KACO new energy.

blueplanet
5.0 TL3 | 6.5 TL3
7.5 TL3 | 8.6 TL3
9.0 TL3 | 10.0 TL3

Operating Instructions

■ **English translation of German original**

These instructions form part of the product and must be observed. They must also be stored in a place which is freely accessible at all times.

Operating Instructions

EN

Contents

EN

1 General information

1.1 About this document

WARNING

Improper handling of the device can be hazardous!

› You must read and understand the operating instructions so that you can install and use the device safely!

1.1.1 Other applicable documents

During installation, observe all assembly and installation instructions for components and other parts of the system. These instructions also apply to the equipment, related components and other parts of the system. Some of the documents which are required for the registration and approval of your photovoltaic (PV) system are included with the operating instructions.

1.1.2 Storing the documents

These instructions and other documents must be stored near the system and be available at all times. The content of these instructions is revised on a regular basis and updated if necessary. You can download the current version of the operating instructions at www.kaco-newenergy.com.

1.1.3 English translation of German original

These operating instructions have been produced in several languages. The German-language version of the operating instructions is the original version. All other language versions are translations of the original operating instructions.

1.2 Layout of Instructions

1.2.1 Symbols used

General hazard

Risk of fire or explosion!

High voltage!

Risk of burns

Authorised electrician Only authorised electricians are permitted to carry out tasks indicated with this symbol!

1.2.2 Safety warnings symbols guide

DANGER

High risk

Failure to observe this warning will lead directly to serious bodily injury or death.

WARNING

Potential risk

Failure to observe this warning may lead to serious bodily injury or death.

CAUTION

Low-risk hazard

Failure to observe this warning will lead to minor or moderate bodily injury.

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CAUTION

Risk of damage to property

Failure to observe this warning will lead to property damage.

1.2.3 Additional information symbols

NOTE

Useful information and notes

EN **Country-specific function**

Functions restricted to one or more countries are labelled with country codes in accordance with ISO 3166-1.

1.2.4 Instructions symbols guide

Instructions

↻ Prerequisite(s) before carrying out the following step(s) (optional)

1. Carry out step.
2. (Additional steps, if applicable)

» Result of the step(s) (optional)

1.3 Target group

All activities described in the document may only be carried out by specially trained personnel with the following qualifications:

- Knowledge about how an inverter functions and operates
- Training in the handling of hazards and risks during the installation and operation of electrical devices and systems
- Education concerning the installation and startup of electrical units and systems
- Knowledge of applicable standards and directives
- Knowledge and adherence to this document with all safety notices.

2 Safety

DANGER

Lethal voltages are still present in the terminals and cables of the inverter even after the inverter has been switched off and disconnected!

Severe injuries or death will occur when touching the cables and terminals in the inverter.

› Only appropriately qualified and authorised electricians may open, install or maintain the inverter.

› Keep the inverter closed when the unit is in operation.

› Do not touch the cables or terminals when switching the unit on and off.

› Do not make any modifications to the inverter.

The electrician is responsible for observing all existing standards and regulations.

- In particular, be sure to observe the standard IEC-60364-7-712:2002 "Requirements for special installations or locations – solar photovoltaic (PV) power supply systems".
- Ensure operational safety by providing proper grounding, conductor dimensioning and appropriate protection against short circuiting.

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- Observe all safety instructions on the inverter and in these operating instructions.
- Switch off all voltage sources and secure them against being inadvertently switched back on before performing visual inspections and maintenance.
- When taking measurements while the inverter is live:
  - Do not touch the electrical connections.
  - Remove all jewellery from your wrists and fingers.
  - Ensure that the testing equipment is in safe operating condition.
- Stand on an insulated surface when working on the inverter.
- Modifications to the surroundings of the inverter must comply with the applicable national and local standards.
- When working on the PV generator, it is also necessary to switch off the DC voltage with the DC isolator switch in addition to disconnecting the PV generator from the grid.

2.1 Proper use

The inverter converts the DC voltage generated by the PV modules into AC voltage and feeds it into the grid. The inverter is built according to the latest technological standards and safety regulations. Nevertheless, improper use may cause lethal hazards for the operator or third parties, or may result in damage to the unit and other property.

Operate the inverter only with a permanent connection to the public power grid.

Any other or additional use of the device shall be regarded as improper. This includes:

- Mobile use
- Use in rooms where there is a risk of explosion
- Use in outdoor areas if the inverter is exposed to direct sunlight, rain or a storm
- Operation outside the specifications intended by the manufacturer
- Modifying the unit
- Standalone operation.

2.2 Protection features

The following monitoring and protective functions are integrated into KACO inverters:

- Overvoltage conductors/varistors to protect the power semiconductors from high-energy transients on the grid and generator side.
- Temperature monitoring of the heat sink
- EMC filters to protect the inverter from high-frequency grid interference
- Grid-side grounded varistors to protect the inverter against burst and surge pulses
- Islanding detection according to the current standards.

2.3 More information

NOTE

The EU Declaration of Conformity can be found in the appendix. For information on grid coupling, grid protection and safety parameters along with more detailed instructions see our web site at http://www.kaco-newenergy.de/.

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3 Description

3.1 Mode of Operation

The inverter converts the DC voltage generated by the PV modules into AC voltage and feeds it into the grid. The starting procedure begins when there is sufficient sunlight and a specific minimum voltage is present in the inverter. The feed-in process begins once the PV generator has passed the insulation test and the grid parameters are within the requirements imposed by the grid operator for a specific monitoring time. If, as it gets dark, the voltage drops below the minimum voltage value, feed-in operation ends and the inverter switches off.

3.2 Diagram

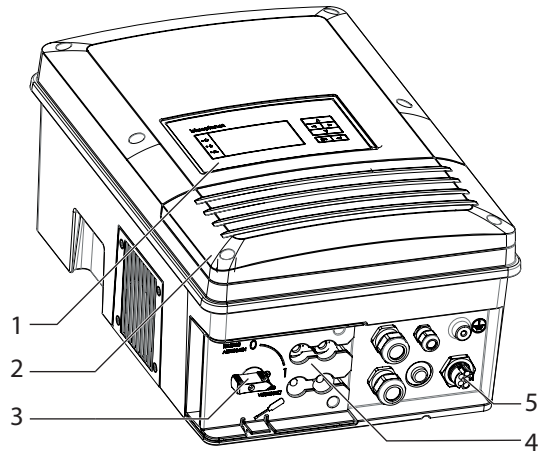

Figure 1: Inverter diagram

Key			
1	Control panel	4	DC connection (DC connector)
2	Cover for the connection area	5	AC connection (5-pole connecting plug)
3	DC isolator switch		

3.2.1 Mechanical components

DC isolator switch

The DC isolator switch is located on the underside of the inverter. The DC isolator switch is used to disconnect the inverter from the PV generator in order to carry out service.

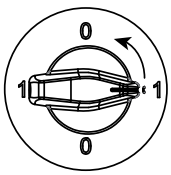

Figure 2: DC isolator switch

Disconnecting the inverter from the PV generator

☞ Switch the DC isolator switches from 1 (ON) to 0 (OFF).

Connecting the inverter to the PV generator

☞ Switch the DC isolator switches from 0 (OFF) to 1 (ON).

3.2.2 Electrical functions

A potential-free relay contact is integrated in the inverter. Use this contact for one of the following functions:

Fault signal relay

The potential-free relay contact closes as soon as there is a fault during operation. You use this function, for example, to signal a fault visually or acoustically.

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Priwatt

The energy that is provided by the PV system can be put to use directly by the appliances that are connected in your home.

The potential-free contact can switch larger appliances (e.g. air conditioning units) on and off with the "priwatt" function activated. This requires an external power supply and an external load relay.

When the function is active, either the remaining runtime (in hours and minutes) or the shutdown threshold (in kW) is displayed on the start screen depending on the operating mode selected. The "priwatt" function is not active in the factory default setting. The option can be configured in the Settings menu.

3.2.3 Interfaces

You configure the interfaces and the web server in the Settings menu.

The inverter has the following interfaces for communication and remote monitoring:

Ethernet interface

Monitoring can occur directly on the unit using the integrated Ethernet interface. A local web server is installed in the unit for this purpose.
For the monitoring of a system consisting of multiple inverters, we recommend the utilization of the Powador-web portal on our homepage.

RS485 interface

In addition to the monitoring via the Ethernet interface, the monitoring can be executed via the RS485 interface. For monitoring your PV system using the RS485 interface, KACO new energy GmbH offers monitoring devices.

Only the RS485 interface continues to transmit data if the inverter in an inverter group fails.

USB interface

The USB connection of the inverter is a type A socket. It is located on the connection circuit board behind the cover for the connection area. The USB connection is specified to draw 100 mA of power. Use the USB interface to read out stored operating data and to load software updates using a FAT32-formatted USB stick.

"Inverter Off" input

If Powador-protect is installed as a central grid and system protection, the fail-safe disconnection of suitable Powador or blueplanet inverters from the public grid can be initiated by a digital signal instead of interface switches. This requires the inverters in the photovoltaic system to be connected to the Powador-protect.

If a Powador-protect is used for fast shutdown, it must be used as grid protection. The RS485 interface is not required for this.

For information on the installation and use see this manual, the Powador-protect manual and the instructions for use of the Powador-protect on the KACO new energy website.

S0 interface (optional)

The S0 interface transmits pulses between a pulsing counter and a tariff metering unit. It is a galvanically isolated transistor output. It is designed according to DIN EN 62053-31:1999-04 (pulse output devices for electromechanical and electronic meters).

The S0 interface pulse rate can be chosen in three unit intervals (500, 1,000 and 2,000 pulses/kWh).

The optional extension module is available from the service department of KACO new energy.

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3.2.4 Inverter as part of a PV system

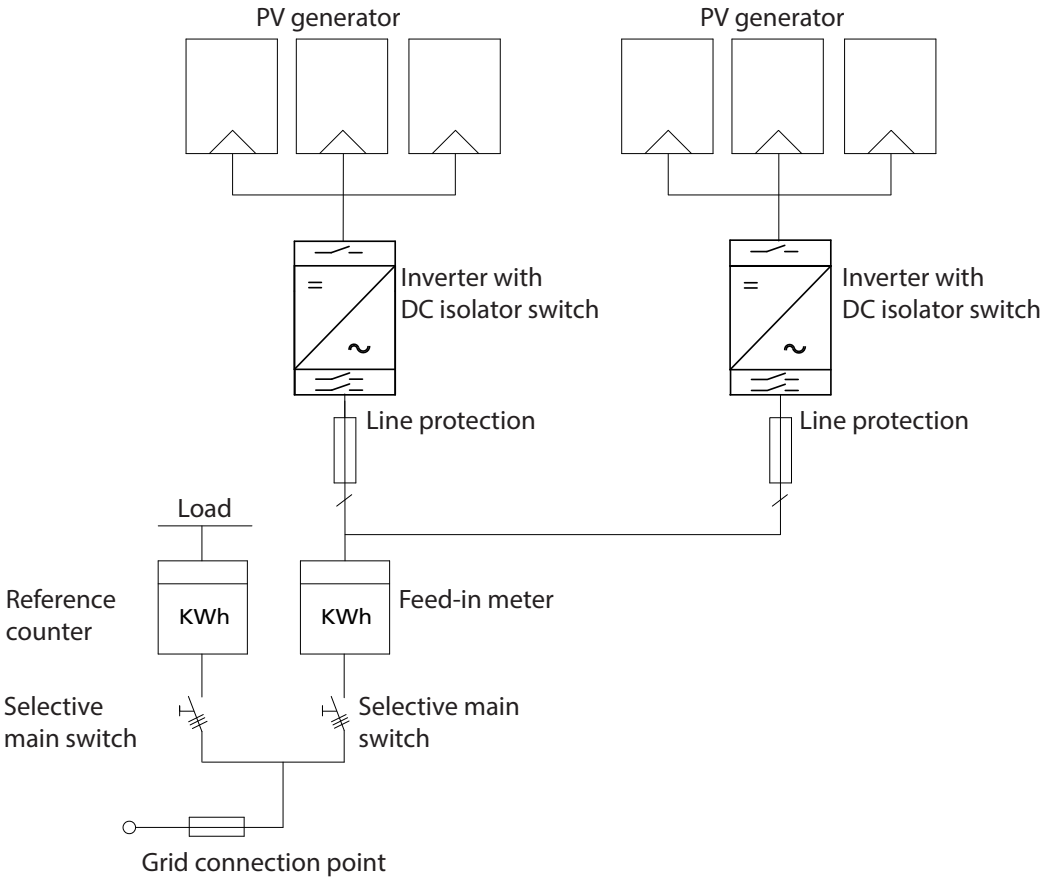


Figure 3: Circuit diagram of a system with two inverters

Key	Definition / Information about the connection
PV generator	The PV generator, i.e. the PV modules, converts the radiant energy of sunlight into electrical energy.
Inverter with:	
- DC connection	The PV generator is connected directly to the inverter's DC connection. 2 strings can be connected to the DC connection.
- DC isolator switch	Use the DC isolator switch to disconnect the inverter from all power sources on the PV generator side.
Circuit breaker	A circuit breaker is an overcurrent protection device.
Feed-in meter	The feed-in meter is to be specified and installed by the power supply company. Some power supply companies also allow the installation of your own calibrated meters.
Selective main switch	If you have questions about the selective main switch, contact your power supply company.

EN

4 Technical Data

4.1 Electrical data

Product name: KACO blueplanet	5.0 TL3	6.5 TL3	7.5 TL3
Input levels			
Recommended maximum DC power [kW]	6	7.8	9
MPP@Pnom from [V] to [V]	240 ... 800	310 ... 800	350 ... 800
Operating range from [V] to [V]		200 ... 950	
Starting voltage [V]*		250	
No-load voltage ($U_{OC\,max}$) [V]		1 000	
Max. input current [A]		2 x 11	
Max. power per MPP tracker [W]	5 200	6 700	7 700
Number of strings / MPP controls		2 / 2	
max. short-circuit current ($I_{SC\,max}$) [A]		16 (per tracker)	
max. input source feedback current		0	
Output levels			
Rated power [VA]	5 000	6 500	7 500
Grid voltage [V]	240 / 415 (3/N/PE) /230 / 400 (3/N/PE) / 220 / 380 (3/N/PE)		
Voltage range: continuous operation		305-480 (Ph-Ph)	
Rated current [A]	3x 7,00 @ 415 V; 3x 7,25 @ 400 V; 3x 7,60 @ 380 V	3x 9,10 @ 415 V; 3x 9,50 @ 400 V; 3x 9,90 @ 380 V	3x 10,50 @ 415 V; 3x 10,90 @ 400 V; 3x 11,40 @ 380 V
max continous current [A]	3 x 8.00	3 x 10.50	3 x 12.00
Contribution to peak short-circuit current (îp) [A]		35	
Initial short-circuit alternating current (Ik" first single period effective value) [A]		16.5	
Start-up current [A]		1.03	
Rated frequency / Frequency range [Hz]		50/60 / 45 - 65 Hz	
cos phi		0.30 inductive ...0.30 capacitive	
Number of feed-in phases		3	
THD [%]		3.85	
General electrical data			
Efficiency [%]	98.3	98.3	98.3
European efficiency [%]	97.4	97.6	97.7
Power consumption: Night [W]		2	
Feed-in starts at [W]		20	
Circuit design		Transformerless	
Grid monitoring		Country-specific	
Ground fault monitoring		Yes	

