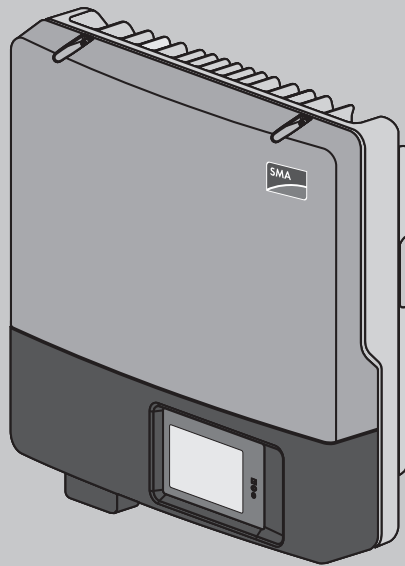




Service Manual

**SUNNY BOY 3000TL / 3600TL / 4000TL / 5000TL /
6000TL**



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1 Information on this Document

1.1 Validity

This document describes how to rectify certain errors and how to replace defective components. This document supplements the documents that are enclosed with each product and does not replace any locally applicable standards or directives. Read and observe all documents supplied with the product.

This document is valid for the following device types:





- SB 3000TL-21 (Sunny Boy 3000TL)
- SB 3600TL-21 (Sunny Boy 3600TL)
- SB 4000TL-21 (Sunny Boy 4000TL)
- SB 5000TL-21 (Sunny Boy 5000TL)
- SB 6000TL-21 (Sunny Boy 6000TL)

1.2 Target Group

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

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

1.3 Symbols

Symbol	Explanation
 DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury
 WARNING	Indicates a hazardous situation which, if not avoided, can result in death or serious injury
 CAUTION	Indicates a hazardous situation which, if not avoided, can result in minor or moderate injury
NOTICE	Indicates a situation which, if not avoided, can result in property damage
	Information that is important for a specific topic or goal, but is not safety-relevant
<input type="checkbox"/>	Indicates a requirement for meeting a specific goal

Symbol	Explanation
☑	Desired result
✘	A problem that might occur

1.4 Nomenclature

Complete designation	Designation in this document
Sunny Boy	Inverter, product
Electronic Solar Switch	ESS
SMA BLUETOOTH Wireless Technology	BLUETOOTH

2 Safety

2.1 Safety Information

This section contains safety information that must be observed at all times when working on or with the product.

To prevent personal injury and property damage and to ensure long-term operation of the product, read this section carefully and observe all safety information at all times.

⚠ DANGER

Danger to life due to high voltages of the PV array

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

- Do not touch uninsulated cable ends.
- Do not touch the DC conductors.
- Do not touch any live components of the inverter.
- Have the inverter mounted, installed and commissioned only by qualified persons with the appropriate skills.
- If an error occurs, have it rectified by qualified persons only.
- Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document (see Section 2.2 "Disconnecting the Inverter from Voltage Sources", page 7).

⚠ DANGER

Danger to life due to electric shock

Touching an ungrounded PV module or array frame can cause a fatal electric shock.

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

⚠ CAUTION

Risk of burns due to hot enclosure parts

Some parts of the enclosure can get hot during operation.

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

NOTICE

Damage to the display or the type label due to the use of cleaning agents

- If the inverter is dirty, clean the enclosure, the enclosure lid, the type label, the display and the LEDs with a damp cloth only.

2.2 Disconnecting the Inverter from Voltage Sources

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

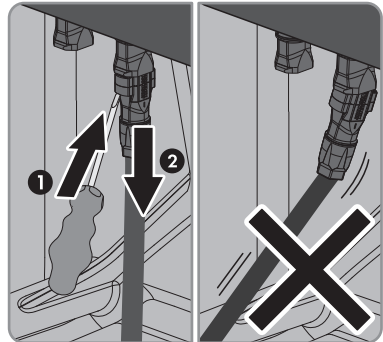
NOTICE

Destruction of the measuring device due to overvoltage

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

Procedure:

1. Disconnect the circuit breaker and secure it against reconnection.
2. If an additional DC load-break switch is available, switch off the DC load-break switch and secure against re-connection.
3. If an ESS is plugged in, remove the ESS.
4. If the multifunction relay is used, switch off any supply voltage to the load.
5. Wait until the LEDs, the display and if necessary, the load connected to the multi-function relay, are switched off.
6. Use a current clamp to ensure that no current is present in the DC cables.
7. Remove all screws of the lower enclosure lid using an Allen key (AF 3) and remove the enclosure lid.
8. Release and remove all DC connectors. Insert a slotted screwdriver or an angled screwdriver (blade width 3.5 mm) into one of the slide slots and pull the DC connectors out downwards. Do not pull on the cable.



