Installation Manual

SUNNY TRIPOWER 60-JP

STP60-JP-10-IA-en-12 | Version 1.2

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Legal Provisions

SMA Warranty

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

Trademarks

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Nomenclature

Complete designation	Designation in this document
Sunny Tripower 60	Inverter, product
SMA Digital I/O Box	I/O Box

IMPORTANT SAFETY INFORMATION

The following symbols are used in this document:

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
⚠ SKILLED PERSON	Indicates that the following section contains tasks that must be performed by qualified persons only
i	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
✖	A problem that might occur

General Safety

⚠ CAUTION

This manual contains important instructions that must be followed during installation and maintenance of the inverter.

Before Installation

Check the inverter and the packaging for damage. If in doubt, contact the supplier before commencing installation.

⚠ WARNING

Installation Service

For optimum safety, follow the steps described in this document. Keep in mind that the inverter has two voltage carrying sides, the PV input and the utility grid.

⚠ DANGER

Disconnecting the inverter

Before working on the inverter, disconnect it from the utility grid by means of the AC breaker and switch off PV using the integrated PV load-break switch (DC load-break switch). Ensure that the inverter cannot be unintentionally reconnected. Use a voltage detector to ensure that the unit is disconnected and voltage free. The inverter can still be charged with very high voltage at hazardous levels even when it is disconnected from utility grid and PV modules. Wait at least five minutes after disconnection from the utility grid and PV modules before proceeding.

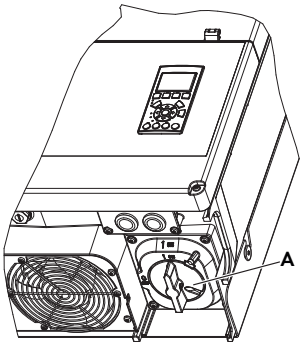

Figure1: PV load-break switch

A	PV load-break switch

INFORMATION

The PV load-break switch can be secured in the "Off" position using a padlock.

⚠ CAUTION

DC voltages up to 1000 V are present in a PV system even when the inverter is disconnected from the utility grid. Faults or inappropriate use may lead to electric arcing.

⚠ CAUTION

MAINTENANCE AND MODIFICATION

Only authorized personnel are permitted to repair or modify the inverter. To ensure personal safety, use only original spare parts available from the supplier.

⚠ WARNING

INSTALLER

Input and output circuits are isolated from the enclosure. System grounding is the responsibility of the installer.

⚠ WARNING

RISK OF ELECTRIC SHOCK

This manual is intended for use by qualified personnel only. To reduce the risk of electric shock, do not perform any maintenance work other than that specified in the manual unless you are qualified to do so.

⚠ WARNING

Danger due to ground fault on DC side during operation

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

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

⚠ WARNING

The inverter is not equipped with a transformer and is intended to be installed with an ungrounded (floating) PV array.

⚠ WARNING

Input and output circuits are isolated from the enclosure. System grounding is the responsibility of the installer.

⚠ CAUTION

All persons responsible for the installation and maintenance of inverters must be:

- Trained and authorized in general safety rules for work on electric equipment.
- Familiar with local requirements, rules and regulations for the installation.

⚠ CAUTION

The inverter does not provide overcurrent protection. This must be provided by the installer. See table 5.8

⚠ CAUTION

The temperature of the cooling elements and components in the inverter can exceed 70°C. There is a risk of burns. The inverter is to be installed in such way that hot components cannot be touched.

NOTICE

Damage to the product due to outgassing of sealants

Sealants such as silicone, polyurethane foam or sealing foam can outgas. Outgassing of sealants can damage the product and impair its functionality.

- Do not use any sealants for sealing.
- Only use the provided material for sealing.

INFORMATION

The symbol for grounding conductors used in this manual is identified in figure 2.18.

An illustration of the DC disconnector can be found in Section 3.2.2, page 24.

INFORMATION

For information about the operating temperature range, see Section 5.3, page 35.

INFORMATION

This manual contains information about field wiring connections and torque specifications. See Section 5.4, page 36.

Symbols on the inverter

Symbol	Explanation
	Danger to life due to electric shock The product operates at high voltages. All work on the product must be carried out by qualified persons only.
	Danger This symbol indicates that the inverter must be additionally grounded if additional grounding or equipotential bonding is required at the installation site.
	Danger to life due to high voltages in the inverter; observe waiting time. High voltages that can cause lethal electric shocks are present in the live components of the inverter. Prior to performing any work on the inverter, disconnect it from all voltage sources as described in this document.
	Risk of burns due to hot surfaces The product can get hot during operation. Avoid contact during operation. Allow the product to cool down sufficiently before carrying out any work.
	Observe the documentation Observe all documentation supplied with the product.

Compliance

Further information can be found in the download area of www.SMA-Solar.com (see also Section 5, page 32).

1 Introduction

The inverter is only designed for operation in grid-connected PV systems. The inverter converts direct current from PV modules into grid-compliant three-phase alternating current. For operation, the inverter must be connected to a utility grid and with a sufficient number of PV modules. The inverter is not suitable for other applications (such as operation with batteries or wind turbine systems).

The PV system consists of four main components:

- Inverter
- PV array junction box

  The PV array junction box enables the bundling of the necessary number of PV strings for the inverter. Each inverter requires a PV array junction box.
- SMA Inverter Manager

  The SMA Inverter Manager is always required for the operation of the inverter. Up to 42 inverters can be connection to each SMA Inverter Manager. The SMA Inverter Manager handles all communication of the inverters. It serves as central interface for data acquisition systems, upload to cloud services and power-plant control.
- Local commissioning and service tool (LCS-Tool)

  The LCS-Tool is required for commissioning and servicing the inverter via the SMA Inverter Manager. The LCS-Tool is the primary user interface for the PV system.

1.1 System Overview

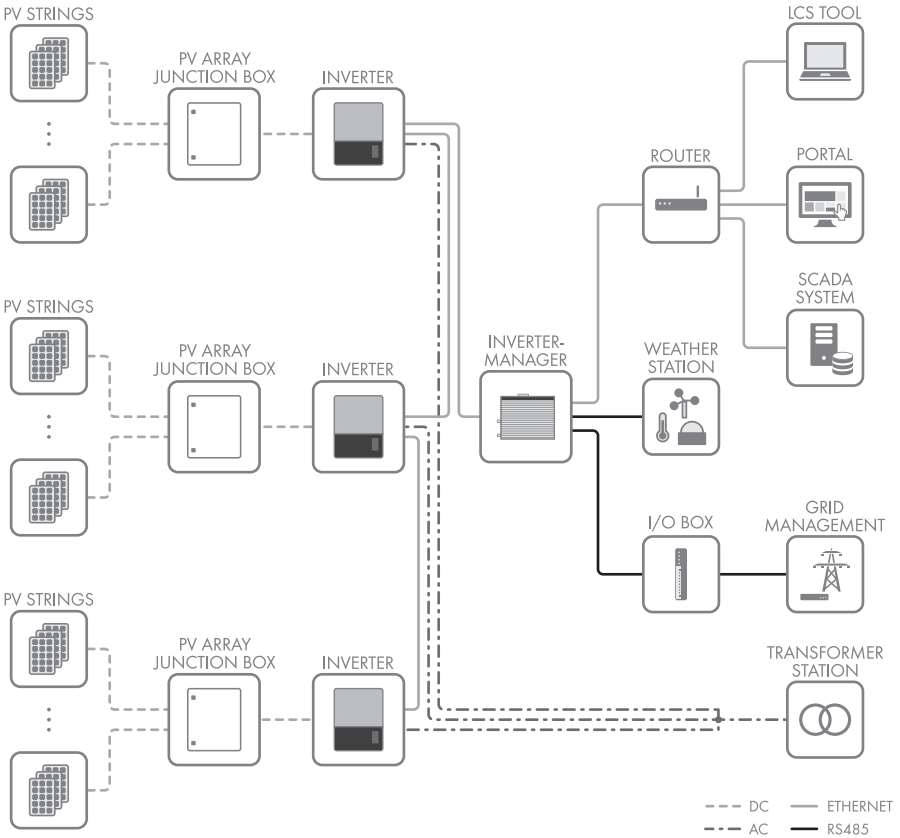

Figure 1.1 System overview

1.2 Purpose of This Manual

The manual contains information on the installation and commissioning of the inverter.

