

SOFAR 60 ... 80KTLX-G3

Installation and operating manual

Version 01 | March 2023

English



SOFAR 60KTLX-G3, 80KTLX-G3

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1 About this manual

This manual contains important safety information that must be observed during installation and maintenance of the device.

Carefully read this manual before use and retain it for future reference!

This manual must be treated as an integral component of the device. The manual must be kept in close proximity to the device, including when it is handed over to another user or moved to a different location.

1.1 Copyright declaration

The copyright of this manual is owned by SOFARSOLAR. It may not be copied – neither partially nor completely – by companies or individuals (including software, etc.) and must not be reproduced or distributed in any form, or with the appropriate means.

SOFARSOLAR reserves the right to final interpretation. This manual may be amended following feedback from users or customers. Please consult our website at <http://www.sofarsolar.eu> for the latest version.

The current version was updated on 11/07/2023.

1.2 Structure of the manual

This manual contains important safety and installation instructions that must be observed during installation and maintenance of the device.

1.3 Scope

This product manual describes the installation, electrical connection, commissioning, maintenance, and fault elimination procedures of the SOFAR 60... 80KTLX-G3 inverters.

1.4 Target group

This manual is intended for specialist electrical engineers who are responsible for the installation and commissioning of the inverter in the PV system, as well as the PV system operators.

1.5 Symbols used

This manual contains information on safe operation and uses symbols to ensure the safety of persons and property as well as the efficient operation of the inverter. Please read through the following symbol explanations carefully in order to prevent injury or property damage.

⚠ DANGER

Non-observance will result in death or serious injury.

- Follow the warnings in order to prevent death or serious injury!

⚠ WARNING

Non-observance may result in death or serious injury.

- Follow the warnings in order to prevent serious injury!

⚠ CAUTION

Non-observance may result in minor injury.

- Follow the warnings in order to prevent injury!

ATTENTION

Non-observance may result in property damage!

- Follow the warnings in order to prevent damage to or destruction of the product.

NOTE

- Provides tips essential to the optimal operation of the product.

2 Basic safety information

NOTE

- If you have any questions or problems after reading the following information, please contact SOFARSOLAR

This chapter details the safety information pertaining to the installation and operation of the device.

2.1 Safety information

Read and understand the instructions within this manual and familiarise yourself with the relevant safety symbols in this chapter before beginning with the installation of the device and eliminating any faults.

Before connecting to the power grid, you must obtain official authorisation from the local power grid operator in accordance with the corresponding national and state requirements. Furthermore, operation may only be carried out by qualified electricians.

Please contact the nearest authorised service centre if any maintenance or repairs are required. Please contact your dealer to obtain information about your nearest authorised service centre. Do NOT carry out repairs on the device yourself; this may lead to injury or property damage.

Before installing the device or carrying out maintenance on it, you must open the DC switch in order to interrupt the DC voltage of the PV generator. You can also switch off the DC voltage by opening the DC

switch in the Array junction box. Not doing this may result in serious injury.

2.1.1 Qualified personnel

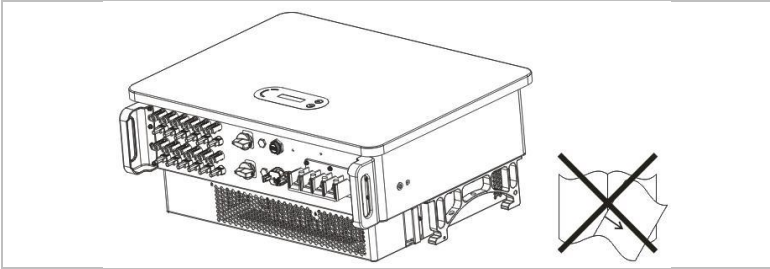
Personnel tasked with the operation and maintenance of the device must have the qualifications, competence and experience required to perform the described tasks, while also being capable of fully understanding all instructions contained within the manual. For safety reasons, this inverter may only be installed by a qualified electrician who:

- has received training on occupational safety, as well as the installation and commissioning of electrical systems
- is familiar with the local laws, standards and regulations of the grid operator.

SOFARSOLAR assumes no responsibility for the destruction of property or any injuries to personnel caused by improper usage.

2.1.2 Installation requirements

Please install the inverter according to the information contained in the following section. Mount the inverter to a suitable object with a sufficient load-bearing capacity (e.g. walls, PV frames etc.) and ensure that the inverter is upright. Choose a suitable place for the installation of electrical devices. Ensure that there is sufficient space for an emergency exit which is suitable for maintenance. Ensure sufficient ventilation in order to guarantee an air circulation for the cooling of the inverter.



2.1.3 Transport requirements

The factory packaging is specifically designed to prevent transport damage, i.e. violent shocks, moisture and vibrations. However, the device must not be installed if it is visibly damaged. In this case, notify the responsible transport company immediately.

2.1.4 Labelling on the device

The labels must NOT be concealed by items and foreign objects (rags, boxes, devices, etc.); they must be regularly cleaned and kept clearly visible at all times.

2.1.5 Electrical connection

Observe all applicable electrical regulations when working with the Solar inverter.

⚠ DANGER**Dangerous DC voltage**

- Before establishing the electrical connection, cover the PV modules using opaque material or disconnect the PV generator from the inverter. Solar radiation will cause dangerous voltage to be generated by the PV generator!

⚠ DANGER**Danger through electric shock!**

- All installations and electrical connections may only be carried out by trained electricians!

IMPORTANT**Authorisation for grid feed-in**

- Obtain authorisation from the local power grid operator before connecting the inverter to the public power grid.

NOTE**Voiding of guarantee**

- Do not open the inverter or remove any of the labels. Otherwise, SOFARSOLAR shall assume no guarantee.

2.1.6 Operation

DANGER

Electric shock

- Contact with the electrical grid or the device's terminals may result in an electric shock or fire!
- Do not touch the terminal or the conductor which is connected to the electrical grid.
- Follow all instructions and observe all safety documents that refer to the grid connection.

CAUTION

Burning due to hot housing

- While the inverter is being operated, several internal components will become very hot.
- Please wear protective gloves!
- Keep children away from the device!

2.1.7 Repair and maintenance

DANGER

Dangerous voltage!

- Before carrying out any repair work, first switch off the AC circuit breaker between the inverter and power grid, and then the DC switch.
- After switching off the AC circuit breaker and the DC switch, wait a minimum of 5 minutes before starting any maintenance or repair work.

IMPORTANT**Unauthorised repairs!**

- Following the elimination of any faults, the inverter should be fully functional once more. Should any repairs be required, please contact a local authorised service centre.
- The internal components of the inverter must NOT be opened without the relevant authorisation. Shenzhen SOFARSOLAR Co., Ltd. assumes no responsibility for any resulting losses or defects.

2.2 Symbols and signs

⚠ CAUTION**Beware of burning hazards due to the hot housing!**

- While the inverter is in operation, only touch the display and the buttons, as the housing can become hot.

ATTENTION**Implement earthing!**

- The PV generator must be earthed in accordance with the requirements of the local power grid operator!
- For reasons of personal safety, we recommend that all PV module frames and inverters of the PV system are reliably earthed.

⚠ WARNING




Damage due to overvoltage

- Ensure that the input voltage does not exceed the maximum permissible voltage. Overvoltage may cause long-term damage to the inverter, as well as other damage that is not covered by the warranty!

2.2.1 Symbols on the inverter

Several symbols pertaining to safety can be found on the inverter. Please read and understand the content of these symbols before starting the installation.

Symbol	Description
	Residual voltage is present in the inverter! Before opening the inverter, you should wait five minutes to ensure that the capacitor has been fully discharged.
	Caution! Danger through electric shock
	Caution! Hot surface
	The product is compliant with EU guidelines
	Earthing point
	Please read the manual before installing the inverter

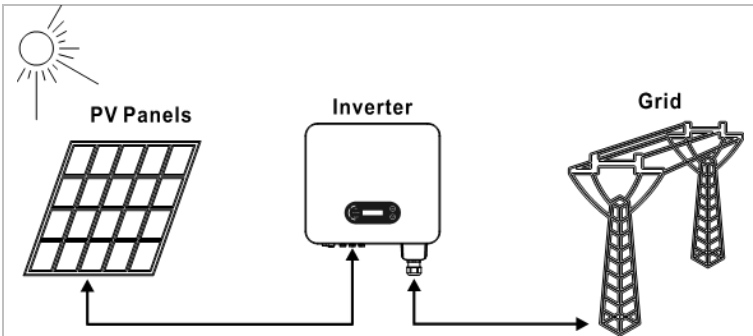
Symbol	Description
IP	Device degree of protection according to EN 60529
+ -	Positive and negative poles of the DC input voltage
	The inverter must always be transported and stored with the arrows pointing upward
	The temperature range in which the inverter can operate
	RCM (Regulatory Compliance Mark) The product meets the requirements of the applicable Australian standards.

3 Product features

This chapter describes the product features, dimensions and efficiency levels.

3.1 Product dimensions

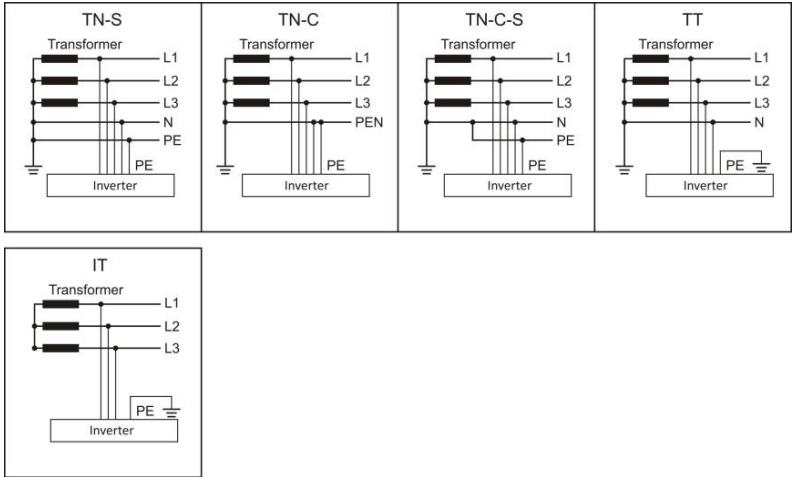
The SOFAR 60... 80KTLX-G3 is a grid-coupled PV inverter with up to two MPPTs which converts the direct current generated by PV systems into a three-phase alternating current and feeds it into the public power grid. The AC circuit breaker and DC switch are used as a disconnecting device and must be easily accessible.



SOFAR 60 ... 80KTLX-G3 inverters may only be used with photovoltaic modules which do not require one of the poles to be earthed. In normal operation, the operating current must not exceed the limits specified within the technical data. Only photovoltaic modules may be connected at the input of the inverter (no batteries or other power sources must be connected).