9. Ensure that no voltage is present at the DC inputs of the inverter.
10. Use a suitable measuring device to check that no voltage is present at the AC connecting terminal plate between **L** and **N** and **L** and **PE**. Insert the test probe (maximum diameter: 2 mm) in each round opening of the terminal.
11. Flip the display up to have more space to make the measurement. Loosen the screw on the display.
 - The display clicks into place.
12. Ensure that no voltage is present between any terminal of the multifunction relay and **PE** of the AC connecting terminal plate.

13.

<i>NOTICE</i>

Damage to the inverter due to electrostatic discharge

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

- Ground yourself before touching any component.

3 Cleaning the Inverter

NOTICE**Damage to the display or the type label due to the use of cleaning agents**

- If the inverter is dirty, clean the enclosure, the enclosure lid, the type label, the display and the LEDs with a damp cloth only.
- If the cooling fins on the rear of the enclosure are dirty, clean them using a soft brush.
- If the air ducts on the top of the inverter are dirty, clean them using a soft brush.

4 Troubleshooting

4.1 LED Signals

The LEDs indicate the operating state of the inverter.

LED	Status	Explanation
Green LED	glowing	Feed-in operation If an event occurs during feed-in operation, an event message will be shown on the display (for event messages see the service manual at www.SMA-Solar.com).
	flashing	The conditions for feed-in operation are not yet met. As soon as the conditions are met, the inverter will start feed-in operation.
Red LED	glowing	Error If an error occurs, the error message and the corresponding event number will be shown in the display. The error must be rectified by a qualified person (for troubleshooting, see the service manual at www.SMA-Solar.com).
Blue LED	glowing	BLUETOOTH communication is activated.

4.2 Event Messages

Display message	Cause
Self-test	The self-test is in progress.
Set parameter	The parameter changes are being adopted.
Parameters set successfully	The parameter changes were successfully adopted.
Update file OK	The update file found is valid.
SD memory card is read	The SD memory card is searched for update files and the update file is checked.
No new update SDcard	The SD memory card contains an update file that has already been used.
Update communication	The inverter is performing an update of the communication component.
Update main CPU	The inverter is updating the inverter component.
Update RS485i module	The inverter is updating the corresponding component.
Update Speedwire	The inverter is updating the corresponding component.
Webconnect update	The inverter is updating the corresponding component.
Update Bluetooth	The inverter is updating the corresponding component.

Display message	Cause
Upd. language table	The inverter is updating the corresponding component.
Update completed	The inverter has successfully completed the update.
Grid param. unchanged	The parameters are locked and you cannot change them.
Inst. code valid	The entered Grid Guard code is valid. Protected parameters have now been unlocked and you can adjust the parameters. The parameters will be automatically locked again after ten feed-in hours.

4.3 Error Messages

Event number	Display message, cause and corrective measures
101 to 103	<p>Grid fault</p> <p>The grid voltage or grid impedance at the connection point of the inverter is too high. The inverter has disconnected from the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range. <p>If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.</p> <p>If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service (see Section 11, page 30).</p>
202 to 203, 205	<p>Grid fault</p> <p>The utility grid has been disconnected, the AC cable is damaged or the grid voltage at the connection point of the inverter is too low. The inverter has disconnected from the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Make sure that the circuit breaker is switched on. • Make sure that the AC cable is not damaged. • Make sure that the AC cable is correctly connected. • Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range. <p>If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits.</p> <p>If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service (see Section 11, page 30).</p>

Event number	Display message, cause and corrective measures
301	<p>Grid fault</p> <p>The ten-minute average value of the grid voltage is no longer within the permissible range. The grid voltage or grid impedance at the connection point is too high. The inverter disconnects from the utility grid to maintain power quality.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range. If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits. If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service (see Section 11, page 30).
401	<p>Grid fault</p> <p>The inverter is no longer in grid-parallel operation. The inverter has stopped feeding into the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the grid connection for significant short-term frequency fluctuations.
501	<p>Grid fault</p> <p>The power frequency is not within the permissible range. The inverter has disconnected from the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If possible, check the power frequency and observe how often fluctuations occur. If fluctuations occur frequently and this message is displayed often, contact the grid operator and request approval to change the operating parameters of the inverter. If the grid operator gives his approval, discuss any changes to the operating parameters with the Service.
601	<p>Grid fault</p> <p>The inverter has detected an excessively high proportion of direct current in the grid current.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the grid connection for direct current. • If this message is displayed frequently, contact the grid operator and check whether the monitoring threshold on the inverter can be raised.

