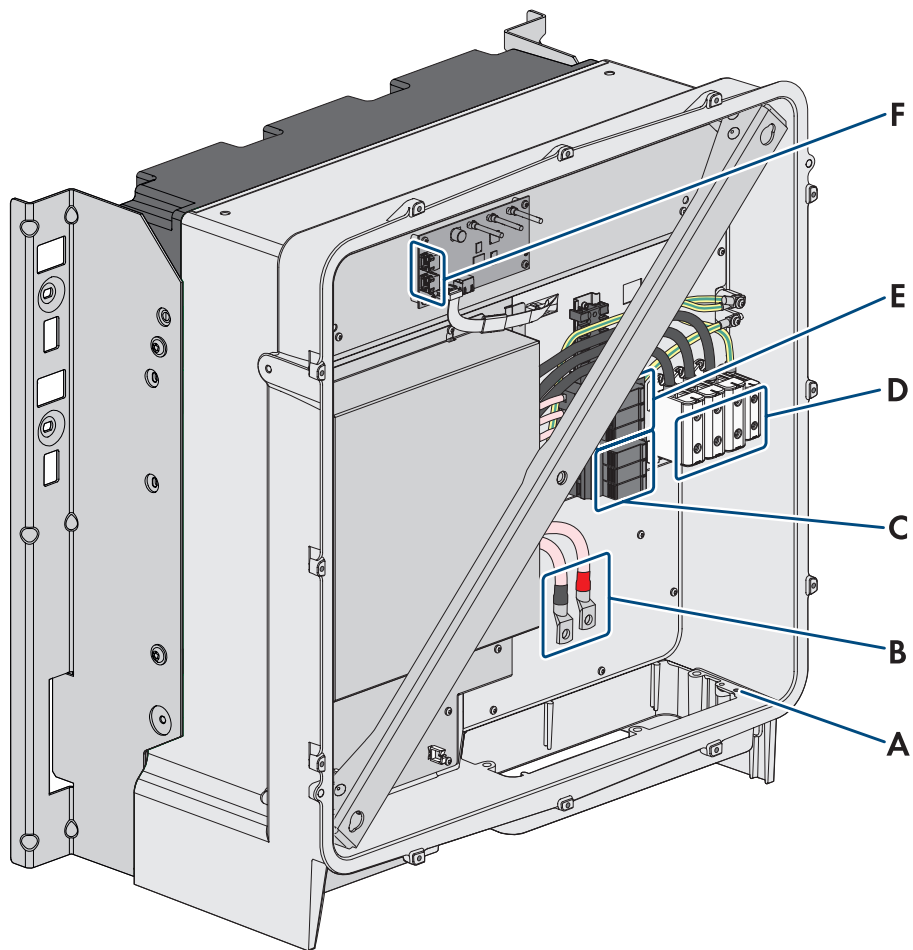
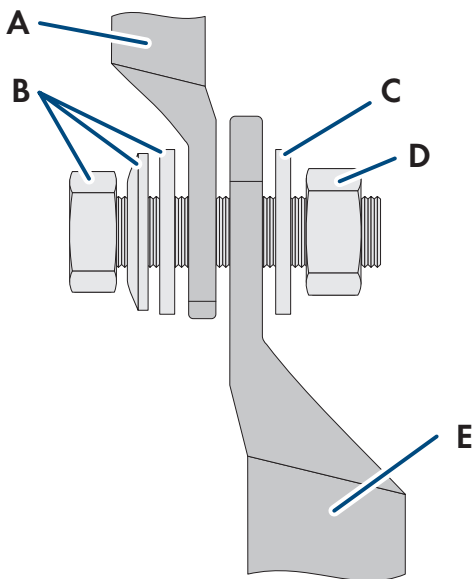


Figure 9: Connection areas in the interior of the product

Position	Designation
A	Equipment grounding terminal for the equipment grounding conductor of the PV array
B	Cable for DC connection with tin-plated copper terminal lugs
C	DC surge protection devices
D	Terminal blocks for AC connection
E	AC overvoltage protection elements
F	Network Ports

7.3 DC connection overview

1 DC-Kabel



2 DC-Kabel

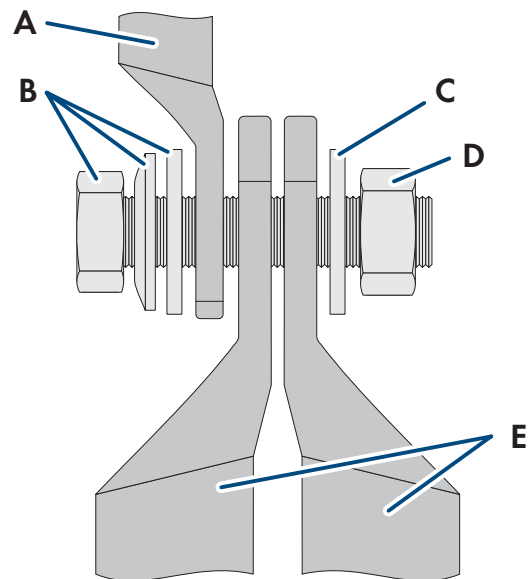


Figure 10: DC connection overview

Position	Designation
A	DC cable with tin-plated copper terminal lugs (installed in the product)
B	M10x40 combination hexagon head screw (AF16)
C	Washer M10
D	Hex nut M10
E	DC cable with terminal lug (to be provided by the customer)

7.4 Electrical connection procedure

⚠ QUALIFIED PERSON

This section describes the procedure for the electrical connection of the product. It provides an overview of the steps, which must be performed in the prescribed sequence.

Procedure	See
1. Ensure that the requirements for the electrical connection are fulfilled.	Section 7.1, page 27
2. Connect the AC cables.	Section 7.5, page 31
3. Connect the network cables.	Connecting the Network Cables
4. Connect the PV modules.	Section 7.6, page 32

7.5 Connecting the AC Cable

⚠ QUALIFIED PERSON

Requirements:

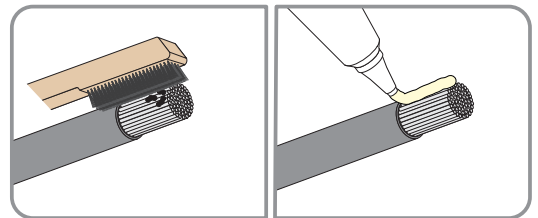
- A suitable medium-voltage transformer must be available. For the SHP 100-21, depending on the local standards and connection conditions, a medium-voltage transformer is not absolutely necessary.

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

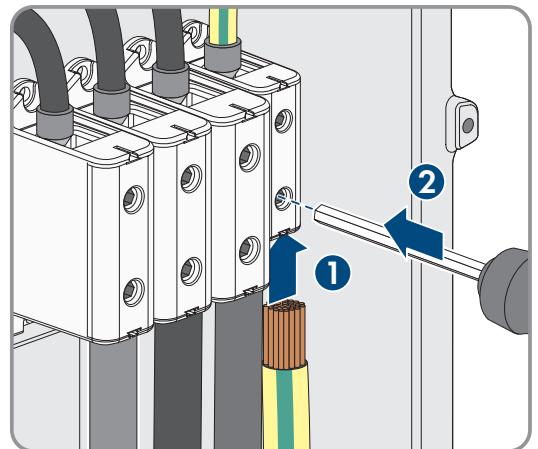
- Protective grease (only for conductors made of aluminum)

Procedure:

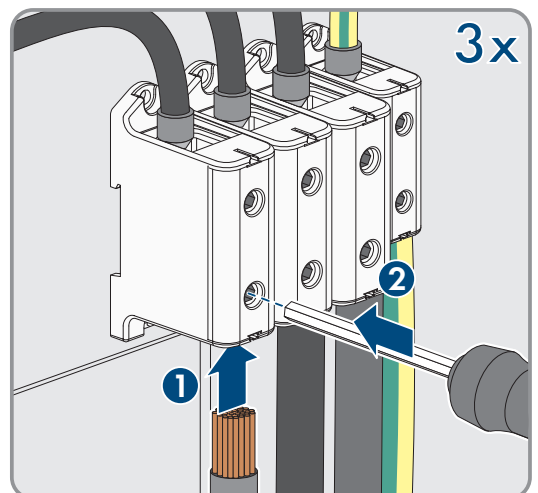
1. Ensure that the AC miniature circuit breaker is switched off and that it cannot be reconnected.
2. Shorten the cable if necessary.
3. Dismantle the cable.
4. Strip the insulation on the insulated conductors each by 30 mm (1.2 in).
5. Remove any cable remnants from the product.
6. For conductors made of aluminum, remove any oxide film and apply protective grease to the conductors.



7. Connect the grounding conductor to the terminal as labeled. To do so, position the conductor as far as it will go into the corresponding terminal and tighten the screw of the terminal (AF5, torque for a conductor cross-section of 10 mm² to 50 mm²: 12 Nm; torque for a cable cross-section of 1/0 AWG to 6 AWG: 10 Nm (90 in-lb)).



8. Connect L1, L2 and L3 to the terminals according to the label. To do so, position each conductor as far as they will go into the corresponding terminal and tighten the screw of the terminal (AF 8, torque for a conductor cross-section of 50 mm² to 95 mm²: 20 Nm; torque for a cable cross-section of 120 mm² to 150 mm²: 30 Nm; torque for a cable cross-section of 300 kcmil to 1 AWG: 24 Nm (216 in-lb)).



9. Ensure that the correct conductors are assigned to the terminals.
10. Ensure that all conductors are securely in place.

Also see:

- [Overvoltage category](#) ⇒ [page 27](#)

7.6 Connecting the DC Cables

⚠ QUALIFIED PERSON

NOTICE

Damage to the product due to ground fault on DC side during operation

Due to the transformerless topology of the product, the occurrence of ground faults on DC side during operation can lead to irreparable damage. Damages to the product due to a faulty or damaged DC installation are not covered by warranty. The product is equipped with a protective device that checks whether a ground fault is present during the starting sequence. The product is not protected during operation.

- Ensure that the DC installation is carried out correctly and no ground fault occurs during operation.

Requirements:

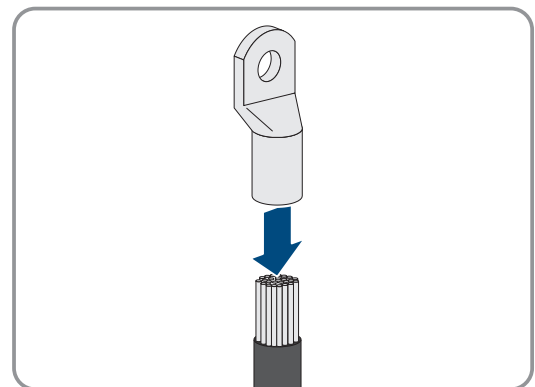
- One PV combiner box must be available.
- There must be an external DC load-break switch between the PV inverter and the PV modules (e.g. a PV combiner box including a load-break switch).
- The DC cables must be inserted into the product.

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

- Clean cloth
- Ethanol cleaning agent
- Press tool

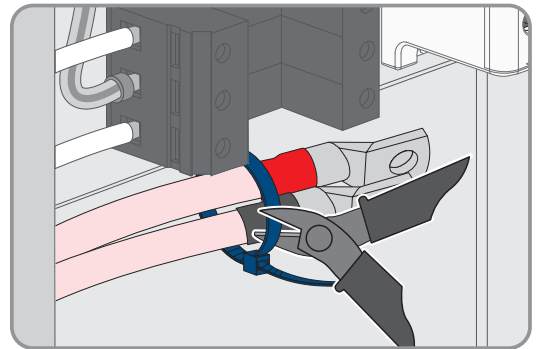
Procedure:

1. Ensure that no voltage is present on the DC cables.
2. Dismantle the DC cables.
3. Fit terminal lugs to the DC conductors.

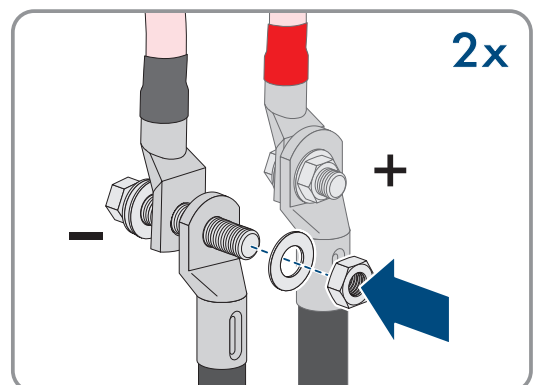


4. Remove any cable remnants from the product.

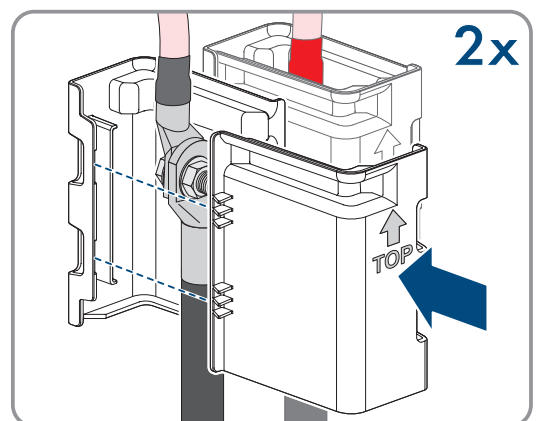
5. Remove the fixing of the pre-harnessed DC cables from the product.



6. Clean the contact surfaces of all terminal lugs using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
7. Connect the DC cables with each other. To do this, insert the screw and washer assembly (M10x40) from behind through the round holes in the terminal lugs and tighten it from the front with the washer (M10) and the hex nut (SW16, torque: $24 \text{ Nm} \pm 2 \text{ Nm}$ (212 in-lb)). Ensure correct polarity.



8. Place the touch protection elements around the terminal lugs and plug together until they audibly click into place.



7.7 Connecting the equipment grounding conductor

⚠ QUALIFIED PERSON

NOTICE

Damage to the product due to ground fault on DC side during operation

Due to the transformerless topology of the product, the occurrence of ground faults on DC side during operation can lead to irreparable damage. Damages to the product due to a faulty or damaged DC installation are not covered by warranty. The product is equipped with a protective device that checks whether a ground fault is present during the starting sequence. The product is not protected during operation.

- Ensure that the DC installation is carried out correctly and no ground fault occurs during operation.

Requirements:

- One PV combiner box must be available.

- There must be an external DC load-break switch between the PV inverter and the PV modules (e.g. a PV combiner box including a load-break switch).
- The equipment grounding conductor must be inserted in the product.

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

- One terminal lug for connection of equipment grounding conductor of PV array (flange hole: M6, cross-section: appropriate to equipment grounding conductor)
- Clean cloth
- Ethanol cleaning agent
- Press tool

Procedure:

1. Ensure that no voltage is present on the DC cables.
2. Dismantle the equipment grounding conductor.
3. Attach a terminal lug to the equipment grounding conductor.
4. Clean the contact surfaces of the terminal lug using a clean cloth and ethanol cleaning agent and do not touch the contact surfaces after cleaning.
5. Connect the equipment grounding conductor to the equipment grounding terminal using the hexagon socket screw (M6x16, TX20, torque: 6 Nm ± 0.3 Nm (53 in-lb ± 2.65 in-lb)).

8 Commissioning

8.1 Procedure for commissioning in systems with System Manager

⚠ QUALIFIED PERSON

This section describes the procedure of commissioning an inverter that is used in systems with System Manager (e.g. SMA Data Manager). The System Manager is the device for the configuration of the overall system. The configuration is transferred to all inverters in the system.

It provides an overview of the steps, which must be performed in the prescribed sequence.

i The system password is also the password for the user interface

The system password assigned via the System Manager is also the password for the user interface of the inverter.

