



PV Inverter

SUNNY BOY 2500TL Single Tracker

SUNNY BOY 3000TL Single Tracker

Installation Manual

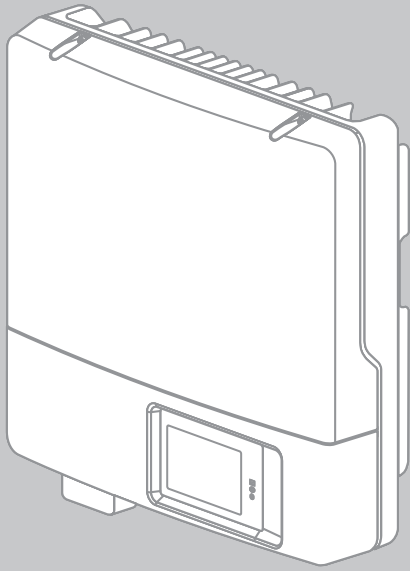


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1 Information on this Document

1.1 Validity

This document is valid for the following device types:

- SB 2500TLST-21
- SB 3000TLST-21

1.2 Target Group

This document is for skilled persons. Only skilled persons with appropriate qualification are allowed to perform the tasks set forth in this document (see Section 2.2 "Qualification of Skilled Persons" (page 11)).


1.3 Additional Information


Additional information is available at www.SMA.de/en.


Title	Document type
Miniature Circuit-breaker	Technical information
Measured Values, Operating Parameters, and Event Messages	Technical description
SMA Bluetooth – SMA Bluetooth® Wireless Technology in Practice	Technical information
SMA Bluetooth® Wireless Technology	Technical description
Module Technology	Technical information
Capacitive Leakage Currents	Technical information


1.4 Symbols Used


The following types of safety precautions and general information appear in this document:

 DANGER!
<p>DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.</p>

 WARNING!
<p>WARNING indicates a safety precaution which, if not avoided, could result in death or serious injury.</p>

 CAUTION!
<p>CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.</p>

 NOTICE!
<p>NOTICE indicates a situation which, if not avoided, could result in property damage.</p>

 Information	<p>Information provides tips that are valuable for effective installation and operation of the product.</p>
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- This symbol indicates the result of an action.

Nomenclature

The following nomenclature is used in this document:

Complete designation	Designation in this document
Sunny Boy 2500TL Single Tracker/ Sunny Boy 3000TL Single Tracker	Inverter, product
Electronic Solar Switch	ESS
SMA Bluetooth® Wireless Technology	Bluetooth

Abbreviations

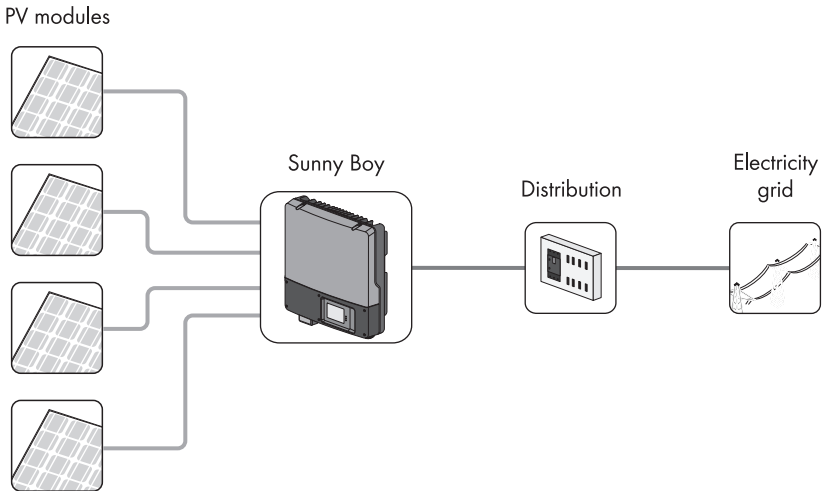
Abbreviation	Designation	Explanation
AC	Alternating Current	-
AF	Width Across Flats	The distance between two parallel flat surfaces ("flats") of a screw head.
DC	Direct Current	-
EC	European Community	-
LED	Light-Emitting Diode	-
MPP	Maximum Power Point	-
MSL	Mean Sea Level	-
NetID	Network Identification	Identification number for SMA <i>Bluetooth</i> network
PE	Protective Earth	Protective conductor
PV	Photovoltaics	-
VDE	Verband der Elektrotechnik Elektronik Informationstechnik e.V.	Association for Electrical, Electronic and Information Technologies

2 Safety

2.1 Intended Use

The Sunny Boy is a PV inverter, which converts the direct current of the PV array to grid-compliant alternating current and feeds it into the electricity grid.

Principle of a PV plant with this Sunny Boy



The Sunny Boy is suitable for indoor and outdoor use.

The Sunny Boy may only be operated with PV arrays (PV modules and cabling) of protection class II. The PV modules must be suitable for use with the Sunny Boy and must have been released by the module manufacturer.

It is only permissible to use PV modules with large capacities to earth if their coupling capacity does not exceed 1.4 μF .

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

For safety reasons, it is not permitted to modify the product or install components that are not explicitly recommended or distributed by SMA Solar Technology AG for this product.

Only use the Sunny Boy in accordance with the information provided in the enclosed documentation. Any other use may result in personal injury or property damage.

- Do not mount the inverter on flammable construction materials.
- Do not mount the inverter in areas where highly flammable materials are stored.
- Do not mount the inverter in a potentially explosive atmosphere.

The enclosed documentation is an integral part of this product.


- Read and observe the documentation.
- Keep the documentation in a convenient place for future reference.


2.2 Qualification of Skilled Persons

The work described in this document must be performed by skilled persons only. Skilled persons must have the following qualifications:

- Knowledge of how an inverter works and is operated
- Training in how to deal with the dangers and risks associated with installing and using electrical devices and plants
- Training in the installation and commissioning of electrical devices and plants
- Knowledge of all applicable standards and directives
- Knowledge of and adherence to this document and all safety precautions

2.3 Safety Precautions

	DANGER! Danger to life due to high voltages in the inverter
<p>High voltages which may cause electric shocks are present in the conductive parts of the inverter.</p> <ul style="list-style-type: none">• Prior to performing any work on the inverter, disconnect the inverter on the AC and DC sides (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).	

	DANGER! Risk of burns due to electric arc
<p>To prevent arcing when disconnecting cables in the PV array, the ESS and DC connectors must be removed from the inverter, or the external DC switch-disconnector must be switched off and the DC connectors must be removed from the inverter before performing any work on the PV array.</p> <ul style="list-style-type: none">• Before starting work on the PV array, always disconnect the inverter on the AC and DC sides (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).• Attach the enclosed warning label "Risk of burns from electric arc" so that it is clearly visible on the external AC disconnection device.	

**WARNING!****Risk of electric shock if DC connectors are pulled out under load**

If you disconnect the DC connectors from the inverter under load, an electric arc may occur, causing electric shock and burns.

- If the inverter is not equipped with an Electronic Solar Switch and the regulations in the country of installation require an external DC switch-disconnector, you must install an external DC switch-disconnector.
- Switch off the AC miniature circuit-breaker and disconnect the inverter on the DC side before pulling out the DC connectors.

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

Some parts of the enclosure may become hot during operation.

- Do not touch any parts other than the lower enclosure lid of the inverter during operation.

**NOTICE!****Water and dust intrusion can damage the inverter.**

If the inverter is not equipped with an ESS, the electronics in the inverter comply with degree of protection IP65 when closed. If the inverter is equipped with an ESS, the electronics in the inverter comply with degree of protection IP65 when the inverter is closed and with the ESS plugged in. The inverter is then protected against dust and water intrusion. The inverter connection area complies with degree of protection IP54. It is protected against interior dust deposits and splash water from all angles.

- When the ESS is not plugged in, measures must be taken to protect the inverter against dust and water.
- Replug the ESS after carrying out any work on the inverter.

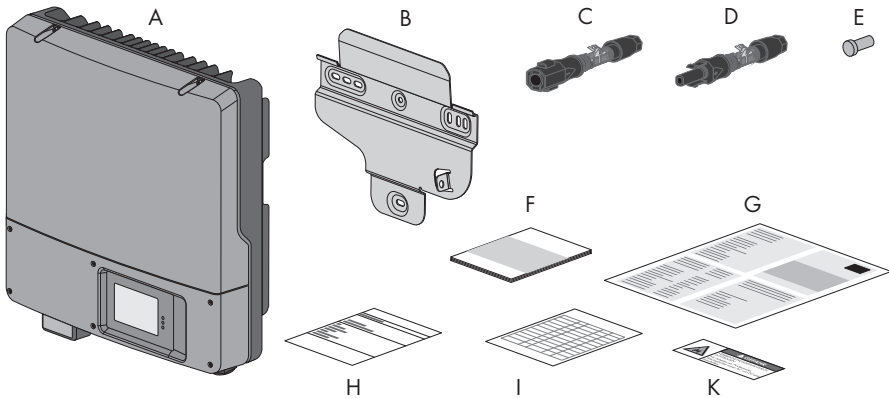
**Earthing of the PV array**

Comply with local regulations for the earthing of the modules and the PV array.

SMA Solar Technology AG recommends connecting the array frame and other electrically conductive surfaces so that there is continuous conduction, and earthing them in order to ensure maximum protection for property and persons.

3 Scope of Delivery

Check the scope of delivery for completeness and any externally visible damage. Contact your specialist dealer if the delivery is incomplete or you find any damage.

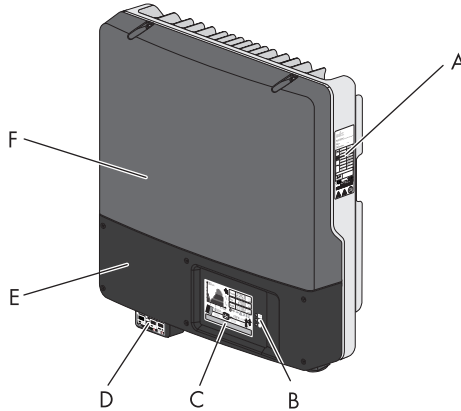


Object	Quantity	Description
A	1	Sunny Boy
B	1	Wall mounting bracket
C	2	Positive DC connector
D	2	Negative DC connector
E	4	Sealing plugs for the DC connectors
F	1	Installation manual
G	1	User manual
H	1	Set of documents with explanations and certificates
I	1	Supplementary sheet with inverter default settings
K	1	Warning label "Risk of burns from electric arc" for the disconnection device on the AC side.

4 Product Description

4.1 Sunny Boy







The Sunny Boy is a PV inverter, which converts the direct current of the PV array to grid-compliant alternating current and feeds it into the electricity grid.



Item	Description
A	Type label
B	LEDs
C	Display
D	Electronic Solar Switch*
E	Lower enclosure lid
F	Upper enclosure lid

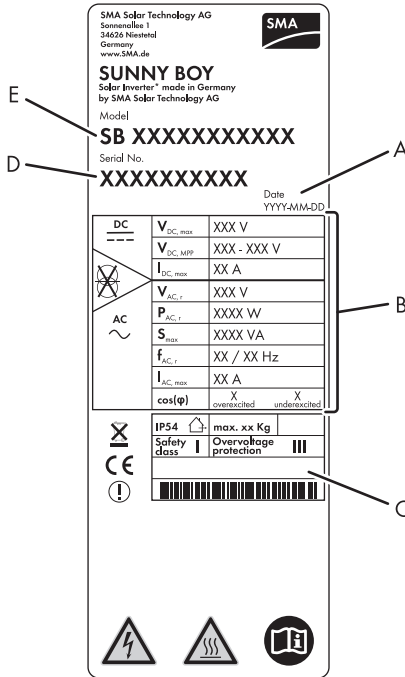
*optional

4.2 Symbols on the Inverter

Symbol	Description	Explanation
	Inverter	This symbol defines the function of the green LED. It indicates the operating state of the inverter.
	Observe the documentation.	This symbol defines the function of the red LED. It indicates a fault or disturbance. Please read the manual to find information on how to remedy the fault or disturbance.
	Bluetooth	This symbol defines the function of the blue LED. It indicates that communication via <i>Bluetooth</i> is activated.
	QR Code [®] for SMA bonus programme	For information on the SMA bonus programme, see www.SMA-Bonus.com .
	NOTICE, danger!	Observe the connection requirements for a second protective conductor 6.3.1 "Conditions for the AC Connection" (page 29).
	Danger to life due to high voltages in the inverter	The capacitors in the inverter may be charged with very high voltages. <ul style="list-style-type: none"> Disconnect the inverter from voltage sources (see Section 8.2) and wait 5 minutes before opening the upper lid, in order to allow time for the capacitors to discharge.

4.3 Type Label












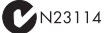
The type label uniquely identifies the inverter. The type label is located on the right-hand side of the enclosure.



Item	Description	Explanation
A	Date	Inverter manufacture date (year-month-day)
B	Device-specific characteristics	-
C	Additional information	Field for additional information, e.g. information on country-specific standards
D	Serial No.	Inverter serial number
E	Model	Device type

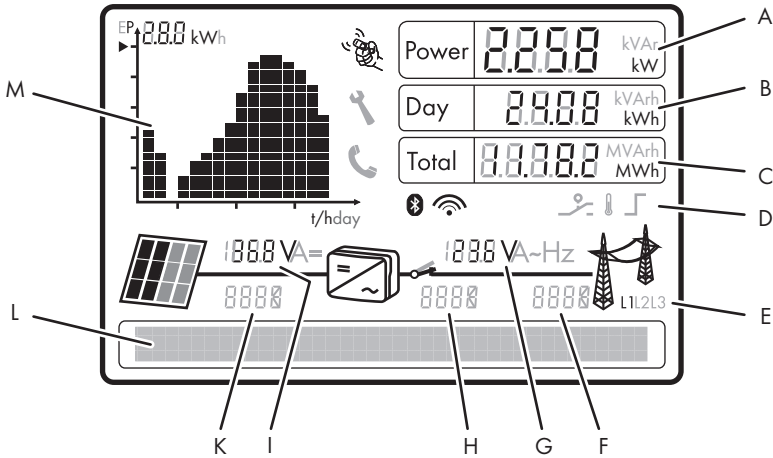
The information on the type label is intended to help you use the inverter safely and receive targeted customer support from the SMA Service Line. The type label must remain permanently attached to the inverter.

Symbols on the Type Label

Symbol	Description	Explanation
	Danger to life due to high voltages	The inverter operates at high voltages. All work on the inverter must be carried out by skilled persons only.
	Risk of burns from hot surfaces	The inverter can get hot during operation. Avoid contact during operation. Allow the inverter to cool down sufficiently before carrying out any work. Wear personal protective equipment such as safety gloves.
	Observe the documentation.	Observe all documentation that is supplied with the inverter.
	Without transformer	The inverter does not have a transformer.
	DC	Direct current
	AC	Alternating current
IP54	Degree of protection: IP54	The inverter is protected against interior dust deposits and against splash water from all angles.
	Outdoor	The inverter is suitable for outdoor installation.
	Proper disposal	The inverter must not be disposed of together with the household waste.
CE	CE marking	The inverter complies with the requirements of the applicable EC directives.
	Device class label	The product is equipped with a wireless component that complies with the harmonised standards.
	RAL quality mark for solar products	The inverter complies with the requirements of the German Institute for Quality Assurance and Labelling.
	Certified safety	The inverter complies with the requirements of the European Equipment and Product Safety Act.
	Australian mark of conformity	The inverter complies with the requirements of the applicable Australian guidelines.