The following additional materials are available:

- Quick reference guide for the installation of the inverter - information necessary for commissioning and for establishing communication.
- Installation manual for the SMA Inverter Manager and the I/O Box - information necessary for commissioning and for establishing communication.
- Service manual for replacing the fan – for information required to replace a fan.
- Service manual for replacing the SPDs – contains information required to replace surge protection devices.

These documents are available in the download area at www.SMA-Solar.com. You can also request these from the supplier of the inverter.

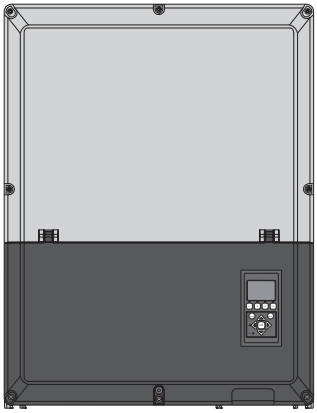

Figure 1.2 Front view of the inverter

Abbreviation	Description
cat5e	Category 5 twisted pair cable (enhanced) for data transmission
DHCP	Dynamic Host Configuration Protocol – enables automatic assignment of the network address via the DHCP server
DSL	Digital Subscriber Line
EMC (directive)	Electromagnetic compatibility directive
ESD	Electrostatic discharge
FRT	Fault Ride Through
GSM	Global System for Mobile Communications (standard for digital cellular mobile network)
HDD	Hard Disk Drive
IEC	International Electrotechnical Commission – international standards organization
IT	Isolated Terra
LCS	Local commissioning and service tool (LCS-Tool)
LED	Light-emitting diode
LVD (Directive)	Low-voltage directive
MCB	Miniature circuit breaker
MPP	Maximum Power Point
MPPT	Maximum Power Point Tracking determines the point of optimum PV power
P	P is the symbol for active power and is measured in Watts (W).
PCB	Printed circuit board
PCC	Point of Common Coupling - point of interconnection The point on the public electricity network to which other customers are, or could be, connected.
Grounding conductor	Protective grounding
PELV	Protected Extra-Low Voltage
PLA	Power Level Adjustment = Output power limitation
P_{nom}	Power [W], Nominal active power
POC	Connection point The point at which the PV system is connected to the public utility grid.
P_{STC}	Power [W], Standard Test Conditions
PV	Photovoltaic, photovoltaic cells
RCD	Residual-current device
RCMU	Residual Current Monitoring Unit
R_{ISO}	Insulation resistance
ROCOF	Rate of Change of Frequency
Q	Q is the symbol for reactive power and is measured in reactive volt-amperes (VAr).
S	S is the symbol for apparent power and is measured in volt-amperes (VA).
STC	Standard Test Conditions
SW	Software
THD	Total Harmonic Distortion
TN-S	Terra Neutral - Separate. AC Network
TN-C	Terra Neutral - Combined. AC Network
TN-C-S	Terra Neutral - Combined - Separate. AC Network
TT	AC grid with separation between operational ground of the generator and ground of the load system
DNO	Distribution Network Operator

1.3 Unpacking

Check the scope of delivery of each product for completeness and any externally visible damage.

Contact your distributor if the scope of delivery is incomplete or damaged.

The delivery may contain parts

that are not required for the installation.

Content:

- Inverter
- Wall mounting bracket
- Accessories bag containing:
  - 6 wall plugs 8 x 50 mm
  - 6 mounting screws 6 x 60 mm
  - 1 M25 cable gland with sealing grommet for Ethernet cables
  - 1 grounding bolt M6 x 12 mm
  - 2 x terminal blocks (lug combiner) for connection of two PV cables each per voltage side
- Installation manual
- Quick reference guide for installation

1.4 Inverter Type Label

The type label uniquely identifies the inverter. You will require the information on the type label to use the product safely and when seeking customer support from the SMA Service Line. You will find the following information on the type label:

- Device type (Model)
- Serial number (Serial No.)
- Date of manufacture
- Device-specific characteristics

1.5 Installation Sequence

1. Pay special attention to the important safety information at the beginning of this manual.
2. Mount the inverter according to Section 2.1, page 13, Section 2.2, page 14, Section 2.3, page 15.
3. Open the inverter in accordance with Section 2.5, page 16.
4. Install the AC supply in accordance with Section 2.6, page 16.
5. Install Ethernet in accordance with Section 5.7, page 38.
6. Install the PV module in accordance with Section 2.9, page 19 using a PV array junction box.
7. Close the inverter in accordance with Section 2.5, page 16.
8. Turn on AC.
9. Finalize commissioning by using the Local Commissioning and Service Tool (LCS-Tool). The tool is available from the download area at www.SMA-Solar.com. The hardware requirements for the LCS-Tool are:
   - PC with Windows™ 7 and later
   - 1 GB HDD
   - 2 GB RAM

   The LCS-Tool must be installed on a local PC drive. The PC must be connected to the system network of the SMA Inverter Manager. For setup via the LCS-Tool, refer to Section 3.2.1, page 23.
10. Switch on the PV system via the PV load-break switch.
11. Verify the installation by:
    - Inverter display: LED "On" is permanently green.
    - LCS-Tool: In the inverter view, the status is "On grid".
12. The inverter is in operation now.

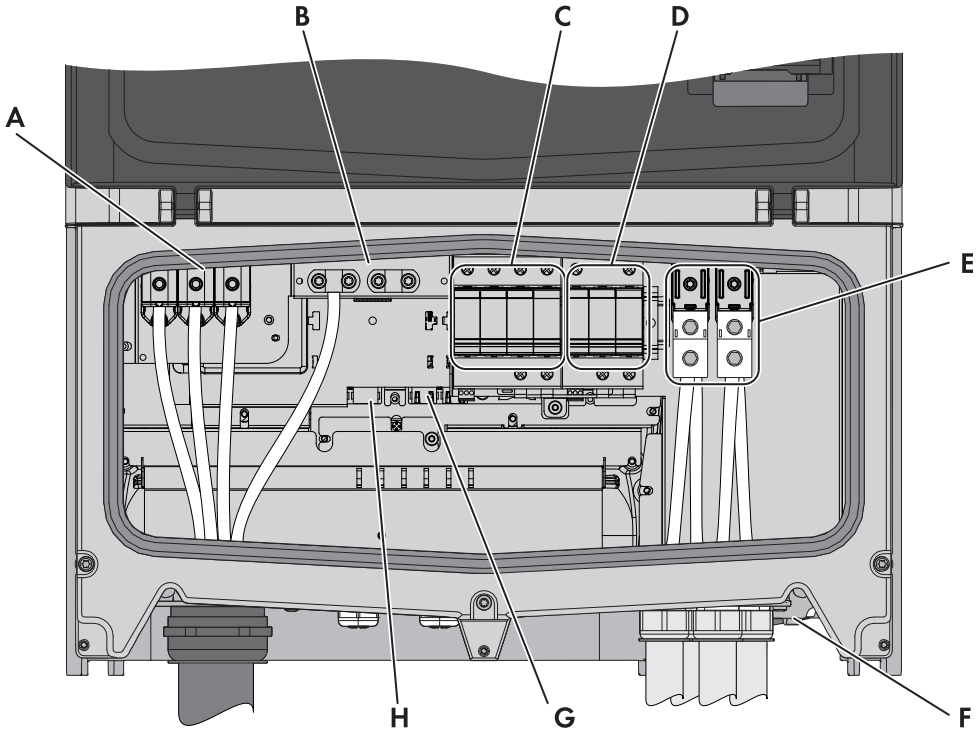

Figure 1.3 Overview of the installation area

PELV (safe to touch)	
B	Device grounding
G	Ethernet interface x 2
H	RS485 interface (not in use)
Live Parts	
A	AC terminals
E	PV terminals
Others	
C	AC overvoltage protection (SPDs)
D	DC overvoltage protection (SPDs)
F	PV load-break switch

Table 1.2 Overview of the installation area

2 Installation

2.1 Environment and Clearances

Figure 2.1 Avoid constant contact with water

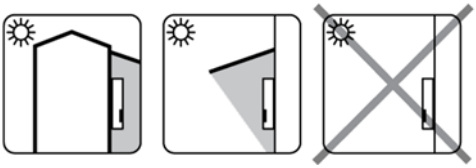

Figure 2.2 Avoid direct solar irradiation

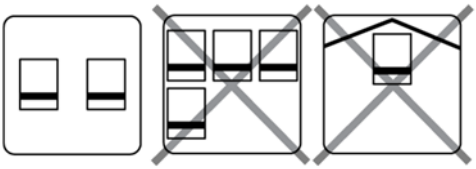

Figure 2.3 Ensure adequate air flow

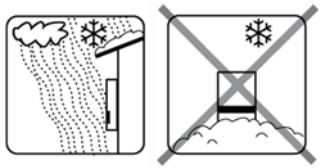

Figure 2.4 Ensure adequate air flow

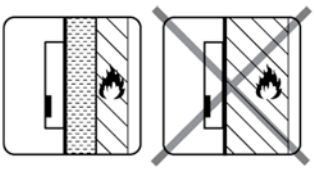

Figure 2.5 Mount on non-flammable surface

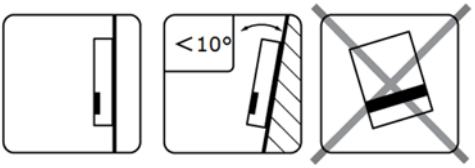

Figure 2.6 Mount upright on vertical surface. A backward tilt of ten degrees is allowed.