Procedure	See
1. Commission the inverter.	Commissioning the Inverter
2. The initial configuration of the inverter is made via the System Manager. The configuration is transferred to the inverter and the settings of the inverter are overwritten.	Manual of the System Manager
3. Make any active and reactive power settings for the inverter required by the grid operator.	-
4. Deactivate the Webconnect function of the inverter via the Sunny Portal. This prevents unnecessary connection attempts of the inverter with Sunny Portal.	Sunny Portal

8.2 Procedure for commissioning in systems without System Manager

QUALIFIED PERSON

This section describes the procedure of commissioning an inverter that is used in systems without System Manager (e.g. SMA Data Manager).

It provides an overview of the steps, which must be performed in the prescribed sequence.

The system password is also the password for the user interface

The system password assigned via the System Manager is also the password for the user interface of the inverter.

Procedure		See
1.	Commission the inverter.	Section 8.3, page 35
2.	Establish a connection to the user interface of the inverter. There are various connection options to choose from for this: <ul style="list-style-type: none"> • Direct connection via Ethernet • Connection via Ethernet in the local network 	Section 9.3.1, page 44 Section 9.3.2, page 45
3.	Log into the user interface.	Section 8.4, page 37
4.	Select the inverter configuration option. Please note that the SMA Grid Guard code for changing the grid-relevant parameters must be available after completion of the first ten feed-in hours or installation assistant. You can request the SMA Grid Guard code via the Online Service Center.	Section 8.5, page 37
5.	Only for SHP FLEX-US: Set power, AC voltage and electric current and mark the set values using the supplied permanent marker on the label next to the type label.	Section 8.8, page 39
6.	If necessary, set the parameters for voltage and frequency monitoring.	Section 8.9, page 41
7.	Ensure that the country standard has been configured correctly.	Section 9.16, page 54
8.	Make further inverter settings as needed.	Section 9.9, page 51

8.3 Commissioning the Inverter

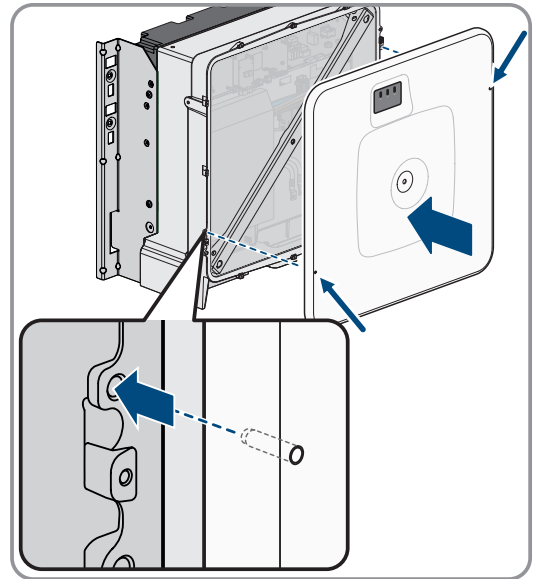
QUALIFIED PERSON

Requirements:

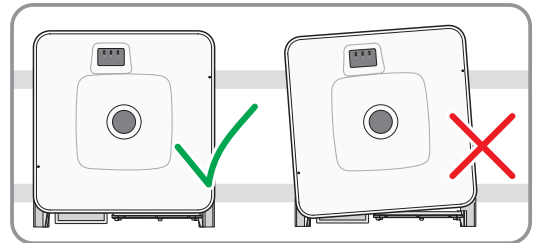
- A means of disconnecting the inverter from the PV modules must be present.
- The AC circuit breaker must be correctly rated and mounted.
- The inverter must be correctly mounted.
- All cables must be correctly connected.

Procedure:

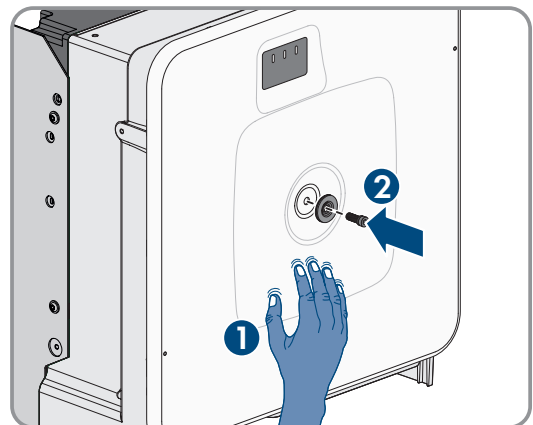
1. Position the enclosure lid. The two guide pins on the enclosure lid must slide into the guide openings on the enclosure lid.



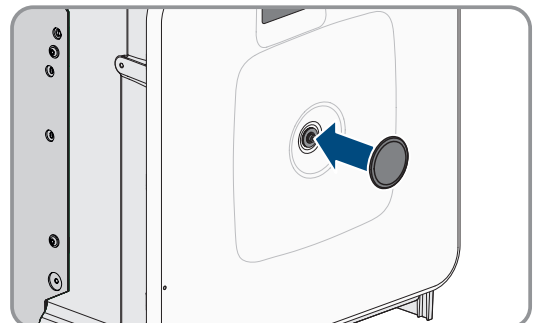
2. Ensure that the cover sits straight on the enclosure.



3. Hold the enclosure lid pressed against the enclosure and screw it tight. (Hex socket, AF 8, torque: 18 Nm).



4. Place the cover on the screw in the enclosure lid.



5. Option: Switch on the transformer.
6. Switch on DC via the PV combiner box or the external DC switch.

7. Switch on the AC circuit breaker.
 - All 3 LEDs light up. The start-up phase begins.
 - All 3 LEDs go out again after approximately 90 seconds.
 - Depending on the available power, the green LED pulses or is continuously illuminated. The inverter is feeding in.
8. If the green LED is still flashing, the conditions for activating feed-in operation are not yet met. As soon as the conditions for feed-in operation are met, the inverter starts with feed-in operation and, depending on the available power, the green LED will light up continuously or it will pulse.
9. If the red LED lights up, an event has occurred. Find out which event has occurred and, if necessary, initiate countermeasures.

8.4 Logging into the user interface for the first time

i Password assignment for user and installer

The passwords for the user groups **Installer** and **User** must be assigned when accessing the user interface for the first time. If the inverter was registered in a System Manager (e.g. SMA Data Manager) and the system password was assigned, the system password is also the installer password. In this case, only the user password must be assigned.

- If you as a specialist assign the user password, only pass the password on to persons to access the inverter data via the user interface.
- If you as a user assign the installer password, only pass the password on to persons to receive access to the system.

i Installer password for inverters registered in a System Manager or in Sunny Portal

To be able to register the inverter in a System Manager (e.g. SMA Data Manager) or in a Sunny Portal system, the password for the user group **Installer** must match the system password. If you assign a password for the user group **Installer** via the user interface of the inverter, the same password must also be used as the system password.

- Assign a uniform installer password to all SMA devices in the system.

Procedure:

1. In the drop-down list **Language**, select the desired language.
 2. In the **Password** field, enter a password for the **User** user group.
 3. In the **Repeat password** field, enter the password again.
 4. Click on **Save**.
 5. In the **New password** field, enter a password for the **Installer** user group. Assign a uniform password to all SMA devices to be registered in a system. The installer password is also the system password.
 6. In the **Repeat password** field, enter the password again.
 7. Click on **Save and log in**.
- The **Configuring the Inverter** page opens.

Also see:

- [Establishing a Direct Connection via Ethernet ⇒ page 44](#)
- [Establishing a Connection via Ethernet in the local network ⇒ page 45](#)

8.5 Carry out the configuration using the installation assistant

⚠ QUALIFIED PERSON

The installation assistant helps you to configure the inverter and guides you to the most important settings.

Requirements:

- You are logged in as **Installer**, and the user interface is open on the **Configuring the Inverter** page.
- When configuring after completion of the first ten feed-in hours, the SMA Grid Guard code must be available in order to change the grid-relevant parameters. You can request the SMA Grid Guard code via the Online Service Center.

Procedure:

1. Select the configuration option **Configuration with Installation Assistant**.
 - The installation assistant will open.
 2. For every setting made in a step, select [**Save and next**].
 - In the last step, all made settings are listed in a summary.
 3. To correct settings you made, select [**Back**], navigate to the desired step, correct settings and select [**Save and continue**].
 4. Once all settings are correct, select [**Next**] in the summary.
 5. To save the settings to a file, select [**Export a summary**] and save the file on your smart device.
 6. To export all parameters and their settings, select [**Export all parameters**]. This exports all parameters and their settings into an HTML file.
- The start page of the user interface opens.

Also see:

- [Logging Into the User Interface](#) ⇒ page 45
- [Layout of the installation assistant](#) ⇒ page 50

8.6 Adopting the Configuration from a File

QUALIFIED PERSON

You can adopt the inverter configuration from a file. To do this, there must be an inverter configuration saved to a file.

Requirements:

- You are logged in as **Installer**, and the user interface is open on the **Configuring the Inverter** page.
- When configuring after completion of the first ten feed-in hours, the SMA Grid Guard code must be available in order to change the grid-relevant parameters. You can request the SMA Grid Guard code via the Online Service Center.

Procedure:

1. Select the configuration option **Adopting configuration from a file**.
2. Select [**Browse...**] and select the desired file.
3. Select [**Import file**].

8.7 Carry out the configuration manually

QUALIFIED PERSON

You can configure the inverter manually by setting the desired parameters.

Requirements:

- You are logged in as **Installer**, and the user interface is open on the **Configuring the Inverter** page.
- When configuring after completion of the first ten feed-in hours, the SMA Grid Guard code must be available in order to change the grid-relevant parameters. You can request the SMA Grid Guard code via the Online Service Center.

Procedure:

1. Select the configuration option **Manual Configuration**.
 - The **Device Parameters** menu on the user interface will open and all available parameter groups of the inverter will be displayed.
2. Click on [**Edit parameters**].
3. Select the desired parameter group.
 - All available parameters of the parameter group will be displayed.
4. Set the desired parameters.
5. Select [**Save all**].
 - The inverter parameters are set.

Also see:

- [Logging Into the User Interface](#) ⇒ page 45

8.8 SHP FLEX-US

8.8.1 Configuration SHP FLEX-US

QUALIFIED PERSON

The SHP FLEX-US can be flexibly adjusted in terms of power and AC voltage and current. As a result, the SHP FLEX-US can be optimized for repowering purposes and used variably.

After commissioning the SHP FLEX-US, the following parameters must be set so that the product can be used as a replacement for existing devices.

If the grid protection limits have already been configured using a country data set or beyond, this does not have to be done again. The product works with standardized values based on the respectively set nominal voltage or the set maximum current.

If the country data set is changed or set again after configuring the following parameters, the **Grid nominal voltage** parameter must be set again.

If required by the grid operator, there is the option of having the parameters for apparent and active power limitation locked by Service via remote access. To do this, a suitable connection with external access to the grid must exist. Further information is available from Service.

AC voltage

Name	Value to be set
Inverter nominal voltage	Nominal voltage (RMS, line conductor-line conductor) of the system
Nominal grid voltage	Nominal voltage (RMS, line conductor-line conductor) of the system

AC current

Name	Value to be set
AC current limitation	Maximum current of the AC output

AC power

Name	Value to be set
Nominal apparent power VAMaxOut	Maximum apparent power of the AC output
Nominal active power WMaxOut	Maximum active power of the AC output
Nominal reactive power VArMaxQ1	Maximum reactive power of the AC output
Nominal reactive power VArMaxQ4	Maximum reactive power of the AC output

Further parameters

Name	Value to be set
Minimum voltage input	PV voltage to start the feed-in operation. Formula: AC voltage x 1.55
Critical voltage to end feed-in	Minimum PV voltage to which the MPP tracker tracks down. Formula: AC voltage x 1.4
Disconnection limit for leakage current	Disconnection threshold for the leakage current. Formula: Set power in kW / 100
Disconnection limit for the lagging component of the leakage current	Disconnection threshold for the lagging component of the leakage current. Should be set to the same values as Disconnection limit for leakage current

Also see:

- [Changing parameters](#) ⇒ page 51

8.8.2 Label for SHP FLEX-US configuration

QUALIFIED PERSON

On the product next to the type label a label is attached on which the set values must be checked using the permanent marker supplied. It should be noted that each digit of a number must be checked exactly once.

The label with the information about the set values ensures that the grid operator can be certain that the product settings are correct and that a follow-up inspection by the certification authorities is no longer necessary.

8.8.3 Example configuration SHP FLEX-US

Here we show you an example configuration and the corresponding marking on the label next to the type label.



Example configuration

- AC voltage (parameter **Nominal system voltage**) is set to 315 V.
- Max. AC power (parameter **Nominal active power WMaxOut**) is set to 65 kW.
- Max. AC current (parameter **AC current limitation**) is set to 120 A.

AC-Voltage [V]		
0	<input type="checkbox"/>	0 <input type="checkbox"/>
1	<input checked="" type="checkbox"/>	1 <input type="checkbox"/>
2	<input type="checkbox"/>	2 <input type="checkbox"/>
3	<input checked="" type="checkbox"/>	3 <input type="checkbox"/>
4	<input type="checkbox"/>	4 <input type="checkbox"/>
5	<input type="checkbox"/>	5 <input checked="" type="checkbox"/>
6	<input type="checkbox"/>	6 <input type="checkbox"/>
7	<input type="checkbox"/>	7 <input type="checkbox"/>
8	<input type="checkbox"/>	8 <input type="checkbox"/>
9	<input type="checkbox"/>	9 <input type="checkbox"/>

Max. AC-Power [kW]		
0	<input checked="" type="checkbox"/>	0 <input type="checkbox"/>
1	<input type="checkbox"/>	1 <input type="checkbox"/>
2	<input type="checkbox"/>	2 <input type="checkbox"/>
3	<input type="checkbox"/>	3 <input type="checkbox"/>
4	<input type="checkbox"/>	4 <input type="checkbox"/>
5	<input type="checkbox"/>	5 <input checked="" type="checkbox"/>
6	<input checked="" type="checkbox"/>	6 <input type="checkbox"/>
7	<input type="checkbox"/>	7 <input type="checkbox"/>
8	<input type="checkbox"/>	8 <input type="checkbox"/>
9	<input type="checkbox"/>	9 <input type="checkbox"/>

Max. AC-Current [A]		
0	<input type="checkbox"/>	0 <input checked="" type="checkbox"/>
1	<input checked="" type="checkbox"/>	1 <input type="checkbox"/>
2	<input checked="" type="checkbox"/>	2 <input type="checkbox"/>
3	<input type="checkbox"/>	3 <input type="checkbox"/>
4	<input type="checkbox"/>	4 <input type="checkbox"/>
5	<input type="checkbox"/>	5 <input type="checkbox"/>
6	<input type="checkbox"/>	6 <input type="checkbox"/>
7	<input type="checkbox"/>	7 <input type="checkbox"/>
8	<input type="checkbox"/>	8 <input type="checkbox"/>
9	<input type="checkbox"/>	9 <input type="checkbox"/>

All settings are parameterized accordingly to the certified ranges on the type label

206472-00.01

Figure 11: Marking of the exemplary configuration on the label next to the type label

8.9 Adjustable parameters for voltage and frequency monitoring

⚠ QUALIFIED PERSON

You can set the following parameters for voltage and frequency monitoring via the user interface of the inverter.

Name	Value/range	Default value
Voltage monitoring upper maximum threshold	1.5 p.u. to 3 p.u.	1.78 p.u.
Voltage monitoring upper maximum threshold, tripping time	0.1 ms to 5 ms	0.312 ms
Voltage monitoring, upper maximum threshold as RMS value	1 p.u. to 2 p.u.	1.2 p.u.
Voltage monitoring, upper minimum threshold as RMS value for tripping time	0 ms to 1000000 ms	160 ms
Voltage monitoring median maximum threshold (Overvoltage/Fast)	1 p.u. to 2 p.u.	1.1 p.u.
Voltage monitoring median max. threshold trip.time (Overvoltage/Fast, maximum time)	0 ms to 1000000 ms	13000 ms
Voltage monitoring lower maximum threshold (Overvoltage/Slow)	1 p.u. to 2 p.u.	1.1 p.u.