4.4 Display


The display shows the current operating data of the inverter (e.g. status, power, input voltage) as well as faults and disturbances.



Item	Designation	Explanation
A	Power	Displays the current power
B	Day	Displays the amount of energy fed in so far today
C	Total	Total amount of energy fed in until now
D	Active functions	The symbols indicate which communication or power regulation functions are enabled.
E	Phase assignment	Shows assignment of the inverter to a phase. It is also used to indicate external power limitation.
F	Electricity grid event number	Event number of a disturbance in the electricity grid
G	Output voltage/ output current	The display alternately shows the output voltage and the output current of the inverter.
H	Inverter event number	Event number of a device disturbance
I	Input voltage/ input current	The display alternately shows the input voltage and the input current of the inverter.
K	PV array event number	Event number of a disturbance in the PV array
L	Text line	The text line shows event messages or instructions.
M	Power and yield curve	The diagram shows the changes in power over the last 16 feed-in hours or the energy yields over the last 16 days. Tap the display once to switch between views.

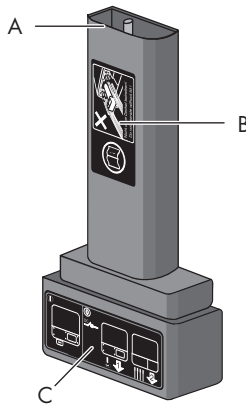
Symbols on the Display

Symbol	Description	Explanation
	Tap symbol	You can operate the display by tapping it: <ul style="list-style-type: none"> • Tapping once: the backlight switches on or the display scrolls to the next display message. • Tapping twice: the display shows, in succession, the firmware version, the serial number or description of the inverter, the <i>Bluetooth</i> NetID, the set country standard and the display language.
	Telephone receiver	Device disturbance present. Contact the SMA Service Line.
	Spanner	Disturbance which can be resolved on-site.
	<i>Bluetooth</i>	<i>Bluetooth</i> communication is enabled.
	<i>Bluetooth</i> connection	<i>Bluetooth</i> connection to other devices is active.
	Multi-function relay	The multi-function relay is active.
	Temperature symbol	The power of the inverter is limited due to excessive temperature.
	Power limitation	External active power limitation via the Power Reducer Box is active.
	PV array	-
	Inverter	-
	Grid relay	If the grid relay is closed, the inverter feeds power into the grid. If the grid relay is open, the inverter is disconnected from the grid.

Symbol	Description	Explanation
	Electricity grid	-

4.5 Electronic Solar Switch

The ESS is an optional DC load disconnect unit. The ESS prevents electric arcs from forming when you remove the DC connector.



Item	Description	Explanation
A	Plug	-
B	Safety precautions sticker	<ul style="list-style-type: none"> • Never operate the inverter without the lower enclosure lid in place. • Observe all documentation that accompanies the inverter.
C	ESS sticker	<ul style="list-style-type: none"> • 1 When the ESS is plugged in, the DC electric circuit remains closed. • 2 To interrupt the DC electric circuit, you first need to perform steps 1 and 2. • 1 Remove the ESS. • 2 Remove all DC connectors.

When plugged in, the ESS forms a conductive path between the PV array and the inverter. Removing the ESS interrupts the electric circuit and allows you to safely disconnect the DC connectors from the inverter.

4.6 Bluetooth

The inverter is equipped with a *Bluetooth* interface as standard and can consequently communicate with other *Bluetooth* devices (for information on supported SMA products, see www.SMA-Solar.com).

If you wish to communicate via *Bluetooth*, you can protect the inverter with one plant password for the user and one plant password for the installer.

All inverters are delivered with a default plant password for the user (0000) and a default plant password for the installer (1111). To protect the plant from unauthorised access, you must change the plant passwords using a communication product (for information on changing the plant password, refer to the manual of the communication product).

If you do not wish to communicate via *Bluetooth*, deactivate the *Bluetooth* communication (see Section 6.6.2 "Setting the Bluetooth NetID" (page 50)).

4.7 Slot for Communication Interface

The inverter can optionally be fitted with an extra communication interface (e.g., RS485 or Speedwire/Webconnect). This communication interface will enable the inverter to communicate with specific SMA communication products (for information on supported products, see www.SMA-Solar.com).

The communication interface can either be retrofitted or installed ex works if specified in the corresponding order.

Depending on the type of communication, RS485, *Bluetooth* or Speedwire/Webconnect, the parameters and messages are displayed differently in the communication products.

Example: How the country data set parameter is displayed

- For communication via RS485: parameter **CntrySet**
 - For communication via *Bluetooth* or Speedwire/Webconnect: parameter **Set country standard**
-

4.8 Slot for Multi-Function Interface

The inverter is equipped with a slot for multi-function interfaces. This slot is designed to connect a simple multi-function relay, an SMA Power Control Module or a fan retrofit kit. The multi-function interface can be retrofitted or installed at the factory according to a specific order.

Multi-Function Relay

You can configure the multi-function relay for various operating modes. The multi-function relay is used, for example, to switch fault indicators on or off (for information on installation and configuration, see installation manual of the multi-function relay).

SMA Power Control Module

The SMA Power Control Module enables the inverter to implement grid management services and is equipped with an additional multi-function relay (for information on installation and configuration, see installation manual of the SMA Power Control Module).

Fan Retrofit Kit

The fan retrofit kit is used for additional inverter cooling at high ambient temperatures and also has a multi-function relay (for information on installation and configuration, see the fan retrofit kit installation manual). The fan retrofit kit and the SMA Power Control Module cannot be operated in parallel.

4.9 Operating Parameters

Various operating parameters control the functionality of the inverter. Apart from the country data set, the operating parameters of the inverter can only be adjusted using an SMA communication product. You can adjust the country data set before commissioning or within the first ten feed-in hours via two rotary switches in the inverter (see Section 6.5.2 "Setting the Country Standard and Language using the Rotary Switches" (page 48)).

4.10 Grid Management

The inverter is equipped with grid management functions.

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

For detailed information on the parameters of these functions, see the Technical Descriptions "Measured Values, Operating Parameters and Event Messages" and "Parameter Settings - Sunny Boy 2500TL / 3000TL Single Tracker Sunny Boy 3000TL / 3600TL / 4000TL / 5000TL" at www.SMA.de/en in the "Technical Description" category of the respective inverter.

4.11 Varistors




Varistors are voltage-dependent resistors to protect the inverter against overvoltage. The inverter is equipped with two thermally-monitored varistors.

The function of the varistors can diminish with age or repeated strain as a result of overvoltage. This can cause varistors to wear. The inverter detects if one of the varistors is defective and indicates a disturbance.

The varistors are specially manufactured for use in the inverter and are not commercially available. You must order new varistors directly from SMA Solar Technology AG.

5 Mounting

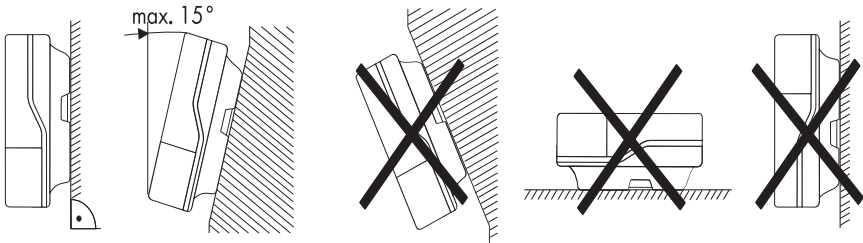
5.1 Safety

	DANGER! Danger to life due to fire or explosions
<p>Despite careful construction, electrical devices can cause fires.</p> <ul style="list-style-type: none">• Do not mount the inverter on flammable construction materials.• Do not mount the inverter in areas where highly flammable materials are stored.• Do not mount the inverter in a potentially explosive atmosphere.	
	CAUTION! Risk of burns due to hot enclosure parts
<ul style="list-style-type: none">• Mount the inverter in such a way that it cannot be touched inadvertently during operation.	
	CAUTION! Risk of injury due to the heavy weight of the inverter
<ul style="list-style-type: none">• When mounting, bear in mind that the inverter weighs approx. 23 kg.	

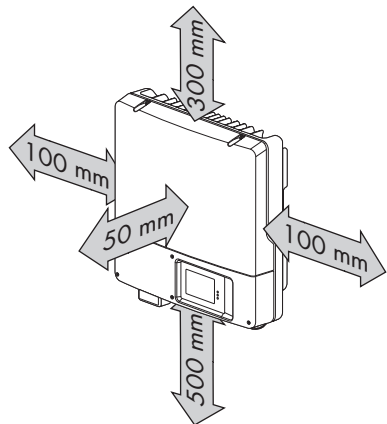
5.2 Selecting the Mounting Location

Take the following requirements into consideration when selecting the mounting location:

- The mounting location must be inaccessible to children.
- The mounting method and location must be suitable for the weight and dimensions of the inverter (see Section 13 "Technical Data" (page 84)).
- Mount on a solid surface.
- The mounting location must be clear and safely accessible at all times without the use of additional aids such as scaffolding or lifting platforms. Non-fulfillment of these criteria may restrict execution of servicing.



- Mount vertically or tilted backwards by max. 15°.
- The connection area must face downwards.
- Never mount the device with a forward tilt.
- Never mount the device with a sideways tilt.
- Do not mount horizontally.
- Mount at eye level in order that operating states can be read at all times.
- The ambient temperature should be below 40°C to ensure optimum operation.
- Do not expose the inverter to direct solar irradiation as this can cause excessive heating and thus power reduction.
- In living areas, do not mount the unit on plasterboard walls or similar in order to avoid audible vibrations. When in use, the inverter emits noises which may be perceived as a nuisance in a living area.
- Observe the recommended minimum clearances to the walls as well as to other inverters and objects as shown in the diagram. This will ensure sufficient heat dissipation and gives you enough space to unplug the ESS.
- If multiple inverters are mounted in areas with high ambient temperatures, increase the clearances between the inverters and ensure an adequate fresh-air supply. This will prevent a reduction in inverter power as a result of high temperatures (details on temperature derating can be found in the Technical Information "Temperature Derating" at www.SMA.de/en). A fan for connection to the inverter is available as an accessory (see Section 14 "Accessories" (page 90)).



5.3 Mounting the Inverter

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

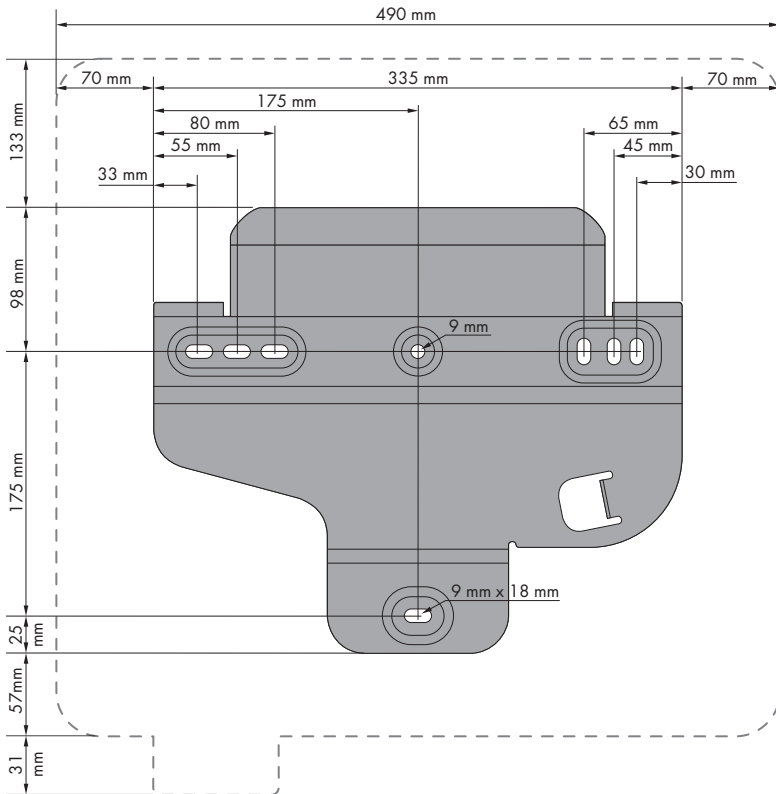
- 3 screws (diameter: at least 6 mm)
- 3 wall plugs
- 3 washers (external diameter: at least 18 mm)

1. Use the wall mounting bracket as a drilling template and mark the positions of the drill holes.



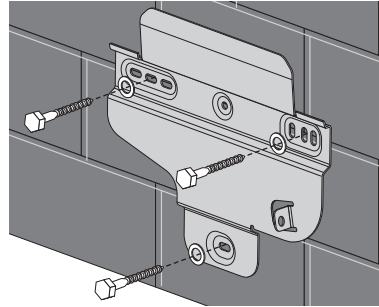
Number of drill holes to use

- When mounting onto the wall, use at least two of the horizontal holes and the lower centre hole.
- Use the two holes in the centre when mounting the device on a pillar.

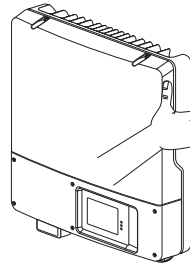


2. Drill the holes.

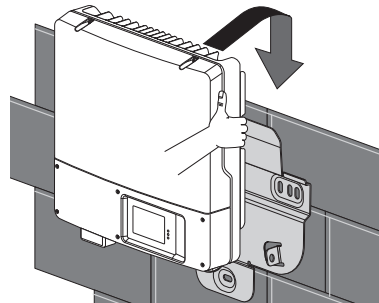
3. Attach the wall mounting bracket using appropriate screws (diameter min. 6 mm) and washers (outer diameter min. 18 mm).



4. Transport the inverter using the recessed grips on the sides.



5. Hook the inverter into the mounting bracket from above.



6. Check both sides of the inverter to make sure it is correctly in place.

Optional Anti-Theft Protection

To protect the inverter from theft, you can lock it to the wall mounting bracket using a padlock.

The padlock must meet the following requirements:

- Size:

A: 6 mm ... 8 mm diameter

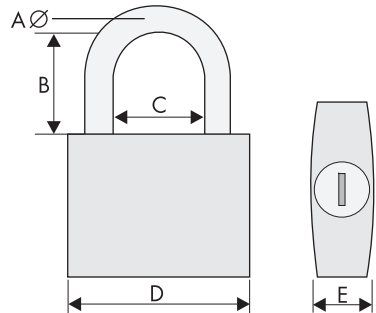
B: 23 mm ... 29 mm

C: 23 mm ... 28 mm

D: 39 mm ... 50 mm

E: 13 mm ... 18 mm

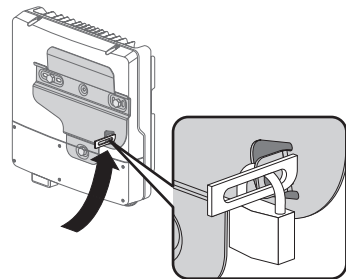
- stainless
- hardened shackle
- protected lock cylinder



Outdoor installation

Always use a lock suitable for outdoor applications. Check regularly that the padlock is working properly.

- Thread the padlock shackle from the centre of the device outwards through the metal clip on the wall mounting bracket and the slot on the inverter, and close the padlock.