3.2 Power grid types

SOFAR 60 ... 80KTLX-G3 are compatible with the following grid types:



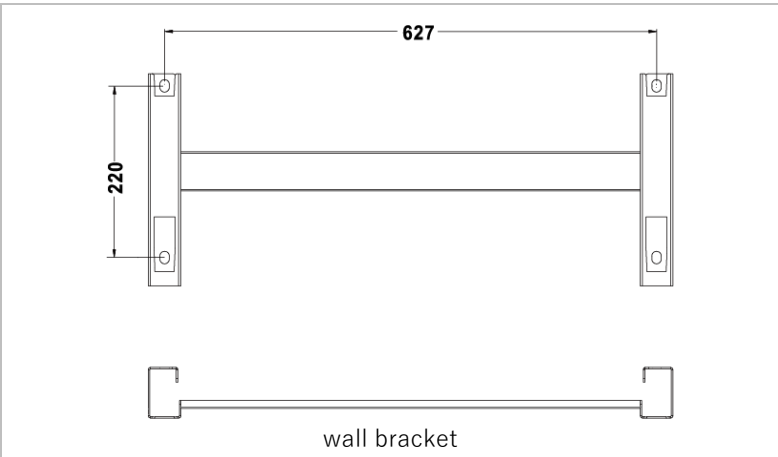
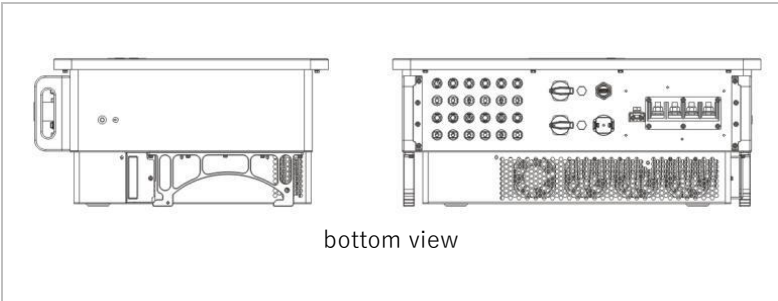
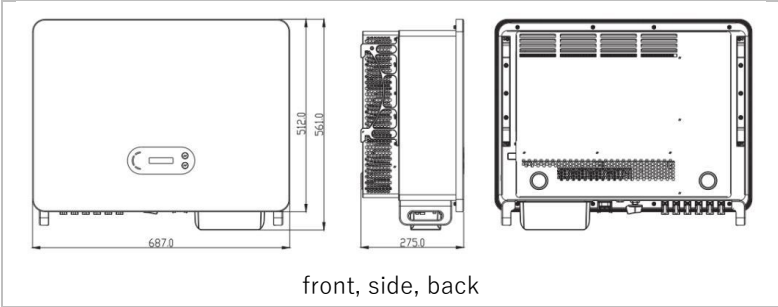
NOTE

- For the TT grid, voltage between N and PE should be less than 30 V.

3.3 Product dimensions

All SOFAR 60 ... 80KTLX-G3 have the following dimensions:

$$L \times W \times H = 687 \text{ mm} \times 561 \text{ mm} \times 275 \text{ mm}$$



3.4 Labelling on the device

Labelling must not be covered or removed!



3.5 Functional features

The DC output generated by the PV generator is filtered by the input board before it reaches the power board. The input board also provides functions such as the detection of insulation impedance and the measurement of the DC current and voltage. The DC current is converted into AC current by the power board. The AC current is filtered by the output board and fed into the power grid. The output board also provides functions such as grid voltage and current measurement, earth fault protection and a disconnecting relay. The control board supplies the auxiliary energy, controls the operating state of the inverter and displays the operating status on the display board. An error code will appear on the display if the inverter is in an abnormal operating state. At the same time, the control board may trigger the relay in order to protect the internal components.

3.5.1 Functions

A Digital inputs (DRMs)

The inverter can be switched on/off or the grid power can be controlled via the external control.

B Feeding of reactive power into the grid

The inverter is capable of generating reactive power and can also feed it into the grid. The setting of the power factor (Cos Phi) can be controlled via the serial RS485 interface.

C Limitation of the active power fed into the grid

The inverter can limit the active power fed into the grid to a specific value (as a percentage of the rated output).

D Output reduction at overfrequency within the grid

If the grid frequency is higher than the limit value, the inverter will reduce the output power; this is required to ensure stability of the grid.

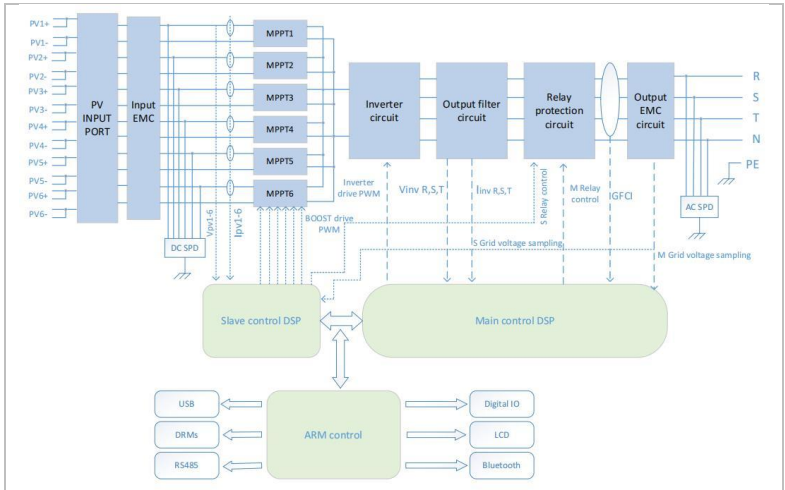
E Data transfer

The inverter (or a group of inverters) can be monitored remotely via the RS485 communication bus or via WiFi/GPRS.

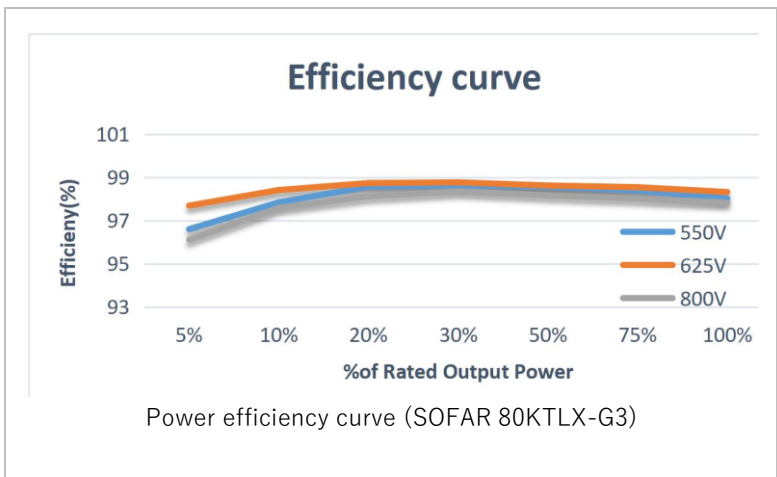
F Software update

The device supports local updates via USB stick and remote updates via WiFi/GPRS.

3.5.2 Electrical block diagram



3.6 Efficiency curve



4 Installation

4.1 Installation information

DANGER

Fire hazard

- Do NOT install the inverter on flammable material.
- Do NOT install the inverter in an area in which flammable or explosive material is stored.

CAUTION

Burning hazard

- Do NOT install the inverter in places where it can be accidentally touched. The housing and heat sink may become very hot while the inverter is being operated.

IMPORTANT

Weight of the device

- Take into account the weight of the inverter when transporting and moving it.
- Choose a suitable installation location and -surface.
- Commission a minimum of two persons with the installation of the inverter.
- Do not set down the inverter upside-down.

4.2 Installation procedure

Mechanical installation is performed as follows:

1. Examine the inverter before installation

2. Prepare the installation
3. Select an installation location
4. Transport the inverter
5. Mount the rear panel
6. Install the inverter

4.3 Examination before installation

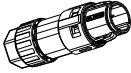
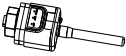




4.3.1 Checking the external packaging materials

Packaging materials and components may become damaged during transportation. Therefore, the external packaging materials must be examined before the inverter is installed. Check the external packaging material for damage, e.g. holes and cracks. If you discover any cases of damage, do not unpack the inverter and contact the transport company and/or dealer immediately. It is recommended that the packaging material should be removed within 24 hours before installing the inverter.

4.3.2 Checking the delivery scope

After unpacking the inverter, check that the delivery items are both intact and complete. In the event of any damage or missing components, contact the wholesaler.




No.	Image	Description	Quantity
1		Inverter SOFAR 60 ... 80KTLX-G3	1
2		Wall bracket	1
3		AC waterproof cover	1
4		M8*80 Hexagon screws	4
5		PV+ metal pin	12
6		PV- metal pin	12
7		PV+ input terminal	12
8		PV- input terminal	12
9		M4 cross screw (for waterproof cover)	6
10		M6*30 hexagon screw (for locking rear panel)	2
11		M6*12 hexagon screw (for grounding)	1
12		AC terminal insulation partition	5

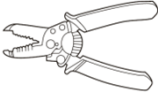

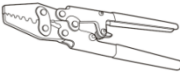
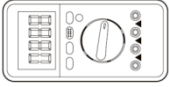

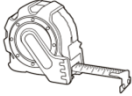
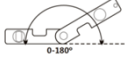
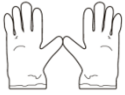

13		COM terminal	1
14		WiFi stick logger	1
15		Manual	1
16		Warranty card	1
17		Product Certification	1
18		Warranty registration form	1




*) second Pcs. for SOFAR 40...50KTLX-G3 + SOFAR 50KTLX-G3-HV

4.4 Tools

Prepare the tools required for the installation and the electrical connection.

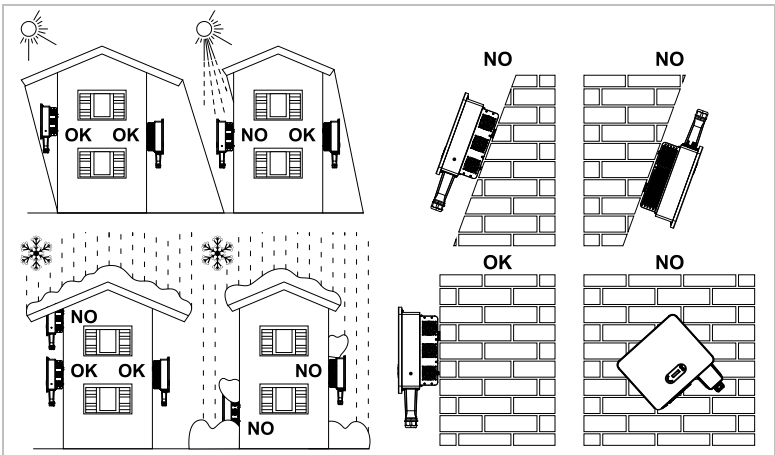
No.	Tool	Model	Function
01		Hammer drill Recommended drill: 60 mm	Used to drill holes in the wall.
02		Screwdriver	Used to tighten and loosen screws when installing the AC power cable; to remove and install the screws of the AC terminal
03		Removal tool	Used to remove the PV terminal