Name	Value/range	Default value
Voltage monitoring lower max. threshold trip. time (Overvoltage/Slow, maximum time)	0 ms to 1000000 ms	1000000 ms
Voltage monitoring upper minimum threshold (Undervoltage/Slow)	0 p.u. to 1 p.u.	0.88 ms
Voltage monitoring upper min. threshold trip. time (Undervoltage/Slow, maximum time)	0 ms to 1000000 ms	1000000 s
Voltage monitoring, median minimum threshold (undervoltage/fast)	0 p.u. to 1 p.u.	0.88 ms
Voltage monitoring, median minimum threshold, tripping time (undervoltage/fast, maximum time)	0 ms to 1000000 ms	21000 ms
Voltage monitoring, lower minimum threshold as RMS value	0 p.u. to 1 p.u.	0.5 p.u.
Voltage monitoring, lower minimum threshold as RMS value for tripping time	0 ms to 1000000 ms	2000 ms
Frequency monitoring median maximum threshold	50 Hz to 66 Hz	62 Hz
Frequency monitoring, median maximum threshold, tripping time (overfrequency, maximum time)	0 ms to 1000000 ms	160 ms
Frequency monitoring lower maximum threshold (Overfrequency)	50 Hz to 66 Hz	61.2 Hz
Frequency monitoring lower maximum threshold, tripping time	0 ms to 1000000 ms	300000 ms
Frequency monitoring upper minimum threshold (Underfrequency)	44 Hz to 60 Hz	58.5 Hz
Frq. monitoring upper min. threshold trip. time (Underfrequency, maximum time)	0 ms to 1000000 ms	300000 ms
Frequency monitoring, median minimum threshold	44 Hz to 60 Hz	56.5 Hz
Frequency monitoring, median minimum threshold, tripping time	0 ms to 1000000 ms	160 ms
Protection against voltage increase	1 to 2	2 p.u.
Protection against voltage increase, tripping time	40 ms to 10000 ms	10000 ms
Minimum voltage for reconnection	0 p.u. to 1 p.u.	0.917 p.u.
Maximum voltage for reconnection	2 p.u. to 2 p.u.	1.05 p.u.
Nominal grid voltage	0.8 p.u. to 1.2 p.u.	1 p.u.

Also see:

- [Changing parameters ⇒ page 51](#)

9 Operation

9.1 Layout of the 'Configuring the Inverter' page

⚠ QUALIFIED PERSON

After you have assigned the password for the user groups **Installer** and **User** and logged in as **Installer**, the **Configuring the Inverter** page opens.

On the **Configuring the Inverter** page, different configuration options for the first configuration of the device are available to choose from. SMA Solar Technology AG recommends carrying out the configuration with the installation assistant. This way, you ensure that all relevant parameters are set for optimal inverter operation.

- Adopting the Configuration from a File
- Configuring the Installation Assistant (Recommended)
- Manual configuration

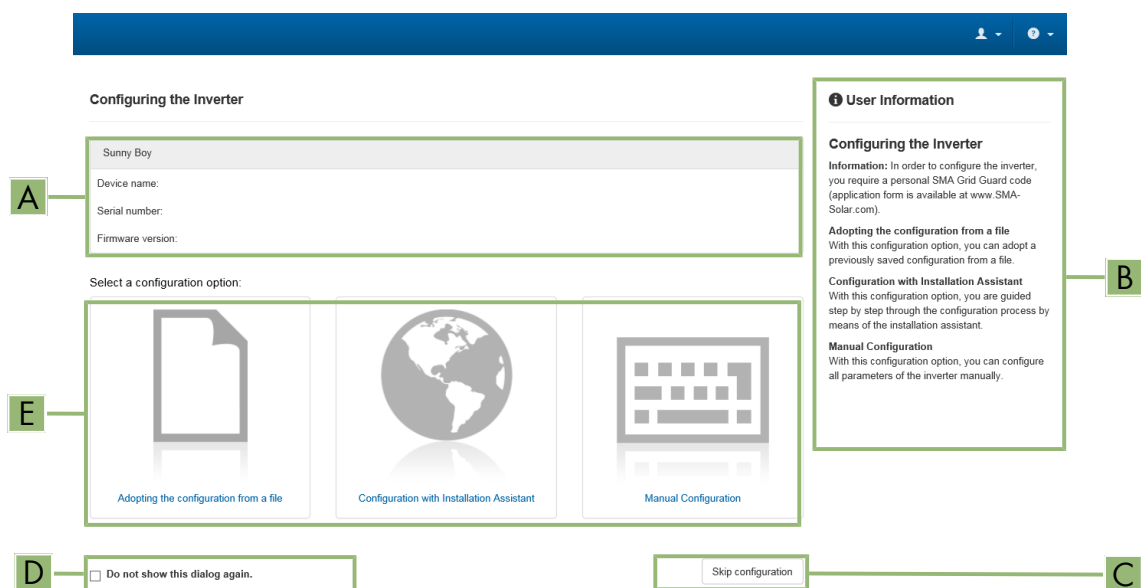


Figure 12: Layout of the **Configuring the Inverter** page

Position	Designation	Description
A	Device information	Provides the following information: <ul style="list-style-type: none"> • Device name • Inverter serial number • Inverter firmware version
B	User information	Provides brief information on the listed configuration options
C	Skip configuration	Offers the option of skipping the inverter configuration and go directly to the user interface (not recommended)
D	Checkbox	Allows you to choose not to have the displayed page displayed again when the user interface is called up again
E	Configuration options	Provides a selection of the various configuration options

Also see:

- [Carry out the configuration using the installation assistant](#) ⇒ page 37

- [Adopting the Configuration from a File](#) ⇒ page 38
- [Carry out the configuration manually](#) ⇒ page 38

9.2 Information for the use of the user interface

You can operate the product via the user interface. The user interface can be accessed via the web browser of an end device (e.g. laptop) as soon as a network connection between the product and the end device has been established.

Requirements:

- The product must be commissioned.
- The respective latest version of one of the following web browsers must be installed: Chrome, Edge, Firefox or Safari.
- There is a network connection between the product and the end device
 - Direct connection via Ethernet
 - Connection via Ethernet in the local network

You can log into the user interface with the following user groups:

- **User**
- **Installer**

Certain settings may only be changed by the user group **Installer**.

The installer's SMA Grid Guard code must be available to change network-relevant settings after the first 10 hours of feed-in operation, or after completing the installation assistant. You can request the SMA Grid Guard code via the Online Service Center.

Also see:

- [User Interface](#) ⇒ page 17

9.3 Establishing a connection to the user interface

9.3.1 Establishing a Direct Connection via Ethernet

i IP address of the product

- Default IP address of the product for direct connection via Ethernet: **169.254.12.3**

i Usage of cookies

For the correct display of the user interface, cookies are required. The cookies are used for convenience only. By using this user interface you agree to the placement of cookies.

Requirements:

- An end device (e.g. laptop) with an Ethernet interface must be available.
- The product must be connected directly to the end device.

Procedure:

1. Open the web browser of your end device.
2. Enter the IP address **169.254.12.3** into the address bar and press the enter key.

3. **i** Web browser signals a security vulnerability

After the IP address has been entered, a message might appear indicating that the connection to the user interface of the product is not secure. SMA Solar Technology AG guarantees the security of the user interface.

- Continue loading the user interface.

- The login page of the user interface opens.

Also see:

- [Logging Into the User Interface ⇒ page 45](#)

9.3.2 Establishing a Connection via Ethernet in the local network

i New IP address for connecting with a local network

If the product is connected to a local network (e.g. via a router), the product will receive a new IP address. Depending on the type of configuration, the new IP address will be assigned automatically by the DHCP server (router) or manually by you. Upon completion of the configuration, the product can only be reached via the following access addresses:

- Generally applicable access address: IP address manually assigned or assigned by the DHCP server (router) (identification via network scanner software or network configuration of the router).
- Access address for Apple and Linux systems: **SMA[serial number].local** (e.g. SMA0123456789.local)
- Access address for Windows and Android systems: **https://SMA[serial number]** (e.g. https://SMA0123456789)

i Usage of cookies

For the correct display of the user interface, cookies are required. The cookies are used for convenience only. By using this user interface you agree to the placement of cookies.

Requirements:

- The product must be connected to the local network via a network cable (e.g. via a router).
- The product must be integrated into the local network. Tip: There are various methods of integrating the product into the local network with the aid of the installation assistant.
- The end device (e.g. laptop or tablet) must be in the same local network as the product.

Procedure:

1. Open the web browser of your end device.
2. Enter the IP address of the product into the address bar and press the enter key.

3. **i** **Web browser signals a security vulnerability**

After the IP address has been entered, a message might appear indicating that the connection to the user interface of the product is not secure. SMA Solar Technology AG guarantees the security of the user interface.

- Continue loading the user interface.

- The login page of the user interface opens.

Also see:

- [Logging Into the User Interface ⇒ page 45](#)

9.4 Logging Into the User Interface

Requirement:

- A connection to the user interface of the inverter has been established and the login page is open.

Procedure:

1. In the drop-down list **Language**, select the desired language.
2. Select the desired user group in the drop-down list **User group**.
3. Enter the password in the field **Password**.
4. Select **Login**.

- The start page of the user interface opens.

9.5 Logging out of the user interface

Requirement:

- You are logged in on the user interface as **User** or **Installer**.

Procedure:

1. On the right-hand side of the menu bar, select the menu **User Settings**.
 2. In the subsequent context menu, select [**Logout**].
- The login page of the user interface opens. The logout was successful.

9.6 Start Page Design of the User Interface

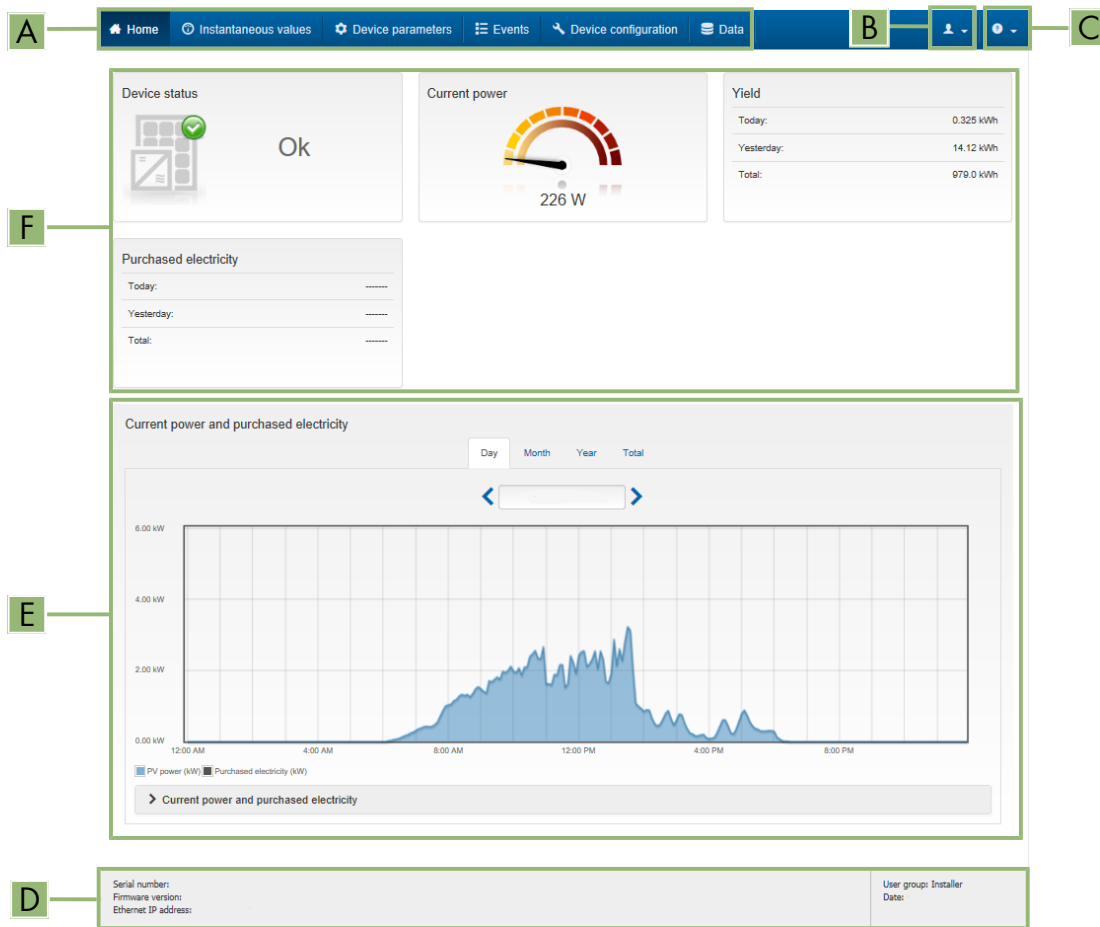


Figure 13: Design of the user interface's home page (example)

Position	Designation	Description
A	Menu	<p>Provides the following functions:</p> <ul style="list-style-type: none"> • Home Opens the user interface home page • Instantaneous Values Current measured values of the inverter • Device Parameters The various operating parameters of the inverter can be viewed and configured here depending on the user group. • Events All events that have occurred in the selected time period are displayed here. The event types are Information, Warning and Error. Currently existing events of the types Error and Warning will be additionally displayed in the Device status viewlet. However, only the higher-priority event is displayed. If, for example, there is a Warning and an Error present at the same time, only the error will be displayed. • Device Configuration Various settings for the inverter can be made here. The selection available is dependent on which user group you are logged in as and the operating system of the device with which the user interface has been called up. • Data You will find all data that is saved in the internal memory of the inverter on this page.
B	User settings	<p>Provides the following functions, depending on the user group logged in:</p> <ul style="list-style-type: none"> • Starting the installation assistant • Set access rights • Activating and Deactivating the Smart Inverter Screen • SMA Grid Guard login • Show eManual • Logout
C	Help	<p>Provides the following functions:</p> <ul style="list-style-type: none"> • Displaying information on Open Source licenses used • Link to the website of SMA Solar Technology AG
D	Status bar	<p>Displays the following information:</p> <ul style="list-style-type: none"> • Inverter serial number • Inverter firmware version • IP address of the inverter in the local network • User group logged in • Date and device time of the inverter

Position	Designation	Description
E	Current power and current consumption	Temporal progression of the PV power and the power consumption of the household over the selected time period. Please note, the power consumption will only be displayed if an energy meter is installed in the PV system.
F	Status display	<p>The various areas display information on the current status of the PV system.</p> <ul style="list-style-type: none"> • Device status Displays whether the inverter is currently in a fault-free operating state or whether there is an Error or Warning present. • Current power Displays the power currently being generated by the inverter. • Yield Displays the energy yield of the inverter. • Grid supply Displays the energy supply from the utility grid. • Power at the grid connection point Indicates which power is currently fed in or obtained at the grid-connection point.

9.7 Layout of the installation assistant

⚠ QUALIFIED PERSON

The installation assistant guides you step-by-step through the steps required for initial configuration of the product.