Table 1: Electrical data

Product name: KACO blueplanet	8.6 TL3	9.0 TL3	10.0 TL3
Input levels			
Recommended maximum DC power [kW]	10.3	10.8	12
MPP@Pnom from [V] to [V]	403 ... 800	420 ... 800	470 ... 800
Operating range from [V] to [V]		200 ... 950	
Starting voltage [V]*		250	
No-load voltage ($U_{OC\ max}$) [V]		1 000	
Max. input current [A]		2 x 11	
Max. power per MPP tracker [W]	8 800	8 800	8 880
Number of strings / MPP controls		2 / 2	
max. short-circuit current ($I_{SC\ max}$) [A]		16 (per tracker)	
max. input source feedback current		0	
Output levels			
Rated power [VA]	8 600	9 000	10 000
Grid voltage [V]	240 / 415 (3/N/PE) /230 / 400 (3/N/PE) / 220 / 380 (3/N/PE)		
Voltage range: continuous operation		305-480 (Ph-Ph)	
Rated current [A]	3x 12,00 @ 415 V; 3x 12,50 @ 400 V; 3x 13,10 @ 380 V	3x 12,60 @ 415 V; 3x 13,00 @ 400 V; 3x 13,70 @ 380 V	3x 14,95 @ 415 V; 3x 14,50 @ 400 V; 3x 15,20 @ 380 V
max continous current [A]	3 x 13.20	3 x 14.00	3 x 15.50
Contribution to peak short-circuit current (îp) [A]	41	35	41
Initial short-circuit alternating current (Ik" first single period effective value) [A]	18.9	16.5	18.9
Start-up current [A]		1.03	
Rated frequency / Frequency range [Hz]		50/60 / 45 - 65 Hz	
cos phi		0.30 inductive ...0.30 capacitive	
Number of feed-in phases		3	
THD [%]		3.85	0,7
General electrical data			
Efficiency [%]	98.3	98.3	98.3
European efficiency [%]	97.9	97.9	97.9
Power consumption: Night [W]		2	
Feed-in starts at [W]		20	
Circuit design		Transformerless	
Grid monitoring		Country-specific	
Ground fault monitoring		Yes	

Table 2: Electrical data

EN

4.2 Mechanical data

Product name: KACO blueplanet	5.0-10.0 TL3
Display	Graphical LCD, 3 LEDs
Controls	4-way button, 2 buttons
Interfaces	2 x Ethernet, USB, RS485, error relay 4 x digital inputs (optional)
Fault signal relay	Potential-free NO contact 30 V / 1 A
AC connections	5-pole connection plug
DC connections	4 (2 x 2) SUNCLIX connector
Ethernet connection: Cable connection	Cable connection via M25 cable fitting
Ambient temperature range [°C]	-25 ... +60, power derating from +40
Humidity range (non-condensing) [%]	100
Maximum installation elevation [m above sea level]	3000
Temperature monitoring	Yes
Cooling (free convection (K) / fan (L))	L
Protection rating according to EN 60529	IP65
Degree of contamination	2
Noise emission [dB(A)]	<53
DC isolator switch	Built-in
Housing	Plastic (ASA/PC), aluminium
H x W x D [mm]	approx. 522 x 363 x 246
Total weight [kg]	30
CE conformity	Yes

Table 3: Mechanical data

* The DC starting voltage can be set in the menu if needed.

4.3 Identification

Identifying the unit

↻ You will find the name plate with product-specific data for service and other requirements specific to installation on the right side panel of the inverter. This data includes:

- Product name
- Part no.
- Serial no.
- Date of manufacture
- Technical Data
- Disposal information
- Certification marking, CE marking.

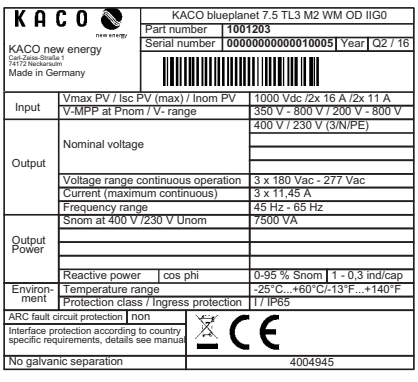


Figure 4: Name plate

EN

5 Transportation and Delivery

Every inverter leaves our factory in proper electrical and mechanical condition. Special packaging ensures that the units are transported safely. The shipping company is responsible for any transport damage that occurs.

5.1 Scope of delivery

- 1 inverter
- 1 wall bracket
- 1 installation kit
- 1 set of documentation (DE, EN, quick start guide in other languages)

Checking your delivery

1. Inspect your inverter thoroughly.
2. Immediately notify the shipping company in case of the following:
   - Damage to the packaging that indicates that the inverter may have been damaged
   - Obvious damage to the inverter.
3. Send a damage report to the shipping company immediately.

The damage report must be received by the shipping company in writing within 6 days following receipt of the inverter. We will be glad to help you if necessary.

5.2 Transportation

CAUTION

Impact hazard, risk of breakage to the inverter

› Pack the inverter securely for transport.
› Carefully transport the inverter using the carrying handles of the packaging box.
› Do not subject the inverter to shocks.

For safe transportation of the inverter, use the holding openings in the carton.

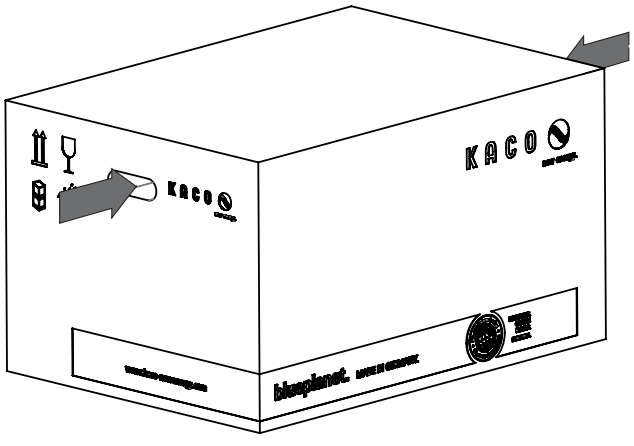


Figure 5: Transportation of the inverter

Packaging (folding cartons) (H x W x D (mm))	390 x 510 x 660
Total weight [kg]	35.2

Table 4: Dimensions and weight

EN

6 Mounting

DANGER

Risk of fatal injury due to fire or explosions!

Fire caused by flammable or explosive materials in the vicinity of the inverter can lead to serious injuries.

› Do not mount the inverter in an area at risk of explosion or in the vicinity of highly flammable materials.

CAUTION

Risk of burns from hot housing components!

Coming into contact with the housing can cause burns.

› Mount the inverter so that it cannot be touched unintentionally.

Installation location

- As dry as possible, climate-controlled, with the waste heat dissipated away from the inverter
- Air circulation should not be blocked
- When installing the unit in a control cabinet, provide forced ventilation so that the heat is sufficiently dissipated
- Access to the inverter must also be possible without additional tools
- For outdoor installation, fit the inverters in such a way that they are protected against direct sunlight, moisture and dust penetration
- For easy operation, ensure during installation that the display is slightly below eye level.

Wall surface

- Must have adequate load-bearing capacity
- Must be accessible for installation and maintenance
- Must be made of heat-resistant material (up to 90 °C)
- Flame resistant
- Minimum clearances to be observed during assembly: see Figure 10 on page 16.

NOTE

Access by maintenance personnel for service

Any additional costs arising from unfavourable structural or mounting conditions will be billed to the customer.

CAUTION

Property damage due to gases that have an abrasive effect on surfaces when they come into contact with ambient humidity caused by weather conditions.

The inverter housing can be severely damaged by gases (ammonia, sulphur, etc.) if it comes into contact with ambient humidity caused by weather conditions.

If the inverter is exposed to gases, it must be mounted so that it can be seen at all times.

› Perform regular visual inspections.

› Immediately remove any moisture from the housing.

› Take care to ensure sufficient ventilation of the inverter.

› Immediately remove dirt, especially on vents.

› Failure to observe these warnings may lead to inverter damage which is not covered by the KACO new energy GmbH manufacturer warranty.

EN

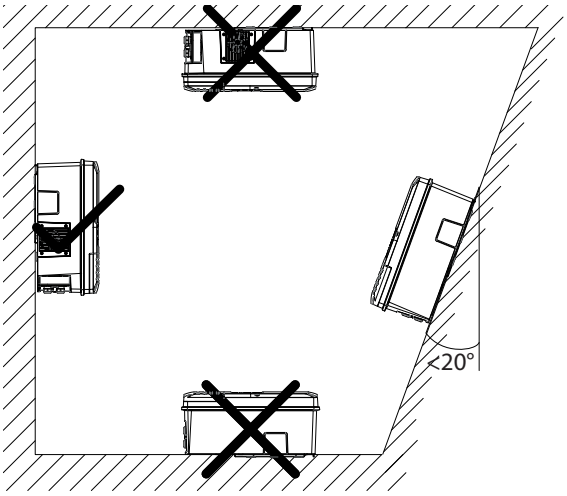


Figure 6: Instructions for wall mounting

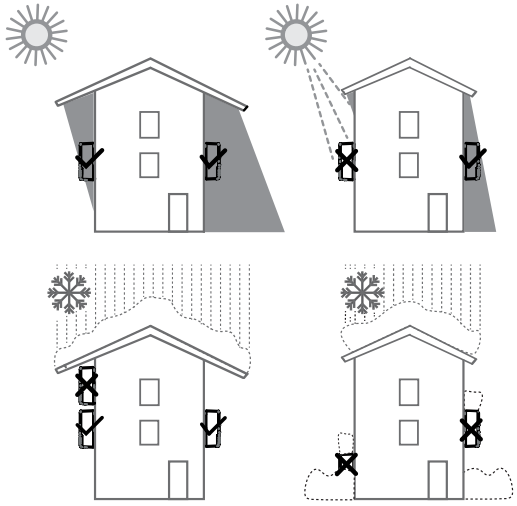


Figure 7: Inverter for outdoor installation

CAUTION

Use suitable mounting parts.

- Use mounting material suitable for the subsurface or the mounting material included in the delivery.
- Mount the inverter upright on a vertical wall only.
- For a free-standing mounting an incline of 20° is permissible.
- For upright installation outdoors: Weather-proof base required.

6.1 Unpacking

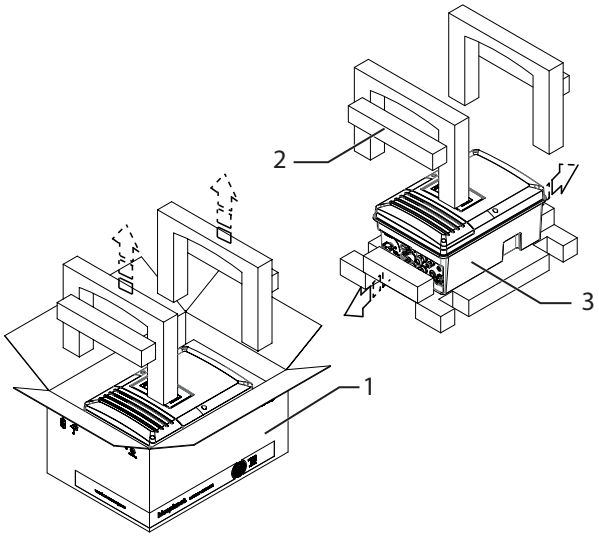


Figure 8: Unpacking the unit

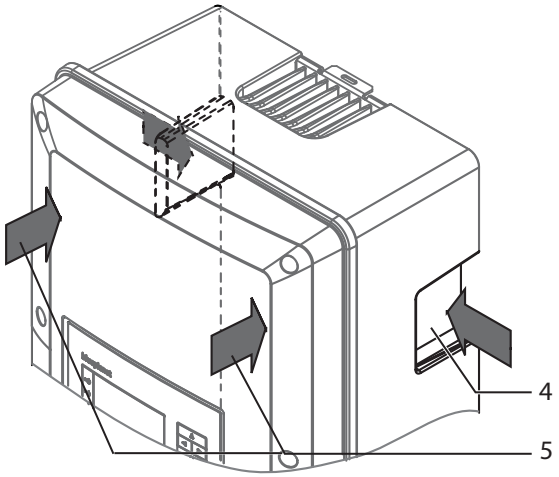


Figure 9: Erect the device

Key			
1	Carton	4	Opening for erection purposes
2	Protective packaging	5	Centre of gravity
3	Inverter		

EN

CAUTION

Risk of injury caused by excessive physical strain.

Lifting the device for transportation or to change location can lead to injuries (e.g. back injuries).

› Only lift the unit using the openings provided.

› The unit must be transported and installed by at least 2 persons.

Unpacking the unit

↻ The unit is transported to the installation location.

1. Open carton at the front.
2. Remove installation material and documentation.
3. Pull up top protective packaging for removal.
4. Remove inverter from the packaging.
5. Place the protective packaging back into the carton.
6. Lift the inverter at the intended positions and erect (see Figure 9 on page 15).

» If the unit is in the correct installation position: Proceed with the installation of the wall holder.

6.2 Installing the wall bracket

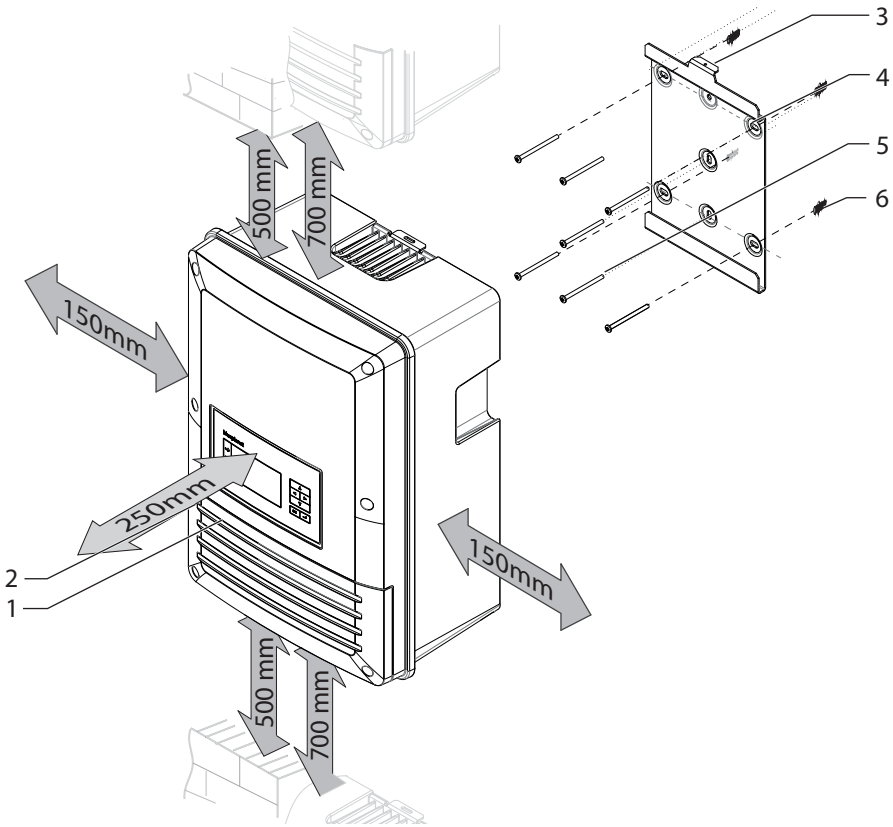


Figure 10: Minimum distances/wall bracket

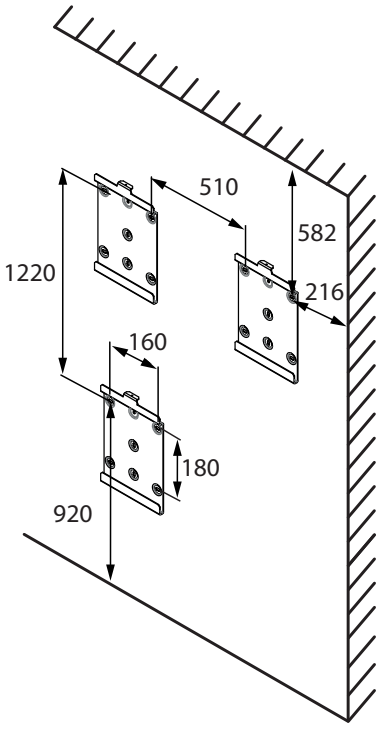


Figure 11: Position of wall bracket / suspension

Key

1	Cover for connection area	4	Wall bracket
2	Screws for mounting (2x Torx)	5	Screws for mounting
3	Bracket with detachment protector	6	Fixings for mounting

EN

Installing the wall bracket

↻ Remove wall bracket and mounting kit from the packaging.