Figure 2.7 Avoid dust and ammonia gases

INFORMATION

When selecting the installation site, ensure that the product and warning messages on the inverter are visible at all times. For details, refer to Section 5, page 32.

2.2 Mounting the Wall Mounting Bracket

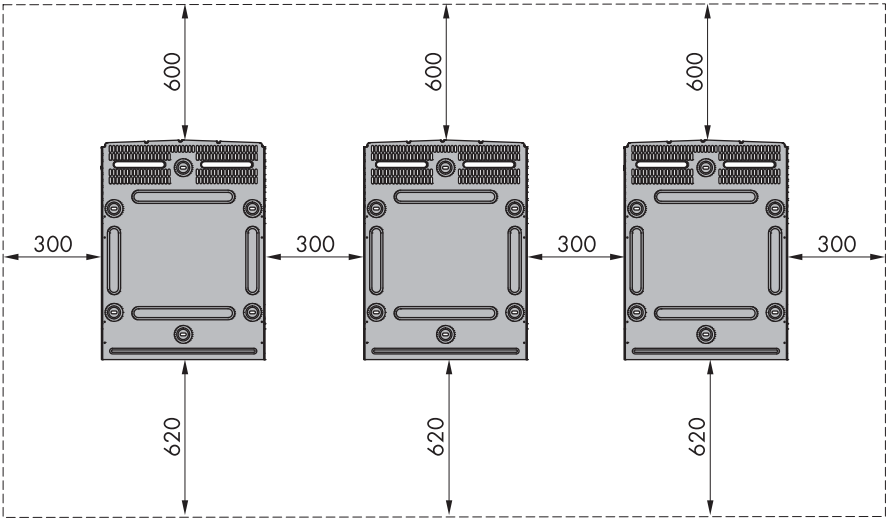

Figure 2.8 Safety clearances in mm

INFORMATION

The safety clearances to other objects must be maintained to ensure sufficient air circulation (see figure 2.8).

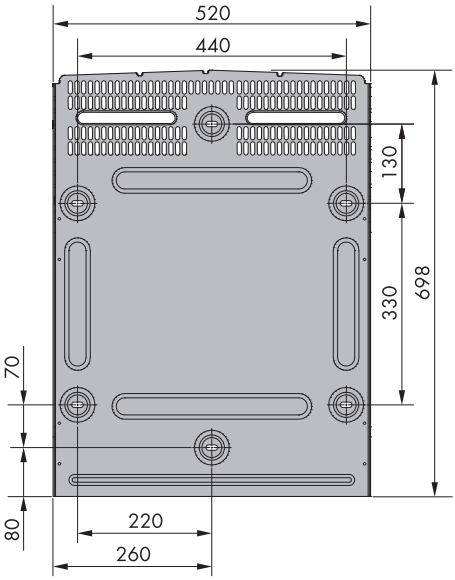

Figure 2.9 Dimensions of wall mounting bracket in mm

INFORMATION

Use of the wall mounting bracket delivered with the inverter is mandatory. Warranty claims will expire if the inverter is operated without the wall mounting bracket. It is strongly recommended to use all six mounting holes (see figure 2.10).

Mounting of the wall mounting bracket:

- Mount the wall mounting bracket in the designated area.
- Use screws and wall plugs that can safely carry the weight of the inverter.
- Ensure that the wall mounting bracket is correctly aligned.
- When installing one or several inverters, observe the safety clearances to ensure sufficient airflow. Clearances are specified in figure 2.8 and on the wall mounting bracket label.
- Mounting multiple inverters side by side in a single row is recommended. Contact the supplier for guidelines when mounting inverters in more than one row.
- Ensure adequate clearance at the front, for safe installation and service access to the inverter.

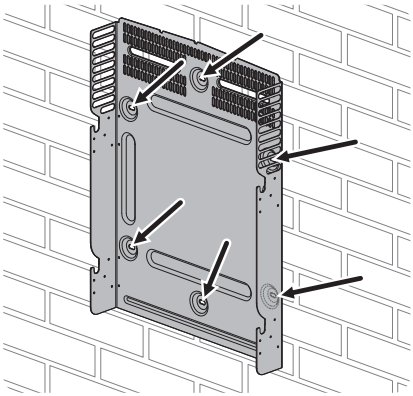

Figure 2.10 Mounting of the wall mounting bracket

2.3 Mounting the Inverter

⚠ CAUTION

When handling the inverter observe the local health and safety regulations.

Procedure:

1. Attach M12 lifting bolts and matching nuts to the inverter (not included in the scope of delivery).
2. Lift the inverter.

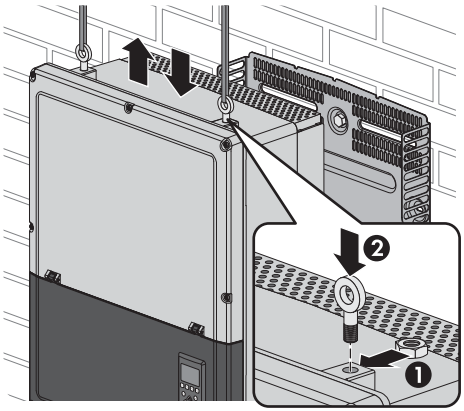

Figure 2.11 Attaching the lifting bolts and lifting the inverter

3. Locate the slots on the side of the wall mounting bracket.
4. On the inverter, position the side screws against the wall mounting bracket slots. Push the inverter so the side screws slide into the two lower slots and the two upper slots.

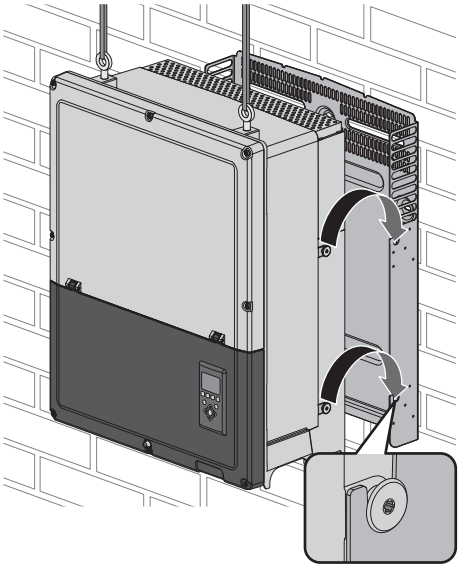

Figure 2.12 Hooking the inverter into the wall mounting bracket

5. Check that the four side screws sit securely in the wall mounting bracket slots.
6. Release the inverter.

2.4 Disassembling the Inverter

Procedure:

1. Disassemble the inverter in the reverse mounting order.
2. Lift and slide the inverter out of the wall mounting bracket slots.
3. Lift the inverter off the wall mounting bracket.

2.5 Access to the Installation Area

⚠ DANGER

Before working on the inverter, disconnect it from the utility grid by means of the AC breaker and switch off PV using the integrated PV load-break switch (DC load-break switch). Ensure that the inverter cannot be unintentionally reconnected. Use a voltage detector to ensure that the unit is disconnected and voltage free. The inverter can still be charged with very high voltage at hazardous levels even when it is disconnected from utility grid and PV modules. Wait at least five minutes after disconnection from the utility grid and PV modules before proceeding.

