Operating manual

SUNNY TRIPOWER X 20-US / 25-US / 30-US

ENGLISH

STPxx-US-50-BE-en-13 | Version 1.3

Legal Provisions

The information contained in these documents is the property of SMA Solar Technology AG. No part of this document may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, be it electronic, mechanical, photographic, magnetic or otherwise, without the prior written permission of SMA Solar Technology AG. Internal reproduction used solely for the purpose of product evaluation or other proper use is allowed and does not require prior approval.

SMA Solar Technology AG makes no representations or warranties, express or implied, with respect to this documentation or any of the equipment and/or software it may describe, including (with no limitation) any implied warranties of utility, merchantability, or fitness for any particular purpose. All such representations or warranties are expressly disclaimed. Neither SMA Solar Technology AG nor its distributors or dealers shall be liable for any indirect, incidental, or consequential damages under any circumstances.

The exclusion of implied warranties may not apply in all cases under some statutes, and thus the above exclusion may not apply.

Passwords managed by this SMA product are always stored encrypted.

Specifications are subject to change without notice. Every attempt has been made to make this document complete, accurate and up-to-date. Readers are cautioned, however, that product improvements and field usage experience may cause SMA Solar Technology AG to make changes to these specifications without advance notice or per contract provisions. SMA Solar Technology AG shall not be responsible for any damages, including indirect, incidental or consequential damages, caused by reliance on the material presented, including, but not limited to, omissions, typographical errors, arithmetical errors or listing errors in the content material.

SMA Warranty

You can download the current warranty conditions from the Internet at www.SMA-Solar.com.

Software licenses

The licenses for the installed software modules (open source) can be found in the user interface of the product.

Trademarks

All trademarks are recognized, even if not explicitly identified as such. Missing designations do not mean that a product or brand is not a registered trademark.

SMA Solar Technology AG

Sonnenallee 1

34266 Niestetal

Germany

Tel. +49 561 9522-0

Fax +49 561 9522-100

www.SMA.de

E-mail: info@SMA.de

Status: Monday, December 16, 2024

Copyright © 2024 SMA Solar Technology AG. All rights reserved.

Table of contents

1 Information on this Document 9
1.1 Validity 9
1.2 Target Group 9
1.3 Content and Structure of this Document 9
1.4 Levels of Warning Messages 9
1.5 Symbols in the Document 10
1.6 Typographies in the document 10
1.7 Designations in the Document 10
1.8 Additional Information 11

2 Safety 12
2.1 Intended Use 12
2.2 IMPORTANT SAFETY INSTRUCTIONS 13

3 Scope of delivery 19

4 Product overview 21
4.1 Device function 21
4.2 System Overview 22
4.2.1 Sunny Tripower X as System Manager 22
4.2.2 Sunny Tripower X with SMA Data Manager as System Manager 23
4.3 Product Description 24
4.4 Symbols on the Product 24
4.5 Interfaces and Functions 25
4.5.1 User Interface 25
4.5.2 Device Key (DEV KEY) 26
4.5.3 Diagnostic function 26
4.5.4 Digital inputs 26
4.5.5 Integrated Plant Control 26
4.5.6 Arc-Fault Circuit Interrupter (AFCI) 26
4.5.7 Modbus 27
4.5.8 Multifunction relay (MFR) 27
4.5.9 Grid Management Services 28
4.5.10 Rapid Shutdown Equipment 28
4.5.11 Fast stop function 29
4.5.12 SMA Dynamic Power Control 29
4.5.13 SMA ShadeFix 29
4.5.14 SMA Smart Connected 30
4.5.15 SMA Speedwire 30
4.5.16 Surge arrester type 1+2 or type 2 30
4.5.17 Wi-Fi 30

4.6 LED Signals ... 30

5 Mounting ... 32

5.1 Requirements for Mounting ... 32
5.1.1 Requirements for the Mounting Location ... 32
5.1.2 Permitted and prohibited mounting positions ... 32
5.1.3 Dimensions for mounting ... 33
5.1.4 Recommended clearances for mounting ... 33
5.2 Mount the product. ... 34
5.3 Mounting equipment grounding bar ... 36
5.4 Mount the DC terminal cover (optional) ... 36

6 Electrical Connection ... 38

6.1 Requirements for the electrical connection ... 38
6.1.1 Permitted grid configurations ... 38
6.1.2 Residual-current monitoring unit ... 38
6.1.3 Load-break switch and cable protection ... 38
6.1.4 Overvoltage category ... 38
6.1.5 Requirements on the AC conductors ... 38
6.1.6 Network cable requirements ... 39
6.1.7 Requirements for the PV modules per input ... 39
6.1.8 Requirements on the equipment grounding conductor of the PV modules ... 39
6.1.9 Requirements on DC Conductors ... 39
6.1.10 Signal cable requirements ... 40
6.1.11 Additionally required material for the connection to digital inputs ... 40
6.2 Overview of the Connection Area ... 40
6.2.1 View from Below ... 40
6.2.2 Interior View ... 41
6.3 Electrical connection procedure ... 42
6.4 Connecting the AC conductors ... 42
6.5 Connecting the Network Cables ... 45
6.6 Connection to the Multifunction Relay ... 46
6.6.1 Digital output (MFR) ... 46
6.6.2 Pin assignment MFR ... 46
6.6.3 Connect signal source to MFR ... 46
6.7 Connection to digital input DI 1-4 ... 47
6.7.1 Digital input DI 1-4 ... 47
6.7.2 Pin assignment DI 1-4 ... 48
6.7.2.1 Digital input DI 1-4 ... 48
6.7.3 Circuitry overview DI 1-4 ... 48
6.7.3.1 Digital input DI 1-4 ... 48
6.7.4 Connecting signal source to DI 1-4 ... 49
6.8 Connection to digital input DI 5-6 ... 50

6.8.1 Digital input DI 5-6 ... 50
6.8.2 Pin assignment DI 5-6 ... 50
6.8.3 Circuitry overview DI 5 ... 51
6.8.4 Circuitry overview DI 6 ... 51
6.8.5 Connecting Signal Source to Digital Input DI 5-6 ... 51
6.9 DC connection ... 53
6.9.1 Assembling the DC Connectors ... 53
6.9.2 Connecting the PV Array ... 54

7 Commissioning ... 58
7.1 Procedure for commissioning as a subordinate device ... 58
7.2 Procedure for commissioning as System Manager ... 58
7.3 Commissioning the Inverter ... 60

8 Operation ... 61
8.1 Establishing a connection to the user interface ... 61
8.1.1 Connection in the local network ... 61
8.1.1.1 Access addresses for the product in the local network ... 61
8.1.1.2 Ports for data communication in the local network ... 61
8.1.1.3 Establishing a Connection via Ethernet in the local network ... 62
8.1.1.4 Establishing a Connection via WLAN in the Local Network ... 63
8.1.2 Direct connection via Wi-Fi ... 63
8.1.2.1 Connection options for Wi-Fi direct connection ... 63
8.1.2.2 Access information for direct Wi-Fi connection ... 64
8.1.2.3 Establishing a direct Wi-Fi connection with WPS ... 64
8.1.2.4 Establishing direct Wi-Fi connection with Wi-Fi network search ... 64
8.2 WPS function ... 65
8.2.1 Connection options with WPS ... 65
8.2.2 Activating WPS for automatic connection ... 65
8.2.3 Activating WPS for direct connection to a smart device ... 65
8.3 Design of the User Interface ... 66
8.4 Access rights to the user interface ... 67
8.5 Changing parameters ... 67
8.6 Arc-Fault Circuit Interrupter (AFCI) ... 67
8.7 Digital output (MFR) ... 68
8.7.1 Use of the digital output (MFR) ... 68
8.7.2 Configure the digital output (MFR) ... 69
8.8 Configure digital inputs ... 69
8.9 Configuring the digital input DI 1-4 for the external setpoint ... 70

8.10 Generating the I-V Characteristic Curve ... 71
8.11 Activating a Digital Product ... 71
8.12 Energy management ... 72
8.12.1 Predefined energy management profiles ... 72
8.12.2 Used energy management profiles ... 72
8.12.3 Setting options for peak load shaving ... 73
8.12.4 Creating a new energy management profile ... 74
8.12.5 Deactivating the energy management ... 75
8.12.6 Activating the energy management ... 75
8.12.7 Changing an energy management profile ... 76
8.13 Backup file ... 76
8.13.1 Function and content of the backup file ... 76
8.13.2 Creating a Backup File ... 77
8.14 Carry out a manual firmware update ... 77
8.15 Device Administration ... 78
8.15.1 Register Devices ... 78
8.15.2 Delete devices ... 78
8.16 Resetting the product to default setting ... 78
8.17 Deleting the Admin Account ... 79
8.18 Q on Demand 24/7 ... 79
8.19 Country standard ... 80
8.20 Overview of Grid Types ... 81

9 Disconnecting the Inverter from Voltage Sources ... 82

10 Cleaning ... 85

11 Troubleshooting ... 86
11.1 Event messages ... 86
11.2 Calculating the insulation resistance ... 101
11.3 Checking the PV System for Ground Faults ... 102
11.4 Cleaning the Fans ... 103
11.5 Manual restart after electric arc ... 104

12 Decommissioning the Product ... 105

13 Disposal ... 107

14 Technical Data ... 108
14.1 General Data ... 108
14.2 DC Input ... 109
14.3 AC Output ... 109
14.4 Digital inputs ... 111

14.5 Digital output (multifunction relay) 111
14.6 Communication 111
14.7 Data Storage Capacity 111
14.8 Efficiency 112
14.9 Protective Devices 112
14.10 Climatic Conditions 112
14.11 Equipment 112
14.12 Torques 113

15 Accessories 114

16 Compliance Information 115

17 Contact 116

1 Information on this Document

1.1 Validity

This document is valid for:

- STP 20-US-50 (Sunny Tripower X 20-US) from firmware version 03.06.15.R
- STP 25-US-50 (Sunny Tripower X 25-US) from firmware version 03.06.15.R
- STP 30-US-50 (Sunny Tripower X 30-US) from firmware version 03.06.15.R

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, regulations, 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.

The latest version of this document and additional information about the product can be found in PDF format and as an 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

Symbol	Explanation
	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Required result
	Example
⚠ QUALIFIED PERSON	Sections describing activities to be performed by qualified persons only

1.6 Typographies in the document

Typography	Use	Example
bold	• Messages • Terminals • Elements on a user interface • Elements to be selected • Elements to be entered	• Connect the insulated conductors to the terminals **X703:1** to **X703:6**. • Enter **10** in the field **Minutes**.
>	• Connects several elements to be selected	• Go to **Settings > Date**.
[**Button**] [**Key**]	• Button or key to be selected or pressed	• Select [**Enter**].
#	• Placeholder for variable components (e.g., parameter names)	• Parameter **WCtlHz.Hz#**

1.7 Designations in the Document

Complete designation	Designation in this document
Sunny Tripower X	Inverter, product

1.8 Additional Information

Additional information is available at www.SMA-Solar.com.

Title and information content	Type of information
"PUBLIC CYBER SECURITY - Guidelines for a Secure PV System Communication"	Technical Information
"Efficiency and Derating" Efficiency and derating behavior of the SMA inverters	Technical Information
"Parameters and Measured Values" Device-specific overview of all parameters and measured values and their setting options Information about the SMA Modbus registers	Technical Information
"SMA Modbus ®-interface - ennexOS" Information on the SMA Modbus interface	Technical Information
"SunSpec Modbus ®-interface - ennexOS" Information about the SunSpec Modbus interface and supported information models	Technical Information
Answers to frequently asked questions	FAQ on product page

2 Safety

2.1 Intended Use

The Sunny Tripower is a transformerless PV inverter with 3 MPP trackers that converts the direct current of the PV modules to grid-compliant three-phase current and feeds it into the utility grid.

The product is suitable for indoor and outdoor use.

If the product is operated with a medium-voltage transformer, the low-voltage side must be configured in a star formation and the neutral point 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).

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

Transformerless (Non-isolated)

The product is not equipped with a transformer and therefore has no galvanic isolation.

The neutral conductor of the AC output is not bonded to ground within the product.

- Do not operate grounded PV modules together with the product. If grounded PV modules are connected to the product, an event will occur. The event will be displayed, along with the associated message, in the event list on the user interface of the product.
- Only ground the mounting frames of the PV modules.
- The neutral conductor of the AC output is not bonded to ground within the product. When connecting a utility grid without neutral conductor, N and PE of the AC terminal must be bridged.

PV modules with a high capacity to ground must only be used if the coupling capacity of all PV modules does not exceed 6 µF.

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

The product is approved for the US and Canadian market.

The products by SMA Solar Technology AG are not suitable for use in

- Medical devices, in particular products for supplying life-support systems and machines,
- Aircraft, the operation of aircraft, the supply of critical airport infrastructure and airport systems,
- Rail vehicles, the operation and supply of rail vehicles and their critical infrastructure.

The above list is not exhaustive. Contact us if you are unsure whether products by SMA Solar Technology AG are suitable for your application.

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.

The documentation must be strictly followed. Deviations from the described actions and the use of materials, tools, and aids other than those specified by SMA Solar Technology AG are expressly forbidden.

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 as well as disregard of the documentation 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 documentation supplied is an integral part of SMA products. 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, some residual risks remain 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.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Do not disconnect the DC connectors under load.
- 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

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 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 DC input voltage range of 1000 V or higher.

⚠ CAUTION

Risk of fire

- To reduce the risk of fire, connect only to a circuit provided with maximum branch-circuit overcurrent protection 60 A in accordance with the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

⚠ CAUTION

Risk of burns due to hot enclosure parts

The enclosure and the enclosure lid may get hot during operation. The DC load-break switch can not become hot.

- Do not touch hot surfaces.
- Wait until the inverter has cooled down before touching the enclosure or enclosure lid.

⚠ 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.
- Use the carrying handles or hoist when transporting the product. To attach the hoist system, eye bolts must be screwed into the threads provided, which are located on the right and left of the product's mounting lugs.
- Wear suitable personal protective equipment for all work on the product.

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.
- 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.
- Only use listed rain-tight or liquid-tight conduit fittings to attach the conduits to the product.

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

Manipulation of system data in networks

You can connect the supported SMA products to the Internet. When connected to the Internet, there is a risk that unauthorized users can access and manipulate the data of your system.

- Set up a firewall.
- Close unnecessary network ports.
- If absolutely necessary, only enable remote access via a virtual private network (VPN).
- Do not use the port forwarding feature. This also applies to the used Modbus ports.
- Disconnect system components from other network components (network segmentation).

NOTICE

High costs due to inappropriate Internet tariff

Depending on use, the data volume of the product transferred via the Internet may vary in size. The data volume depends, for example, on the number of devices in the system, the frequency of device updates, the frequency of data transfer to Sunny Portal or the use of FTP push. High costs for the Internet connection can be the result.

- SMA Solar Technology AG recommends using an Internet flat rate.

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.

Communication disturbances in the local network

The IP address range 192.168.12.0 to 192.168.12.255 is occupied for communication amongst SMA products and for direct access to SMA products.

Communication problems might occur if this IP address range is used in the local network.

- Do not use the IP address range 192.168.12.0 to 192.168.12.255 in the local network.

DHCP Server is recommended

The DCHP server automatically assigns the appropriate network settings to your nodes in the local network. A manual network configuration is therefore not necessary. In a local network, the Internet router is usually the DHCP server. If the IP addresses in the local network are to be assigned dynamically, DHCP must be activated in the Internet router (see the Internet router manual). In order to receive the same IP address by the internet router after a restart, set the MAC address binding.

In networks where no DHCP server is active, proper IP addresses must be assigned from the free address pool of the network segment to all network participants to be integrated during commissioning.

A country data set must be set for feed-in operation

A country data set must be set (e.g. via the product commissioning wizard or a System Manager) in order for the inverter to start feed-in operation during commissioning.

If no country data set is set, then feed-in operation will be stopped. This state is signaled by the green and red LEDs flashing simultaneously.

The inverter will automatically start feed-in operation only after the inverter configuration is completed.

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.

Electrical installations (for North America)

All installations must conform with the laws, regulations, codes and standards applicable in the jurisdiction of installation (e.g. *National Electrical Code*® ANSI/NFPA 70 or *Canadian Electrical Code*® CSA-C22.1.).

- Before connecting the product to the utility grid, contact your local grid operator. The electrical connection of the product must be carried out by qualified persons only.
- Ensure that the cables or conductors used for electrical connection are not damaged.

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.

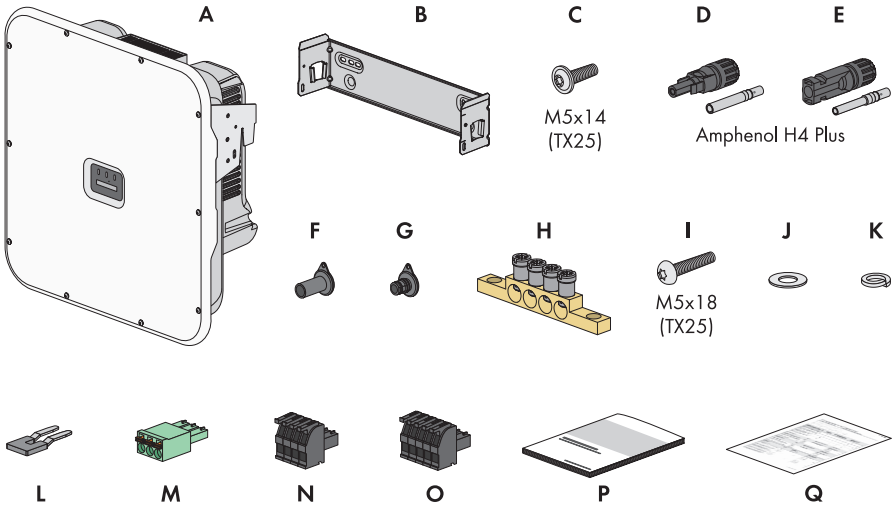


Figure 1: Components included in scope of delivery

Position	Quantity	Designation
A	1	Inverter
B	1	Mounting bracket
C	2	Screw M5x14
D	6	Positive DC connector
E	6	Negative DC connector
F	6	Sealing plug for unused negative DC inputs
G	6	Sealing plug for unused positive DC inputs
H	1	Equipment grounding bar
I	2	Screw M5x18
J	2	Washer
K	2	Conical spring washer
L	1	Jumper
M	1	3-pole terminal block
N	1	4-pole terminal block

Position	Quantity	Designation
O	1	5-pole terminal block
P	1	Quick reference guide with password label on the rear side The label contains the following information: • PIC (Product Identification Code) identification key for registering the system in Sunny Portal • RID (Registration Identifier) registration ID for registering the system in Sunny Portal • Wi-Fi password WPA2-PSK (WiFi Protected Access 2 - Preshared Key) for direct connection to the product via Wi-Fi • Device Key (DEV KEY) for resetting the administrator password
Q	1	Production test report

4 Product overview

4.1 Device function

It is possible to use and configure the inverter either as a system manager or as a subordinate device.

