



# Instruction Manual

**KACO blueplanet 2.0 - 5.0 TL1**  
- PSD, internal AFCI

- Authorized Electricians

**K A C O**



new energy.



# Installation Instructions

for authorized electricians

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# 1 General Notes

## 1.1 About this documentation



### WARNING

**Improper handling of the inverter can be hazardous**

› IMPORTANT SAFETY INSTRUCTIONS.

› You must read and understand the operating instructions before you can install and use the inverter safely.



This manual is intended for us inverter model and shall be followed during installation and maintenance.

Model type - US Version	Spezial feature
KACO blueplanet 2.0 TL1 M1 WM OD US3A	Standard
KACO blueplanet 2.0 TL1 M1 WM OD US39	PSD box, internal AFCI
KACO blueplanet 3.0 TL1 M2 WM OD US3A	Standard
KACO blueplanet 3.0 TL1 M2 WM OD US39	PSD box, internal AFCI
KACO blueplanet 4.0 TL1 M2 WM OD US3A	Standard
KACO blueplanet 4.0 TL1 M2 WM OD US39	PSD box, internal AFCI
KACO blueplanet 5.0 TL1 M2 WM OD US3A	Standard
KACO blueplanet 5.0 TL1 M2 WM OD US39	PSD box, internal AFCI

Table 1: Inverter types

### 1.1.1 Other applicable documents

During installation, observe all assembly and installation instructions for components and other parts of the system. These instructions are delivered together with the respective components and other parts of the system.

Visit <http://www.kaco-newenergy.com/service/warranty> to register your system for warranty-based service. If a copy of the warranty card is included with the operating instructions, you may use this to register your system.

### 1.1.2 Retention of documents

SAVE THESE INSTRUCTIONS. These instructions and other documents must be stored near the system and be available whenever they are needed.



## 1.2 Design features

### 1.2.1 Symbols used in this document



General hazard symbol




Risk of fire or explosion



High voltage



Risk of burns

 **Authorised electrician** The tasks indicated with this symbol may only be carried out by an authorised electrician.

### 1.2.2 Description of safety instructions



#### **DANGER**

##### **Imminent danger**

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



#### **WARNING**

##### **Potential danger**

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.

#### **CAUTION**

##### **Hazard with risk of property damage**

Failure to observe this warning will lead to property damage.

### 1.2.3 Description of additional information



#### **NOTICE**

Useful information and notes

### 1.2.4 Description of action instructions

#### **Action instructions**

a) One-step actions or actions that can be carried out in any sequence:

- ⌚ Prerequisite(s) for your action(s) (optional if they have been performed earlier)
- ☞ Carry out action.
- ☞ (Additional actions, if applicable)
- » Result of your action(s) (optional)

b) Multi-step action instructions that must be carried out in a fixed sequence:

1. Carry out action.
2. (Additional actions, if applicable)
- » Result of your action(s) (optional)

## 2 Safety



### DANGER

**Lethal voltages are still present in the terminals and leads of the inverter even after the inverter has been switched off and disconnected. Lethal voltages are still present from the PV array, PV System Disconnects and the touch safe fuse holders.**

**With the PSD disconnected from both AC and DC sources, the inverters terminals are open, and the inverter can be removed and replaced with no voltage present.**

Risk of severe injury or death if the leads and/or terminals in the inverter are touched when voltage is present.

Only authorised operator may open, install and maintain the inverter.

- › Keep the inverter closed when the unit is in operation.
- › Do not touch the leads and/or terminals when switching the unit on and off.
- › Do not make any modifications to the inverter.



### WARNING



**Non standard anti islanding trip points could damage connected devices**

- › Any changes to the default anti-islanding frequency and voltage trip limits must be approved by the connecting electric utility.

### NOTICE

In order to change the anti-islanding trip settings from their default values the following must be agreed with the connecting utility operator:



- Explicit authorization from the connecting electric utility is required.
- Connecting electric utility operator will specify the new values to be used in coordination with the system owner.
- When using the Mexico country code setting, the standard trip points exceed IEEE 1547 default limits based on requirements from Comisión Federal de Electricidad (CFE).

### NOTICE



KACO new energy does not accept any risk of lost production resulting from detected arcs, whether false positive or actual occurrences.

KACO new energy cannot be held liable for any damage due to fire or arcing damage regardless of the status of detection of an arc in the attached PV array. This could include but is not limited to parallel arc faults, improperly maintained modules, racking or other associated equipment, or other factors.

You are responsible for observing all existing standards and regulations.

- Keep unauthorized persons away from the inverter and PV system.
- Complete all electrical installations in accordance with local electrical codes and the National Electrical Code (NEC), ANSI/NFPA 70.
- Ensure operational safety by providing proper grounding, conductor dimensioning and appropriate protection against short circuiting.
- Observe the 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 while it is switched on.
- Modifications to the surroundings of the inverter must comply with the applicable national and local standards.
- When working on the PV array, it is also necessary to switch off the DC voltage with the DC disconnect in addition to disconnecting the PV array from the grid.

## 2.1 Intended use

The inverter converts clean renewable DC energy into AC energy for export (feed-in) into the utility.

The 2.0-5.0 TL1 M1/2 WM OD US\_\_ designed, tested, and listed to the UL 1741, CSA-C22.2 No. 107.1.01 and the NFPA 70.



### **WARNING**



#### **Potential danger**

- › Only authorized personnel who are qualified for the VAC and VDC voltage ratings should install or maintain this equipment. Lethal hazards exist which may result in serious injuries or death.

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

Any other or additional use is not considered the intended use. This includes:

- Mobile use
- Use in rooms where there is a risk of explosion
- Use in rooms where the humidity is higher than 95%
- Operation outside of the specification intended by the manufacturer
- Standalone operation.

## 2.2 Protection features

For your safety, the following monitoring and protective functions are integrated into the KACO blueplanet 2.0-5.0 TL1 inverter:

- Overvoltage injuries or death/varistors to protect the power semiconductors from high-energy transients on the grid and PV array 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 surge pulses
- Islanding detection according to IEEE 1547.1 and VDE 0126-1-1
- Arc-fault circuit interrupter (AFCI) according of the National Electrical Code Section 690.11

## 2.3 Safety standards and regulatory compliance

The product line has been evaluated, and certified by nationally recognized test laboratories to the following safety features and regulatory compliance:

<b>2.0-5.0TL1 M2 WM OD US__</b>			
UL 1741-1:1999 Rev. May 2007	X	NFPA 70	X
CSA 22.2 No. 107-1:2001 Rev 2006	X	UL 1699B (DC AFDI)	X
IEEE Std. 1547-2003	X	UL 1998	X
IEEE Std. 1547.1-2005	X	Directive concerning Electromagnetic Compatibility with Class B (Council Directive 2004/108/EC)	X
FCC Rules 47 CFR Part 15	X	Low Voltage Directive (Council Directive 2006/95/EC)	X

The blueplanet inverter has complete on-board overcurrent, over-temperature and anti-islanding protection.

### 3 PV system description

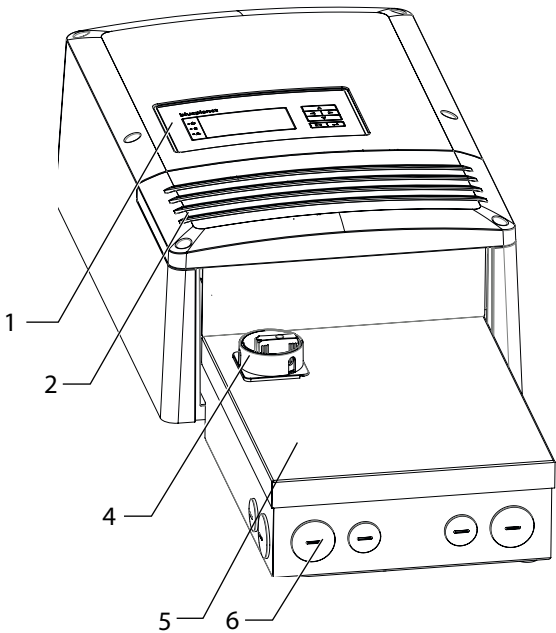
#### 3.1 Summary of operation

The PV system creates clean AC energy from sunlight. The PV array absorbs the energy of sunlight, and produces DC energy. The inverter's role is to maximize the amount of DC energy inverted into AC, and exported to the utility grid during the feed in mode of operation.

The feed in process starts with enough sunlight exposed to the PV array for the specific minimum voltage and current levels. The amount of energy available to the inverter is directly tied to the amount of sunlight being absorbed by the PV array.

##### 3.1.1 Design of the inverter

Version US39



Version US3A

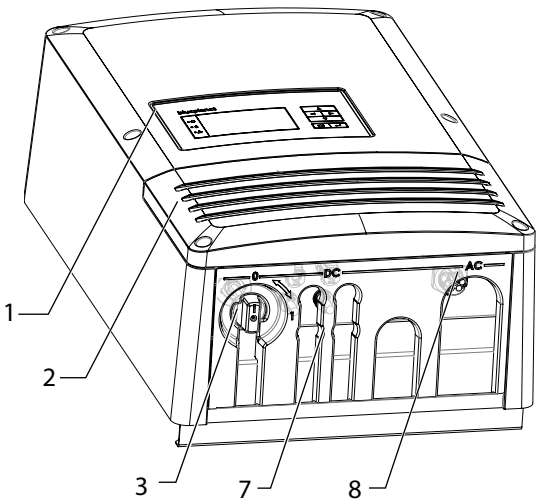


Figure 1: Inverter with integrated PV System Disconnect (PSD)

Figure 2: Inverter without PV System Disconnect (PSD)

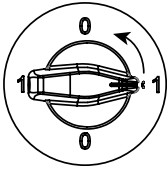
##### Key

1	Operator panel	5	AFCI and/or revenue meter (inside PSD)
2	Cover for the interface terminals	6	AC/DC connection knockouts
3	DC disconnect switch	7	DC connection
4	DC disconnect switch	8	AC connection

##### 3.1.2 Mechanical components

###### DC disconnection switch

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


**Disconnecting the inverter from the PV generator**

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

**Connecting the inverter to the PV generator**

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

### 3.1.3 Electrical functions

#### Fault signal relay

A potential-free relay contact is integrated in the inverter. The contact closes as soon as there is a fault during operation.

### 3.1.4 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

The 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 monitoring a system comprising several inverters, we recommend you use an external data logging and monitoring system. The Ethernet interface is prepared for connection to Powador Web.

#### RS485 interface

Use this monitoring variant if you cannot check the function of the system on-site on a regular basis, e.g. if your place of residence is located a great distance from the system. To connect the RS485 interface, contact your authorised electrician.

For monitoring your PV system using the RS485 interface, KACO new energy offers several solar monitoring devices. In case of inverter failure in a group of inverter only the RS485 interface send also data for monitoring.

#### USB interface

The USB connection of the inverter is a type A socket. The USB port is located on the connection board on the underside of the inverter under a cover.

The USB connection is specified to draw 100 mA of power. Use the USB interface for reading out stored operating data and loading 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 inverters from the public grid can be initiated by a digital signal instead of tie circuit-breakers. This requires the inverters in the photovoltaic system to be connected to the Powador-protect. 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 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).