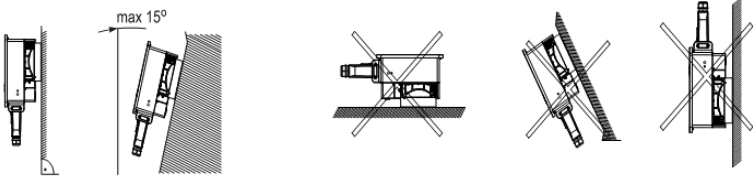
No.	Tool	Model	Function
04		Wire stripper	Used to strip the wire
05		M6 Allen key	Used to turn the screw to connect the rear panel to the inverter.
06		Crimping tool	Used to crimp power cables
07		Multimeter	Used to check the earthing
08		Marker	Used for marking
09		Measuring tape	Used to measure distances
10		Spirit level	Used to align the wall bracket
11		ESD gloves	for the installer
12		Safety goggles	for the installer

No.	Tool	Model	Function
13		Anti-dust respiratory mask	for the installer
14		Socket wrench	Used to install the expansion bolts
15		Hammer	Used to install the expansion bolts

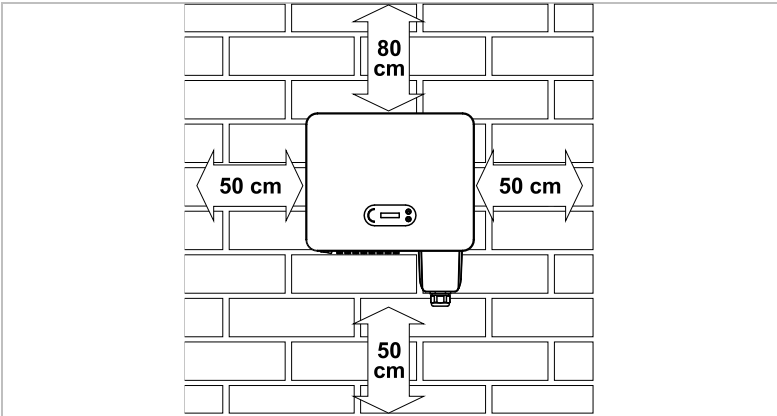
4.5 Installation location

Choose a suitable position for the installation of the inverter. Ensure that the following requirements have been fulfilled:

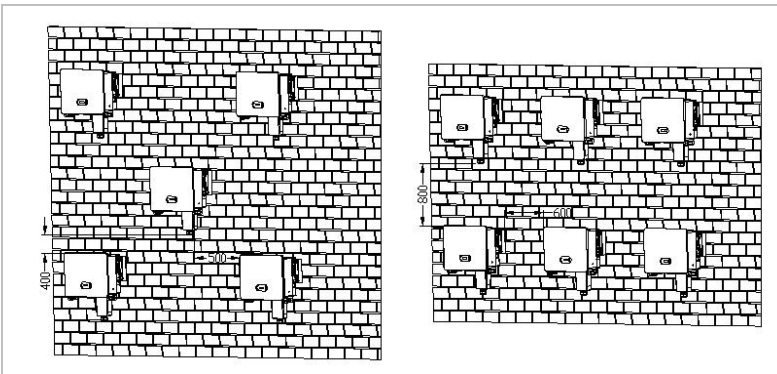




Minimum distances for individual SOFAR 60 ... 80KTLX-G3 inverters:

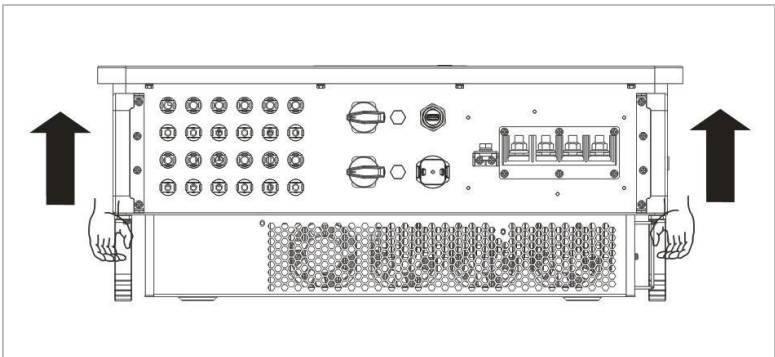
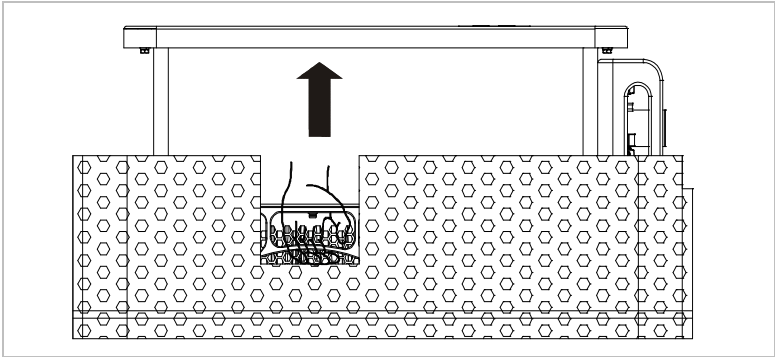


Minimum distances for several SOFAR 60 ... 80KTLX-G3 inverters:



4.6 Unpacking the inverter

1. Open the packaging and have at least two people grip underneath the inverter at both sides.



2. Lift the inverter out of the packaging and move it to its installation position horizontally.

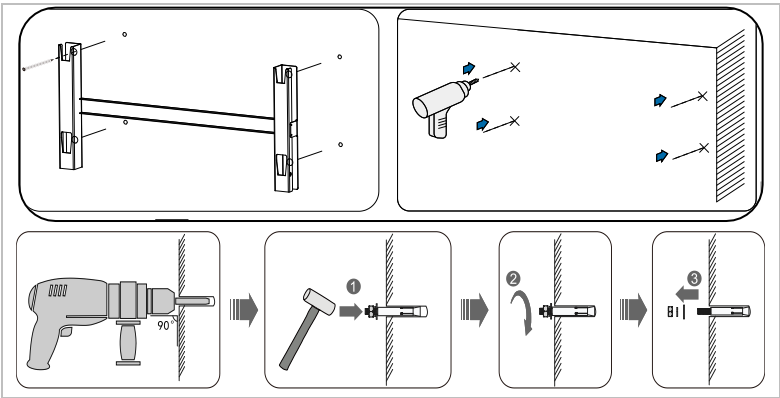
ATTENTION

Mechanical damage

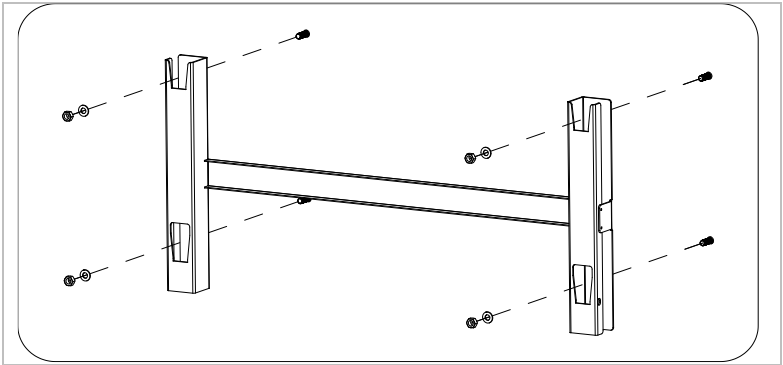
- In order to prevent injuries and damage to the device, ensure that the inverter is kept balanced while it is being moved - it is very heavy.
- Do not place the inverter on its connections, as these are not designed to bear its weight. Place the inverter horizontally on the ground.
- When you place the inverter on the ground, place foamed material or paper underneath it in order to protect its housing.

4.7 Installation of the inverter

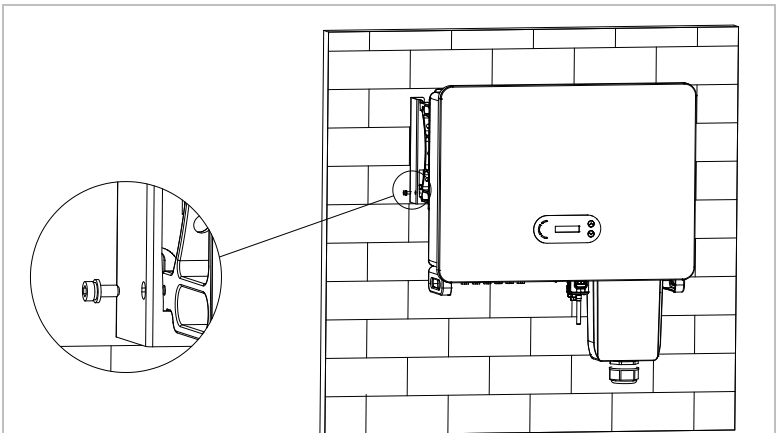
- 1 Hold the wall bracket in the desired place and mark the three holes. Put the wall bracket aside and drill the holes.



- 2 Fasten the rear panel to the wall using the M8*80 screws.



- 3 Place the inverter in the wall bracket. Secure the inverter to the wall bracket using the **Error! Reference source not found..**



5 Electrical connections

5.1 Safety instructions

This topic describes the electrical connections of the inverter SOFAR 60 ... 80KTLX-G3. Read this section thoroughly and carefully before connecting the cables.

DANGER

Electrical voltage at the DC connections

- Ensure that the DC switch is OFF before establishing the electrical connection. The reason is that the electrical charge remains in the capacitor after the DC switch has been switched off. Therefore, at least 5 minutes must lapse before the capacitor has been electrically discharged.

DANGER

Electrical voltage

- PV modules generate electrical energy when exposed to sunlight, and this may present an electrical shock hazard. Therefore, cover the PV modules with an opaque sheet before connecting to the DC input power cable.

NOTE

- Open circuit voltage of the PV strings should not exceed 1100 V.

ATTENTION**Qualification**

- The installation and maintenance of the inverter must be carried out by an electrician.

The connected PV modules must be compliant with IEC 61730 class A.

Model	Max. PV Panel ISC	Max. AC output current
SOFAR 60KTLX-G3	6*60 A	100 A
SOFAR 80KTLX-G3		133.3 A

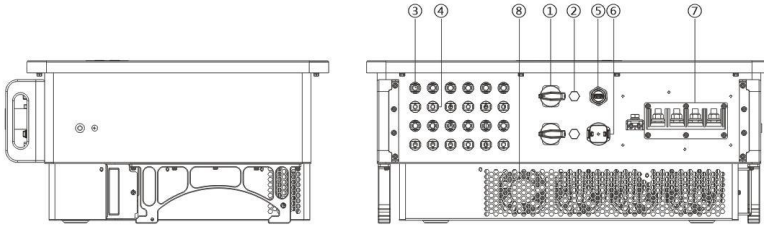
5.2 Electrical connection

The electrical connection is established as follows:

1. Connect PE cable
2. Connect DC input cable
3. Connect AC output power cable
4. Connect communication cable (optional)

5.3 Connections**⚠ CAUTION****Damage during transportation**

- Please check the product packaging and connections carefully prior to installation.