⚠ CAUTION

Observe ESD safety regulations. Discharge any electrostatic charge by touching the grounded enclosure, before handling any electronic component.

Procedure:

1. To open the cover, loosen the three lower front screws using a TX 30 screwdriver. The screws are captive screws and cannot fall out.
2. Raise the cover by 180 degrees. A magnet enables the cover to stay open.

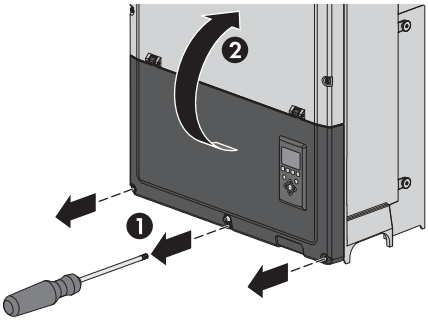

Figure 2.13 Loosen front screws and lift the cover

3. To close the cover, lower it into place and fasten the three front screws.

2.6 AC Grid Connection

⚠ DANGER

These instructions for AC grid connection are for qualified personnel only. To reduce the risk of electric shock, do not perform any maintenance work other than that specified in the manual unless you are qualified to do so.

⚠ CAUTION

For fuse and RCD information, refer to Section 5, page 32. AC fuse rating must not exceed the ampacity of the conductors used.

IMI Detection

The inverter has a built-in IMI/RCMU (Insulation Monitoring Interrupter / Residual Current Monitoring Unit).
The inverter acts on residual DC current and a sudden change in the ground fault current. This functionality is activated during normal operation.

Insulation Resistance Detection

The inverter has a built-in insulation resistance detection. The insulation resistance detector performs a measurement of the connected PV system resistance to ground before the inverter connects to the grid. If the resistance is below the grid code set value, the inverter will wait and re-measure the resistance after a short while. When the resistance is above the grid code set value, the inverter performs a self-test and connects to the grid.

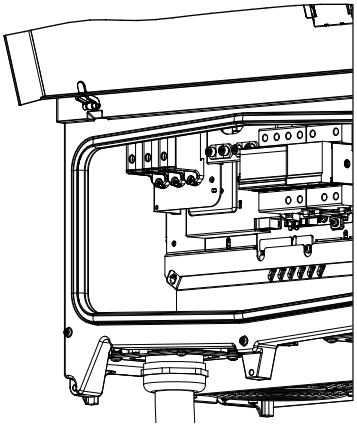

Figure 2.14 Installation area

Cable requirements STP 60-JP-10

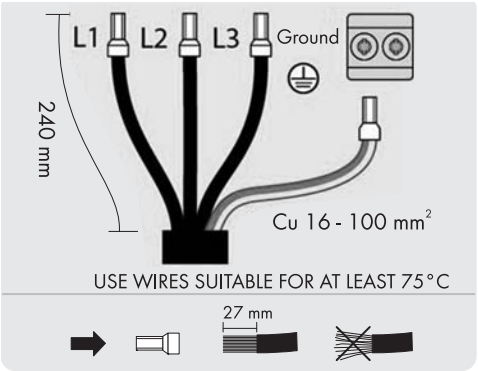

Figure 2.15 AC cable STP 60-JP-10

INFORMATION

Cables with multi-strand, fine-strand or extra fine-strand conductors can be used for AC connection (see figure 2.15 and 2.16). The cables must be suitable for a temperature of at least 75°C.

When using fine-strand or extra fine-strand conductors, bootlace ferrules must be used for the connection.

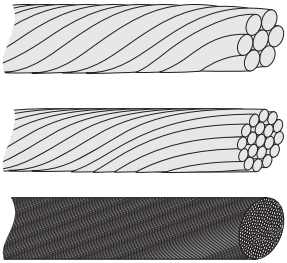

Figure 2.16 Cables with different conductors (from top to bottom): multi-strand, fine-strand and extra fine-strand

The inverter may only be connected to a three-phase utility grid.

Strip off the insulation of all four AC cable conductors. The protective conductor (PE) must be longer than the grid wires.

1. Verify that the nominal voltage of the inverter matches the grid voltage.
2. Ensure that the main circuit breaker is released, and take precautions to prevent reconnection.
3. Open the front cover.
4. Insert the cable through the AC cable gland to the terminal block.
5. Connect the three grid wires (L1, L2, L3) and the grounding conductor (PE) to the terminal block with the respective markings. The grounding conductor is marked with the symbol shown in figure 2.17.
6. Optional: Make an extra PE connection at the secondary PE grounding points using the external device grounding bolt delivered with the inverter. See figure 5.2.
7. All conductors must be properly attached with the correct tool (screwdriver bit, length min. 50 mm) and correct torque, see Section 5.4, page 36.

Figure 2.17 Protective conductor symbol

⚠ WARNING

LEAKAGE CURRENT HAZARD

Insufficient grounding of the inverter can lead to serious injuries or lethal injuries.

- Ensure the correct grounding of the devices by a certified electrical installer.

2.7 Cable Entry

The mounting brackets for the cable glands are already pre-mounted.

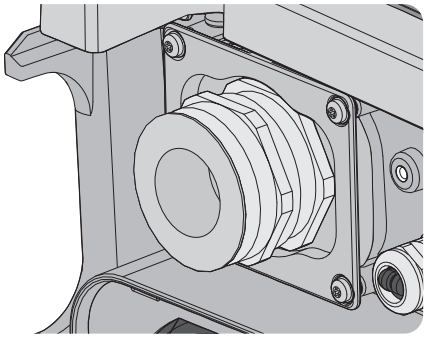

Figure 2.18 AC cable gland

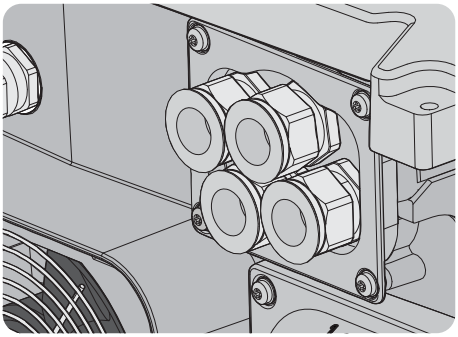

Figure 2.19 DC cable gland

Terminal	Range[1)]	Conductor material	Cable sheath diameter with supplied cable gland
STP 60-JP-10: AC+PE	16 to 100 mm²	Al/Cu	38 to 44 mm
PV	16 to 60 mm²	Cu	13 to 18 mm

Table 2.1 Suitable conductor sizes

[1)] Always observe the ampacity of cables used.

2.8 Ethernet Connections

When used outdoors, make sure to use a suitable cable (see Section 5.6 “Technical Data of the Communication Interface”, page 37). If the cable is very stiff, an intermediate terminal should be used to achieve greater flexibility of the cable before it is connected to the inverter. For some cables, it might be sufficient to remove the hard outer mantle of the part of the cable inside the inverter enclosure. In this way, the RJ45 Ethernet connectors mounted on the printed circuit boards are protected against excessive stress, which could lead to damages or problems with the connection.

Procedure:

1. Do not remove the RJ45 connector on the Ethernet cable.
2. Run the cables through the base of the inverter via cable glands. See figure 2.20.
3. Cut slice in rubber grommet. Place the grommet in the gland to ensure proper seal.
4. Plug into the Ethernet connector.

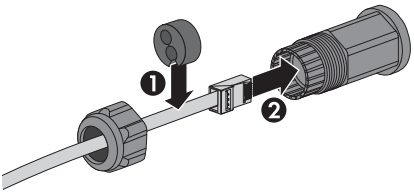

Figure 2.20 Run cables through cable glands

2.9 PV Connection

2.9.1 External PV Array Junction Boxes

PV strings must be connected to the DC input via an external PV array junction box. The PV array junction box connects the PV strings of the PV array and protects the individual strings against overcurrent with appropriate fuse protection.

INFORMATION

The same number and type of modules must be connected to all PV strings connected to the PV array junction box. In addition, all connected modules must have the same orientation.

INFORMATION

Observe correct fuse rating. Consult the module manufacturer's manuals for information on correct string fuse rating.

INFORMATION

Use a suitable voltage detector that can measure up to 1000 V DC. Verify the polarity and maximum voltage of the PV arrays by measuring the PV open-circuit voltage.