Event number	Display message, cause and corrective measures
701	<p>Frq. not permitted > Check parameter</p> <p>The power frequency is not within the permissible range. The inverter has disconnected from the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If possible, check the power frequency and observe how often fluctuations occur. <p>If fluctuations occur frequently and this message is displayed often, contact the grid operator and request approval to change the operating parameters of the inverter.</p> <p>If the grid operator gives his approval, discuss any changes to the operating parameters with the Service.</p>
801	<p>Waiting for grid voltage > Grid failure > Check AC circuit breaker</p> <p>The AC cable is not correctly connected or the country data set is not correctly configured.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the AC cable is correctly connected (see the operating manual of the inverter). • Ensure that the country data set has been configured correctly. • Check the fuse.
901	<p>PE conn. missing > Check connection</p> <p>The grounding conductor is not correctly connected.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that PE is correctly connected (see operating manual of the inverter).
1001	<p>L/N swapped > Check connection</p> <p>The connection of L and N is swapped.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that L and N are correctly connected (see operating manual of the inverter).
1501	<p>Reconnection fault grid</p> <p>The changed country data set or the value of a parameter you have set does not correspond to the local requirements. The inverter cannot connect to the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the country data set has been configured correctly. Check the setting of the rotary switches A and B or select the operating parameter Set country standard and check the value.

Event number	Display message, cause and corrective measures
3301 to 3303	<p data-bbox="292 185 490 212">Unstable operation</p> <p data-bbox="292 220 997 331">The ten-minute average value of the grid voltage is no longer within the permissible range. The grid voltage or grid impedance at the connection point is too high. The inverter disconnects from the utility grid to maintain power quality.</p> <p data-bbox="292 339 508 367">Corrective measures:</p> <ul data-bbox="311 375 997 646" style="list-style-type: none"> <li data-bbox="311 375 997 432">• Check whether the grid voltage at the connection point of the inverter is permanently in the permissible range. If the grid voltage is outside the permissible range due to local grid conditions, contact the grid operator. The grid operator must agree with an adjustment of the voltage at the feed-in point or with a change of the monitored operating limits. If the grid voltage is permanently within the permissible range and this message is still displayed, contact the Service (see Section 1 1, page 30).
3304	<p data-bbox="292 659 499 686">Gen. output too low</p> <p data-bbox="292 694 997 746">The DC output of the PV array is too low. The inverter cannot connect to the utility grid.</p> <p data-bbox="292 754 508 782">Corrective measures:</p> <ul data-bbox="311 790 997 882" style="list-style-type: none"> <li data-bbox="311 790 580 817">• Wait for higher irradiation. <li data-bbox="311 825 997 882">• If this message is displayed frequently with medium irradiation, ensure that the PV system is correctly rated and the PV array correctly wired.
3401 to 3402	<p data-bbox="292 895 695 922">DC overvoltage > Disconnect generator</p> <p data-bbox="292 930 997 989">Overvoltage at the DC input. This can destroy the inverter. This message is additionally highlighted by rapid flashing of the backlight.</p> <p data-bbox="292 997 508 1024">Corrective measures:</p> <ul data-bbox="311 1032 997 1335" style="list-style-type: none"> <li data-bbox="311 1032 997 1090">• Immediately disconnect the inverter from all voltage sources (see Section 2.2, page 7). <li data-bbox="311 1098 997 1182">• Check whether the DC voltage is below the maximum input voltage of the inverter. If the DC voltage is below the maximum input voltage of the inverter, reconnect the DC connectors to the inverter. <li data-bbox="311 1190 997 1275">• If the DC voltage is above the maximum input voltage of the inverter, ensure that the PV array has been correctly rated or contact the installer of the PV array. <li data-bbox="311 1283 997 1335">• If this message is repeated frequently, contact the Service (see Section 1 1, page 30).

Event number	Display message, cause and corrective measures
3501	<p>Insulation failure > Check generator</p> <p>The inverter has detected a ground fault in the PV array.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the PV system for ground faults (see Section 5, page 19).
3601	<p>High discharge curr. > Check generator</p> <p>The leakage currents of the inverter and the PV array are too high. There is a ground fault, a residual current or a malfunction.</p> <p>The inverter interrupts feed-in operation immediately after exceeding a threshold. When the fault is eliminated, the inverter automatically reconnects to the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the PV system for ground faults (see Section 5, page 19).
3701	<p>Resid.curr.too.high > Check generator</p> <p>The inverter has detected a residual current due to temporary grounding of the PV array.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the PV system for ground faults (see Section 5, page 19).
3801 to 3802	<p>DC overcurrent > Check generator</p> <p>Overcurrent at the DC input. The inverter briefly interrupts feed-in operation.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • If this message is displayed frequently, ensure that the PV array has been correctly rated and wired.
3901 to 3902	<p>Waiting for DC start conditions > Start cond. not met</p> <p>The feed-in conditions for the utility grid are not yet fulfilled.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Wait for higher irradiation. • If this message is displayed frequently in the morning, increase the voltage limit for starting grid feed-in. Change the parameter Critical voltage to start feed-in. • If this message is displayed frequently with medium irradiation, ensure that the PV array is correctly rated.
6001 to 6438	<p>Self-diagnosis > Interference device</p> <p>The cause must be determined by the Service.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Contact the Service (see Section 11, page 30).