Obtain the optional interface card through our service at KACO new energy

### 3.1.5 Major components of a PV system

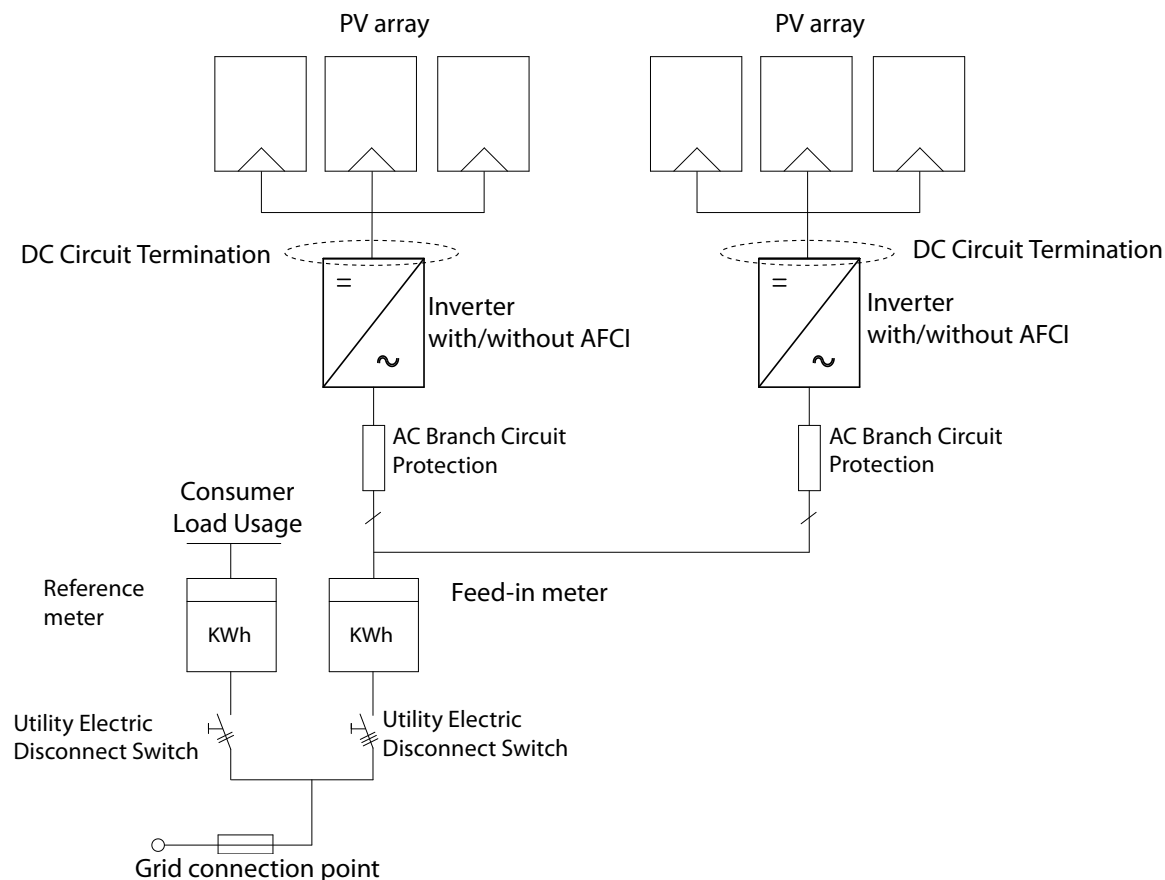


Figure 3: PV system illustration with two inverters

#### A summary of the components

##### PV array

PV arrays consist of PV modules connected in series and parallel. Each series-connected set is called a string. The electrical properties of the PV array are determined by how many PV modules are in a string, and how many of the strings are connected in parallel. k

##### DC circuit connection

The PV array comprises individual PV circuits, with each circuit containing one positive and one negative contributor. The individual PV circuits are connected in parallel at a DC circuit termination point. The DC circuits can be terminated either outside the inverter, or inside the inverter as shown in Figure 3 on page 10.

##### AFCI (depending of Inverter type)

An AFCI is a device intended to provide protection from the effects of arc faults by recognizing characteristics unique to arcing and by functioning to de-energize the circuit when an arc fault is detected. In addition to recognizing arcing characteristics, a branch/feeder AFCI circuit breaker has short-circuit protection.

These devices also have overload protection for the circuit. Prolonged overloading of the circuit causes heating, which subsequently damages conductor insulation and can cause possible damage to equipment and other components in the electrical circuit.

##### Feed-in meter

The feed-in meter is specified and installed by the power supply company. Some power supply companies also allow the installation of your own calibrated meters.

##### Utility Electric Disconnect Switch

Your utility operator or authority having jurisdiction (AHJ), may require an external visible blade disconnect, which is not required by the NFPA 70

## 4 Technical Data

Product: KACO blueplanet	2.0 TL1	3.0 TL1	4.0 TL1	5.0 TL1
DC electrical specifications				
DC maximum input voltage (VDC)	600			
DC maximum peak power operating range (MPP) (VDC)	190-510	140-510	185-510	235-510
DC operating range (VDC)	125-550			
DC minimum start voltage (VDC)	150			
DC maximum operating current per channel (ADC)	1 x 11	2 x 11	2 x 11	2 x 11
DC max Isc per channel (ADC)	1 x 13.2	2 x 13.2	2 x 13.2	2 x 13.2
Max input source backfeed current (ADC)	0			
DC input overload protection	yes, voltage and current during operation			
DC input terminals / conductor size	US39 = PV Fuseholder AWG 14 - 6 US3A = Phoenix Sunclix AWG 13 - 9			
AC electrical specifications				
AC max continuous output power (W)	2,000	3,000	4,000	4,600 @ 208V 4,800 @ 220V 5,000 @ 240V
CEC weighted eff (%)	> 97			
AC nominal voltage / operating range L to Neutral (VAC)	208V with / without N / 220V with / without N / 240V with / without N			
AC continuous output current (A)	8.3 @ 240V 9.1 @ 220V 9.7 @ 208V	12.5 @ 240V 13.6 @ 220V 14.5 @ 208V	16.7 @ 240V 18.2 @ 220V 19.2 @ 208V	20.0 @ 240V 21.8 @ 220V 22.0 @ 208V
Frequency nominal / range (Hz)	60 / 60.5 to 59.3			
Power factor	1 - 0.3 (ind/cap)			
Total harmonic distortion %	< 0.5			
Standby losses (W)	US3A < 4.0 W / US39 < 4.6 W			
AC short circuit protection	None			
AC input terminals / conductor size	US39 = AC Fuseholder AWG 14 - 6 / Terminal Bl. 20 - 6 AWG US3A = Phoenix PRC-5-FC-FS6 15 - 9 AWG			
AC Maximum output fault current (A) and duration ms	380* / 254 / 0,09 (ms) (89.2μs)			
booster unit	integrated			

Table 2: Electrical Data

\* The value is based on the discharging of the filter capacitor

PV system disconnect (PSD)	2.0 TL1	3.0 TL1	4.0 TL1	5.0 TL1
Integrated DC disconnect	Depending of inverter type (see Table 1 on page 4)			
DC Disconnection device	Rotary switch visible and accessible from outside of enclosure			
DC Disconnection ratings	25 A, 2/4 pole, Load Break, Pos and Neg (Depending on inverter type)			
DC over current protection devices (OCPD)	Depending on inverter type (see Table 1 on page 4)			
DC LOTO Provision	LOTO is possible			
Mechanical and environmental specifications				
Mechanical integration	Wall mounting			
Enclosure construction	Plastic cover and Al sheet metal (inverter), Al sheet metal (PSD)			
Unit Weight (lb/kg)	33 / 15	36 / 16.5	36 / 16.5	36 / 16.5
Unit Weight with PSD box (lb/kg)	38,5/ 17,5	42 / 19	45 / 20,5	45 / 20,5
Unit dimensions HxWxD (In/mm)	[31,9x14,44x8,8] 810x367x227			
Unit dimensions without PSD HxWxD (In/mm)	[22x14,44x8,8] 560x367x227			
Environmental				
Operating temp range (°F / °C)	(-13 to 140 / -25 to 60)			
Storage temp range (°F / °C)	(-22 to 158 / -30 to 70)			
Noise emissions	<35 db			
Humidity %	0 to 95 non condensing			
Type of protection	IP54 / NEMA 3R			
Cooling	passively cooled			
Altitude (ft / m)	6500 / 2000			
Communications and user interface				
User interface	Graphical user interface with 3 LED status indicators			
Connectivity	EVU remote, 2 x Ethernet, USB, RS485 optional: S0 ,4-DI, 4-D0			
Safety features and regulatory compliance				
UL / IEEE / CSA / FCC	UL 1741x 2nd Ed 2010 / CSA C22.2No 107.1 / IEEE 1547 / FCC Class B			
Internal AFCI	AFCI compliant with UL1699B provided with US39 models			
Fault signal relay	Potential free normally open contact			
DC polarity safeguard	Short circuit diode			
GFDI compliant with NEC 690.35 for use with ungrounded PV system arrays.	UL1741 listed for residual ground fault current isolation monitor and interrupter function.			

Table 2: Electrical Data



## 4.1 Trip level settings to shutdown Inverter

No.	Description	Trip setting	Persistent time
1	DC Input Over Voltage Level 1	550 V_DC	2 sec
2	DC Input Over Voltage Level 2	560 V_DC	20 msec + 2 sec level1
3	DC Input Under Voltage	50 V_DC	1 sec
6	DC Link Instantaneous Over Voltage	610 V_DC	176,5 µsec
7	DC Link Instantaneous Under Voltage	330 V_DC	1 msec
9	Inverter Instantaneous Over Current	36,77 A_peak	88,2 µsec

Table 3: Trip level settings to shutdown Inverter

## 4.2 Trip level settings to stop Inverter

Description	Minimum level	Maximum level	Default level	Minimum time	Maximum time	Default time
Line Under Voltage Fast	50 %	88 %	50 %	0.16 sec	0.16 sec	0.16 sec
Line Under Voltage Slow	88 %	100 %	88 %	0.16 sec	2 sec	2 sec
Line Over Voltage Fast	110 %	120 %	120 %	0.16 sec	0.16 sec	0.16 sec
Line Over Voltage Slow	100 %	110 %	110%	0.16 sec	1 sec	1 sec
Line Under Frequency Fast	57 Hz	59.8 Hz	59.3 Hz	0.16 sec	300 sec	0.16 sec
Line Under Frequency Slow	57 Hz	57 Hz	57 Hz	0.16 sec	0.16 sec	0.16 sec
Line Over Frequency	60 Hz	60.5 Hz	60.5 Hz	0.16 sec	0.16 sec	0.16 sec

Table 4: Trip level settings to stop Inverter

## 5 Transportation and Delivery

## 5.1 Delivery

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

## Scope of delivery

- 1 inverter
- 1 installation kit
- Documentation set (Instruction manuals for operator and authorized electricians)

## Checking your delivery

1. Thoroughly inspect your inverter.
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. Immediately send a damage report to the shipping company.