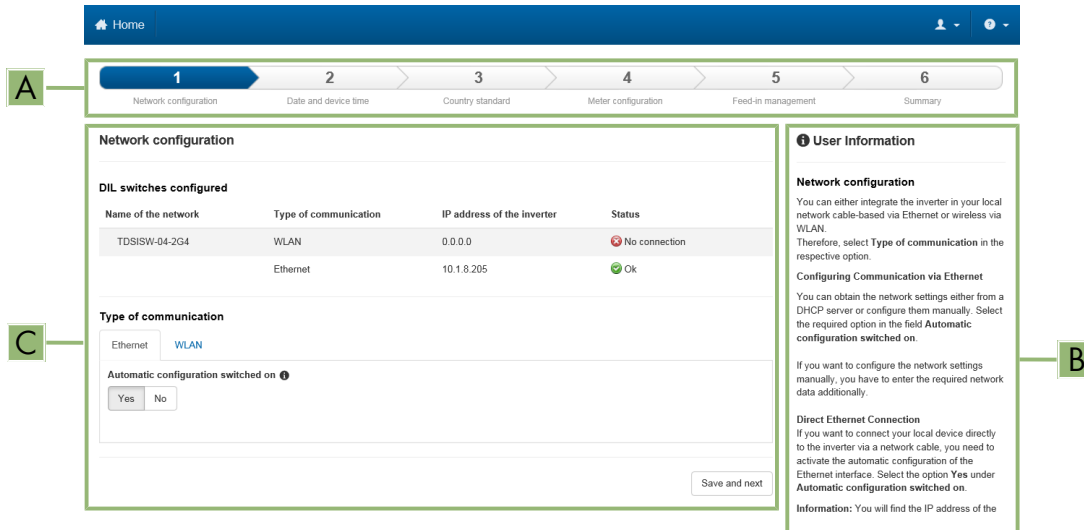


Figure 14: Layout of the installation assistant (example)

Position	Designation	Description
A	Configuration steps	Overview of the installation assistant steps. The number of steps depends on the type of device and the additionally installed modules. The current step is highlighted in blue.
B	User information	Information about the current configuration step and the setting options of the configuration step.
C	Configuration field	You can make settings in this field.

Also see:

- [Establishing a connection to the user interface ⇒ page 44](#)
- [Starting the Installation Assistant ⇒ page 50](#)

9.8 Starting the Installation Assistant

⚠ QUALIFIED PERSON

The installation assistant guides you step-by-step through the initial configuration of the product.

Requirements:

- The personal SMA Grid Guard code of the Installer must be available for the changing of grid-relevant settings after completion of the first 10 operating hours or of the installation assistant. You can request the SMA Grid Guard code via the Online Service Center.
- You are logged in on the user interface as **Installer**.

Procedure:

1. Select the menu **User settings** on the home page of the user interface.
 2. In the context menu, select [**Starting the installation assistant**].
- The installation assistant will open.

Also see:

- [Layout of the installation assistant](#) ⇒ page 50

9.9 Changing parameters

The parameters of the product are set to certain values by default. You can change the parameters to optimize the performance of the product.

This section describes the basic procedure for changing parameters. Always change parameters as described in this section.

Some function-sensitive parameters can only be viewed by qualified persons and can only be changed by qualified persons by entering the personal SMA Grid Guard code. You can request the SMA Grid Guard code via the Online Service Center.

Accepting the settings

Saving the made settings is indicated by an hourglass symbol on the user interface. If the DC voltage is sufficient, the data is transferred directly to the inverter and accepted. If the DC voltage is too low (e. g. in the evening), the settings are saved, but they cannot be directly transferred to or accepted by the inverter. As long as the inverter has not yet received and accepted the settings, the hourglass symbol will continue to be displayed on the user interface. The settings will be accepted when there is sufficient DC voltage applied and the inverter restarts. As soon as the hourglass symbol appears on the user interface, the settings have been saved. The settings will not be lost. You can log off of the user interface and leave the system.

Requirements:

- You are logged in on the user interface.
- Changes to grid-relevant parameters must be approved by the responsible grid operator.

Procedure:

1. Call up the menu **Device parameters**.
 2. Click on [**Edit parameters**].
 3. Log in using the SMA Grid Guard code to change those parameters designated by a lock (only for installers). In the menu, select **User Settings > SMA Grid Guard Login**, enter the SMA Grid Guard code and select [**Login**].
 4. Expand the parameter group that contains the parameter which is to be configured.
 5. Change the required parameters.
 6. Select [**Save all**] to save the changes.
- The parameters are set.

Also see:

- [Establishing a connection to the user interface](#) ⇒ page 44
- [Information for the use of the user interface](#) ⇒ page 44

9.10 Generating a product key for the first time

If you have forgotten the product's password, you can use the product key to create a new one. The product key is stored only on the device. A lost product key cannot be recovered, it can only be recreated.

Creating a product key is not mandatory, but is recommended by SMA Solar Technology AG because the product key significantly increases the security of the system. A product key must be generated for each of the user groups **User** and **Installer**.

Requirements:

- The user interface is open and you are logged in as **User** or **Installer**.

Procedure:

1. Select the menu **User settings**.
2. Select [**Access rights**].
3. Select [**Product key**].
4. Enter the specific device secret of the product. Which specific device secret is used and where you can find the specific device secret is indicated on the user interface.
5. Click on [**Generate**].
 - A string representing the product key is generated.
6. Write down the product key immediately and keep it safe. After leaving this page, the newly generated product key can no longer be displayed. The copy of the product key must be accessible only to you.

Also see:

- [Establishing a connection to the user interface](#) ⇒ page 44
- [Logging Into the User Interface](#) ⇒ page 45
- [Restoring the password with product key](#) ⇒ page 72
- [Restoring the password without product key](#) ⇒ page 73

9.11 Generate new product key

If the product key has become accessible to unauthorized persons, you can generate a new product key at any time.

Requirements:

- The currently valid product key must be available.
- The user interface is open and you are logged in as **User** or **Installer**.

Procedure:

1. Select the menu **User settings**.
2. Select [**Access rights**].
3. Select [**Product key**].
4. Enter the currently valid product key.
5. Click on [**Generate**].
 - A string representing the new product key is generated.
6. Write down the new product key immediately and keep it safe. After leaving this page, the newly generated product key can no longer be displayed. The previously valid product key is invalid after a new product key is generated. The copy of the product key must be accessible only to you.

Also see:

- [Establishing a connection to the user interface](#) ⇒ page 44
- [Logging Into the User Interface](#) ⇒ page 45
- [Restoring the password with product key](#) ⇒ page 72
- [Restoring the password without product key](#) ⇒ page 73

9.12 Activate Service access

In the event of a malfunction of the product, it may be necessary for a service user authorized by SMA Solar Technology AG to access the user interface of the product.

Service access must be activated to execute warranty services. If a quick and uncomplicated service intervention is to be enabled in an emergency, the service access must be permanently activated.

You have the option of activating the service access permanently or for a certain period of time.

Requirements:

- The user interface is open and you are logged in as **User** or **Installer**.

Procedure:

1. Select the menu **User settings**.
2. Select [**Access rights**].
3. Select [**Service**].
4. To activate service access permanently, click on [**Yes, permanently**] in the drop-down list.
5. To enable service access for a specific time, click on [**Yes, temporary**] in the drop-down list and adjust the expiration date if necessary.
6. Click on [**Save**].

Also see:

- [Establishing a connection to the user interface](#) ⇒ page 44
- [Logging Into the User Interface](#) ⇒ page 45

9.13 Deactivate Service access

Requirements:

- The user interface is open and you are logged in as **User** or **Installer**.

Procedure:

1. Select the menu **User settings**.
2. Select [**Access rights**].
3. Select [**Service**].
4. In the drop-down list select the entry [**No**].
5. Click on [**Save**].

Also see:

- [Establishing a connection to the user interface](#) ⇒ page 44
- [Logging Into the User Interface](#) ⇒ page 45

9.14 Dynamic power display (green LED)

As standard, the product signals its power dynamically via the pulsing of the green LED. When doing so, the LED flashes on and off uniformly or is permanently lit at full power. The various gradations are related here to the set active power limit of the product.

You can deactivate the dynamic power display. In this case, the green LED is lit permanently in feed-in operation.

Channel	Name	Group	Settings
Operation.GrnLedWInd	Dynamic power display via green LED	Device > Operation	<ul style="list-style-type: none"> • On (default) • Off

Also see:

- [Logging Into the User Interface](#) ⇒ page 45
- [Changing parameters](#) ⇒ page 51

9.15 Password

The password for the product can be changed for both user groups. Furthermore, the user group **Installer** can change the password for the user group **User** as well as its own password.

i **PV systems registered in a communication product**

With PV systems that are registered in a System Manager (e.g. SMA Data Manager) or in Sunny Portal, you can also assign a new password for the user group **Installer** via the System Manager. The password for the user group **Installer** is also the system password. If you assign a password for the user group **Installer** via the user interface of the inverter that does not correspond to the system password in the System Manager, the inverter can no longer be reached by the System Manager.

- Ensure that the password of the **Installer** user group corresponds to the system password.

Channel	Name	Group	Settings
Acs.PwdUsr	Set user password	User rights > Access control	<ul style="list-style-type: none"> • Random password according to password guideline
Acs.PwdIstl	Set installer password	User rights > Access control	<ul style="list-style-type: none"> • Random password according to password guideline

Also see:

- [Changing parameters](#) ⇒ page 51

9.16 Country standard

The product is set to a generally valid country standard by default. While commissioning the product using the installation assistant, a country standard appropriate for the installation site and intended purpose must be selected for the product to start operating.

You can change the country standard via the user interface.

i **The country data set must be set correctly.**

If you select a country data set which is not valid for your country and purpose, it can cause a disturbance in the PV system and lead to problems with the grid operator. When selecting the country data set, you must always observe the locally applicable standards and directives as well as the properties of the PV system (e.g. PV system size, grid-connection point).

- If you are not sure which standards and directives are valid for your country or purpose, contact the grid operator.

Channel	Name	Group	Settings
Country	Set the country standard	Grid monitoring > Grid monitoring	Selection of different country data sets

9.17 Q on Demand 24/7

With the "Q on Demand 24/7" function, the inverter remains connected to the utility grid overnight and is supplied with power via the utility grid in order that it can provide reactive power. When connected overnight, the inverter only draws an insignificant amount of active power from the utility grid to supply its internal assemblies. Depending on grid conditions and PV module characteristics, the inverter can provide up to 100% of its nominal power as reactive power.

The provision of reactive power during feed-in operation leads to a reduction of the feed-in power. This means that at 100% reactive power, the feed-in power is 0%. If the inverter is disconnected from the utility grid outside of feed-in operation, the "Q on Demand 24/7" function is not active. The "Q on Demand 24/7" function can only be restarted once there is sufficient PV power at the DC inputs of the inverter, meaning that the inverter can briefly switch back to feed-in operation at least once.

The general setting of the grid management services (e.g. cos phi setpoint or Q(V) characteristic curve) can not be fully set independently of the "Q on Demand 24/7" function via the relevant parameters - "Q on Demand 24/7" only permits Q specifications. It is to be noted here that certain settings can have an influence on other grid-support settings and functions.

This means that if the "Q on Demand 24/7" function" is active, no other grid-supporting functions (e.g., cos phi) are possible between day and night operation of the inverter. Should an independent reactive power provision be desired between day- and night operation, the reactive power provision must be communicated to the inverter via a superordinate control unit.

The function "Q on Demand 24/7" is not compatible with the reactive power mode **cos φ (P) charac. curve** or **cos φ (V) charac. curve**.

Currently, the provision of reactive power can only be read off via the phase currents and phase voltages in the instantaneous values (**Instantaneous values > AC Side > Phase currents / Phase voltage**) or requested via Modbus.

You can set the reactive power mode using the following parameters.

Channel	Name	Group	Settings
Inverter.VArMod-Cfg.VArModOut-Flb	Reactive power mode in case of active power output	System and device control > Inverter > Reactive power mode > Reactive power mode in case of active power output	Selection of various reactive power modes
Inverter.VArMod-Cfg.VArModZerW	Reactive power for zero power output	System and device control > Inverter > Reactive power mode > Reactive power mode in case of zero power output	Selection of various reactive power modes

9.18 Saving the Configuration in a File

You can save the current configuration of the product to a file. To configure the products, you can use this file as a backup of this product and then import the file back into this product or other products of the same type or device family. When saving, only the device parameters will be saved, not any passwords.

Requirement:

- You are logged in on the user interface.

Procedure:

1. Select the menu **Device Configuration**.
2. Select [**Settings**].
3. In the context menu, select [**Saving the configuration in a file**].
4. Follow the instructions in the dialog.

Also see:

- [Adopting a Configuration from a File](#) ⇒ page 56

9.19 Adopting a Configuration from a File

QUALIFIED PERSON

To configure the product, you can transfer the configuration from a file. To do this, you must first save the configuration of another product of the same type or the same device family to a file. When saving, only the device parameters will be adopted, not any passwords.

Requirements:

- Changes to grid-relevant parameters must be approved by the responsible grid operator.
- The SMA Grid Guard code must be available. You can request the SMA Grid Guard code via the Online Service Center.
- You are logged in on the user interface as **Installer**.

Procedure:

1. Select the menu **Device Configuration**.
2. Select [**Settings**].
3. In the context menu, select [**Adopting the configuration from a file**].
4. Follow the instructions in the dialog.

Also see:

- [Saving the Configuration in a File](#) ⇒ page 55

9.20 Modbus function

The Modbus interface is deactivated by default and the communication ports 502 set.

To access SMA products with SMA Modbus® or SunSpec® Modbus®, the Modbus interface must be activated. After enabling the interface, the communication ports of both IP protocols can be changed.

Measures for data security during activated Modbus interface

If you activate the Modbus interface, there is a risk that unauthorized users may access and manipulate the data or devices in your PV system.

To ensure data security, take appropriate protective measures such as:

- Set up a firewall.
- Close unnecessary network ports.
- Only enable remote access via VPN tunnel.
- Do not set up port forwarding at the communication port in use.

If you would like to deactivate an activated Modbus interface again, you can reset the product to the default settings or deactivate the activated parameters again.

Also see:

- [Modbus](#) ⇒ page 17

9.21 Automatic firmware update

The product can automatically download and install a firmware update. You can activate the automatic firmware update either via the user interface of the product or the System Manager (e.g. SMA Data Manager) or via the Sunny Portal.

If the automatic firmware updated is deactivated, you can manually search and install new firmware versions.

You can activate or deactivate the automatic firmware update using the following parameter.

Channel	Name	Group	Settings
Upd.AutoUpdIsOn	Automatic updates activated	Device > Update > Automatic update	<ul style="list-style-type: none"> • Yes • No (default)

Also see:

- [Updating firmware via the user interface ⇒ page 57](#)
- [Updating Firmware with Update File via the User Interface ⇒ page 57](#)

9.22 Updating Firmware with Update File via the User Interface

QUALIFIED PERSON

Requirements:

- An update file with the desired firmware of the product must be available. You can download the update file from the product page under www.SMA-Solar.com.
- You are logged in on the user interface as **Installer**.

Procedure:

1. Select the menu **Device Parameters**.
2. Click on **[Edit parameters]**.
3. Select the menu **Device Configuration**.
4. In the product row, click on the gear icon and select **Update firmware**.
5. Select **[Browse]** and select the update file for the product.
6. Select **Update firmware**.
7. Follow the instructions in the dialog.
8. Open the user interface and check the events to see whether the firmware update has been completed successfully.

9.23 Updating firmware via the user interface

QUALIFIED PERSON

Requirements:

- The product must be connected to the Internet.
- You are logged in on the user interface as **Installer**.

Procedure:

1. Select the menu **Device Parameters**.
 2. Click on **[Edit parameters]**.
 3. Go to **Device > Update**.
 4. Select the parameter **Check for update and install it** and set it to **Execute**.
 5. Click on **[Save all]**.
- The firmware is updated in the background.

10 Disconnecting the product from voltage sources

⚠ QUALIFIED PERSON

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.

⚠ WARNING

Danger to life due to electric shock from destruction of the measuring device due to overvoltage

Overvoltage can damage a measuring device and result in voltage being present in the enclosure of the measuring device. Touching the live enclosure of the measuring device results in death or lethal injuries due to electric shock.

- Only use measuring devices with a measurement ranges designed for the maximum AC and DC voltage of the inverter.