⚠ CAUTION

The inverter is protected against short-term reverse polarity. Not correcting reverse polarity results in irreparable defects of the inverter and will void the warranty.

- Make sure that the cables are properly connected to the inverter so that the inverter can feed in DC input voltage.

The combined power from the PV array junction box must be connected to the DC input of the inverter.

⚠ CAUTION

PV array is floating, with both the (+) and (-) conductors connected to the PV inputs of the inverter. Neither conductor is connected to ground.

The DC power can be disconnected with the inverter-integrated DC load-break switch.

⚠ WARNING

Do NOT connect PV to ground!

⚠ WARNING

Danger due to ground fault on DC side during operation

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

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

⚠ WARNING

Do not operate the DC load-break switch in the event of ground fault

Do not operate the DC load-break switch of the inverter in the event of a ground fault. Switching off the DC voltage using a suitable DC load-break switch in the Combiner Box is still possible.

- Do not perform any further actions on the inverter.
- Contact Service immediately.

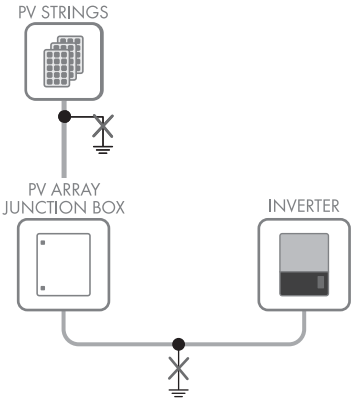

Figure 2.21 Do not connect PV to ground!

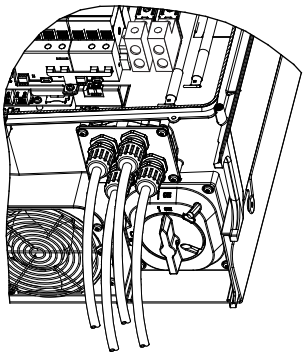

Figure 2.22 DC connection area

INFORMATION

Cables with multi-strand, fine-strand or extra fine-strand conductors can be used for AC connection (see figure 2.23). The cables must be suitable for a temperature of at least 75°C.

When using fine-strand or extra fine-strand conductors, bootlace ferrules must be used for the connection.

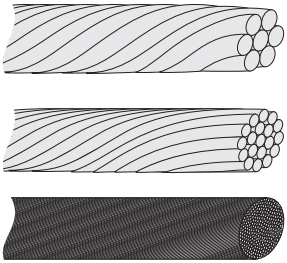

Figure 2.23 Cables with different conductors (from top to bottom): multi-strand, fine-strand and extra fine-strand

1. Switch the PV load-break switch on the inverter to "Off" and, if available, also on the PV array junction box.
2. Attach the DC terminal blocks (lug combiner) supplied to the PV terminals. Observe the right tools (screwdriver bit - length min. 50 mm) and torques, see section Section 5.4, page 36.

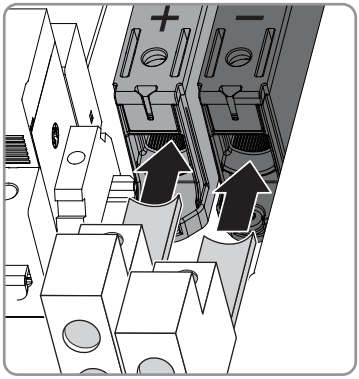

Figure 2.24 Connection of the DC terminal blocks (lug combiner)

3. Assemble the PV cables of the PV array junction box before connecting them to the DC terminal blocks (lug combiner).

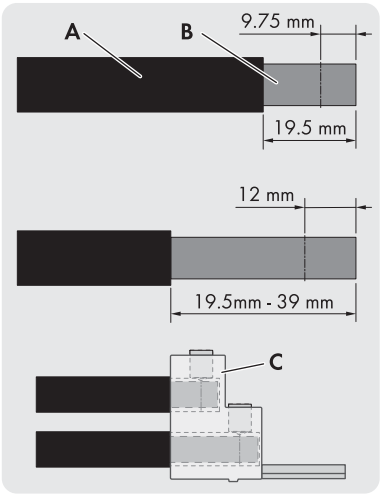

Figure 2.25 Connect to PV input

A	Cable with insulation
B	Copper conductor (max. 60 mm²)
C	DC terminal block (lug combiner)

4. Connect the PV cables to the terminal blocks (lug combiner). Ensure correct polarity (see figure 2.26).

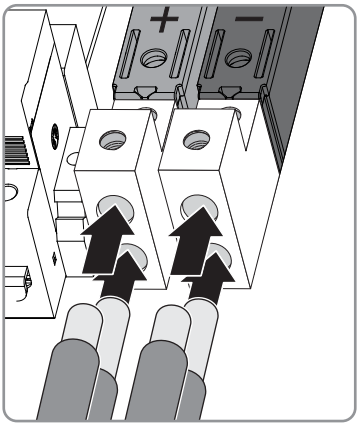

Figure 2.26 Connect to PV input

5. All wires must be properly fastened with the correct tool (screwdriver bit - length min. 50 mm) and right torque, see Section 5.4, page 36.

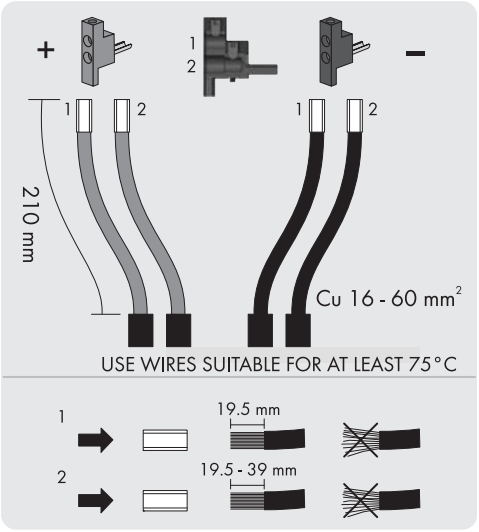

Figure 2.27 DC label

Protection class of PV modules

The inverter must only be operated with PV modules of protection class II, compliant with IEC 61730, application class A.

Only connect PV modules to the inverter. Other energy sources are not allowed.

⚠ WARNING

PV modules generate a voltage when exposed to light.

2.10 Closure

1. Close the cover of the inverter installation area. Fasten the three front screws (see Section 5.4, page 36).
2. Turn on AC power.

3 Initial Setup and Start

3.1 User Interface

The user interface comprises:

- Local display, for all inverter variants. The local display shows status information of the inverter. It is not possible to set up or configure the inverter via the display. The "#" in the display explains the operation modes.
- Local commissioning and service tool (LCS-Tool). The LCS tool can be used for configuring one or more inverters.

3.1.1 Operating Modes

The inverter has five operation modes, indicated by LEDs.

Status	LEDs	LEDs
Off grid	Green	– – – – – – – –
	Red	– – – – – – – –
Connecting	Green	▬ ▬ ▬ ▬ ▬
	Red	– – – – – – – –
On grid	Green	▬ ▬ ▬ ▬ ▬
	Red	– – – – – – – –
Internal inverter event	Green	▬ ▬ ▬ ▬ ▬
	Red	– – – – – – – –
Fail safe	Green	– – – – – – – –
	Red	▬ ▬ ▬ ▬ ▬

Table 3.1 Operating modes

Off grid (LEDs off)

#0-51

When no power has been fed into the AC grid for more than 10 minutes, the inverter disconnects from the grid and shuts down. User and communication interfaces remain powered for communication purposes.

Connecting (green LED flashing)

#52-53

Once the PV input voltage reaches the DC initial voltage, the inverter goes into operation.
The inverter performs a series of internal self-tests, including measurement of the resistance between the PV array and ground. Meanwhile, it also monitors the grid parameters. If the grid parameters are within the specifications during the required period (depending on the grid code), the inverter starts feeding into the utility grid.

On grid (green LED glowing)

#60

The inverter is connected to the AC grid and feeds into the grid. The inverter disconnects from the utility grid in the following cases:

- The inverter recognizes abnormal grid conditions (depending on the grid code).
- An internal event occurs.
- PV power is insufficient (no electric current has been fed in for approx. ten minutes).