When using an inverter as a System Manager, ensure that the system size does not exceed 135 kVA and that a maximum of up to 5 additional devices (e.g., 3 inverters, 1 charging station and 1 energy meter) can be integrated into the system.

You carry out the device function via the commissioning wizard.

Inverter as System Manager

If you configure the inverter as System Manager, the inverter as a main device in conjunction with an energy meter takes over the control at the point of interconnection and can receive control signals. The inverter can control other subordinate devices, takes over the monitoring of the system and the communication to the Sunny Portal powered by ennexOS.

Subordinate device

If you configure the inverter as a subordinate device, it does not take over control. The subordinate inverter receives specifications from the System Manager (e.g. an SMA Data Manager) and implements them. Before a subordinate device can be recorded in a System Manager, you must commission all subordinate devices.

4.2 System Overview

4.2.1 Sunny Tripower X as System Manager

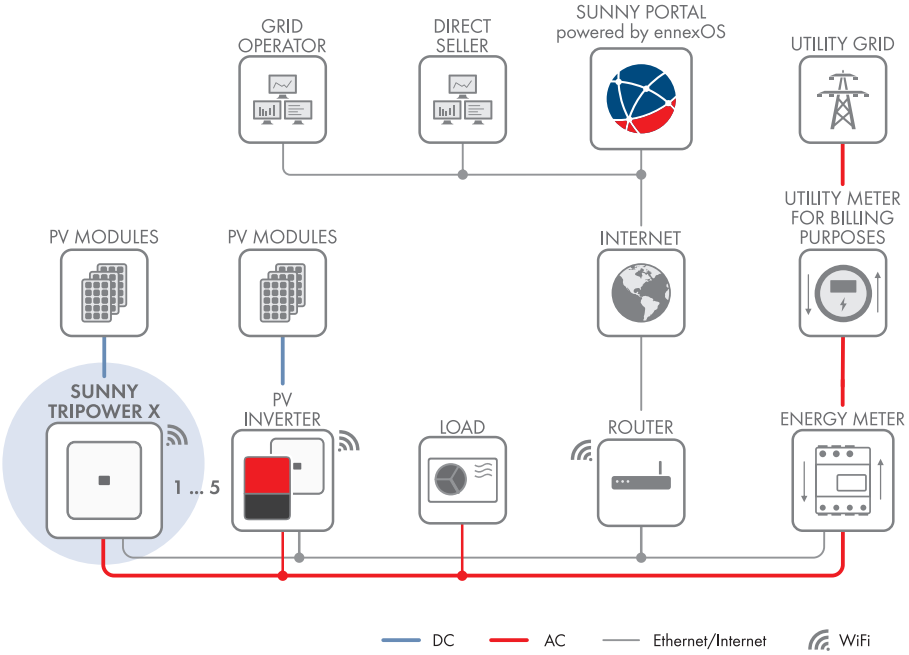


Figure 2: System with Sunny Tripower X as System Manager and one energy meter

4.2.2 Sunny Tripower X with SMA Data Manager as System Manager

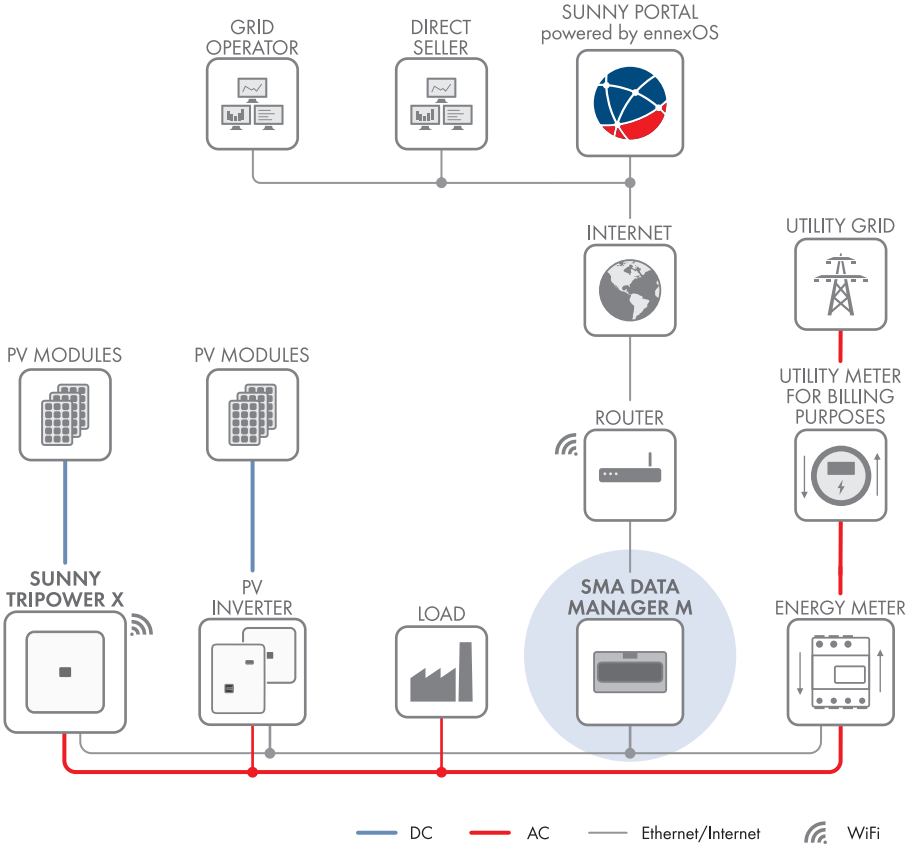


Figure 3: System with Sunny Tripower X and SMA Data Manager as System Manager

4.3 Product Description

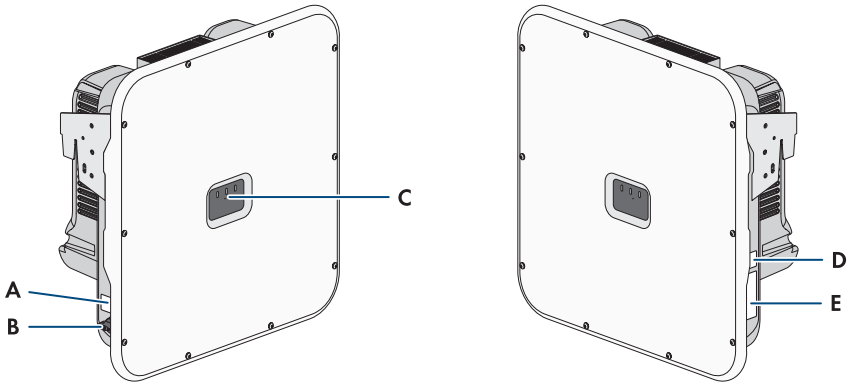


Figure 4: Design of the product

Position	Designation
A	Warning label
B	DC load-break switch
C	LEDs The LEDs indicate the operating state of the product.
D	A label with a QR code to be scanned using the SMA apps
E	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: • Device type (Model) • Serial number (Serial No. or S/N) • Date of manufacture • Device specific characteristics

Also see:

- LED Signals ⇒ page 30

4.4 Symbols on the Product

Symbol	Explanation
	Beware of electrical voltage The product operates at high voltages.

Symbol	Explanation
	Beware of hot surface The product can get hot during operation.
	Danger to life due to high voltages in the inverter; observe a waiting time of 5 minutes. High voltages that can cause lethal electric shocks are present in the live components of the inverter. Before carrying out any work on the inverter, always de-energize the inverter as described in this document and secure it against reconnection.
	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 documentation 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.
	Shielded ground wire This symbol indicates the position for the connection of an additional equipment grounding conductor.
	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 *National Electrical Code*®, the *Canadian Electrical Code*® and IEEE 1547.

4.5 Interfaces and Functions

4.5.1 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 device (e.g. smartphone, tablet or laptop) to connect to the product's user interface using a web browser.

Also see:

- Design of the User Interface ⇒ page 66
- Access rights to the user interface ⇒ page 67

4.5.2 Device Key (DEV KEY)

If you have forgotten the administrator password for the product, you can reset the administrator account with the Device Key and assign a new password. The Device Key can be used to prove the identity of the product in digital communication. The Device Key is located on the back of the quick reference guide that comes with the product. Keep the Device Key safe in case you forget the administrator password.

4.5.3 Diagnostic function

The inverter has a diagnostic function for measuring the current/voltage characteristic curve (I-V characteristic curve) of the PV modules connected to DC inputs. The characteristic curve shows deviations and changes from the ideal curve. By this, problems in the PV modules can be detected at an early stage.

Also see:

- Generating the I-V Characteristic Curve ⇒ page 71

4.5.4 Digital inputs

The product is equipped with digital inputs as standard.

Digital input **DI 1-4** is intended for connection of an external signal source for active power limitation.

Digital input **DI 5-6** is intended for connection of an external signal source for fast stop.

4.5.5 Integrated Plant Control

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

4.5.6 Arc-Fault Circuit Interrupter (AFCI)

The inverter is equipped with an integrated photovoltaic (PV) arc-fault circuit interrupter as required for PV systems by *National Electrical Code®* ANSI/NFPA 70 (NEC). The inverters' arc-fault circuit interrupter (AFCI) functionality is certified to Standard UL 1699B Edition 1 (August 2018), Photovoltaic (PV) DC Arc-Fault Circuit Protection, which defines requirements for PV arc-fault protection devices intended for use in solar photovoltaic electrical energy systems as described in NEC 690.11.

The arc-fault circuit interrupter (AFCI) is activated as standard and is set so that the current flow is interrupted after each electric arc and restarts automatically. If 5 electric arcs are detected within 24 hours, the inverter interrupts feed-in operation permanently and a manual restart must be carried out. If the installation conditions permit this, you can change the default setting.

The arc-fault circuit interrupter (AFCI) can detect electric arcs in the PV modules and the module wiring of connected strings. The arc-fault circuit interrupter ensures that the inverter ceases operations and interrupts any electric arcs as soon as they are detected. This involves halting the flow of current.

The arc-fault circuit interrupter (AFCI) has proved extremely reliable, meaning that the inverter dependably detects and interrupts electric arcs that actually occur in the PV electric circuit and is generally not susceptible to false tripping. AFCI incidents output by the inverter should be regarded as reliable indicators of actual errors in the PV electric circuit displayed and should be investigated immediately and thoroughly by qualified persons to localize and rectify errors in the PV electric circuit.

Arc-fault circuit interrupter without permanent operation interruption

If the arc-fault circuit interrupter (AFCI) is configured with automatic restart, the system should be monitored closely and recurring faults in the AFCI should be investigated immediately by qualified persons. If it is not possible to identify the cause of the error, the inverter should be taken out of operation until the investigation and corrective action can be completed. Recurring errors may cause damage to neighboring conductors and system components, which could result in more extensive system failures and damage and even to uncontrolled electric arcs and fires.

Also see:

- Arc-Fault Circuit Interrupter (AFCI) ⇒ page 67
- Manual restart after electric arc ⇒ page 104

4.5.7 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

4.5.8 Multifunction relay (MFR)

The inverter is equipped with a multifunction relay as standard. The multifunction relay is an interface that can be configured for the operating mode used by a particular system.

The multifunction relay can only be used if the inverter is configured as System Manager.

Also see:

- Use of the digital output (MFR) ⇒ page 68

4.5.9 Grid Management Services

The inverter is a grid support interactive inverter.

The inverter was tested in accordance with UL 1741 SB / IEEE 1547-2018 (10/2022) to be compliant with the source requirements documents of the states available at the time of the test.

For connecting the inverter to the utility grid, no additional grid monitoring equipment is necessary.

4.5.10 Rapid Shutdown Equipment

The inverter is listed as PV Rapid Shutdown Equipment (PVRSE) according to UL 1741.

All DC inputs and AC outputs of this product comply with photovoltaic rapid shutdown requirements for controlled conductors outside the array.

A complete PV Rapid Shutdown System (PVRSS) consists of the PV inverter, PV array disconnect switches, and a Rapid Shutdown initiation device. The Rapid Shutdown initiation device serves to initiate a rapid shutdown. The PV Rapid Shutdown System must limit the DC conductors to < 30 V within 30 seconds.

NOTICE - The inverter's Rapid Shutdown function is initiated by disconnecting the inverter from the AC grid voltage, for example, by opening the main PV system AC disconnect. The AC disconnect that serves as the Rapid Shutdown initiation device must be readily accessible and clearly marked in accordance with *National Electrical Code®*. The Rapid Shutdown status of the PV system will be indicated by the On/Off (Closed/Open) position of this AC disconnect. The Off (Open) position indicates that a rapid shutdown has been initiated.

If PV array disconnect switches compliant with the SunSpec communication signal for Rapid Shutdown systems are installed, the inverter can transmit a SunSpec-compliant "permission to operate" signal to them via its DC input conductors. When a rapid shutdown is initiated, the inverter will stop transmitting the SunSpec signal. When the SunSpec signal is not being received, the PV array disconnect switches are responsible for reducing line voltages within the PV array in accordance with *National Electrical Code®*. In the event of a rapid shutdown via the SunSpec communication signal, it is important that all PV modules connected to the inverter are always equipped with SunSpec-compliant PV array disconnect switches, otherwise the inverter cannot start feed-in operation. For reliable discharge of the DC connection conductors, it is necessary for the sum of the standby voltages of all PV array disconnect switches of a string to be > 3.6 V and < 30 V. In addition, the recommended total length of all DC lines of a string should not exceed 300 m (1000 ft). The total length defines the length of the entire string wiring including the connection cable of the PV module switch in the string (measured from the positive DC terminal to the negative DC terminal of the inverter).

A PV Rapid Shutdown system can also be installed using PV array disconnect switches initiated in case of power failures or other means. In these cases, it must be ensured that the PV system Rapid Shutdown initiation device initiates a rapid shutdown of the PV array devices at the same time that the inverter is disconnected from grid voltage.

The PV array disconnect switches must disconnect the PV array from the inverter within a maximum of 15 seconds after Rapid Shutdown initiation.

The inverter is capable of grid support operation where in case of a power failure or by activating the AC disconnect, the inverter remains connected to the utility grid for a defined ride-through time and waits for voltage recovery. If grid voltage does not recover within the defined ride-through time, the inverter disconnects from the grid and a rapid shutdown is initiated.

The Rapid Shutdown function is disabled by default. The Rapid Shutdown function should only be enabled when PV array disconnect switches have been installed within the PV array or between the PV array and the inverter. The Rapid Shutdown function can be enabled during or after inverter commissioning via the user interface by selecting the operating mode suitable for the PV array disconnect switches. If the Rapid Shutdown function is enabled and no PV array disconnect switches are installed, the inverter cannot discharge the connected DC input conductors during a rapid shutdown. As a result, the inverter can be damaged.

WARNING - THIS PV RAPID SHUTDOWN EQUIPMENT DOES NOT PERFORM ALL OF THE FUNCTIONS OF A COMPLETE PV RAPID SHUTDOWN SYSTEM. THIS PV RAPID SHUTDOWN EQUIPMENT MUST BE INSTALLED WITH OTHER EQUIPMENT TO FORM A COMPLETE PV RAPID SHUTDOWN SYSTEM THAT MEETS THE REQUIREMENTS OF NEC (NFPA 70) FOR CONTROLLED CONDUCTORS OUTSIDE THE ARRAY. OTHER EQUIPMENT INSTALLED IN OR ON THIS PV SYSTEM MAY ADVERSLY AFFECT THE OPERATION OF THE PV RAPID SHUTDOWN SYSTEM. IT IS THE RESPONSIBILITY OF THE INSTALLER TO ENSURE THAT THE COMPLETED PV SYSTEM MEETS THE RAPID SHUT DOWN FUNCTIONAL REQUIREMENTS. THIS EQUIPMENT MUST BE INSTALLED ACCORDING TO THE MANUFACTURER'S INSTALLATION MANUAL.

4.5.11 Fast stop function

The fast stop function is a digital input on the inverter via which the inverter can be disconnected from the utility grid. It can be triggered by means of an external potential-free contact (break contact or make contact). It can be configured whether the disconnection from the utility grid should take place when the contact is open or closed.

The fast stop function is deactivated by default and must be activated in the inverter.

4.5.12 SMA Dynamic Power Control

SMA Dynamic Power Control is a pre-installed software that allows a System Manager to control the active and reactive power of up to 5 inverters.

4.5.13 SMA ShadeFix

The inverter is equipped with the shade management system SMA ShadeFix. SMA ShadeFix uses an intelligent MPP tracking system to determine the operating point with the highest output during shading conditions. With SMA ShadeFix, inverters use the best possible energy supply from the PV modules at all times to increase yields in shaded systems.

SMA ShadeFix is disabled by default, and can be enabled if required.

The time interval of SMA ShadeFix is usually 6 minutes. This means that the inverter determines the optimum operating point every 6 minutes. Depending on the PV system or shading situation, it may be useful to adjust the time interval.