NOTICE

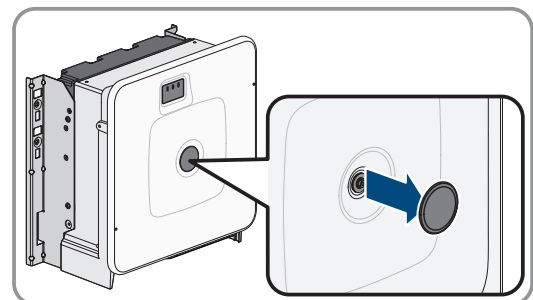
Damage to the inverter due to switching operations on the transformer

If voltages are present in the inverter, switching operations on the transformer can lead to large fluctuations in the voltage in the inverter. Large fluctuations in voltage can damage components in the inverter.

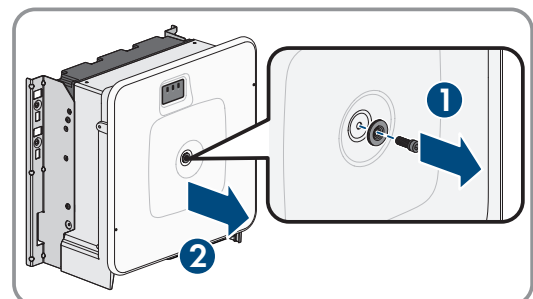
- Disconnect the inverter from voltage sources before performing any switching operations on the transformer.

Procedure:

1. Disconnect the AC miniature circuit breaker and secure against reconnection.
2. Disconnect the DC terminal of the inverter via the PV combiner box or the external DC switch.
3. Wait 5 minutes. This will ensure that the capacitors are discharged.
4. Wait until the LEDs have gone out.
5. Remove the cover from the enclosure lid.

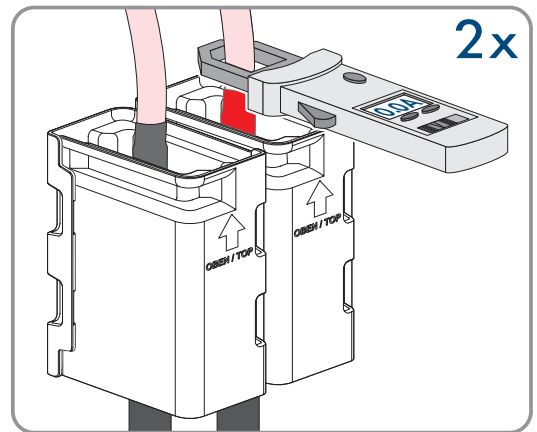


6. Unscrew the screw on the enclosure lid (hex socket, AF8) and remove the enclosure lid.

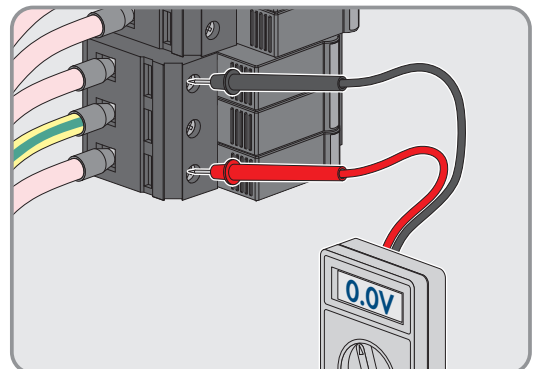


7. Set the cover, screw with seal, washer with seal and enclosure lid aside and store safely.

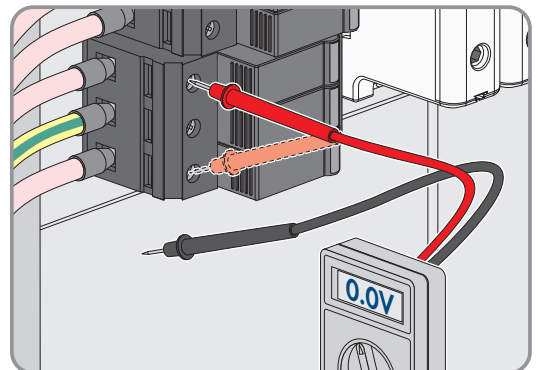
8. Use a current clamp to ensure that no current is present in the DC cables. As a result, a possible residual current can be detected.



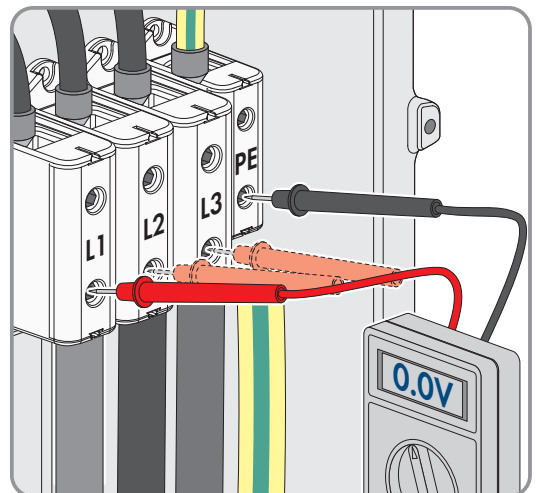
9. Ensure that no voltage is present between the positive terminal and negative terminal on the DC surge protection devices using a suitable measuring device. To do so, insert the test probe (maximum diameter: 2.5 mm (0.078 in)) into the measuring points of the DC surge protection devices.



10. Ensure that no voltage is present between the positive terminal and ground as well as between the negative terminal and ground on the DC surge protection devices using a suitable measuring device. To do so, insert a test probe (maximum diameter: 2.5 mm (0.078 in)) into the measuring points of the DC surge protection devices and hold the other one, for example, on the enclosure.



11. Ensure that no voltage is present on the AC terminal block between L1 and grounding conductor, L2 and grounding conductor, and L3 and grounding conductor using a suitable measuring device. To do so, insert the test probe (maximum diameter: 2.5 mm (0.078 in)) into the measuring points of the respective terminal blocks.



12. Optional: Shut off the transformer.

11 Cleaning

The product must be cleaned regularly to ensure that the product is free of dust, leaves and other dirt.

NOTICE

Damage to the product due to cleaning agents

The use of cleaning agents may cause damage to the product and its components.

- Clean the product and all its components only with a cloth moistened with clear water.

12 Troubleshooting

12.1 Event Messages

12.1.1 Event 501

QUALIFIED PERSON

Event message:

- System incident

Explanation:

The grid frequency is not within the permissible range. The inverter has disconnected from the utility grid.

Corrective measures:

- If possible, check the grid frequency and observe how often fluctuations occur.
If fluctuations occur frequently and this message is displayed often, contact the grid operator and request approval to change the operating parameters of the inverter.
If the grid operator gives his approval, discuss any changes to the operating parameters with the Service.

12.1.2 Event 507

QUALIFIED PERSON

Event message:

- Active power limit AC frequency

Explanation:

The inverter has reduced its power due to a too-high grid frequency to ensure grid stability.

Corrective measures:

- If possible, check the grid frequency and observe how often fluctuations occur. If fluctuations occur frequently and this message is displayed often, contact the grid operator and request approval to change the operating parameters of the inverter. If the grid operator gives his approval, discuss any changes to the operating parameters with the Service.

12.1.3 Event 601

QUALIFIED PERSON

Event message:

- System incident

Explanation:

The inverter has detected an excessively high proportion of direct current in the grid current.

Corrective measures:

- Check the grid connection for direct current.
- If this message is displayed frequently, contact the grid operator and check whether the monitoring threshold on the inverter can be raised.

12.1.4 Event 701

⚠ QUALIFIED PERSON**Event message:**

- Frequency not permitted
- Check parameter

Explanation:

The grid frequency is not within the permissible range. The inverter has disconnected from the utility grid.

Corrective measures:

- Check the AC cabling from the inverter to the feed-in meter.
- If possible, check the grid frequency and observe how often fluctuations occur.
If fluctuations occur frequently and this message is displayed often, contact the grid operator and request approval to change the operating parameters of the inverter.
If the grid operator gives his approval, discuss any changes to the operating parameters with the Service.

12.1.5 Event 1302

⚠ QUALIFIED PERSON**Event message:**

- Wait for grid voltage
- Grid connection installation error
- Check grid and fuses

Explanation:

L or N not connected.

Corrective measures:

- Ensure that the line conductors are connected.
- Ensure that the miniature circuit breaker is switched on.
- Ensure that the AC cable is not damaged and that it is connected correctly.

12.1.6 Event 1501

⚠ QUALIFIED PERSON**Event message:**

- Reconnection fault grid

Explanation:

The changed country standard or the value of a parameter you have set does not correspond to the local requirements. The inverter cannot connect to the utility grid.

Corrective measures:

- Ensure that the country standard has been configured correctly. To do this, select the parameter **Set country standard** and check the value.

12.1.7 Event 3401

QUALIFIED PERSON

Event message:

- DC overvoltage
- Disconnecting generator

Explanation:

Overvoltage at the DC input. This can destroy the inverter.

This message is signaled additionally by rapid flashing of the LEDs.

Corrective measures:

- **Immediately** disconnect the inverter from all voltage sources.
- Check whether the DC voltage is below the maximum input voltage of the inverter. If the DC voltage is below the maximum input voltage of the inverter, reconnect the DC cables to the inverter.
- If the DC voltage exceeds the maximum input voltage of the inverter, ensure that the PV array has been correctly rated or contact the installer of the PV array.
- If this message is repeated frequently, contact the Service.

12.1.8 Event 3501

QUALIFIED PERSON

Event message:

- Insulation error
- Check generator

Explanation:

The inverter has detected a ground fault in the PV array.

Corrective measures:

- Check the PV system for ground faults.

12.1.9 Event 3601

QUALIFIED PERSON

Event message:

- High leakage current
- Check generator

Explanation:

The leakage current of the inverter and the PV module is too high. There is a ground fault, a residual current or a malfunction.

The inverter interrupts feed-in operation immediately after exceeding a threshold. When the fault is eliminated, the inverter automatically reconnects to the utility grid.

Corrective measures:

- Check the PV system for ground faults.

12.1.10 Event 3701**⚠ QUALIFIED PERSON****Event message:**

- Residual current too high
- Check generator

Explanation:

The inverter has detected a residual current through brief grounding of the PV array.

Corrective measures:

- Check the PV system for ground faults.

12.1.11 Event 3902**⚠ QUALIFIED PERSON****Event message:**

- Waiting for DC start conditions
- Start conditions not met

Explanation:

The feed-in conditions for the utility grid are not yet fulfilled.

Corrective measures:

- Ensure that the PV array is not covered by snow or otherwise shaded.
- Wait for higher irradiation.
- If this message is displayed frequently in the morning, increase the voltage limit for starting grid feed-in. Change the parameter **Critical voltage to start feed-in**.
- If this message is displayed frequently with medium irradiation, ensure that the PV array is correctly rated.

12.1.12 Event 6001-6438**⚠ QUALIFIED PERSON****Event message:**

- Self-diagnosis
- Device fault

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact the Service.

12.1.13 Event 6501**⚠ QUALIFIED PERSON****Event message:**

- Self-diagnosis
- Overtemperature

Explanation:

The inverter has switched off due to excessive temperature.

Corrective measures:

- Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush.
- Ensure that the inverter has sufficient ventilation.
- Ensure that the inverter is not exposed to direct solar irradiation.
- Ensure the maximum ambient temperature is not exceeded.

12.1.14 Event 6511**⚠ QUALIFIED PERSON****Event message:**

- Overtemperature

Explanation:

An overtemperature has been detected in the choke area.

Corrective measures:

- Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush.
- Ensure that the inverter has sufficient ventilation.
- Ensure that the inverter is not exposed to direct solar irradiation.

12.1.15 Event 6512**Event message:**

- Minimum operating temperature not reached

Explanation:

The inverter will only recommence grid feed-in once the temperature has reached at least -25°C .

12.1.16 Event 6701**⚠ QUALIFIED PERSON****Event message:**

- Communication failure

Explanation:

Error in the communication processor, the inverter continues feeding in, however. The cause must be determined by the Service.

Corrective measures:

- If this message is displayed frequently, contact the Service.

12.1.17 Event 7001**⚠ QUALIFIED PERSON****Event message:**

- Fault sensor interior temperature

Explanation:

A temperature sensor in the inverter is defective and the inverter interrupts the feed-in operation. The cause must be determined by the Service.

Corrective measures:

- Contact the Service.

12.1.18 Event 7102**⚠ QUALIFIED PERSON****Event message:**

- Parameter file not found or defective

Explanation:

The parameter file was not found or is defective. Loading the parameter file has failed. The inverter continues to feed in.

Corrective measures:

- Copy the parameter file to the correct folder again.

12.1.19 Event 7303**⚠ QUALIFIED PERSON****Event message:**

- Host computer update failed

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact the Service.

12.1.20 Event 7324**⚠ QUALIFIED PERSON****Event message:**

- Wait for update conditions

Explanation:

The testing of the update conditions was not successful. The firmware update package is not suitable for this inverter.

Corrective measures:

- Retry update.
- Ensure that the selected update file is suitable for this inverter.
- If this message is displayed again, contact the Service.

12.1.21 Event 7330**Event message:**

- Wait for update conditions

Explanation:

The testing of the update conditions was not successful. The firmware update package is not suitable for this inverter.

12.1.22 Event 7333**⚠ QUALIFIED PERSON****Event message:**

- Update transport failed

Explanation:

Update file could not be copied to the inverter's internal memory.

Corrective measures:

- Retry update.
- If this message is displayed again, contact the Service.

12.1.23 Event 7347**⚠ QUALIFIED PERSON****Event message:**

- Incompatible file

Explanation:

The configuration file is not suitable for this inverter.

Corrective measures:

- Ensure that the selected configuration file is suitable for this inverter.
- Retry import.

12.1.24 Event 7348**⚠ QUALIFIED PERSON****Event message:**

- Incorrect file format

Explanation:

The configuration file is not of the required format or is damaged.

Corrective measures:

- Ensure that the selected configuration file is of the required format and is not damaged.

- Retry import.

12.1.25 Event 7349

QUALIFIED PERSON

Event message:

- Incorrect login rights for configuration file

Explanation:

The user group logged in does not have the user rights necessary to be able to import a configuration.

Corrective measures:

- Log in as **Installer**.
- Import configuration file again.

12.1.26 Event 7619

QUALIFIED PERSON

Event message:

- Communication fault with meter unit
- Check communication to the energy meter

Explanation:

The inverter is not receiving any data from the energy meter.

Corrective measures:

- Ensure that the energy meter is correctly integrated into the same network as the inverter (see energy meter manual).

12.1.27 Event 7701

QUALIFIED PERSON

Event message:

- Self-diagnosis
- Device fault

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact the Service.

12.1.28 Event 7801

QUALIFIED PERSON

Event message:

- Fault overvoltage protector

Explanation:

One or more surge arresters have tripped or one or more surge arresters are not inserted correctly.

Corrective measures:

- Ensure that the surge arrester is inserted correctly.
- If surge arresters have tripped, replace the tripped surge arresters with new surge arresters.

12.1.29 Event 8003**⚠ QUALIFIED PERSON****Event message:**

- Active power limit Temperature

Explanation:

The inverter has reduced its power output for more than 10 minutes due to excessive temperature.

Corrective measures:

- Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush.
- Ensure that the inverter has sufficient ventilation.
- Ensure the maximum ambient temperature is not exceeded.
- Ensure that the inverter is not exposed to direct solar irradiation.

12.1.30 Event 8101**⚠ QUALIFIED PERSON****Event message:**

- Communication failure

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact the Service.

12.1.31 Event 8708**⚠ QUALIFIED PERSON****Event message:**

- Timeout in communication for active power limitation

Explanation:

Communication to the system control absent. Depending on the fallback 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.