1. Mark the positions of the drill holes using the slots in the wall bracket.
   NOTE: The minimum clearances between two inverters, or the inverter and the ceiling/floor have already been taken into account in the diagram.
2. Fix wall bracket to the wall with the supplied mounting fixtures.
   Make sure that the wall bracket is aligned correctly.

» Proceed with the installation of the unit.

6.3 Installing the unit

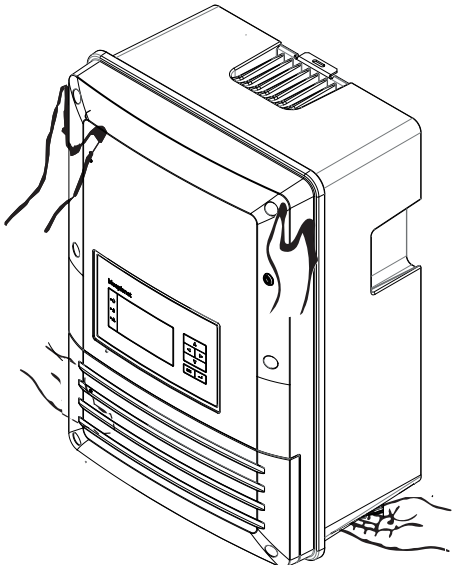


Figure 12: Lift the unit

Installing the unit

1. Hang the inverter on the wall bracket using the suspension brackets on the back of the housing.
2. Secure the inverter with the enclosed screw to the detachment protector on the wall bracket.

» The mounting of the inverter is complete. Continue with the installation.

NOTE

Power reduction due to heat accumulation.

If the recommended minimum clearances are not observed, the inverter may go into power regulation mode due to insufficient ventilation and the resulting heat build-up.

› Maintain minimum clearances.

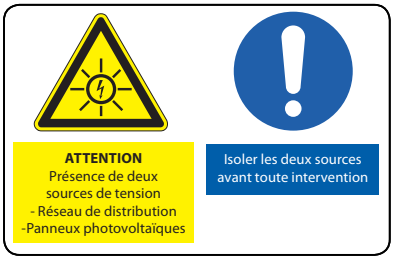
› Provide for sufficient heat dissipation.

FR

Attachment of safety label in accordance with UTE C 15-712-1

The code of practice UTE C 15-712-1 requires that, upon connection to the French low-voltage distribution network, a safety sticker showing a warning to isolate both power sources when working on the device must be attached to each inverter.

☞ Attach the provided safety sticker visibly to the outside of the inverter housing.



Authorised electrician

EN

7 Electrical connection

DANGER

Lethal voltages are still present in the terminals and cables of the inverter even after the inverter has been switched off and disconnected!

Severe injuries or death will occur when touching the cables and terminals in the inverter.

The inverter may only be opened and installed by an accredited electrician, who has been approved by the public power supplier (country-specific).

The inverter must be mounted in a fixed position before being connected electrically.

- Observe all safety regulations and current technical connection specifications of the responsible power supply company.
- Disconnect the AC and DC sides.
- Secure both sides against being inadvertently switched back on.
- Ensure that the AC and DC sides are completely isolated and voltage free.
- Connect the inverter only after the aforementioned steps have been taken.

7.1 Preparing the AC connection

7.1.1 Opening and viewing the connection area

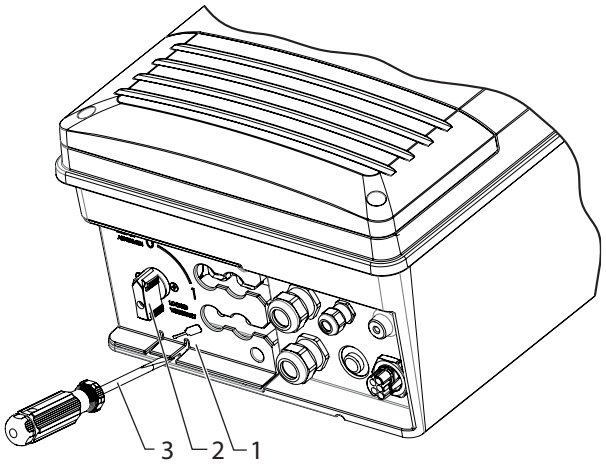


Figure 13: Uncover the DC connection

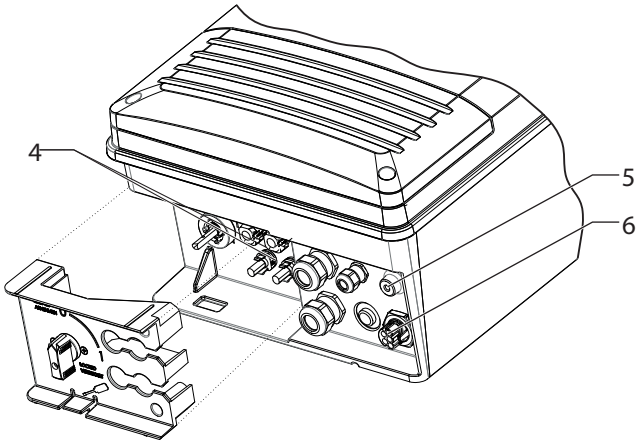


Figure 14: Connection area: Electrical connection

Key			
1	Cover to safeguard the DC connections	4	DC connector for PV generator
2	DC isolator switch	5	Housing grounding
3	Screwdriver	6	AC connection socket for grid connection

Open connection area

↻ You have mounted the inverter on the wall.

1. Switch the DC isolator switches to 0 to remove the cover.
2. Carefully unlatch cover at the marked position using a screwdriver.
3. Remove cover and store for connection
4. Surveying the connection area

» Configure AC connection plug.

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7.1.2 Configure AC connection plug

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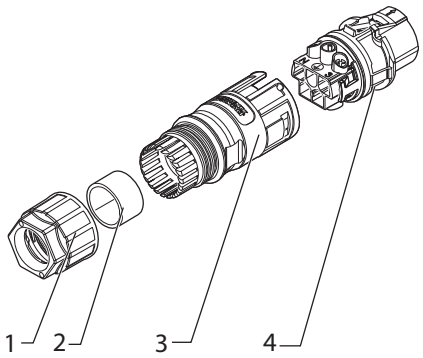

Figure 15: AC connection plug

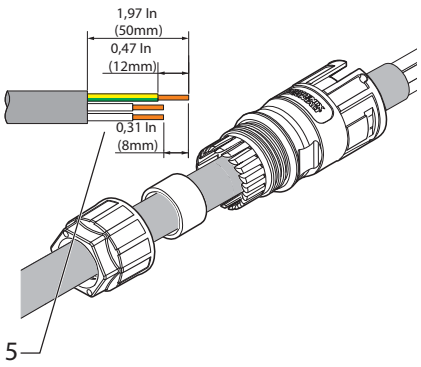

Figure 16: Remove cable insulation

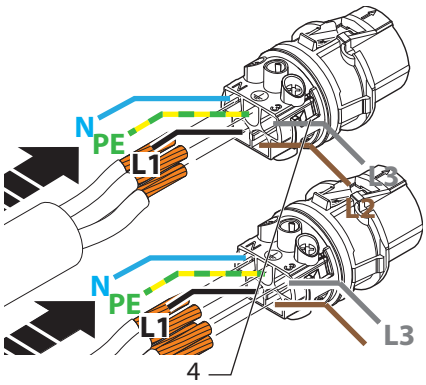

Figure 17: Connect cable to the contact carrier

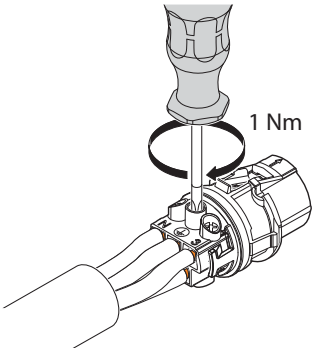

Figure 18: Tighten screws

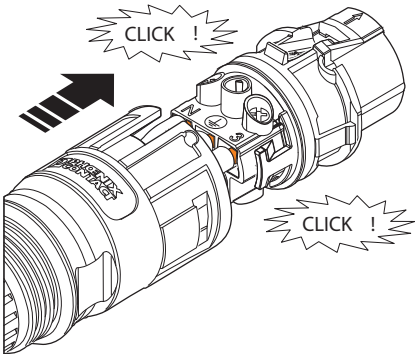

Figure 19: Press contact carrier into the housing

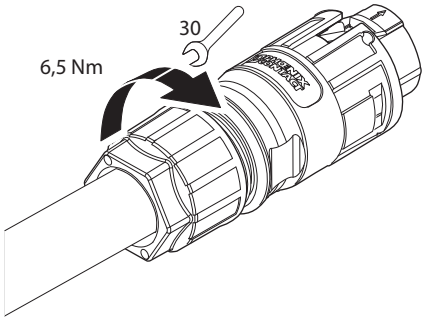

Figure 20: Tighten the cable screw fitting

Key

1	Cable fitting	4	Contact plug
2	Seal	5	Cable lengths
3	Housing		

Configure AC connection plug

↻ Connection area opened.

1. Slide the cable fitting over the cable.
2. Select seal according to cable diameter used (8 ... 12 mm/ 12 ... 16 mm/ 16 ... 21 mm).
3. Slide the housing and seal over the cable.
4. Remove 50 mm of the outer cladding.
5. Shorten wires N, L1, L2, L3 by 8 mm.
6. Strip 12 mm of the insulation from wires (N, L1, L2, L3 , PE).
7. With flexible wires we recommend the use of wire sleeves conforming to DIN 46228 that are pressed together using crimping pliers (CRIMPFOX 6).
8. Insert wires into the contacts in accordance with the markings on the contact carrier.
9. Tighten the screws on the contact carrier with 1 Nm.
10. Press contact carriers into the housing with an audible "click".
11. Secure the housing with a screwdriver (size 30).
    Tighten the cable fitting using a torque of 6.5 Nm.

» Make the electrical connection.

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NOTE

The permissible bending radius of at least 4 x the cable diameter should be observed during installation. Excessive bending force may negatively impact the protection rating.
All mechanical loads must be absorbed in front of the connection plug.

7.1.3 Cable and fuse requirements

NOTE

Select the following specifications in accordance with the following master conditions:

- Country specific installation standards
- Line length
- Type of line installation
- Local temperatures

Note the following cable cross-sections and the required tightening torques:

	AC connection	DC connection
Max. cable cross-section without wire sleeves	2.5 - 6.0 mm²	2.5-6 mm² (DC plug connector)
Max. cable cross-section with wire sleeves	4.0 mm²	-
Length of insulation to be stripped off	12 mm	
Tightening torque	1 Nm (on contact carrier)	
String fuses	max. 25 A	-
Overvoltage conductor	Installed internally, Type III, 1 per MPP tracker	
Combiner box	-	Installed internally
Protection class	3	
Overvoltage category	III	

Table 5: Recommended cable cross-sections/protection devices

7.2 Connection to the power grid

The power connection wires are connected on the right of the connection area (see Figure 21 on page 20).

NOTE

If the cable impedance is high (i.e. long grid-side cables), the voltage at the grid terminals of the inverter will increase during feed-in to the grid. The inverter monitors this voltage. If it exceeds the country-specific grid overvoltage limit value, the inverter switches off.

› Ensure that the cable cross-sections are sufficiently large or that the cable lengths are sufficiently short.

Making the grid connection

↻ AC connection plug configured.

1. Connect the configured plug connectors to the device connector by fitting into place.
2. Lay the lead correctly and in accordance with the following rules:
   - Lines around the enclosure are installed with a distance of more than 20 cm
   - Cable not via semiconductor (cooling body)
   - Excessive bending force may negatively impact the protection rating. Lay the lead with a bending radius of at least 4 times the cable diameter.

» The inverter is now connected to the power grid.

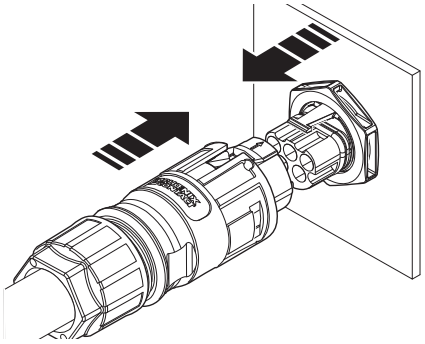

Figure 21: Engage the AC connector with the device connector.

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NOTE

An AC-side disconnection unit must be provided during the final installation stage. This cut-off mechanism must be installed so that it can be accessed at any time without obstruction.

NOTE

If a residual current circuit breaker is necessary due to the installation specification, a type A residual current circuit breaker must be used.

If the type **A** is used, the insulation threshold must be set **to greater than/equal (>) 200kOhm** in the "Parameters" menu (section 8.3 on page 33).

For questions regarding the appropriate type, please contact your installer or our KACO new energy customer service.

7.3 Preparing the DC connection

7.3.1 Configuring the DC plug connector

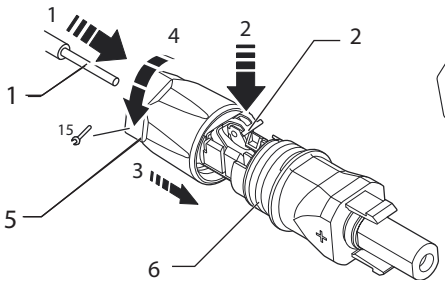

Figure 22: Insert wires

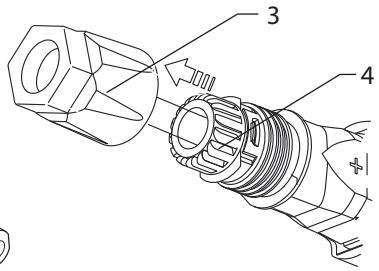

Figure 23: Slide insert into sleeve

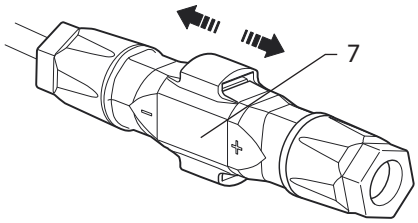

Figure 24: Check fastening

Key

1	Wire for DC connection	5	Cable fitting
2	Spring	6	Contact plug
3	Insert	7	Coupling
4	Sleeve		

Configuring the DC plug connector

NOTE: Before proceeding with the isolation ensure that you do not cut any individual wires.

1. Isolate wire for DC connection by 15 mm.
2. Insert isolated wire with twisted ends carefully up to the end stop.

NOTE: Wire ends must be visible in the spring.

3. Close the spring so that the spring latches.
4. Slide insert into sleeve.
5. Tighten cable fitting with the help of a 15 mm fork wrench applying a torque of 2 Nm.
6. Join insert with contact plug.
7. Check latch by lightly pulling on the coupling.

» Make the electrical connection.

NOTE

The permissible bending radius of at least 4x the cable diameter should be observed during installation. Excessive bending force may negatively impact the protection rating.

› All mechanical loads must be absorbed in front of the plug connection.

› Rigid adaptations are not permitted on DC plug connectors.

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7.3.2 Checking the PV generator for a ground fault

DANGER

Risk of fatal injury due to electric shock!

Severe injury or death will result if the live connections are touched. When there is solar radiation, DC voltage will be present at the open ends of the DC cables.