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

## 5.2 Transportation



## WARNING



### Impact hazard, risk of breakage to the inverter

- › Securely pack the inverter for transport.
- › Carefully transport the inverter using the carrying handles of the carton.
- › Do not subject the inverter to shocks.

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

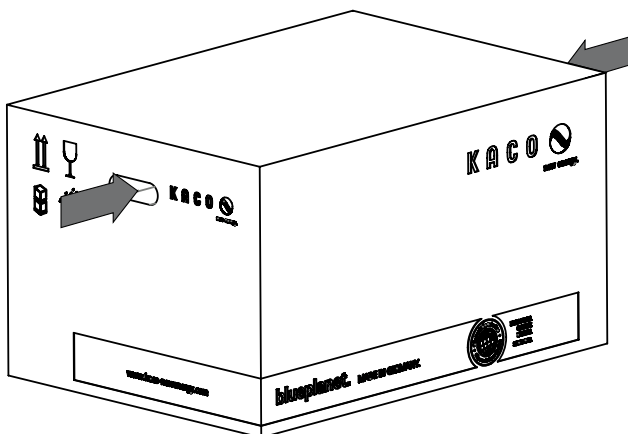


Figure 4: Transportation of the inverter

## 6 Mounting the Inverter



### 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.

### Ideal Installation space

- › Do not mount the inverter in an area at risk of explosion or in the vicinity of highly flammable materials.
- If possible, the ideal installation space would be as dry as possible, climate-controlled, with the waste heat dissipated away from the inverter,
- In all installation cases, unobstructed air circulation and the visibility of the display at eye level are strongly recommended.
- Access to the inverter must also be possible without additional tools,
- For outdoor installation, fit the inverters in such a way to ensure that they are protected against direct sunlight, moisture - and dust penetration,
- If installing the unit in a control cabinet, provide forced ventilation so that the heat is sufficiently dissipated.

### Wall

- With sufficient load-bearing capacity
- Accessible for installation and maintenance
- Made from heat-resistant material (up to 194°F/90°C)
- Flame resistant
- Minimum clearance during installation: see Figure 9 on page 17 and Figure 10 on page 18.

### CAUTION

#### **Use suitable mounting fixtures.**

- › Only use the supplied mounting fixtures.
- › Mount the inverter upright on a vertical wall only.
- › For a free-standing mounting an incline of 20° is allowed.



### NOTICE

#### **Power reduction due to heat accumulation.**

If the recommended minimum clearances are not observed, the inverter can have power regulation and a protective shutdown due to insufficient ventilation and the associated heat

- › Maintain minimum clearances.
- › Provide for sufficient heat dissipation.

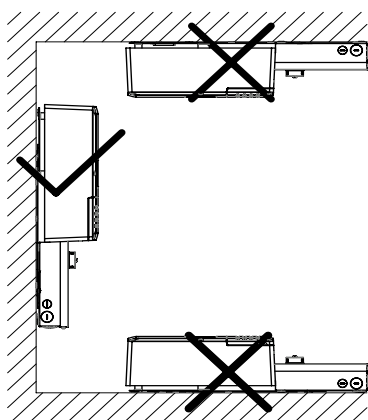


Figure 5: Instructions for wall mounting (inverter with PSD)

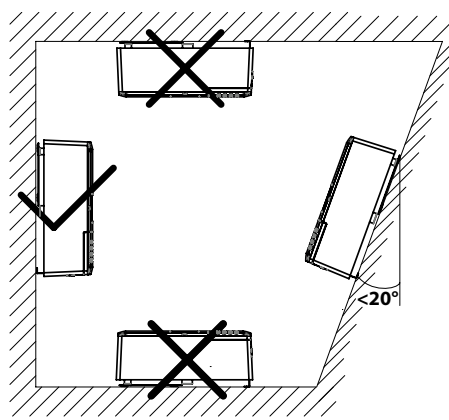


Figure 6: Instructions for wall mounting

## 6.1 Unpacking

### CAUTION

**The inverter is very heavy – risk of injury!**



- › Please pay attention to the weight, higher centre of gravity and areas for lifting the unit.
- › Select suitable mounting location and mounting base.
- › Use mounting material corresponding to or included with the base for mounting the inverter.
- › The inverter should be always carried by 2 people.

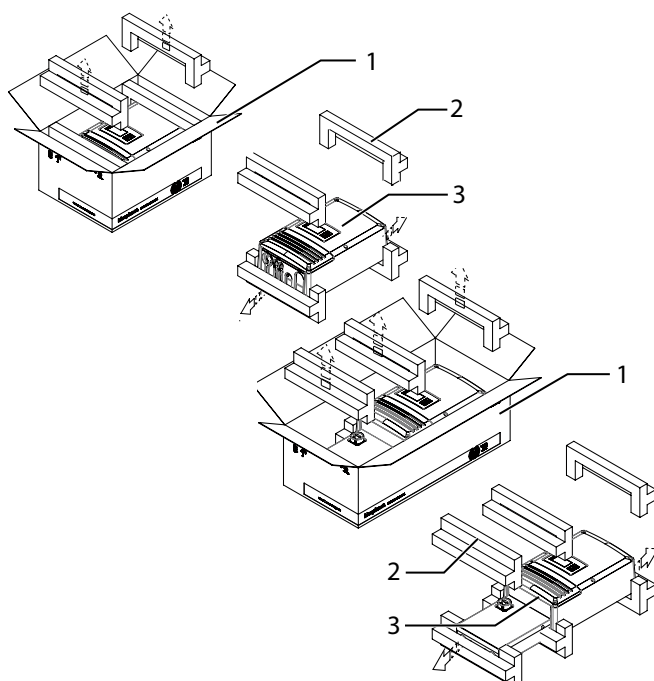


Figure 7: Unpacking the inverter

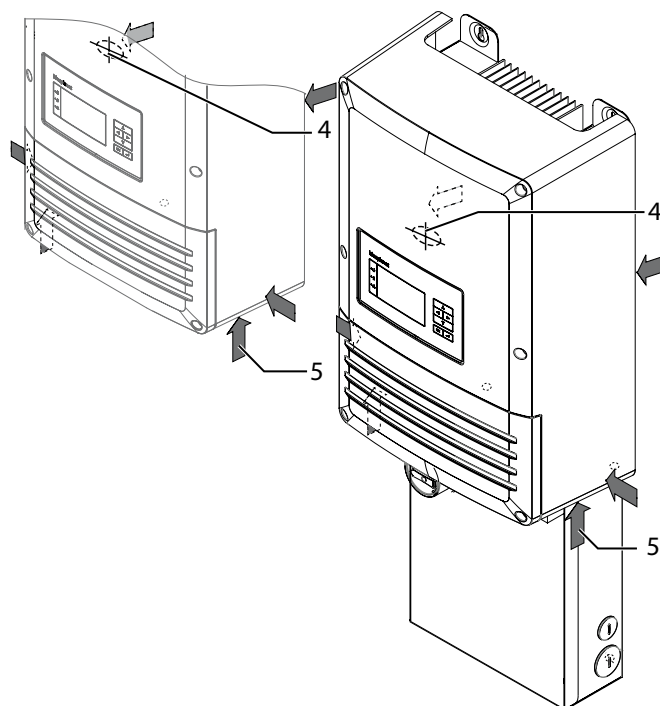


Figure 8: Lift inverter

### key

1	Carton	4	Centre of gravity of the inverter
2	Protective packaging	5	Areas for lifting the unit
3	Inverter		

## Unpacking the inverter

1. Open carton at the front.
  2. Remove installation material and documentation.
  3. To take out the inverter, break the upper protective packaging from the side outwards.
  4. Take out the Inverter together with the bottom protective packaging of the carton.
  5. Remove the protective packaging from the unit and place back into the carton.
  6. Lift the inverter from the provided areas (see Figure 8).
- » Continue mounting the inverter.