Corrective measures:

- Ensure that the connection to the system manager is intact and that no cables are damaged or that no plugs have been pulled.

12.1.32 Event 8709

QUALIFIED PERSON

Event message:

- Timeout in communication for reactive power setpoint

Explanation:

Communication to the system control absent.

Corrective measures:

- Ensure that the connection to the system manager is intact and that no cables are damaged or that no plugs have been pulled.

12.1.33 Event 8710

QUALIFIED PERSON

Event number:

- Timeout in communication for cos phi setpoint

Explanation:

Communication to the system control absent.

Corrective measures:

- Ensure that the connection to the system manager is intact and that no cables are damaged or that no plugs have been pulled.

12.1.34 Event 9002

QUALIFIED PERSON

Event message:

- SMA Grid Guard code invalid

Explanation:

The SMA Grid Guard code entered is incorrect. The operating parameters are still protected and cannot be changed.

Corrective measures:

- Enter the correct SMA Grid Guard code.

12.1.35 Event 9003

QUALIFIED PERSON

Event message:

- Grid parameters locked

Explanation:

Changes to the grid parameters are now blocked. In order to be able to make changes to the grid parameters, from now on you must log in using the SMA Grid Guard code.

Corrective measures:

- Log in as **Installer** and enter the SMA Grid Guard code.

12.1.36 Event 9007

QUALIFIED PERSON

Event message:

- Abort self-test

Explanation:

The self-test was terminated.

Corrective measures:

- Ensure that the AC connection is correct.
- Ensure that the country data set has been entered correctly.
- Restart the self-test.

12.1.37 Event 9107

QUALIFIED PERSON

Event message:

- Self-diagnosis
- Device fault

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact the Service.

12.1.38 Event 10110

QUALIFIED PERSON

Event message:

- Time synchronization failed: [xx]

Explanation:

No time information could be called up from the set NTP server.

Corrective measures:

- Ensure that the NTP server was configured correctly.
- Ensure that the inverter is integrated into a local network with Internet connection.

12.1.39 Event 10248

QUALIFIED PERSON

Event message:

- [Interface]: network busy

Explanation:

The network is busy. Data exchange between the devices is not at an optimum and is greatly delayed.

Corrective measures:

- Increase the query intervals.
- If necessary, reduce the number of devices in the network.

12.1.40 Event 10249**⚠ QUALIFIED PERSON****Event message:**

- [Interface]: network busy

Explanation:

The network is overloaded. There is no data exchange between the devices.

Corrective measures:

- Reduce the number of devices in the network.
- If necessary, increase the data query intervals.

12.1.41 Event 10250**⚠ QUALIFIED PERSON****Event message:**

- [Interface]: package error rate [ok / high]

Explanation:

The package error rate has changed. If the package error rate is high, the network is overloaded or the connection to the network switch or DHCP server (router) is impaired.

Corrective measures:

- Ensure that with an Ethernet connection, the network cable and the network connector are not damaged and that the network connectors are correctly plugged.
- If necessary, increase the data query intervals.
- If necessary, reduce the number of devices in the network.

12.1.42 Event 10252**⚠ QUALIFIED PERSON****Event message:**

- [Interface]: communication disrupted

Explanation:

There is no valid signal on the network line.

Corrective measures:

- Ensure that with an Ethernet connection, the network cable and the network connector are not damaged and that the network connectors are correctly plugged.
- Ensure that the DHCP server (router) and any network switches are signaling correct operation.

12.1.43 Event 10253

QUALIFIED PERSON

Event message:

- [Interface]: connection speed goes to [100 Mbit / 10 Mbit]

Explanation:

The data transfer rate has changed. The cause for the status [10 Mbit] can be a defective plug, a defective cable or the pulling or plugging of the network connector.

Corrective measures:

- Ensure that with an Ethernet connection, the network cable and the network connector are not damaged and that the network connectors are correctly plugged.
- Ensure that the DHCP server (router) and any network switches are signaling correct operation.

12.1.44 Event 10254

QUALIFIED PERSON

Event message:

- [Interface]: duplex mode goes to [Full / Half]

Explanation:

The duplex mode (data transfer mode) has changed. The cause for the status [Half] can be a defective plug, a defective cable or the pulling or plugging of the network connector.

Corrective measures:

- Ensure that with an Ethernet connection, the network cable and the network connector are not damaged and that the network connectors are correctly plugged.
- Ensure that the DHCP server (router) and any network switches are signaling correct operation.

12.1.45 Event 10282

QUALIFIED PERSON

Event message:

- [User group]-Login via [protocol] locked

Explanation:

After several incorrect login attempts, login has been blocked for a limited time. In this case, the User login will be blocked for 15 minutes, the Grid Guard login for 12 hours.

Corrective measures:

- Wait until the given time has expired and then retry login.

12.2 Restoring the password with product key

If you have forgotten your user group, you can use the product key to restore the password.

If you have not yet generated the product key, you can restore the password with a specific device secret.

i Password assignment for inverters that are registered in a System Manager (e.g. SMA Data Manager)

The password for the user group **Installer** is also the system password for the PV system in the System Manager or Sunny Portal. Changing the password of the user group **Installer** can lead to the inverter no longer being able to be reached by the System Manager.

- In the System Manager, assign the changed password of the user group **Installer** as the new system password (see the manual of the System Manager).

Requirements:

- The login page of the user interface must be open.
- The product key for the selected user group must be available.

Procedure:

1. Select the group **User** or **Installer**.
2. Click on [**Forgot your password?**].
3. Enter the product key. If you have not yet generated your product key, enter the specific device secret. Which specific device secret is used and where you can find the specific device secret is indicated on the user interface.
 - The page for generating a new password will open.
4. Generate a new password.
5. Click on [**Save**] to save the changes.

Also see:

- [Establishing a connection to the user interface](#) ⇒ page 44
- [Generating a product key for the first time](#) ⇒ page 51
- [Generate new product key](#) ⇒ page 52

12.3 Restoring the password without product key

If you have forgotten the product's password and the product key has been lost, you can create a new password and a new product key by carrying out the following steps.

i Password assignment for inverters that are registered in a System Manager (e.g. SMA Data Manager)

The password for the user group **Installer** is also the system password for the PV system in the System Manager or Sunny Portal. Changing the password of the user group **Installer** can lead to the inverter no longer being able to be reached by the System Manager.

- In the System Manager, assign the changed password of the user group **Installer** as the new system password (see the manual of the System Manager).

Requirements:

- The login page of the user interface must be open.

Procedure:

1. Select the group **User** or **Installer**.
2. Click on [**Forgot your password?**].
3. Click on [**Product key lost?**] wählen. If you have not yet generated a product key, the name of the specific device secret is displayed instead of **Product key**. In this case, click on [**### lost?**].
4. Read the help text and enter a new password.
5. Click on [**Next**].

6. Perform one of the displayed actions within the specified time period.
 - A newly generated product key is displayed.
 - If the action performed was tapping the enclosure lid 2 times, the blue LED will flash rapidly.
7. Write down the new product key immediately and keep it safe. After leaving this page, the newly generated product key can no longer be displayed. The previously valid product key is invalid after a new product key is generated. The copy of the product key must be accessible only to you.
8. Select [**Login**].
 - You are logged in on the user interface of the product.

Also see:

- [Establishing a connection to the user interface ⇒ page 44](#)
- [Generating a product key for the first time ⇒ page 51](#)
- [Generate new product key ⇒ page 52](#)

12.4 Calculating the insulation resistance

The expected total resistance of the PV system or of an individual string can be calculated using the following formula:

The exact insulation resistance of a PV module can be obtained from the module manufacturer or the datasheet.

$$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

The exact insulation resistance of a PV module can be obtained from the module manufacturer or the datasheet.

For the resistance of a PV module an average value can be assumed: for thin-film PV modules approximately 40 MΩ and for polycrystalline and monocrystalline PV modules approximately 50 MΩ per PV module (for further information on calculating the insulation resistance see the Technical Information "Insulation Resistance (Riso) of Non-Galvanically Isolated PV Systems" at www.SMA-Solar.com).

Also see:

- [Checking the PV System for Ground Faults ⇒ page 74](#)

12.5 Checking the PV System for Ground Faults

QUALIFIED PERSON

If the red LED is glowing and the event number 3501, 3601 or 3701 is being displayed in the **Results** menu on the inverter user interface, there may be a ground fault present. The electrical insulation from the PV system to ground is defective or insufficient.

DANGER

Danger to life due to electric shock when touching live system components in case of a ground fault

If a ground fault occurs, parts of the system may still be live. Touching live parts and cables results in death or lethal injuries due to electric shock.

- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Only touch the cables of the PV modules on their insulation.
- 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.
- Ensure that no voltage is present and wait 5 minutes before touching any parts of the PV system or the product.

⚠ WARNING**Danger to life due to electric shock from destruction of the measuring device due to overvoltage**

Overvoltage can damage a measuring device and result in voltage being present in the enclosure of the measuring device. Touching the live enclosure of the measuring device results in death or lethal injuries due to electric shock.

- Only use measuring devices with a measurement ranges designed for the maximum AC and DC voltage of the inverter.

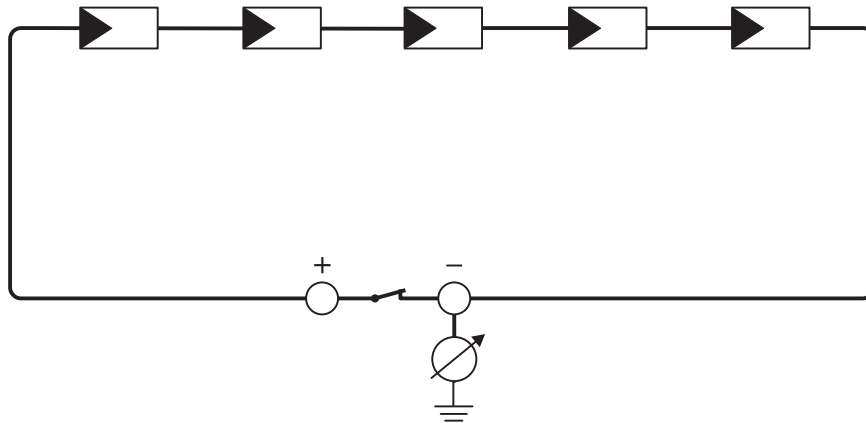


Figure 15: Schematic diagram of the measurement

Required equipment:

- Suitable device for safe disconnection and short-circuiting
- Measuring device for insulation resistance

i Device required for safe disconnection and short-circuiting of the PV array

The insulation resistance can only be measured with a suitable device for safe disconnection and short-circuiting of the PV array. If no suitable device is available, the insulation measurement must not be carried out.

Procedure:

1. Calculate the expected insulation resistance per string.
2. Disconnect the inverter from all voltage sources .
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.
13. If the inverter still displays an insulation error, contact the Service. The PV modules might not be suitable for the inverter in the present quantity.

Also see:

- [Calculating the insulation resistance](#) ⇒ page 74

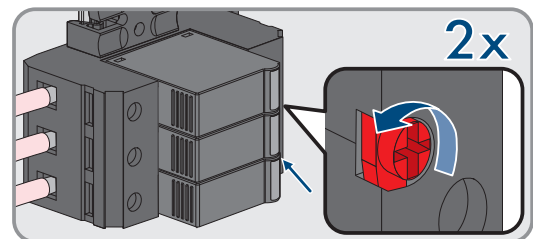
12.6 Replacing the Surge Arrester

⚠ QUALIFIED PERSON

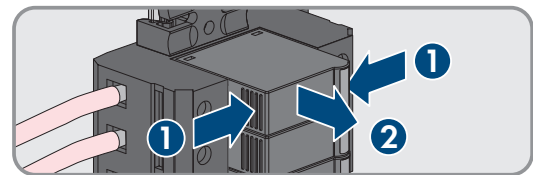
If the inverter displays event number 7801, an error is present in the surge arresters or the surge arresters have tripped. If the surge arresters have tripped, replace the tripped surge arresters with new surge arresters.

Procedure:

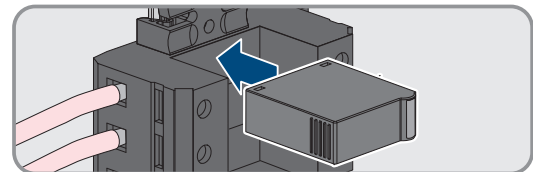
1. Disconnect the product from voltage sources .
2. Unlock the surge arresters by using a screwdriver to turn the latch to the open position.



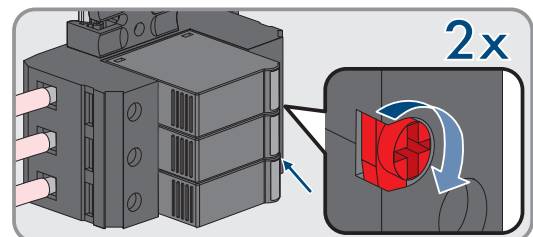
3. Pull the surge arresters out of the slots.



4. Dispose of the surge arresters in accordance with the locally applicable disposal regulations for electronic waste.
5. Insert new surge arresters.



6. Lock the surge arresters by using a screwdriver to turn the latch to the closed position.



7. Ensure that each surge arrester is securely inserted into its slot.
8. Put the product into operation again.

12.7 Cleaning the Fans

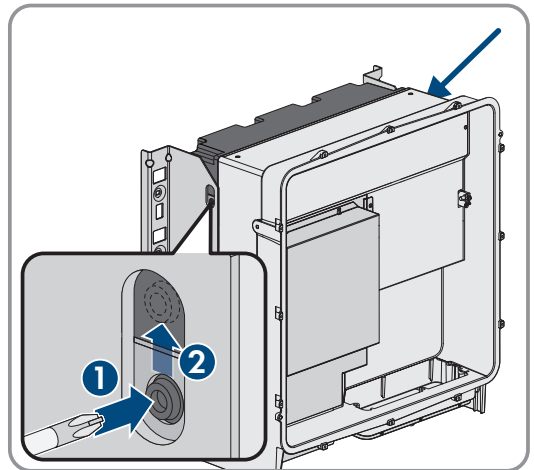
⚠ QUALIFIED PERSON

If the performance of the fans is decreasing, it can be restored by cleaning the fans.

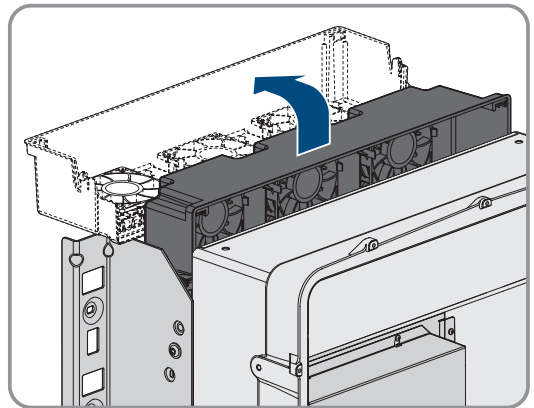
Procedure:

1. Disconnect the product from voltage sources .

- Unlock the fan bracket on the right and left of the product. To do so, press in the locking tabs and push them upwards.



- Move the fan bracket upwards and fold it backwards. When doing this, note that the fan bracket cannot be removed completely, because the fan cable connects it to the product.