Storage of the key

Keep the key in a safe place in case it is needed for service purposes.

6 Electrical Connection

6.1 Safety



NOTICE!

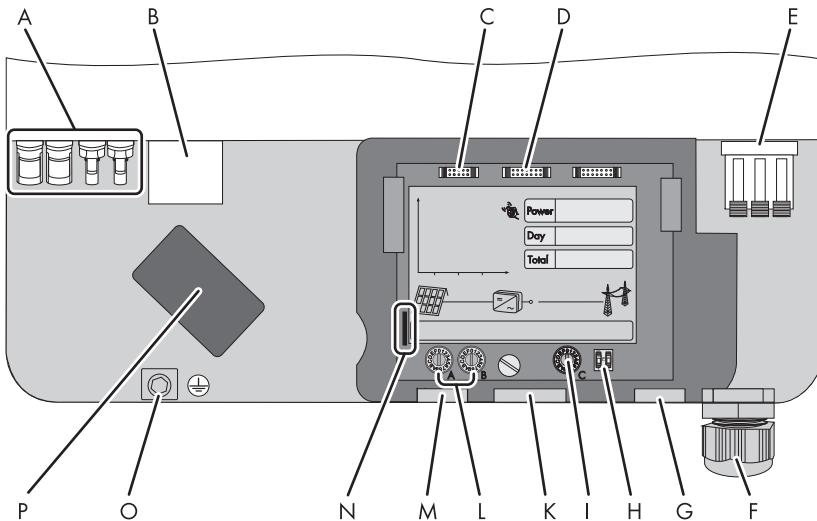
Electrostatic discharge can damage the inverter

Internal components of the inverter can be irreparably damaged by electrostatic discharge.

- Earth yourself before touching any components.

6.2 Overview of the Connection Area

The following figure shows the inverter connection area with the lower enclosure lid open.



Item	Description
A	DC connectors for connecting the strings
B	Socket for connecting the ESS*
C	Plug for connecting the optional multi-function relay or additional fan kit
D	Plug for optional communication via RS485
E	Terminal for the AC cable
F	Cable gland (12 mm ... 21 mm) for routing the AC cable
G	Enclosure opening for connecting the optional multi-function relay or additional fan kit or optional communication via RS485

Item	Description
H	Switch for temporarily changing the display language to English (for service purposes)
I	Rotary switch for the configuration of <i>Bluetooth</i> communication
K	Enclosure opening for optional communication via RS485
L	Rotary switches for setting the country standard and display language
M	Enclosure opening for connecting the optional multi-function relay or additional fan kit
N	Slot for SD Card
O	Earth terminal for additional earthing of the inverter
P	Enclosure opening for installing a fan (available as an additional fan kit)

*optional

6.3 Connection to the Electricity Mains (AC)

6.3.1 Conditions for the AC Connection

- Comply with the connection requirements of your network operator.

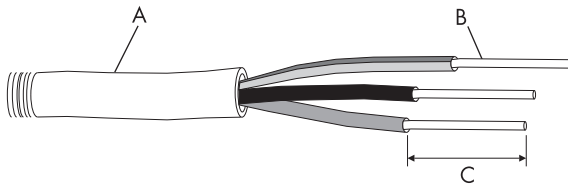
Residual-Current Device

The inverter is equipped with an integrated all-pole-sensitive residual-current monitoring unit. The inverter can automatically differentiate between residual currents and normal capacitive leakage currents. If the network operator stipulates a residual-current protective device, you must use a residual-current protective device that triggers in the event of a residual current of 100 mA or more. Further information on the use of a residual-current protective device can be found in the Technical Information "Criteria for Selecting an RCD" at www.SMA.de/en.

Cable Dimensioning

Use Sunny Design Version 2.0 or higher for sizing the conductor cross-sections (see Sunny Design program at www.SMA.de/en).

Cable Requirements



Object	Description	Value
A	External diameter	12 mm ... 21 mm
B	Conductor cross-section	maximum 10 mm ²
C	Stripping length	approx. 12 mm

Connection of a Second Protective Conductor

The inverter is equipped with a protective conductor monitoring device. This protective conductor monitoring device detects when there is no protective conductor connected and disconnects the inverter from the electricity grid if this is the case. Depending on the installation site and earthing system, it may be advisable to deactivate the protective conductor monitoring. This would apply, for instance, if there is no neutral conductor and you intend to install the inverter between two line conductors. If you are uncertain about this, ask your network operator or SMA Solar Technology AG to advise.

- Depending on the earthing system, deactivate the protective conductor monitoring device (see Section 7.4).
- To ensure safety in accordance with IEC 62109 when the protective conductor monitoring is deactivated, connect a protective conductor to the connecting terminal plate for the AC cable (minimum cross-section: 10 mm², copper wire).

or

- Connect a second protective conductor with the same cross-section as the original protective conductor (see Section 6.3.3 "Additional Earthing of the Enclosure" (page 35)). This will prevent touch current if the original protective conductor fails.



Connection of a second protective conductor

In some countries a second protective conductor is required as a matter of principle. In each case, observe the applicable regulations for the site.

Load Disconnection Unit



Attach the warning labels on the load disconnect unit on the AC side

To prevent arcing, always disconnect the inverter from the AC **and** DC side before starting work on the PV array.

Attach the warning label "Risk of burns from electric arc" so that it is clearly visible on the external AC disconnection device.

You must install a **separate** miniature circuit-breaker for each inverter in order to ensure that the inverter can be securely disconnected under load. The maximum permissible fuse protection can be found in Section 13 "Technical Data" (page 84).

For detailed information and examples of miniature circuit-breaker design, see the Technical Information "Miniature Circuit-Breaker" at www.SMA.de/en.

**DANGER!****Danger to life due to fire**

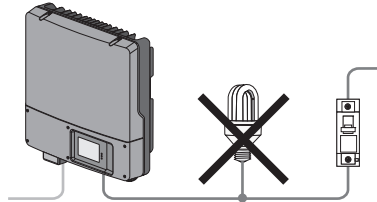
When more than one inverter is connected in parallel to the same miniature circuit-breaker, the protective function of the miniature circuit-breaker is no longer guaranteed. This could result in a cable fire or destruction of the inverter.

- Never connect several inverters to the same miniature circuit-breaker.
- Observe the maximum permissible fuse protection of the inverter when selecting the miniature circuit-breaker.

**DANGER!****Danger to life due to fire**

When a generator (inverter) and a load are connected to the same miniature circuit-breaker, the protective function of the miniature circuit-breaker is no longer guaranteed. The currents from the inverter and the electricity grid can accumulate to form overcurrents which are not detected by the miniature circuit-breaker.

- Never connect loads between the inverter and the miniature circuit-breaker without fuse protection.
- Always fuse loads separately.

**NOTICE!****Damage to the inverter by using screw-type fuses as a load disconnection unit**

A screw-type fuse, e.g. DIAZED fuse or NEOZED fuse, is not a switch-disconnector and thus may **not** be used as a load disconnection unit. A screw-type fuse only acts as cable protection.

If the inverter is disconnected under load using a screw-type fuse, the inverter may be damaged.

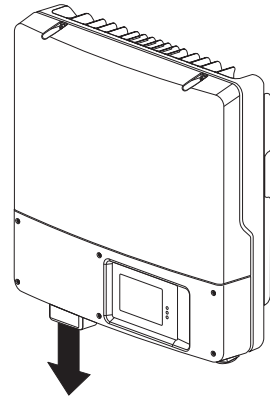
- Use only a switch-disconnector or a miniature circuit-breaker as a load disconnection unit.

6.3.2 Connecting the Inverter to the Electricity Mains (AC)

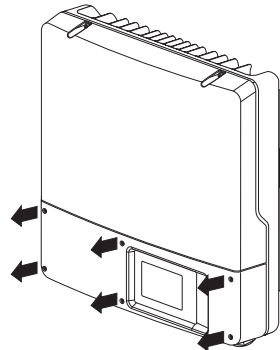
1. Make sure that the mains voltage is within the permissible voltage range.

The exact operating range of the inverter is specified in the operating parameters. The corresponding documents are available in the download area at www.SMA.de/en, in the "Technical Description" category of the respective inverter.

2. Shut down the miniature circuit-breaker and secure it to prevent reactivation.
3. If an external DC switch-disconnector is in use, disconnect it.
4. If an ESS is in use, disconnect the ESS.



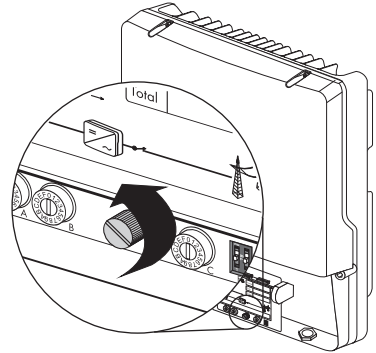
5. Loosen all six captive screws and remove the lower enclosure lid. Use an Allen key (AF 3) to do this.



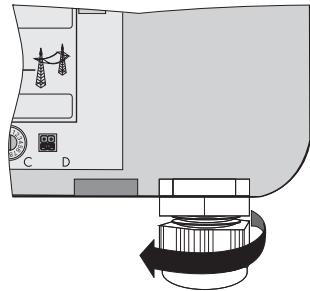
6. Check that the country setting of the inverter is correct using the supplementary sheet with the default settings provided.

If the inverter is not set to the desired country standard, then adjust the country standard (see Section 6.5.2 "Setting the Country Standard and Language using the Rotary Switches" (page 48)).

7. For ease of connection, loosen the display screw until the display can be flipped up.



8. Flip the display up until it clicks into place.
9. Undo the swivel nut of the AC cable gland and remove the filler-plug from the cable gland.

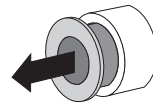


Seal in the AC cable gland

There is a two-part seal in the cable gland. Remove the internal ring insert if necessary, e.g. to introduce a thicker cable.

The following guideline values apply:

- Cable diameter with seal and insert: 12 mm ... 16 mm
- Cable diameter with seal only and without insert: 15 mm ... 21 mm



10. Pull the cable through.
11. Raise all 3 terminals of the AC terminal as far as they will go.



NOTICE!

Risk of fire when connecting two conductors to a single terminal

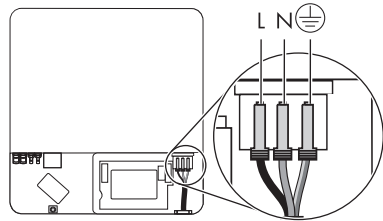
If two conductors are connected to one terminal, this may result in a poor electrical contact which could pose a risk of overheating or fire.

- Never connect more than one conductor per terminal.

12. Connect L, N and the protective conductor (PE) to the AC terminal in accordance with the label.

The protective conductor must be 5 mm longer than the insulated L and N wires.

L and N must not be swapped.



CAUTION!

Danger of crushing when terminals snap shut

The terminals close by snapping down fast and hard.

- Press the terminals down with your thumb, do not grip the sides of the terminal between fingers and thumb.
- Keep fingers away from the terminals.

13. Close all terminals of the AC terminal until they snap into place.
14. Check that the cable ends are firmly secured.
15. Fold down the display and fasten the screw hand-tight.
16. Hand-tighten the swivel nut firmly to the cable gland. Ensure that the cable is securely in place.



DANGER!

Danger to life due to high voltages in the inverter

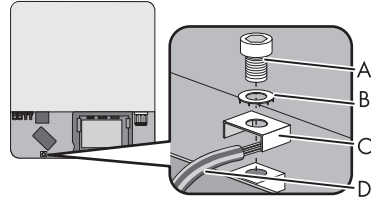
- Do not switch on the miniature circuit-breaker until the PV array has been connected and the inverter is securely closed.

17. Attach the enclosed warning label "Risk of burns from electric arc" so that it is clearly visible on the load disconnect unit on the AC side.

6.3.3 Additional Earthing of the Enclosure

If required in the country of installation, you can use the earth terminal on the enclosure to connect a second protective conductor or as equipotential bonding.

1. Undo screw (A) half way. Use an Allen key (AF 4) to do this.
 2. Insert the stripped earthing cable (D) under the clamping bracket (C) (maximum conductor cross-section 10 mm²).
 3. Fasten terminal (C):
 - Place the conical spring washer over the screw. The grooved side of the conical spring washer must face towards the screw head.
 - Tighten the screw (torque: 6 Nm). Use an Allen key (AF 4) to do this.
- The teeth of the conical spring washer press into the clamping bracket. The earthing cable now has conductive connection to the enclosure.



6.4 Connecting the PV Array (DC)

6.4.1 Conditions for DC Connection



Use of Y adaptors

Y adaptors must not be visible or freely accessible within close proximity of the inverter.

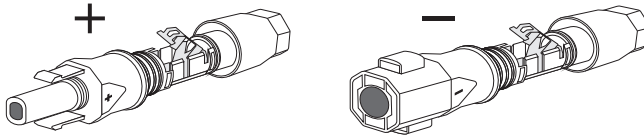
- The DC circuit must not be interrupted by Y adaptors.
- Observe the procedure for disconnecting the inverter (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).
- Requirements for the PV modules of the connected strings:
 - same type
 - same number of in-series-connected PV modules
 - identical alignment
 - identical tilt
- The connection cables of the PV modules must be equipped with connectors. The DC connectors for the DC connection are included in the delivery.
- At the DC input of the inverter, the following limits must not be exceeded:

Maximum input voltage	Maximum input current
750 V (DC)	15.0 A (DC)

6.4.2 Assembling the DC Connectors

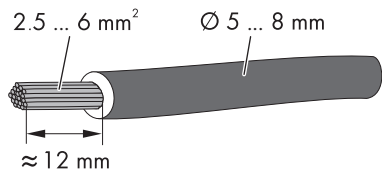
All PV display module connection cables must be equipped with the DC connectors supplied before connecting them to the inverter.

Assemble the DC connectors as described below. Be sure to observe the correct polarity. The DC connectors are marked with the symbols "+" and " - ".



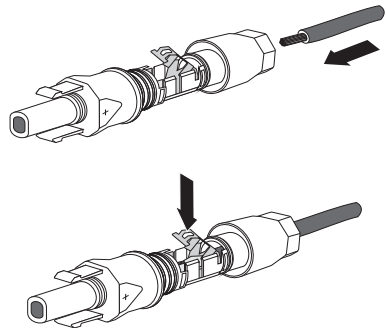
Cable Requirements

- Use a PV1-F cable.


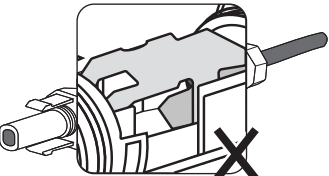
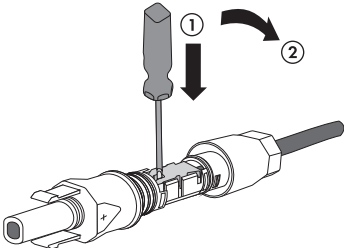


Procedure

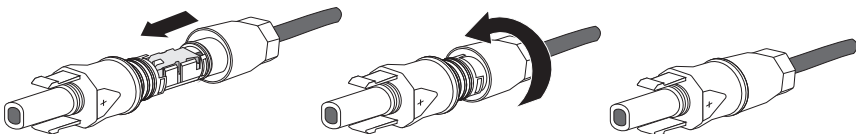
1. Lead the stripped cable all the way into the DC connector.
2. Press the clamping bracket down until it audibly snaps into place.