## 6.2 Mount

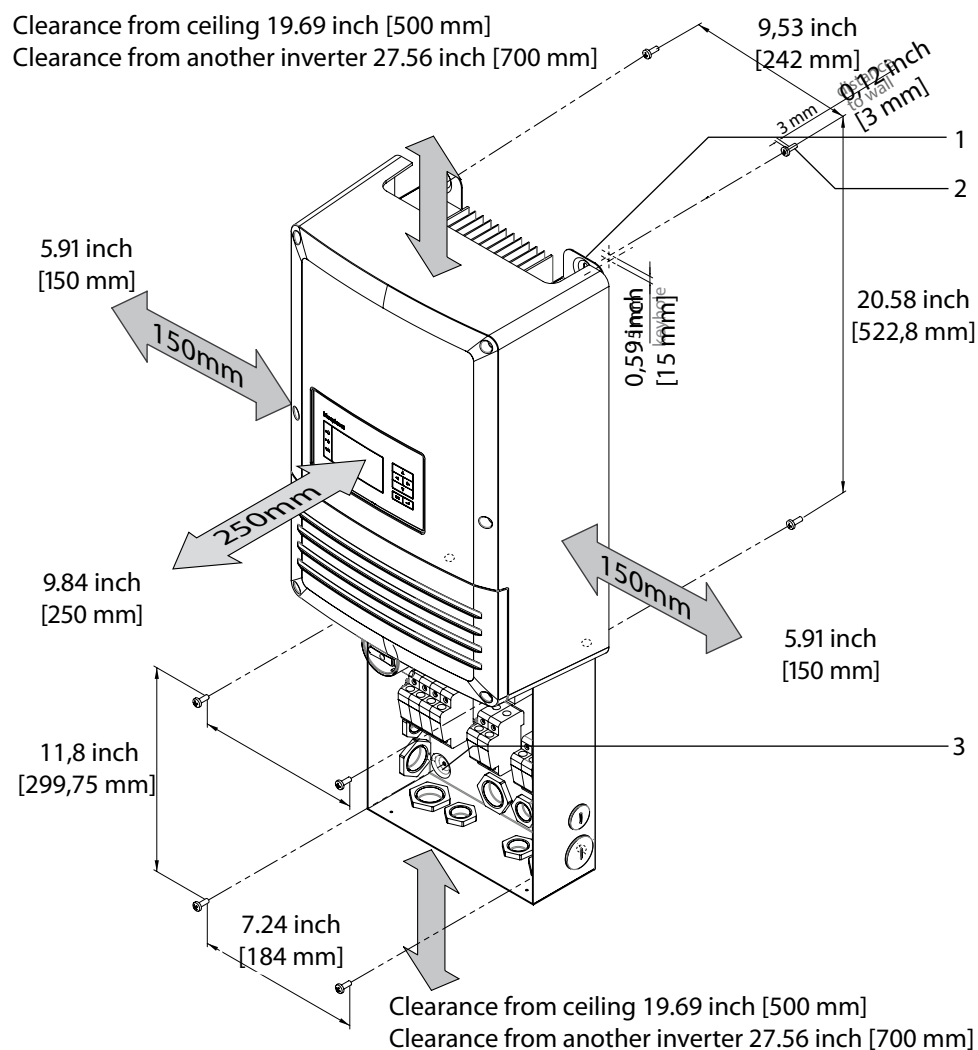


Figure 9: Minimum clearances/Mounting holes

### Key

1	Key-holes for suspension (2x)	3	Detachment holes (4x) (protection guard)
2	Mounting screws (6x)		

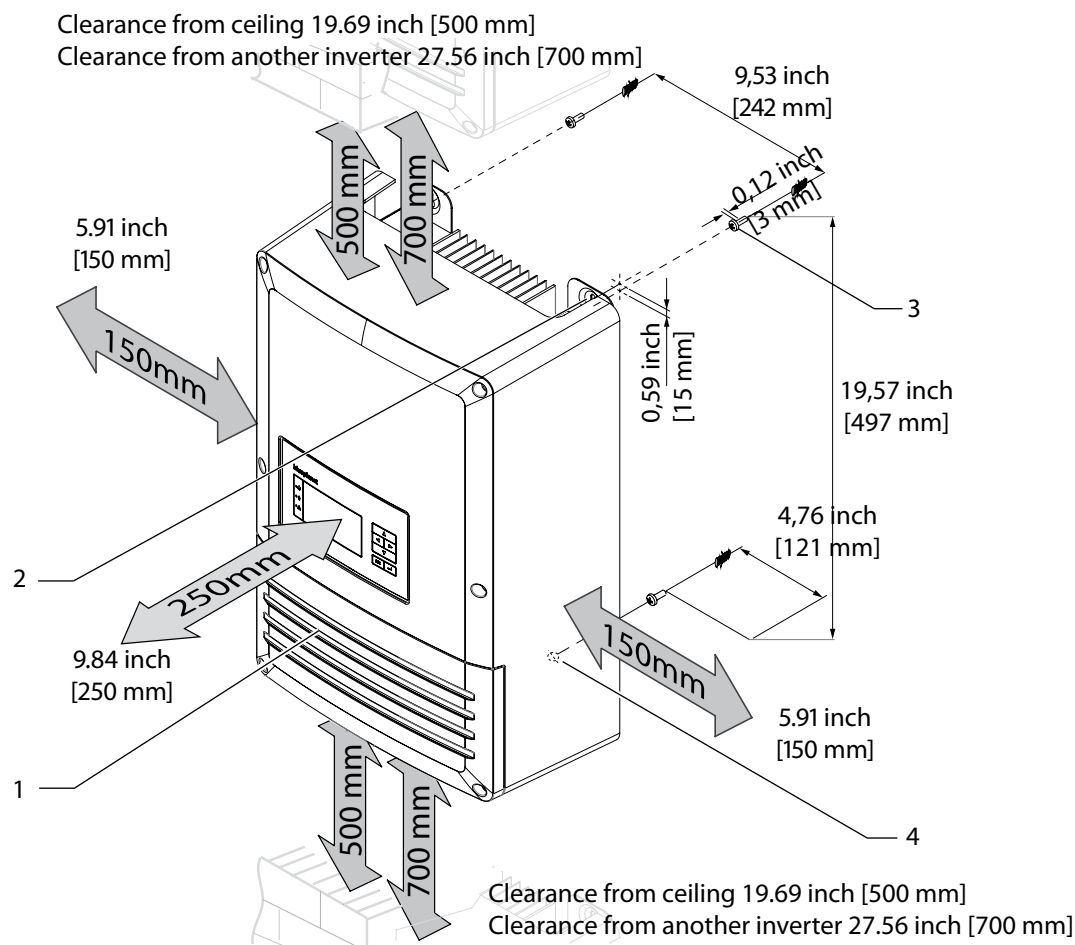


Figure 10: Minimum clearances/mounting plate for inverter without PSD

## Key

1	Cover	3	Mounting screws (3x)
2	Key-holes for suspension (2x)	4	Detachment holes (1x) (protection guard)

## Mounting the inverter

1. Mark the positions of the upper drill holes using the keyholes in the case lug.  
 NOTICE: The minimum clearances between two inverters, or the inverter and the ceiling/floor have already been taken into account in the drawing.
2. Fix the inverter with the enclosed screws and suitable wall plugs at the wall.
3. Fix the inverter by 1 (without PSD) or 4 (with PSD box) additional screws as protection guard inside the housing on the wall.

## 7 Installing the Inverter



### DANGER

**Lethal voltages are still present in the terminals and leads of the inverter even after the inverter has been switched off and disconnected.**

Severe injuries or death if the leads and terminals in the inverter are touched.

Only authorised electricians who are approved by the supply grid operator may open and install the inverter.



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

- › Observe all safety regulations and the currently applicable technical connection specifications of the responsible power supply company.
- › Disconnect the AC and DC circuits.
- › Lock Out and Tag Out the AC and DC circuits in compliance with local regulations.
- › Assure that the AC and DC circuits are completely de-energized.
- › Connect the inverter only after the aforementioned steps have been taken.

### 7.1 Opening the connection area (inverter with PSD box)

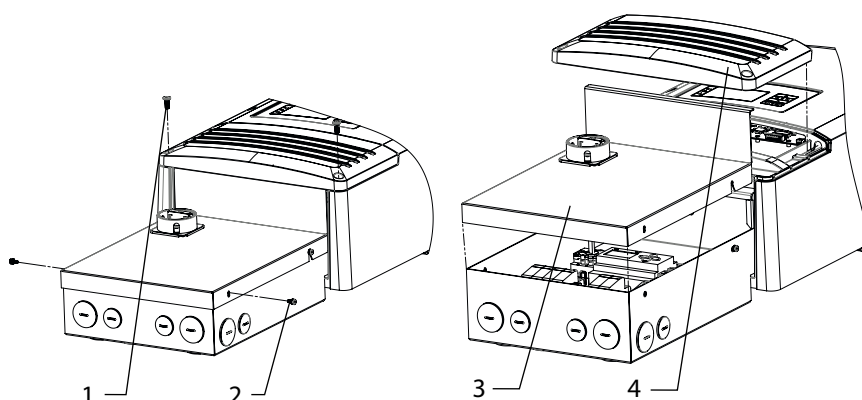


Figure 11: Disconnect and open PV system disconnect (PSD)

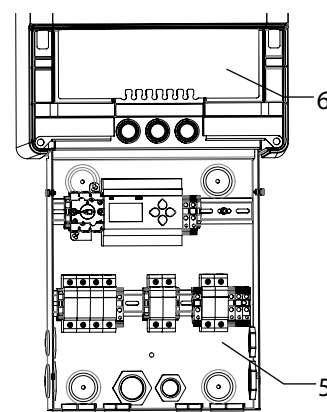


Figure 12: Connection area

#### Key

1	Mounting screws (2x)	4	Cover
2	Mounting screws for PSD cover (4x)	5	Connection area PSD - DC / AC
3	Cover for PSD	6	Connection area interfaces

#### Open connection area

- You have mounted the inverter on the wall.
- 1. Turn the AC disconnect to the off position to release the cover interlock.
- 2. loosening the 2 mounting screws from.
- 3. unscrew the T30 Torx mounting screws from the front side of the inverter.
- 4. Remove cover for the inverter.
- 5. Terminate both AC and DC circuits in accordance with the NFPA 70 and other local requirements.
- » Continue with electrical connection in PV system disconnect box.



#### NOTICE

Install the inverter in accordance with NFPA 70 and additional local requirements.

## 7.2 Opening the connection area (inverter without PSD box)

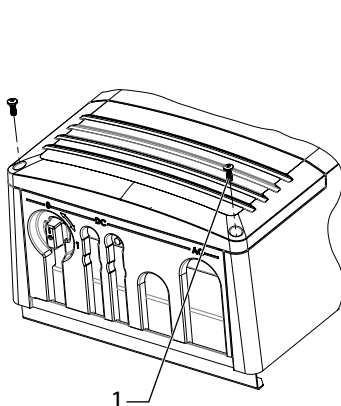


Figure 13: Disassemble cover

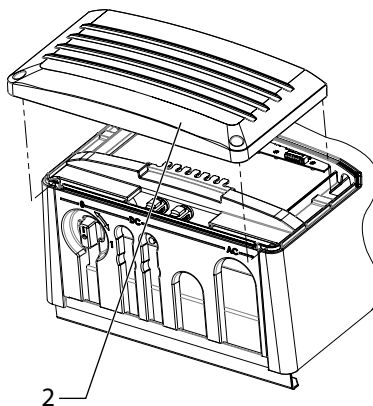


Figure 14: Remove cover

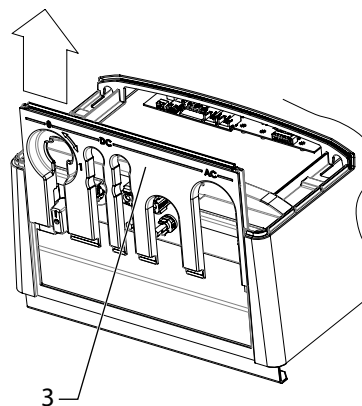


Figure 15: Remove slider

### Key

1	Mounting screws (2x)	3	Slider
2	Cover		

### Open connection area

- ⌚ You have mounted the inverter on the wall.
- 1. Turn the DC disconnection switch to off position.
- 2. unscrew the T30 Torx mounting screws from the front side of the connection cover.
- 3. Remove the slider.
- » Continue with mounting AC-Device plug in connector.