4.5.14 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.

4.5.15 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.

4.5.16 Surge arrester type 1+2 or type 2

The inverter has a DIN rail that serves as a mounting location for the DC overvoltage protection. The DC overvoltage protection with surge protection devices of the type 1+2 or type 2 is available as an accessory. The surge protection devices limit dangerous overvoltages.

4.5.17 Wi-Fi

The product is equipped with a Wi-Fi interface as standard. The inverter is delivered with the WLAN interface activated as standard. If you do not want to use WLAN, you can deactivate the WLAN interface.

In addition, the product has a WPS function. The WPS function is for automatically connecting the product to a network (e.g. via router) and establish a direct connection between the product and a smart device.

4.6 LED Signals

The LEDs indicate the operating state of the product.

LED signal	Explanation
Green LED and red LED flash simultaneously (2 s on and 2 s off)	No country data set set Operation of the product is stopped because no country data set is set. The product automatically starts operation as soon as the configuration has been carried out (e.g. using the commissioning wizard or via a System Manager).

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 is glowing	Operation The product is in operation.
The green LED is off	No DC voltage is present.
The red LED is glowing	Error Operation of the product has been stopped. In addition, a specific event message and the associated event number are displayed on the user interface of the product or the System Manager (e.g. SMA Data Manager) (see Section 11.1, page 86).
Red LED is flashing (0.25 s on, 0.25 s off, 0.25 s on, 1.25 s off)	Warning Communication with the System Manager failed. The inverter continues to operate with restricted function (e.g., with set fallback level). In addition, a specific event message and the associated event number are displayed on the user interface of the product or the System Manager (e.g. SMA Data Manager) (see Section 11.1, page 86).
The blue LED is flashing slowly (2 s on and 2 s off)	Communication connection is being established. The product is establishing a connection with a local network or is establishing a direct connection to a smart device (e.g., smartphone, tablet or laptop).
The blue LED is flashing fast (0.25 s on and 0.25 s off)	A System Manager is requesting identification of the product.
The blue LED is glowing	There is an active connection with a local network or there is a direct connection with a smart device (e.g., smartphone, tablet or laptop).
Blue LED is off	There is no active connection.
All 3 LEDs are on	Product update or booting procedure.

5 Mounting

5.1 Requirements for Mounting

5.1.1 Requirements for the Mounting Location

⚠ WARNING

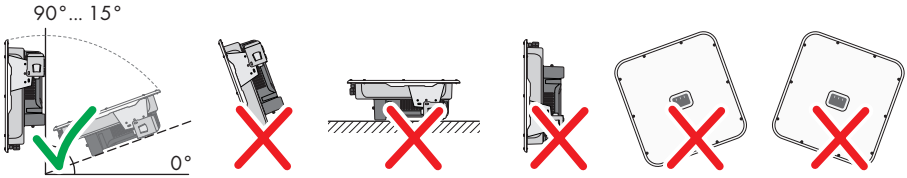
Danger to life due to fire or explosion

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.

- ☐ A solid support surface must be available. When mounted on drywall or similar materials, the product emits audible vibrations during operation which could be perceived as annoying.
- ☐ The mounting location must be suitable for the weight and dimensions of the product.
- ☐ 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.
- ☐ The mounting location should be freely and safely accessible at all times without the need for any auxiliary equipment (such as scaffolding or lifting platforms). Non-fulfillment of these criteria may restrict servicing.
- ☐ The DC load-break switch of the product must always be freely accessible.
- ☐ All ambient conditions must be met.
- ☐ The ambient temperature should be 0°C to +45°C (32°F to +113°F) to ensure optimal operation.

5.1.2 Permitted and prohibited mounting positions



5.1.3 Dimensions for mounting

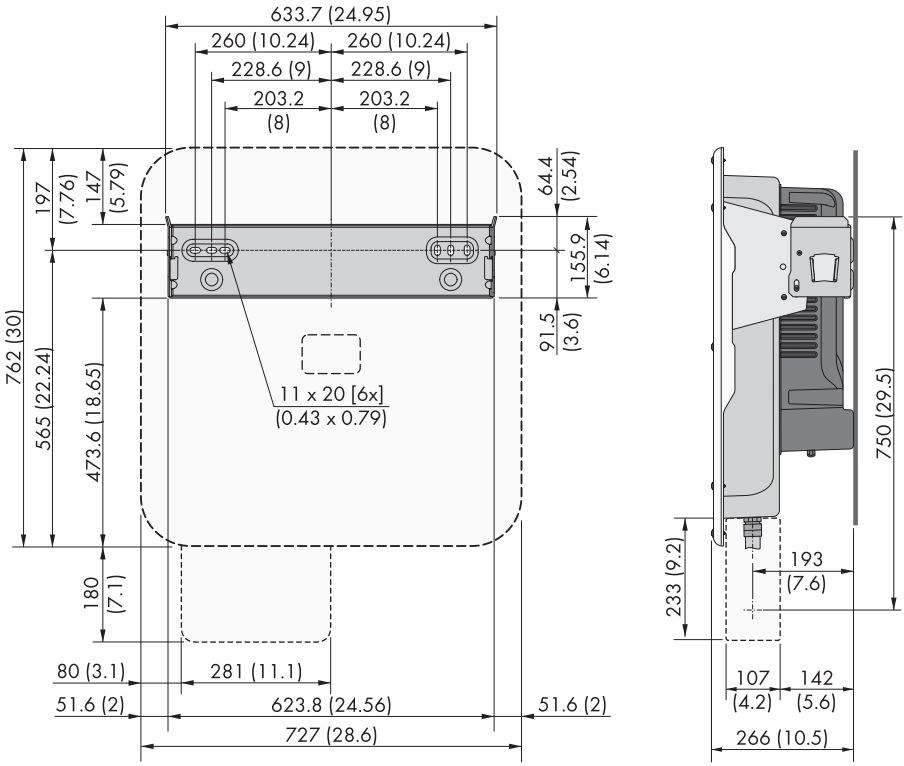


Figure 5: Position of the anchoring points(Dimensions in mm (in))

5.1.4 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 distances are permissible without causing any risk to safety or service life of the product.

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 working distances.

- Ensure that the prescribed working distances 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.

☐ If multiple products are mounted in areas with high ambient temperatures, increase the clearances between the products and ensure sufficient fresh-air supply.

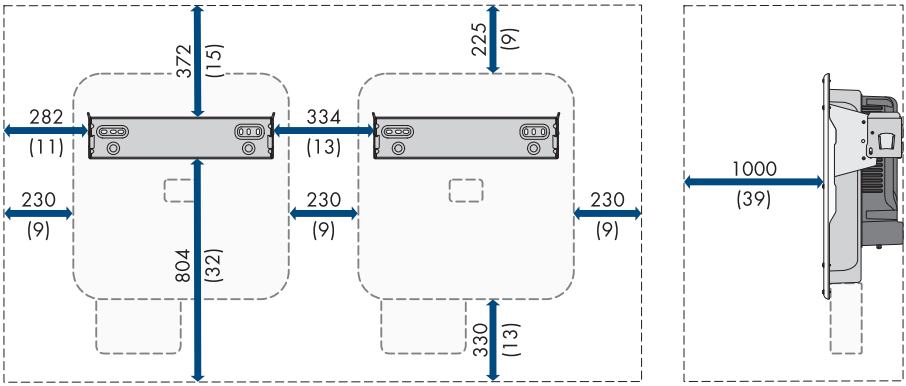


Figure 6: Recommended clearances(Dimensions in mm (in))

5.2 Mount the product.

⚠ QUALIFIED PERSON

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

☐ For transport with a hoist: 2 eye bolts (M8)

☐ For mounting:

- 2 screws that are suitable for the support surface and the weight of the inverter
- 2 washers suitable for the screws

☐ To protect the product against theft: 1 padlock suitable for outdoor use. The padlock shackle should have a 7.5 mm (0.375 in) diameter.

⚠ CAUTION

Risk of injury due to weight of product

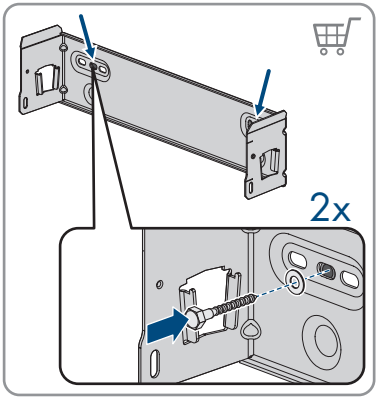
Injuries may result if the product is lifted incorrectly or dropped while being transported or mounted.

- Transport and lift the product carefully. Take the weight of the product into account.
- Use the carrying handles or hoist when transporting the product. To attach the hoist system, eye bolts must be screwed into the threads provided, which are located on the right and left of the product's mounting lugs.
- Wear suitable personal protective equipment for all work on the product.

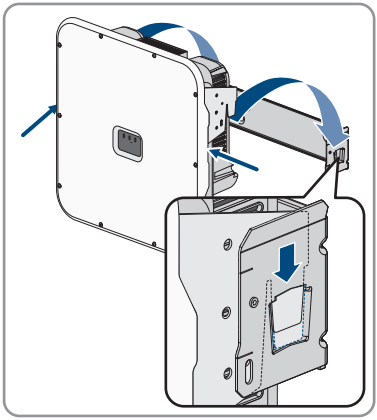
Procedure:

1. Align the mounting bracket horizontally and mark the position of the drill holes.
2. Set the mounting bracket aside and drill the marked holes.

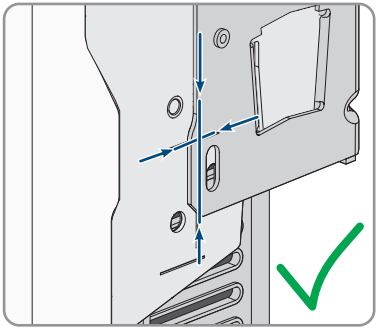
3. Tighten the mounting bracket horizontally with screws and washers.



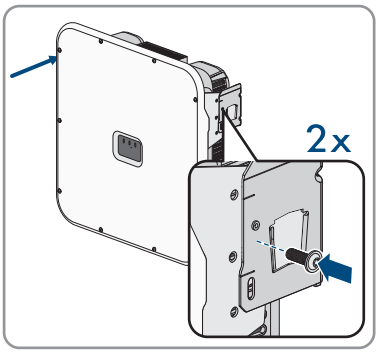
4. Hook the inverter into the mounting bracket.



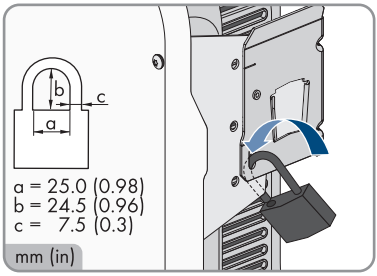
5. Ensure that the inverter is securely in place. The inverter is correctly hooked in when the openings in the mounting bracket and the mounting tab line up.



6. Secure the inverter to the mounting bracket on both sides with an M5x14 screw. Insert screws into the screw holes on the left and right tab of the mounting bracket and tighten them (TX25, torque: 1.5 Nm (13 in-lb)).



7. To secure the inverter against theft, guide the padlock shackle through the metal tab of the mounting bracket and through the mounting tab of the inverter before closing it.

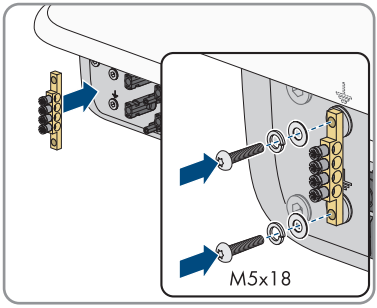


8. Keep the key of the padlock or the number combination for opening it in a safe place.

5.3 Mounting equipment grounding bar

⚠ QUALIFIED PERSON

- Fasten the equipment grounding bar with 1 washer, 1 serrated conical spring washer and 1 M5x18 screw each at the top and bottom of the screw point (TX25, torque: 4 Nm ±0.3 Nm (35 in-lb ±2.7 in-lb).



5.4 Mount the DC terminal cover (optional)

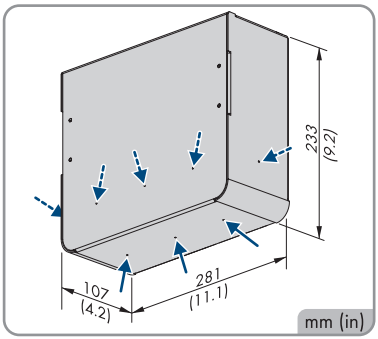
⚠ QUALIFIED PERSON

Requirements:

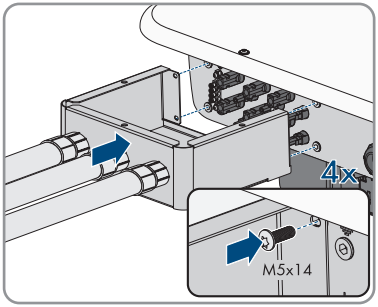
☐ The DC terminal cover must be available as an accessory .

Procedure:

1. Drill or punch holes required for connecting the conduits at the pre-notched spots.



2. Mount the enclosure on the bottom of the inverter using the M5x14 screws from the scope of delivery of the accessory kit (TX25, torque: 4 Nm (35 in-lb)).



3. Mount the conduits for the DC connection to the DC terminal cover.

6 Electrical Connection

6.1 Requirements for the electrical connection

6.1.1 Permitted grid configurations

The inverter approved for operation in the following utility grids:

- 480 V / 277 V WYE

6.1.2 Residual-current monitoring unit

The inverter does not require an external residual-current device when operating. If local regulations require the use of a residual-current device, the following must be observed:

☐ The inverter is compatible with residual-current devices of type A and B that have a rated residual current of 100 mA or higher. Each inverter in the system must be connected to the utility grid via a separate residual-current device.

6.1.3 Load-break switch and cable protection

☐ In PV systems with multiple inverters, protect each inverter with a separate three-phase circuit breaker. Make sure to observe the maximum permissible fuse protection (see Section 14, page 108). This will prevent residual voltage from being present at the corresponding cable after disconnection.

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

☐ The load-break switch or circuit breaker must be suitable listed (see *National Electrical Code*® ANSI/NFPA 70) or Canadian Electrical Code® CSA C22.1).

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

6.1.4 Overvoltage category

The product can be used in grids of overvoltage category III or lower in accordance with UL 62109-1. 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).

6.1.5 Requirements on the AC conductors

☐ Conductor type: copper wire

☐ The conductors must be solid or fine-stranded. When using fine-stranded wire, bootlace ferrules can be used.

☐ Conductor cross-section: 10 mm² to 16 mm² (8 AWG to 6 AWG)

☐ Insulation stripping length: 18 mm to 20 mm (0.71 in to 0.79 in)

☐ The conductors with regards to its ampacity, rated temperatures, operating conditions and its power loss must be made in accordance with the local standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1. If the manufacturer (SMA Solar Technology AG) requires a higher conductor cross-section than the standard, the range of the manufacturer must be observed.

Also see:

- Connecting the AC conductors ⇒ page 42

6.1.6 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
☐ Shielding: SF/UTP, S/UTP, SF/FTP or S/FTP
☐ Number of insulated conductor pairs and insulated conductor cross-section: at least 2 x 2 x 0.22 mm² (2 x 2 x 24 AWG)
☐ Maximum cable length between 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.

6.1.7 Requirements for the PV modules per input

☐ All PV modules should be of the same type.
☐ All PV modules should be aligned and tilted identically.
☐ The maximum permitted system voltages of the inverter must not be exceeded.
☐ The maximum short-circuit current must not be exceeded.
☐ The positive connection cables of the PV modules must be equipped with positive DC connectors.
☐ The negative connection cables of the PV modules must be equipped with the negative DC connectors.

6.1.8 Requirements on the equipment grounding conductor of the PV modules

☐ The conductors must be made of solid wire, stranded wire or fine stranded wire. When using fine stranded wire, bootlace ferrules must be used.
☐ Conductor type: aluminum and copper wire
☐ Conductor cross section: 2.5 mm² to 25 mm² (14 AWG to 4 AWG)

6.1.9 Requirements on DC Conductors

☐ Conductor cross-section: 3.31 mm² to 5.26 mm² (12 AWG to 10 AWG)
☐ Conductor type: copper wire

- ☐ Maximum permissible temperature: 90°C (194°F)
- ☐ The conductors with regards to its ampacity, rated temperatures, operating conditions and its power loss must be made in accordance with the local standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.

6.1.10 Signal cable requirements

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

- ☐ Conductor cross-section: 0.5 mm² to 0.75 mm² (21 AWG to 19 AWG)
- ☐ External diameter: Max. 8 mm (0.3 in)
- ☐ Maximum cable length: 100 m (328 ft)
- ☐ Insulation stripping length: 6 mm (0.24 in)
- ☐ Sheath stripping length: 150 mm (5.9 in)
- ☐ UV-resistant for outdoor use
- ☐ The cable type and cable-laying method must be appropriate for the application and location.