3. Ensure that the cable is correctly positioned:

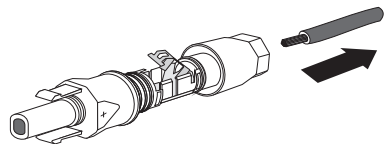
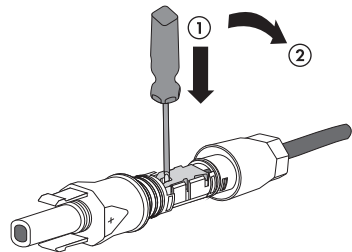
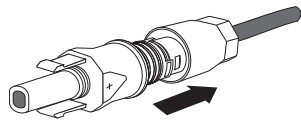
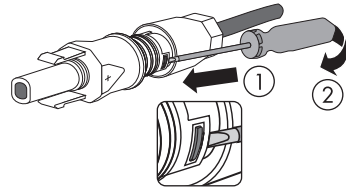
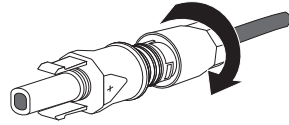
Result	Measure
<p>☑ If the stranded wires are visible in the chamber of the clamping bracket, the cable is correctly positioned.</p> 	<ul style="list-style-type: none"> • Proceed to Step 4.
<p>☑ If the stranded wires are not visible in the chamber, the cable is not correctly positioned.</p> 	<ul style="list-style-type: none"> • Release the clamping bracket. To do so, insert a 3.5 mm screwdriver into the clamping bracket and lever it open.  <ul style="list-style-type: none"> • Remove the cable and go back to step 1.

4. Push the swivel nut up to the thread and tighten (torque: 2 Nm).



6.4.3 Disassembling the DC Connector

1. Unscrew the swivel nut.
2. To release the DC connector: Insert a 3.5 mm screwdriver into the snap slot on the side and lever it open.
3. Carefully pull the DC connector apart.
4. Release the clamping bracket. To do so, insert a 3.5 mm screwdriver into the clamping bracket and lever it open.
5. Remove the cable.



6.4.4 Connecting the PV Array (DC)



DANGER!

Danger to life due to high voltages in the inverter

- Before connecting the PV array, make sure that the miniature circuit-breaker is disconnected and cannot be reconnected.



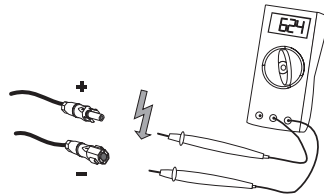
NOTICE!

Excessive voltages can destroy the multimeter

- Only use multimeters with a DC input voltage range up to at least 1,000 V.

1. Check the connection cable of the PV modules for correct polarity and make sure that the maximum input voltage of the inverter is not exceeded.

At an ambient temperature above 10°C, the open-circuit voltage of the PV modules must not be more than 90% of the maximum inverter input voltage. If this is not the case, review the plant design and the PV module circuitry. At lower ambient temperatures, the maximum input voltage of the inverter could otherwise be exceeded.



NOTICE!

Destruction of the inverter due to overvoltage

If the voltage of the PV modules exceeds the maximum input voltage of the inverter, it could be destroyed by the overvoltage. This will void all warranty claims.

- Do not connect any strings to the inverter which have an open-circuit voltage greater than the maximum input voltage of the inverter.
- Check the plant design.

2. Check strings for earth faults (see Section 1 1.5 "Checking the PV Array for Earth Faults" (page 75)).



DANGER!

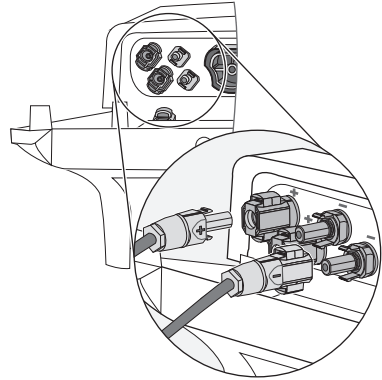
Danger to life due to electric shock.

- Do not connect any strings in which earth faults are present.
- Before connecting the DC cable, rectify the earth fault in the respective string.

3. Check the DC connectors for correct polarity and connect them.

☑ The DC connectors click audibly into place.

For details on how to release the DC connectors, see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56).



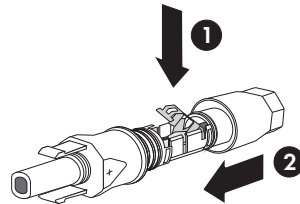
4. If you do not need all DC inputs on the inverter, seal the enclosure with DC connectors and sealing plugs:



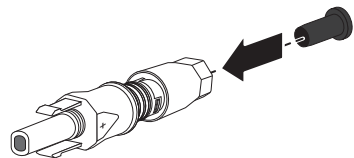
Sealing plugs

- Do **not** insert the sealing plugs **directly** into the DC inputs on the inverter.

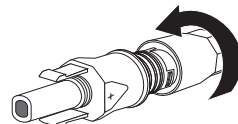
- For unused DC connectors, push down the clamping bracket and push the swivel nut up to the thread.



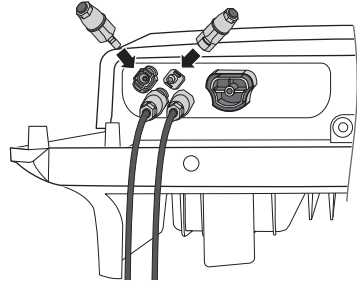
- Insert the sealing plug into the DC connector.



- Tighten the swivel nut (torque: 2 Nm).

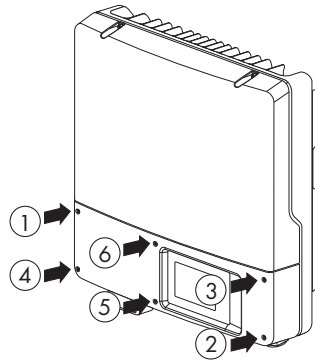


- Insert the DC connectors with sealing plugs into the corresponding DC inputs on the inverter.
- ☑ The DC connectors click audibly into place.

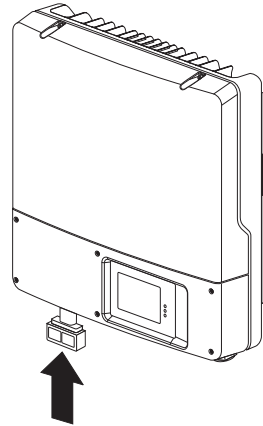


5. Ensure that all DC connectors are securely in place.
6. Close the lower enclosure lid again using the six screws.

Tighten the screws (2 Nm torque) in the order shown on the right.



7. If an ESS is used, check it for wear as described in Section 9.3 "Checking the Electronic Solar Switch for Wear" (page 61) and reattach it firmly.



NOTICE!

Damage to the ESS

If it is not connected correctly, the ESS can be damaged.

- Plug the handle firmly onto the jack of the ESS.
- The handle must be flush with the enclosure.
- Make sure that the ESS is securely attached to the inverter.



Currents in DC cabling

After connecting the ESS or switching on the DC switch-disconnector, DC currents may occur in the DC cabling, even when there is no AC-side supply. This is not an error but normal behaviour of the inverter when in operation.

- The PV array is connected. You can now commission the inverter (see Section 7 "Commissioning" (page 51)). Other connection options are optional (see Section 6.6 "Communication" (page 49)).

6.5 Setting the Country Standard and Display Language

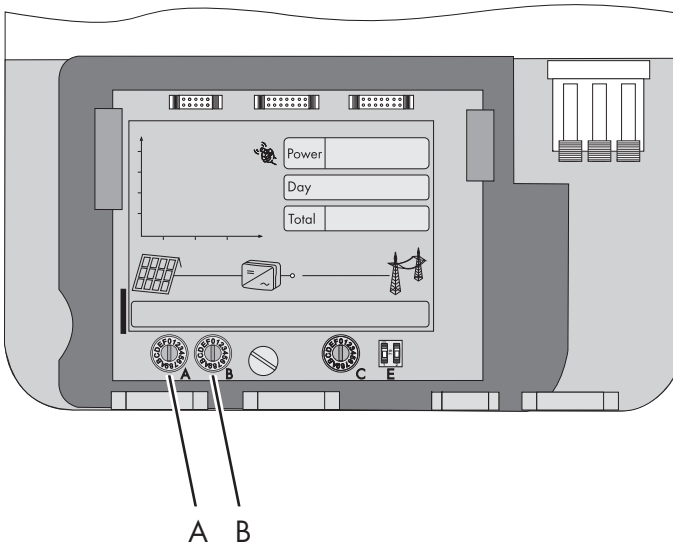
The inverter can be configured for various countries. This can be done prior to commissioning via 2 rotary switches on the display or after commissioning by configuring the "CntrySet" or "Set country standard" parameter using a communication product (e.g. Sunny WebBox or Sunny Explorer). For devices ordered without any specified country of installation, the default country data set is "VDE-AR-N4105-HP" and the display language is set to German.

Both rotary switches are set to 0 upon delivery. If you have ordered the inverter with specific country settings, they will have already been preset at the factory via a communication product. In this case, you will not be able to recognise the currently valid setting by the switch position.

If changes are made via the rotary switches or via a communication product, the default grid parameters are overwritten. They cannot be restored, and must be re-entered via a communication product.

The display language can be changed at any time using the rotary switches, independent of the grid parameters. This means that the default grid parameters remain unchanged, but the display messages are shown in the set language.

Changes will be applied immediately after switching the miniature circuit-breaker on. If an unprogrammed switch setting is selected, the inverter displays an error message. The last valid setting is retained.



SMA Grid Guard-Protected Country Data Sets

In some countries, the local connection conditions demand a mechanism which prevents the feed-in parameters from being changed. Therefore, certain country data sets are protected against unauthorised changes. They can only be unlocked with a personal access code - the SMA Grid Guard code.

SMA Grid Guard-protected country data sets are automatically locked for 10 feed-in hours after commissioning, or after the last alteration. If the country data set is changed after these 10 feed-in hours, the inverter will not apply the changes but display the error message "Grid param. locked". If, however, a later change to the country data set only relates to a change of the display language via the rotary switches in the inverter, this change is immediately applied.

It is also possible to configure country data sets (parameter "CntrySet" or "Set country standard"), and to lock or unlock these manually via a communication product. To lock a data set, enter the digit sequence "54321" instead of the password in the SMA Grid Guard code field. The data set can only be unlocked by entering a personal, 10-digit SMA Grid Guard code which is valid for a maximum of 10 feed-in hours. The application form for the personal access code is available at www.SMA.de/en, in the "Certificate" category of the respective inverter.

The language can be configured without a password, regardless of the country data set.



Changing parameters in SMA Grid Guard-protected country data sets

If the parameters within protected country data sets are changed, these are no longer protected and instead of the standard "ADJ" or "Special setting" is displayed. In this case, a change to parameters is not locked automatically after 10 feed-in hours, but has to be locked manually. To manually lock the parameters, set the SMA Grid Guard code to "54321".



Further information on parameter settings

For detailed information on making adjustments and changing parameters, see the corresponding user manual for your communication product.

The last change (executed via rotary switch or communication product) is always verified and activated if applicable. Consequently, the switch position may not necessarily show the actual country setting.

6.5.1 Checking the Country Standard

Make sure that the inverter is set to the country of installation.

Before commissioning:

- Check that the country standard of the inverter is correct by comparing the default settings of the inverter listed on the supplementary sheet provided.

After commissioning:

- Check that the country standard is correct on the basis of the display message during (re-)commissioning (see Section 7 "Commissioning" (page 51)).
 - Check whether the country standard is correct by tapping the display twice and viewing the display messages of the start-up phase again.
- or**
- Check that the country standard is correct using the "SMA grid guard" measuring channel via a communication product.



Display language

Once you have set the country standard, you can always set the display language later using rotary switch B. However, you have to then set rotary switch A to "0" in order to keep the country data set.

The settings of each country data set are specified in the operating parameters. The parameters can be read using a communication product. The description of the operating parameters is available at www.SMA.de/en in the category "Technical Description" of the respective inverter.

(A)	(B)	Country data set	Display language	Grid Guard protection	Country
0	0	default setting	default setting	dependent on parameter set	dependent on parameter set
0	1	retained	English	dependent on parameter set	dependent on parameter set
0	2	retained	German	dependent on parameter set	dependent on parameter set
0	3	retained	French	dependent on parameter set	dependent on parameter set
0	4	retained	Spanish	dependent on parameter set	dependent on parameter set
0	5	retained	Italian	dependent on parameter set	dependent on parameter set
0	6	retained	Greek	dependent on parameter set	dependent on parameter set
0	7	retained	Czech	dependent on parameter set	dependent on parameter set

(A)	(B)	Country data set	Display language	Grid Guard protection	Country
0	8	retained	Korean	dependent on parameter set	dependent on parameter set
0	9	retained	Portuguese	dependent on parameter set	dependent on parameter set
0	A	retained	Dutch	dependent on parameter set	dependent on parameter set
0	B	retained	Slovenian	dependent on parameter set	dependent on parameter set
0	C	retained	Bulgarian	dependent on parameter set	dependent on parameter set
0	D	retained	Polish	dependent on parameter set	dependent on parameter set
1	0	VDE0126-1-1	German	yes	Germany, Switzerland,
1	2	VDE-AR-N4105 ^{a)}	German	yes	Germany
1	4	VDE-AR-N4105-MP ^{b)}	German	yes	Germany
1	6	VDE-AR-N4105-HP ^{c)}	German	yes	Germany
1	8	VDE0126-1-1	French	yes	Switzerland, France
1	9	VDE0126-1-1/UTE ^{d)} *	French	yes	France
2	0	VDE0126-1-1	Italian	yes	Switzerland
3	1	CEI 0-21 intern ^{e)}	Italian	yes	Italy
3	2	CEI 0-21 extern ^{f)}	Italian	yes	Italy
4	0	RD1699*	Spanish	yes	Spain
4	1	RD1663/661-A*	Spanish	yes	Spain
4	8	PPC*	Greek	no	Greece
4	9	PPC*	English	no	Greece
5	8	G83/1-1	English	no	England
5	A	G59/2	English	no	England
6	0	EN50438*	German	yes	various EU countries
6	1	EN50438*	English	yes	various EU countries
6	2	EN50438*	French	yes	various EU countries
6	3	EN50438*	Italian	yes	various EU countries