- | | |
|-----------------------------|-----------------------------|
| ① DC switch | ② Venting valve |
| ③ PV input ports (positive) | ④ PV input ports (negative) |
| ⑤ WiFi/GPRS/Ethernet | ⑥ COM Port (RS485) |
| ⑦ AC output | ⑧ Fans |

5.4 Connecting the PE cables

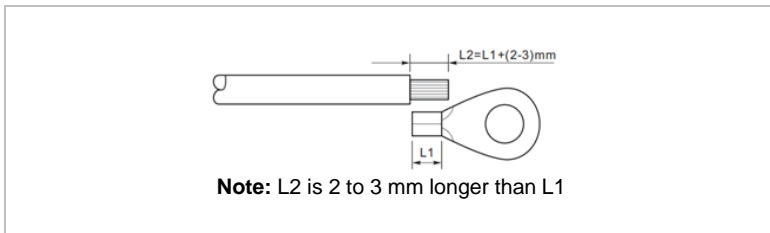
Connect the inverter to the equipotential bonding bar by using the protective earth cable (PE) for grounding.

ATTENTION

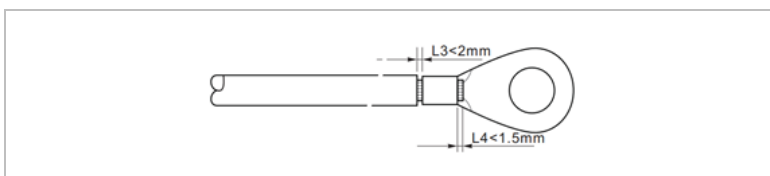
Pole earthing not permissible!

- As the inverter is transformerless, the plus and minus poles of the PV generator must NOT be earthed. Otherwise, the inverter will malfunction. In the PV system, not all live metal parts (e.g. PV module frames, PV frame, generator connection box housing, inverter housing) require earthing.

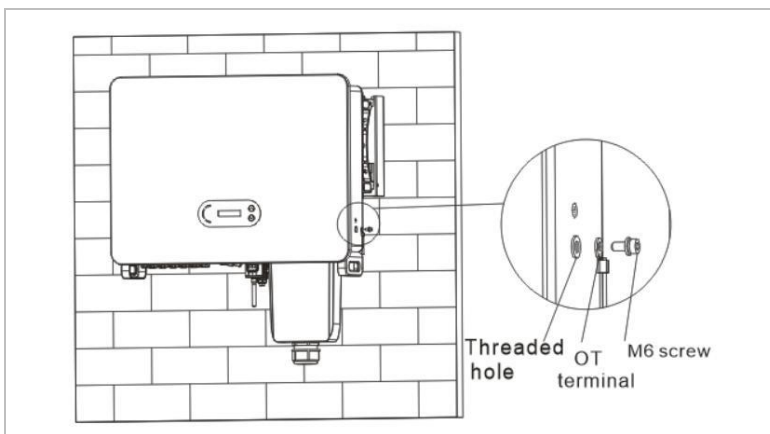
1. Remove the insulation of the cable. For outside use, cables of $> 16\text{mm}^2$ are recommended for earthing).



2. Crimp the cable to the ring terminal. Recommended OT terminal: OT-M6.



3. Tighten the crimped ring terminal with the M6 screw by using a torque wrench of 5 to 7 Nm:



5.5 Connecting the DC cables

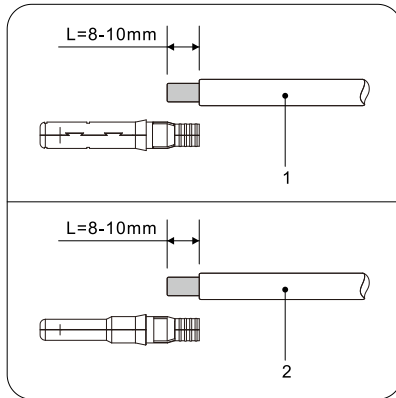
NOTE

- Maximum tolerance voltage ≥ 1100 V

Please observe the recommended cable dimensions:

- Cu cable cross section: 2.5 ... 6 mm²
- Cable outside diameter: 6 ... 9 mm

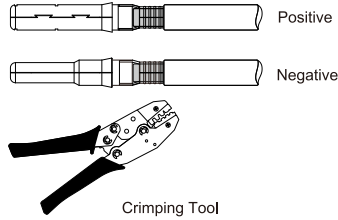
1. Insert the positive and negative DC cables into the corresponding cable glands.



① Positive DC cable

② Negative DC cable

- Use a crimping plier to crimp the DC cables.

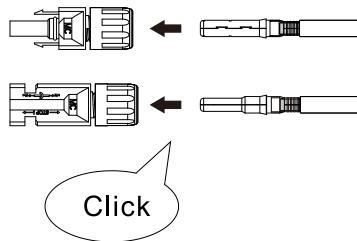


⚠ CAUTION

Danger of reverse polarity!

- Ensure that the polarity is correct before plugging into the DC connections!

- Insert the crimped DC cables into the corresponding connector housing until you hear a “clicking” sound.

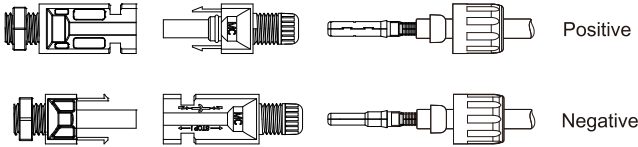


③ Positive

④ Negative

- Verify the voltage level of the DC input with a multimeter and ensure that the polarity is correct.

5. Connect the DC connector to the inverter.



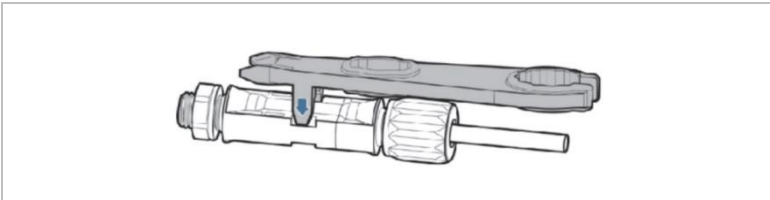
Removing the connectors

⚠ CAUTION

Danger of DC arcing

- Before removing the plus and minus connector, ensure that the DC switch has been set to OFF.

In order to remove the plus and minus connection from the inverter, insert a removal key into the locking and press on the key with the adequate force as shown in the following illustration:



5.6 Connecting the AC power cables

Connect the inverter to the AC power distributor or the power grid using AC power cables.

⚠ CAUTION**AC connection**

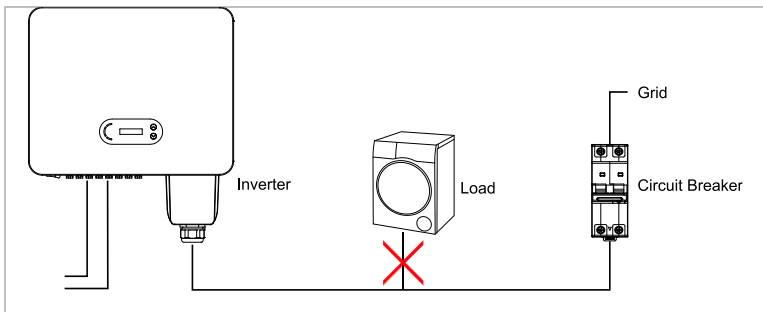
- Each inverter must have its own circuit breaker.
- Do not connect any consumers between the inverter and circuit breaker!
- The AC disconnecting device must be easily accessible.

NOTE

- The inverter SOFAR 60... 80KTLX-G3 has a built-in AFI (univ. sensitive residual current protection). If an external AFI is required, we recommend an AFI type A or B RCD featuring a residual current of 100 mA or higher.
- Please follow the national rules and regulations for the installation of external relays or circuit breakers!

Dimensioning

For correct installation, five-core outdoor cables should be used. To simplify the installation process, use flexible cables. The recommended cable specifications are listed in the following table.



Model	Cable cross-section Cu/Al cable (mm ²)		Multi-core outdoor cable (mm)	AC circuit breaker specifications
	L/N end	PE end		
60KTLX-G3	50...70	16...25	< 63	120A/380V/3P
80KTLX-G3	70...95	16...25		150A/380V/3P

NOTE

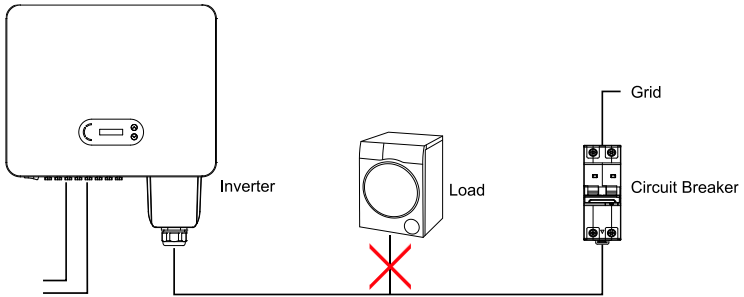
- The AC circuit braker must comply to $I\Delta N=0.3A$
- The resistance at connection point must less than 2Ω

You need to use five core outdoor cables, the recommended AC cable and residual current device (RCD) can be used as below table:

If a RCD is required under local regulations, SOFAR recommends a type A or B RCD with sensitivity of 100 mA or higher.

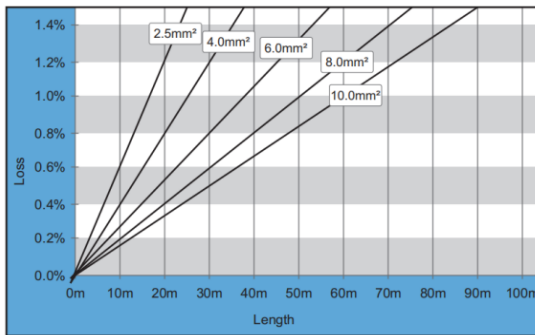
Where local electricity code requires an RCD with a lower leakage rating, the discharge current might result in nuisance tripping of the external RCD. SOFAR recommends the following measure in selecting an external RCD to avoid nuisance tripping:

- 1: Selecting appropriate RCD.
- 2: Configure the trip current of inverter internal RCD to a lower value that the trip current of the external RCD.



Please choose the high-quality PV cable and ensure the power loss is less than 1%. The inverter AC side to grid connection point must less than 100m.

The relationship between the leakage power in the AC cable and the cable length, the cable cross-section, is displayed in the following illustration:



The AC output terminal is equipped with a high-current 5-core terminal block and a customized waterproof cover (IP65). Please follow below steps to connect the AC cable.

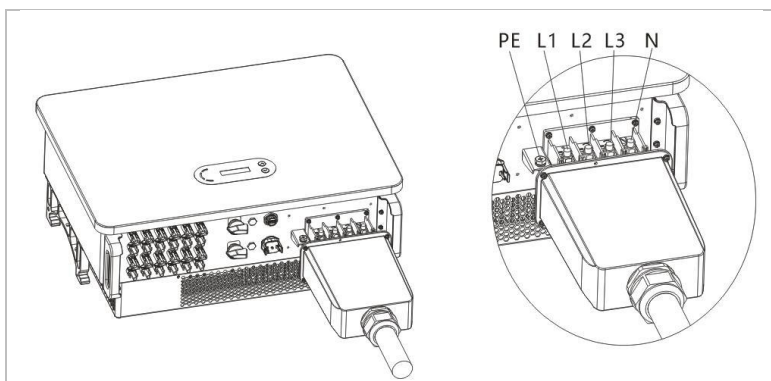
5.6.1 Installation instructions

⚠ CAUTION

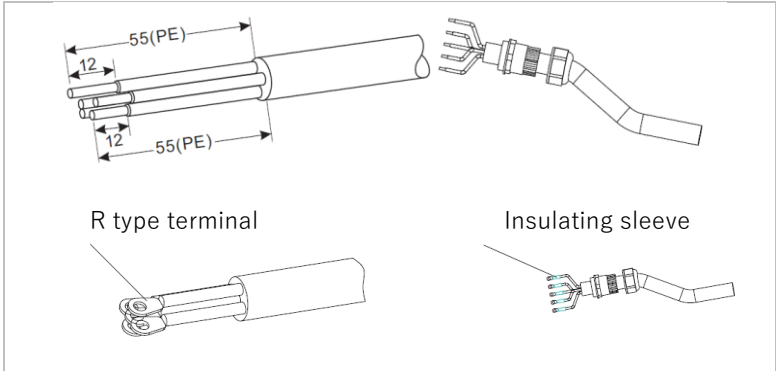
Electrical voltage

- Ensure that the grid has been switched off before removing the AC connector.