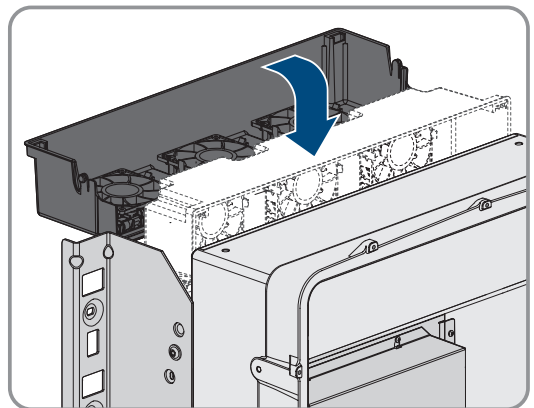


4. NOTICE

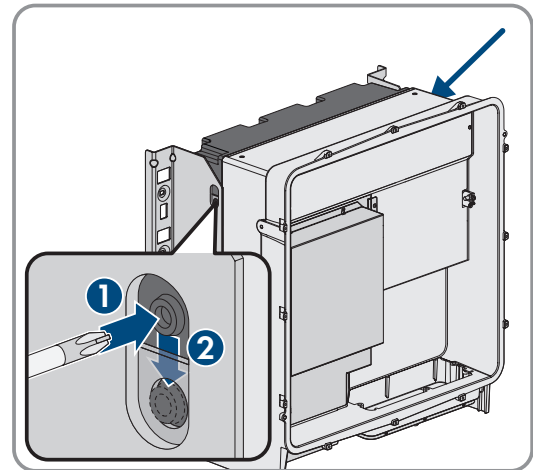
Damage to the fans due to compressed air

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

- If the cooling fins are dirty, clean them using a soft brush.
- Insert the locking tabs on the left and right of the fan bracket into the recesses and the top into the suspensions.



7. Press the fan bracket firmly downwards so that the locking tabs engage on the right and left.



8. Put the product into operation again.

12.8 Diagnostic function in the event of a defective Speedwire communication

If several Speedwire devices in line topology are connected to each other in the system and the Speedwire communication does not function properly, you have the option of activating diagnostic functions for simple troubleshooting.

The following diagnostic functions are available:

- Activating the Speedwire communication display on the product (see Section 12.9, page 78)
- Testing the Speedwire communication by using SMA Data Manager (see Section 12.10, page 78)

12.9 Activating the Speedwire communication display

By activating this diagnostic function, the product can signal how many network cables are connected by the blue LED flashing. This lets you quickly check the following items:

- Is the network cable plugged in for products where only 1 network cable is to be connected?
- Is only 1 network cable connected for products where 2 network cables are to be connected?

Procedure:

1. In the parameter group **Device > Operation**, select the parameter **Ethernet link diagnostic via LED** and set this to **On**.
 - Blue LED glows (2 s on and 250 ms off): 2 network cables are connected to the inverter.
 - Blue LED flashes (2 s on and 250 ms off): 1 network cable is connected to the inverter.
 - Blue LED is not flashing: No network cable is connected.
2. Check whether for the products where the blue LED is not flashing there really should not be a network cable connected.
3. Check for the products where the blue LED is flashing whether there should actually only be 1 network cable connected or whether 2 network cables should be connected here.

12.10 Testing the Speedwire communication by using SMA Data Manager

If there is an SMA Data Manager in the system, the product can use the red LED to signal whether the Speedwire communication is working properly. The diagnostic function can only be activated via the user interface of the SMA Data Manager.

Procedure:

1. Select the **Communication diagnostic** parameter via the SMA Data Manager user interface and set it to **On**.
 - ☑ The red LED of the product flashes (250 ms on and 250 ms off): The communication of the Speedwire devices connected in line topology is working properly.
 - ☑ The red LED of the product does not flash: The Speedwire communication is not working properly.
2. Check the communication link of the products with faulty Speedwire communication.

13 Decommissioning

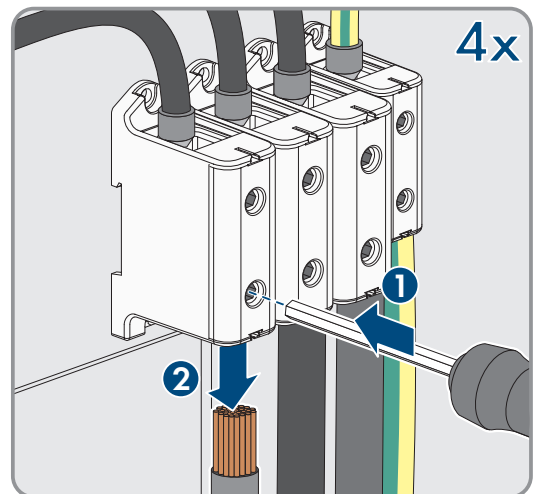
13.1 Disconnecting product connections

⚠ QUALIFIED PERSON

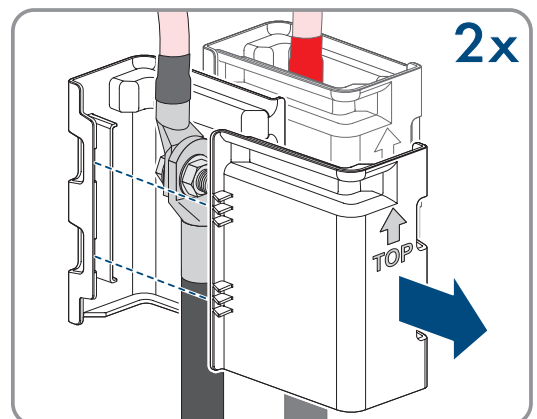
To decommission the product completely upon completion of its service life, first disconnect all connections from the product.

Procedure:

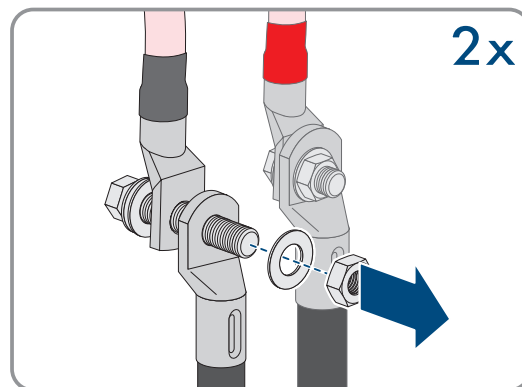
1. Disconnect the product from voltage sources .
2. Remove the AC cable from the inverter. Loosen the screws of the terminals L1, L2 and L3 (AF8) and the screws of the terminal (AF5).



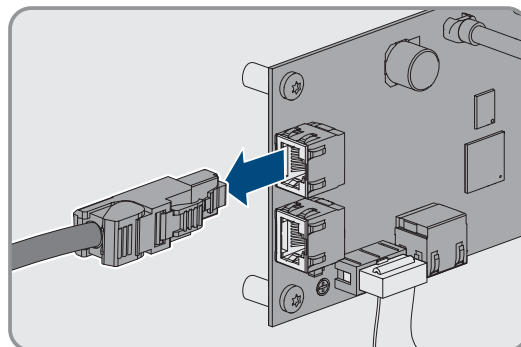
3. Remove the protection elements against contact from the terminal lugs for the DC connection. To do so, unlock the side brackets.



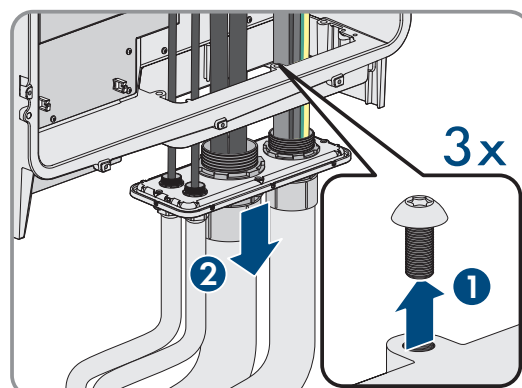
4. Remove the DC cable connection. Loosen the hex nuts and remove the combined hexagon head screw (AF16).



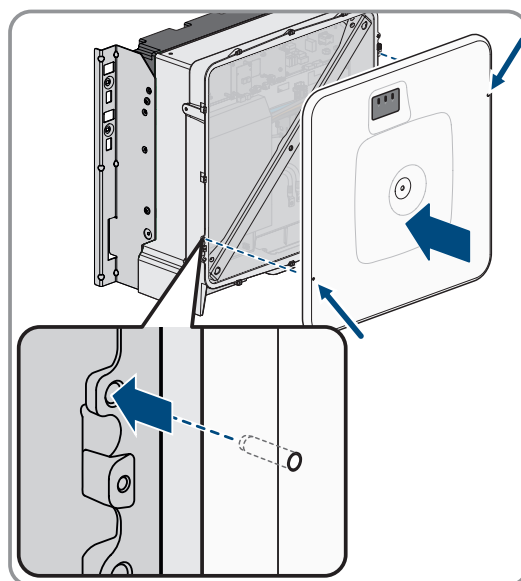
5. Remove the network cables from the network ports.



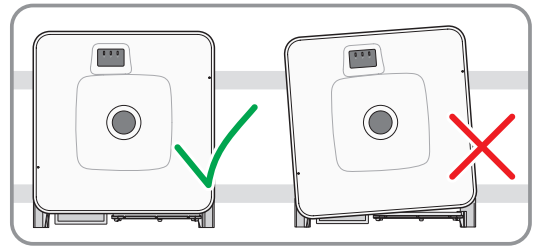
6. Remove all cable conduits from the connecting plate. To do this, screw the conduit fittings out of the openings from the inside.
7. Dismantle the connecting plate. To do so, unscrew the three screws (TX40).



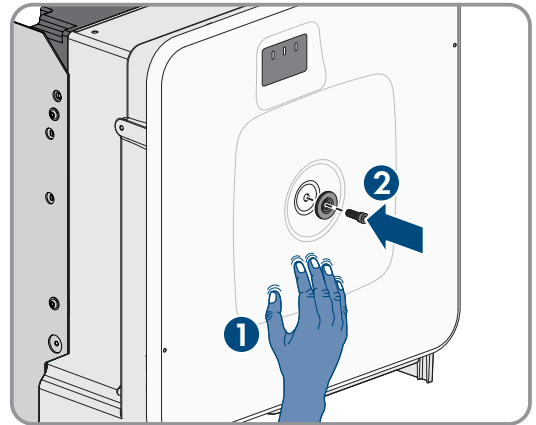
8. Position the enclosure lid. The two guide pins on the enclosure lid must slide into the guide openings on the enclosure lid.



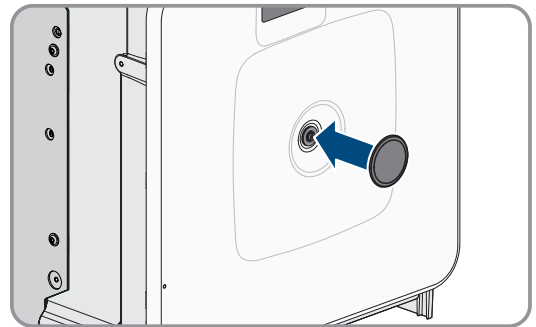
9. Ensure that the cover sits straight on the enclosure.



10. Hold the enclosure lid pressed against the enclosure and screw and tighten the screw (hex socket AF8, torque: 18 Nm).



11. Place the cover on the screw in the enclosure lid.



12. Disassemble the product (see Section 13.2, page 81).

13.2 Disassembling the product

⚠ QUALIFIED PERSON

To decommission the product completely upon completion of its service life, disassemble the product as described in the following.

⚠ CAUTION

Risk of injury due to weight of product

Injuries may result if the product is lifted incorrectly or dropped while being transported or mounted.

- Transport and lift the product carefully. Take the weight of the product into account.
- Wear suitable personal protective equipment for all work on the product.
- Transport the product using the carrying handles or hoist. Take the weight of the product into account.
- Use all carrying handles provided during transport with carrying handles.
- Do not use the carrying handles as attachment points for hoist equipment (e.g. straps, ropes, chains). Insert eye bolts into threads provided on top of the product to attach the hoist system.

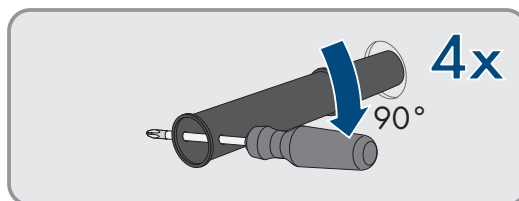
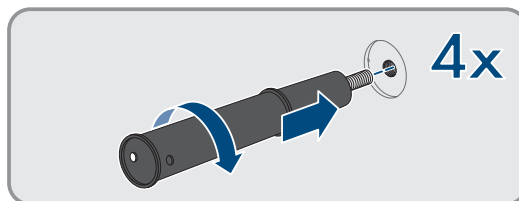
Requirements:

- All connections of the product are disconnected .
- Original packaging or packaging suitable for the weight and dimensions of the product is available.

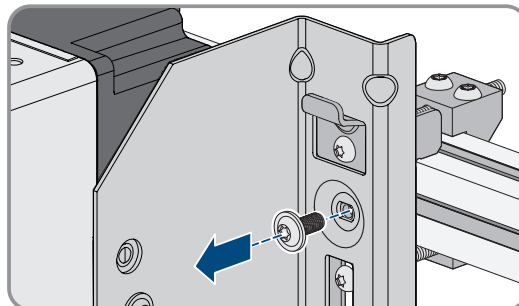
- A pallet is available.
- Mounting material for attaching the packaging on the pallet is available (e.g. tie-down straps).
- All transport handles are in place.

Procedure:

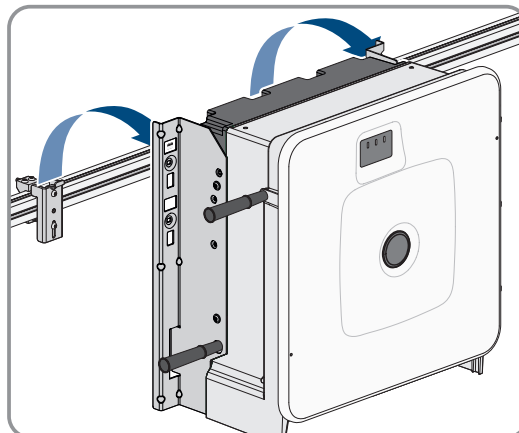
1. Screw the transport handles as far as they will go into the tapped holes on the right- and left-hand side until they lie flush with the enclosure. When doing so, ensure that the transport handles are screwed into the tapped holes so that they are perfectly straight. If the transport handles are not screwed in straight, this can make it more difficult or even impossible to unscrew them later on. The tapped holes may get damaged, thus making it difficult to mount the transport handles again.
2. Insert a screwdriver into the holes in the transport handle and turn the screwdriver through 90°. This ensures that the transport handles are securely tightened.



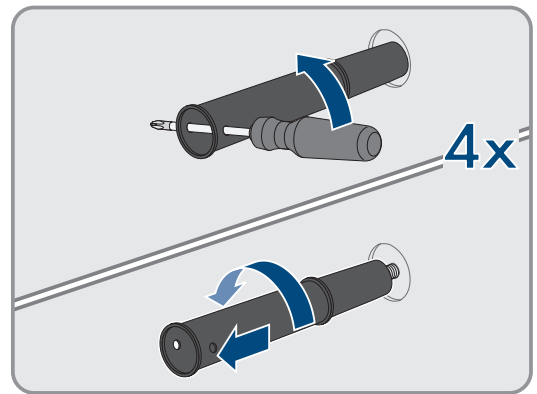
3. If the product should be lifted from the mounting bracket with the help of a hoist, screw the eye bolts into the threads on the top of the product and attach the hoist to them. The hoist must be suitable for the weight of the product.
4. Unscrew the screw for securing the product to the mounting brackets on the right and left (TX40).



5. Remove the product from the mounting lugs of the mounting brackets by moving it upward.



- Remove all 4 transport handles from the tapped holes. If necessary, insert a screwdriver into the holes on the transport handle and use the screwdriver to remove the transport handle.



- If the product should be stored or shipped: Package the product and the wall mounting bracket. To do this, use original packaging or packaging suitable for the weight and size of the product and secure the packaging to the pallet with tension straps.
- Dispose of the product if necessary (see Section 14, page 83).

14 Disposal

The product must be disposed of in accordance with the locally applicable disposal regulations for waste electrical and electronic equipment.