(A)	(B)	Country data set	Display language	Grid Guard protection	Country
6	4	EN50438*	Spanish	yes	various EU countries
6	5	EN50438*	Greek	yes	various EU countries
6	6	EN50438*	Czech	yes	various EU countries
6	7	EN50438*	Portuguese	yes	various EU countries
6	8	EN50438*	Bulgarian	yes	various EU countries
6	9	EN50438*	Polish	yes	various EU countries
7	0	EN50438-CZ*	Czech	yes	Czech Republic
7	1	EN50438-CZ*	English	yes	Czech Republic
7	2	EN50438-CZ*	German	yes	Czech Republic
7	4	PPDS*	Czech	yes	Czech Republic
7	5	PPDS*	English	yes	Czech Republic
7	6	PPDS*	German	yes	Czech Republic
7	8	C10/11	French	yes	Belgium
7	9	C10/11	English	yes	Belgium
7	A	C10/11	German	yes	Belgium
C	0	Customer	English	no	flexible
C	1	Customer	German	no	flexible
C	2	Customer	French	no	flexible
C	3	Customer	Spanish	no	flexible
C	4	Customer	Italian	no	flexible
C	5	Customer	Greek	no	flexible
C	6	Customer	Czech	no	flexible
D	0	Off-Grid 60 Hz*	English	no	flexible
D	1	Off-Grid 60 Hz*	German	no	flexible
D	2	Off-Grid 60 Hz*	French	no	flexible
D	3	Off-Grid 60 Hz*	Spanish	no	flexible
D	4	Off-Grid 60 Hz*	Italian	no	flexible
D	5	Off-Grid 60 Hz*	Greek	no	flexible
D	6	Off-Grid 60 Hz*	Czech	no	flexible
E	0	Off-Grid 50 Hz*	English	no	flexible
E	1	Off-Grid 50 Hz*	German	no	flexible

(A)	(B)	Country data set	Display language	Grid Guard protection	Country
E	2	Off-Grid 50 Hz*	French	no	flexible
E	3	Off-Grid 50 Hz*	Spanish	no	flexible
E	4	Off-Grid 50 Hz*	Italian	no	flexible
E	5	Off-Grid 50 Hz*	Greek	no	flexible
E	6	Off-Grid 50 Hz*	Czech	no	flexible
a) Setting in accordance with VDE-AR-N-4105 for PV plants ≤ 3.68 kVA (Germany)					
b) Setting in accordance with VDE-AR-N-4105 for PV plants > 3.68 kVA and < 13.8 kVA (Germany)					
c) Setting in accordance with VDE-AR-N-4105 for PV plants > 13.8 kVA (Germany)					
d) Special setting for France: Bluetooth transmission power reduced in accordance with French requirements					
e) Setting in accordance with CEI 0-21 for PV plants ≤ 6 kW (Italy)					
f) Setting in accordance with CEI 0-21 for plants with external grid and plant protection > 6 kW (Italy)					
* Planned					

If the inverter is not set to the country of installation, there are several ways of configuring the required country standard:

- Setting via the two rotary switches (see Section 6.5.2 "Setting the Country Standard and Language using the Rotary Switches" (page 48)).
- Alternatively you can conduct the settings via the "CntrySet" or "Set country standard" parameters via a communication product, once you have commissioned the inverter.
- If you require adjusted parameter settings for your installation site, you can change these with the help of a communication product.

6.5.2 Setting the Country Standard and Language using the Rotary Switches

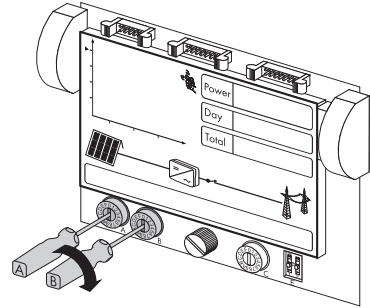
1. Disconnect the inverter and open it (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).

DANGER!
Danger to life due to high voltages in the event of electricity grid failure

If you set the inverter to stand-alone grid operation "Off-Grid 50 Hz"/"Off-Grid 60 Hz", you are not allowed to operate the inverter on the electricity grid, but only on the stand-alone grid, because the inverter does not satisfy any country-specific standards and guidelines in this setting. In the event of electricity grid failure, this will prevent the danger of backfeed.

- If the inverter is set to "Off-Grid 50 Hz" or "Off-Grid 60 Hz", never operate the inverter directly on the electricity grid.

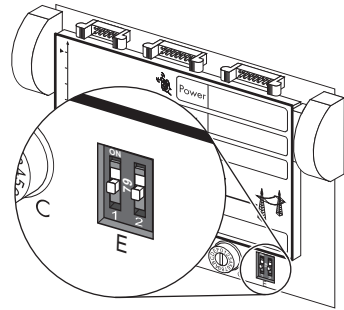
- Set the arrows on both rotary switches (A and B) to the required positions with a screwdriver (see table in Section 6.5.1 "Checking the Country Standard" (page 45)). Use a screwdriver with blade width 2.5 mm.



Temporarily setting the display language to English

In addition, it is possible to use a switch to set the display language to English temporarily, e.g. for service purposes. This will have no effect on the inverter parameter settings.

- Push the left switch 1 up until it locks into place. Use an object with a small tip, e.g. a ballpoint pen to do this.
- To reset the display language to the original language, push the left switch 1 back down until it locks into place.



- Close the inverter (see Section 8.3 "Closing the Inverter" (page 59)).

6.6 Communication

6.6.1 Interface for RS485 Communication

If you have ordered an inverter with an interface for wireline communication, the inverter will be delivered with the interface ready installed.

You can also subsequently order an interface for wireline communication (see Section 14 "Accessories" (page 90)). You will find a detailed illustration of the wiring principle and instructions for conversion in the communication interface retrofit kit.

6.6.2 Setting the *Bluetooth* NetID

Communication with a communication product via *Bluetooth* is activated by default. Networking with other inverters via *Bluetooth* is deactivated by default.

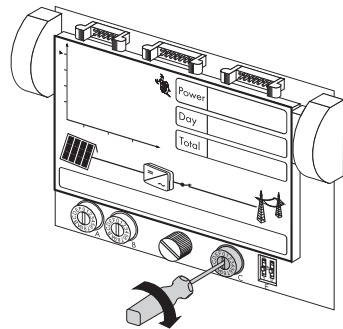
The following configuration settings are possible via a rotary switch (switch C):

Switch position (NetID)	Setting
0	<i>Bluetooth</i> communication is deactivated.
1	Communication with a communication product via <i>Bluetooth</i> is activated and networking with other inverters is deactivated. (default setting)
2 ... F	Networking via <i>Bluetooth</i> with other inverters is activated.

In order to restrict communication via *Bluetooth* between the inverters of your PV plant and those of neighbouring systems, you can assign an individual NetID to the inverters of your PV plant (switch position 2 ... F). However, this is only necessary if neighbouring plants are situated within a radius of 500 m.

For all inverters in your PV plant to be detected by your communication product, they must all have the same NetID.

1. Disconnect the inverter and open it (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).
2. Set the arrow on the rotary switch (C) to the required position with a screwdriver. Use a 2.5 mm screwdriver for this purpose.
3. Close the inverter (see Section 8.3 "Closing the Inverter" (page 59)).



Activation of settings

The *Bluetooth* settings will only be applied once the inverter has been commissioned.

6.6.3 Multi-Function Relay

If you have ordered an inverter with a multi-function relay, the multi-function relay is installed upon delivery. You can subsequently order a multi-function relay (for order number, see Section 14 "Accessories" (page 90)).

A description of the installation and electrical connection can be found in the installation manual of the multi-function relay.

You can find detailed information on the configuration of the multi-function relay in the Technical Description "Multi-functional relay and OptiTrac Global Peak" at www.SMA.de/en.

7 Commissioning

7.1 Commissioning the Inverter

1. The following conditions must be fulfilled before commissioning:
 - Correct mounting (see Section 5.3)
 - Correct country setting (see Section 6.5.1)
 - AC cable is correctly connected (electricity grid)
 - Protective conductor is correctly connected (see Section 6.3.3)
 - DC cables (PV strings) are correctly connected
 - Unused DC inputs are closed using the corresponding DC connectors and sealing plugs
 - All enclosure openings are closed
 - The enclosure lid is securely screwed into place
 - An external DC switch-disconnector is connected or, if applicable, the ESS is firmly in place
 - The AC distribution is correctly installed
 - The miniature circuit-breaker is correctly sized

2. Switch the miniature circuit-breaker on.

Green LED is lit: commissioning successful.

or

Green LED will flash if irradiation is insufficient: grid connection conditions have not yet been reached. Wait for sufficient irradiation.

or

Red LED is lit: a disturbance has occurred. Locate and eliminate the fault (see Section 11 "Troubleshooting" (page 63)).



Self-test in accordance with CEI 0-21 during initial start-up (applies to Italy only)

The Italian standard prescribes that an inverter can only operate on the electricity grid after the disconnection times for overvoltage, undervoltage, minimum frequency and maximum frequency have been checked.

If you have configured the **CEIO-21 Int / CEI 0-21 intern** country data set, start the self-test (see Section 7.3 "Self-Test in Accordance with CEI 0-21 for Plants ≤ 6 kW" (page 53)).




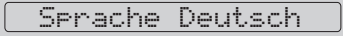
3. If a multi-function relay is connected, switch on the supply voltage to the relay.
4. For communication via *Bluetooth*, make the following settings:
 - Change the plant time (see the manual of the communication product).
 - Change the passwords (see the manual of the communication product).

7.2 Display Messages during the Start-up Phase



Illustrated display messages

The display messages illustrated in this section serve as examples and, depending on the country setting, may differ from the actual display messages on your inverter.

- The firmware version of the internal processors appears first in the text line. 
- After 5 seconds, or after tapping on the display, the serial number or the description of the inverter and the NET ID for communication via *Bluetooth* will appear. The designation of the inverter can be changed via a communication product. 
- After a further 5 seconds, or after a further tap, the configured country standard is displayed (example: "VDE-AR-N4105-MP"). 
- After a further five seconds, or after a further tap, the configured language is displayed (example: "Sprache Deutsch" (Language German)). 
- During normal operation, the text line of the display will be blank. For event messages displayed in the text line and their meaning, refer to Section 11 "Troubleshooting" (page 63).



Showing display messages again

If you want to view the display messages of the start phase again whilst in normal operation, double-tap the display.

7.3 Self-Test in Accordance with CEI 0-21 for Plants ≤ 6 kW

7.3.1 Starting the Self-Test



The self-test only applies to inverters that are configured with the country data set **CEI0-21 Int/CEI 0-21 intern**.

The self-test is only valid for inverters licensed for Italy and configured with the country data set **CEI0-21 Int /CEI 0-21 intern**.

If the inverter is configured to **CEI0-21 Ext / CEI 0-21 extern**, no self-test is required.

The Italian standard requires that all inverters in plants ≤ 6 kW feeding into the electricity grid perform a self-test in accordance with CEI 0-21. During the self-test, the inverter will consecutively check the reaction times for overvoltage, undervoltage, maximum frequency and minimum frequency.

The self-test changes the upper and lower trip-limit values for each protective function on a linear basis for frequency monitoring and voltage monitoring. As soon as the measured value exceeds the permitted trip-limit value, the inverter disconnects from the electricity grid. In this way, the inverter determines the reaction time and checks itself.

After the self-test has been completed, the inverter automatically switches back to feed-in operation, resets the original shutdown conditions and connects to the electricity grid.

Requirements:

- Country data set must be configured to **CEI0-21 Int / CEI 0-21 intern**.
 - or
 - Country data set must be configured to **trimmed / Special setting** based on **CEI0-21 Int / CEI 0-21 intern**.
 - A report for entering the test results in compliance with CEI 0-21 must be on hand.
 - The inverter must be in operation and in the start-up phase.
1. As soon as the configured country data set appears in the display, tap once on the display within ten seconds.
 - A message informing you that the self-test has started is shown in the display: **Avvio Autotest**.
 - The message Avvio Autotest is not shown in the display? You exceeded the 10-second time limit so the self-test cannot start.
 - Restart the self-test (see Section 7.3.3).
 2. Tap on the display within 20 seconds and enter the test results into the test report as they appear.
 - The self-test starts.
 - The inverter displays the results of the individual tests for overvoltage, undervoltage, maximum frequency and minimum frequency. The results are displayed three times in succession for ten seconds each.

Example: Display messages for overvoltage test

- Name of the test: **Autotest (59.S1) 240.00V**
 - Disconnection value: **Valore di soglia con 230,00 V**
 - Normative value: **Va. taratura 253.00V**
 - Disconnection time: **Tempo intervento 0.02s**
 - Current mains voltage: **Tensione di rete Val. eff.: 229.80V**
-

7.3.2 Abortion of the Self-Test

If, during the self-test, an unexpected disconnection requirement occurs, the self-test is aborted. The same applies if the DC voltage is so low that feed-in cannot be continued.

- A message informing you that the self-test has been aborted is shown in the display for ten seconds: **Autotest interrotto**.
- Restart the self-test (see Section 7.3.3).

7.3.3 Restarting the Self-Test

1. Disconnect the miniature circuit-breaker and secure against reconnection.
2. If the multi-function relay is used, switch off the load supply voltage.
3. Remove the ESS from the inverter for five minutes and then plug it in again firmly.
4. Restart the inverter
 - The inverter is now back in the start-up phase and you can start the self-test (see Section 7.3.1).

7.4 Deactivating Protective Conductor Monitoring

If the inverter is to be installed in an IT system or other earthing system for which it is advisable to deactivate the protective conductor monitoring, deactivate it by means of a communication product as described in this section (for information on the setting of operating parameters, see respective communication product manual).

Requirements:

- A communication product that is appropriate for the type of communication used must be available.
1. Log in to the communication product as an Installer.
 2. Set the parameter **PE Anschlussüberwachung** or **PEOpnMon** to **Aus** or **Off**.
 3. Save setting.

8 Opening and Closing

8.1 Safety



DANGER!

Danger to life due to high voltages in the inverter

Before opening the inverter, observe the following:

- Disconnect the miniature circuit-breaker and secure against reconnection.
- If a multi-function relay is connected, disconnect its supply voltage and ensure that it cannot be reconnected.

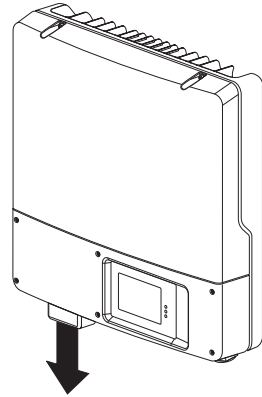


DANGER!

Danger to life due to electric shock.

If the DC connectors are pulled out without first disconnecting the ESS or switching off the DC switch-disconnector, a dangerous electric arc can occur.

- Disconnect the ESS or switch off the DC switch-disconnector first.
- Then, open the lower enclosure lid and remove the DC connectors.



NOTICE!

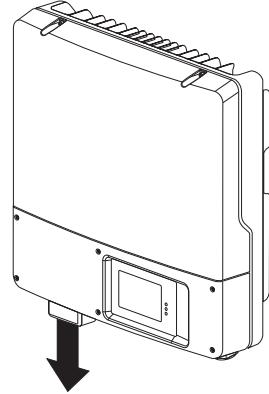
Electrostatic discharge can damage the inverter

The internal components of the inverter can be irreparably damaged by electrostatic discharge.

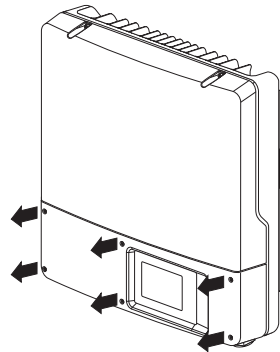
- Earth yourself before touching any components.

8.2 Disconnecting the Inverter from Voltage Sources

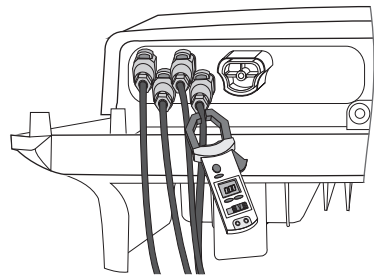
1. Disconnect the miniature circuit-breaker and secure against reconnection.
2. If a multi-function relay is connected, disconnect its supply voltage and ensure that it cannot be reconnected.
3. If an external DC switch-disconnector is in use, disconnect it.
4. If an ESS is in use, disconnect it.