Internal inverter event (green LED flashing)

#54

The inverter waits for an internal state within the thresholds (e.g. due to too high a temperature) before reconnecting to the utility grid.

Fail safe (red LED flashing)

#70

If the inverter detects an error in its circuits during the self-test (in the "Connecting" operating mode) or during operation, it switches over to the "Fail safe" operating mode and is disconnected from the utility grid. The inverter remains in the "Fail safe" operating mode until the PV power has been absent for ten minutes or the inverter has been shut down completely (AC+PV).

3.2 Display

INFORMATION

It may take some time until the display responds after switching on.

The integrated display on the inverter front gives the user access to information about the PV system and the inverter.

Figure 3.1 Overview of display buttons and functionality

Button	Function
F1	Adjust the contrast level of display. Use arrow up/down button while pressing the F1 button.
F2	No function
F3	
F4	
Home	Return to main screen
OK	No function
Up arrow	A step up
Down arrow	A step down
Arrow right	Toggles screen right
Arrow left	Toggles screen left
Back	Return to main screen
On – green LED	
Alarm – red LED	

Table 3.2 Display with control and function buttons

The screen design is divided into different sections:

1. Main screen. Current and daily yield.
   This section contains:
   - Actual output power (kW)
   - Yield of the current day (kWh)
   - Total yield (kWh)
   - Current date
   - Current time
   - Operating mode (#)
2. Inverter information. This section contains:
   - Inverter device type
   - Inverter name
   - Inverter serial number
   - IP address
   - Serial number of the SMA Inverter Manager
   - Software version of the inverter
3. Actual values This section contains:
   - PV voltage and current
   - Phase-to-phase voltages
   - Phase currents
   - Grid frequency

3.2.1 Initial Setup via LCS-Tool

The inverter and the SMA inverter manager must be commissioned via the local commissioning and service tool (LCS-Tool). Commissioning is necessary before the inverter is connected to the AC utility grid and feed-in operation begins.

The LCS too enables the selection of predefined country data sets for different utility grids. Customer-specific country data sets can be provided by SMA and imported via the LCS tool (see installation manual of the SMA Inverter Manager / SMA Digital I/O Box / LCS Tool).

After installation, check all cables and close the inverter.

Turn on AC power.

⚠ WARNING

Selecting the correct grid code is important in order to comply with the local and national standards.

It is possible to create customer-specific grid code files with adjusted set values (see Section 3.2.4).

3.2.2 Switching on the PV Load-Break Switch

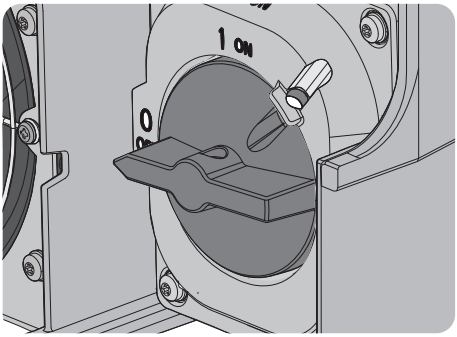

Figure 3.2. PV load-break switch

Switch on the PV load-break switch at the inverter and, if available, at the PV array junction box.

3.2.3 Commissioning

The inverter starts automatically if sufficient solar irradiation is available. Commissioning takes a few minutes. During this period, the inverter performs a self-test.

INFORMATION

The inverter is protected against short-term reverse polarity. The inverter does not generate feed-in power until any reverse polarity is corrected.

⚠ CAUTION

Prolonged reverse polarity leads to a failure of the inverter and thus will void the warranty.

- Make sure that the cables are correctly connected to the inverter.

3.2.4 Grid Code File

INFORMATION

If the desired grid code is not available, or if the LCS tool displays a warning about incompatible software versions, the grid code and software library must be updated on the LCS tool.

It is possible to create customer-specific grid code files with adjusted set values. For this purpose, please contact SMA Technology AG.

3.2.5 Configuring the Fallback

If the communication between the inverter and the SMA Inverter Manager is interrupted, the inverter switches to a previously defined operating state (Fallback). The desired operating state when communication is interrupted, can be activated and configured with the customer-specific grid code file or via the LCS tool. For further information on the configuration of the system fallback between the SMA Inverter Manager and a superior control unit (e.g. SCADA system or Power Plant Controller) see installation manual of the SMA Inverter Manager / SMA Digital I/O Box / LCS Tool.

INFORMATION

Observe the specifications of your electric utility company.

Parameter	Configurable value range
Switch-on time after interrupted communication	2 to 20 sec.
Length of fallback	0 to 100 days
Reaction P	0 to 100%
Reaction Q (Q has a higher priority than P)	0 to 100%

Table 3.3 Configurable parameters after communication interruption

4 Service

4.1 Troubleshooting and Repair

The information is organized in tables showing messages appearing in the LCS tool, known as events. The tables contain descriptions of events as well as explanations of which actions to take when an event occurs.

Type of event	Indicates whether the event is of the grid, PV, internal or fail safe category.
ID	The specific event ID.
Display	Text shown in display.
Description	Description of the event.
Measure	Description of which action to take prior to contacting any other parties.
DNO	If the prescribed action has not identified the malfunction, contact the DNO for further assistance.
SMA Service Line	If the prescribed action has not identified the malfunction, contact Service for further assistance (see Section 6 "Contact", page 39).
PV	If the prescribed action has not identified the malfunction, contact the PV module supplier for further assistance.

Grid-Related Events

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
1–6		Grid voltage too low.	Check voltage and AC installation. If the voltage is zero, check the fuses.	x	-	-
7–9		Grid voltage average too high for ten minutes.	Check that the installation is correct in accordance with the installation manual. If so, request a new grid code file with increased voltage limit or reactive power for voltage suppression.	x	-	-
10–15		Grid voltage too high.	Check voltage and AC installation.	x	-	-
16–18		The inverter has detected a voltage peak on the grid.	Check voltage and AC installation.	x	-	-
19, 22		Grid frequency too low or too high.	Check power frequency.	x	-	-
28–30		Grid frequency change exceeded.	Check deviation of the grid frequency.	x	-	-
31–33		DC current share in utility grid is too high.	For repeated daily occurrences, perform onsite grid analysis.	-	x	-

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
34–37		The residual-current monitoring unit (RCMU) detected an overcurrent.	Turn off both DC and AC supply and wait until the display turns off. Then turn on DC and AC supply and observe if the event reoccurs. Visual inspection of all PV cables and modules.	-	x	-
40	Utility grid not OK.	The utility grid has been outside the permissible range for more than ten minutes (frequency and/or voltage).	Check grid frequency, grid voltage, software version and grid code setting.	x	-	-
41–43		Fault ride through. The inverter has detected that the grid voltage was below or above a certain level.	If this event is reported several times each day, perform onsite grid analysis.			
48, 51		Grid frequency too low or too high.	Check grid frequency and AC installation.	x	-	-
54–56		DC current share in utility grid is too high (stage 2).	For repeated daily occurrences, perform onsite grid analysis.	x	-	-
61		Grid failure, open phase detected.	If the event reoccurs several times each day, contact the responsible grid operator.	x	-	-
62		Grid failure.	If the event reoccurs several times each day, contact the responsible grid operator.	x	-	-
64-81		Grid voltage on phase too low.	Check voltage and AC installation. If the voltage is zero, check the fuses.	x	-	-

Figure 4.1 Grid-related events

PV-related events

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
103	PV current is too high/ waiting	Too many PV modules connected in parallel. Should only appear on newly installed systems.	Check number of strings in parallel and current ratings. Has the current limit been exceeded? Reconnect strings in parallel.	-	x	x
115, 260	PV ISO too low	The resistance between the PV strings and ground (PE) is too low for the inverter to be commissioned. This will force the inverter to make a new measurement after ten minutes.	Make a visual inspection of all PV cables and modules for correct installation according to the installation manual. The event could indicate that the PE connection is missing. **Warning:** A repeated occurrence of this message on several consecutive days indicates a general problem in the DC insulation. In this case, a comprehensive test of the insulation is necessary, since even a sudden ground fault during operation cannot be excluded. **Warning:** A ground fault during operation can completely destroy the device.	-	x	x
258	PV voltage too high/ waiting	The DC voltage is too high.	Make sure that PV system and layout correspond to recommendations in the manuals.	-	x	x
278		DC voltage warning.	Make sure that PV system and layout correspond to recommendations in the manuals.	-	x	x