### 7.2.1 AC-Device plug in connector

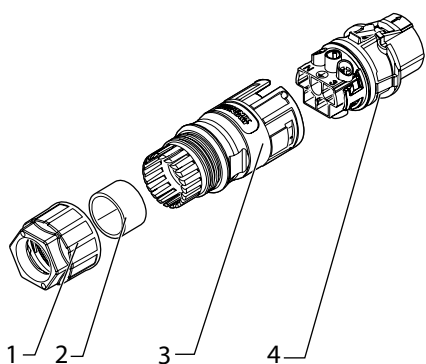


Figure 16: Assembling the plug

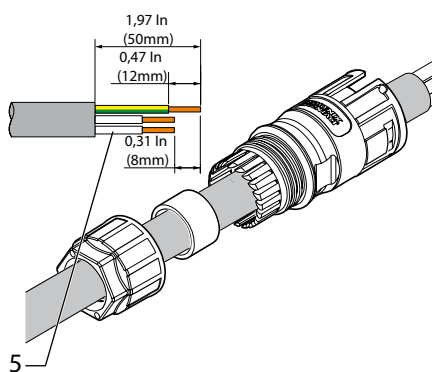


Figure 17: Prepare cable

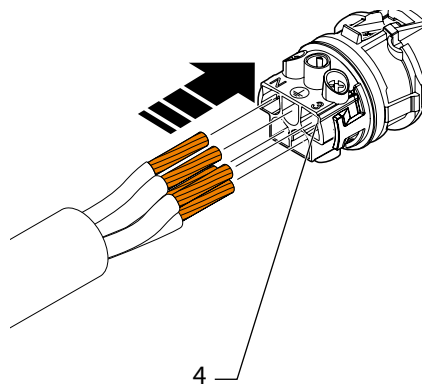


Figure 18: Connect wires



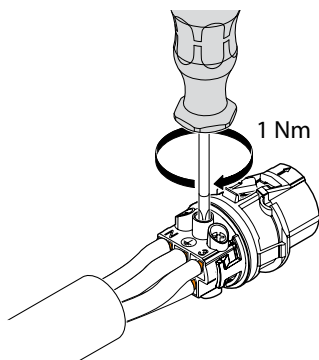


Figure 19: Torque screw in contact carrier

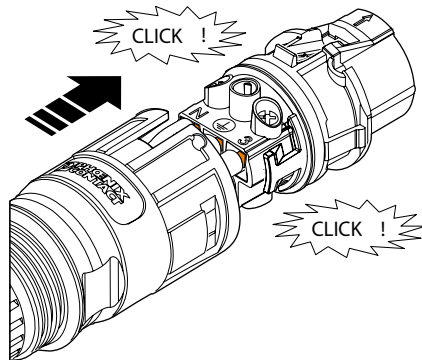


Figure 20: Push contact carrier into housing

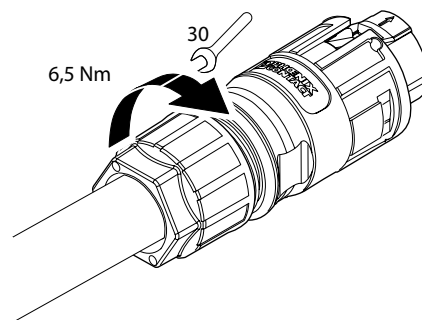


Figure 21: Tighten cable gland

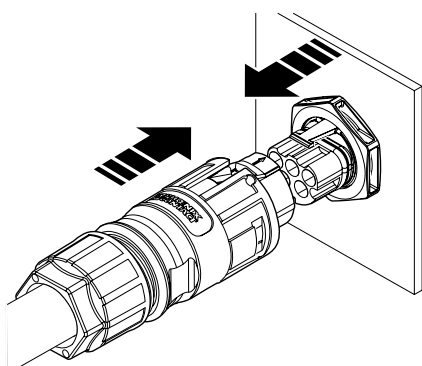


Figure 22: Connecting the plug-in connector

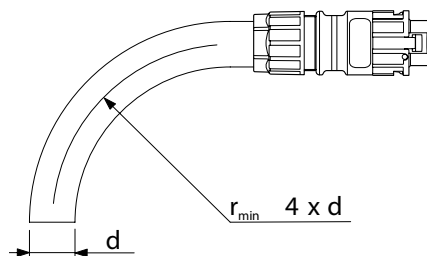


Figure 23: bending radii

### Key

1	Cable gland	4	contact carrier
2	Seal	5	wires
3	Housing		

### PRC plug-in connector

⌚ Connection area opened.

1. Push the cable gland over the cable.
  2. Select a seal that fits to your cable diameter.
  3. Push the housing with the seal over the cable.
  4. Strip 50 mm off the cable.
  5. Shorten the wires N and L1, L2, L3 by 8 mm.
  6. Strip 12 mm off the wires.
  7. For flexible wires, we recommend using ferrules acc. to DIN 46228 that are crimped with jointing clamp CRIMPFOX
  8. Connect the wires to the contact carrier. Please refer to pin assignment (see Chapter 7.2.2 on page 22)
  9. Torque the screws to 1 Nm on the contact carrier.
  10. Push the contact carrier into the housing until it snaps in audibly.
  11. Tighten the cable gland to a torque of 6.5 Nm.
  12. Snap the preassembled connector into the device.
- » Continue with making electrical connections

## 7.2.2 Standard deviating at pin assignment

### CAUTION

#### Hazard with risk of damage inverter due wrong pin assignment

Damage to the inverter caused by connecting the wires in accordance with the plug labelling.

- › Query local grid connection type.
- › Connect leads to the contact plug according to the grid connection type in accordance with a diagram below.

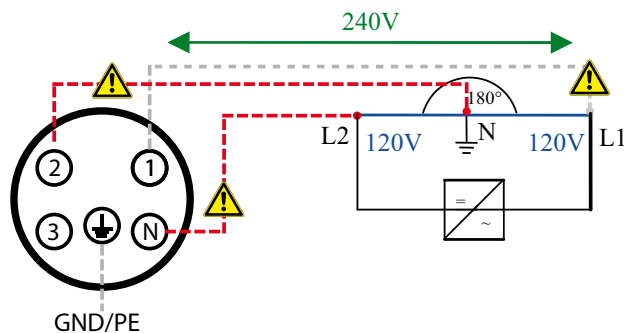


Figure 24: 240/120 V Split Phase

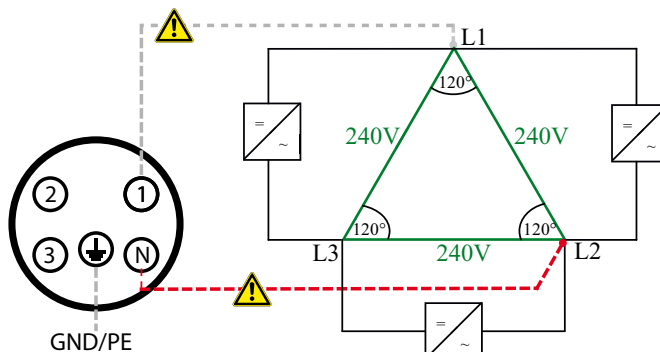


Figure 25: 240 V Delta

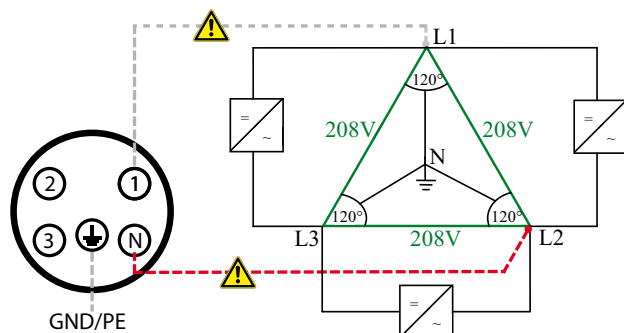


Figure 26: 208/120 V WYE

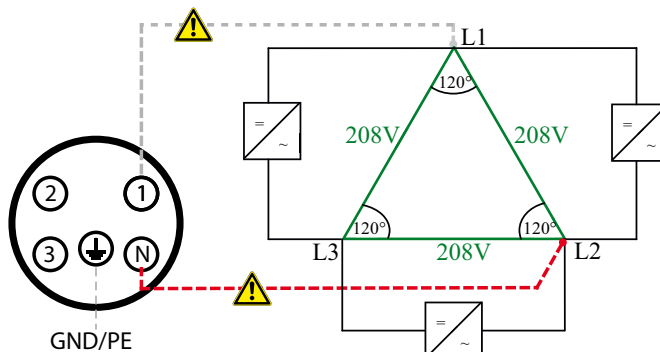


Figure 27: 208 V Delta



### WARNING

#### Impact hazard, risk of breakage to the inverter

- › Do not connect the inverter to the 480V Delta or 480V/277V WYE power grids.



### NOTICE

Observe the permitted bending radii during layout, because the degree of protection might become endangered if the bending forces are too great (see Figure 23).  
 Alleviate mechanical loads before the plug-in connector (e.g. by employing cable binders).

## 7.3 Making the electrical connections (inverter with PSD box)

Make the connection to the PV array and the grid connection via the PCB terminals in the connectors on the bottom of INV / terminals in PSD. Maintain the following conductor cross-sections:

	AC circuit Inv / PSD L1-L3 / N	DC circuit Inv / PSD
Max. conductor cross-section without wire sleeves	6 / (14 / 6) AWG	14 / 6 AWG
Length of insulation to be stripped off	2/5 in	2/5 in

### 7.3.1 Connecting the inverter to the power grid



#### **DANGER**



#### **Risk of fatal injury due to electric shock**

Severe injuries or death will result if the live connections are touched.

- › Disconnect the inverter from all power sources before you insert the grid power lead into the unit.



#### **CAUTION**

#### **Risk of fire**

Insufficient over current protection can increase the risk of fire.

- › Connect only to a circuit provided with a branch circuit over-current protection in accordance with the national electrical code ANSI/NFPA 70.

- › 15 A (possible fuse size 10 A)

\* OCPD rating unchanged with PSD

*AC circuit voltage drop of 2% or less is recommended for runs of greater than 60 feet from the point of common coupling (PCC). AC conductor ampacity calculations are based on the NFPA 70 and additional requirements.*



#### **NOTICE**

This unit is provided with adjustable trip limits and can be aggregated above 30kW on a single point of common connection.



#### **NOTICE**

The installation shall indicate wiring methods in accordance with NFPA 70 and additional local requirements.

Use copper conductors only.



#### **NOTICE**

When impedance of the AC circuit to the utility connection is high, the voltage at the grid terminals of the inverter will increase during feed-in to the utility. The inverter monitors this voltage, and if the value exceeds the country-specific threshold value, the inverter will disconnect with an error message.

- › AC circuit voltage drop of 2% or less is recommended for runs of greater than 60 feet from the point of common coupling (PCC).
- › AC conductor ampacity calculations are based on the NFPA 70 and additional requirements.

The grid connection leads are connected on the right side of the connection area

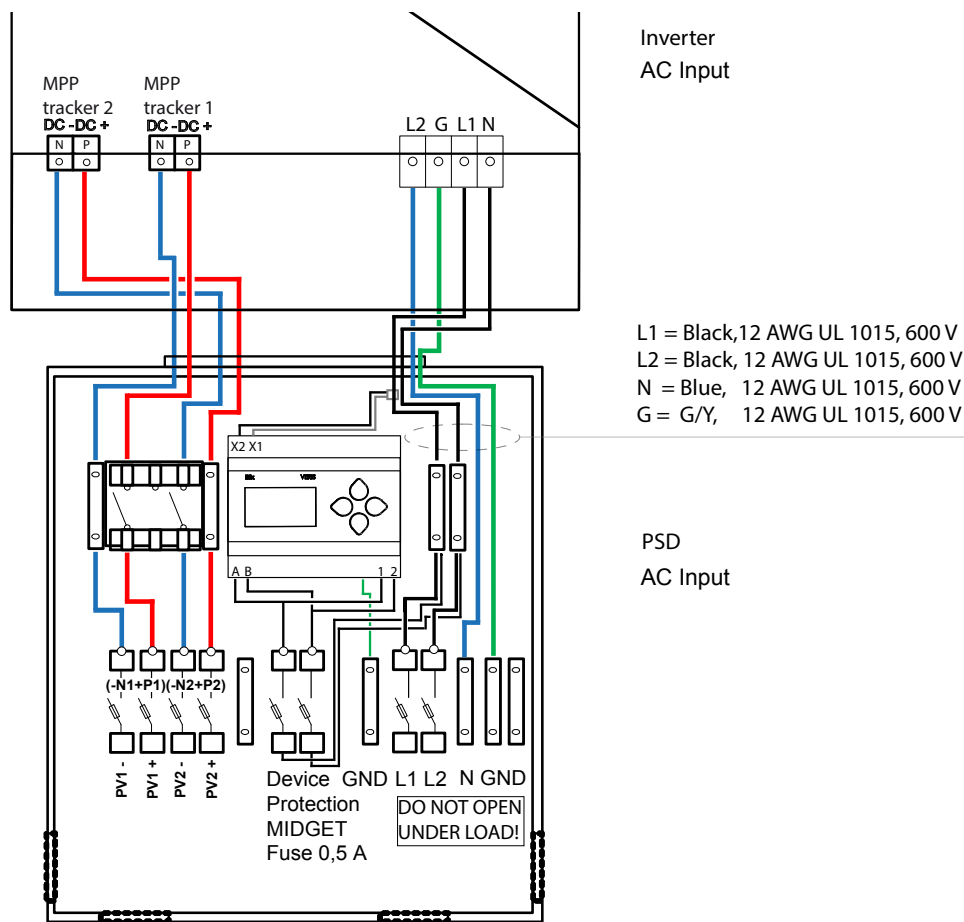


Figure 28: Connection terminals for AC/DC-leads (PSD with AFCI and revenue meter)

### Connecting the inverter to the utility grid

- ⌚ You must remove the desired knockouts at the PSD box for cable connection. The inverter is NEMA 4 rated. KACO requires that you use UL 514B watertight conduit connection at the conduit entrance.
- ⌚ Feed in the AC circuit through the PSD housing.
- 13. Strip AC circuit conductors 2/5"
- 14. Route the AC circuit conductors to the AC terminals.
- 15. Open the locks of the PCB terminals.
- 16. Connect the AC circuit to the PCB terminals, and in accordance with the PCB labeling, L1, L2, N, and GND.
- 17. Close the locks of the PCB terminals.
- 18. Check that all connected conductors are tightly seated.
- » The inverter is now connected to the utility grid.