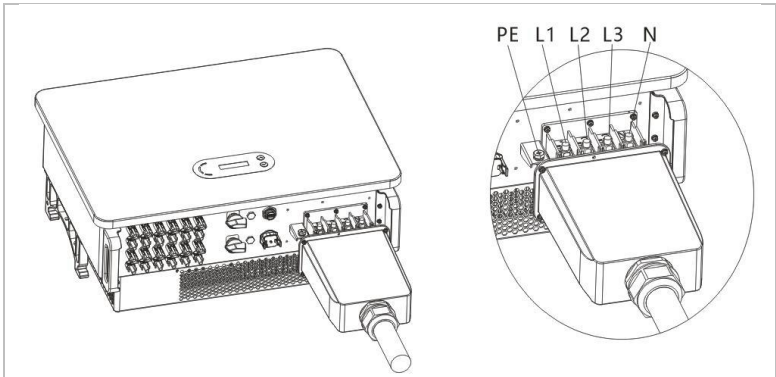
1. Remove the waterproof cover with a screwdriver, and remove the stopper from the waterproof cable gland;



2. Select the suitable cable according to the table above. Remove the insulating layer of the AC output cable using a wire stripper and in accordance with the following illustration, and then guide the cables through the cable gland.



3. Connect the cables to the AC terminal block and tighten the M8 screws (6 ... 10 Nm) and M6 screws (5 ... 7 Nm). Then tighten the AC cover screws (2 ... 3 Nm);

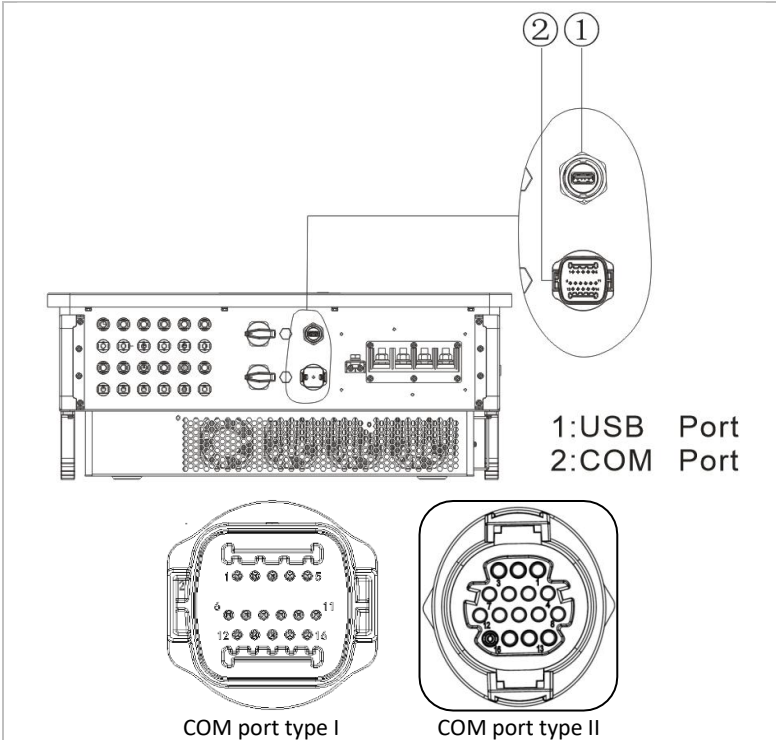


NOTE

- When an aluminum cable is used, a copper/aluminum conversion terminal is required. This is supplied together with the copper terminals.

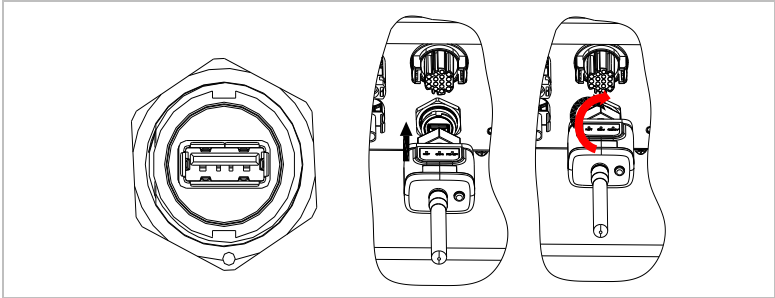
5.7 Communication ports

The SOFAR 60 ... 80KTLX-G3 inverters come with one of the following two COM ports and one USB port.



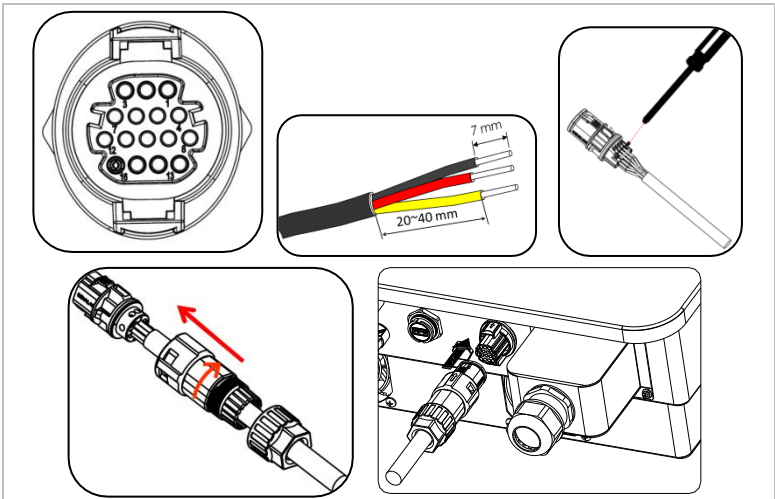
5.7.1 USB port

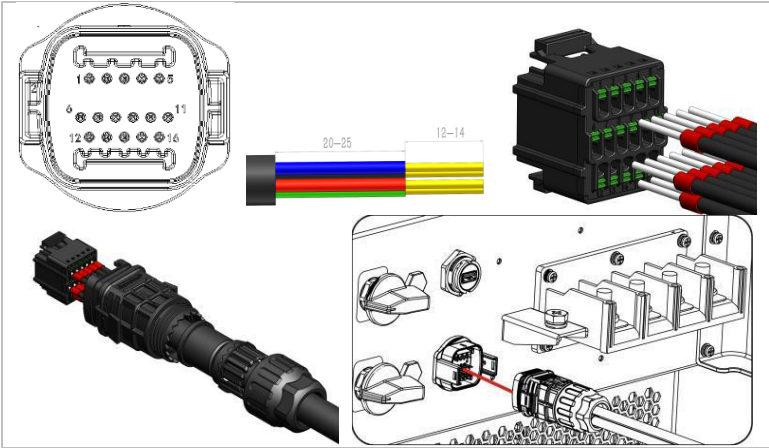
The USB port can be used to update the inverter's software version, or for connecting a WiFi-stick or Ethernet cable.



5.7.2 COM port

Please follow below steps to install the COM cable according to the correct COM port :





Please refer to below table for the specific PIN assignments.

Function	Pin	Definition	Note
Inverter monitoring and system control	1	RS485 A1-1	RS485 Signal+
	2	RS485 A1-2	RS485 Signal +
	3	RS485 B1-1	RS485 Signal -
	4	RS485 B1-2	RS485 Signal -
Energy meter port	5	RS485 A2	RS485 Signal +
	6	RS485 B2	RS485 Signal -
Grounding	7	GND.S	Signal GND
Logic interface for power control and remote shutdown	8	DRM0	Remote shutdown
	9	DRM1/5	Digital input 1
	10	DRM2/6	Digital input 2
	11	DRM3/7	Digital input 3
	12	DRM4/8	Digital input 4

5.7.3 Logic Interface: DRMs, Power Control and remote shutdown

The DRM/Logic interface is used to control the inverter by external signals, usually provided from grid operators with ripple control receivers or other means. The logic interface inputs are defined according to different standard requirements.

The grid protection relays can trigger the internal grid relays to open within 150 ms.

NOTE

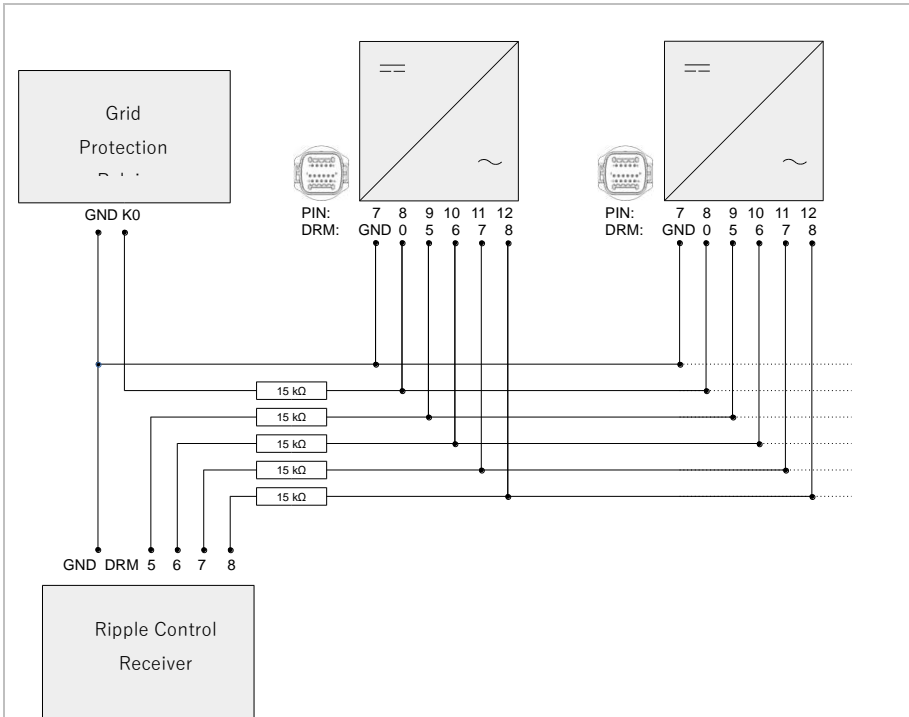
- The DRM0 inputs need a 15k Ω resistor in series to the input to feed-in power!

DRMs for AS/NZS 4777.2:2015 and AS/NZS 4777.2:2020

Also known as Inverter Demand Response Modes (DRMs).