› Only touch the PV generator cables on the insulation. Do not touch the exposed ends of the cables.

› Avoid short circuits.

› Do not connect any strings with a ground fault to the unit.

DANGER

Risk of fatal injury due to contact voltage!

› In accordance with IEC62109-1 §5.3.1., grounding on the PV modules or strings is prohibited under any circumstances.

Checking the PV generator for a ground fault

1. Determine the DC voltage between:
   - protective earth (PE) and the positive cable of the PV generator
   - protective earth (PE) and the negative cable of the PV generator.

If stable voltages can be measured, there is a ground fault in the DC generator or its wiring. The ratio between the measured voltages gives an indication as to the location of this fault.

2. Rectify any faults before taking further measurements.
3. Determine the electrical resistance between:
   - protective earth (PE) and the positive cable of the PV generator
   - protective earth (PE) and the negative cable of the PV generator.

In addition, ensure that the PV generator has a total insulation resistance of more than 2.0 MOhm, since the inverter will not feed in if the insulation resistance is too low.

4. Rectify any faults before connecting the DC generator.

7.3.3 Designing the PV generator

NOTE

In accordance with IEC 61730 Class A, connected PV modules must be dimensioned for the DC system voltage provided, and at least for the value of the AC grid voltage.

7.4 Connecting the PV generator

DANGER

Risk of fatal injury due to contact voltage!

› During installation: Electrically disconnect the DC positive and DC negative from the protective earth (PE).

› Disconnect the inverter from the PV generator using the integrated DC isolator switch.

› Remove the plug connector.

Connect the PV generator to the 2 DC positive and the 2 DC negative connection plugs on the underside of the housing (see Figure 25 on page 23). Note the wiring examples given below. The inverter detects these typical configurations automatically. In individual cases, you need to set the selected DC connection after installation in the menu.

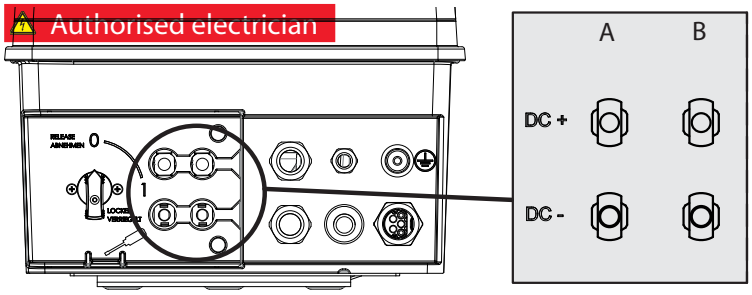

Figure 25: Connections for DC positive and DC negative

Key			
A	MPP tracker A	B	MPP tracker B
	DC-Plus/DC-Minus-Connections to MPP tracker A		DC-Plus/DC-Minus-Connections to MPP tracker B

7.4.1 Maximum generator power

The input power of the inverter is limited only by the maximum input current per input. This causes the maximum input power to increase with the input voltage.

NOTE

The overall power of the unit continues to be limited. If the first input is connected to more than P_{max} per MPP tracker, the maximum input power of the second input is reduced.

DANGER

In the expected temperature range of the generator, the values for the no-load-voltage and the short circuit current must never exceed the values for U_{ocmax} and I_{scmax} in accordance with the technical data. (See Table 1 on page 10)

7.4.2 Connection

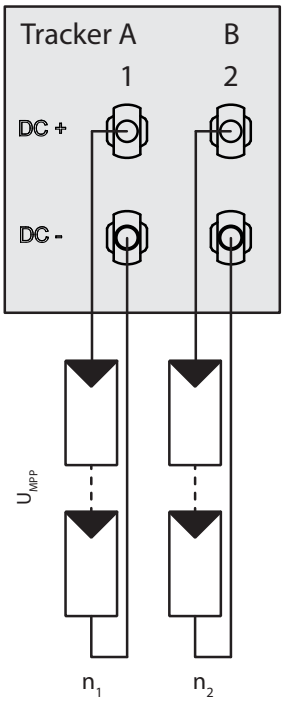

Figure 26: Two generators each on one MPP tracker

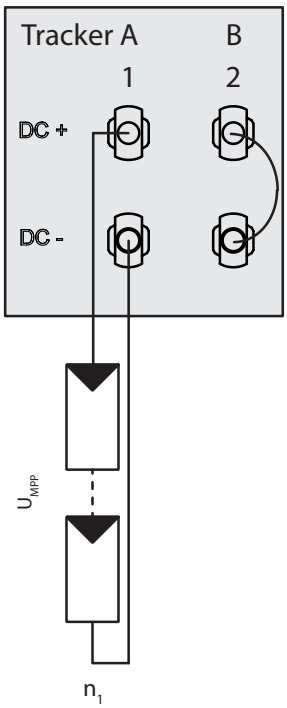

Figure 27: One generator on 1st tracker, second tracker eactivated

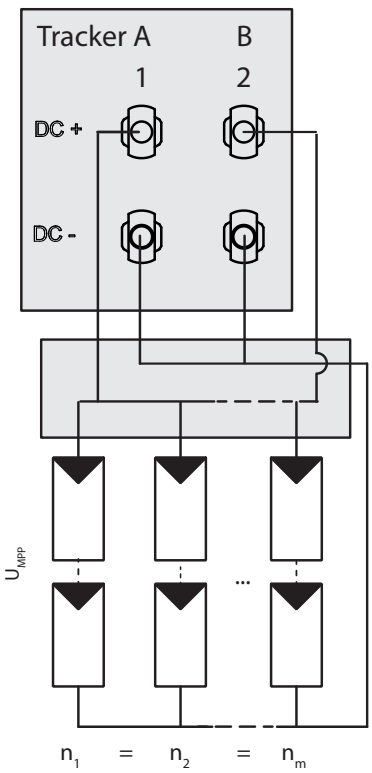

Figure 28: One generator parallel on both MPP trackers

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1.) Two generators each on one MPP tracker	2.) One generator on 1st tracker, second tracker deactivated	3.) One generator parallel on both MPP trackers
The MPP voltages of the two DC lines can be different.The MPP voltages of the two DC paths can be different. They are tracked by separate, independently operating MPP trackers (MPP trackers A and B). Select the wiring option in the menu item "DC connection" on page 39	If one of the MPP trackers (A or B) is not used, then it must be short-circuited, otherwise faults can occur during the self-test of the unit and the feed-in operation is not guaranteed. The short-circuiting of an MPP tracker does not result in the device being damaged.	The DC inputs can also be connected in parallel. In this case, only lines with the same MPP voltage may be connected in parallel (Un1=Un2=Unm). The maximum permissible rated current (DC) doubles with parallel connection of both MPP trackers. In case of a parallel input connection, MPP trackers A and B must be bridged. Select the wiring option in the menu item "DC connection" on page 39
Electrical data		
I_{max} Depending on PV generator. The input current per tracker must not be exceed 11A.		≤ 2 * max. rated current (DC)

NOTE

Always use the 1 or 3 switch variant, before an MPP tracker is short-circuited and therefore remains unused.

7.4.3 Connecting the PV generator

DANGER

Risk of fatal injury due to electric shock!

Severe injury or death will result if the live connections are touched. When there is solar radiation, DC voltage will be present at the open ends of the DC cables.

› Do not touch the exposed ends of the cables.

› Avoid short circuits.

Connecting the PV generator

1. Remove protective caps from the DC connection plugs.
2. Connect PV generator to the DC plug connectors on the underside of the housing.
3. Meet the requirements of the protection rating by closing the unused plug connectors with protective caps.
4. Put on cover to safeguard the DC connections and latch into place by pressing it. (Figure 25 on page 23

» The inverter is connected to the PV generator.

7.5 Grounding the housing

DANGER

Dangerous voltage due to two operating voltages!

Severe injuries or death may occur if the cables and terminals in the device are touched.

› The discharge time of the capacitors is up to 5 minutes. It is not permissible to open the device until this time has expired.

› Establish ground connection under all circumstances before connecting the supply circuit.

› Make sure that the device is isolated from the public power supply and the system power supply before starting work.

An optional grounding of the housing is possible at the grounding point provided for that purpose in the connec-

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tion area of the inverter. Please observe any national installation regulations in this regard.

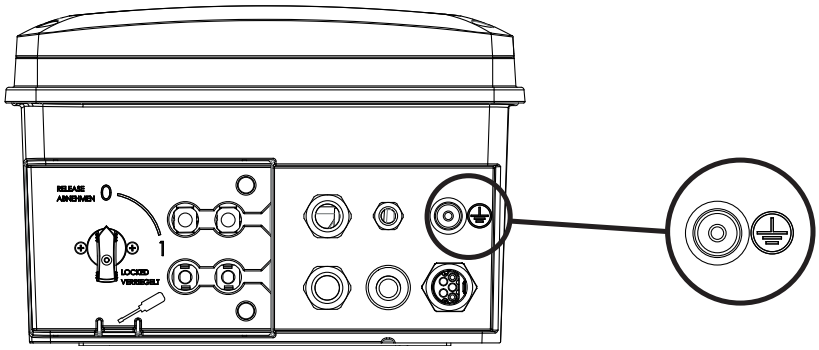

Figure 29: Grounding point in the connection area

Grounding the housing

1. Detach cable fitting for grounding the housing.
2. Remove the insulation from the grounding cable and isolate.
3. Furnish the stripped cable with an M4 ring cable lug.
4. Screw the ring cable lug to the grounding point with an M4/TX30 screw.
5. Check that the cable is secure.

» Housing is grounded.

7.6 Connecting the interfaces

All interfaces are located on the connection circuit board behind the cover for the connection area. Use the cable fittings and plug connections provided (see Figure 31 on page 26).

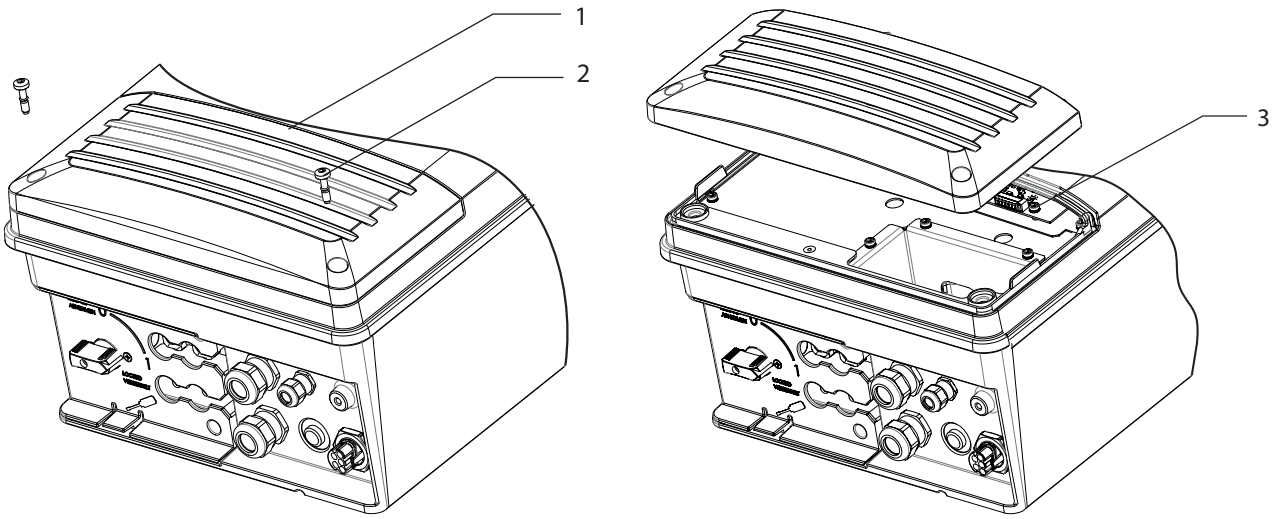

Figure 30: Access to connection area of the interfaces

Key			
1	Cover for connection area (interfaces)	2	Screws for mounting
3	Connection circuit board		

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DANGER

Risk of fatal injury due to electric shock!

Severe injury or death may result from improper use of the interface connections and failure to observe protection class III.

› The SELV circuits (SELV: safety extra low voltage) can only be connected to other SELV circuits with protection class III.

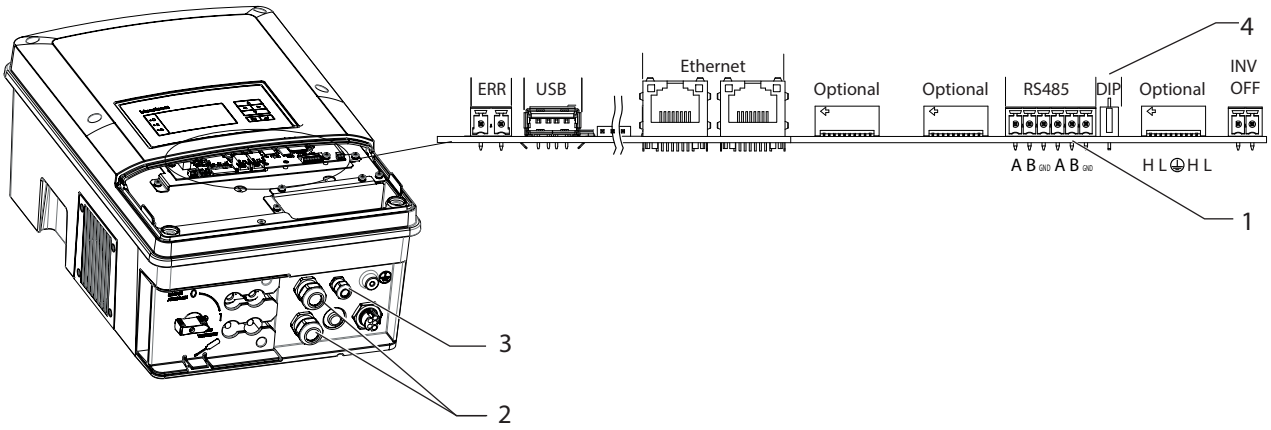

Figure 31: Connection area: Connection and assignment of the interfaces

Key			
1	Interface connections / pin assignment	3	Cable fitting for RS485 connection cable
2	Cable fitting (M25) for Ethernet connection cable	4	DIP switch for terminating resistor R_a

7.6.1 Connecting the fault signal relay

DANGER

Risk of fatal injury due to electric shock!

Severe injury or death may result from improper use of the interface connections.

› Ensure that for a connection, no grid voltage of insulated or just separated cables reaches SELF areas.

› Cap cables short enough that individual wires cannot come in contact with other cables or components on the hard drive.

The contact is designed as an N/O contact and is labelled "ERR" on the circuit board.

Maximum contact load	
DC	30 V/1 A

Connecting the fault signal relay

1. Unscrew the cable fitting.
2. Thread the connection cables through the cable fitting.
3. Attach the connection cables to the terminal clamps.
4. Tighten the cable fitting.

EN

7.6.2 Connecting the Ethernet interface

NOTE

The connection plug of an RJ45 cable is larger than the opening of an M25 cable fitting when it is installed. For this reason, remove the sealing insert before installation and thread the Ethernet cable outside of the cable fitting through the sealing insert.

NOTE

Use a suitable network cable of at least category 5. The maximum length of a network segment is 100 m. Ensure that the cable is correctly assigned. The Ethernet connection of the inverter supports auto-sensing. You can use both crossed and 1:1 protectively-wired Ethernet connection cables.

Connecting an Ethernet cable to the inverter

1. Loosen and remove the cover of the cable fitting (see Figure 31 on page 26).
2. Remove the sealing insert.
3. Thread the connection cable through the cover of the cable fitting and the sealing insert.
4. Insert the sealing insert into the cable fitting.
5. Connect the connection cables to one of the corresponding Ethernet interfaces (see Figure 31 on page 26).
6. Attach and tighten the cover of the cable fitting.