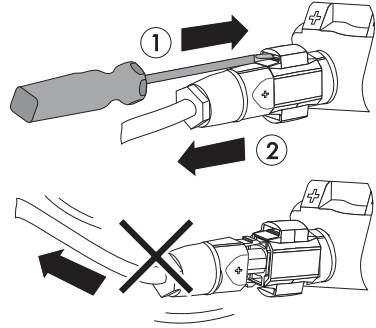
5. Loosen all six captive screws and remove the lower enclosure lid. Use an Allen key (AF 3) to do this.



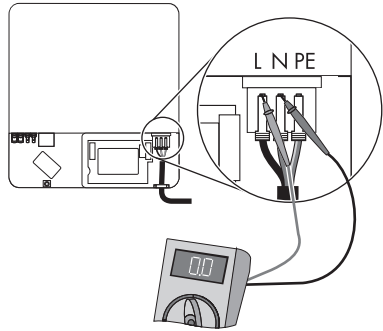
6. Use a current clamp to make sure no current is present in the DC cables.
 - If current is present, check the installation.



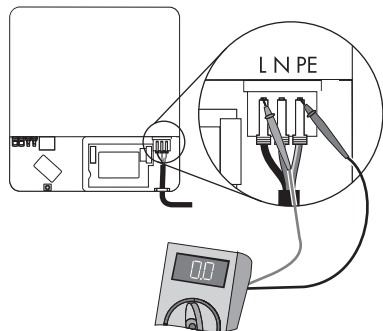
7. Release and disconnect all DC connectors.
 To do this, insert a flat-blade screwdriver (blade width: 3.5 mm) into one of the side slots and pull the DC connectors straight out.
 Do **NOT PULL ON THE CABLE**.



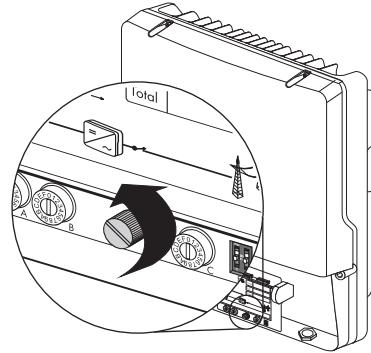
8. Wait until the LEDs, display and fault indicator have gone out.
9. Verify the absence of voltage between L to N at the AC terminal using a suitable multimeter. The maximum diameter of the test probe is 2 mm.
 - ☑ If voltage is present, check the installation.



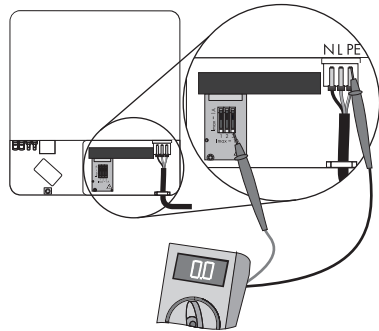
10. Verify that no voltage is present between L and PE at the AC terminal using a suitable multimeter.
 - ☑ If voltage is present, check the installation.



11. Loosen the screw on the display and flip the display up until it clicks into place.



12. Verify the absence of voltage in the multi-function relay against PE at all terminals. The maximum diameter of the test probe is 2 mm.
 - If voltage is present, check the installation.



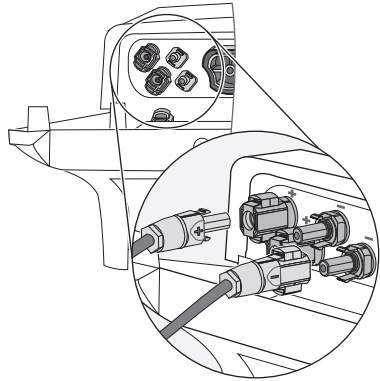
- The inverter is open and no voltage is present.

8.3 Closing the Inverter

1. Check the DC connectors for correct polarity and connect them to the inverter.

The DC connectors click audibly into place.

To release the DC connectors, see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56).



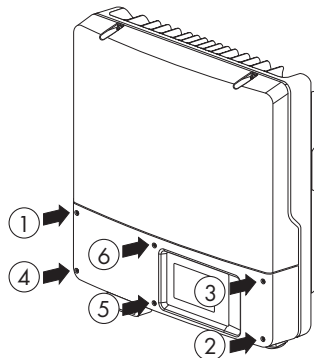
2. Close all unused DC inputs to seal the inverter (see Section 6.4.4 "Connecting the PV Array (DC)" (page 39)).
3. Ensure that all DC connectors are securely in place.

! DANGER!
Danger to life due to electric shock.

If the inverter is operated without the lower enclosure lid, the DC connectors can be disconnected while under load, which may cause arcing.


- Insert the ESS only when the lower enclosure lid is closed.
- Only operate the inverter with the lower enclosure lid closed. This will ensure that the DC connectors cannot be readily removed.

4. Attach the lower enclosure lid to the enclosure and fasten it using the six screws. Use an Allen key (AF 3) to tighten the screws in the order shown on the right (torque 2 Nm).



5. If an external DC switch-disconnector is in use, disconnect it.

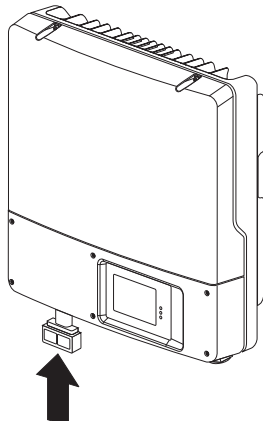
6. If an ESS is used, check it for wear (see Section 9.3 "Checking the Electronic Solar Switch for Wear" (page 61)), and plug it in firmly.



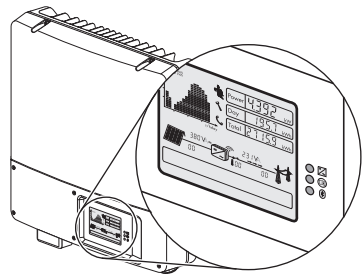
NOTICE!

The ESS can be damaged if it is not connected correctly.

- Plug the ESS in securely.
The ESS handle must be flush with the enclosure.
- Check that the ESS is securely in place.



7. If a multi-function relay is connected, switch on the supply voltage to the relay.
8. Switch the miniature circuit-breaker on.
9. Check that the display and the LEDs are indicating a normal operating state (see Section 7 "Commissioning" (page 51)).



- The inverter is now closed and in operation.

9 Maintenance and Cleaning

9.1 Cleaning the Inverter

If the inverter is soiled, clean the enclosure lid, the display and the LEDs with clear water and a cloth only.

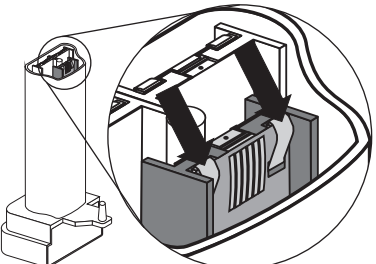
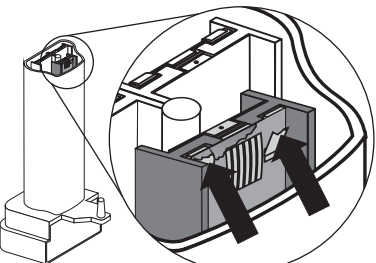
9.2 Checking Heat Dissipation

If the inverter regularly reduces its power output due to excessive heat (temperature symbol on the display lights up), this may be for one of the following reasons:

- The cooling fins on the rear side of the enclosure are clogged.
 - Clean the cooling fins using a soft brush.
- The air ducts at the top are clogged.
 - Clean the air ducts using a soft brush.

9.3 Checking the Electronic Solar Switch for Wear

Check the ESS for wear before plugging it in.

Result	Measure
<p><input checked="" type="checkbox"/> The metal tongues inside the plug are not damaged or discoloured.</p> 	<ol style="list-style-type: none"> 1. Insert the handle of the ESS securely into the socket at the bottom of the enclosure. 2. Recommission the inverter (see Section 7 "Commissioning" (page 51)).
<p><input checked="" type="checkbox"/> The metal tongues inside the plug have a brown discolouration or are burned out.</p> 	<p>The ESS can no longer safely disconnect the DC side.</p> <ol style="list-style-type: none"> 1. Replace the ESS handle before attaching it again. Order the new ESS handle through the SMA Service Line (see Section 15 "Contact" (page 91)). 2. After replacing the ESS, commission the inverter again (see Section 7 "Commissioning" (page 51)).

10 Slot for SD Card

The SD card is used to import files if you need to perform a firmware update after consulting the SMA Service Line.

SMA Solar Technology AG will send you a file with the firmware update by e-mail or on an SD card, or will make the file available in the download area at www.SMA.de/en.

For a description of the firmware update, see the download area at www.SMA.de/en.



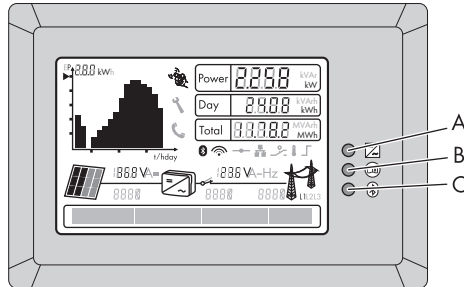
Properties of the SD card

Use an SD card that is FAT16 or FAT32 formatted and has a maximum storage capacity of 2 GB.

Use the SD card exclusively for this inverter. Do not save any multimedia files or other unsuitable files on the SD card.

11 Troubleshooting

11.1 LED Signals



Item	Description	Status	Explanation
A	Green LED	Lit	Operation
		Flashing	Grid connection conditions are not yet met.
B	Red LED	Lit	Error
C	Blue LED	Lit	Bluetooth communication is activated.
		Flashing	The inverter has been identified via Sunny Explorer by setting the "Find device" parameter.

11.2 Event Messages



No display in the event of insufficient DC voltage

It is only possible to take measurements and display messages when there is sufficient DC voltage.

During an update, the relevant display message is shown in the text line of the display.

Message	Description
Avvio Autotest	Only relevant for an installation in Italy: tapping on the display starts the self-test in accordance with Enel-GUIDA (see Section 7.3 "Self-Test in Accordance with CEI 0-21 for Plants ≤ 6 kW" (page 53)).
Grid param.unchanged	The selected switch setting is not programmed or there is no country data set available on the SD card.
Inst. code valid	The SMA Grid Guard code entered is valid. The configured country data set is now unlocked and can be changed. If it is a Grid Guard-protected country data set, the unlocking is valid for a maximum of 10 feed-in hours.
No new update SDcard	There is no update file relevant for this inverter on the SD card or the available update has already been carried out.
Parameters set successfully	A new country data set has been configured.
SD card is read	The inverter is currently reading the SD card.
Set parameter	The inverter is setting the configured parameters.
Upd. language table	The inverter is updating the language table.
Update Bluetooth	The inverter is updating the <i>Bluetooth</i> component.
Update communication	The inverter is updating the communication component.
Update completed	The inverter has successfully completed the update.
Update file OK	The update file found is valid.
Update main CPU	The inverter is updating the inverter component.
Update RS485I module	The inverter is updating the communication interface.

11.3 Error messages



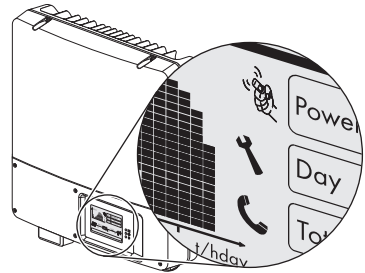
No display in the event of insufficient DC voltage

It is only possible to take measurements and display messages when there is sufficient DC voltage.

The text line on the display shows the relevant display messages whenever an error occurs. The event numbers for the displayed error messages appear above the text line. If the error persists for a prolonged period, the red LED lights up and the fault indicator is activated (if connected).

In addition, depending on the type of disturbance, the "spanner" or "telephone receiver" symbol on the display light up.

- Spanner: signifies a disturbance that can be remedied on site.
- Telephone receiver: signifies a device disturbance. Contact the SMA Service Line.



Event no.	Message	Cause and corrective measures
101 ... 103	Grid fault	<p>The mains voltage has exceeded the permissible range. This error can have the following causes:</p> <ul style="list-style-type: none"> • The mains voltage at the termination point of the inverter is too high. • The grid impedance at the termination point of the inverter is too high. <p>The inverter disconnects itself from the electricity grid for safety reasons.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the mains voltage and grid connection on the inverter. <p>If the mains voltage is outside the permissible range due to local grid conditions, ask your network operator if the voltage can be adjusted at the feed-in point or if it would be acceptable to change the monitored operating limits.</p> <p>If the mains voltage is within the tolerance range, yet this error is still displayed, contact the SMA Service Line.</p>

Event no.	Message	Cause and corrective measures
202 ... 205	Grid fault	<p>The mains voltage has fallen below the permissible range. This error can have the following causes:</p> <ul style="list-style-type: none"> • Electricity grid disconnected • AC cable damaged • The mains voltage at the termination point of the inverter is too low. <p>The inverter disconnects itself from the electricity grid for safety reasons.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check whether the miniature circuit-breaker has tripped. • Check the mains voltage and grid connection on the inverter. <p>If the mains voltage is outside the permissible range due to local grid conditions, ask your network operator if the voltage can be adjusted at the feed-in point or if it would be acceptable to change the monitored operating limits.</p> <p>If the mains voltage is within the tolerance range, yet this error is still displayed, contact the SMA Service Line.</p>
301	Grid fault	<p>The 10-minute-average mains voltage is no longer within the permissible range.</p> <p>This can be caused by one of the following:</p> <ul style="list-style-type: none"> • The mains voltage at the termination point of the inverter is too high. • The grid impedance at the termination point of the inverter is too high. <p>The inverter disconnects to assure compliance with the power quality of the electricity grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the mains voltage at the termination point of the inverter: <p>If, due to local grid conditions, the mains voltage exceeds the configured threshold, ask the network operator whether the voltage can be adjusted at the feed-in point, or whether it would be acceptable to modify the threshold for power quality monitoring.</p> <p>If the mains voltage is permanently within the tolerance range and this error is still displayed, contact the SMA Service Line.</p>

Event no.	Message	Cause and corrective measures
401 ... 404	Grid fault	<p>The inverter is no longer in grid-parallel operation and has stopped feed-in for safety reasons.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the grid connection for strong, short-term frequency variations. <p>If there are frequent fluctuations and this error occurs as a result, ask your network operator if it would be acceptable to change the operating parameters.</p> <p>Discuss the proposed parameters with the SMA Service Line.</p>
501	Grid fault	<p>The mains frequency is not within the permissible range. The inverter disconnects itself from the electricity grid for safety reasons.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If possible, check the mains frequency and observe how often major fluctuations occur. <p>If there are frequent fluctuations and this error occurs as a result, ask your network operator if it would be acceptable to change the operating parameters.</p> <p>Discuss the proposed parameters with the SMA Service Line.</p>
601	Grid fault	<p>The internal monitoring function of the inverter has detected an excessively high proportion of direct current in the grid current. The inverter disconnects from the electricity grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the grid connection for direct current. • If this event occurs often, check with the network operator whether it is possible to raise the threshold for monitoring.
701	Freq. not permitted	<p>The mains frequency is outside the permissible range. The inverter disconnects from the electricity grid for safety reasons.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If possible, check the mains frequency and observe how often major fluctuations occur. <p>If there are frequent fluctuations and this error occurs as a result, ask your network operator if it would be acceptable to change the operating parameters.</p> <p>Discuss the proposed parameters with the SMA Service Line.</p>

Event no.	Message	Cause and corrective measures
801	Waiting for grid voltage	<p>There is no mains voltage at the AC output of the inverter.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the fuse and replace it if necessary. • Check AC installation. • Check whether there is a general power failure.
	Grid failure	
	Check fuse	
901	PE conn. missing	<p>The PE connection is missing. Half of the mains voltage may be present on an unearthed enclosure. The inverter will not connect to the electricity grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check AC installation. • Connect the PE cable to the AC terminal (see Section 6.3.2 "Connecting the Inverter to the Electricity Mains (AC)" (page 32)).
	Check connection	
1001	L / N swapped	<p>L and N have been connected the wrong way round. The inverter will not connect to the electricity grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Correct the connection (see Section 6.3.2 "Connecting the Inverter to the Electricity Mains (AC)" (page 32)).
	Check connection	
1101	Installation fault	<p>A second phase is connected to N.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Correct the connection, (see Section 6.3.2 "Connecting the Inverter to the Electricity Mains (AC)" (page 32)).
	Check connection	
3301 ... 3303	Unstable operation	<p>There is not enough power at the DC input of the inverter for stable operation. This may be caused by snow on the PV modules or insufficient sunlight. The inverter interrupts feed-in operation.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Wait until irradiation is higher. • If this event recurs at medium irradiation, check the PV plant design and make sure the PV array is wired properly.