### NOTICE

An AC branch circuit protection must be provided in accordance with the NFPA 70 and other local requirements.

The maximum branch circuit protection is stated in caution note chapter 7.3.1 on page 23.

If a residual current circuit breaker is necessary due to local requirements, KACO requires that you must use a type A AFI (AC/DC-sensitive residual current circuit breaker).

## 7.4 Making the electrical connection (inverter without PSD box)

Make the connection to the PV generator and the grid connection using the connection terminals.

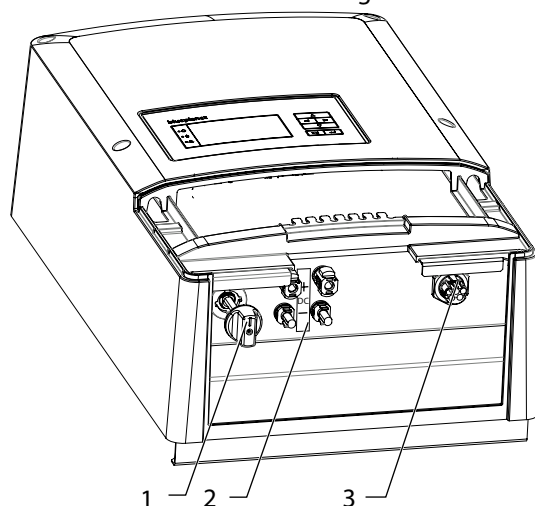


Figure 29: Connection terminals for AC/DC-leads

### key

1	DC-Disconnect switch	3	AC-Connector
2	DC-Connector for PV array	5	

### 7.4.1 Connecting the inverter to the power grid

The power connection wires are connected on the right of the connection area (Figure 30 on page 26).



### DANGER

#### Risk of fatal injury due to electric shock

Severe injury or death will result if the live connections are touched.

- › Disconnect the inverter completely from all power sources before connecting up to the grid.
- › Make sure that the device is isolated from the public power supply and the system power supply before starting work.



#### Recommended conductor cross-sections and fuse protection of AC-connection cables for fixed wiring.

For cable lengths up to 20m, use the specified conductor cross-sections. Longer cable lengths require larger conductor cross-sections.

Model	Conductor cross-section	Fuse protection: gL safety fuses or comparable automatic circuit breakers
KACO blueplanet 2.0-5.0 TL1	14-6 AWG	25 A for 6 AWG conductor cross-section

Table 5: Recommended conductor cross-sections and fuse protection of AC-connection cables

### NOTE



When the line resistance 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 the voltage exceeds the country-specific grid overvoltage limit value, the inverter switches off.

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

### Making the grid connection

- ⌚ AC connector configured.
- 1. Connect the configured plug connectors to the device connector by fitting into place.
- 2. Lay cables correctly.

» The inverter is now connected to the power grid.

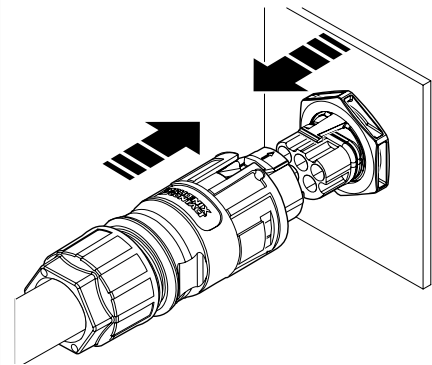


Figure 30: Engage the AC connector with the device connector.



### NOTE

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

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

## 7.4.2 Disconnect AC-plug in



### DANGER

**Risk of fatal injury due to electric shock**

**Never disconnect the 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.

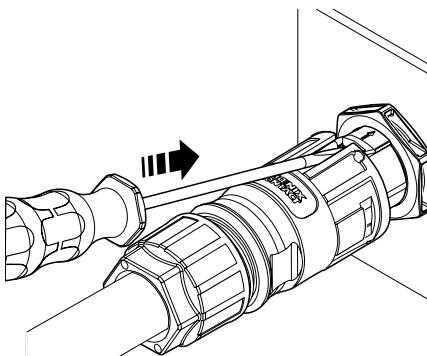


Figure 31: Disconnect the AC connector from the device connector

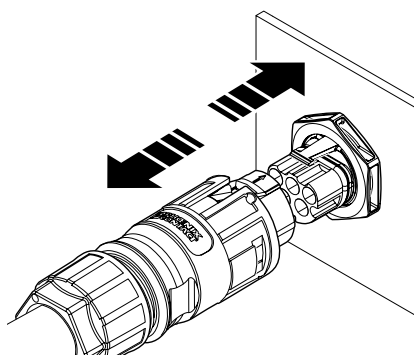


Figure 32: Disconnect the AC connection

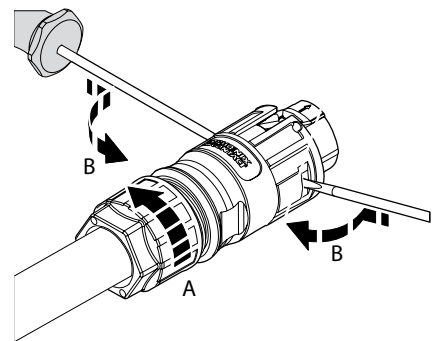


Figure 33: Unfasten the cable

### PRC plug-in connector release

- ⌚ 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.

## 7.5 Connecting the PV array

Connect the PV array to 2 DC positive and 2 DC negative connection terminals in the connection area of the inverter, or the PSD. (Depends on inverter type)



### DANGER



#### Risk of fatal injury due to contact voltages.

- › During installation: Electrically disconnect the DC positive and DC negative from the protective earth (PE).
- › Removing the connection without previously disconnecting the inverter from the DC array can result in a hazard to health and damage to the inverter.

### 7.5.1 Before the connection

#### Ensure that there is no ground fault

1. Determine the DC voltage between the
  - Protective earth (PE) and the positive lead of the PV array
  - Protective earth (PE) and the negative lead of the PV array

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 the
  - Protective earth (PE) and the positive lead of the PV array
  - Protective earth (PE) and the negative lead of the PV array

Low resistance ( $< 2 \text{ M}\Omega$ ) indicates a high-ohm ground fault of the PV array.

4. Rectify any faults before connecting the PV array.

### 7.5.2 Maximum input power

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



#### NOTICE

The overall power of the unit continues to be limited. If one input is connected to more than  $P(\text{DCmax})/2$ , the maximum input power of the second input decreases accordingly. Take care that the maximum input power is not exceeded.

### 7.5.3 Standard PV system connection



#### DANGER

##### Risk of fatal injury due to electric shock



Severe injuries or death will result if the live connections are touched. When there is irradiance, DC voltage is present on the open ends of the DC leads.

- › Do not touch the open ends of the leads.
- › Avoid short circuits.

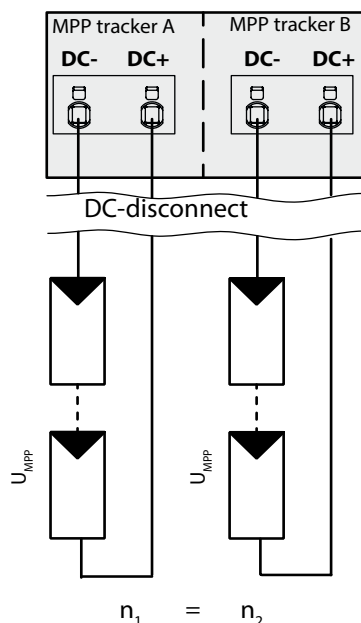


Figure 34: Recommended standard connection

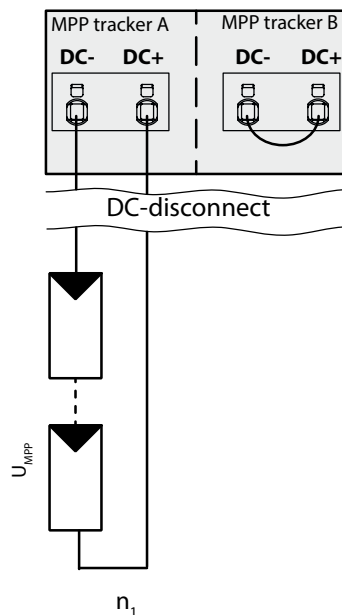


Figure 35: Recommended connection with short-circuits the unused MPP Tracker B

Electrical Data for	standard connection	unused MPP trackers
<b>Connecting the DC inputs</b>	Number of modules per string $n_1=n_2$	Number of modules per string: $n_1=n_m$
<b><math>P_{\max}</math></b>	per string < 4,7 kW	Per string < 0.5 * max. recommended PV generator power $P_{\max}$ on the MPP tracker used < max. power per tracker
<b><math>I_{\max}</math></b>	< 11 A per tracker	< max. rated current (DC)



#### NOTE

If one of the MPP trackers (A or B) is not used, then it must be short-circuited, otherwise faults can occur in 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 recommended standard connection or the parallel input connection should always be used as a matter of course before an MPP tracker is short-circuited and therefore remains unused.



## 7.5.4 Connect PV array (Inverter with PSD box)



### DANGER

#### Risk of fatal injury due to electric shock



Severe injuries or death will result if the live connections are touched. When there is irradiance, DC voltage is present on the open ends of the DC leads.

- › Do not touch the open ends of the leads.
- › Avoid short circuits.

### Connecting the PV array

- You must remove the desired knockouts at the PSD box for cable connection. The KACO inverter is NEMA 4 rated. KACO requires that you use UL 514B watertight conduit connection at the conduit entrance.
- 1. Strip DC circuit conductors 3/5" per (see chapter 7.3 on page 23)
- 2. Route the DC circuit conductors to the DC terminals.
- 3. Connect the DC circuits to the PCB terminals, and in accordance with the PCB labeling.
- » The inverter is connected to the PV array.