Connecting the inverter to the network

↻ Connect the Ethernet cable to the inverter.

↻ Configure the Ethernet interface in the configuration menu.

☞ Connect the Ethernet cable to the network or a computer.

☞ Configure the Ethernet settings and the web server in the Settings/Network menu.

7.6.3 Connecting the RS485 bus

NOTE

Ensure that the DATA+ and DATA- wires are properly connected. Communication is not possible if the wires are reversed!

Different manufacturers do not always interpret the standard on which the RS485 protocol is based in the same way. Note that the wire designations (DATA- and DATA+) for wires A and B may vary from one manufacturer to another.

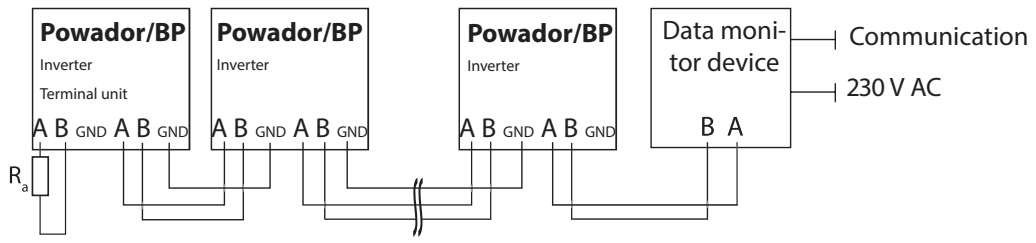

Figure 32: RS485 interface wiring diagram

Properties of the RS485 data line	
Maximum length of the RS485 bus line	The maximum permitted length of the RS485 bus is 1200 m. This length can be reached only under optimum conditions. Cable lengths exceeding 500m generally require a repeater or a hub.
Maximum number of connected bus devices	30 inverters + 1 data monitoring unit

EN

Data line	Twisted, shielded. Recommendations: LI2YCYv (twisted pair) black for laying cable outside and in the ground, 2 x 2 x 0.5 LI2YCY (twisted pair) grey for dry and damp indoor spaces, 2 x 2 x 0.5

Connecting the RS485 bus

☞ To prevent interference during data transmission:

- When connecting wire A (-) and wire B (+), observe the wire pairing (Figure 33)
- Do not lay RS485 bus lines in the vicinity of live DC/AC cables.

1. Unscrew the cable fitting.
2. Thread the connection cables through the cable fitting.
3. Connect the connection cables to the corresponding connection terminals (see Figure 31 on page 26).
4. Connect all inverters and the data monitoring unit in this way:
   – Wire A (-) to wire A (-)
   – Wire B (+) to wire B (+) and GND to GND (Figure 32 on page 27)
5. Tighten the cable fitting.
6. Activate the terminating resistor on the terminal unit. (Figure 31 on page 26)

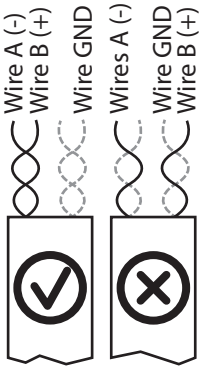

Figure 33: Assignment of twisted-pair wires

7.6.4 Connecting "Inverter Off"

NOTE

The Powador-protect digital output can only be used with suitable KACO inverters. When using devices from other manufacturers or in combination with KACO inverters, external bus coupler circuit-breakers as a minimum must be used for shutting down devices from other manufacturers.

Connecting and activating “INV OFF" digital input

↻ Can only be used with suitable KACO inverters.

1. Unscrew the cable fitting.
2. Thread the connection cables through the cable fitting.
3. Connect wire A (+) to the terminal marked "INV+" on the first inverter via the "DO1" terminal of the Powador-protect.
4. Connect wire B (-) to the terminal marked "INV-" on the first inverter via the "GND" terminal of the Powador-protect.
5. Connect the other inverters to one another as follows:
   – wire A (+) to wire A (+) and wire B (-) to wire B (-).
6. Tighten the cable fitting.
7. After commissioning: Activate the support for the Powador-protect in the parameter menu under the "Powador-protect" menu item.

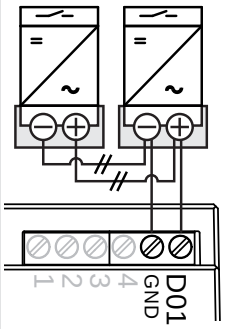

Figure 34: Powador-protect

7.7 Sealing the connection area

1. The requirements of protection rating are met by closing the unused cable fittings with blind caps.
2. Place the connection cover on the connection area of the inverter.
3. Screw in the screws to fasten the connection cover (blue).

EN

7.8 Switching on the device

DANGER

Lethal voltages are still present in the terminals and cables of the inverter even after the inverter has been switched off and disconnected!

Severe injuries or death will occur when touching the cables and terminals in the inverter.

Only appropriately qualified and authorised electricians may start up the inverter.

CAUTION

Risk of burns from hot housing components!

The housing surface and the heat sink can reach a surface temperature of 75° in operation.

› Do not touch the housing surface or heat sink during and immediately after operation.

› Allow the device to cool down before touching the housing surface.

Switching on the device

↻ The inverter has been mounted and electrically installed.

↻ The PV generator supplies a voltage above the configured start voltage.

1. Connect the grid voltage using the external circuit breakers.
2. Connect the PV generator using the DC isolator switch (0 ⟶ 1).

» The inverter begins to operate.

» During initial start-up: Follow the instructions of the New Connection Wizard.

EN

8 Configuration and Operation

8.1 Controls

The inverter has a backlit LCD display as well as three status LEDs. The inverter is operated using 6 buttons.

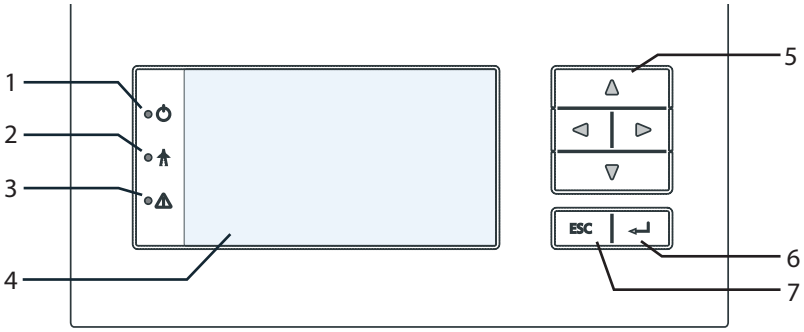

Figure 35: Control panel

Key			
1	"Operating" LED	5	4-way button
2	"Feed-in" LED	6	"Enter" key
3	"Fault" LED	7	"ESC" key
4	LCD		

8.1.1 LED indicators

The 3 LEDs on the front of the inverter show the different operating states. The LEDs can display the following states:

LED illuminated | LED flashing | LED not illuminated

The LED indicators show the following operating status:

Operating status	LEDs	Display	Description
Start			The green "Operating" LED is illuminated if an AC voltage is present, (independently of the DC voltage).
Feed-in start		Power fed into the grid or measured values	The green "Operating" LED is lit. The green "Feed-in" LED is illuminated after the country-specific waiting period*. The inverter is ready to feed in, i.e. is on the grid. You can hear the grid relay switch on.
Feed-in operation		Power fed into the grid or measured values	The green "Operating" LED is lit. The green "Feed-in" LED is lit. The "Feed-in" icon appears on the desk-top. The inverter feeds into the grid.

* The waiting period ensures that all network parameters are in the permissible ranges.

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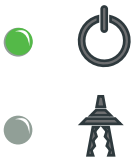
Operating status	LEDs	Display	Description
Non-feed-in operation		Status message	The display shows the corresponding message.
Fault		Fault message	The display shows the corresponding message. The red "Fault" LED is illuminated.

8.1.2 Graphical display

The graphical display shows measured values and data and allows the configuration of the inverter using a graphical menu. In normal operation, the backlighting is switched off. As soon as you press one of the control buttons, the backlighting is activated. If no button is pressed for an adjustable period of time, it switches off again. You can also activate or deactivate the backlighting permanently.

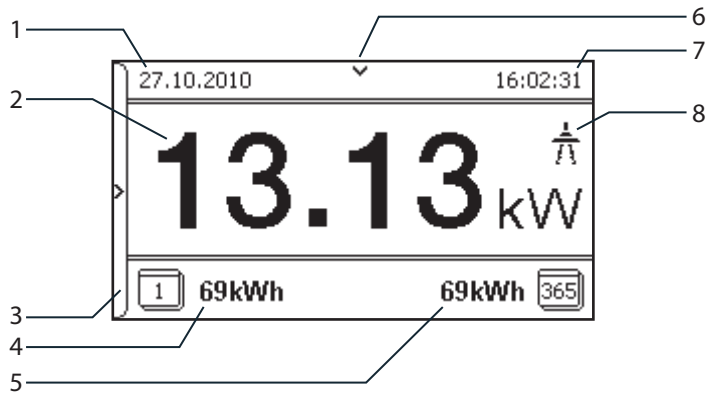


Figure 36: Desktop

Key			
1	Current date	5	Annual yield
2	Current power	6	Indicator for daily yield curve
3	Menu indicator	7	Current time
4	Daily yield	8	Feed-in indicator

After being switched on and after initial commissioning is complete, the inverter displays the start screen (the desktop). If you are in the menu and do not touch the control buttons for 2 minutes, the inverter returns to the desktop.

For initial commissioning, see section 8.2 on page 33.

NOTE

Depending on the tolerances of the measuring elements, the measured and displayed values are not always the actual values. However, the measuring elements ensure maximum solar yield. Due to these tolerances, the daily yields shown on the display may deviate from the values on the grid operator's feed-in meter by up to 15%.

NOTE

Calculating efficiency by measuring the current and voltage values can lead to misleading results due to the tolerances of the measurement devices. The sole purpose of these measured values is to monitor the basic operation of the system.

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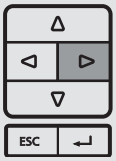
8.1.3 Control buttons

The inverter is operated using the 4-way button and the Enter and ESC buttons.

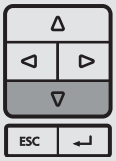
Desktop

Opening the menu



↻ The inverter is operating.
↻ The LCD is showing the desktop.
☞ Press the right arrow button.
» The main menu opens.

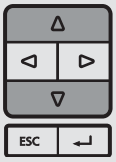
Displaying the daily output



↻ The inverter is operating.
↻ The LCD is showing the desktop.
☞ Press the down arrow button.
» The LCD displays the daily yield in a diagram.
☞ To return to the desktop, press any button.

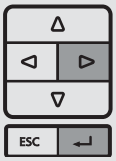
Inverter menu

Navigating through the menu



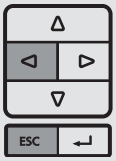
↻ You have left the desktop. The inverter displays the menu.
☞ Use the up and down arrow buttons.

Opening a menu item or a setting



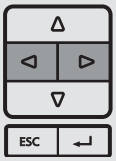
☞ Use the right arrow button and the Enter button.

Jump to the next higher menu level/discard changes



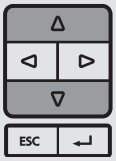
☞ Press the left arrow button or the ESC button.

Selecting an option



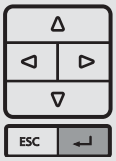
☞ Use the right and left arrow buttons.

Changing an option/the value of an input field



☞ Use the up and down arrow buttons.

Saving changed settings



☞ Press the Enter button.

EN

8.2 Initial start-up

When started for the first time, the inverter displays the configuration assistant. It takes you through the settings necessary for the initial start-up.

NOTE

After configuration is completed, the configuration assistant does not appear again when the inverter is restarted. You can then change the country setting only in the password-protected parameter menu. The other settings can still be changed in the Settings menu.

NOTE

The DC and AC power supply must be guaranteed during configuration.

The sequence of the settings required for initial start-up is preset in the configuration assistant.

Navigation

- ☞ In order to select a setting, press the up and down buttons.
- ☞ To select the next menu item, press the Enter button.
- ☞ To return to the most recently selected menu item, press the ESC button.
- ☞ Set the required settings.
- ☞ Press the Enter button in the last menu item.

Initial configuration

- ☞ Select the menu language.
- ☞ Select the country of operation with grid type.
- ☞ Set the date and time.
- ☞ To store the set operator country and grid type permanently, confirm these settings with "Yes".
- » You have completed the initial configuration. The inverter begins to operate.

8.3 Menu structure

8.3.1 Display on the LCD

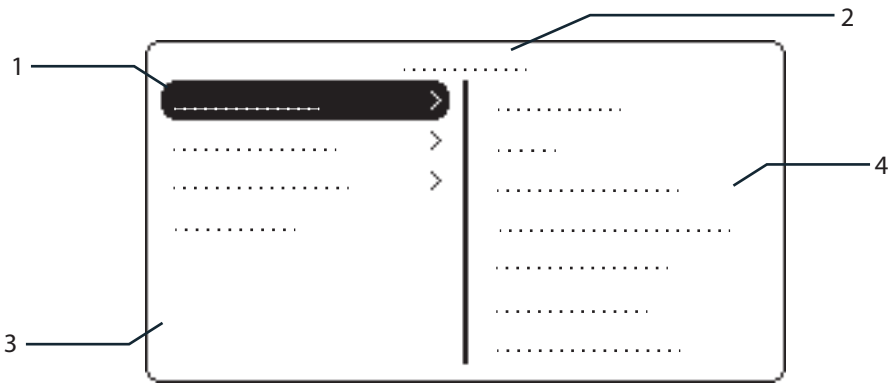


Figure 37: Main menu

Key			
1	Selected menu item	3	Menu items of the active menu level
2	Name of the active menu level	4	Menu items of the next lower menu level

EN

8.3.2 Menu structure

NOTE

The menu items displayed on-screen are dependent on the country and network settings, and may vary according to the type of device.

Icons used:

1-2-3-4	Menu level (0, 1, 2, 3)	↳	Submenu available
	Display menu	**EN**	Country-specific setting
	Option menu	**FR-HTA**	Country and grid type-specific setting
	Password protected menu (password can be requested from KACO Service)		

Country-spec. setting	menu level	Display/ setting		Action in this menu/meaning
All countries	Desktop	**Desktop**	↳	☞ Press the right arrow button.
	1-2-3-4	**"Measurements" menu**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
	1-2-3-4	**Generator**		Displays the DC-side voltage, amperage and power.
	1-2-3-4	**Grid**		Displays the AC-side voltage, amperage and power.
	1-2-3-4	**Power control**		Displays the current value of the external power limitation by the grid operator.
	1-2-3-4	**cos-phi**		Indicates the status of the reactive power control.
	1-2-3-4	**Unit temperature**		Displays the temperature in the inverter housing.
	1-2-3-4	**Yield counter**		Displays the yield in kWh. ☞ Reset the counter using the "Reset" key.
	1-2-3-4	**Yield today**		Displays the cumulative yield for the current day.
	1-2-3-4	**Total yield**		Displays the total yield up to now.
	1-2-3-4	**CO2 savings**		Displays the calculated CO_2 savings (in kg).
	1-2-3-4	**Oper. hrs cntr**		Displays the duration of operation in hours. ☞ Reset the counter using the "Reset" key.
	1-2-3-4	**Oper. time today**		Displays the duration of operation on today's date.
	1-2-3-4	**Total oper. time**		Displays the total operating time.
	1-2-3-4	**Log data display**	↳	☞ Open the menu: Press the right arrow button or the Enter button. ☞ Measurement data can be transferred to a USB stick by selecting it and moving it.