Event no.	Message	Cause and corrective measures
3401 ... 3402	DC overvoltage Disconnect generator	<p>The DC input voltage connected to the inverter is too high. The inverter interrupts feed-in operation.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Immediately disconnect the inverter from the PV array (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)). Otherwise, the inverter could be destroyed. • Check that the DC voltage of the strings is in compliance with the input voltage range of the inverter before reconnecting the inverter to the PV array. • If the voltage is within the permissible input voltage range, the inverter may be defective. Contact the SMA Service Line.
3501	Insulation resist. Check generator	<p>The inverter has detected an earth fault in the PV array and does not connect to the electricity grid for safety reasons. Damaged insulation can cause electric shock.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check strings for earth faults (see Section 11.5 "Checking the PV Array for Earth Faults" (page 75)). • The installer of the PV array must remedy any earth faults before the affected string is reconnected.
3601	High discharge curr. Check generator	<p>The leakage current from the inverter and the PV array is too high.</p> <p>This can be caused by a sudden earth fault, a residual current or a device malfunction.</p> <p>The inverter interrupts feed-in operation immediately after exceeding the specified threshold and then automatically reconnects to the electricity grid once the fault has been remedied.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check strings for earth faults (see Section 11.5 "Checking the PV Array for Earth Faults" (page 75)). • The installer of the PV array must remedy the earth faults before you re-connect the affected string.

Event no.	Message	Cause and corrective measures
3701	Resid.curr.too.high	The inverter has detected residual current and interrupts feed-in operation. Corrective measures: <ul style="list-style-type: none"> • Check strings for earth faults (see Section 1 1.5 "Checking the PV Array for Earth Faults" (page 75)). • The installer of the PV array must remedy the earth faults before you re-connect the affected string.
	Check generator	
3801 ... 3802	DC overcurrent	The inverter switches off due to an overcurrent on the DC side. Corrective measures: If this event occurs frequently: <ul style="list-style-type: none"> • Check the design and the circuitry of the PV array.
	Check generator	
3901 ... 3902	Waiting for DC start conditions	The input power or voltage of the PV modules is not yet sufficient for feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Wait until irradiation is higher. • If this event recurs at medium irradiation levels, check the PV plant design and the correct circuitry of the PV array.
	Start cond. not met	
6001 ... 6438	Self diagnosis	Internal device fault. The inverter interrupts feed-in operation. Corrective measures: <ul style="list-style-type: none"> • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
	Interference device	
6501 ... 6502	Self diagnosis	The inverter interrupts feed-in operation due to interior overheating. Corrective measures: <ul style="list-style-type: none"> • Ensure sufficient ventilation. • Check the heat dissipation (see Section 9.2 "Checking Heat Dissipation" (page 61)).
	Overtemperature	
6603 ... 6604	Self diagnosis	The inverter has detected an internal overload and interrupts feed-in operation. Corrective measures: <ul style="list-style-type: none"> • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
	Overload	

Event no.	Message	Cause and corrective measures
6701 ... 6702	Comm. disturbed	A fault has occurred in the internal communication of the inverter. The inverter continues feeding into the electricity grid. Corrective measures: If this event occurs frequently: <ul style="list-style-type: none"> Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
6801 ... 6802	Self diagnosis Input A defective	Inverter input A is defective. Corrective measures: <ul style="list-style-type: none"> Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
6901 ... 6902	Self diagnosis Input B defective	Inverter input B is defective. Corrective measures: <ul style="list-style-type: none"> Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
7001 ... 7002	Sensor fault	A temperature sensor in the inverter is faulty. The inverter interrupts feed-in operation. Corrective measures: <ul style="list-style-type: none"> Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
7008	Disturbance sensor display temperature	The ambient-temperature sensor is faulty. The display does not switch off at temperatures below -25°C and may be irreparably damaged as a result. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
7101	SD card defective	The SD card is not formatted correctly or is defective. Update failed. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> Re-format the SD card. Re-save the files to the SD card.
7102	Parameter file not found or defective	The parameter file was not found or is defective. Update failed. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> Copy the parameter file into the directory SD card drive:\PARASET.

Event no.	Message	Cause and corrective measures
7105	Param. setting failed	Operating parameters cannot be set via the SD card. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Check the parameters for valid values. • Ensure change rights via SMA Grid Guard code.
7106	Update file defect.	The update file is defective. Update failed. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Re-format the SD card. • Re-save the files to the SD card.
7110	No update file found	No new update file found on the SD card. Update failed. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Copy the update file into the SD card drive :\UPDATE directory.
7201 ... 7202	Data stor. not poss.	Internal device fault, the inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • If this fault occurs often, contact the SMA Service Line (see Section 15 "Contact" (page 91)).
7303	Update main CPU failed	Internal device fault. The inverter continues feeding into the electricity grid. In very rare cases, the firmware is damaged and the inverter interrupts feed-in. Corrective measures: <ul style="list-style-type: none"> • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
7305	Update RS485I module failed	Internal device fault, the inverter continues feeding into the electricity grid.
7307	Update Bluetooth failed	Corrective measures: <ul style="list-style-type: none"> • Re-try update.
7311	Update language table failed	<ul style="list-style-type: none"> • If this fault occurs again, contact the SMA Service Line (see Section 15 "Contact" (page 91)).
7401	Varistor defective	At least one of the thermally monitored varistors is defective. The inverter is no longer protected against overvoltage. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Check the varistors (see Section 11.6 "Checking the Function of the Varistors" (page 77)).

Event no.	Message	Cause and corrective measures
7508	External fan fault	The fan is clogged or defective. The inverter may reduce its power output due to overheating. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Clean the fan • Replace the fan
	Replace fan	
7701 ... 7703	Self diagnosis	Internal device fault. The inverter disconnects from the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
	Interference device	
8001	Derating occurred	The power supplied by the inverter has been reduced to below nominal power for more than 10 minutes due to overheating. Corrective measures: If this event occurs frequently: <ul style="list-style-type: none"> • Ensure sufficient ventilation. • Check the heat dissipation (see Section 9.2 "Checking Heat Dissipation" (page 61)).
8101 ... 8104	Comm. disturbed	A fault has occurred in the internal communication of the inverter. The inverter continues feeding into the electricity grid. Corrective measures: <ul style="list-style-type: none"> • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
8801 ... 8803	No display	The display is blank. The inverter continues feeding into the electricity grid. This error can have the following causes: <ul style="list-style-type: none"> • The ambient temperature is so low that the display disconnects to protect itself. • The inverter cannot identify the display type. • No display is connected or the connection is defective. Corrective measures: <ul style="list-style-type: none"> • Wait until the temperature has risen above -25°C. • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
9002	Inst. code invalid	The SMA Grid Guard code entered (personal installer password) is not valid. Corrective measures: <ul style="list-style-type: none"> • Enter a valid SMA Grid Guard code.

Event no.	Message	Cause and corrective measures
9003	Grid param. locked	The current country data set is locked. Corrective measures: <ul style="list-style-type: none"> • Enter a valid SMA Grid Guard code for changing the country data set.
9005	Changing grid param. not possible	This error can have the following causes: <ul style="list-style-type: none"> • The selected rotary switch setting for the language settings is not programmed. • The parameters to be changed are protected. • DC voltage at the DC input is not sufficient to run the main CPU. Corrective measures: <ul style="list-style-type: none"> • Check the rotary switch setting (see Section 6.5.1 "Checking the Country Standard" (page 45)). • Enter the SMA Grid Guard code. • Ensure sufficient DC voltage is available (green LED is glowing or flashing).
	Ensure DC supply	

11.4 DC Current after AC-side Disconnection

In spite of the AC side having been disconnected, a current is still detectable in the DC cables with a current clamp. This is not an error but normal behaviour of the inverter when in operation.

- Always disconnect the inverter on the AC **and** DC sides (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).

11.5 Checking the PV Array for Earth Faults

If the red LED is glowing and the inverter displays event number "3501", "3601" or "3701", then there is probably an earth fault in the PV array.

Check the strings for earth faults as described below:

1. Disconnect the inverter and open it (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).

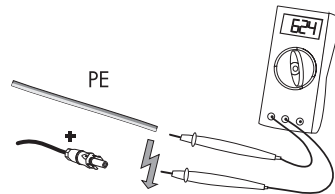


Notice!

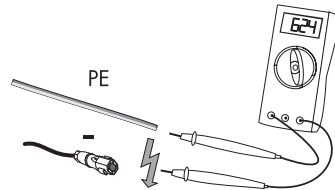
Excessive voltages can destroy the multimeter

- Only use multimeters with a DC input voltage range up to at least 1,000 V.

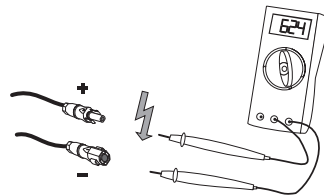
2. Measure the voltages between the positive pole of each string and the earth potential (PE).



3. Measure the voltages between the negative pole of each string and the earth potential (PE).



4. Measure the voltages between the positive and negative poles of each string.



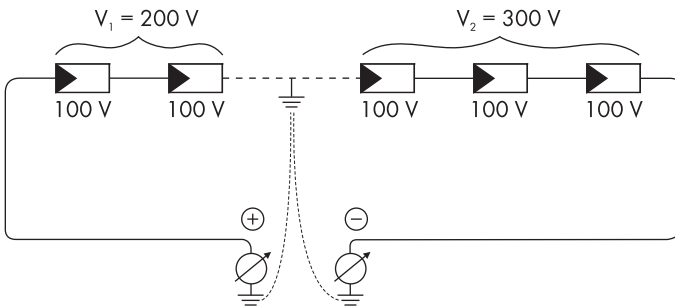
- An earth fault is present if the measured voltages are stable and the sum of the voltages of the positive pole against earth potential and the negative pole against earth potential of a string is approximately equal to the voltage between the positive and negative poles.

Result	Measure
<input checked="" type="checkbox"/> You have detected an earth fault .	<ul style="list-style-type: none"> The installer of the PV array must remedy the earth fault in the affected string before you reconnect the string to the inverter. You can determine the location of the earth fault using the illustration below. Do not reconnect the faulty string. Recommission the inverter (see Section 7.1 "Commissioning the Inverter" (page 51)).
<input checked="" type="checkbox"/> You have not detected an earth fault.	<p>One of the thermally monitored varistors is probably defective.</p> <ul style="list-style-type: none"> Check the function of the varistors (see Section 11.6 "Checking the Function of the Varistors" (page 77)).

Location of the earth fault

The approximate position of the earth fault can be determined from the ratio of the measured voltages between the positive pole against earth potential (PE) and the negative pole against earth potential (PE).

Example:



In this case, the earth fault is between the second and third PV module.

- The earth fault check is now complete.

11.6 Checking the Function of the Varistors

If the inverter displays the event number "7401", then one of the varistors is probably defective. Varistors are wear parts. Their functional efficiency diminishes with age or following repeated responses as a result of overvoltages. It is therefore possible that one of the thermally monitored varistors has lost its protective function.



NOTICE!

Destruction of the inverter due to overvoltage

If varistors are missing or defective, the inverter is no longer protected against overvoltages.

- In PV plants with a high risk of overvoltages, never operate the inverter without varistors.
- Replacement varistors should be fitted as soon as possible.

Check the varistors as described below:

1. Disconnect the inverter and open it (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).



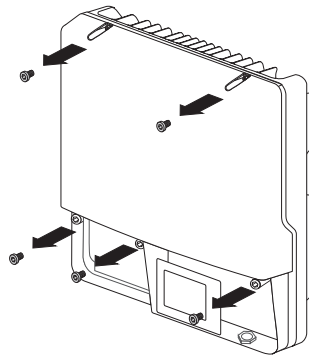
DANGER!

Danger to life due to high voltages in the inverter

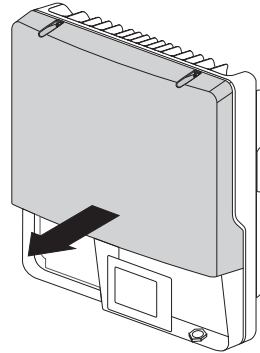
The capacitors in the inverter may be charged with very high voltages.

- Wait five minutes before opening the upper enclosure lid, in order to allow time for the capacitors to discharge.

2. Undo the screws of the upper enclosure lid. Use an Allen key (AF 4) to do this.



3. Pull the upper enclosure lid forwards to remove it.



NOTICE!

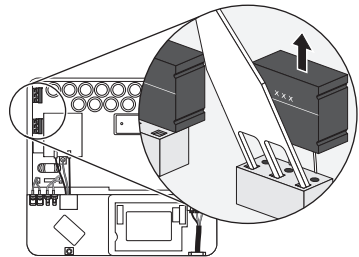
Electrostatic discharge can damage the inverter

Components on the inside of the inverter may be irreparably damaged due to electrostatic discharge.

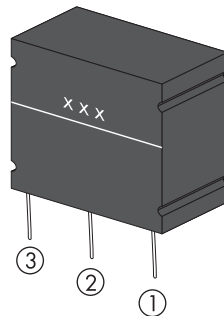
- Earth yourself before touching any components.

4. Remove all varistors.

If you have not received an insertion tool for operating the terminals with your replacement varistors, contact SMA Solar Technology AG.