Event number	Display message, cause and corrective measures
6501 to 6502	<p>Self-diagnosis > Overtemperature</p> <p>The inverter has switched off due to excessive temperature.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush. • Ensure that the inverter has sufficient ventilation.
7008	<p>Disturbance sensor display temperature</p> <p>The cause must be determined by the Service.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Contact the Service (see Section 11, page 30).
7101	<p>SD card defective</p> <p>The SD memory card is not formatted.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Re-format the SD memory card. • Re-save the files to the SD memory card.
7102	<p>Parameter file not found or defective</p> <p>The parameter file was not found or is defective. The update failed. The inverter continues feeding power into the grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Copy the parameter file \PARASET into the card drive directory.
7105	<p>Param. setting failed</p> <p>It was not possible to set the parameter via the SD memory card. The inverter continues feeding power into the grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the parameters for valid values. • Ensure change rights via SMA Grid Guard code.
7106	<p>Update file defect.</p> <p>Update file on the SD memory card is faulty.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Re-format the SD memory card. • Re-save the files to the SD memory card.
7110	<p>No update file found</p> <p>No update file has been found.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Copy the update file in the SD memory card folder. Select the folder \UPDATE.

Event number	Display message, cause and corrective measures
7201 to 7202	<p>Data stor. not poss.. Internal error. The inverter continues to feed into the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Contact the Service (see Section 11, page 30).
7303	<p>Update main CPU failed The cause must be determined by the Service.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Contact the Service (see Section 11, page 30).
7305	<p>Update RS485I module failed Internal error. The inverter continues to feed into the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Retry update. • If this message is displayed again, contact the Service (see Section 11, page 30).
7307	<p>Update BT failed Internal error. The inverter continues to feed into the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Retry update. • If this message is displayed again, contact the Service (see Section 11, page 30).
7311	<p>Update language table failed Internal error. The inverter continues to feed into the utility grid.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Retry update. • If this message is displayed again, contact the Service (see Section 11, page 30).
7401	<p>Varistor defective At least one of the thermally monitored varistors is defective.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Check the function of the varistors (see Section 6, page 22).
7508	<p>External fan fault The external fan is defective or blocked.</p> <p>Corrective measures:</p> <ul style="list-style-type: none"> • Ensure that the fan is clean. • Ensure that the external fan is correctly connected.

Event number	Display message, cause and corrective measures
8001	<p data-bbox="292 185 479 209">Derating occurred</p> <p data-bbox="292 220 1003 272">The inverter has reduced its power output for more than ten minutes due to excessive temperature.</p> <p data-bbox="292 284 508 308">Corrective measures:</p> <ul data-bbox="311 319 981 405" style="list-style-type: none"> <li data-bbox="311 319 981 371">• Clean the cooling fins on the rear of the enclosure and the air ducts on the top using a soft brush. <li data-bbox="311 383 770 405">• Ensure that the inverter has sufficient ventilation.
8801 to 8803	<p data-bbox="292 424 407 448">No display</p> <p data-bbox="292 459 710 483">The cause must be determined by the Service.</p> <p data-bbox="292 494 508 518">Corrective measures:</p> <ul data-bbox="311 529 770 552" style="list-style-type: none"> <li data-bbox="311 529 770 552">• Contact the Service (see Section 11, page 30).
9002	<p data-bbox="292 568 468 592">Inst. code invalid</p> <p data-bbox="292 603 1003 655">The SMA Grid Guard code entered is incorrect. The operating parameters are still protected and cannot be changed.</p> <p data-bbox="292 667 508 691">Corrective measures:</p> <ul data-bbox="311 702 710 727" style="list-style-type: none"> <li data-bbox="311 702 710 727">• Enter the correct SMA Grid Guard code.
9003	<p data-bbox="292 743 493 767">Grid param. locked</p> <p data-bbox="292 778 919 802">The parameters are now locked. You cannot change the parameters.</p> <p data-bbox="292 813 508 837">Corrective measures:</p> <ul data-bbox="311 849 844 871" style="list-style-type: none"> <li data-bbox="311 849 844 871">• Unlock the parameters with the SMA Grid Guard code.
9005	<p data-bbox="292 887 852 911">Changing grid param. not possible > Ensure DC supply</p> <p data-bbox="292 922 665 946">This error can have the following causes:</p> <ul data-bbox="311 957 958 1078" style="list-style-type: none"> <li data-bbox="311 957 958 1010">• The selected rotary switch setting for the country configuration is not programmed. <li data-bbox="311 1021 754 1045">• The parameters to be changed are protected. <li data-bbox="311 1056 958 1078">• The DC voltage at the DC input is not sufficient to run the main CPU. <p data-bbox="292 1090 508 1114">Corrective measures:</p> <ul data-bbox="311 1125 975 1246" style="list-style-type: none"> <li data-bbox="311 1125 908 1149">• Ensure that the country data set has been configured correctly. <li data-bbox="311 1160 642 1184">• Enter the SMA Grid Guard code. <li data-bbox="311 1195 975 1246">• Ensure that sufficient DC voltage is available (green LED is glowing or flashing).