6.1.11 Additionally required material for the connection to digital inputs

- ☐ 1 conduit (trade size: 27 mm (1 in) or smaller with suitable reducer bush)
- ☐ 1 rain-tight conduit fitting or conduit fitting for wet locations complying with UL 514B (trade size: 27 mm (1 in) or smaller with suitable reducing bush)

6.2 Overview of the Connection Area

6.2.1 View from Below

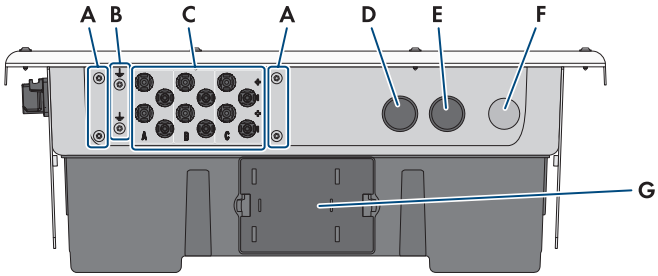


Figure 7: Bottom view of product

Position	Designation
A	Screw-on points for the DC-TERM-COVER (available as accessory)
B	Screw-on points for the equipment grounding bar
C	Positive and negative connectors for DC connection

Position	Designation
D	Enclosure opening for the network cables and signal cables (for conduits of trade size 34.5 mm (1 in) or smaller with suitable reducer bushing)
E	Enclosure opening for connecting to the digital inputs and to the multifunction relay (for conduits of trade size 34.5 mm (1 in) or smaller with suitable reducer bushing)
F	Enclosure opening for connecting the utility grid (for conduits of trade size 34.5 mm (1 in) or smaller with suitable reducer bushing)
G	Fan drawer

6.2.2 Interior View

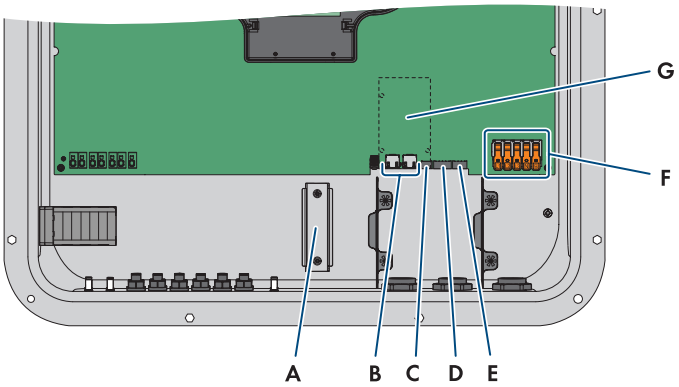


Figure 8: Connection areas in the interior of the product

Position	Designation
A	DIN rail for installing the DC overvoltage protection
B	Network Ports
C	**MFR** slot for connection to the multifunction relay
D	Slot **DI 1-4** for connecting digital signal sources (e.g. for active power reduction)
E	Slot **DI 5-6** for connecting digital signal sources (e.g. for fast stop) Slot **DI 7** is not assigned
F	Terminal blocks for AC connection

6.3 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 6.1, page 38
2.	Connect the AC cables.	Section 6.4, page 42
3.	Connect the network cables.	Section 6.5, page 45
4.	Connect to the multifunction relay (optional)	Section 6.6, page 46
5.	Connect signal source to digital inputs (optional)	Section 6.7, page 47 Section 6.8, page 50
6.	Connect the PV modules.	Section 6.9, page 53

6.4 Connecting the AC conductors

⚠ QUALIFIED PERSON

Additionally required material:

- ☐ 1 conduit (trade size: 27 mm (1 in) or smaller with suitable reducer bush)
- ☐ Sealing compound for sealing the join between the conduit and inverter if a weep hole has been added to the conduit
- ☐ 1 rain-tight conduit fitting or conduit fitting for wet locations complying with UL 514B (trade size: 27 mm (1 in) or smaller with suitable reducing bush)

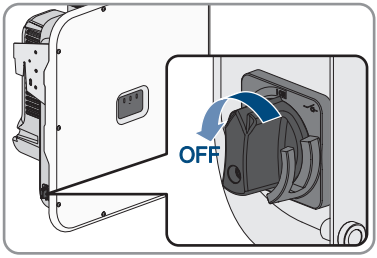
Requirements:

- ☐ The AC and DC electric circuits are isolated from the enclosure. If required by the National Electrical Code® ANSI/NFPA 70 or Canadian Electrical Code® CSA C22.1, the installer is responsible for grounding the system.
- ☐ All electrical installations must be carried out in accordance with the local standards and the *National Electrical Code*® ANSI/NFPA 70 or the *Canadian Electrical Code*® CSA C22.1.
- ☐ The grid voltage must be within the permissible range. The exact operating range of the inverter is specified in the operating parameters .

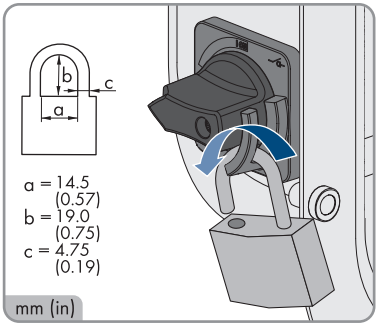
Procedure:

1. Disconnect the miniature circuit breaker from all 3 line conductors and secure against reconnection.

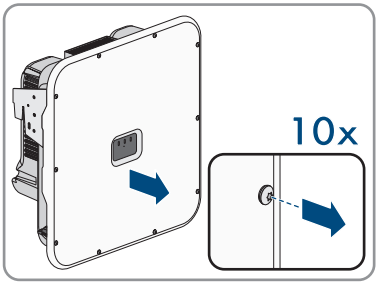
2. Ensure that the DC load-break switch is in the **O** position / **OFF**.



3. If your country requires the DC load-break switch to be protected against reconnection, secure the DC load-break switch against reconnection with a padlock.

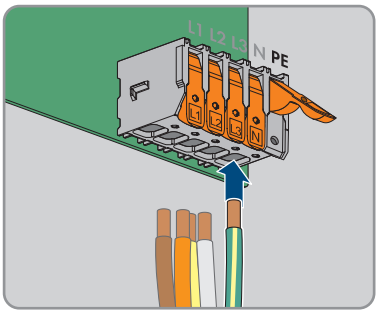


4. Unscrew the screws of the enclosure lid with a Torx screwdriver (TX 25) and remove the enclosure lid carefully forward.

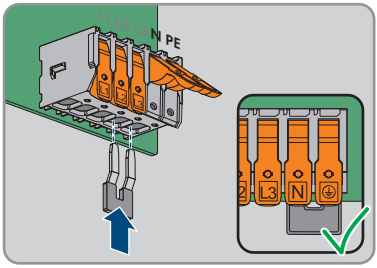


5. Remove the adhesive tape from the enclosure opening for the AC connection.
6. Attach the conduit to the enclosure opening.
7. Guide the conductors from the conduit into the inverter.
8. Strip off the conductor insulation by 0.71 in to 0.79 in each.
9. If necessary, provide each conductor with a bootlace ferrule.

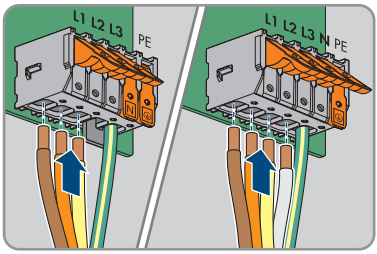
10. Press the locking lever of terminal **PE** upward, guide the equipment grounding conductor into the terminal, and press the locking lever downward again.



11. For connection without a neutral conductor, use the jumper provided to bridge terminal blocks **PE** and **N**. For this, press the locking levers of terminals **PE** and **N** upward, guide the jumper into the terminals, and press the locking levers downward again.



12. Press the locking levers of terminals **L1**, **L2**, **L3**, and if applicable **N** upward, guide conductors **L1**, **L2**, **L3**, and if applicable **N** into the terminals according to the labeling, and press the locking levers downward again.



13. Ensure that the correct conductors are assigned to all the terminals.
14. Ensure that all conductors are securely in place.
15. If a weep hole has been added to the conduit, seal the conduit with sealing compound.

Also see:

- Requirements on the AC conductors ⇒ page 38

6.5 Connecting the Network Cables

⚠ QUALIFIED PERSON

⚠ 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.

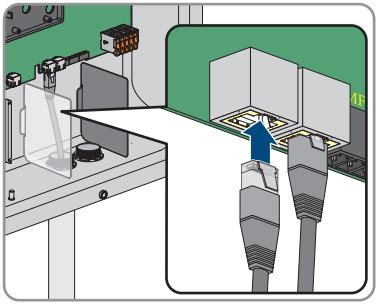
Additionally required material (not included in the scope of delivery):

- ☐ Network cables(see Section 6.1.6, page 39)
- ☐ Where required: Field-assembly RJ45 connector.
- ☐ 1 conduit (trade size: 27 mm (1 in) or smaller with suitable reducer bush)
- ☐ Sealing compound for sealing the join between the conduit and inverter if a weep hole has been added to the conduit
- ☐ 1 rain-tight conduit fitting or conduit fitting for wet locations complying with UL 514B (trade size: 27 mm (1 in) or smaller with suitable reducing bush)

Procedure:

1. Disconnect the inverter from all voltage sources (see Section 9, page 82).
2. Remove filler plug from the enclosure opening for the network cables.
3. Insert the conduit fitting into the opening and tighten from the inside using the counter nut.
4. Attach the conduit to the conduit fitting.
5. Guide the network cable out of the conduit into the inverter.
6. When using a self-assembly network cable, assemble the RJ45 connectors and connect them to each network cable (see connector documentation).

7. Insert each network cable into one of the network ports.



8. Ensure that the network cables are securely in place by pulling slightly on them.
9. If the inverter is installed outdoors, install overvoltage protection for all components in the network.
10. If you would like to integrate the inverter into a local network, connect the other end of a network cable to the local network (e.g., via a router).
11. If a weep hole has been added to the conduit, seal the conduit with sealing compound.

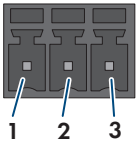
6.6 Connection to the Multifunction Relay

6.6.1 Digital output (MFR)

The multifunction relay (MFR) is a digital output that can be specifically configured to the system.

In a system with multiple inverters, you must carry out the connection to the multifunction relay of the System Manager.

6.6.2 Pin assignment MFR

Digital input	Pin	Assignment
	1	NO
	2	CO
	3	NC

6.6.3 Connect signal source to MFR

⚠ QUALIFIED PERSON

Additionally required material:

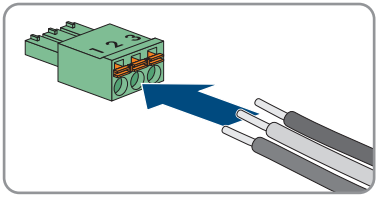
- ☐ Conduit (trade size: 27 mm (1 in) or smaller with suitable reducer bush)
- ☐ Sealing compound for sealing the join between the conduit and inverter if a weep hole has been added to the conduit
- ☐ Rain-tight conduit fittings or conduit fittings for wet locations complying with UL 514B (trade size: 27 mm (1 in) or smaller with suitable reducing bush)

Requirements:

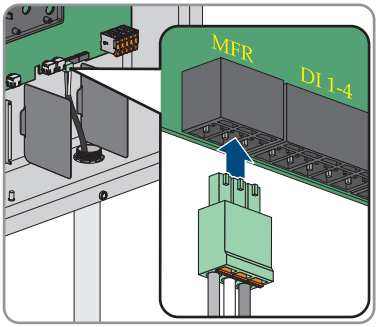
☐ The technical requirements of the multifunction relay must be met (see Section 14, page 108).

Procedure:

1. Disconnect the inverter from all voltage sources (see Section 9, page 82).
2. Insert the conduit fitting into the opening and tighten from the inside using the counter nut.
3. Remove the filler plug from the enclosure opening which is located at the bottom of the inverter.
4. Attach the conduit to the conduit fitting.
5. Guide the conductors from the conduit into the inverter.
6. Strip the insulation off the conductor 6 mm (0.24 in).
7. Connect the conductors to the 3-pole terminal block according to the operating mode. Ensure that the conductors are plugged completely into the terminal points up to their insulation.



8. Insert the three-pole terminal block with the connected conductors into the **MFR** slot.



9. Ensure that the terminal block is securely in place.
10. Ensure that all conductors are correctly connected.
11. Ensure that the conductors sit securely in the terminal points. Tip: To release the conductors, open the terminal points using a suitable tool.
12. If a weep hole has been added to the conduit, seal the conduit with sealing compound.

Also see:

- Additionally required material for the connection to digital inputs ⇒ page 40
- Signal cable requirements ⇒ page 40

6.7 Connection to digital input DI 1-4

6.7.1 Digital input DI 1-4

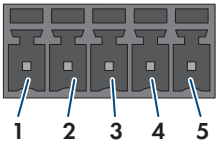
An external signal source can be connected to digital input **DI 1-4** (e.g. for active power limitation).

In a system with multiple inverters, the external signal source must be connected to digital input **DI 1-4** of the System Manager.

Also see:

- Configuring the digital input DI 1-4 for the external setpoint ⇒ page 70

6.7.2 Pin assignment DI 1-4

Digital input D1-4	Pin	Assignment
	1	Digital input 1
	2	Digital input 2
	3	Digital input 3
	4	Digital input 4
	5	Voltage supply output

6.7.2.1 Digital input DI 1-4

An external signal source can be connected to digital input **DI 1-4** (e.g. for active power limitation).

In a system with multiple inverters, the external signal source must be connected to digital input **DI 1-4** of the System Manager.

6.7.3 Circuitry overview DI 1-4

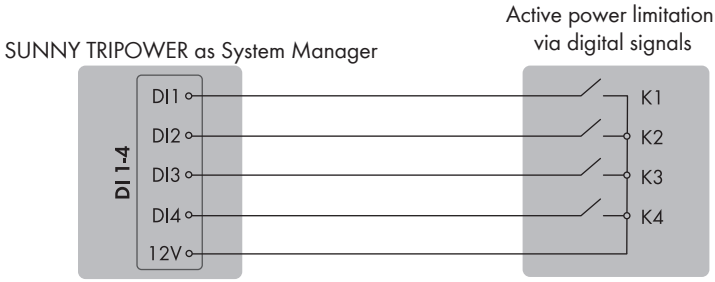


Figure 9: Connection of a signal source for active power limitation via digital signals on the Sunny Tripower, which is to be configured as a System Manager

6.7.3.1 Digital input DI 1-4

An external signal source can be connected to digital input **DI 1-4** (e.g. for active power limitation).

In a system with multiple inverters, the external signal source must be connected to digital input **DI 1-4** of the System Manager.

6.7.4 Connecting signal source to DI 1-4

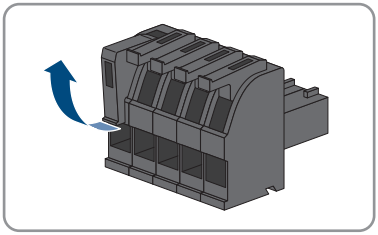
⚠ QUALIFIED PERSON

Additionally required material:

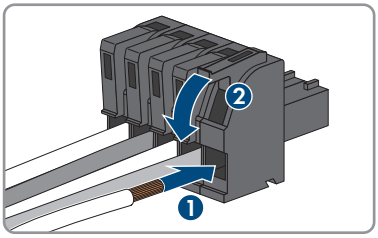
- ☐ Conduit (trade size: 27 mm (1 in) or smaller with suitable reducer bush)
- ☐ Sealing compound for sealing the join between the conduit and inverter if a weep hole has been added to the conduit
- ☐ Rain-tight conduit fittings or conduit fittings for wet locations complying with UL 514B (trade size: 27 mm (1 in) or smaller with suitable reducing bush)

Procedure:

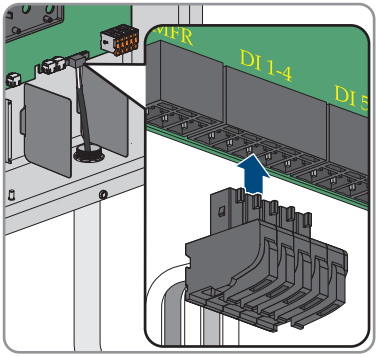
1. Connect the connection cable to the digital signal source (see the manual from manufacturer).
2. Disconnect the inverter from all voltage sources (see Section 9, page 82).
3. Remove the filler plug from the enclosure opening which is located at the bottom of the inverter.
4. Insert the conduit fitting into the opening and tighten from the inside using the counter nut.
5. Attach the conduit to the conduit fitting.
6. Guide the conductors from the conduit into the inverter.
7. Strip the insulation off the conductor 6 mm (0.24 in).
8. Release the conductor entries on the supplied five-pole connector.



9. Connect the conductors of the connection cable to the supplied five-pole connector. To do so, plug the conductors into the conductor entries and close the conductor entries. Observe the connector assignment.



10. Plug the five-pole connector into the socket **DI 1-4** on the product. Observe the pin assignment.



11. Ensure that the connector is securely in place.
12. Ensure that all conductors are correctly connected.
13. Ensure that the conductors sit securely in the terminal points.
14. If a weep hole has been added to the conduit, seal the conduit with sealing compound.

Also see:

- Digital input DI 1-4 ⇒ page 47
- Circuitry overview DI 1-4 ⇒ page 48
- Additionally required material for the connection to digital inputs ⇒ page 40
- Signal cable requirements ⇒ page 40

6.8 Connection to digital input DI 5-6

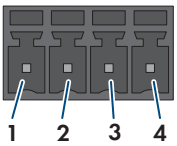
6.8.1 Digital input DI 5-6

An external signal source can be connected to digital input **DI 5-6** (e.g. for fast stop).