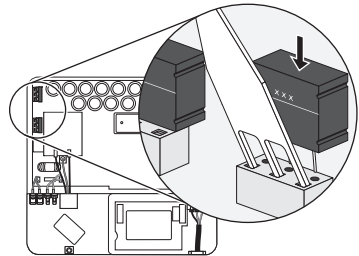


5. Use a multimeter to check each varistor for a conductive connection between terminals 2 and 3.

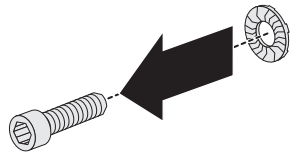


Result	Measure
<input checked="" type="checkbox"/> There is a conductive connection.	The varistor is functional. There must be a different error in the inverter. <ul style="list-style-type: none"> • Contact the SMA Service Line (see Section 15 "Contact" (page 91)).
<input checked="" type="checkbox"/> There is no conductive connection.	The respective varistor is defective and must be replaced. <p>Varistor failure is generally due to influences that affect all varistors in a similar manner (temperature, age, induced overvoltage). SMA Solar Technology AG recommends replacing all varistors.</p> <p>The varistors are specially manufactured for use in the inverter and are not commercially available. You must order replacement varistors directly from SMA Solar Technology AG (see Section 14 "Accessories" (page 90)). Only use original varistors that are sold by SMA Solar Technology AG.</p> <ul style="list-style-type: none"> • For replacing the varistors, proceed to step 6.

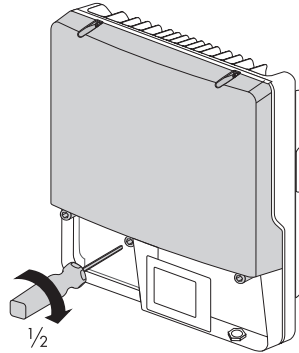
6. Insert an insertion tool into the openings of the terminal contacts.
7. Insert new varistors into the slots (as shown in the diagram on the right).
 Make sure that the labelling points to the left, i.e. towards the insertion tool.



8. Close and earth the inverter:
 - Place one conical spring washer over each screw. The grooved side of the conical spring washer must face the screw head.

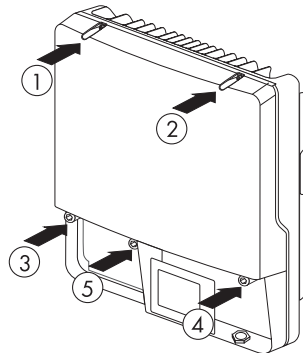


- Attach the upper enclosure lid to the enclosure and tighten the centre lower screw halfway. Use an Allen key (AF 4) to do this.



- Secure the upper enclosure lid in the sequence 1 to 5 (torque: 6 Nm). Use an Allen key (AF 4) to do this.

- The teeth of the conical spring washer press into the upper enclosure lid. The lid is thus earthed.



9. Close the lower enclosure lid and commission the inverter again (see Section 8.3 "Closing the Inverter" (page 59)).

12 Decommissioning

12.1 Dismantling the Inverter

1. Disconnect the inverter and open it (see Section 8.2 "Disconnecting the Inverter from Voltage Sources" (page 56)).
2. Remove all communication cables from the inverter.



CAUTION!

Risk of burns due to hot enclosure parts

- Wait 30 minutes for the enclosure to cool down before disassembling.

3. If necessary, remove the padlock.
4. Remove the inverter by lifting it upwards off the wall mounting bracket.

12.2 Replacing the Enclosure Lid

In the event of a fault, your inverter may need to be replaced. If this is the case, you will receive a replacement device fitted with an upper and lower transport lid.

Prior to returning your inverter to SMA Solar Technology AG, you must replace the upper and lower enclosure lids of your inverter with the corresponding transport lids:

1. Disassemble the inverter (see Section 12.1 "Dismantling the Inverter" (page 81)).



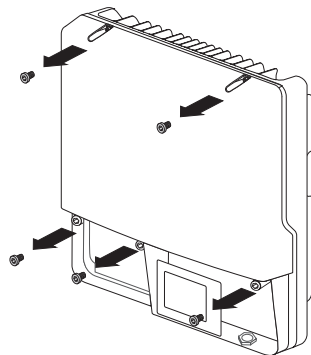
DANGER!

Danger to life due to high voltages in the inverter

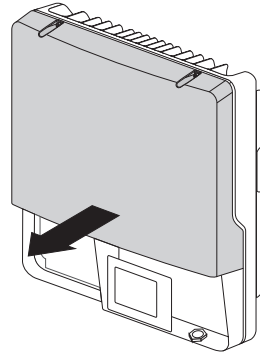
The capacitors in the inverter may be charged with very high voltages.

- Wait five minutes before opening the enclosure cover, in order to allow time for the capacitors to discharge.

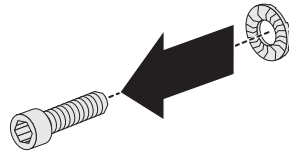
2. Undo the screws of the upper enclosure lid. Use an Allen key (AF 4) to do this.



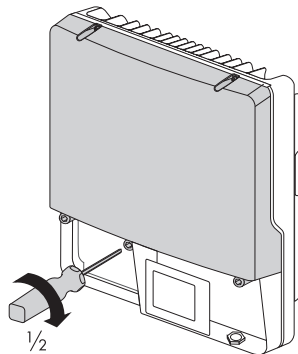
3. Pull the upper enclosure lid forwards to remove it.



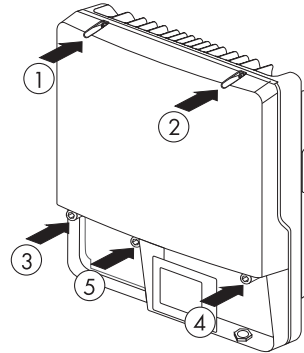
4. Remove the two transport lids from the replacement device in the same manner.
5. Close and earth the replacement device:
 - Place one conical spring washer over each screw. The grooved side of the conical spring washer must face the screw head.



- Attach the upper enclosure lid to the enclosure and tighten the centre lower screw halfway. Use an Allen key (AF 4) to do this.



- Fasten the upper enclosure lid in the sequence 1 to 5 (torque: 6 Nm). Use an Allen key (AF 4) to do this.
- The teeth of the conical spring washer press into the upper enclosure lid. The lid is thus earthed.



6. Mount the replacement device (see Section 5 "Mounting" (page 23)).
7. Connect the replacement device (see Section 6 "Electrical Connection" (page 28)).
8. Commission the replacement device (see Section 7 "Commissioning" (page 51)).
9. Now mount the two transport lids of the replacement device onto the defective inverter.
 - You can now send the defective inverter back to SMA Solar Technology AG.

12.3 Packing the Inverter

- Package the inverter in the original packaging if available.
- If the original packaging is not available, use a cardboard box suitable for the weight and size of the inverter.

12.4 Storing the Inverter

Store the inverter in a dry place where ambient temperatures are always between -25°C and $+60^{\circ}\text{C}$.

12.5 Disposing of the Inverter

Dispose of the inverter at the end of its service life in accordance with the disposal regulations for electronic waste which apply at the installation location at that time. Alternatively, send it back to SMA Solar Technology AG with shipping paid by sender, and labelled "ZUR ENTSORGUNG" ("for disposal") (for contact, see page 91)

13 Technical Data

13.1 DC/AC

13.1.1 Sunny Boy 2500TL Single Tracker

DC Input

Maximum DC power at $\cos \varphi = 1$	2,650 W
Maximum input voltage*	750 V
MPP voltage range	180 V ... 500 V
Rated input voltage	400 V
Minimum input voltage	125 V
Initial input voltage	150 V
Maximum input current	15 A
Maximum input current per string	15 A
Number of independent MPP inputs	1
Strings per MPP input	2

* The maximum open-circuit voltage that can occur at -10°C cell temperature must not exceed the maximum input voltage.

AC Output

Rated power at 230 V, 50 Hz	2,500 W
Maximum apparent AC power	2,500 VA
Rated grid voltage	230 V
AC nominal voltage	220 V / 230 V / 240 V
AC voltage range*	180 V ... 280 V
Nominal AC current at 220 V	11.4 A
Nominal AC current at 230 V	10.9 A
Nominal AC current at 240 V	10.4 A
Maximum output current	12.4 A
Total harmonic factor of output current at AC total harmonic factor < 2%, AC power > 0.5 nominal AC power	≤ 4%
Rated mains frequency	50 Hz
AC mains frequency*	50 Hz/60 Hz
Operating range at AC mains frequency 50 Hz	45 Hz ... 55 Hz
Operating range at AC mains frequency 60 Hz	55 Hz ... 65 Hz
Displacement power factor, adjustable	0.8 _{overexcited} ... 0.8 _{underexcited}
Feed-in phases	1
Connection phases	1
Overvoltage category as per IEC 60664-1	III

* Depending on country setting

Efficiency

Maximum efficiency, η_{\max}	97.0%
European weighted efficiency, η_{EU}	95.8%

13.1.2 Sunny Boy 3000TL Single Tracker

DC Input

Maximum DC power at $\cos \varphi = 1$	3,200 W
Maximum input voltage*	750 V
MPP voltage range	213 V ... 500 V
Rated input voltage	400 V
Minimum input voltage	125 V
Initial input voltage	150 V
Maximum input current	15 A
Maximum input current per string	15 A
Number of independent MPP inputs	1
Strings per MPP input	2

* The maximum open-circuit voltage that can occur at -10°C cell temperature must not exceed the maximum input voltage.

AC Output

Rated power at 230 V, 50 Hz	3,000 W
Maximum apparent AC power	3,000 VA
Rated grid voltage	230 V
AC nominal voltage	220 V / 230 V / 240 V
AC voltage range*	180 V ... 280 V
Nominal AC current at 220 V	13.6 A
Nominal AC current at 230 V	13.1 A
Nominal AC current at 240 V	12.5 A
Maximum output current	14.6 A
Total harmonic factor of output current at AC total harmonic factor < 2%, AC power > 0.5 nominal AC power	$\leq 4\%$
Rated mains frequency	50 Hz
AC mains frequency*	50 Hz/60 Hz
Operating range at AC mains frequency 50 Hz	45 Hz ... 55 Hz
Operating range at AC mains frequency 60 Hz	55 Hz ... 65 Hz
Displacement power factor, adjustable	0.8 _{overexcited} ... 0.8 _{underexcited}
Feed-in phases	1
Connection phases	1
Overvoltage category as per IEC 60664-1	III

* Depending on country setting

Efficiency

Maximum efficiency, η_{\max}	97.0%
European weighted efficiency, η_{EU}	96.1%

13.2 General Data

Width x height x depth, without Electronic Solar Switch	490 mm x 488 mm x 185 mm
Width x height x depth with Electronic Solar Switch	490 mm x 519 mm x 185 mm
Weight	23 kg
Length x width x height of packaging	597 mm x 617 mm x 266 mm
Transport weight	26 kg
Climatic category as per IEC 60721-2-1	4K4H
Operating temperature range	- 25 °C ... +60 °C
Maximum permissible value for relative humidity, non-condensing	100%
Maximum operating altitude above MSL	2,000 m
Noise emission (typical)	≤ 25 dB(A)
Power loss in night mode	< 1 W
Topology	transformerless
Cooling concept	convection
Degree of protection for electronics according to IEC 60529	IP65
Connection area degree of protection according to IEC 60529	IP54
Protection class according to IEC 62103)	I

13.3 Protective Devices

DC reverse polarity protection	short-circuit diode
Input-side load disconnect unit*	Electronic Solar Switch
DC overvoltage protection	thermally monitored varistors
AC short-circuit current capability	current control
Grid monitoring	SMA Grid Guard 3
Maximum permissible fuse protection	25 A
Earth fault monitoring	insulation monitoring: $R_{\text{ISO}} > 625 \text{ k } \Omega$
All-pole sensitive residual-current monitoring unit	available

* optional

13.4 Approvals

National standard, status 01/13*	SB 2500TLST-21	SB 3000TLST-21
VDE 0126-1-1	✓	✓
C10/C11	✓	✓
PPDS	○	○
UTE C15-712-1	○	○
PPC	○	○
EN 50438	○	○
RD 1699/2011	○	○
RD 661/2007	○	○
G83/1-1	✓	✓
G59/2	✓	✓
VDE-AR-N 4105	✓	✓
NRS 97-2-1	✓	✓
SI4777	○	○
IEC61727	○	○
CEI 0-21	✓	✓
AS 4777	○	○

○ In planning stage

* C10/11 (05/2009): Only possible when the phase voltage is 230 V.

EN 50438: Does not apply to all country standard deviations of EN 50438.

RD 1669 and RD 661/2007: contact the SMA Service Line for restrictions in specific regions.

NRS 97-2-1: This standard stipulates that a special label be attached to the AC distribution to draw attention to the AC-side disconnection of the inverter in case of grid failure (for more details, see NRS 97-2-1, Sec. 4.2.7.1 and 4.2.7.2)

13.5 Climatic Conditions

As per IEC 60721-3-4, Installation type C, Class 4K4H

Extended temperature range	- 25°C ... +60°C
Extended humidity range	0% ... 100%
Extended air pressure range	79.5 kPa ... 106 kPa

As per IEC 60721-3-2, transport type E, Class 2K3

Temperature range	- 25°C ... +70°C
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13.6 Features

DC connection	SUNCLIX DC connector
AC connection	spring clamp terminal
Display	LC graphic display
Bluetooth	as standard
RS485, galvanically isolated	optional
Multi-function relay	optional
Electronic Solar Switch	optional

13.7 Electronic Solar Switch

Electrical endurance in the event of short circuit, at nominal current 35 A	at least 50 switching processes
Maximum switching current	35 A
Maximum switching voltage	800 V
Maximum PV power	12 kW
Degree of protection when plugged in	IP65
Degree of protection when unplugged	IP21

13.8 Torques

Upper enclosure lid screws	6.0 Nm
Lower enclosure lid screws	2.0 Nm
Additional earth terminal	6.0 Nm
SUNCLIX swivel nut	2.0 Nm
RS485 interface fastening screw	1.5 Nm
Multi-function relay fastening screw	1.5 Nm

13.9 Earthing Systems

TN-C	suitable
TN-S	suitable
TN-C-S	suitable
TT, if $V_{N,PE} < 1.5 \text{ V}$	suitable

13.10 Data Storage Capacity

Daily energy yield performance	63 days
Daily yields	30 years
Event messages for users	250 events
Event messages for installers	250 events

14 Accessories

You will find the corresponding accessories and spare parts for your product in the following overview. If required, you can order them from SMA Solar Technology AG or your specialised dealer.

Description	Brief description	SMA order number
Replacement varistors	Set of thermally monitored varistors	MSWR-TV9
Electronic Solar Switch	ESS handle (spare)	Order the new ESS handle via the SMA Service Line (see Section 15 "Contact" (page 91)).
Multi-function relay	Multi-function relay for retrofitting in PV inverters	MFR01-10
RS485 retrofit kit	RS485 interface	DM-485CB-10
Speedwire/Webconnect retrofit kit	Speedwire/Webconnect Data Module for retrofitting in the PV Inverter	SWDM-10
SMA Power Control Module	SMA Power Control Modules for retrofitting in PV inverters	PWCMOD-10
SUNCLIX DC connector	Field plug for conductor cross-sections of 2.5 mm ² ... 6 mm ²	SUNCLIX-FC6-SET
Additional fan kit	Fan for installation in the inverter	FANKIT01-10

15 Contact

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

- Inverter device type
- Inverter serial number
- Type and number of connected PV modules
- Four-digit event number and display message of the inverter
- Optional equipment, e.g. communication products
- Use of a multi-function relay
- Mounting location

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