5 Checking the PV System for Ground Faults

If the inverter displays the event numbers **3501**, **3601** or **3701**, there could be a ground fault. The electrical insulation from the PV system to ground is defective or insufficient.

⚠ WARNING

Danger to life due to electric shock

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

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

NOTICE

Destruction of the measuring device due to overvoltage

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

Procedure:

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

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

Test by Measuring the Voltage

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

Procedure:

1. **⚠ DANGER**

Danger to life due to high voltages

- Disconnect the inverter from all voltage sources (see Section 2.2, page 7).

2. Measure the voltages:

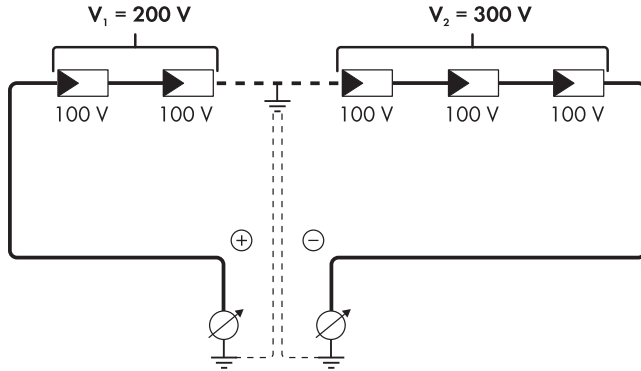
- Measure the voltage between the positive terminal and the ground potential (PE).
- Measure the voltage between the negative terminal and the ground potential (PE).
- Measure the voltage between the positive and negative terminals.

If the following results are present at the same time, there is a ground fault in the PV system:

- All measured voltages are stable.
- The sum of the two voltages to ground potential is approximately equal to the voltage between the positive and negative terminals.
- If a ground fault is present, determine the location of the ground fault via the ratio of the two measured voltages and eliminate the ground fault.

Example: Location of the ground fault

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



3. If a definite ground fault cannot be measured and the message is still displayed, measure the insulation resistance.
4. Reconnect the strings without ground faults to the inverter and recommission the inverter (see Section 8, page 25).

Test by Measuring the Insulation Resistance

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

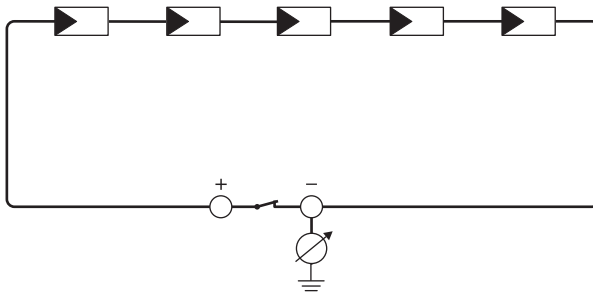


Figure 1: Schematic diagram of the measurement

Calculating the insulation resistance

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

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

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

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

Required devices:

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

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

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

Procedure:

1. Calculate the expected insulation resistance per string.

2.  **DANGER**

Danger to life due to high voltages

- Disconnect the inverter from all voltage sources (see Section 2.2, page 7).

3. Install the short circuit device.

4. Connect the measuring device for insulation resistance.

5. Short-circuit the first string.

6. Set the test voltage. The test voltage should be as close as possible to the maximum system voltage of the PV modules but must not exceed it (see datasheet of the PV modules).

7. Measure the insulation resistance.

8. Eliminate the short circuit.

9. Measure the remaining strings in the same manner.

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

10. Reconnect to the inverter only those strings from which the ground fault has been eliminated.

11. Reconnect all other strings to the inverter.

12. Recommission the inverter (see Section 8, page 25).

13. If the inverter still displays an insulation error, contact Service (see Section 11, page 30). The PV modules might not be suitable for the inverter in the present quantity.

6 Checking the Function of the Varistors

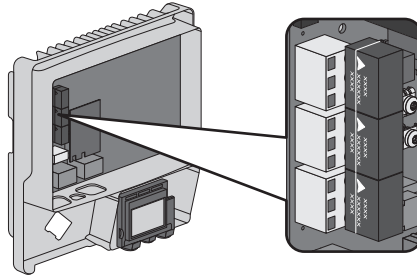


Figure 2: Varistors inside the inverter

NOTICE

Destruction of the inverter due to overvoltage

If varistors are missing, the inverter is no longer protected against overvoltage.