Figure 4.2 PV-related events

System-Related Events

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
2000		Communication assembly is booting.	-	-	-	-
2010, 2011		The software update of the main CPU has started / has finished.	-	-	-	-

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
2012 - 2018		The software update failed.	Restart the software update. If an error occurs during the update, contact Service.	-	x	-
2030		Transmission of the grid code to the main computer failed.	If this event occurs frequently, contact Service.	-	x	-
2050		Ethernet connection is active	No measure necessary. This error is used, for example, to identify bad Ethernet cables.	-	-	-
2051		Ethernet connection is disconnected	No measure necessary. This error is used, for example, to identify bad Ethernet cables.	-	-	-
2052, 2053		Transmission of the Grid Code from the SMA Inverter Manager to the inverter has started/ended.	-	-	-	-
2054		Transmission of the Grid Code from the SMA Inverter Manager to the inverter has failed.	If this event occurs frequently, contact Service.	-	-	-
2055	Fallback activated	The inverter switched to the fallback mode after the communication with the SMA Inverter Manager was interrupted.		-	-	-
2056	Fallback completed	The inverter has switched back to normal operation after having been in the fallback mode due to a communication disturbance with the SMA Inverter Manager.		-	-	-

Table 4.3 System-related events

Internal Events

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
201–208		The internal temperature of the inverter is too high.	Verify that no objects or dust are on top of the inverter and make sure that the air ducts are clear and not blocked.	-	x	-
209, 210		Voltage in DC link is too high.	If the event persists, reset the inverter by disconnecting DC and AC. If the event is repeated, check the maximum PV voltage using the display to see if it is above the limits.	-	x	-
211	Low fan speed	Fan speed is too low.	Check whether the inverter fan is blocked.	-	x	-
213–215		Internal error. Voltage measured before and after the relay differs too much.	Contact Service.	-	x	-
216–218		Current measured on AC side is too high.	Contact Service.	-	x	-
219–221		Internal error. Voltage measured before and after the relay differs too much.	Contact Service.	-	x	-
225–240, 275		Failure in memory/EEPROM.	Restart the inverter. If the event persists, contact Service.	-	x	-
241, 242, 245, 249		Internal communications fault.	Restart the inverter. If the event persists, contact Service.	-	x	-
248		Internal CPU error.	Restart the inverter. If the event persists, contact Service.	-	x	-
252–254		Current measured on AC side is too high.	If the event repeats, contact Service.	-	x	-
243, 263		Internal error.	Restart the inverter. If the event persists, contact Service.	-	x	-
279		Temperature sensor error.	If the event persists, contact Service.	-	x	-
280		Self-test 24-hour timeout. Self-test must run at least once per 24 hours.	None.	-	-	-

ID	Status message	Description	Measure	DNO	SMA Service Line	PV
281		Too many RCMU events during the past 24 hours. Only four automatic reconnect attempts after event 34 is allowed during a 24-hour period. The inverter will automatically try to reconnect after a certain period.	Wait up to 24 hours. If event 34 recurs, follow the action for event 34.	-	x	-
282		Grid code settings invalid.	Restart the inverter. If the event persists, ask Service to generate a new grid code file or reselect a standard grid code.	-	x	-
283		Gatedrive error.	Restart the inverter. If the event persists, contact Service.	-	x	-
323		Internal fan error. Maximum output power has been reduced.	If the event repeats, contact Service.	-	x	-

Table 4.4 Internal events

Events caused by the self-test

ID	Description	Measure	DNO	SMA Service Line	PV
100	PV input current is negative. Sensor fault.	Check the polarity of the PV system. If polarity is correct, contact Service.	-	x	-
264	Measurement circuit test failed.	If the event persists, contact Service.			
266	Measurement circuit test failed.	Warning: Do not operate the DC load-break switch of the inverter. Switching off the DC voltage using a suitable DC load-break switch in the Combiner Box is still possible. Do not perform any further actions or switching operations on the inverter. Contact Service immediately.	-	x	-
272	PV overvoltage protection device error. Inverter will continue operation without overvoltage protection.	Replace PV overvoltage protection device. See SPD replacement instructions for details.	-	x	-
273	Grid overvoltage protection device error. Inverter will continue operation without overvoltage protection.	Replace PV overvoltage protection device. See SPD replacement instructions for details.	-	x	-
274	Overvoltage protection device status unknown.	Restart the inverter. If the event persists, contact Service.	-	x	-

ID	Description	Measure	DNO	SMA Service Line	PV
350–352	Residual-current monitoring unit (RCMU) self-test failed.	Contact Service.	-	x	-
353	Current sensor test failed.	Contact Service.	-	x	-
356–361	Transistor and relay test failed or inverter relay has failed (contact assumed welded).	Warning: Do not operate the DC load-break switch of the inverter. Switching off the DC voltage using a suitable DC load-break switch in the Combiner Box is still possible. Do not perform any further actions or switching operations on the inverter. Contact Service immediately.	-	x	-
366	Residual-current monitoring unit (RCMU) self-test failed.	Contact Service.	-	x	-

Table 4.5 Events caused by the self-test

4.2 Maintenance

Ensure that the heat sink at the rear of the inverter is not covered.

Clean the contacts of the PV load-break switch once a year. Clean by cycling the switch to on and off positions ten times. The PV load-break switch is located at the bottom of the inverter.

For correct operation and a long service life, ensure free air circulation for the following areas:

- around the heat sink at the top and side of the inverter where the air exhausts, and
- towards the fan at the inverter base.

To clear obstructions, clean using compressed air, a soft cloth, or a brush.

⚠ WARNING

The temperature of the heat sink can exceed 70°C.

5 Technical Data

5.1 Specifications

Parameter	STP 60-JP-10
AC	
Nominal apparent power[1)]	60000 VA
Nominal active power[2)]	60000 W
Reactive power range[1)]	0 to 60000 var
Nominal AC voltage	3 / PE; 420 V (50 Hz) 3 / PE; 440 V (60 Hz)
Supported grounding systems	TT, TN
Nominal AC current at 420 Vac	3 x 82.5 A
Nominal AC current at 440 Vac	3 x 78,7 A
Max. AC current	3 x 87 A
AC total harmonic distortion (THD at nominal output power)	< 3 %
Power factor – standard	> 0.99 at nominal power
Displacement power factor	0 overexcited to 0 underexcited
Stand-by power consumption (for communication)	3 W
Nominal grid frequency (range)	50 Hz/60 Hz (± 10%)
DC	
Maximum PV array power	90000 Wp
Input voltage range (at 420 Vac / at 440 Vac)	593 V to 1000 V / 622 V to 1000 V
Nominal voltage DC (at 420 Vac / at 440 Vac)	660 V / 690 V
MPP voltage range (at 420 Vac / at 440 Vac)	598 V to 800 V / 627 V to 800 V
Startup voltage (at 420 Vac / at 440 Vac)	628 V / 660 V
Max. input voltage	1000 V
Min. power on the grid	100 W
Max. input current / max. short-circuit current	110 A / 150 A
Number of independent MPP inputs / strings per MPP input	1/2 (split up by external PV array junction box)
Overvoltage categories	AC: Overvoltage category III (OVC III), PV: Overvoltage category II (OVC II)
Integrated DC surge arrester	Type II
Integrated AC surge arrester	Type II/III (combined)

Parameter	STP 60-JP-10
Efficiency	
Max. EU efficiency	98.8 %
Efficiency in accordance with JIS C 8961	98 %
MPPT efficiency, static	99.9 %
Enclosure	
Dimensions (W / H / D)	740 × 570 × 306 mm
Weight	75 kg
Acoustic noise level	58 dB(A) (typical)

Table 5.1 Specifications

[1] at nominal grid voltage
[2] at nominal grid voltage, Cos(phi) = 1.