Also see:

- Circuitry overview DI 5 ⇒ page 51
- Circuitry overview DI 6 ⇒ page 51

6.8.2 Pin assignment DI 5-6

Digital input	Pin	Assignment
	1	Digital input 5
	2	Digital input 6
	3	Not assigned
	4	Voltage supply output

6.8.3 Circuitry overview DI 5

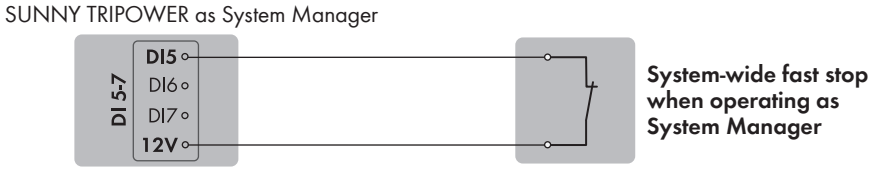


Figure 10: Connection of a system-wide fast-stop switch to digital input DI 5 of the Sunny Tripower that is to be configured as System Manager

6.8.4 Circuitry overview DI 6

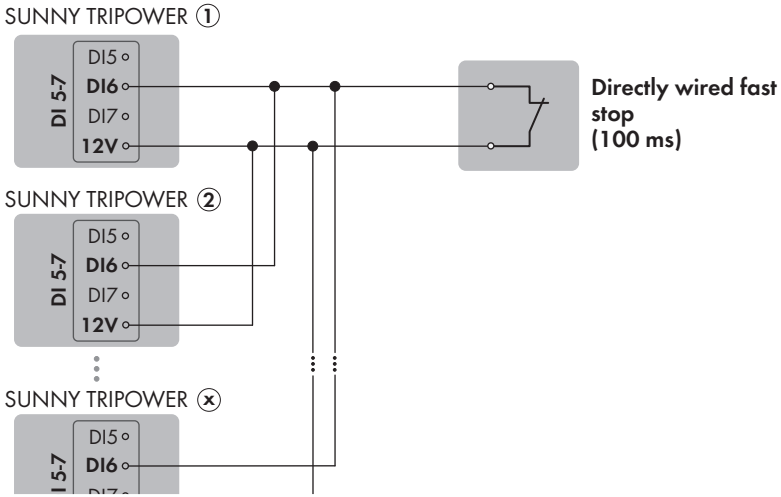


Figure 11: Connection of a fast-stop switch (100 ms) to digital input DI 6 of one or more Sunny Tripower in the system

6.8.5 Connecting Signal Source to Digital Input DI 5-6

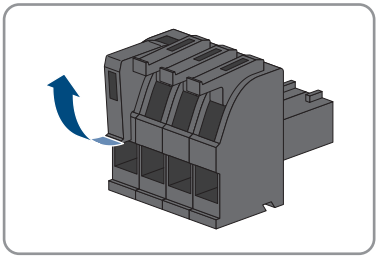
⚠ QUALIFIED PERSON

Additionally required material:

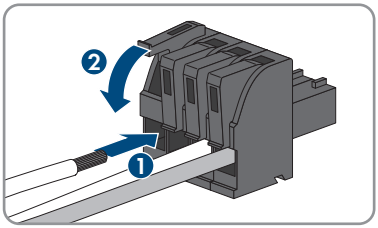
- ☐ Conduit (trade size: 27 mm (1 in) or smaller with suitable reducer bush)
- ☐ Sealing compound for sealing the join between the conduit and inverter if a weep hole has been added to the conduit
- ☐ Rain-tight conduit fittings or conduit fittings for wet locations complying with UL 514B (trade size: 27 mm (1 in) or smaller with suitable reducing bush)

Procedure:

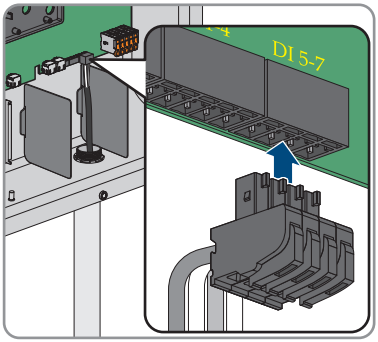
1. Connect the connection cable to the digital signal source (see the manual from manufacturer).
2. Disconnect the inverter from all voltage sources (see Section 9, page 82).
3. Remove the filler plug from the enclosure opening which is located at the bottom of the inverter.
4. Insert the conduit fitting into the opening and tighten from the inside using the counter nut.
5. Attach the conduit to the conduit fitting.
6. Guide the conductors from the conduit into the inverter.
7. Strip the insulation off the conductor 6 mm (0.24 in).
8. Release the conductor entries on the supplied four-pole connector.



9. Connect the connection cable to the supplied four-pole connector. To do so, plug the conductors into the conductor entries and close the conductor entries. Observe the connector assignment.



10. Plug the four-pole connector into the socket **DI 5-7** on the product. Observe the pin assignment.



11. Ensure that the connector is securely in place.
12. Ensure that all conductors are correctly connected.
13. Ensure that the conductors sit securely in the terminal points.
14. If a weep hole has been added to the conduit, seal the conduit with sealing compound.

Also see:

- Additionally required material for the connection to digital inputs ⇒ page 40
- Signal cable requirements ⇒ page 40

6.9 DC connection

6.9.1 Assembling the DC Connectors

⚠ QUALIFIED PERSON

For connection to the inverter, all PV module connection cables must be fitted with the DC connectors provided. Assemble the DC connectors as described in the following (refer to the manufacturer manual for further information on assembling the DC connectors). Be sure to observe the correct polarity.

⚠ 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.
- Disconnect the product from voltage sources and ensure it cannot be reconnected before working on the device.
- Do not disconnect the DC connectors under load.
- Wear suitable personal protective equipment for all work on the product.

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

- ☐ Stripping tool
- ☐ Crimping tool suitable for crimping the cold-formed contact ferrules (observe manufacturer information).
- ☐ Tool for tightening the swivel nut (observe manufacturer information).
- ☐ Where applicable, tool for checking whether the conductors with contact ferrules plug far enough into the DC connector (observe manufacturer information).

Procedure:

1. Strip off the conductor insulation by 7 mm ±0.5 mm (0.28 in ±0.02 in).
2. Thread the cold-formed contact ferrule onto the stripped conductor and crimp using a crimping tool suitable for the cold-formed contact ferrule.
3. Guide the conductor with the cold-formed contact ferrule into the connector until the cold-formed contact ferrule snaps audibly into place in the DC connector.
4. Ensure that the conductor with the cold-formed contact ferrule is plugged far enough into the DC connector and has snapped into place.
5. Tighten the DC connector swivel nut (torque: 3.5 Nm to 4 Nm (31 in-lb to 35 in-lb)).

Also see:

- Requirements on DC Conductors ⇒ page 39

6.9.2 Connecting the PV Array

⚠ QUALIFIED PERSON

⚠ 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 DC input voltage range of 1000 V or higher.

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.

NOTICE

Damage to the DC connectors due to the use of contact cleaner of other cleaning agents

Some contact cleaners or other cleaning agents may contain substances that decompose the plastic of the DC connectors.

- Do not use contact cleaners or other cleaning agents for cleaning the DC connectors.

NOTICE

Destruction of the inverter due to overvoltage

If the open-circuit voltage of the PV modules exceeds the maximum input voltage of the inverter, the inverter can be destroyed due to overvoltage.

- If the open-circuit voltage of the PV modules exceeds the maximum input voltage of the inverter, do not connect any strings to the inverter and check the design of the PV system.

Requirements:

☐ The miniature circuit breaker must be switched off and prevented from being reconnected.

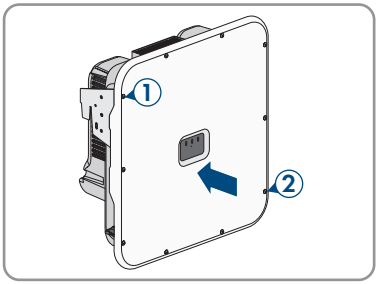
☐ The DC load-break switch must be set to **OFF** and, depending on local regulations, prevented from restarting using a padlock.

☐ The cables of the PV modules must be equipped with DC connectors.

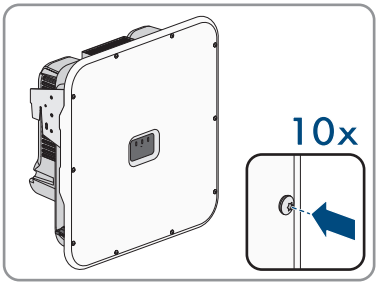
☐ If the DC terminal cover is available as an accessory, the DC terminal cover must be mounted on the inverter and the DC cables must be routed through the conduits into the DC term cover (see Section 5.4, page 36).

Procedure:

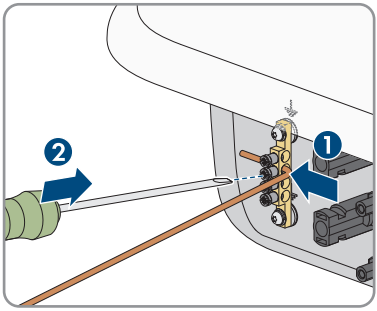
1. Position the enclosure lid and first insert the upper-left (position **1**) and lower-right (position **2**) screws and fasten them hand-tight (TX25).



2. Insert and tighten all screws (TX25, torque: 6 Nm ± 0.3 Nm (53 in-lb ± 2.65 in-lb)).

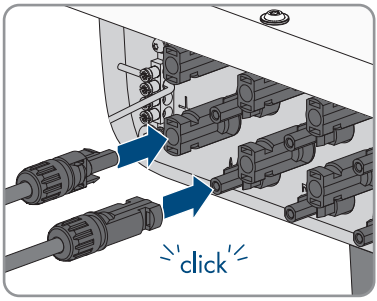


3. Strip the insulation of every equipment grounding conductor by 10 mm (0.4 in).
4. Connect every equipment grounding conductor of the PV modules to the equipment grounding bar. To do this, plug the equipment grounding conductor into a contact opening on the equipment grounding bar and tighten the corresponding screw using a cross-head screwdriver (torque: 4 Nm (35 in-lb).



5. Measuring the voltage of the PV array. Ensure that the maximum input voltage of the inverter is adhered to and that there is no ground fault in the PV system.
6. Check whether the DC connectors have the correct polarity.
7. If the DC connector is equipped with a DC cable of the wrong polarity, the DC connector must be reassembled. When this is done, the DC cable must always have the same polarity as the DC connector.

8. Ensure that the open-circuit voltage of the PV array does not exceed the maximum input voltage.
9. Connect the assembled DC connectors to the inverter.



☑ The DC connectors snap into place.

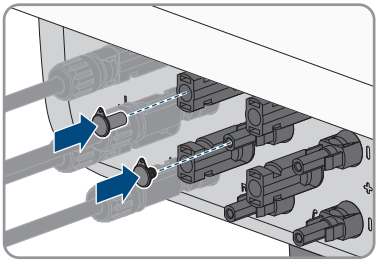
10. Ensure that all DC connectors are securely in place.
11.

NOTICE

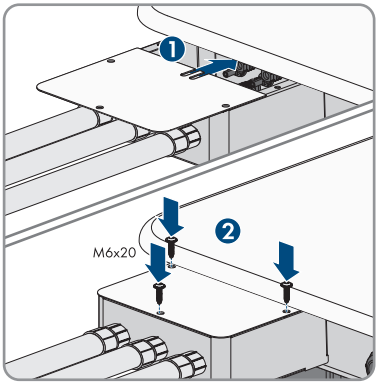
Damage to the product due to sand, dust and moisture ingress if the DC inputs are not closed

The product is only properly sealed when all unused DC inputs are closed with sealing plugs. Sand, dust and moisture penetration can damage the product and impair its functionality.

12. Seal the DC connectors that are not required on the product with the supplied sealing plugs.



13. If the DC terminal cover is available as an accessory, mount the cover of the DC terminal cover with the 3 M6x20 screws (TX25, torque: 6 Nm (53 in-lb)).



Also see:

- Requirements for the PV modules per input ⇒ page 39
- Requirements on the equipment grounding conductor of the PV modules ⇒ page 39

7 Commissioning

7.1 Procedure for commissioning as a subordinate device

⚠ QUALIFIED PERSON

This section describes the procedure of commissioning an inverter that is used in systems with or without System Manager.

In systems with System Manager, only 1 device can be used as System Manager at a time (e.g. SMA Data Manager or an inverter as System Manager). All other devices must be configured as a subordinate device and recorded in the System Manager.

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

Procedure		See
1.	Commission the inverter.	Section 7.3, page 60
2.	Establish a connection to the user interface of the inverter. There are various connection options to choose from for this: • Direct connection via Wi-Fi • Connection via WLAN in the local network • Connection via Ethernet in the local network	Section 8.1.2, page 63 Section 8.1.1, page 61
3.	If required, change the network configuration on the welcome page. The automatic network configuration recommended by SMA Solar Technology AG via DHCP server is activated by default. Only change the network configurations if the default configuration is not suitable for your network.	Commissioning Assistant
4.	Carry out the configuration using the Commissioning Assistant. When doing so, select **Subordinate device** in the device function.	Commissioning Assistant
5.	Register the inverter as an SMA Speedwire device in the System Manager.	Commissioning Assistant of the System Manager

Also see:

- Device function ⇒ page 21

7.2 Procedure for commissioning as System Manager

⚠ QUALIFIED PERSON

This section describes the procedure of commissioning an inverter that is used in systems as System Manager.

Only 1 device in the system can be used as System Manager at a time (e.g. SMA Data Manager or an inverter as System Manager). All other devices must be configured as a subordinate device and recorded in the System Manager.

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

Procedure		See
1.	Commission all SMA Speedwire devices that are to be subordinate to the System Manager (e.g., inverters, energy meters).	Manual of the devices
2.	Commission the inverter that is to be configured as the System Manager.	Section 7.3, page 60
3.	Establish a connection to the user interface of the inverter that is to be configured as System Manager. There are various connection options to choose from for this: • Direct connection via Wi-Fi • Connection via WLAN in the local network • Connection via Ethernet in the local network	Section 8.1.2, page 63 Section 8.1.1, page 61
4.	If required, change the network configuration on the welcome page. The automatic network configuration recommended by SMA Solar Technology AG via DHCP server is activated by default. Only change the network configurations if the default configuration is not suitable for your network.	Commissioning Assistant
5.	Carry out the configuration using the Commissioning Assistant. Select **Inverter as System Manager** in the device function.	Commissioning Assistant
6.	Make further settings if necessary (e.g., configure multifunction relay, configure arc-fault circuit interrupter).	Section 8, page 61
7.	To monitor the system in the Sunny Portal and view the data visually, create a user account in the Sunny Portal and create a system in the Sunny Portal or add devices to an existing system.	https://ennexOS.SunnyPortal.com

Also see:

- Device function ⇒ page 21

7.3 Commissioning the Inverter

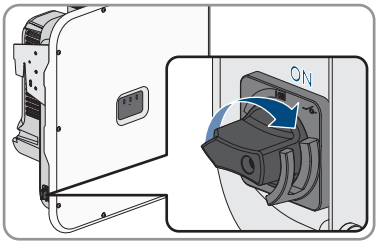
⚠ QUALIFIED PERSON

Requirements:

- ☐ The AC circuit breaker must be correctly rated and mounted.
- ☐ The product must be correctly mounted.
- ☐ All cables must be correctly connected.
- ☐ The enclosure lid must be mounted.

Procedure:

1. If necessary, switch on the supply of the connected signal sources.
2. If the DC load-break switch has been secured with a padlock, open and remove the padlock on the DC load-break switch.
3. Switch on the DC load-break switch.



4. Switch on the AC circuit breaker.
5. If the green and red LEDs flash simultaneously during initial commissioning, operation is stopped because no country data set has been set yet. For the inverter to begin operation, the configuration must be completed and a country data set must be set.
6. 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.
7. If the red LED lights up, an event has occurred. Find out which event has occurred and, if necessary, initiate countermeasures.
8. Ensure that the inverter feeds in correctly.

Also see:

- Event messages ⇒ page 86

8 Operation

8.1 Establishing a connection to the user interface

8.1.1 Connection in the local network

8.1.1.1 Access addresses for the product in the local network

DHCP Server is recommended

The DCHP server automatically assigns the appropriate network settings to your nodes in the local network. A manual network configuration is therefore not necessary. In a local network, the Internet router is usually the DHCP server. If the IP addresses in the local network are to be assigned dynamically, DHCP must be activated in the Internet router (see the Internet router manual). In order to receive the same IP address by the internet router after a restart, set the MAC address binding.

In networks where no DHCP server is active, proper IP addresses must be assigned from the free address pool of the network segment to all network participants to be integrated during commissioning.

Communication disturbances in the local network

The IP address range 192.168.12.0 to 192.168.12.255 is occupied for communication amongst SMA products and for direct access to SMA products.

Communication problems might occur if this IP address range is used in the local network.

- Do not use the IP address range 192.168.12.0 to 192.168.12.255 in the local network.

If the product is connected to a local network (e.g. via an Internet router or Wi-Fi), 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 (Internet router) or manually by you.

Upon completion of the configuration, the product can only be reached via the listed access addresses in the local network:

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

8.1.1.2 Ports for data communication in the local network

In small local networks the use of certain ports is unrestricted. In industrial networks, the use of these ports may require authorization from the system administrator. For proper operation, the outgoing Internet connection must allow the use of the following ports and URLs:

Port and URL	Use
Port 80 and 443 (http/https) update.sunnyportal.de	Updates

Port and URL	Use
Port 123 (NTP) ntp.sunny-portal.com	Time synchronization with Sunny Portal (if not provided by the Internet router)
Port 443 (https/TLS) ldm-devapi.sunnyportal.com	Data transmission
Port 443 (https/TLS) ennexos.sunnyportal.com	User interface
Port 9524 (TCP) wco.sunnyportal.com	SMA Webconnect 1.5 and SMA SPOT

8.1.1.3 Establishing a Connection via Ethernet in the local network

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: You can change the network configuration on the welcome page of the product.

☐ A smart device (e.g. laptop) must be available.

☐ The smart device must be in the same local network as the product.

☐ The respective latest version of one of the following web browsers must be installed on the smart device: Chrome, Edge, Firefox or Safari.

Procedure:

1. Open the web browser of your smart device.
2. Enter the access address of the product in the address bar of the web browser.
3. **Web browser displays warning**

   After the access address of the product has been entered, a message might appear indicating that the connection to the user interface of the product is not secure.

   - Continue loading the user interface (scroll to bottom and click proceed/advance).

☑ When you connect to the user interface for the first time, the welcome page opens. The Commissioning Assistant for configuring the product can be started via the welcome page.

☑ The login page of the user interface opens if the product has already been configured.

Also see:

- SMA Speedwire ⇒ page 30
- Access addresses for the product in the local network ⇒ page 61
- Ports for data communication in the local network ⇒ page 61

8.1.1.4 Establishing a Connection via WLAN in the Local Network

Requirements:

☐ The product must be commissioned.