- Do not operate the inverter without varistors in PV systems with a high risk of overvoltages.
- Do not recommission the inverter until the defective varistors have been replaced.

NOTICE

Destruction of the measuring device due to overvoltage

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

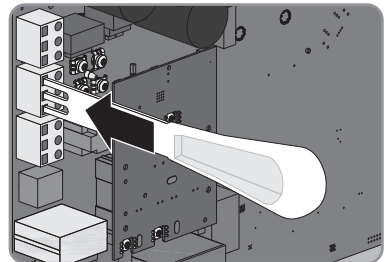
Check the function of each varistor as described in the following:

Procedure:

1. **⚠ DANGER**

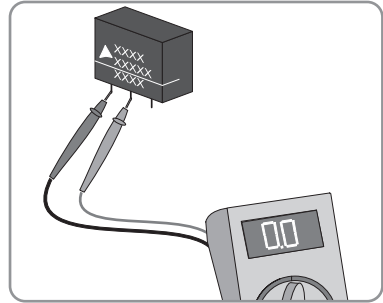
Danger to life due to high voltages

- Disconnect the inverter from all voltage sources (see Section 2.2, page 7).
2. Loosen the screws on the upper enclosure lid using an Allen key (AF 4) and remove the enclosure lid.
 3. Position the insertion tool in the clamping contacts of the connecting terminal plate.



4. Remove the varistor from the connecting terminal plate.

5. Use a measuring device to measure whether there is a conductive connection between the middle and the left-hand varistor lead. Hold the varistor with the labeling pointing forward.



If there is no conductive connection, the varistor is defective. SMA Solar Technology AG recommends replacing all varistors immediately.

- Order new varistors and insertion tools from SMA Solar Technology AG.
- If new varistors are available, replace all varistors (see Section 7, page 24).

If a conductive connection is present, contact the Service (see Section 11, page 30).

7 Replacing the Varistors

Proceed as follows to replace each varistor.

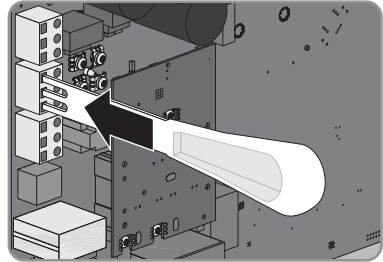
Procedure:

1. **⚠ DANGER**

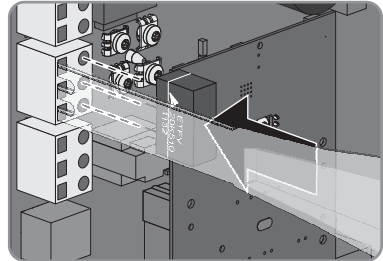
Danger to life due to high voltages

- Disconnect the inverter from all voltage sources (see Section 2.2, page 7).

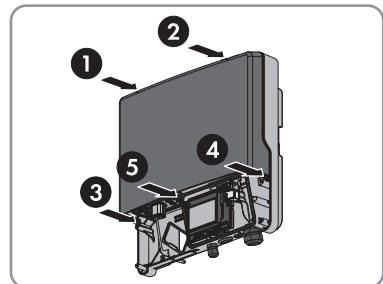
2. Loosen the screws on the upper enclosure lid using an Allen key (AF 4) and remove the enclosure lid.
3. Position the insertion tool into the clamping contacts of the connecting terminal plate.



4. Remove the varistor from the connecting terminal plate.
5. Insert the new varistor into the connecting terminal plate. The labeling on the varistor must point left to the enclosure.



6. Remove the insertion tool from the clamping contacts of the connecting terminal plate.
7. Position the upper enclosure lid with the five screws and conical spring washers on the enclosure and tighten it using an Allen key (AF 4) in the order 1 to 5 (torque: $6 \text{ Nm} \pm 0.3 \text{ Nm}$). The teeth on the conical spring washers must face the enclosure lid.



8. Recommission the inverter (see Section 8, page 25).

8 Recommissioning the Inverter

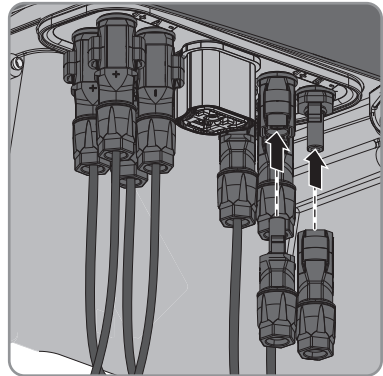
If you have disconnected the inverter from all voltage sources (e.g. for configuration purposes) and want to recommission it, proceed as follows.