Parameter	STP 60-JP-10
Protection class (according to IEC 62109-1)	I
Electrical	
Electrical safety	• IEC 62109-1/IEC 62109-2 (Class I, grounded – Communication part Class II, PELV)
Functional	
Functional Safety	• Voltage and frequency monitoring • Monitoring of DC current share in AC current • Insulation resistance monitoring • FI monitoring
Islanding detection - grid failure	• Active frequency shift • Disconnection • Three-phase monitoring • ROCOF/SFS
RCD compatibility[1]	Type B, 1000 mA

Table 5.2 Safety specifications

[1] depending on local regulations

5.2 Compliance

International standards	STP 60-JP-10
Efficiency	Peak efficiency, standard: EN 50530
	JIS efficiency, Standard: JIS C 8961
EC low-voltage directive	2014/35/EU
EC directive for electromagnetic compatibility (EMV)	2014/30/EU
Safety	EN 62109-1:2010/EN 62109-2:2011
Functional Safety	EN 62109-2:2011
EMC, interference immunity	EN 61000-6-2:2005
EMC, emission	EN 55011:2016 group 1, class A
Harmonic currents	EN 61000-3-12:2011
CE	Yes
Properties of the supply grid	IEC 61727
	EN 50160

5.3 Installation Conditions

Parameter	Specification
Operating temperature range	-25 °C to 60 °C*
Storage temperature	-30°C to 60°C
Relative humidity	5% to 95%, (non-condensing)
Pollution degree	PD2
Environmental category IEC62109-1	Outdoor, wet (see Section 2, page 13)
Environmental class in accordance with IEC 60721-3-4	4K4H/4Z4/4B2/4S3/4M2/4C2
Cooling concept	Forced air cooling
Air quality - general	ISA S71.04-1985 Class G3 (at 75% rF)
Air quality - coastal, heavy industrial and agricultural zones	Must be measured and classified in accordance with ISA S71.04-1985: G3 (at 75% RH)
Vibration	< 1 G
Enclosure protection class	IP65
UL 50E enclosure type	NEMA 3R
Maximum operating altitude above mean sea level	2000 m above sea level (power reductions may occur starting at an altitude of 1000 m).**
Installation	Avoid constant contact with water. Avoid direct solar irradiation. Ensure adequate air flow. Mount on non-flammable surface. Mount upright on vertical surface. Prevent dust and ammonia gases.

* Potential power reduction above 45°C (for further information see technical information "Efficiencies and Derating")

** Installation at altitudes > 2000 m are possible on request; contact SMA Solar Technology AG for this.

Table 5.6 Installation conditions

5.4 Torque Specifications

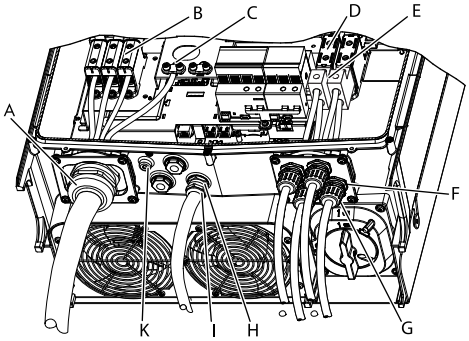

Figure 5.2 Overview of inverter with torque indications

Torque STP 60-JP-10

	Parameter	Tools	Torque
A	M63 cable gland	Wrench 65/68 mm	6 Nm
	Swivel nut for M63 cable gland	Wrench 65/68 mm	3 Nm
B	AC terminals	TX 30 x 50	14 Nm
C	Primary grounding conductor (secondary grounding conductor directly to the right of it)	TX 30	3.9 Nm
D	PV terminals	TX 30 x 50	14 Nm
E	DC collective terminals (Lug combiner)	TX 30 x 50	4 Nm
F	M25 cable gland	Wrench 33 mm	10 Nm
G	Swivel nut of the M25 cable gland	Wrench 33 mm	1.8 Nm
H	M25 cable gland	Wrench 33 mm	4 Nm
I	Swivel nut for M25 cable gland	Wrench 33 mm	1.8 Nm
K	M6 equipment grounding (equipotential bonding terminal)	TX 20	3.9 Nm
	Front screw (not shown)	TX 30	1.5 Nm

Table 5.7: Torques STP 60-JP-10

5.5 Specifications for Grid Protection

Parameter	STP 60-JP-10
Maximum inverter current, I_{ACmax}	87 A
Recommended type of time-lag fuse gL/gG (IEC 60269-1)	125 A
Recommended circuit breaker type B or C	125 A
Maximum fuse rating	125 A

Table 5.9: Specifications for grid protection

INFORMATION

Observe local regulations.

5.6 Technical Data of the Communication Interface

Interface	Parameter	Parameter details	Specification
Ethernet	Cable	Cable sheath diameter (⌀)	2 x 5 to 7 mm
		Cable type	STP cable (Shielded Twisted Pair, CAT 5e or SFTP CAT 5e)[1)]
		Cable characteristic impedance	100 Ω to 120 Ω
	RJ45 connector: 2 pcs. RJ45 for Ethernet	Wire size	0.14 to 0.25 mm² (depending on the design of the RJ45 plug)
		Cable shield termination	Via RJ45 plug
	Galvanic interface insulation		Yes, 500 Vrms
	Direct protection against contact	Double/reinforced insulation	Yes
	Short-circuit protection		Yes
	Communication	Network topology	Star connection, ring connection and daisy chain
	Cable	Max. cable length between inverters	100 m
	Max. number of inverters	Per SMA Inverter Manager	42

Table 5.10 Technical data of the communication interfaces

[1)] (see Section 2.8 "Ethernet Connections", page 19)

5.7 Ethernet Connections

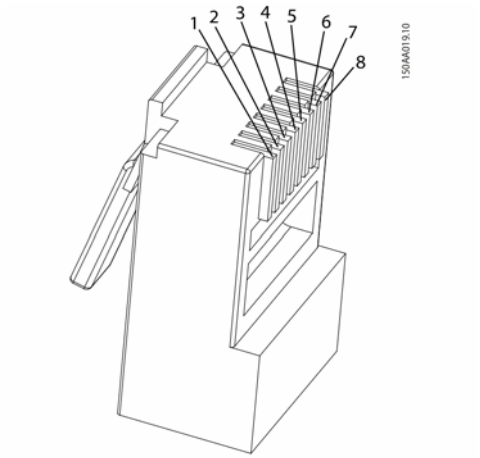

Table 5.4 Pin assignment of the RJ45 plug for Ethernet

Pin assignment Ethernet	Color standard Cat. 5 T-568A	Cat. 5 T-568B
1. RX+	Green/white	Orange/white
2. RX	Green	Orange
3. TX+	Orange/white	Green/white
4.	Blue	Blue
5.	Blue/white	Blue/white
6. TX-	Orange,	Green
7.	Brown/white	Brown/white
8.	Brown	Brown

5.7.1 Network topology

The inverter has two Ethernet RJ45 pin connectors that enable the connection of several inverters in line topology (as an alternative to the usual star topology).

INFORMATION

Ring topology (C in figure 5.5) is only permitted if realized with Ethernet switch supporting spanning tree.

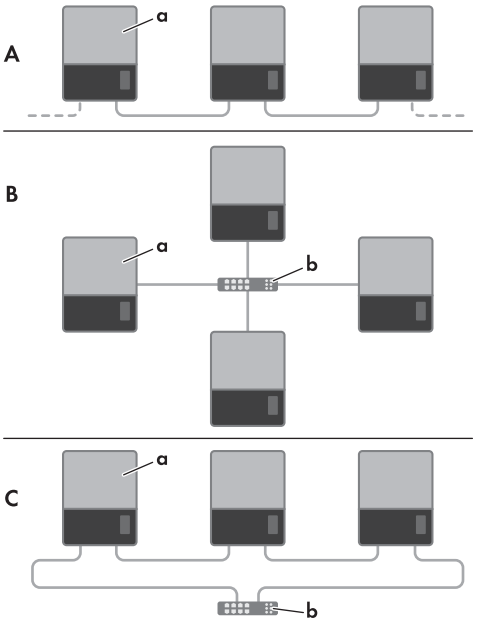

Figure 5.5 Network topology

A	Linear daisy chain
B	Star topology
C	Ring topology (only if spanning tree is used)
a	Inverter
b	Ethernet switch

Status of the LEDs next to the Ethernet port is explained in Table 5.13. There are two LEDs per interface.

Status	Yellow LED	Green LED
Off	10 MBit/s data transfer rate	No link
On	100 MBit data transfer rate	Link
Flashing	-	Activity

Table 5.13 LED status

6 Contact

If you have technical problems with 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
- Inverter firmware version
- Special country-specific settings of the inverter (if applicable)
- Type and number of PV modules connected
- Mounting location and altitude of the inverter
- Display message

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