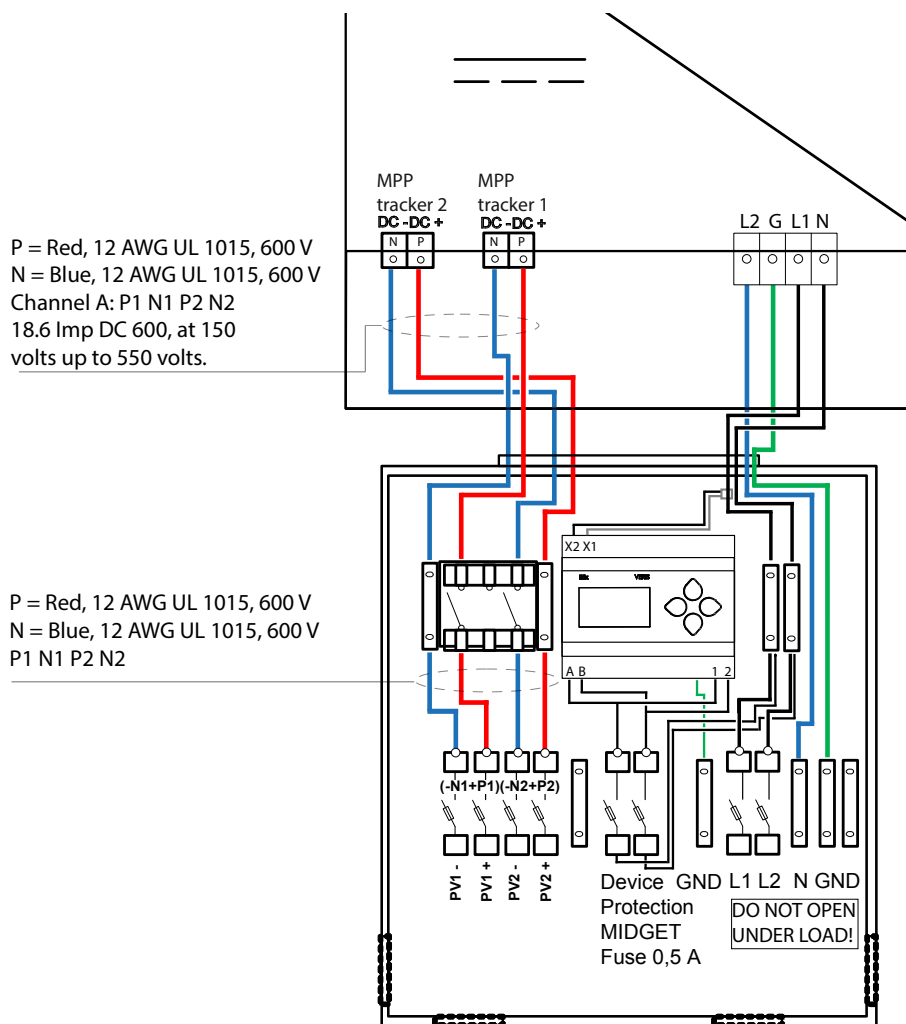


Figure 36: Connection terminals for DC positive and DC negative leads (for Example KACO blueplanet 5.0 TL3 (2 MPPT))

### 7.5.5 Connect PV array (Inverter without PSD box)

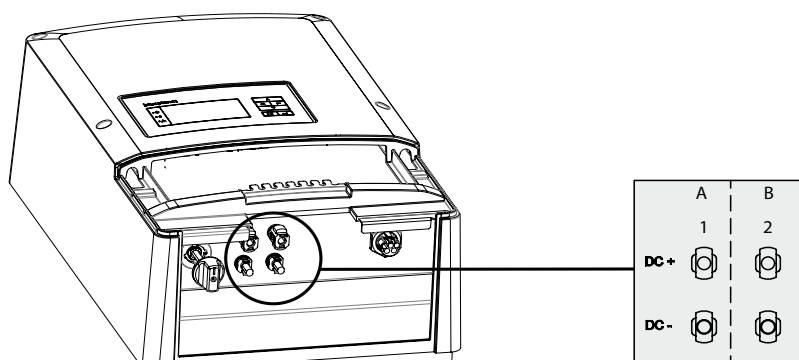


Figure 37: Connection terminals for DC positive and DC negative leads

#### Key

A	MPP tracker A	B	MPP tracker B
1	DC-Plus/DC-Minus connections	2	DC-Plus/DC-Minus connections

#### 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 by closing the unused plug connectors with protective caps.
- » The inverter is connected to the PV generator.

### 7.5.6 Grounding the housing



#### NOTICE


The KACO product line construction topology is that of a non isolated (transformerless) inverter.

UL1741 and the NFPA 70 does not require a grounding electrode conductor (GEC), and ground electrode termination point for non isolated inverters.

UL1741 and the NFPA only require a GEC terminal within the inverter if the inverter bonds the PV system to ground. Non isolated inverters do not bond the PV system to ground.

The NFPA 70 2011 sec 690.47 covering grounding electrodes contains significant clarifications over previous revisions. Sec 690.47 requires all PV systems to have a grounding electrode system, and details several methods of compliance.

Further code making dialog for the 2014 also has been presented, which adds additional clarification stating that ungrounded PV systems can have the their equipment grounding requirements met by the AC equipment grounding system without the requirement for a DC GEC or grounding system.

An optional grounding terminal is provided inside the inverters as shown in Figure 15. Ground the housing of the inverter, if necessary, at the grounding point provided for that purpose in the connection area of the inverter. It is marked with the  symbol.

## 7.6 Connecting the interfaces

All interface connectors are located on the connection board.

### **DANGER**

#### **Risk of fatal injury due to electric shock**



Severe injury or death from improper use of the interface connections and non-observance of protection class III.

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



### **NOTICE**

When laying the interface connection cables, note that too little clearance to the DC or AC leads can cause interference during data transfer.

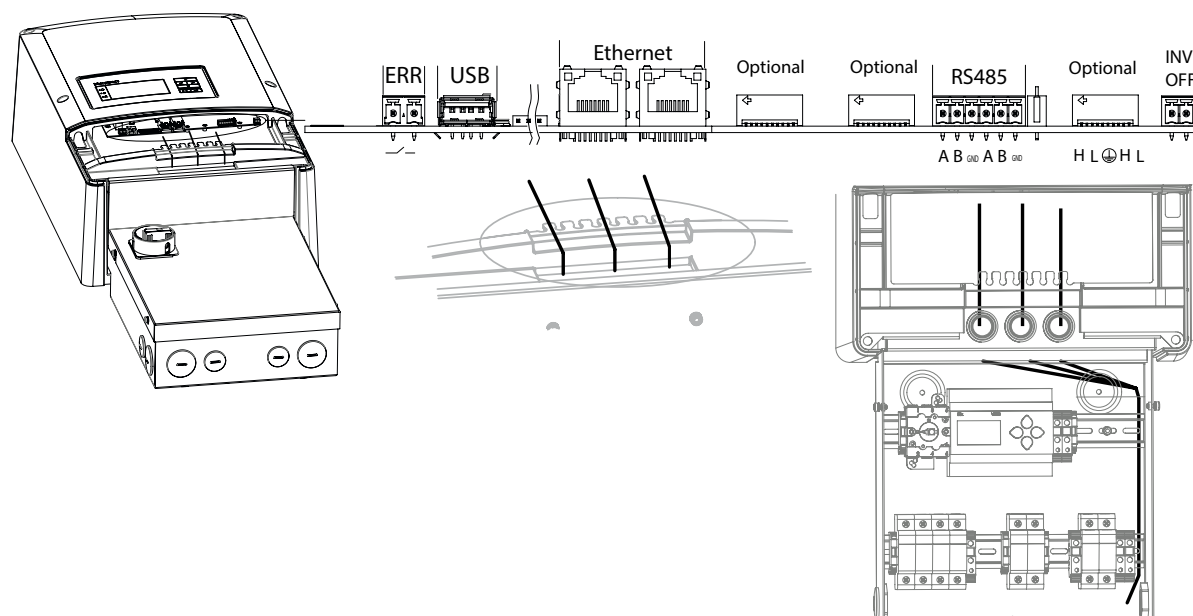


Figure 38: Connection area: Connection and pinout of the interfaces (Inverter with PSD box)

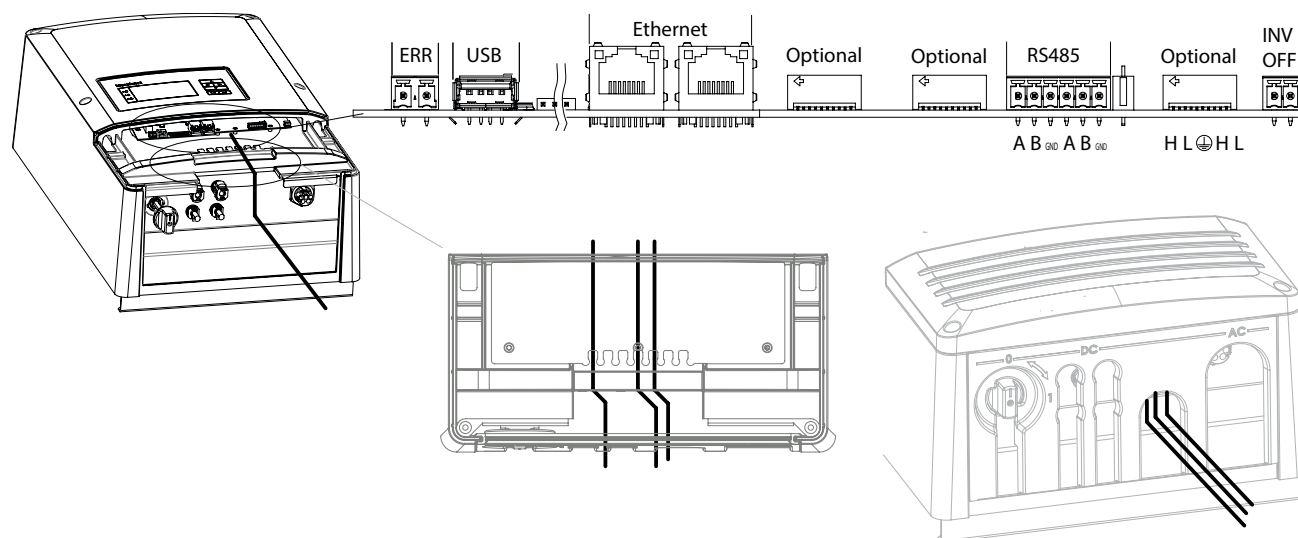


Figure 39: Connection area: Connection and pinout of the interfaces (Inverter without PSD)

## 7.6.1 Connecting the RS485 bus

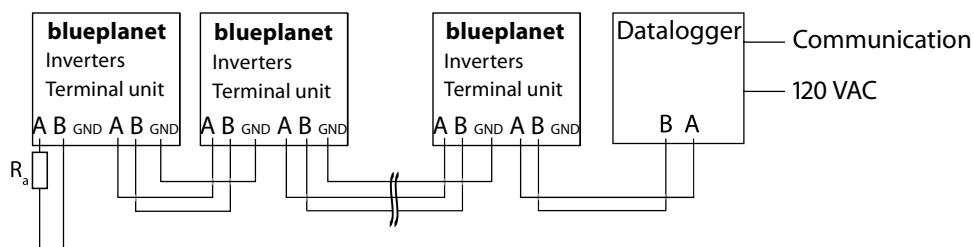


Figure 40: RS485 interface wiring diagram



### NOTICE

Different manufacturers interpret the standard on which the RS485 protocol is based in different ways. Note that the wire designations (- and +) for wires A and B can be different depending on the manufacturer.