15 Replacing the Product with a Replacement Device

⚠ QUALIFIED PERSON

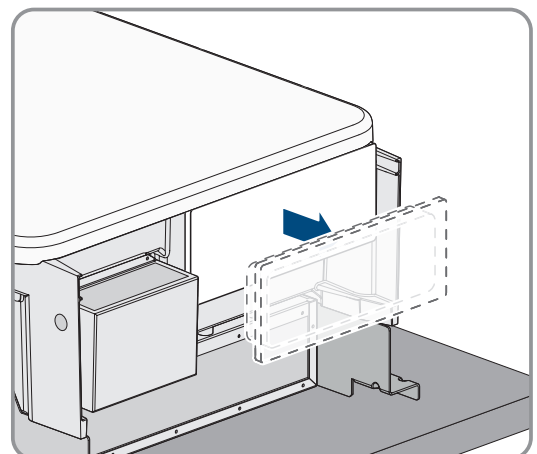
Under fault conditions, the product may need to be replaced. If this is the case, you will receive a replacement device from SMA Solar Technology AG. If you received a replacement device, replace the defective product with the replacement device as described below.

i Transport lid on the replacement device

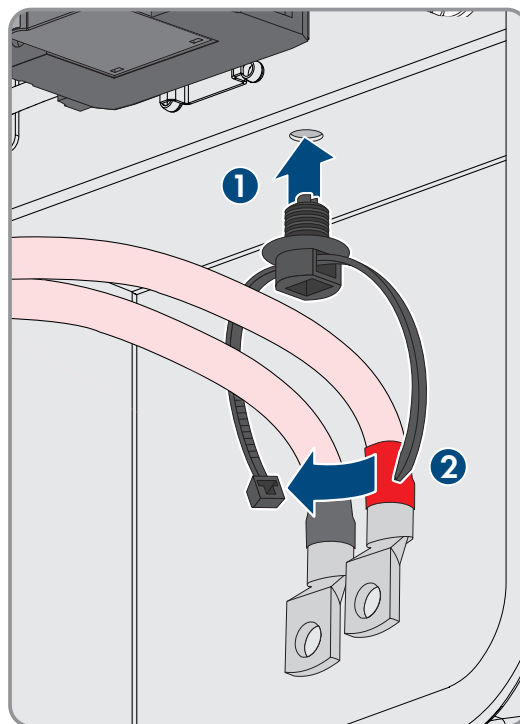
The enclosure lid of the replacement device can be a transport lid (see info on the enclosure lid). In this case, the transport lid must be exchanged for the enclosure lid of the defective product. The procedure for this is described below at the relevant point.

Procedure:

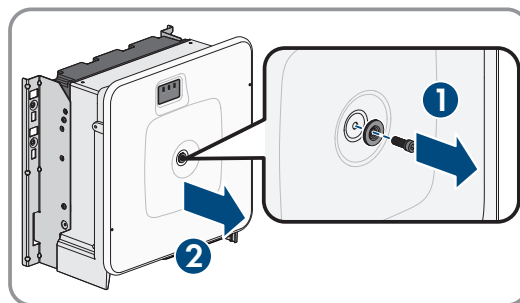
- To simplify the configuration of the replacement device, save the configuration data of the defective product to a file.
- Disconnect the product connections of the defective product .
- Disassemble the defective product (see Section 13.2, page 81).
- Remove the transport cover, which is located in the enclosure opening of the replacement device instead of the connecting plate, and use it for the defective product.



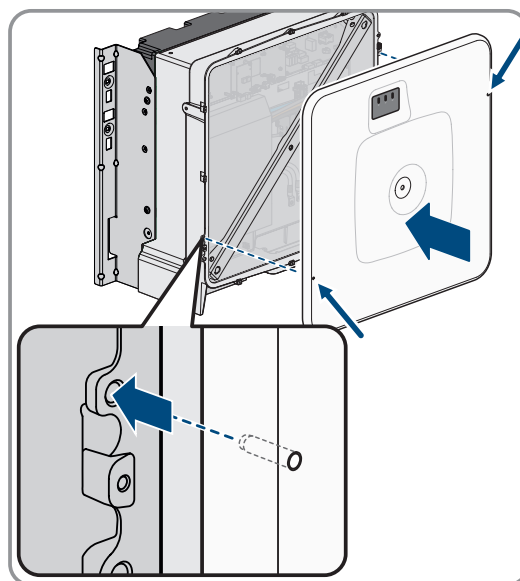
5. Secure the pre-configured DC connection cables in the defective product for transport. To do so, screw the supplied cable tie into the hole below the DC surge protection devices and place and tighten the cable tie around the DC connection cables.



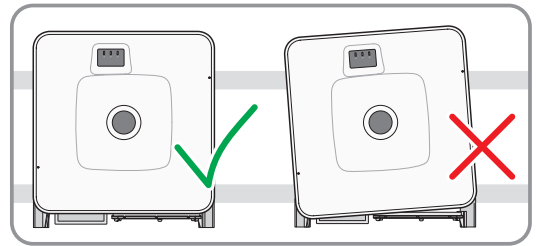
6. Mount the replacement device and make the electrical connections as described in this document. Use the connection plate and the DC protection elements against contact of the defective product.
7. If you have to replace the enclosure lid: Remove the cover from the enclosure lid.
8. If you have to replace the enclosure lid: Unscrew the screw on the enclosure lid (hex socket, AF8) and remove the enclosure lid.



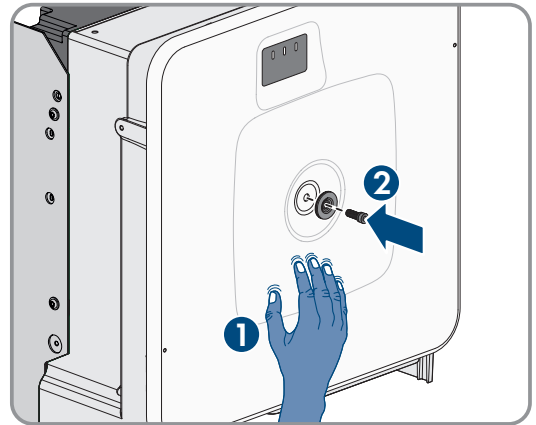
9. If you have to replace the enclosure lid: Carry out the following 4 steps.
10. Position the enclosure lid. The two guide pins on the enclosure lid must slide into the guide openings on the enclosure lid.



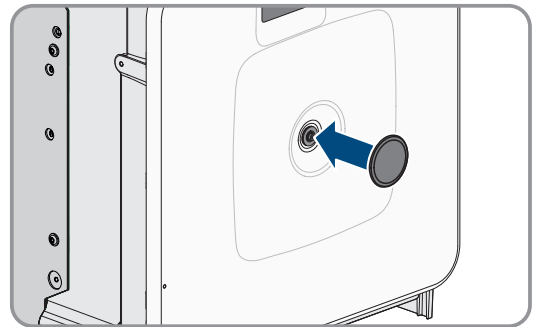
11. Ensure that the cover sits straight on the enclosure.



12. Hold the enclosure lid pressed against the enclosure and screw and tighten the screw (hex socket AF8, torque: 18 Nm).



13. Place the cover on the screw in the enclosure lid.



14. Establish a connection to the user interface.

15. On the **Configure inverter** page, select the **Adopt the configuration from a file** configuration option and load the saved configuration file of the defective product .

16. If the defective product had been registered by a communication product, replace it with the new product in the communication product.

17. Pack the defective product in the packaging of the replacement device.

18. Fasten the packaging to the pallet on which the replacement device was supplied using the reusable lashing straps.

19. Arrange for pick-up by SMA Solar Technology AG.

16 Technical Data

16.1 General Data

Width x height x depth without feet and without disconnectors

770 mm x 830 mm x 462 mm
(30.3 in x 32.7 in x 18.2 in)

Weight with enclosure lid and connecting plate

99 kg (218 lbs)

Weight without enclosure lid and connecting plate

90 kg (198.4 lbs)

Length x width x height of the packaging	1 150 mm x 850 mm x 630 mm (45.3 in x 33.5 in x 24.8 in)
Transport weight (including pallet)	115 kg (254 lbs)
Operating temperature range	-25 °C to +60 °C (-13 °F to +140 °F)
Storage temperature	-40 °C to +70 °C (-40 °F to +158 °F)
Maximum permissible value for relative humidity, condensing	100 %
Maximum operating altitude above mean sea level (MSL)	3000 m (9843 ft)
Typical noise emission	69 dB(A)
Power loss in night mode	< 5 W
Topology	Transformerless (Non-isolated)
Cooling method	SMA OptiCool
Number of fans	3
Enclosure degree of protection according to UL 50	Type 4X
Protection class	I
National standards and approvals, as per 11/2022	UL 62109-1, IEEE 1547, CAN/CSA-C22.2 No. 62109, FCC Part 15 (Class A)

Equipment

DC terminal	Terminal lug
AC connection	Screw terminals

Data Storage Capacity

Daily energy yields	63 days
Daily yields	30 years
Event messages for users	1024 events
Event messages for installers	1024 events

16.2 DC Input

	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
Maximum power of PV array	250000 W _p	300000 W _p	330000 W _p	344000 W _p
Maximum input voltage	1500 V	1500 V	1500 V	1500 V
MPP voltage range	705 V to 1450 V	880 V to 1450 V	924 V to 1450 V	968 V to 1450 V

	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
Rated input voltage	830 V	960 V	994 V	1025 V
Minimum input voltage	684 V	855 V	898 V	941 V
Initial input voltage	780 V	940 V	986 V	1032 V
Maximum input current	180 A	180 A	180 A	180 A
Maximum short-circuit current	325 A	325 A	325 A	325 A
Maximum reverse current into the PV modules ¹⁾	0 A	0 A	0 A	0 A
Number of independent MPP trackers	1	1	1	1
Number of inputs	1	1	1	1

16.3 AC Output

	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
Rated power at nominal AC voltage, 60 Hz	125000 W	150000 W	165000 W	172000 W
Maximum apparent AC power	125000 VA	150000 VA	165000 VA	172000 VA
Rated grid voltage	480 V	600 V	630 V	660 V
Nominal AC voltage	480 V	600 V	630 V	660 V
AC voltage range ²⁾	422 V to 582 V	480 V to 690 V	504 V to 725 V	528 V to 759 V
Nominal AC current at nominal AC voltage	151 A	145 A	151 A	151 A
Maximum output current	151 A	151 A	151 A	151 A
Total harmonic distortion (THD)	< 3%	< 3%	< 3%	< 3%
Maximum residual output current	662.8 A	662.8 A	662.8 A	662.8 A
Duration of the maximum residual output current	446.7 ms	446.7 ms	446.7 ms	446.7 ms

¹⁾ The topology prevents a reverse current from the inverter in the system

²⁾ Depending on the configured country data set

	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
Line synchronization characteristics	Method 2	Method 2	Method 2	Method 2
Rated grid frequency	60 Hz	60 Hz	60 Hz	60 Hz
Operating range at AC grid frequency 60 Hz	54 Hz to 66 Hz	54 Hz to 66 Hz	54 Hz to 66 Hz	54 Hz to 66 Hz
Operating range at AC grid frequency 50 Hz	44 Hz to 56 Hz	44 Hz to 56 Hz	44 Hz to 56 Hz	44 Hz to 56 Hz
Limits of accuracy of voltage measurement	2% of the AC voltage	2% of the AC voltage	2% of the AC voltage	2% of the AC voltage
Limits of accuracy of frequency measurement	±0.1 Hz	±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%	± 0.1%
Limits of accuracy of current measurement	1% of the AC current	1% of the AC current	1% of the AC current	1% of the AC current
Limits of accuracy of power (active/reactive) measurement	5% of the nominal AC power	5% of the nominal AC power	5% of the nominal AC power	5% of the nominal AC power
Limits of accuracy of power factor measurement	0.01	0.01	0.01	0.01
Limits of accuracy of time measurement	0.001 s	0.001 s	0.001 s	0.001 s
Output power at +60°C (+140°F) at minimum MPP voltage, 60 Hz	98 kW	125 kW	125 kW	131 kW
Output power at +60°C (+140°F) at maximum MPP voltage, 60 Hz	96 kW	123 kW	125 kW	131 kW
Power factor at rated power	1	1	1	1
Range of the displacement power factor (adjustable)	0.8 overexcited to 0.8 underexcited	0.8 overexcited to 0.8 underexcited	0.8 overexcited to 0.8 underexcited	0.8 overexcited to 0.8 underexcited

	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
Compatible transformer-winding configuration	Wye connection with grounded neutral point	Wye connection with grounded neutral point	Wye connection with grounded neutral point	Wye connection with grounded neutral point
Output phases	3	3	3	3
Line conductor	3 grounding conductor	3 grounding conductor	3 grounding conductor	3 grounding conductor
Surge category in accordance with UL 62109	III	III	III	III

16.4 Efficiency

Efficiency

	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
Maximum efficiency, η_{\max}	99.0 %	99.1 %	99.2 %	99.2 %
CEC weighted efficiency, η_{CEC}	98.5 %	99.0 %	99.0 %	99.0 %

16.5 Protective Devices

DC reverse polarity protection	Available
DC overvoltage protection	Surge arrester type 2
AC overvoltage protection ¹⁾	Surge arrester type 2
AC short-circuit current capability	Current control
Grid monitoring	SMA Grid Guard 10.0
Maximal output overcurrent protection	250 A
Ground fault monitoring ³⁾	Insulation monitoring: $R_{\text{iso}} > 32.2 \text{ k}\Omega$
All-pole sensitive residual-current monitoring unit	Available
Active anti-islanding method	Available
Frequency shift	Available

16.6 Climatic Conditions

Installation in accordance with IEC 60721-3-4, Class 4K4H

Extended temperature range	-25 °C to +60 °C (-13 °F to +140 °F)
Extended humidity range	0% to 100%

³⁾ The specified value is the default value. The value can be configured via parameters%.

Threshold for relative humidity, non-condensing	100%
Extended air pressure range	79.5 kPa to 106 kPa

Transport in accordance with IEC 60721-3-4, Class 2K3

Temperature range	-40°C to +70°C (-40°F to +158°F)
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16.7 Torques

Screws of mounting bracket (M8x105, TX40)	12 Nm ± 2 Nm (106 in-lb ± 17.7 in-lb)
Screws for attaching the inverter to the mounting brackets (M8x16, TX40)	12 Nm ± 2 Nm (106 in-lb ± 17.7 in-lb)
Screws for attaching the connecting plate to the inverter (M8x70, TX40)	8 Nm ± 0.5 Nm (71 in-lb ± 4 in-lb)
Screws AC terminals L1, L2 and L3 (AF8)	24 Nm (216 in-lb)
Screws AC terminal of grounding conductor (AF5)	10 Nm (90 in-lb)
Screws for attaching equipment grounding conductor of PV modules	6 Nm ± 0.3 Nm (53 in-lb ± 2.65 in-lb)
Screws for DC connection (AF16)	24 Nm ± 2 Nm (212 in-lb)
Screw enclosure lid (AF8)	18 Nm ± 0.3 Nm (159 in-lb ± 2.65 in-lb)

17 Compliance Information

FCC Compliance

This device complies with Part 15 of the FCC Rules and with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes :

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications made to this equipment not expressly approved by SMA Solar Technology AG may void the FCC authorization to operate this equipment.

18 Contact

If you have technical problems with our products, please contact the SMA Service Line. The following data is required in order to provide you with the necessary assistance:

- Type of device
- Serial number
- Firmware version
- Event message
- Mounting location and mounting height
- Type of communication
- Type and number of PV modules
- Type of the communication products connected
- Use the name of the system in Sunny Portal (if available)
- Access data for Sunny Portal (if available)
- Special country-specific settings (if available)
- Detailed description of the problem

You can find your country's contact information at:



<https://go.sma.de/service>

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