☐ The product must be integrated into the local network. Tip: You can change the network configuration on the welcome page of the product.

☐ A smart device (e.g. laptop) must be available.

☐ The smart device must be in the same local network as the product.

☐ The respective latest version of one of the following web browsers must be installed on the smart device: Chrome, Edge, Firefox or Safari.

Procedure:

1. Open the web browser of your smart device.
2. Enter the access address of the product in the address bar of the web browser.
3. **Web browser displays warning**

   After the access address of the product has been entered, a message might appear indicating that the connection to the user interface of the product is not secure.

   - Continue loading the user interface (scroll to bottom and click proceed/advance).

☑ When you connect to the user interface for the first time, the welcome page opens. The Commissioning Assistant for configuring the product can be started via the welcome page.

☑ The login page of the user interface opens if the product has already been configured.

Also see:

- Access addresses for the product in the local network ⇒ page 61
- Ports for data communication in the local network ⇒ page 61

8.1.2 Direct connection via Wi-Fi

8.1.2.1 Connection options for Wi-Fi direct connection

You have several options to connect the product to a smart device. The procedure can be different depending on the devices. If the procedures described do not apply to your end device, establish the direct connection via Wi-Fi as described in the manual of your end device.

The following connection options ar available:

- Direct Wi-Fi connection with WPS (see Section 8.1.2.3, page 64)
- Direct Wi-Fi connection with Wi-Fi network search (see Section 8.1.2.4, page 64)

8.1.2.2 Access information for direct Wi-Fi connection

Communication disturbances in the local network

The IP address range 192.168.12.0 to 192.168.12.255 is occupied for communication amongst SMA products and for direct access to SMA products.

Communication problems might occur if this IP address range is used in the local network.

- Do not use the IP address range 192.168.12.0 to 192.168.12.255 in the local network.

Access information for the direct WiFi connection can be found below:

- SSID: **SMA[serial number]** (e.g. SMA0123456789)
- Device-specific Wi-Fi password: WPA2-PSK (see type label of the product)
- Default access address: **https://smalogin.net** or **https://192.168.12.3**

8.1.2.3 Establishing a direct Wi-Fi connection with WPS

Requirements:

☐ A smart device with WPS function must be available.

Procedure:

1. Enable the WPS function on the inverter. To do this, tap on the enclosure lid of the inverter twice.
   ☑ The blue LED flashes quickly for approx. two minutes. The WPS function is active during this time.
2. Enable the WPS function on your smart device.
3. Open the web browser of your smart device and enter **https://smalogin.net** in the address bar.

☑ When you connect to the user interface for the first time, the welcome page opens. The Commissioning Assistant for configuring the product can be started via the welcome page.

☑ The login page of the user interface opens if the product has already been configured.

Also see:

- Access information for direct Wi-Fi connection ⇒ page 64

8.1.2.4 Establishing direct Wi-Fi connection with Wi-Fi network search

1. Search for Wi-Fi networks with your smart device.
2. Select the SSID of the product **SMA[serial number]** in the list with the detected Wi-Fi networks.
3. Enter the device-specific Wi-Fi password (see WPA2-PSK on the type label).

4. Open the web browser of your smart end device and enter **https://smalogin.net** in the address bar.
   ☑ When you connect to the user interface for the first time, the welcome page opens. The Commissioning Assistant for configuring the product can be started via the welcome page.
   ☑ The login page of the user interface opens if the product has already been configured.
5. If the login page of the user interface does not open, enter the IP address **192.168.12.3** or, if your smart terminal supports mDNS services, **SMA[serial number].local** or **https://SMA[serial number]** in the address bar of the web browser.

Also see:

- Access information for direct Wi-Fi connection ⇒ page 64

8.2 WPS function

8.2.1 Connection options with WPS

You have several options to use the WPS function. Depending on the possible application of the WPS function, the procedure for activation will vary.

The following options are available:

- WPS for automatic connection to a network (e.g. via a router)
- WPS for direct connection between the product and a smart device

8.2.2 Activating WPS for automatic connection

Requirements:

☐ WLAN must be activated in the product.
☐ WPS must be activated on the router.
☐ The user interface is open and you are logged in.

Procedure:

1. Select the menu **Configuration**.
2. Select **Network configuration** menu item.
3. Click on the button **Use WPS** in the **Wi-Fi** section.
4. Click on [**Save**].

☑ The WPS function is activated and the automatic connection to the network can be established.

8.2.3 Activating WPS for direct connection to a smart device

- Tap on the enclosure lid of the product twice in direct succession.

☑ The WPS function is activated for about 2 minutes. Activation is signaled by rapid flashing of the blue LED.

8.3 Design of the User Interface

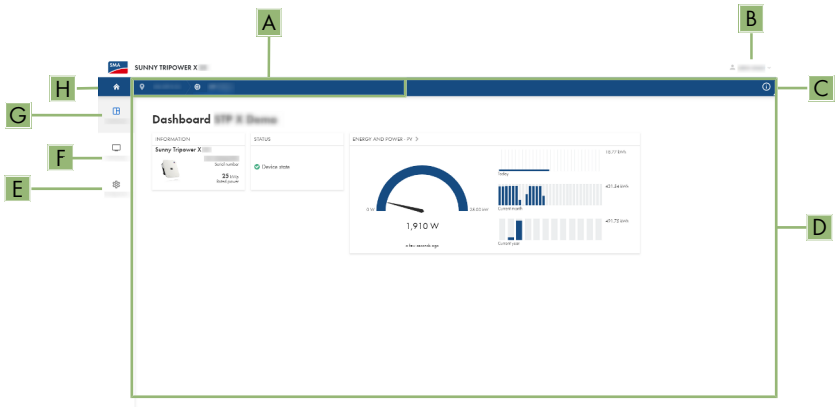


Figure 12: Design of the User Interface

Position	Designation	Description
A	Focus navigation	Enables the navigation between the following levels: • System • Device
B	User settings	Provides the following functions: • Configuring personal data • Logout
C	System information	Displays the following information: • System • Device information • Licenses • eManual
D	Content Area	Displays the dashboard or content of the selected menu.
E	Configuration	Offers different views for configuration, depending on the selected level and user role.
F	Monitoring	Offers different views for monitoring, depending on the scope of the connected devices.
G	Dashboard	Displays information and instantaneous values of the device or system currently selected.
H	Home	Opens the user interface home page

8.4 Access rights to the user interface

1 administrator is created during registration. As administrator, you can add further system users who can configure user rights or delete users.

This gives users access to the system and to the devices recorded in the system.

You can assign the following rights for users:

- Administrator
- User
- Installer

8.5 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.

Requirements:

☐ The user interface must be open and you must be logged in.

☐ Changes to grid-relevant parameters must be approved by the responsible grid operator, and can only be made as **Administrator** or **Installer**.

Procedure:

1. Choose the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the **Parameters** menu item.
4. Call up the parameter via the search function or navigate to the parameter.
5. Change the parameter value.
6. Click on [**Save**].

8.6 Arc-Fault Circuit Interrupter (AFCI)

⚠ QUALIFIED PERSON

You can set the arc-fault circuit interrupter using the following parameters.

Channel	Name	Settings
AfciIsOn	**AFCI switched on**	**Yes**
		No

You can use the following parameters to set the manual restart after an arc fault detection.

Channel	Name	Settings
Operation.ManRstr.IsOn	**Manual restart activated**	**Yes** **No**
Operation.ManRstr.ManRstrAFCI	**Manual restart after arc detection**	**On** **Off** **Yes, after 5 electric arc detections within 24 hrs**

Also see:

- Arc-Fault Circuit Interrupter (AFCI) ⇒ page 26
- Changing parameters ⇒ page 67
- Manual restart after electric arc ⇒ page 104

8.7 Digital output (MFR)

8.7.1 Use of the digital output (MFR)

The digital output (MFR) can be switched depending on measured values or states.

You have several options to use the digital output.

Possible use	Category	Explanation
Notification in the event of an error	System state	System is in warning or error state.
Alarm in case of warning or error	System state	System is in error state.
Direct selling enabled	System state	The active power limitation of the direct seller is currently used for the point of interconnection.
Battery state of charge[1)]	Monitoring	Balanced state of charge of all batteries in the system
System active power[1)]	Monitoring	Sum of the active power of all PV inverters in the system.
System reactive power[1)]	Monitoring	Balance of the reactive power of all selected PV inverters in the system.
Reactive power setpoint[1)]	Setpoints	Reactive power value to be set.
Setpoint of active power limitation[1)]	Setpoints	The active power value currently to be set.

[1)] Conditions for activating the outlet signal must be specified

Possible use	Category	Explanation
Standardized measured voltage value for Q(V)[1)]	Grid connection point	Standardized measured voltage value from the point of interconnection. For this, you require a valid Q(V) configuration in the grid management services.
System active power (grid-supplied power)[1)]	Grid connection point	Currently drawn active power.
System active power (grid feed-in)[1)]	Grid connection point	Currently fed-in active power.
System reactive power at the grid connection point[1)]	Grid connection point	Current reactive power.

8.7.2 Configure the digital output (MFR)

⚠ QUALIFIED PERSON

Requirements:

☐ A signal source must be connected to the digital output (**MFR**).

☐ The inverter to which the signal source is connected, must be configured as System Manager.

☐ The user interface must be open and you must be logged in as **Installer** or **Administrator**.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the menu item **I/O configurations**.
4. Select **+ New I/O configuration** to add a new configuration.
5. Select the type of the I/O channel **Digital output**.
6. Select the use for the digital output.
7. If necessary, activate inversion of the signal. Observe the pin assignment of the terminal block.
8. Click on [**Save**].

Also see:

- Use of the digital output (MFR) ⇒ page 68

8.8 Configure digital inputs

⚠ QUALIFIED PERSON

Requirements:

☐ The user interface must be open and you must be logged in.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the menu item **I/O configurations**.
4. Select **+ New I/O configuration** to add a new configuration.
5. Select the type of the I/O channel **Digital input**.
6. Select the use for the digital input.
7. Adjust further required settings (if applicable).
8. Assign a name to the I/O channel.
9. Click on [**Save**].

8.9 Configuring the digital input DI 1-4 for the external setpoint

⚠ QUALIFIED PERSON

If the grid operator specifications were not configured via the commissioning wizard, you can carry out the configuration as described below.

Requirements:

☐ A ripple control receiver or remote terminal unit for active power setpoints must be connected to digital input **DI 1-4**.

☐ The inverter that is connected to the ripple control receiver or the remote terminal unit must be configured as System Manager.

☐ The user interface must be open and you must be logged in as **Installer** or **Administrator**.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the menu item **Grid management service**.
4. For the active and reactive power select **Configuration & activation**.
5. Open the configuration wizard for **Grid operator specifications** under **Active power**.
6. Activate **Source for external setpoint**.
7. Select **Digital inputs**.
8. Select **+ New I/O configuration**.
9. Select the System Manager as the source for the digital signal.
10. Select the digital inputs 1-4.
11. Configure the grid operator specifications. You can add a new line for each default value and specify the combination of signals (bits).
12. Click on **[Accept]**.
13. Configure the fallback behavior for missing setpoints.
14. If necessary, configure the behavior in case of setpoint change.

8.10 Generating the I-V Characteristic Curve

⚠ QUALIFIED PERSON

Requirements:

☐ The user interface must be open and you must be logged in as **Installer** or **Administrator**.

Procedure:

1. Select the product in the focus navigation.
2. Select the **Monitoring** menu.
3. Select the menu item **Diagnosis**.
4. Select the **I-V characteristic curve**.
5. Select [**New measurement**].
6. Use the measurement results to check whether there are any deviations or changes.
7. If necessary, carry out measures to correct the problems on the PV modules.
8. Export the results if necessary.

Also see:

- Diagnostic function ⇒ page 26

8.11 Activating a Digital Product

If you purchased a digital product via the SMA Online Shop at www.SMA-Onlineshop.com, you can activate this digital product as described below.

Each digital product can only be activated once and has no run-time restriction unless otherwise stated.

Requirements:

- An active Internet connection is required at the time of activation.
- The activation key must be present. You can find the activation key on the invoice that was sent to the e-mail address, which has been stored in the customer profile of the SMA Online Shop.
- The user interface must be open and you must be logged in as **Installer** or **Administrator**.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the **Digital products** menu item.
4. In the row of the product to be activated, click the [**Activate**] button.
   ☑ The activation window opens.
5. Enter the activation key and click the [**Activate**] button. Please note: All letters are capital letters. All hyphens are mandatory fields.

8.12 Energy management

8.12.1 Predefined energy management profiles

The page of the user interface shows predefined energy management profiles that are stored in the product. These profiles form the basis for configuring the energy management.

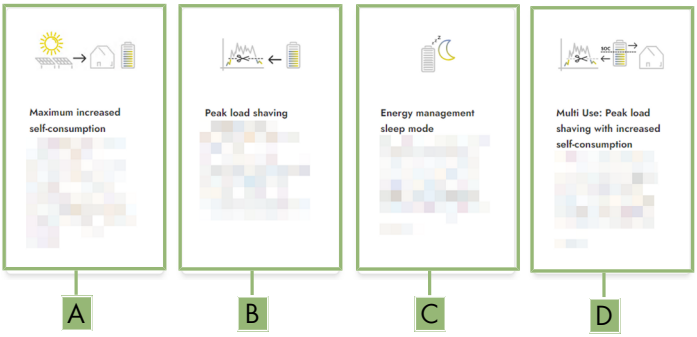


Figure 13: Overview of predefined energy management profiles

Position	Energy management profile
A	Maximum Increased Self-Consumption
B	Peak Shaving
C	Sleep mode
D	Multiuse (combination of increased self-consumption and peak load shaving)

Also see:

- Creating a new energy management profile ⇒ page 74

8.12.2 Used energy management profiles

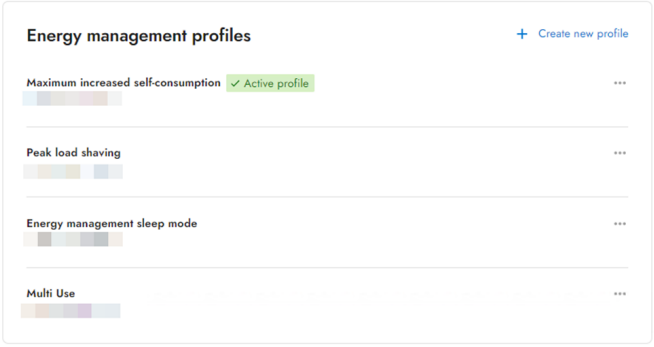


Figure 14: Overview of the used energy management profiles (example)

This overview shows all energy management profiles that were activated at least once before. The energy management profile currently active is highlighted.

When the energy management is started for the first time after commissioning, no energy management profiles are displayed on this page.

Also see:

- Predefined energy management profiles ⇒ page 72
- Creating a new energy management profile ⇒ page 74
- Activating the energy management ⇒ page 75
- Deactivating the energy management ⇒ page 75
- Changing an energy management profile ⇒ page 76

8.12.3 Setting options for peak load shaving

Setting option	Explanation
Threshold value for peak load shaving	Limiting value for the grid supply from which the battery is to be used to reduce peak loads. Only whole numbers are accepted as an entry.
Billing interval in the tariff	Interval for billing the performance prices: If the tariff of your electric utility company does not specify an interval for billing the performance prices or if the interval for billing the performance prices is not known, select the **Unknown** option.
Adjustment	If no value is specified for the **Billing interval in the tariff**, the option **Immediate adjustment** is always active. In this case, peak load shaving is controlled according to the instantaneous value of the grid supply at the point of interconnection. If a value for the **Averaging interval in the tariff** is specified, the option **Averaging interval** can be selected. In this case, peak load shaving is controlled according to the averaging value of the grid supply at the point of interconnection. If a peak load that is too high cannot be curtailed, the resulting overload can be compensated for at another time in the averaging interval. It can happen that the inverter curtails the grid-supplied power even further than specified by the threshold for peak load shaving.

Setting option	Explanation
Automatic threshold adjustment	Only if a value for the **Averaging interval in the tariff** is specified, can the function **Autom. threshold adjustment** be used. If the option **Adaptively increase threshold** is activated and the threshold for peak load shaving could not be observed despite adjustment via the averaging interval, the threshold is automatically increased. Exceeding the original threshold specifies the measure for the adaptive increase. Optionally, the threshold for peak load shaving can be reset to the originally entered value at the end of the billing period.
Battery charge	The parameter **Battery charge** controls the charging behavior of the inverter during peak load shaving: If the state of charge of the battery should always be as high as possible, for example, activate or leave the option **Recharge start voltage corresponds to threshold for peak load shaving** activated for the parameter **Battery state of charge**. If recharging of the battery from the utility grid is to be avoided, for example, deactivate the option **Recharge start voltage corresponds to threshold for peak load shaving** and set the **Recharge start voltage** to 0 kW for the parameter **Battery state of charge**.

Also see:

- Creating a new energy management profile ⇒ page 74

8.12.4 Creating a new energy management profile

⚠ QUALIFIED PERSON

When an energy management profile is created, energy management activates automatically.

Requirement:

☐ A suitable energy meter is installed and configured at the point of interconnection within the system.

☐ A battery is available in the system and has been put into operation.

☐ The user interface is open and you are logged in.

Procedure:

1. Select the menu item **Energy management** in the menu **Configuration**.
   ☑ The overview of the used energy management profiles opens.
2. Select the [**Create new profile**] button.
   ☑ The overview of the predefined energy management profiles opens.

3. Click on the profile you want.
   - ☑ In the energy management profiles **Maximum increased self-consumption** and **Sleep mode**, the selected energy management profile is activated automatically.
   - ☑ In the energy management profiles **Peak load shaving** and **Multiuse**, the page to set the parameters opens.
4. To use peak load shaving, set the parameters for the peak load shaving. Take the parameter description for peak load shaving into account.
5. To use the multiuse function, set the parameters for the multiuse function. Take the parameter description for the multiuse function into account.