The inverter recognises all supported Demand Response commands and initiates the reaction within two seconds. The inverter remains in the reduced power mode as long as the input is closed.

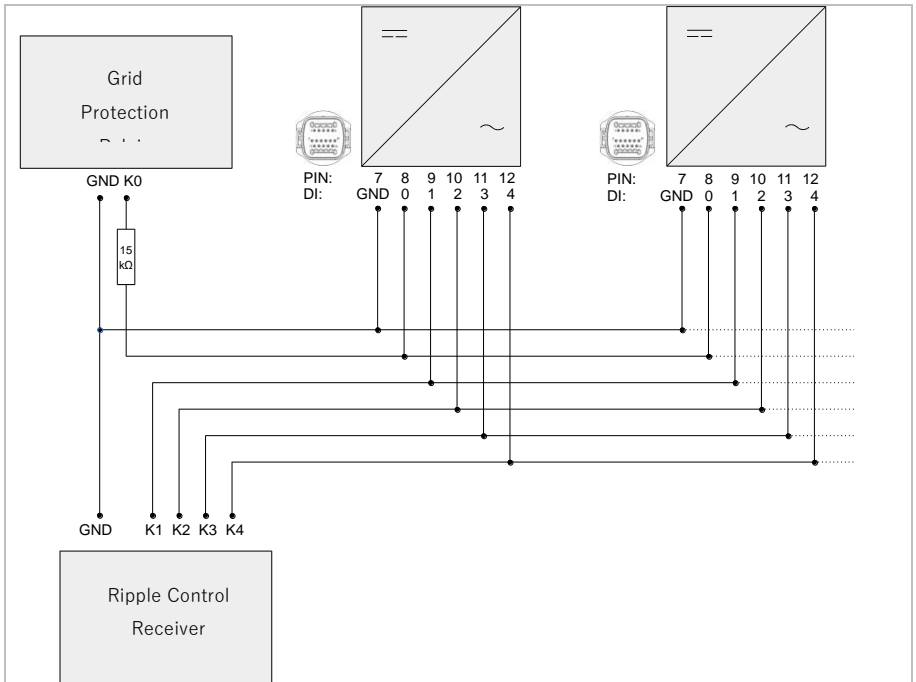
Supported DRM commands are pre-configured: DRM0, DRM5, DRM6, DRM7, DRM8:



Function	Pin	Definition	Note	Digital Input
Grounding	7	GND.S	Signal GND	
DRMs/Logic Interface	8	DRM0	Remote shutdown	
	9	DRM1/5	0% power feed-in	DI 5
	10	DRM2/6	50% power feed-in	DI 6
	11	DRM3/7	75% power feed-in	DI 7
	12	DRM4/8	100% power feed-in	DI 8

Logic interface for VDE-AR-N 4105:2018-11

This function serves to control and/or limit the output power of the inverter. The inverter can be connected to a radio ripple control receiver in order to dynamically limit the output power of all inverters within the system. The inverter remains in the reduced power mode as long as the input is closed.



Function	Pin	Definition	Note	Digital Input
Grounding	7	GND.S	Signal GND	
DRMs/Logic Interface	8	DRM0	Remote shutdown	
	9	DRM1/5	0% power feed-in	DI 5
	10	DRM2/6	30% power feed-in	DI 6
	11	DRM3/7	60% power feed-in	DI 7
	12	DRM4/8	100% power feed-in	DI 8

Remote Shutdown for EN50549-1:2019/VDE ARN 4105:2018-11

The inverter can be disconnected from the grid within 150 ms by an external signal. To use this function the DRM0 input is used. As long as the input is closed (the 15 kΩ is connected at the input), the inverter feeds-in. As soon as the input is shorted or opened, the inverter disconnects from the grid.

Functional description of the terminal

Function	Pin	Definition	Note
Grounding	7	GND.S	Signal GND
DRMs/Logic Interface	8	DRM0	Remote shutdown
	9	DRM1/5	0% power

NOTE

- The Logic interface has to be activated in the LCD screen of the inverter, or with SOFAR View App:
DRM0 active: Remote Shutdown

DRMn active: active power feed-in limitation function

- Also, the power levels in percentage can be adjusted if needed

5.8 Energy meter connection

To use the feed-in limitation function, a SmartMeter is required to measure the power flow at the point of common coupling (PCC). Please refer to below table for the Pin assignments for the RS485 connection between the inverter and the energy meter.

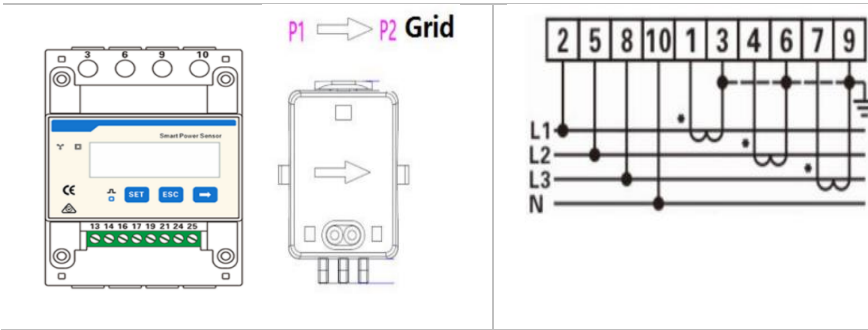
Inverter COM Port Pin	Function	Energy Meter Pin
5	RS485+ (A2)	24
6	RS485- (B2)	25

5.8.1 Feed-in limitation function

With this function, one single inverter can dynamically limit its output power to keep the feed-in power at the point of common coupling (PCC) below a defined setpoint.

To use the feed-in limitation function, an external SmartMeter has to be connected to measure the power flow at the PCC:

SOFAR Part No.	Product	Type
901.00000048-1	Smart Meter (3-phase, CT's)	Chint DTSU666 1,5(6)A
901.00000058-0	Smart Meter (3-phase inline)	Chint DTSU666 5(80)A



NOTE

- The arrow of the CT's must point to the grid

There is different feed-in limitation modes available, which can be set in the LCD screen menu:

"Feed-in Limit" menu

<p>Feed-in Control</p>	<p>Standard Mode. In case of a communication error with the SmartMeter, the inverter limits its output power to the setpoint.</p>
<p>Hard Feed-in Control</p>	<p>When the Hard Feed-in Control is activated, the inverter shuts down whenever the setpoint is exceeded</p>
<p>CTR Total Power</p>	<p>Limit the power of the feeding-in phases to the setpoint. Ignore the phases where energy is bought from the grid (standard-setting)</p>

CTR Phase Power	Limit the feed-in power of the sum of all phases to the setpoint (i.e. Germany)
CTR Selling Power	Limit the feed-in power of each phase to 1/3 of the setpoint

5.9 System monitoring

The SOFAR 60 ... 80KTLX-G3 inverters provide various communication methods for the system monitoring:

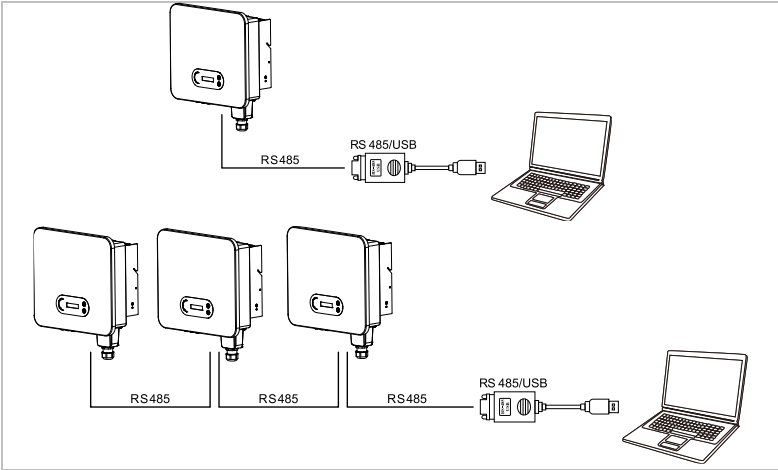
RS485 or WiFi stick (standard), GPRS or Ethernet stick (optional).

5.9.1 RS485 network

You can connect RS485-linked devices to your PC via an RS485 USB adapter or connect them to a data logger.

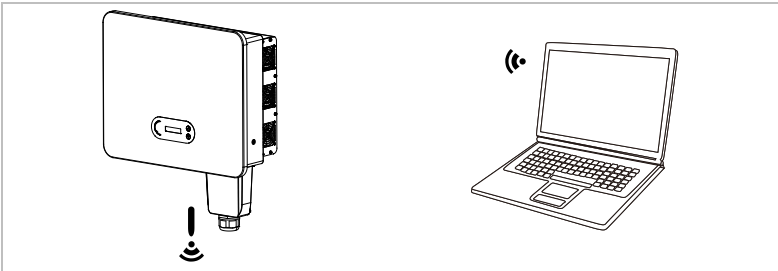
NOTE

- The RS485 line may not be any longer than 1000 m
- Assign each inverter its own modbus address (1 to 31) via the LCD display
- At the last inverter, put a termination resistor of 120 Ohm between RS485+ and RS485-



5.9.2 WiFi-, GPRS-, Ethernet stick

When you have installed the stick logger, the inverters can directly upload your operating, energy and alarm data in the SolarMAN monitoring portal.



NOTE

- The Stick Loggers are using the outgoing TCP port 10000, which could be blocked in some internet routers

5.9.3 Configuration of the WiFi stick via the web browser

Preparation: The WiFi stick is installed in accordance with the previous section and the SOFAR inverter must be in operation.

Carry out the following steps in order to configure the WiFi stick:

- 1 Connect your PC or smartphone with the WiFi network of the WiFi stick. The name of this WiFi network is “AP”, followed by the serial number of the WiFi stick (see rating plate). When you are prompted for a password, you can find it on the label of the WiFi stick (PWD).
- 2 Open an Internet browser and enter the address **10.10.100.254**.
Recommended browsers: Internet Explorer 8+, Google Chrome 15+, Firefox 10+
- 3 Enter the username and password, which are both set to “**admin**” by default. The “Status” page will be opened.
- 4 Click on the “Wizard” in order to configure the WiFi stick for Internet access.

Result The WiFi stick begins to send data to SolarMAN.

Register your system at the website home.solarmanpv.com. For this, enter the serial number found on the stick logger.

Installers use the portal at pro.solarmanpv.com

5.9.4 Setting up the WiFi stick with the app

To download the app, search for “SOLARMAN” in the Apple or Google Play store, or use the following QR codes:

- **SOLARMAN Smart** (for end customers):



- **SOLARMAN Business** (for installers):



Configuration steps

- 1 After starting the app, register as a new user or enter the current SOLARMAN access data.
- 2 Create a new system and save the system data.
- 3 Scan the barcode of the stick logger to assign an inverter to the system.
- 4 Go to the newly created system in order to configure the stick logger (device/logger)
- 5 Press the button on the WiFi stick for 1 second to activate the WPS mode of the stick so that the smartphone can be connected to the WiFi stick.

- 6 Now, select your local WiFi network for Internet access and enter your WiFi password.
- 7 The WiFi stick is configured with the access data.