EN

Coun-try-spec. setting	menu level	Display/ setting		Action in this menu/meaning
All countries	1 2 3 4	**Day display**		Displays the recorded operating data graphically. 1. Select the measured value to be displayed. Supported measured values: • Grid power P(grid) • DC power per string P(PV) 1-2 • DC voltage per string U(PV) 1-2 • Unit temperature 2. Select a day. 3. Press the Enter button. » The display shows the selected data. ☞ Press any button to return to the previous menu.
	1 2 3 4	**Month display**		Displays the recorded operating data graphically. 1. Select a month. 2. Press the Enter button. » The display shows the selected data. ☞ Press any button to return to the previous menu.
	1 2 3 4	**Year display**		Displays the recorded operating data graphically. 1. Select a year. 2. Press the Enter button. » The display shows the selected data. ☞ Press any button to return to the previous menu.
	1 2 3 4	**CSV log data**		☞ Open the menu: Press the right arrow button or the Enter button.
	1 2 3 4	**Decimal separator**		☞ Select decimal sign for export of saved operating data.
	1 2 3 4	**Save to USB**		In this menu, you can export the saved operating data to a connected USB flash storage device. ↻ You have connected a USB flash storage device to the inverter. 1. Select the data to be exported (year, month or day). 2. Press the Enter button. » The inverter writes the data to a connected USB flash storage device.

EN

Country-spec. setting	menu level	Display/ setting		Action in this menu/meaning
All countries	1 2 3 4	**"Settings" menu**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
	1 2 3 4	**Language**		☞ Select the desired language for the user interface.
	1 2 3 4	**Def. total yield**		You can set the total yield to any value, for example, when you have received a replacement unit and want to continue the recording from the present value. ☞ Select the "Save" button and confirm with the Enter button.
	1 2 3 4	**Interface**		☞ Assign a unique RS485 bus address to the inverter ("RS485 address" menu item). The address must not be the same as that of any other inverter or a data monitor device.
	1 2 3 4	**S0 pulse rate**		☞ Set the pulse rate of the S0 connection.
	1 2 3 4	**Priwatt**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
	1 2 3 4	**Activation mode**		☞ Select operating mode **NOTE:** Re-activation depends on the operating mode selected and on the activation conditions.
	1 2 3 4	**Monitoring time**		☞ Set time span during which the power threshold must be exceeded without interruption.
	1 2 3 4	**Power threshold**		☞ Set power threshold from which the monitoring time up to activation begins.
	1 2 3 4	**Operation mode**		☞ Power-dependent: the function remains active until below the set power threshold. ☞ Time-dependent: The function is active depending on the sunlight for the set operating time.
	1 2 3 4	**Operation time**		**NOTE:** The menu option is only available in the "Time-dependent" operation mode. ☞ After connection, the function is active for the set operating time.
	1 2 3 4	**Quick start**		☞ Reduce the waiting times during the self-test by pressing the "Activate" key.
	1 2 3 4	**Logging interval**		☞ Specify the time period between 2 log data recordings.
	1 2 3 4	**Log data backup**		The inverter supports the backing up of all recorded yield data to a connected USB storage device. ☞ Activate or deactivate log data backup.

EN

Country-spec. setting	menu level	Display/ setting		Action in this menu/meaning
All countries	1 2 3 4	**Display**		☞ Configure the contrast setting for the display. ☞ Set the length of time without user input after which the backlighting of the LCD switches off. ☞ Alternatively: Permanently activate or deactivate the backlighting by selecting “On” or “Off”.
	1 2 3 4	**Date & time**		☞ Set the date and time. **NOTE:** For self-diagnostic purposes, the inverter carries out a daily restart at midnight. To avoid having a restart occur during feed-in operation and to always obtain reliable log data, ensure that the time is correctly set.
	1 2 3 4	**Network**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
	1 2 3 4	**DHCP**		Activate or deactivate DHCP. ☞ On: Activate DHCP. Once the DHCP server becomes available, the IP address, subnet mask, gateway and DNS server are automatically applied and the aforementioned menu items are hidden. ☞ Off: DHCP deactivated, make settings manually.
				NOTE: The "IP address", "Subnet masks", "Gateway" and "DNS server" menu options are only displayed with the DHCP deactivated.
	1 2 3 4	**IP address**		☞ Allocate a unique IPv4 address in the network.
	1 2 3 4	**Subnet mask**		☞ Allocate a network mask.
	1 2 3 4	**Gateway**	↳	☞ Enter IPv4 address of gateway.
	1 2 3 4	**DNS server**		☞ Enter IPv4 address of DNS server.
	1 2 3 4	**Web server**		☞ Activate or deactivate the integrated web server. ☞ Set the port at which the web server can be reached.
	1 2 3 4	**Powador-web**		☞ On: The inverter attempts to connect to the Powador-web web portal. ☞ Off: The connection to Powador web is deactivated.
	1 2 3 4	**Modbus TCP**		☞ Activate/deactivate function. ☞ Set network port.
	1 2 3 4	**Connection status**		Indicates the status of the network connection:

EN

Country-spec. setting	menu level	Display/ setting		Action in this menu/meaning
All countries	1 2 3 4	"Parameters" menu	↳	☞ Press the right arrow button or the Enter button. **NOTE:** The inverter does not display the "Parameters" menu in the standard configuration. To display the Parameters menu: 1. Open the menu. 2. Simultaneously hold down the up and down buttons for several seconds.
	1 2 3 4	Country		1. Enter the four-digit password using the 4-way button. The password is unit-specific. 2. Confirm the entry with the Enter button. 3. Set the desired country setting. **NOTE:** This option influences the country-specific operating settings of the inverter. Please consult KACO service for further information.
DE, CH, FR, GR, IT, GB	1 2 3 4	Grid type/guideline		☞ Select the grid type for the inverter's installation location.
AU, BG, FR, GR, PT, ES, CZ, KR	1 2 3 4	Switch-off volt.		The inverter is equipped with redundant 3-phase monitoring. If the grid frequency exceeds or drops below the configured values, the inverter switches off. The minimum switch-off threshold can be set in 1 V increments. ☞ Configure the switch-off values for undervoltage and overvoltage. ☞ Where necessary, set period from occurrence of the fault to shutdown of the inverter.
DE, AU, BG, FR, GR, HU, IL, PT, ES, CZ, KR	1 2 3 4	Switch-off freq.		The inverter continuously monitors the grid frequency. If the grid frequency exceeds or drops below the configured values, the inverter switches off. ☞ Set limit values for underfrequency and overfrequency in 0.1 Hz increments. ☞ Set period from occurrence of the fault to shutdown of the inverter.
DE, BE, FR, IT, CH, AT, PL, UD	1 2 3 4	Overvoltage shutd.		☞ Activate or deactivate password protection. ☞ Specify the shutdown threshold for overvoltage shutdown. The 10-minute average for the measured voltage as per V VDE 0126-1-1:2006 is used. ☞ Set period from occurrence of the fault to shutdown of the inverter.
DE, FR, GB, HU, IL, IN, IT, AT, PL, RU, ES, TH, ZA, UD				☞ Specify the shutdown threshold for fast and slow overvoltage shutdown. ☞ Set period from occurrence of the fault to shutdown of the inverter.
BG, FR, CZ, UD	1 2 3 4	Voltage drop		The voltage drop between the inverter and the feed-in meter is added to the limit value that was set for grid shutdown according to V VDE 0126-1-1:2006. The limit value can be set from 0 to 11 V in 1 V increments. ☞ Specify the switch-off value for the voltage drop (0 to 11 V).

EN

Coun-try-spec. setting	menu level	Display/ setting		Action in this menu/meaning
DE, FR, GB, HU, IL, IN, IT, AT, PL, RU, ES, TH, ZA, UD	1 2 3 4	**Undervoltage shutd.**		☞ Specify the shutdown threshold for fast and slow undervoltage shutdown. ☞ Set period from occurrence of the fault to shutdown of the inverter.
DE, FR, GB, IN, IT, AT, PL, RU, ES, TH, ZA, UD	1 2 3 4	**Overfreq. shutd.**		☞ Set limit value for overfrequency shutdown.
	1 2 3 4	**Underfreq. shutd.**		☞ Set limit value for the underfrequency shutdown.
FR, IL, IN, IT, AT, PL, RU, TH, ZA, UD	1 2 3 4	**Activation condition**		The inverter checks mains voltage and frequency. The grid feed operation begins if the measured values are within the set ranges. ☞ Set minimum and maximum values for the switching on.
DE, CH, BE, FR, GB, IL, IN, IT, AT, PL, RU, ES, TH, ZA, UD	1 2 3 4	**Connect time**		☞ Set period for grid observation (in seconds) when switching on and reconnection after a fault.
IL, IT, ZA	1 2 3 4	**P(f) Gradient**		☞ Set gradient of power limit function with increasing frequency in % / Hz. This percentage relates to the nominal frequency of 50 Hz.
	1 2 3 4	**P(f) thresholds**		☞ Set the frequency thresholds for activating and deactivating the power limitation in Hz.
All countries	1 2 3 4	**DC connection**		☞ Select between standard or parallel installation. ☞ Note the connection examples! (See section 7.4.2 on page 24)
	1 2 3 4	**DC starting volt.**		The inverter begins feed-in as soon as this DC voltage is present. ☞ Set the starting voltage.
	1 2 3 4	**Const. volt. ctrl.**		Lets you deactivate the MPP seek mode in order to operate the inverter with a constant DC voltage. ☞ Activate or deactivate function. ☞ Set value for constant voltage control (200 - 800 V). **NOTE:** For voltages below the minimal MPP voltage the possible input power is reduced. The input current is limited here to 11A per input.

EN

Country-spec. setting	menu level	Display/ setting	Action in this menu/meaning
All countries	1 2 3 4	**Power limitation**	The output power of the inverter can be set permanently to a lower value than the maximum output power by the internal power limiting. This may be necessary in order to limit the maximum power rating of the system at the grid connection point, upon the grid operator's request. The value can be protected from the very first output limitation entry. After setting a limitation, the value can only be changed by entering a device-specific password. The output power can be regulated using via an external power limitation using an extension module and remote control periphery from the grid operator. **Internal:** 1. Activate password protection if necessary. 2. Specify the activation status. 3. Specify the limit value for maximum feed-in power. 4. Confirm the entry with the Enter button. **External (only possible with additional module LP383):** 1. Specify activation status (on/off) 2. Select the activation threshold (Active Low / Active High) from digital input 1, 2, 3 or 4 (only if activation status = on) 3. Specify the power limitation levels (only if activation status = on) a.) Specify levels 0-3 b.) Specify levels 4-7 c.) Specify levels 8-11 d.) Specify levels 12-15 **Gridsave ECO:** a.) Set fallback power b.) Set timeout
	1 2 3 4	**Powador-protect**	Configures the support for grid shutdown by a Powador protect connected to the digital input of the inverter. ↻ For Auto/On: A Powador protect is operating in the photovoltaic system and is connected to the inverter at the digital input/output. ☞ Auto: The inverter automatically detects a Powador-protect integrated into the photovoltaic system. ☞ On: The digital signal of the Powador protect must be present to the digital input of the inverter for the inverter to start with feed-in. ☞ Off: The inverter does not check whether a Powador-protect is integrated into the PV system.
	1 2 3 4	**Iso.resistor**	☞ Set threshold value (in 1 kOhm steps) at which the insulation monitor reports a fault.

EN

Country-spec. setting	menu level	Display/ setting		Action in this menu/meaning
DE, CH, BE, FR, GB, IL, IT, AT, PL, RU, ES, KR, TH, ZA	1-2-3-4	**Reactive power**	↳	☞ Open the menu: Press the right arrow button or the Enter button. ☞ Activating idle power process: select process and press Enter. The active process is highlighted.
	1-2-3-4	**cos-phi specification**		☞ Configure power factor. ☞ If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited/over-excited).
DE, FR, GB, IL, IT, AT, PL, RU, ES, KR, TH, UD, ZA	1-2-3-4	**Q const.**		☞ Set the idle power Q (in %) to a fixed value. ☞ Select the type of phase shift (under-excited/ over-excited).
DE, CH, BE, GB, IT, AT, PL ES, KR, UD	1-2-3-4	**cos-phi(P/Pn)**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
GB, IT, AT, ES, KR	1-2-3-4	**Lock-in voltage**		☞ Power range set as % of rated voltage, where the network support process is active.
	1-2-3-4	**Lock-out voltage**		
DE, BE, FR, GB, IL, IT, AT, PL, RU, ES, KR, TH, UD	1-2-3-4	**Number of support points**		This option defines how many support points can be defined in the subsequent menu. The maximum number of configurable support points depends on the selected grid type. ☞ Specify the number of support points for the idle power characteristic curve.
	1-2-3-4	**1., 2. ...Support point**		☞ Specify the power factor for the 1st, 2nd (etc.) support point ☞ If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited/over-excited).
GB, IT, AT, CH, KR, PL	1-2-3-4	**Q(U) 5 Supports**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
	1-2-3-4	**Lock-in power**		☞ Power range set as % of rated power, in which the network support process is active.
	1-2-3-4	**Lock-out power**		
	1-2-3-4	**Time constant**		☞ Set the response speed of the control.
	1-2-3-4	**Number of support points**		☞ Specify the number of support points for the idle power characteristic curve.
	1-2-3-4	**1., 2. ...Support point**		☞ Specify the support points for voltage, power and nature of the phase shift
GB, IT, KR	1-2-3-4	**Q(U) 2-point**	↳	☞ Open the menu: Press the right arrow button or the Enter button.
	1-2-3-4	**Lock-in power**		☞ Power range set as % of rated power, in which the network support process is active.
	1-2-3-4	**Lock-out power**		
	1-2-3-4	**Time constant**		☞ Set the response speed of the control.
GB, IT, KR	1-2-3-4	**1.-4. Support point**		☞ Specify the support points for voltage, power and nature of the phase shift

EN

Country-spec. setting	menu level	Display/ setting		Action in this menu/meaning
DE-NSp, BE, CH	1 2 3 4	**Line error**		Display of grid faults. ☞ To show the last 5 grid fault messages, select the “Display” key.
DE, GB, AT, CH	1 2 3 4	**Protection parameters**		Display of essential protection parameters. ☞ To show the protection parameters, select the “Display” key.
IT	1 2 3 4	**SPI**		☞ Provides the option of activating or configuring the specific "System Protection Interface" for Italian. (Expansion module required!)
All countries	1 2 3 4	**"Information" menu**		☞ Open the menu: Press the right arrow button or the Enter button.
	1 2 3 4	**Inv. type**		Displays the type designation of the inverter. If feed-in power is actively limited: display maximum power in kW.
	1 2 3 4	**SW version**		Displays the installed software version.
	1 2 3 4	**Serial no.**		Displays the serial number of the inverter.
	1 2 3 4	**Display country**		Displays the selected country setting. Optional: Displays the grid type if a grid type has been selected.
	1 2 3 4	**"Manufacturer" menu**	↳	The display shows information about the unit manufacturer.

8.4 Monitor inverter

The inverter has an integrated web server. This makes it possible to monitor and record the operating state and yield of your PV system.

You can display the recorded data using:

- The integrated LCD
- The integrated web server using an Internet-capable device connected to the Ethernet interface of the inverter
- A storage medium connected to the USB interface, for example, a USB stick.

8.4.1 USB interface

Use an external USB storage device to read operating data saved in the inverter.

Reading log data

NOTE

The USB interface is approved solely for use with USB flash storage devices ("USB sticks"). The maximum available current is 100 mA. If a device with a higher power requirement is used, the power supply for the USB interface automatically shuts down to protect the inverter from damage.

EN

Reading data

1. Connect a suitable USB storage device to the USB interface on the underside of the inverter.
2. Open the "Log data view" menu.
3. Select "Save to USB".
4. Select the desired log data using the 4-way button.
5. Press the Enter button.

» The inverter saves the selected log data to the USB storage device.