Also see:

- Predefined energy management profiles ⇒ page 72
- Used energy management profiles ⇒ page 72
- Setting options for peak load shaving ⇒ page 73

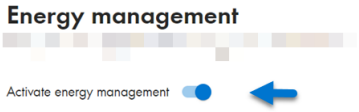
8.12.5 Deactivating the energy management

⚠ QUALIFIED PERSON

A single energy management profile cannot be deactivated, only changed. To deactivate the entire energy management, proceed as described in this section.

Procedure:

1. Log into the user interface of the product.
2. Select the menu item **Energy management** in the menu **Configuration**.
3. Select the slider **Activate energy management**.



Also see:

- Used energy management profiles ⇒ page 72

8.12.6 Activating the energy management

⚠ QUALIFIED PERSON

Requirements:

☐ A suitable energy meter is installed and configured at the point of interconnection within the system.

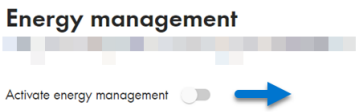
☐ At least 1 energy management profile has already been created.

☐ The user interface is open and you are logged in.

Procedure:

1. Select the menu item **Energy management** in the menu **Configuration**.

2. Select the slider **Activate energy management**.



3. If the required energy management profile is not activated, in the row of the energy management profile, select the ••• button.
4. Select **Activate profile**.

Also see:

- Used energy management profiles ⇒ page 72

8.12.7 Changing an energy management profile

⚠ QUALIFIED PERSON

A single energy management profile cannot be deactivated, only changed.

Requirements:

☐ At least 1 energy management profile has already been created.
☐ The user interface is open and you are logged in.

Procedure:

1. Log into the user interface of the product.
2. Select the menu item **Energy management** in the menu **Configuration**.
3. In the row of the required energy management profile, select the ••• button.
4. Select **Activate profile**.

Also see:

- Used energy management profiles ⇒ page 72

8.13 Backup file

8.13.1 Function and content of the backup file

The backup file is used to transfer configuration information, e.g., when commissioning a replacement device or when restoring previously saved parameter settings.

The backup file includes the following system and device configuration data for your product:

- Grid management services
- Network
- Energy meter
- Sunny Portal setting
- Self-defined Modbus profiles
- System Password
- User interface login data

- List of connected devices

The following information is not included in the backup file:

- Notifications
- Historic energy and performance values

8.13.2 Creating a Backup File

Requirements:

☐ The user interface must be open and you must be logged in.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the **Update and backup** menu item.
4. Select the [**Create backup file**] button.
5. Enter a password to encrypt the backup file and confirm with [**Create and download backup file**]. Please note that the password will be needed later for importing the backup file.
   ☑ An lbd file with all parameter settings is downloaded.

Also see:

- Function and content of the backup file ⇒ page 76

8.14 Carry out a manual firmware update

⚠ QUALIFIED PERSON

Functional limitations during the update

While an update is being performed, the functions of the product may be limited. The product is performing a restart and may be without function at times. This process takes several minutes and cannot be canceled.

Requirements:

☐ An update file with the desired firmware of the product must be available. You can download the update file, for example, from the product page under www.SMA-Solar.com.

☐ The user interface must be open and you must be logged in as **Installer** or **Administrator**.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the **Update and backup** menu item.
4. In the **Manual update** area, click [**Select file**] and select the update file for the product.
   ☑ The user interface confirms that the update file is compatible.
5. If the user interface does not confirm the compatibility of the update file, replace the update file.

6. Select [**Start update**].
7. Follow the instructions in the dialog.
   ☑ The product is performing a restart after the firmware update.
8. Select the **Monitoring** menu.
9. Select the menu item **Event monitor**.
10. Check the events to see whether the firmware update has been completed successfully.

8.15 Device Administration

8.15.1 Register Devices

You can register new devices and add them to the system on system level. This is required, for example, if your system has been expanded.

Requirements:

☐ The user interface must be open and you must be logged in.

Procedure:

1. Select the system in the focus navigation.
2. Select the menu **Configuration**.
3. Select the **Device management** menu item.
4. Select the ⊕ button.
5. Follow the steps of the device registration wizard.

8.15.2 Delete devices

You can delete registered devices on system level.

Requirements:

☐ The user interface must be open and you must be logged in.

Procedure:

1. Select the system in the focus navigation.
2. Select the menu **Configuration**.
3. Select the **Device management** menu item.
4. In the row of the device to be deleted, click the ••• button.
5. Select **Delete device**.
6. Select [**Delete**] in the displayed message.

8.16 Resetting the product to default setting

Loss of data due to replacement or due to resetting to default settings

If the product is reset to the default settings or replaced, all data saved in the product and the admin account will be deleted. Some of the data saved in Sunny Portal can be transmitted to the product after calling up the Sunny Portal system again.

Requirements:

☐ The user interface must be open and you must be logged in.

Procedure:

1. Select the product in the focus navigation.
2. Select the menu **Configuration**.
3. Select the menu item **Device properties**.
4. Select the button [**If you want to reset the device to the default settings, click here**].
5. Select [**Reset**].

8.17 Deleting the Admin Account

⚠ QUALIFIED PERSON

In case the password gets lost, the admin account can be reset and newly created. All system data will be retained.

Requirements:

☐ The Device Key from the label on the back of the supplied manual must be present.

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

Procedure:

1. Select the [**Delete admin account?**] button.
2. Enter the Device Key from the label on the back of the supplied manual.
3. Select [**Delete**].

☑ The product is performing a restart. Then a new admin account can be created.

Also see:

- Device Key (DEV KEY) ⇒ page 26

8.18 Q on Demand 24/7

If the "Q on Demand 24/7" function is activated for longer than 24 hours, a self-test is performed. The inverter is disconnected from the utility grid for a few minutes. The self-test should be carried out at a time when the sun is shining. As soon as enough DC power is available, the PV inverter starts operating again. The time for the self-test is set via the parameter **Time of cyclic insulation measurement**.

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 modes **cos φ(P) charac. curve** or **cos φ(V) charac. curve**.

The provision of reactive power can only be read off in the instantaneous values (**GridMs.TotVAr**, **Reactive power**) or requested via Modbus.

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

Channel	Name	Settings
Inverter.VArModCfg.QoDEna	**Q on Demand**	**On** **Off**
Inverter.VArModCfg.VArCnstCfgDmd.VArNom	**Manual reactive power setpoint for zero power output**	0% to 100%
Inverter.VArModCfg.VArModZerW	**Reactive power for zero active power**	Selection of various reactive power modes
Inverter.VArModCfg.VArModZerWFlb	**Reactive power fallback process in case of zero active power**	Selection of various reactive power modes
Operation.LeakRisMsTm	**Time of cyclic insulation measurement**	Time in minutes starting from 0:00 a.m. (e.g., 600 minutes for 10:00 a.m.)

8.19 Country standard

The product is not set to any country data set at the factory. While commissioning the product using the commissioning wizard, a country data set 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. First select the country data set and then the grid type suitable for your application.

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 The grid type must be set correctly

If you select the wrong grid type, it can cause a disturbance in the PV system and lead to problems with the grid operator.

Channel	Name	Settings
CntrySet	**Set country standard**	Selection of different country data sets

Channel	Name	Settings
Inverter.GriTyp	**Grid type**	Selection of different grid types
Cntry	**Country standard**	Display of the currently set country data set
CntryBas	**Underlying country standard**	Display of the country data set on which the current settings are based
GridMs.GriTyp	**Grid type**	Display of the currently set grid type

8.20 Overview of Grid Types

Depending on the selected country data set, some of the listed grid types can be selected.

Designation	Explanation
GriTyp3P4W_480V_LL	3 line conductors and neutral conductor (3P4W), nominal voltage: 480 V line conductor - line conductor
GriTyp3P4W_400V_LL	3 line conductors and neutral conductor (3P4W), nominal voltage: 400 V line conductor - line conductor
GriTyp3P4W_208V_LL	3 line conductors and neutral conductor (3P4W), nominal voltage: 208 V line conductor - line conductor
GriTyp3P4W_220V_LL	3 line conductors and neutral conductor (3P4W), nominal voltage: 220 V line conductor - line conductor

9 Disconnecting the Inverter from Voltage Sources

⚠ QUALIFIED PERSON

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

⚠ WARNING

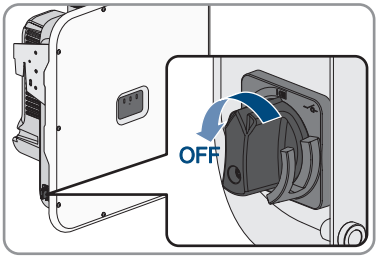
Danger to life due to electric shock from destruction of the measuring device due to overvoltage

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.

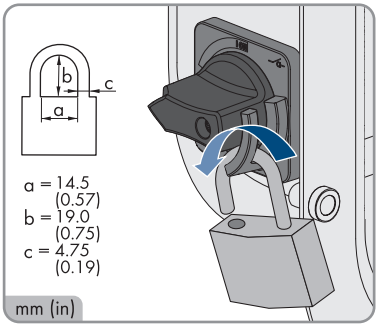
- Only use measuring devices with a DC input voltage range of 1000 V or higher.

Procedure:

1. Disconnect the AC miniature circuit breaker and secure against reconnection.
2. Turn the DC load-break switch of the inverter to position **O**.

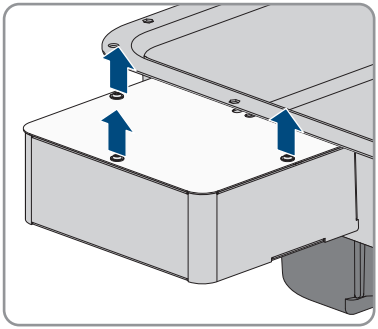


3. If your country requires the DC load-break switch to be protected against reconnection, secure the DC load-break switch against reconnection with a suitable padlock.

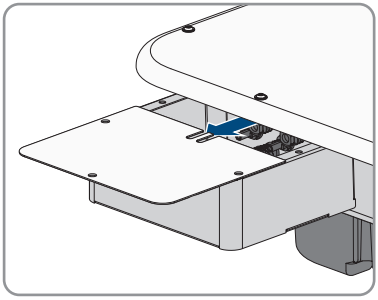


4. If the multifunction relay is used, switch off any supply voltage to the load.
5. Switch off the supply voltage of the digital signal sources if necessary.
6. Wait until the LEDs have gone out.

7. Unscrew the screws (TX25) of the lid if the DC terminal cover is present.



8. Remove the lid downwards if the DC terminal cover is present.



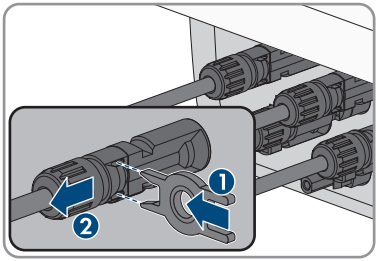
9. Use a current clamp to ensure that no current is present in the DC cables.
10. Note the position of the DC connectors.
11. **⚠ DANGER**

Danger to life due to electric shock when touching exposed DC conductors or DC plug contacts if the DC connectors are damaged or loose

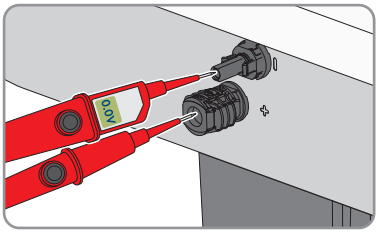
The DC connectors can break or become damaged, become free of the DC cables, or no longer be connected correctly if the DC connectors are released and disconnected incorrectly. This can result in the DC conductors or DC plug contacts being exposed. Touching live DC conductors or DC plug connectors will result in death or serious injury due to electric shock.

- Wear insulated gloves and use insulated tools when working on the DC connectors.
- Ensure that the DC connectors are in perfect condition and that none of the DC conductors or DC plug contacts are exposed.
- Carefully release and remove the DC connectors as described in the following.

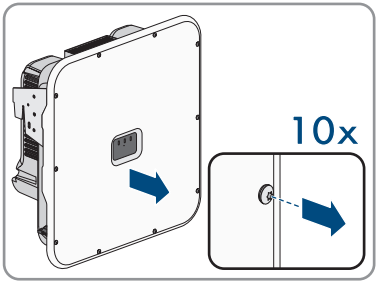
12. Unlock the DC connector using the corresponding unlocking tool and remove (refer to the manufacturer manual for further information).



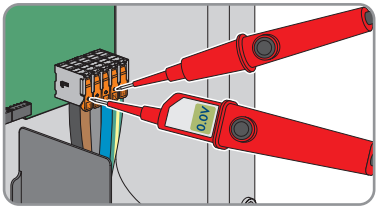
13. Ensure that no voltage is present at the DC inputs on the inverter using a suitable voltage detector.



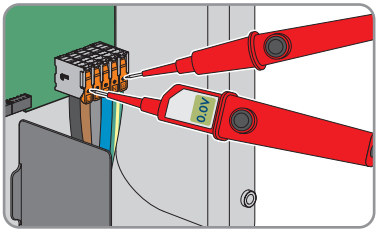
14. Loosen all ten screws of the enclosure lid (TX25) and remove the enclosure lid towards the front.



15. Set the screws and the enclosure lid aside and store safely.
16. Check that there is no voltage between L1 and N, L2 and N, and L3 and N at the AC terminal block for connecting the utility grid. Use a suitable voltage detector for this purpose. To do this, insert the test probes through the openings on the terminal block.



17. Check that there is no voltage between L1 and grounding conductor, L2 and grounding conductor, and L3 and grounding conductor at the AC terminal block for connecting the utility grid. Use a suitable voltage detector for this purpose.



10 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.

Also see:

- Cleaning the Fans ⇒ page 103

11 Troubleshooting

11.1 Event messages

11.1.1 Event 101

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The grid voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid.

Corrective measures:

- Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.

  If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.

  If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service.

11.1.2 Event 102

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The grid voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid.

Corrective measures:

- Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.

  If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.

  If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service.

11.1.3 Event 103

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The grid voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid.

Corrective measures:

- Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.

  If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.

  If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service.

11.1.4 Event 105

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The grid voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid.

Corrective measures:

- Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.

  If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.

  If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service.

11.1.5 Event 301

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The ten-minute average value of the grid voltage is no longer within the permissible range. The grid voltage or grid impedance at the connection point is too high. The inverter disconnects from the utility grid to maintain power quality.

Corrective measures:

- During the feed-in operation, check whether the grid voltage at the connection point of the inverter is permanently in the permissible range.

  If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.

  If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service.

11.1.6 Event 302

⚠ QUALIFIED PERSON

Event message:

- **Active power limited AC voltage**

Explanation:

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

Corrective measures:

- If possible, check the grid voltage 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 approval, discuss any changes to the operating parameters with the Service.

11.1.7 Event 401

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The inverter has disconnected from the utility grid. A stand-alone grid or a very large change in the grid frequency was detected.

Corrective measures:

- Make sure there is no power outage or work being done on the utility grid and contact a grid operator if necessary.
- Check the grid connection for significant short-term frequency fluctuations.

11.1.8 Event 404

⚠ QUALIFIED PERSON

Event message:

- **Grid incident**

Explanation:

The inverter has disconnected from the utility grid. A stand-alone grid or a very large change in the grid frequency was detected.

Corrective measures:

- Make sure there is no power outage or work being done on the utility grid and contact a grid operator if necessary.
- Check the grid connection for significant short-term frequency fluctuations.

11.1.9 Event 501

⚠ QUALIFIED PERSON

Event message:

- **Grid 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 approval, discuss any changes to the operating parameters with the Service.

11.1.10 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 approval, discuss any changes to the operating parameters with the Service.

11.1.11 Event 601

⚠ QUALIFIED PERSON

Event message:

- **Grid 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.

11.1.12 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 wiring 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 approval, discuss any changes to the operating parameters with the Service.

11.1.13 Event 1001

⚠ QUALIFIED PERSON

Event message:

- **L / N swapped**

Explanation:

Incorrect installation of the L / N connection.

Corrective measures:

- Check the AC wiring from the inverter to the feed-in meter.
- Check the AC voltages on the inverter connection.
- If this message is still displayed, contact the Service.

11.1.14 Event 1101

⚠ QUALIFIED PERSON

Event message:

- **Installation error**
- **Check connection**

Explanation:

A second line conductor is connected to N.

Corrective measures:

- Connect the neutral conductor to N.

11.1.15 Event 1302

⚠ QUALIFIED PERSON

Event message:

- **Waiting for grid voltage**
- **Grid connection installation failure**
- **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.

11.1.16 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 data set has been configured correctly. To do this, select the parameter **Set country standard** and check the value.

11.1.17 Event 3501

⚠ QUALIFIED PERSON

Event message:

- **Insulation failure**
- **Check generator**

Explanation:

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

Corrective measures:

- Check the PV system for ground faults.

11.1.18 Event 3601

⚠ QUALIFIED PERSON

Event message:

- **High discharge 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.

11.1.19 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 module.

Corrective measures:

- Check the PV system for ground faults.

11.1.20 Event 3901

⚠ 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 module 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 module is correctly rated and wired.

11.1.21 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 module 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 module is correctly rated.

11.1.22 Event 4301

⚠ QUALIFIED PERSON

Event message:

- **Serial el.arc in String |s0| detected by AFCI mod.**

Explanation:

The inverter has detected an electric arc in the displayed string. If "String N/A" is displayed, the string could not be uniquely assigned.

The inverter stops feeding into the utility grid.

Corrective measures:

- Disconnect the inverter from voltage sources and secure it against being switched on again.
- Check the PV modules and the cabling in the affected string or, if the string was not displayed, in all strings for damage.
- Ensure that the DC connection in the inverter is correct.
- Repair or replace defective PV modules, DC cables or the DC connection in the inverter.
- Start manual restart (if necessary).