WiFi stick status

The LEDs on the WiFi stick provide information regarding the status:

LED	Status	Description
NET:	Communication with the router	On: Connection to server successful
		Flashing (1 sec.): Connection to router successful
		Flashing (0.1 sec.): WPS mode active
		Off: No connection to router
COM	Communication with inverter	Flashing (1 sec.): Communication with inverter
		On: Logger connected to inverter
		Off: No connection to inverter
READY	Logger status	Flashing (1 sec.): Normal status
		Flashing (0.1 sec.): Reset running
		Off: Error status

Reset button

Keystroke	Description
1 sec.	WPS mode
5 sec.	Restart
10 sec.	Restart (reset)

5.9.5 Setting up the Ethernet stick

The Ethernet stick is delivered with DHCP as standard, so it automatically gets an IP address from the router.

If you wish to set up a fixed IP address, connect a PC to the Ethernet stick and open the configuration page via the web address **10.10.100.254**.

6 Commissioning the inverter

6.1 Safety test before commissioning

ATTENTION

Check the voltage range

- Ensure that the DC and AC voltages are within the permissible range of the inverter.

6.2 Starting the inverter

1. Switch on the DC switch.
2. Switch on the AC circuit breaker.

When the DC output generated by the solar system is at a sufficient level, the inverter starts automatically. A correct operation is indicated by the screen displaying “normal”.

If the inverter displays an error message, consult chapter 8 for help.

NOTE



- Different distribution network operators in various countries have differing requirements for the grid connection of grid-coupled PV inverters.
- Ensure that you have selected the correct country code according to regional authority requirements, and consult a qualified electrician or employees of electrical safety authorities.

- SOFARSOLAR is not responsible for the consequences of selecting the incorrect country code.
- The selected country code influences the device grid monitoring. The inverter continuously checks the set limits and, if required, disconnects the device from the grid.

6.3 Smartphone app SOFAR View

The app is available for Android and iOS systems and allows for easy initial setup as well as advanced configurations.

Download link:

iOS	Android
	

After switching on the inverter, the app finds the unit via Bluetooth under its serial number.

The app password for the installation is 6868, for the end customer 8888.

NOTE

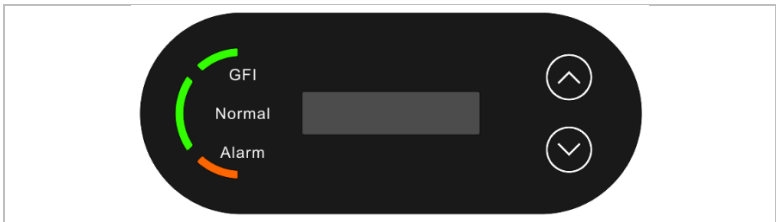
- If the Bluetooth connection does not work, please carry out a firmware update of the inverter.

7 Operation of the device



This chapter describes the LCD and LED displays of the SOFAR 60 ... 80KTLX-G3 inverter.

7.1 Control panel and display field

7.1.1 Buttons and display lights



Buttons

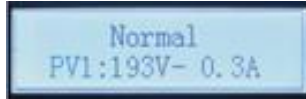
Button	Name	Description
	Up	Short press: Select previous menu item Long press: Exit menu or current interface
	Down	Short Press: Select next menu item Long press: "Enter" button

LED's

- Normal (green) illuminates: "Normal" state
flashes: "Wait" or "Check" state
- Alarm (red) illuminates: "Error"
- GFI (red) illuminates: GFCI faulty

7.2 Standard display

This shows a rolling display of the DC voltage/current (PV1), energy yields (today/total), grid voltage and current, as well as the status.



7.3 Status display

The following table displays the various statuses and their meanings:

Status	Description
Initialisation	The control software is started
Wait	Connecting criteria are checked. The voltage and frequency limits must be within the defined range for a specific duration in accordance with the selected country code.
Check	The inverter checks the insulation resistance, relays and other safety requirements. It will also carry out a self-test to ensure that its software and hardware are functioning faultlessly. If an error or a fault occurs, the inverter will go into the "Error" or "Continuous" state.
Normal	The inverter goes into the "Normal" state, and feeds current into the grid
Fault	The inverter goes into the "Fault" state if an error or a fault occurs. It is normally reset automatically by the inverter.

Status	Description
Permanent	Repeated errors can lead to a permanent error which needs investigation and problem solving on site.

7.4 Menu structure

Hold the down button to show the main menu.

Main menu

1. Enter Settings	See "Feed-in Limit "
2. Event list	See "Set country codes"
3. System Info	See System information menu
4. Display time	See Display time
5. Software update	See Software update

"Settings" menu

1. Set time	Sets the system time for the inverter
2. Clear energy	Deletes the total energy yield of the inverter
3. Clear events	Deletes the historical events recorded in the inverter
4. Country Code	Sets the country and standard applicable to the current application conditions and requirements. Before setting this, ensure that the

	“Activate country setting” option has been activated.
5. On/off control	Local control of inverter
6. Set Energy	Sets the total power generation.
7. Set address	Enter the Modbus address (when several inverters require simultaneous monitoring), standard: 01
8. Set input mode	Either parallel mode or independent mode may be selected.
9. Set language	Sets the display language of the inverter
10. Set Feed-in Limit	Through this function the feed-in limitation function can be enabled or disabled.
11. Logic interface	Activates or deactivates logical interfaces.
12. IV Curve scan	Through this function, the peak point of maximum power can be tracked.
13. PCC select	Select either PCC Meter (default) or PCC ARPC.
14. Feed-in limit mode (please refer to 5.8)	Select from below: Feed-in Control / Hard Feed-in Control CTR Total Power (default) CTR Phase Power CTR Selling Power

NOTE

- The Autotest function is only applicable in Italy. Please contact SOFARSOLAR for the specific steps.

Password

Several settings require a password to be entered (the standard password is 0001). When entering the password, press briefly to change the figure and press and hold to confirm the current figure.

Event list menu

The event list is used to display the real time event recordings, including the total number of events and each specific ID no. and event time. The most recent events are listed at the top.

2. Event list

1. Current event	2. Event "History
Fault information	001 ID04 06150825 (display of the event sequence number, event ID number and time that the event takes place)

System information menu

1. Inverter type

2. Serial number

3. Soft version

4. Hard version

5. Country

6. Modbus address

7. Input mode

Display time

Displays the current system time.

Software update

The user can update the software via the USB flash drive. SOFARSOLAR will provide the firmware update when it is required.

7.5 Software update

1. Switch the DC and AC switches off and then remove the communication cover. If an RS485 line has been connected, ensure that the nut is loosened. Ensure that the communication line is not energised. Remove the cover to prevent the connected communications connector from becoming loose.
2. Insert the USB stick into the computer.
3. SOFARSOLAR will send the firmware update to the user.
4. Unzip the file and copy the original file to a USB stick. Attention: The firmware update file must be in the “firmware” subfolder!

5. Insert the USB flash drive into the USB interface of the inverter.
6. Switch on the DC switch and go to menu item “5. Software update” on the LCD display.
7. Enter the password (the standard password is 0715).
8. The system will then successively update the main DSP, auxiliary DSP and ARM processors. Pay attention to the displays.
9. If an error message appears, switch off the DC switch and wait until the LCD screen goes out. Then, switch the DC switch back on and proceed with the update from step 5.
10. After the update is complete, switch the DC switch off and wait until the LCD screen goes out
11. Re-establish a watertight communication connection
12. Switch the DC and AC circuit breaker back on
13. You can check the current software version in item “3. Software version” of the SystemInfo menu.

8 Troubleshooting handling

8.1 Troubleshooting

This section contains information and procedures pertaining to the remedying of potential problems with the inverter.

To carry out troubleshooting, proceed as follows:

- Check the warnings, error messages or error codes displayed on the screen of the inverter.

If no error information is displayed on the screen, check whether the following requirements have been fulfilled:

- Has the inverter been set up in a clean, dry, well-ventilated area?
- Is the DC switch set to ON?
- Are the cables sufficiently dimensioned and short enough?
- Are the input connections, output connections and the wiring all in good condition?
- Are the configuration settings for the relevant installation correct?
- Are the display field and the communication cables correctly connected and undamaged?

Please proceed as follows to display the recorded problems: Hold the button down to bring up the main menu of the standard interface. Select "2. Event list" and hold the button down to bring up the event list.

Earth fault alarm

This inverter is compliant with IEC 62109-2 Clause 13.9 for earth fault protection.

If an earth fault alarm occurs, the error is displayed on the LCD screen, the red light illuminates and the error can be found in the error history log.

NOTE

- In the case of devices equipped with a stick logger, the alarm information can be viewed on the monitoring portal and retrieved via the smartphone app.

ID	Name	Description	Solution
01	GridOVP	The voltage of the power grid is too high	<p>If the alarm occurs occasionally, then the reason may be the power grid. The inverter automatically returns to its normal operating state when the power grid is back to normal.</p> <p>If the alarm is occurring frequently, check whether the grid voltage/frequency is within a permissible range. If it is, check the AC circuit breaker and the AC cables of the inverter.</p> <p>If the alarm occurs repeatedly, contact the technical support department in order to adjust the voltage and frequency limits after you have obtained the approval of the local power grid operator.</p>
02	GridUVP	The voltage of the power grid is too low	
03	GridOFP	The grid frequency is too high	
04	GridUFP	The grid frequency is too low	

ID	Name	Description	Solution
05	PVUVP	The input voltage is too low	Check whether too few PV modules have been switched in series and correct this if required. The inverter automatically returns to its normal operating state.
06	Vlvrtlow	LVRT function disrupted	Check whether the grid voltage is fluctuating strongly.
07	Vovrthigh	OVRT function disrupted	
09	PVOVP	The input voltage is too high	Check whether too many PV modules have been switched in series and correct this if required. The inverter automatically returns to its normal operating state
10	IpvUnbalance	Input current is not symmetrical	Check the setting of the MPPT input mode (parallel mode/independent mode) of the inverter and correct it as well if required.
11	PvConfigSet Wrong	Incorrect MPPT mode	
12	GFCIFault	Earthing error	If the error occurs occasionally, then external factors may be to blame. The inverter automatically returns to its normal operating state. If the error occurs frequently and lasts for a prolonged period, check whether the insulation resistance between the PV generator and earth (ground) is too low and examine the PV cable insulation.