8.4.2 Web server

The inverter has an integrated web server. After configuring the network and activating the web server in the Settings menu, you can open the web server from an Internet browser. The language version of the website delivered by the web server is adapted dynamically to the pre-set language preferences in your Internet browser. If your Internet browser requests a language that is unknown to the inverter, the web server uses the menu language set in the inverter.

Setting up the web server

Configuring the Ethernet interface

↻ You have connected the inverter to your network.

1. Open the Settings/Ethernet menu.
2. Assign a unique IP address.
3. Assign a subnet mask.
4. Assign a gateway.
5. Save your settings.

Using the web server

To avoid problems with incompatibility, use the most recent version of your Internet browser. JavaScript must be enabled in the browser settings to display the web server correctly.

NOTE

You can also access the web server of the inverter via the Internet. To do this, additional settings of your network configuration, particularly your Internet router, are required.

Note that communication with the inverter is carried out over an unsecured connection, particularly in the case of a connection over the Internet.

Calling up the web server

↻ Configure the Ethernet interface.

↻ Connect the Ethernet interface.

1. Open an Internet browser.
2. In the address field of the Internet browser, enter the IP address of the inverter and open the site.

» The Internet browser displays the start screen of the web server.

After it has opened, the web server displays information about the inverter as well as the current yield data. The web server enables the following measurement data and yield data to be displayed:

- Feed-in power
- Status
- Grid power
- Grid voltage
- Generator power
- Generator voltage
- Unit temperature

In order to display and export yield data, proceed as follows:

EN

Select the display period

1. Open the web server.
2. Select the display period by choosing either daily view, monthly view, yearly view or overview.

Filtering display data (daily view only)

1. Open the web server.
2. Select daily view.
3. To show or hide measured values, select or deselect the corresponding checkboxes in the "Choose view" area.

Exporting data

1. Filter the display data if necessary.
2. Select the display period if applicable (daily, monthly, yearly or overview).
3. Click the "Export data" key.
4. Save the file.

NOTE

Regardless of the display data selected in the "Choose view" area, an export file always contains all measurement data and yield data available for the selected period.

8.5 Performing the software update

You can update the software of the inverter to a new version using the integrated USB interface. Use a FAT32-formatted USB stick to do this. Do not use any storage media with an external power supply such as an external hard disk.

NOTE

Ensure that the AC and DC inverter power supply is active. It is only possible to update all of the inverter's components to the most current software version in this operating state.

CAUTION

Damage to the inverter

The update can fail if the power supply is interrupted during the update process. Parts of the software or of the inverter itself can then be damaged.

» Never disconnect the DC and AC power supply during a software update.

» Do not remove the USB stick during a software update.

Preparing for the software update

1. Download the software update file from the KACO web site and store it on your hard disk.
2. Copy the update file (.KUF) onto the USB stick.

» Perform software update.

NOTE

The update can take several minutes. The "Operating" LED flashes during the update process. The inverter may restart several times.

The following message appears if the DC power supply is too low: "DC power supply too low! Perform update anyway?".

In this case, select "No" and perform the update with a stable voltage supply.

EN

Performing the software update

↻ Prepare for the software update.

1. Connect the USB stick to the inverter.

» The message "Software found. Would you like to load it?" appears on the display.

2. If you would like to perform the update, select the "Yes" button. In the case of "No", pressing the "Enter" key stops the update process and the unit goes into feed-in mode.

» The inverter begins the update.
- The update has been imported in full once the message "Software update successful" appears.
- If the update has failed, the message "Software update incomplete" appears.

3. When a fault occurs, the update process must be repeated.

Alternatively, you can check to see if the update was successful in the menu:

Displaying the software version

☞ Open the Information / Software Version menu.

» The inverter will display the versions and checksums of the software that is currently loaded.

9 Maintenance/Troubleshooting

9.1 Visual inspection

Inspect the inverter and the cables for exterior visible damage and note the operating status display of the inverter. In case of damage, notify your installer. Repairs may only be carried out by authorised electricians.

NOTE

There are components in the housing of the inverter which may only be repaired by our KACO customer service team.

The inverter should be checked for proper operation by a qualified electrician at regular intervals. The inverter contains components that you cannot replace!

9.2 Cleaning the housing

DANGER

Lethal voltages in the inverter!

Serious injuries or death can result if moisture enters the system.

› Only use completely dry objects to clean the inverter.

› Only the exterior of the inverter should be cleaned.

Cleaning the inverter

☞ Do not use compressed air!

☞ Use a vacuum cleaner or a soft brush to remove dust from the fan cover, between the cooling fins and from the top side of the inverter on a regular basis.

☞ Remove dust from the ventilation inlets if necessary.

☞ If necessary, remove the fan cover and remove deposits.

9.3 Replacing or cleaning the fans

The inverter is equipped with an axial fan. The axial fan is mounted on the left housing side. These fans must be replaced if they break down or become very dirty.

EN

Removing the fans

↻ Ensure complete disconnection on the AC and DC sides.

↻ Wait until the fan is no longer turning.

4. Remove fan cover with the screws from the vent cavity (Figure 38).
5. Carefully remove fan cover.
6. Unplug fan plug on the fan.
7. Remove fan from the fan cover by lightly opening the latch bracket. (Figure 39).
8. Clean fan cover.

» Install the replacement fan.

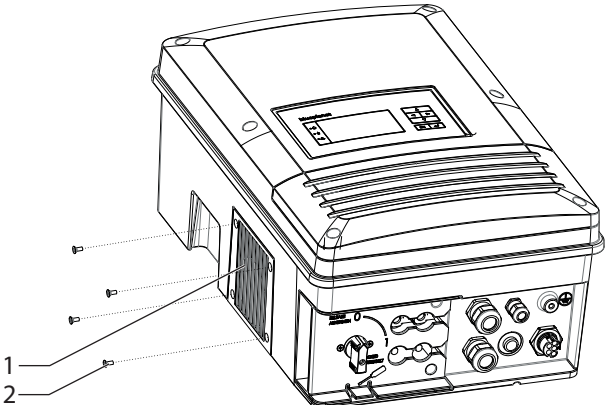


Figure 38: Remove the fan

Key

1 Fan cover

2 Mounting screws

Installing the fan

↻ You have removed the defective fan.

☞ Replace the fan only with a fan recommended by KACO new energy. Ask the service department if necessary.

1. Insert the replacement fan in the fan cover.
2. Latch fan into latch bracket.
3. Plug in the fan plug.
4. Place fan cover onto fan cavity and fasten with the screws.

» The replacement fan is ready for operation.

5. Switch on the inverters.

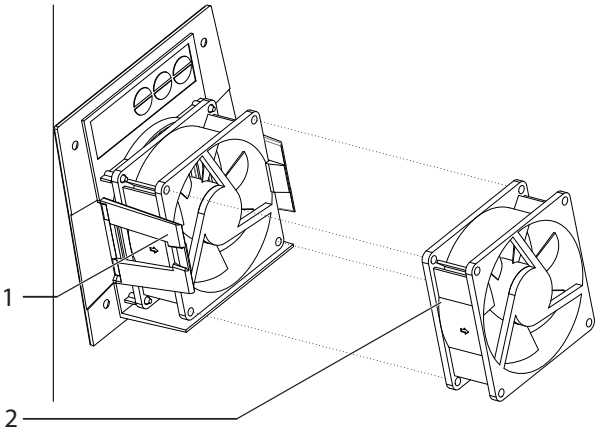


Figure 39: Remove inverter from the cover.

Key

1 Latch bracket

2 Fan

Authorised electrician

9.4 Shutting down for maintenance and troubleshooting

DANGER

Lethal voltages are still present in the terminals and cables of the inverter even after the inverter has been switched off and disconnected!

Severe injuries or death will occur when touching the cables and terminals in the inverter.

When there is solar radiation, DC voltage will be present at the open ends of the DC cables. Arcing may occur if the DC cables are disconnected while they are still live.

The inverter is only permitted to be opened and serviced by an authorised electrician.

- › Observe all safety regulations and the current technical connection specifications from the relevant power supply company.
- › Disconnect the AC and DC sides and secure against being inadvertently switched back on.
- › Do not touch the exposed ends of the cables.
- › Avoid short circuits.
- › Do not open the inverter until these two steps are complete.
- › After shutdown, wait at least five minutes before working on the inverter.

CAUTION

Destruction of the DC connections or fuse holders

The connection terminals or fuse holders can be destroyed by arcing if disconnected or if the fuses are removed.

- › It is absolutely essential that the shutdown sequence is carried out in the correct order.

Shutting down the inverter

1. Switch off the grid voltage by turning off the external circuit breakers.
2. Disconnect the PV generator using the DC isolator switch.

DANGER! The DC cables are still live!

☞ Ensure that there is no voltage present on the grid connection terminals.

9.5 Disconnecting connections

9.5.1 Disconnect AC connection plug

DANGER

Risk of fatal injury due to electric shock!

Never disconnect the connection plug and plug connector under load.

- › Disconnect the inverter completely from all power sources before disconnecting the AC connector.
- › Make sure that the device is isolated from the public power supply and the system power supply before starting work.

EN

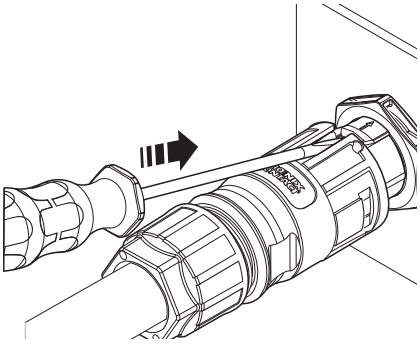


Figure 40: Disconnect the AC connection plug from the device connector

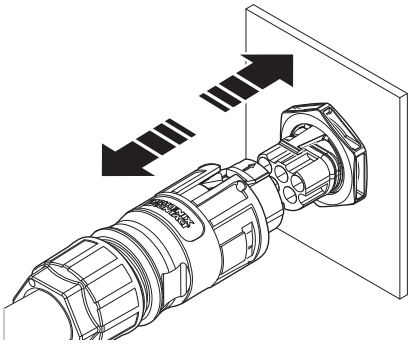


Figure 41: Disconnect AC connection plug

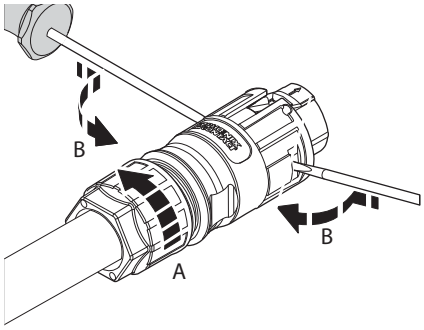


Figure 42: Unfasten the cable

Disconnect AC connection plug

↻ Ensure there is no AC/DC voltage present.

1. Use a screwdriver (blade with 3.5mm) to press the tab on the housing downwards.
2. Unlock the plug connection.
3. Unscrew the cable fitting.
4. Use a screwdriver to unlock the contact carrier on both sides.
5. Remove the contact carrier from the housing.
6. Unfasten and remove the screws on the contact carrier.

9.5.2 Disconnect DC connector

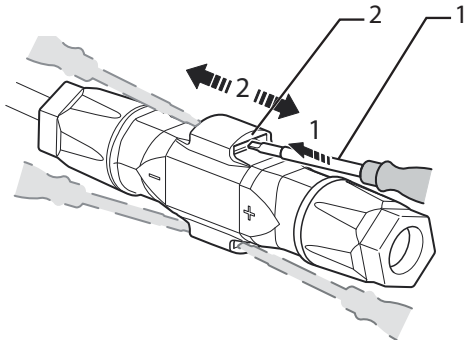


Figure 43: Disconnect connector

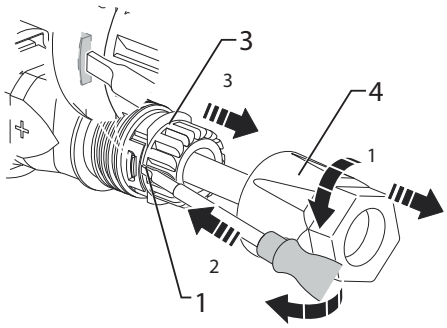


Figure 44: Unfasten DC cable

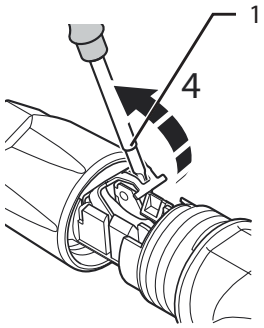


Figure 45: Open the spring

Key

1	Screwdriver	3	Insert
2	Latch	4	Sleeve

EN

Disconnect DC plug connection

↻ Ensure there is no AC/DC voltage present.

1. Use a screwdriver (blade width 3 mm) to push down the latch on the coupling.
2. Leave the screwdriver in place.
3. Separate socket with plug.

Unfasten DC cable

4. Unscrew cable fitting.
5. Insert screwdriver on the side (see Figure 44 on page 48).
6. Pry open connection and pull apart sleeve with insert.
7. Open spring with the screwdriver.
8. Remove wires.

9.6 Faults

9.6.1 Procedure

DANGER

Lethal voltages are still present in the terminals and cables of the inverter even after the inverter has been switched off and disconnected!

Severe injuries or death will occur when touching the cables and terminals in the inverter.

☞ When a fault occurs, notify an appropriately authorised and qualified electrician or KACO new energy GmbH Service.

☞ The operator can only carry out actions marked with a B.

☞ In case of power failure, wait for the system to automatically restart.

☞ Notify your electrician if there is an extended power failure.

B = Action of the operator

E = The indicated work may only be carried out by an authorised electrician!

K = The indicated work may only be carried out by a service employee of KACO new energy GmbH!

9.6.2 Troubleshooting

Fault	Cause of fault	Explanation/remedy	By
The display is blank and the LEDs do not light up	Grid voltage not available	☞ Check whether the DC and AC voltages are within the permitted limits (see Technical Data).	E
		☞ Notify KACO Service.	E
The inverter stops feeding into the grid shortly after being switched on, even though there is sunlight present.	Faulty grid separation relay in the inverter.	If the grid separation relay is defective, the inverter will recognise this during the self-test.	
		☞ Ensure that there is sufficient PV generator power.	E
		☞ If the grid separation relay is defective, have it replaced by KACO Service. ☞ Notify KACO Service.	K

EN

Fault	Cause of fault	Explanation/remedy	By
The inverter is active but is not feeding into the grid. The display indicates a line failure.	Grid-feed is interrupted due to a grid fault.	Due to a grid fault (grid impedance too high, over/undervoltage, over/underfrequency), the inverter stopped the feed-in process and disconnected from the grid for safety reasons.	
		☞ Change the grid parameters within the permitted operating limits (see the "Start-Up" section).	**E**
The grid fuse trips.	The grid fuse capacity is too low.	In case of a high level of solar radiation, the inverter exceeds its rated current for a short period, depending on the PV generator.	
		☞ Select the capacity of the inverter's pre-fuse to be somewhat higher than the maximum feed-in current (see the "Installation" section).	**E**
		☞ Contact the grid operator if the grid failure continues to occur.	**E**
The grid fuse trips.	Damage to the inverter's hardware.	If the grid fuse trips immediately when the inverter goes into feed-in mode (after the start-up period is complete), the inverter's hardware is probably damaged.	
		☞ Contact KACO Service to test the hardware.	**E**
The inverter displays an impossible daily peak value.	Faults in the grid.	The inverter continues to operate as normal without losses to the yield, even when an erroneous daily peak value is displayed. The value is reset overnight.	
		☞ To reset the value immediately, switch the inverter off by disconnecting it from the grid and switching off the DC, then switch it back on.	**E**
Daily yields do not correspond to the yields on the feed-in meter.	Tolerances of the measuring elements in the inverter.	The measuring elements of the inverter have been selected to ensure maximum yields. Due to these tolerances, the daily yields shown may deviate from the values on the feed-in meter by up to 15%.	
		☞ No action	-
The inverter is active but is not feeding into the grid. Display: "Waiting for feed-in"	• Generator voltage too low • Grid voltage or PV generator voltage unstable.	• The PV generator voltage or power is not sufficient for feed-in (solar radiation is too low). • The inverter checks the grid parameters before the feed-in process begins. The length of time it takes to switch back on again differs from country to country, depending on applicable standards and regulations, and may be several minutes. • The starting voltage may have been set incorrectly.	
		☞ Adjust starting voltage in the Parameter menu if required.	**E**

EN

Fault	Cause of fault	Explanation/remedy	By
Noise emission from the inverter.	Particular ambient conditions.	When there are certain ambient conditions, the units may emit audible noises. • Grid interference or grid failure caused by particular loads (motors, machines, etc.) which are either connected to the same point on the grid or located in the vicinity of the inverter. • In cases of volatile weather conditions (frequent switching between sunny and cloudy conditions) or strong solar radiation, a light hum may be audible due to the increased power. • Under particular grid conditions, resonances may form between the unit's input filter and the grid; these may be audible even when the inverter is switched off. These noise emissions do not affect the operation of the inverter. They do not lead to loss of performance, failure, damage or to a shortening of the unit's service life. People with very sensitive hearing (particularly children) are able to hear the high-frequency hum caused by the inverter's operating frequency of approximately 17 kHz.	
		☞ No action	
In spite of high radiation levels, the inverter does not feed the maximum power into the grid.	The device is too hot and the system limits the power.	Because the temperatures inside the unit are too high, the inverter reduces its power to prevent damage to the unit. Note the technical data. Ensure that the convection cooling is not impeded from the exterior. Do not cover the cooling fins.	
		☞ Ensure sufficient cooling of the unit. ☞ Do not cover the cooling fins.	**B, E**

9.7 "Fault" messages on the display/LED

Many fault signals indicate a fault in the grid. They are not operational faults of the inverter. The triggering levels are defined in standards, e.g. VDE0126-1-1. The inverter shuts down if the values exceed or fall below the approved levels.