Requirements:

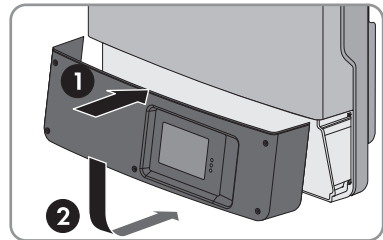
- The circuit breaker must be correctly rated.
- The inverter must be correctly mounted.

Procedure:

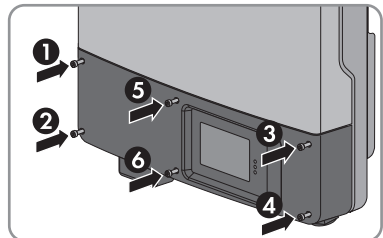
1. Connect the DC connectors to the inverter.
 - The DC connectors snap into place.
2. Seal all unused DC inputs using the DC connectors with sealing plugs.



3. Ensure that all DC connectors are securely in place.
4. Insert the lower enclosure lid from above and fold it down. The screws must protrude from the lower enclosure lid.

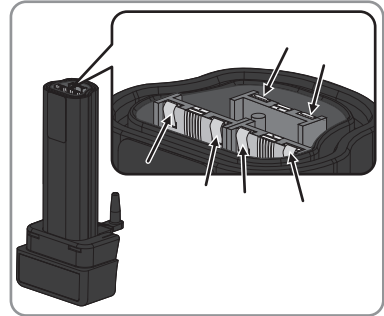


5. Tighten all screws of the lower enclosure lid using an Allen key (AF 3) in the order 1 to 6 (torque: $2 \text{ Nm} \pm 0.3 \text{ Nm}$).
Useful hint: If the screws fall out of the lower enclosure lid, insert the short screw in the upper middle hole and the five long screws in the other holes.



6. If the ESS is used, check it for signs of wear:

- Check the metal mounting tabs inside the ESS for discoloration or damage.
If the metal mounting tabs show brown discoloration or are damaged, order a new ESS from SMA Solar Technology AG and have the ESS replaced.
If the metal mounting tabs show no brown discoloration or damage, the ESS is not worn and can still be used.



- If an ESS is used, the ESS has to be plugged in firmly. The ESS must be aligned parallel to and flush with the enclosure.
- i** **Currents in the DC cabling after connecting the ESS**
After connecting the ESS, DC currents may occur in the DC cabling, even when there is no AC-side supply. This is not an error but normal behavior of the inverter when in operation.
- If an external DC load-break switch is installed, switch it on.
- Switch on the circuit breaker.
- If the multifunction relay is used, connect the supply voltage to the load.
- All three LEDs start to glow and the start-up phase begins. The start-up phase may take several minutes.
- The green LED is glowing and the display alternates between the device type, the firmware version, the serial number or designation of the inverter, the NetID, the configured country data set and the display language.
- Green LED is flashing?
Possible cause of error: the DC input voltage is still too low or the inverter is monitoring the utility grid.
 - Once the DC input voltage is sufficiently high and the grid connection conditions are met, the inverter will start operation.
- The red LED is glowing and an error message and event number appear in the display?
An error has occurred.
 - Rectify the error (see Section 4 "Troubleshooting", page 10).

9 Decommissioning the Inverter

⚠ CAUTION

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

The inverter weighs 30 kg. There is risk of injury if the inverter is lifted incorrectly or dropped while being transported or when attaching it to or removing it from the wall mounting bracket.

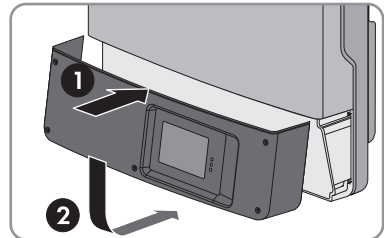
- Transport and lift the inverter carefully.

Procedure:

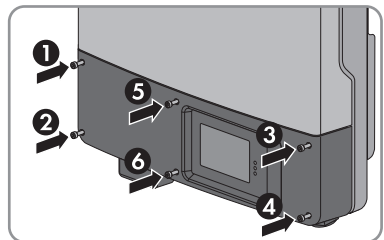
1. ⚠ DANGER

Danger to life due to high voltages

- Disconnect the inverter from all voltage sources (see Section 2.2, page 7).
2. Remove the AC cable from the inverter. Press the locking levers all the way upward and pull the conductors out of the connecting terminal plate for the AC cable.
 3. Press down the locking levers of the connecting terminal plate for the AC cable.
 4. If the multi-function relay or the SMA Power Control Module are used, remove the connection cable from the inverter.
 5. If other cables (e.g. data cables or network cables) are connected, remove them from the inverter.
 6. Insert the lower enclosure lid from above and fold it down. The screws must protrude from the lower enclosure lid.