ID	Name	Description	Solution
14	HwBoostOCP	The input current is too high and has triggered the hardware protection	Check whether the input current is higher than the maximum permissible input current of the inverter. Check the input cables. If both are correct, please contact the technical support department.
15	HwAcOCP	The grid current is too high and has triggered the hardware protection	
16	AcRmsOCP	The grid current is too high	
17	HwADFaultGrid	Grid current measurement error	
18	HwADFaultDCI	DC current measurement error	ID15-ID24 are internal errors of the inverter. Switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
19	HwADFaultVGrid	Grid voltage measurement error	
20	GFCIDeviceFault	GFCI measurement error	
21	MChip_Fault	Master chip error	
22	HwAuxPowerFault	Auxiliary voltage error	
23	BusVoltZeroFault	Bus voltage measurement error	
24	IacRmsUnbalance	The output current is not balanced	

ID	Name	Description	Solution
25	BusUVP	The DC bus voltage is too low	If the configuration of the PV generator is correct (no ID05 error), the possible cause may be linked to insufficient sunlight. The inverter automatically returns to its normal operating state when the level of sunlight is back to normal.
26	BusOVP	The bus voltage is too high	ID26-ID27 are internal errors of the inverter. Switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
27	VbusUnbalan	The bus voltage is not balanced	
28	DciOCP	The DC current is too high	Check the setting of the MPPT input mode (parallel mode/independent mode) of the inverter and correct if required.
29	SwOCPIstan	The grid current is too high	Internal inverter error, switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
30	SwBOCPIstant	The input current is too high	Check whether the input current is higher than the maximum permissible input current of the inverter, then check the input cables. If both are correct, please

ID	Name	Description	Solution
			contact the technical support department.
33	Overload	Reflux overload timeout	Check whether the power is outside the permissible range. If so, set the power to the correct range.
49	ConsistentFault_VGrid	The sample value of the grid voltage between the master DSP and the slave DSP is not consistent.	
50	ConsistentFault_FGrid	The sample value of the grid frequency between the master DSP and the slave DSP is not consistent	
51	ConsistentFault_DC	The sample value of the DCI between the master DSP and the slave DSP is not consistent	ID49-ID55 are internal errors of the inverter. Switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
52	ConsistentFault_GFCI	The sample value of the GFCI between the master DSP and the slave DSP is not consistent	
53	SpiCommLoss	The SPI communication between the master DSP and the slave DSP is faulty	
54	SciCommLoss	The SCI communication between the control board and communications board is faulty	

ID	Name	Description	Solution
55	RelayTestFail	Grid relay error	
56	PvlsoFault	The insulation resistance is too low	Check the insulation resistance between the PV generator and earth (ground), and rectify the error in the event of short-circuiting.
57	OverTempFault_Inv	The temperature of the inverter is too high	Ensure that the mounting position and method both comply with the necessary requirements.
58	OverTempFault_Boost	The DC/DC booster temperature is too high	Check whether the ambient temperature at the installation location exceeds the upper limit value.
59	OverTempFault_Env	The ambient temperature is too high	If so, improve the ventilation in order to reduce the temperature.
65	UnrecoverHardwareAcOCP	The grid current is too high and has caused an unrectifiable hardware error	ID65-ID70 are internal inverter errors, switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
66	UnrecoverBusOverVoltage	The bus voltage is too high and has caused an unrectifiable error	
67	UnrecoverGridCurrentRmsUnbalance	The grid current is unsymmetrical and has caused an unrectifiable error	
68	UnrecoverPVInputCurrentUnbalance	The input current is unsymmetrical and has caused an unrectifiable error	

ID	Name	Description	Solution
69	UnrecoverVbusUnbalance	The bus voltage is unsymmetrical and has caused an unrectifiable error	
70	UnrecoverOCPlInstant	The grid current is too high and has caused an unrectifiable error	
71	UnrecoverPvConfigSetWrong	Incorrect input mode	Check the setting of the MPPT input mode (parallel mode/independent mode) of the inverter and correct if required.
74	UnrecoverIPVInstant	The input current is too high and has caused an unrectifiable error	ID74-ID77 are internal inverter errors, switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
75	UnrecoverWRITEEPROM	The EEPROM cannot be recovered	
76	UnrecoverREADEEPROM	The EEPROM cannot be recovered	
77	UnrecoverRelayFail	The grid relay has a permanent error	
81	OverTempDerating	The inverter has derated itself due to the temperature being too high	Ensure that the installation position and method both comply with the necessary requirements of this user manual. Check whether the ambient temperature at the installation location exceeds the upper limit value. If so, improve the ventilation in order to reduce the temperature.

ID	Name	Description	Solution
82	OverFreqDerating	The inverter has derated itself due to the grid frequency being too high	The inverter automatically reduces the output power when the frequency of the electrical grid is too high. Ensure that the grid frequency is within the permissible range.
83	RemoteDerating	The inverter has derated itself through the remote control	The inverter logs ID83 when the remote power is reduced. Check the wiring of the remote control input and output signal connection on the communication board
84	RemoteOff	The inverter was switched off through the remote control	The inverter logs ID84 in the event of a remote switch-off. Check the wiring of the remote control input and output signal connection on the communication board
85	UnderFrequencyDerating	The inverter has derated itself due to a low grid frequency	The inverter automatically reduces the output power when the frequency of the electrical grid is too low. Ensure that the grid frequency is within the permissible range.
89	UnderFreqUp Power	Underfrequency	Ensure that the grid frequency is within the permissible range.
93	Lightning protection alarm	The overvoltage protection has been triggered	Check whether the device is damaged and contact the technician for assistance.
94	Softwareversionisnotconsistent	The the control board and communications board software is not consistent	Contact the technical support department in order to upgrade the software.

ID	Name	Description	Solution
95	Communicati onboardEEPR OMfault	The EEPROM of the communications board is faulty	ID95 ... ID96 are internal errors of the inverter. Switch the DC switch OFF, wait 5 minutes and then switch the DC switch ON. Check whether the error has been rectified. If not, please contact the technical support department.
96	RTCclockchip anomaly	The RTC clock chip is faulty	
97	Invalid Country	The country is invalid	Check the country setting and correct if required.
98	SDfault	The SD card is defective	Please replace the SD card.

8.2 Maintenance

Inverters do not generally require daily or routine maintenance. Before carrying out cleaning, ensure that the DC switch and AC circuit breaker between the inverter and power grid have been switched off. Wait at least 5 minutes before carrying out cleaning.

8.2.1 Cleaning the inverter

Clean the inverter using an air blower and a dry, soft cloth or a soft bristle brush. Do NOT clean the inverter with water, corrosive chemicals, cleaning agents etc.

8.2.2 Cleaning the heat sink

In order to help guarantee correct long-term operation of the inverter, make sure that there is sufficient space for ventilation around the heat sink. Check the heat sink for blockages (dust, snow etc.) and remove them if present. Please clean the heat sink using an air blower and a dry, soft cloth or a soft bristle brush. Do NOT clean the heat sink with water, corrosive chemicals, cleaning agents etc.

8.2.3 Fan maintenance

Fans must be cleaned and maintained regularly for both performance and safety concerns.

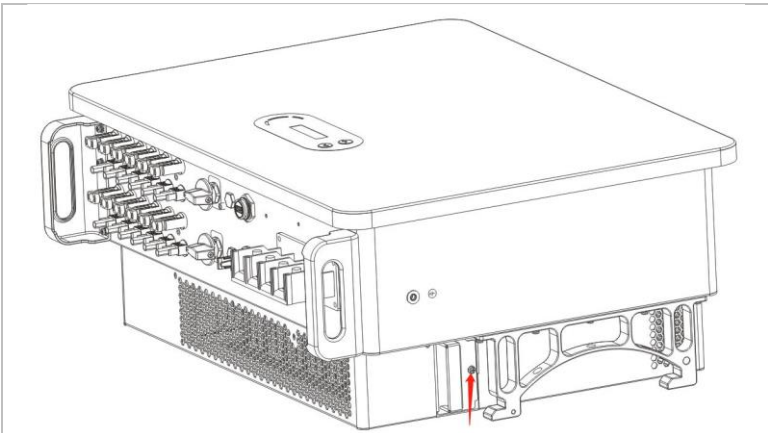
ATTENTION

Regularly clean or maintain

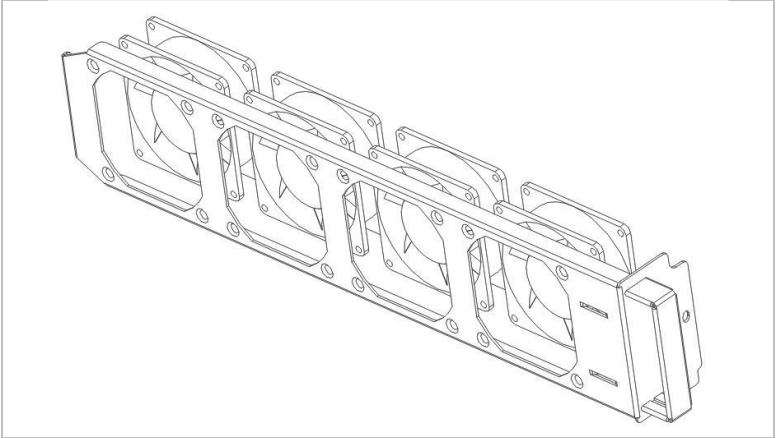
- Broken or faulty fans may cause cooling issues, which may lead to limited heat dissipation and a lower working efficiency of the inverter.

Please follow below steps for maintenance:

- 1 Check the connections to ensure all electric connections are turned off.
- 2 Unscrew the six screws at the four corners of the fan housing:



- 3 Unscrew the screws at the fan position, unplug the terminals at the interface between the fan and the inverter and then remove the fan:



- 4 Use a soft brush to clean the fan. In case of damage, ensure to replace it in time.
- 5 Reinstall the inverter according to the above steps.

9 Technical data

Datasheet	SOFAR 60KTLX-G3	SOFAR 80KTLX-G3
Input (DC)		
Number of MPPT trackers	6	
Number of DC inputs	2 for each MPPT	
Max. input voltage (V)	1100	
Start-up voltage (V)	200	
Rated input voltage (V)	620	
MPPT operating voltage range (V)	180 – 1000	
Full power MPPT voltage range (V)	480 – 850	
Max. input MPPT current (A)	6*40	
Max. input short circuit current per MPPT (A)	6*60	
Output (AC)		
Rated power (W)	60000	80000
Max. AC power (VA)	66000	88000
Max. output current (A)	100	133.3
Rated grid voltage	3 / N / PE, 230 / 400	
Grid voltage range	310 – 480 Vac (according to local standard)	
Rated frequency	50 Hz / 60 Hz	
Grid frequency range	45 – 55 Hz / 55 – 65 Hz (according to local standard)	
Active power adjustable range	0 – 100%	
THDi	< 3%	
Power factor	1 default (adjustable +/-0.8)	

Performance	
Max. efficiency	98.70%
European weighted efficiency	98.20%
Protection	
DC reverse polarity protection	Yes
Anti-islanding protection	Yes
Leakage current protection	Yes
Ground fault monitoring	Yes
PV-array string fault monitoring	Yes
Feed-in limitation function	Yes
DC switch	Yes
Input / output SPD	PV: type II standard, AC: type II standard
Communication	
Standard communication mode	RS485 / WiFi / Bluetooth, optional: Ethernet
General Data	
Ambient temperature range	-30°C – 60°C
Self-consumption at night (W)	<2
Topology	Transformerless
Degree of protection	IP66
Allowable relative humidity range	0 – 100%
Max. operating altitude	4000 m
Noise	< 60 dB
Weight (kg)	50
Cooling	Smart Fan Cooling
Dimension (mm)	687*561*275

Display	LCD, App via Bluetooth
Warranty	10 years, optional: up to 20 years
Standard	
EMC	EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4
Safety standards	IEC 62109-1/2, IEC 62116, IEC 61727, IEC 61683, IEC 60068(1,2,14,30), IEC 60255
Grid standards	VDE V 0124-100, V 0126-1-1, VDE-AR-N 4105, CEI 0-21/CEI 0-16, UNE 206 007-1, EN 50549, G98/G99, EN 50530



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