9.7.1 Display of status and fault messages

Display	Fault LED (red)		
FS (fault status)	● ⚠	**ON**	• Fault signal relay has switched. • Feed-in was ended due to a fault.
OS (operating status)	○ ⚠	**OFF**	• The fault signal relay releases again. • The inverter feeds back into the grid again after a country-specific time period.

Details regarding the fault or operating status can be found either on the display or in the data that was recorded through the RS485 interface.

9.7.2 Status and fault signals

The following table lists the possible status and fault signals that the inverter shows on the LCD and the LEDs.

BS = operating status, FS = fault status;

B = Action of the operator

E = The indicated work may only be carried out by an authorised electrician!

K = The indicated work may only be carried out by a service employee of KACO new energy GmbH!

EN

Status		Display			Explanation	Action	
OS	1	Waiting for feed-in	○	○	Self-test: The grid parameters and generator voltage are being checked.	-	-
OS	2	Generator voltage is too low	○	○	Insufficient generator voltage and power, status before the transition to night shutdown	-	-
OS	8	Self-test	○	○	Checks the shutdown of the power electronics as well as the grid relay before feed-in mode.	-	-
FS	10	Temperature in unit too high	○	🔴	In case of overheating, the inverter switches off. Possible causes: • Excessively high ambient temperature, • Fan covered, • Inverter defective.	☞ Cool off the area around the inverter. ☞ Uncover the fans. ☞ Notify your authorised electrician!	**B** **B** **E**
OS	11	Measured values	🟢	○	Power limitation: If the generator power is too high, the inverter limits itself to the maximum power (e.g. around noon if the generator capacity is too large).		
FS	17	Shutting down Powador-protect	○	🔴	The activated grid and system protection has been tripped.	☞ Wait for reactivation. ☞ Notify your authorised electrician if the fault occurs repeatedly!	**E**
FS	18	Resid. current shutdown	○	🔴	Residual current was detected. The feed-in was interrupted.	☞ Notify your authorised electrician!	**E**
FS	19	Insulation fault generator	○	🔴	There is an insulation fault on the PV generator. The feed-in was interrupted.	☞ Notify your authorised electrician if the fault occurs repeatedly!	**E**
FS	21 22 23	Protective shutdown PV current x	○	🔴	DC current has exceeded the permissible maximum value on PVx. A shutdown is carried out to protect the device.	☞ PV generator may be over-dimensioned	**B**
FS	29	Ground connection check fuse	○	🔴	A ground fault was detected at the PV generator.	☞ Notify your authorised electrician!	**E**
FS	32	Fault Self-test	○	🔴	The internal grid separation relay test has failed.	☞ Notify your authorised electrician if the fault occurs repeatedly!	**E**
FS	33	DC feed-in error			DC feed-in error The DC feed-in has exceeded the permitted value	☞ Wait for reconnection according to country-specific waiting time	**B**
FS	35	Protection shutdown SW	○	🔴	Protective shutdown of the software (AC overvoltage, AC overcurrent, DC link overvoltage, DC overvoltage, DC overtemperature).	Not a fault! Grid-related shutdown, the grid connects again automatically.	

Table 6: Operating status and fault messages on the display

EN

Status		Display			Explanation	Action	
FS	37	Unknown hardware	○	🔴	Hardware was connected that is not compatible with this device or that has not been connected properly.	☞ Notify your authorised electrician!	
FS	38	Generator overvoltage error	○	🔴	The voltage of the DC generator is too high. The PV generator is configured incorrectly.	☞ Notify your authorised electrician!	**E**
FS	41 42	Line failure: Undervoltage L1, Overvoltage L1,	○	🔴	The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed. The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician!	**E**
	43 44	Undervoltage L2, Overvoltage L2,					
	45 46	Undervoltage L3, Overvoltage L3					
FS	47	Grid failure phase-to-phase voltage	○	🔴	The measured line-to-line voltage is outside of the tolerance limits.	☞ Query the software version - Possible update failed-> Repeat update.	**B**
FS	48	Line failure Underfrequency	○	🔴	Grid frequency is too low. This fault may be grid-related.	☞ Notify your authorised electrician!	**E**
FS	49	Line failure Overfrequency	○	🔴	Grid frequency is too high. This fault may be grid-related.	☞ Notify your authorised electrician!	**E**
FS	50	Line failure Average voltage	○	🔴	The grid voltage measurement according to EN 50160 has exceeded the maximum permitted limit value. This fault may be grid-related.	☞ Query the software version - Possible update failed-> Repeat update. ☞ Notify your authorised electrician!	**B** **E**
FS	56	Switch off via digital input	○	🔴	The inverter was disconnected from the grid through a remote command. Remote trip-off	☞ Waiting for reconnection	
FS	57	Waiting for reconnect	○	🔴	Waiting time of the inverter after a fault.	Inverter does not switch on again until the country-specific time has elapsed.	
FS	58	Overtemperature Control card	○	🔴	The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware.	☞ Provide for sufficient ventilation.	**E**
OS	60	Generator voltage too high	○	🔴	The inverter does not begin feeding into the grid until the PV voltage falls below a specified value.	-	-
OS	61	External limit (%)	✳	○	The external limit *Power control* was activated by the superordinate system regulator. The inverter limits its power.		
OS	63	Measured values	🟢	○	P(f)/frequency-dependent power reduction: Frequency-dependent power reduction will be activated when the BDEW (German Association of Energy and Water Industries) Medium Voltage Directive goes into effect. Power reduction starts at a frequency of 50.2 Hz.		

Table 6: Operating status and fault messages on the display

EN

Status		Display			Explanation	Action	
OS	64	Measured values	●	○	Output current limiting: The AC current is limited once the specified maximum value has been reached.		
FS	70	Fan error	●	○	The fan is malfunctioning.	☞ Replace defective fan.	E
FS	71	Fan error	●	○	The external fan is malfunctioning.	☞ Replace defective fan.	E
FS	73	Standalone grid err.	○	●	Standalone mode was detected.	-	-
FS	78	Resid. current shutdown (AFI)	○	●	Measured AFI fault current was > 180 mA. Causes the device to switch off immediately.	-	-
FS	80	Insulation meas. not possible	○	●	The insulation measurement cannot be performed because the generator voltage is too volatile.	-	-
FS	81, 82, 83	Protection shutdown line volt. L1 L2, L3	○	●	Overvoltage has been detected on a conductor. An internal protective mechanism has disconnected the device to protect it against damage.	☞ In case of repeated occurrence: Notify your authorised electrician!	E
FS	84	Protection shutdown undervolt. DC link	○	●	A voltage deviation has been found in the DC link. An internal protective mechanism has disconnected the device to protect it against damage.	☞ In case of repeated occurrence: Notify your authorised electrician!	E
FS	85	Protect. shutdown overvolt. DC link	○	●			E
FS	87, 88, 89	Protection shutdown overcurrent L1, L2, L3	○	●	A current that has been found on a conductor is too high. An internal protective mechanism has disconnected the device to protect it against damage.	☞ In case of repeated occurrence: Notify your authorised electrician!	E
FS	91, 92	Protect. shutdown drop 2.5V Protect. shutdown drop 1.5V	○	●	Internal 2.5 V reference voltage outside the permissible range. Internal 1.5 V reference voltage outside the permissible range.	☞ Notify your authorised electrician!	E
FS	97	Protection shutdown overcurrent HW	○	●	Too much power has been fed into the grid. Complete disconnection of the device.	☞ Notify authorised electrician / KACO Service!	E/K
FS	100	Protect. shutdown HW overheating	○	●	The device has been switched off because the temperatures in the housing were too high.	☞ Check to make sure that the fans are working. ☞ Replace fan if necessary.	B E
FS	101 to 106	Temperature plausibility error, efficiency, DC link, AFI module, relay, DC/DC converter	○	●	The unit has shut down because of implausible internal measured values.	☞ Notify KACO Service!	K
FS	108 to 113	Critical overvoltage/undervoltage L1-L3	○	●	Grid voltage is outside of the upper limits on the indicated phase.	☞ Notify your authorised electrician!	E

Table 6: Operating status and fault messages on the display

EN

10 Service

If you need help solving a technical problem with one of our KACO products, please contact our service hotline.
Please have the following information ready so that we can help you quickly and efficiently:

- Device name / serial number
- Date of installation / Start-up report
- Fault message shown on the display / Description of the fault / Did you notice anything unusual? / What has already been done to analyse the fault?
- Module type and string circuit
- Consignment identification / Delivery address / Contact person (with telephone number)
- Information about the accessibility of the installation site.
  Any additional costs arising from unfavourable structural or mounting conditions shall be billed to the customer.

You can find the following items and other information at our web site http://www.kaco-newenergy.com/:

- our current warranty conditions,
- a complaint form,
- a form for registering your device with us. Please register your unit without delay. In this manner, you can assist us in providing you with the quickest service possible.

Note: The maximum length of the warranty is based on the currently applicable national warranty conditions.

Service hotline	Technical troubleshooting	Technical consultation
Inverter	+49 (0) 7132/3818-660	+49 (0) 7132/3818-670
Data logging and accessories	+49 (0) 7132/3818-680	+49 (0) 7132/3818-690
Customer Service	Monday to Friday 08:00 a.m. to 12:00 p.m. (CET) and 01:00 p.m. to 5:00 p.m.	

11 Shutdown/Disassembly

11.1 Switching off the unit

DANGER

Lethal voltages are still present in the terminals and cables of the inverter even after the inverter has been switched off and disconnected!

Severe injuries or death will occur when touching the cables and terminals in the inverter.

When there is solar radiation, DC voltage will be present at the open ends of the DC cables. Arcing may occur if the DC cables are disconnected while they are still live.

› It is absolutely essential that the shutdown sequence be carried out in the correct order.

› After shutdown, wait at least five minutes before working on the inverter.

› When working on photovoltaic modules, in addition to disconnecting from the grid, always disconnect the DC main switch on the generator junction box at all poles (or the DC plug connectors). A sole disconnecting off the grid voltage is not sufficient!

CAUTION

Risk of burns from hot housing components!

Coming into contact with the housing can cause burns.

› Do not touch the housing surface or semiconductor during and immediately after operation.

› Allow the device to cool down before touching the housing surface.

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DANGER

Destruction of the DC plug connectors

DC plug connectors can be destroyed by arcing if disconnected while still live. It is absolutely essential that the following shutdown sequence be carried out in the correct order:

1. Switch off the grid voltage by turning off the external circuit breakers.
2. Switch off the PV generator using the DC isolator switch.

DANGER! The DC cables are still live!

3. Ensure that there is no voltage present on the grid connection terminals.

11.2 Uninstalling the device

↻ Shut down the inverter.

1. Open the connection area.
2. Remove the interface cable.
3. Detach DC connection plug.
4. Detach AC connection plug.
5. Open the cable fittings.
6. Pull out the cables.

» The inverter is uninstalled. Proceed with disassembly.

11.3 Disassembling the unit

↻ Shut down the inverter.

↻ Uninstall the inverter.

1. Unscrew the detachment protector.
2. Take the inverter down from the wall holder.
3. Securely pack up the inverter if it is to be used later or dispose of the inverter in line with regulations.

11.4 Packaging the unit

↻ The inverter is uninstalled.

1. If possible, always pack the inverter in the original packaging. If this is no longer available, an alternative is to use equivalent packaging.
2. You must be able to close the box completely and it must be able to accommodate the weight and size of the inverter.

11.5 Storing the unit

↻ The inverter is packed.

☞ Store the inverter in a dry place, in accordance with the ambient temperature range

12 Disposal

CAUTION

Risk to the environment if disposal is not carried out in the correct manner

For the most part, both the inverter and the corresponding transport packaging are made from recyclable raw materials.

Unit: Do not dispose of faulty inverters or accessories together with household waste. Ensure that the old unit and any accessories are disposed of in a proper manner.

Packaging: Ensure that the transport packaging is disposed of properly.

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13 Appendix

13.1 EU Declaration of Conformity

Manufacturer's name and address	**KACO new energy GmbH** Carl-Zeiss-Strasse 1 74172 Neckarsulm, Germany
Product description	**Photovoltaic feed-in inverter**
Type designation	**KACO blueplanet 5.0 TL3 M2 WM OD IIG0** **KACO blueplanet 6.5 TL3 M2 WM OD IIG0** **KACO blueplanet 7.5 TL3 M2 WM OD IIG0** **KACO blueplanet 8.6 TL3 M2 WM OD IIG0** **KACO blueplanet 9.0 TL3 M2 WM OD IIG0** **KACO blueplanet 10.0 TL3 M2 WM OD IIG0**

This is to confirm that the units listed above comply with the protection requirements set forth in the Directive of the Council of the European Union of 26th February 2014 on the harmonisation of the laws of the member states relating to Electromagnetic Compatibility (2014/30/EU) and the Low Voltage Directive (2014/35/EU).

The units conform to the following standards:

2014/35/EU "Directive relating to electrical equipment designed for use within certain voltage limits"	**Safety of the unit** IEC 62109-1:2010 IEC 62109-2:2011
2014/30/EU "Directive relating to electromagnetic compatibility"	**Interference immunity** EN 61000-6-2:2005 **Emitted interference** EN 61000-6-3:2007 + A1:2011 **Secondary effects on the grid** EN 61000-3-2:2006 + A1:2009 + A2:2009 EN 61000-3-3:2008

The types mentioned above are therefore labelled with the CE mark.

Unauthorised modifications to the supplied units and/or any use of the units that is contrary to their intended use render this Declaration of Conformity null and void.

Neckarsulm, 20/04/2016
KACO new energy GmbH

p.p. Matthias Haag
Management team for technology / CTO

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3009763-04-170502

KACO new energy.

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