Also see:

- Manual restart after electric arc ⇒ page 104

11.1.23 Event 6001-6499

⚠ QUALIFIED PERSON

Event message:

- **Self-diagnosis**
- **Interference device**

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact Service.

11.1.24 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.

11.1.25 Event 6511

⚠ QUALIFIED PERSON

Event message:

- **Self-diagnosis**
- **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.

11.1.26 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.

11.1.27 Event 6602

⚠ QUALIFIED PERSON

Event message:

- **Overvoltage grid (SW)**

Explanation:

The effective value of the grid voltage is above the permitted voltage threshold values for a specified period of time (AF limit).

Corrective measures:

- Check the grid voltage and connection on the inverter.

  If the grid voltage lies outside the permissible range due to local grid conditions, ask your grid operator if the voltage can be adjusted at the feed-in point or if it would be acceptable to change the monitored operating limits.

11.1.28 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 Service.

11.1.29 Event 7014

⚠ QUALIFIED PERSON

Event message:

- **Fault boost converter temperature sensor**

Explanation:

Fan is always on.

Corrective measures:

- Contact Service.

11.1.30 Event 7015

⚠ 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 Service.

11.1.31 Event 7702

⚠ QUALIFIED PERSON

Event message:

- **Self-diagnosis**
- **Interference device**

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact Service.

11.1.32 Event 7703

⚠ QUALIFIED PERSON

Event message:

- **Self-diagnosis**
- **Interference device**

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact Service.

11.1.33 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.

11.1.34 Event 8501

⚠ QUALIFIED PERSON

Event message:

- **DC current sensor C offset**

Corrective measures:

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

11.1.35 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.

11.1.36 Event 8709

⚠ QUALIFIED PERSON

Event message:

- **Timeout in communication for reactive power spec.**

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.

11.1.37 Event 8710

⚠ QUALIFIED PERSON

Event number:

- **Timeout in communication for cos-Phi spec.**

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.

11.1.38 Event 9002

⚠ QUALIFIED PERSON

Event message:

- **Installer 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.

11.1.39 Event 9003

⚠ QUALIFIED PERSON

Event message:

- **Grid parameter locked**

Explanation:

Changes to the grid parameters are now blocked.

Corrective measures:

- In order to be able to make changes to the grid parameters, you must be logged in as **Administrator** or **Installer** on the user interface. All changes to grid-relevant parameters should be coordinated with the grid operator.

11.1.40 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.

11.1.41 Event 9033

⚠ QUALIFIED PERSON

Event message:

- **Rapid shutdown has been triggered**

Explanation:

The inverter detected the triggering of a rapid shutdown. The AC side of the inverter has been disconnected or the external rapid shutdown initiator has been activated.

11.1.42 Event 9034

⚠ QUALIFIED PERSON

Event message:

- **Error in the rapid shutdown system**

Explanation:

This message can have the following causes:

- The rapid shutdown function was not correctly configured.
- The PV module could not be correctly disconnected. Voltage can be applied to the DC inputs of the inverter.
- The standby voltage of all PV module switches of a string is > 30 V.
- With DC lines laid in parallel, another inverter in the system has caused the Sunspec signal to be overwritten.

Corrective measures:

- Check the settings of the rapid shutdown function and ensure that the operating mode selected is selected according to the DC disconnection unit used.
- Check the functionality of the PV module switches.
- Check the standby voltage of the PV module switches used and ensure that the standby voltage of all PV module switches of a string < 30 V.

11.1.43 Event 9035

⚠ QUALIFIED PERSON

Event message:

- **Rapid shutdown performed successfully**

Explanation:

The voltage at the DC inputs and at the AC output of the inverter was successfully discharged.

11.1.44 Event 9038

⚠ QUALIFIED PERSON

Event message:

- **Redundant rapid shutdown discharge function not assured**

Explanation:

The cause must be determined by the Service.

Corrective measures:

- Contact Service.

11.2 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.

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

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 MOhm and for polycrystalline and monocrystalline PV modules approximately 50 MOhm per PV module.

Also see:

- Checking the PV System for Ground Faults ⇒ page 102

11.3 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 DC input voltage range of 1000 V or higher.

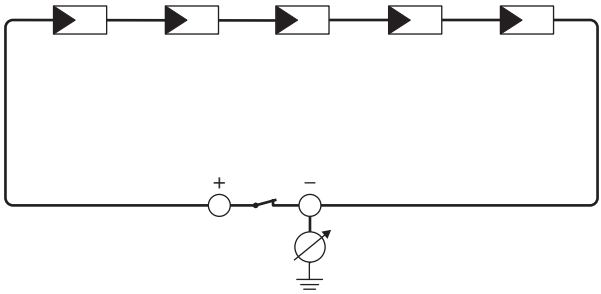


Figure 15: Schematic diagram of the measurement

Required equipment:

☐ Suitable device for safe disconnection and short-circuiting

☐ Measuring device for insulation resistance

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

The insulation resistance can only be measured with a suitable device for safe disconnection and short-circuiting of the PV modules. 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 (see Section 9, page 82).
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:

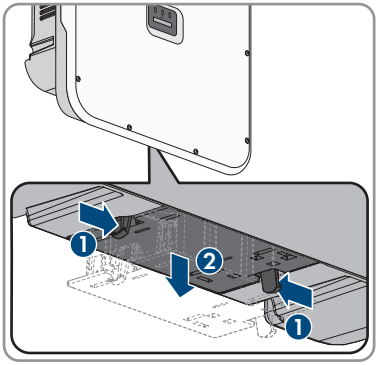
- Calculating the insulation resistance ⇒ page 101

11.4 Cleaning the Fans

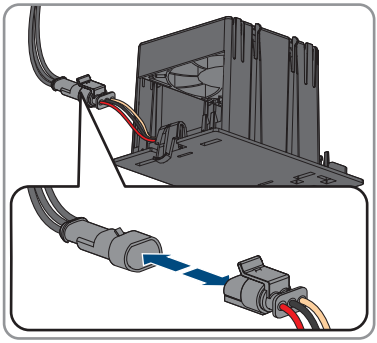
If the inverter reduces its power due to overtemperature or even switches off, it is possible that the fan on the bottom of the inverter is no longer working properly due to contamination. Clean the fan as described in the following.

1. Disconnect the inverter from all voltage sources (see Section 9, page 82).

2. Press the two locking tabs together to release the fan drawer and carefully pull the enclosure with the fan out downward.



3. Disconnect the fan connector in the unlocked state.



4. Clean the fan assembly with a soft brush or a vacuum cleaner.
5. Reinstall the serviced fan assembly in the inverter.
6. Recommission the inverter (see Section 7.3, page 60).

11.5 Manual restart after electric arc

⚠ QUALIFIED PERSON

You can use the following parameter to resume feed-in operation after an electric arc has been detected.

Channel	Name	Settings
Operation.OpMod	**General operating mode**	**Start**

Also see:

- Arc-Fault Circuit Interrupter (AFCI) ⇒ page 26
- Arc-Fault Circuit Interrupter (AFCI) ⇒ page 67

12 Decommissioning the Product

⚠ QUALIFIED PERSON

To decommission the inverter completely upon completion of its service life, proceed as described in this Section.

⚠ 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.
- Use the carrying handles or hoist when transporting the product. To attach the hoist system, eye bolts must be screwed into the threads provided, which are located on the right and left of the product's mounting lugs.
- Wear suitable personal protective equipment for all work on the product.

Procedure:

1. Disconnect the inverter from all voltage sources (see Section 9, page 82).
2. ### ⚠ CAUTION

   Risk of burns due to hot enclosure parts

   - Wait 30 minutes for the enclosure to cool down.
3. If the DC terminal cover is present, disassemble the DC terminal cover. To do so, unscrew the M5x14 screws (TX25).
4. Remove the equipment grounding conductor of the PV modules from the equipment grounding bar. To do so, loosen the screws using a cross-head screwdriver.
5. Remove the equipment grounding bar from the inverter. To do this, unscrew the M5x18 screws (TX25) and remove the screws, washers and serrated conical spring washers.
6. Remove the AC conductors from the inverter. Press the locking levers all the way upward and pull the conductors out of the terminal blocks for the AC connection.
7. Press down the locking levers of the terminal blocks for the AC connection.
8. If the multifunction relay is used, remove the connection cable from the inverter.
9. If other cables (e.g. network cables or signal cables) are connected, remove them from the inverter.
10. If a module is plugged in, remove it from the inverter.
11. Close the enclosure lid of the inverter.
12. If the inverter is protected against theft, open the padlock and remove it.
13. Unscrew the two M5x14 screws protecting the inverter from being lifted off with a screwdriver (TX25).

14. Lift the inverter up and off the mounting bracket.
15. If the inverter is to be stored or shipped in packaging, pack the inverter. Use the original packaging or packaging that is suitable for the weight and dimensions of the inverter.

13 Disposal

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

14 Technical Data

14.1 General Data

Width x height x depth	728 mm x 762 mm x 266 mm (28.7 in x 30 in x 10.5 in)
Weight	35 kg
Length x width x height of the packaging	800 mm x 880 mm x 400 mm (31.5 in x 34.6 in x 15.7 in)
Transport weight (including pallet)	40.5 kg (89.2 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)
Max. permissible value for relative humidity (condensing)	100 %
Maximum operating altitude above mean sea level (MSL)	4000 m (13123 ft)
Typical noise emission	59 dB(A)
Power loss in night mode	< 5 W
Topology	Transformerless (Non-isolated)
Cooling method	SMA OptiCool
Number of fans	1 exterior fan, 2 interior fan
Pollution degree of all enclosure parts	2
Enclosure degree of protection according to UL 50	Type 4X
Corrosivity classification according to IEC 61701 (at a minimum distance of 0.5 km (0.3 mile) from the coast)	C5
Protection class	I
Radio technology	Wi-Fi 802.11 b/g/n
Radio spectrum	2.4 GHz
Maximum transmission power	100 mW
Wi-Fi range in free-field conditions	10 m (33 ft)
Quantity maximum detectable Wi-Fi networks	32

Grid configurations	480/277 V wye connection
National standards and approvals, as per 04/2023	UL 62109-1, UL 1699B Ed. 1, IEEE 1547-2018, UL 1741 SB, UL 3741, *Canadian Electrical Code*® CSA 22.2 No. 62109-1:16 / 62109-2:16, FCC Part 15 (Class A), PV Rapid Shutdown System Equipment in accordance with UL1741:2021, CA Rule 21, HECO Rule 14H, ISO-NE

14.2 DC Input

	STP 20-US-50	STP 25-US-50	STP 30-US-50
Maximum power of PV array	30000 Wp STC	37500 Wp STC	45000 Wp STC
Maximum input voltage	1000 V	1000 V	1000 V
MPP voltage range	350 V to 800 V	430 V to 800 V	515 V to 800 V
Rated input voltage	685 V	710 V	710 V
Minimum input voltage	150 V	150 V	150 V
Initial input voltage	188 V	188 V	188 V
Maximum usable input current per input	24 A	24 A	24 A
Maximum short-circuit current per input[2)]	37.5 A	37.5 A	37.5 A
Maximum reverse current into the PV modules	0 A	0 A	0 A
Number of independent MPP inputs	3	3	3
Strings per MPP input	2	2	2
Overvoltage category in accordance with UL 62109-1	II	II	II

14.3 AC Output

	STP 20-US-50	STP 25-US-50	STP 30-US-50
Rated power at 277 V, 60 Hz	20000 W	25000 W	30000 W

[2)] In accordance with UL 62109-1: $I_{SC\ PV}$

	STP 20-US-50	STP 25-US-50	STP 30-US-50
Maximum apparent power	20000 VA	25000 VA	30000 VA
Rated apparent power	20000 VA	25000 VA	30000 VA
Nominal grid voltage	480 V / 277 V	480 V / 277 V	480 V / 277 V
Rated grid voltage	277 V	277 V	277 V
Voltage range[3)]	244 V to 305 V	244 V to 305 V	244 V to 305 V
Rated current at 277 V	24 A	30 A	36 A
Maximum output current	24 A	30 A	36 A
Maximum output current under fault conditions	682.5 Apeak / 10 ms	682.5 Apeak / 10 ms	682.5 Apeak / 10 ms
Total harmonic distortion of the output current with total harmonic distortion of the AC voltage <2%, and AC power >50% of the rated power	< 3 %	< 3 %	< 3 %
Inrush current	< 10% of the nominal AC current for a maximum of 10 ms	< 10% of the nominal AC current for a maximum of 10 ms	< 10% of the nominal AC current for a maximum of 10 ms
Rated grid frequency	60 Hz	60 Hz	60 Hz
Grid frequency[3)]	60 Hz	60 Hz	60 Hz
Operating range at grid frequency 60 Hz	50 Hz to 66 Hz	50 Hz to 66 Hz	50 Hz to 66 Hz
Power factor at rated power	1	1	1
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
Feed-in phases	3	3	3
Connection phases	3-(N)-PE	3-(N)-PE	3-(N)-PE
Overvoltage category in accordance with UL 62109-1	III	III	III

[3)] Depending on the configured country data set

14.4 Digital inputs

Digital inputs

Quantity	6
Input voltage	12 V DC
Maximum cable length	100 m (328 ft)

14.5 Digital output (multifunction relay)

Number	5
Execution	Potential-free relay contacts
Maximum switching voltage	30 V DC
Maximum switching current	1 A
Minimum switching current	10 mA
Minimum electrical endurance when the maximum switching voltage and maximum switching current are complied with[4)]	100000 switching cycles
Bounce time	5 ms
Reset time	5 ms
Maximum cable length	< 30 m (98 ft)

14.6 Communication

SMA devices	Max. 5 devices with SMA Speedwire (inverters and charging stations) and 1 energy meter, 100 Mbit/s
I/O systems and meters	Ethernet, 10/100 Mbit/s, Modbus TCP

14.7 Data Storage Capacity

1-minute values	7 days
5-minute values	7 days
15-minute values	30 days
60-minute values	3 years
Event messages	1024 events

[4)] Corresponds to 20 years at 12 switching operations per day

14.8 Efficiency

	STP 20-US-50	STP 25-US-50	STP 30-US-50
CEC weighted efficiency, η_{CEC}	97.5 %	98 %	98 %

14.9 Protective Devices

DC reverse polarity protection	Short-circuit diode
Input-side disconnection point	DC load-break switch
DC overvoltage protection	Surge arrester type 1+2 or type 2 (optional)
AC short-circuit current capability	Current control
Grid monitoring	SMA Grid Guard 10.0
Maximal output overcurrent protection	60 A
Ground fault monitoring	Insulation monitoring: R_{iso} > 100 kΩ
All-pole sensitive residual-current monitoring unit	Available
Arc fault detection AFCI, type 1, listed according to UL1699B Ed. 1	Available
Rapid Shutdown Equipment	Self discharge at all DC and AC connection lines < 30 V
Active anti-islanding method	Frequency shift

14.10 Climatic Conditions

Installation in accordance with IEC 60721-3-4, Class 4K26

Extended temperature range	-25°C to +60°C (-13°F to +140°F)
Extended humidity range	0% to 100%
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 2K12

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

14.11 Equipment

DC connection	Amphenol DC connector
AC terminal	Spring-cage terminals
Digital output (multifunction relay)	As standard

Digital inputs, DI 1–4	As standard
Digital inputs, DI 5–7	As standard
DC surge protection devices type 1+2 or type 2	Optional

14.12 Torques

Screws for protecting the inverter from being lifted (TX25)	1.5 Nm (13.3 in-lb)
Equipment grounding bar screws (TX25)	4 Nm (35.4 in-lb ±2.7 in-lb)
Screw installation DC terminal cover (TX25)	4 Nm (35 in-lb)
Enclosure lid screws (TX25)	6 Nm ± 0.5 Nm (53.1 in-lb ± 4.4 in-lb)

15 Accessories

You will find the accessories for your product in the following overview. If required, these can be ordered from SMA Solar Technology AG or your distributor.

Accessory	SMA order number
DC overvoltage protection type 1+2 DC overvoltage protection as accessory for Sunny Tripower X PV inverter consisting of base incl. connection cable and connected surge arresters type 1+2	DC_SPD_KIT7_T1T2
DC overvoltage protection type 2 DC overvoltage protection as accessory for Sunny Tripower X PV inverter consisting of base incl. connection cable and connected surge arresters type 2	DC_SPD_KIT6-10
DC terminal cover DC connection cover as accessory for Sunny Tripower X solar inverter consisting of enclosure, cover and mounting material	DC-TERM-COVER
SMA Sensor Module-US SMA Sensor Module-US with interfaces for the connection of different sensors as accessories for Sunny Tripower X-US, Sunny Tripower CORE1-US and Sunny Boy inverters of type SB3.0-1SP-US-40/-41 / SB3.0-1SP-US-40/-41 / SB5.0-1SP-US-40/-41 / SB6.0-1SP-US-40/-41 / SB7.0-1SP-US-40/-41 / SB7.7-1SP-US-40/-41 consisting of module, mounting material and terminal blocks	MD.SEN-US-40[5)]
AC Disconnect Kit AC circuit breaker as an accessory for Sunny Tripower X-US inverters, consisting of an aluminum mounting bracket, AC circuit breaker unit with a plastic enclosure, and mounting materials	210841-00.01
Roof Mount Kit Mounting system as an accessory for ground-mounted or rooftop installation of Sunny Tripower X PV inverters, consisting of an aluminum sheet and mounting materials	210462-00.01

[5)] Compatible from hardware version A2 with the Sunny Tripower X

16 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.

17 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
- Device configuration (System Manager or subordinate device)
- Special country-specific settings (if available)
- Event message
- Mounting location and mounting height
- Type and number of PV modules
- Optional equipment (e.g. accessories used)
- Use the name of the system in Sunny Portal (if available)
- Access data for Sunny Portal (if available)
- Operating mode of the multifunction relay (if used)
- Detailed description of the problem

You can find your country's contact information at:

https://go.sma.de/service

ENERGY
THAT
CHANGES

SMA

www.SMA-Solar.com