7. Tighten all screws of the lower enclosure lid using an Allen key (AF 3) in the order 1 to 6 (torque: 2 Nm ± 0.3 Nm).
Useful hint: If the screws fall out of the lower enclosure lid, insert the short screw in the upper middle hole and the five long screws in the other holes.



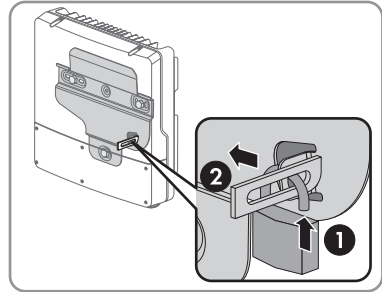
8. If an ESS is used, the ESS has to be plugged in firmly. The ESS must be aligned parallel to and flush with the enclosure.

9. ⚠ CAUTION

Risk of burns due to hot enclosure parts

- Wait 30 minutes for the enclosure to cool down.

10. If the inverter is protected against theft, open the padlock and remove it.



11. Remove the inverter by lifting it vertically up and off the wall mounting bracket.
12. If the inverter is to be stored or shipped in packaging, pack the inverter and, if applicable, the ESS. Use the original packaging or packaging that is suitable for the weight and dimensions of the inverter.
13. Dispose of the inverter in accordance with the locally applicable disposal regulations for electronic waste.

10 Spare Parts

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

Designation	Brief description	SMA order number
Electronic Solar Switch	ESS as spare part	ESS-HANDLE*
Replacement varistors	Set with four thermally-monitored varistors incl. insertion tool	MSWR-TV9
Insertion tool for replacing varistors	Insertion tool for varistors	SB-TVWZ
Fan retrofit kit	Fan to be installed in the inverter for supplementary cooling	FANKIT01-10
SUNCLIX DC connector	Field plug for conductor cross-sections of 2.5 mm ² to 6 mm ²	SUNCLIX-FC6-SET

* When ordering a new ESS, always indicate the device type and serial number of the inverter.

11 Contact

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

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

Australia	SMA Australia Pty Ltd. Sydney	Toll free for Australia: 1800 SMA AUS (1800 762 287) International: +61 2 9491 4200
Belgien/Bel- gique/België	SMA Benelux BVBA/SPRL Mecheln	+32 15 286 730
Brasil	Vide España (Espanha)	
Česko	SMA Central & Eastern Europe s.r.o. Praha	+420 235 010 417
Chile	Ver España	
Danmark	Se Deutschland (Tyskland)	
Deutschland	SMA Solar Technology AG Niestetal	Medium Power Solutions Wechselrichter: +49 561 9522-1499 Kommunikation: +49 561 9522-2499 SMA Online Service Center: www.SMA.de/Service
		Hybrid Energy Solutions Sunny Island: +49 561 9522-399 PV-Diesel Hybridsysteme: +49 561 9522-3199
		Power Plant Solutions Sunny Central: +49 561 9522-299
España	SMA Ibérica Tecnología Solar, S.L.U. Barcelona	Llamada gratuita en España: 900 14 22 22 Internacional: +34 902 14 24 24

France	SMA France S.A.S. Lyon	Medium Power Solutions Onduleurs : +33 472 09 04 40 Communication : +33 472 09 04 41
		Hybrid Energy Solutions Sunny Island : +33 472 09 04 42
		Power Plant Solutions Sunny Central : +33 472 09 04 43
India	SMA Solar India Pvt. Ltd. Mumbai	+91 22 61713888
Italia	SMA Italia S.r.l. Milano	+39 02 8934-7299
Κύπρος/Kıbrıs	Βλέπε Ελλάδα/ Bkz. Ελλάδα (Yunanistan)	
Luxemburg/ Luxembourg	Siehe Belgien Voir Belgique	
Magyarország	lásd Česko (Csehország)	
Nederland	zie Belgien (België)	
Österreich	Siehe Deutschland	
Perú	Ver España	
Polska	Patrz Česko (Czechy)	
Portugal	SMA Solar Technology Portugal, Unipessoal Lda Lisboa	Gratuito em Portugal: 800 20 89 87 Internacional: +351 212377860
România	Vezi Česko (Cehia)	
Schweiz	Siehe Deutschland	
Slovensko	pozri Česko (Česká republika)	
South Africa	SMA Solar Technology South Africa Pty Ltd. Centurion (Pretoria)	08600 SUNNY (08600 78669) International: +27 (12) 643 1785
United King- dom	SMA Solar UK Ltd. Milton Keynes	+44 1908 304899
Ελλάδα	SMA Hellas AE Αθήνα	801 222 9 222 International: +30 212 222 9 222
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