### NOTICE

Calculating efficiency by measuring the current and voltage values leads to unusable 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.

### Connecting the RS485 bus

- ☞ Maximum length of the RS485 wiring: 1,200 m under optimal conditions.
  - ☞ Maximum number of connected bus devices: 31 inverters + 1 data monitoring unit.
  - ☞ Use twisted, shielded data lines. Recommendation (using wire sleeves)
    - LI2YCYv (TP) black for laying cable outside and in the ground 2 x 2 x 0.5
    - LI2YCY (TP) grey for dry and moist spaces 2 x 2 x 0.5
  - ⌚ AC, DC, and communication circuit entries must be fabricated with trade size 1/2-1" KO. KACO requires that you use UL 514B watertight conduit connection at conduit entrances.
1. Thread the connection cable through the hole.
  2. Connect the connection cable to the connection terminals provided (Figure 38 on page 31).
  3. Connect the following to all inverters and Datalogger as follows:
    - Wire A (-) with wire A (-) and
    - Wire B (+) with wire B (+) (see Figure 40 on page 32)
  4. Activate the terminating resistor on the terminal unit.

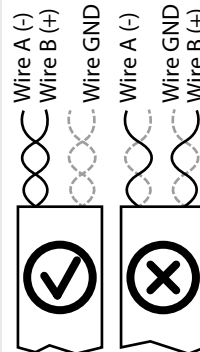


Figure 41: Assignment of twisted-pair wirese

## 7.6.2 Connecting the Ethernet interface



### NOTICE

Use a suitable category 5 network cable. 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 Ethernet connection cables.

**Connecting an Ethernet cable to the inverter**

- ⌚ AC,DC, and communication circuit entries must be fabricated with trade size 1/2-1" KO. KACO requires that you use UL 514B watertight conduit connection at conduit entrances.
- 1. Thread the connection cable through the hole.
- 2. Connect the connection cable to the Ethernet interface (Figure 38 on page 31).

**Connecting the inverter with 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 web server in the Settings menu.

### 7.6.3 Connecting the fault signal relay

The contact is designed as an N/O contact. Maximum contact load: DC 30 V/1 A, AC: 277 V/1 A

**Connecting the fault signal relay**

- ⌚ AC,DC, and communication circuit entries must be fabricated with trade size 1/2-1" KO. KACO requires that you use
- ⌚ UL 514B watertight conduit connection at conduit entrances..
- 1. Thread the connection cable through the hole.
- 2. Connect the connection cable to the connection terminals.

### 7.6.4 Connecting the USB port

**Connecting the USB port**

- ☞ Connect the USB connection cable to the 5-pin connector on the connection board.

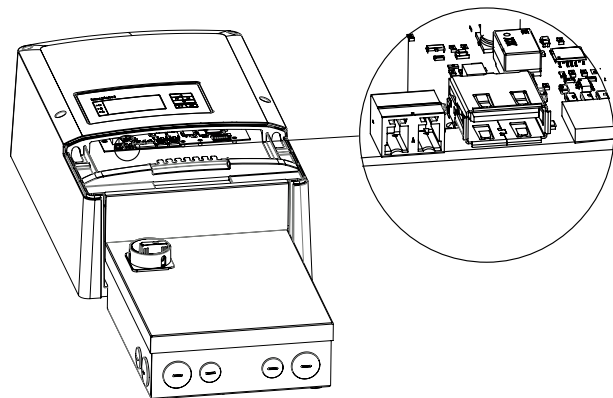


Figure 42: Connecting the USB port

## 7.6.5 Connecting "Inverter off" digital input



### 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, bus coupler circuit-breakers as a minimum must be used for shutting down devices from other manufacturers.

#### Connecting and activating "Inverter 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.

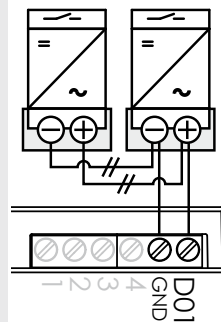


Figure 43: Powador-protect

## 7.7 Sealing the connection area

1. Screw the cover plate with the four mounting screw on the PSD box.
2. Place the connection cover on the connection area of the inverter.
3. Screw in the four Torx screws on the front side of the connection cover.

## 7.8 Starting up the inverter



### DANGER



**Lethal voltages are still present in the terminals and leads of the inverter even after the inverter has been switched off and disconnected.**

Severe injuries or death if the leads and terminals in the inverter are touched.

Only authorised electricians who are approved by the supply grid operator may start up the inverter.

### 7.8.1 Switching on the inverter

- ⌚ The inverter has been mounted and electrically installed.
  - ⌚ The PV array is supplying a voltage > 250 V.
1. Connect the grid voltage using the external circuit breakers and the AC disconnect switch if the optional PSD is provided.
  2. Connect the PV array using the external DC disconnect or the optional DC disconnect with the PSD (0 to 1).
    - » The inverter begins to operate.
    - » During the initial start-up: Follow the instructions on the inverter display..

## 8 Configuration and Operation

### 8.1 Controls

The inverter has a backlit LCD as well as three status LEDs. The inverter is operated using six keys.

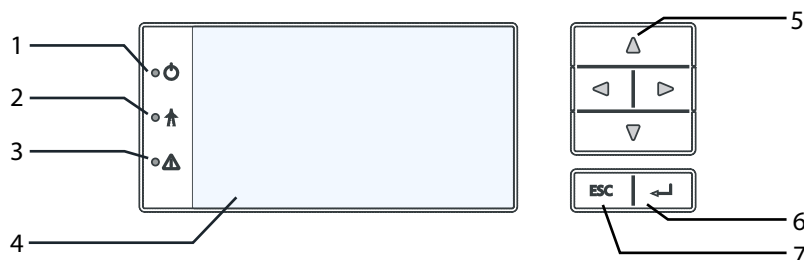


Figure 44: Control panel

#### Key

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

#### 8.1.1 LED indicators

The three LEDs on the front of the inverter show the different operating states. The LEDs can take on the following states:



LED illuminated













LED flashing









LED not illuminated

The LED indicators show the following operating states:

Operating state	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 illuminated. 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 line relay switch on.
Feed-in operation	   	Power fed into the grid or measured values	The green "Operating" LED is illuminated. The green "Feed-in" LED is illuminated. The "Feed-in" icon appears on the desktop. The inverter feeds into the grid.

\* The waiting period ensures that the PV array voltage continuously remains above the power delivery limit of 150 V.

Operating state	LEDs	Display	Description
Non-feed-in operation	   	Status message	The display shows the corresponding message.
Voltage	 	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 keys, the backlight is activated. If no key is pressed for an adjustable period of time, it switches off again. You can also permanently activate or deactivate the backlighting. In sleep mode, the inverter deactivates the display regardless of the selected setting.

### NOTICE



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 and total yields shown on the display, by KACO Powador-web or by a third party monitoring solution may deviate from the values of the grid operator's feed-in meter or the optional Revenue Grade Meter inside the PSD box by up to 15%.

After being switched on and after the initial start-up is complete, the inverter displays the start screen (the desktop). If you are in the menu and do not touch the control keys for two minutes, the inverter returns to the desktop. For information about initial start-up, see section 8.2 on page 38.

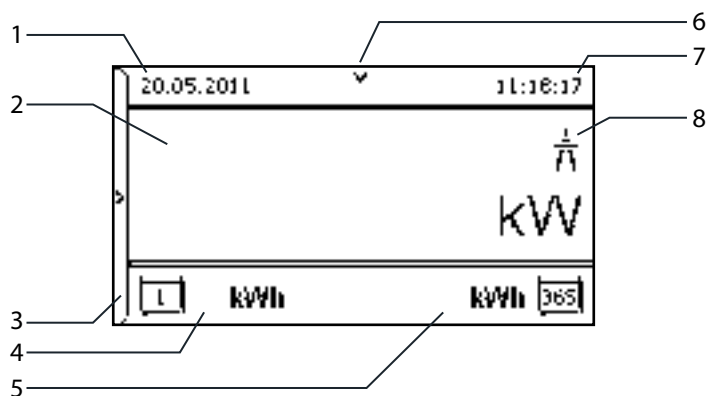


Figure 45: Desktop

### Key

1	Current date	6	Status bar
2	Current power	7	Current time
3	Menu indicator	8	Feed-in indicator
4	Daily yield		
5	Annual yield		



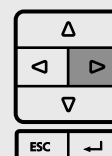
### 8.1.3 Control keys

You operate the inverter using the 4-way key and the OK and ESC control keys.

#### Desktop / Inverter menu

##### Opening the menu

- ↻ The inverter is operating.
- ↻ The LCD is showing the desktop.
- ☞ Press the right arrow key.
- » The menu opens up over the desktop from left to right.



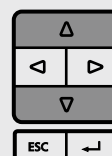
##### Displaying the daily output

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



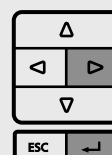
##### Navigate through the menu

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



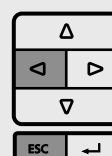
##### Opening a menu item or a setting

- ☞ Use the right arrow key and the OK key.



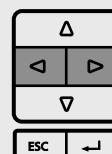
##### Jump to the next higher menu level/discard changes

- ☞ Press the left arrow key or the ESC key.



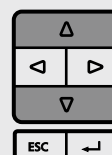
##### Open the parameter menu

- ☞ Simultaneously press the right arrow key and left key for 5 seconds.



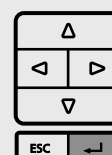
##### A Parameter/the value of an input field

- ☞ Use the keys with the up and down arrows.



##### Saving changed settings

- ☞ Press the OK key.



## 8.2 Commissioning the inverter

The inverter commission menu is present after all successful AC and DC circuit terminations are complete. This provides you the opportunity to configure the inverter for commissioning.



### NOTICE

The commission menu appears only once after all successful AC and DC circuit terminations are complete for initial configuration. It will not reappear when the inverter is restarted. You can change the country setting only in the password-protected parameter menu. The other settings can still be changed in the standard configuration menu.



### NOTICE

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

## 8.3 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.



### NOTICE

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 keys.
- ☞ To select the next menu item, press the OK key.
- ☞ To return to the most recently selected menu item, press the ESC key.
- ☞ Carry out the required settings.

Press the OK key in the last menu item.

» You have completed the initial configuration. The inverter begins to operate.

#### Initial configuration

- ☞ Select menu language.
- ☞ Select country for installation.
- ☞ Select gridtype/guideline for local area.
- ☞ Set date and time.
- ☞ Confirm gridtype setting.
- ☞ Activate arc-fault circuit interrupter (AFCI) and confirm number of observed tracker(s) (depending of inverter type (see „Table 1 on page 4))



### NOTICE

After successful completion of the configuration, 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 configuration menu.

## 8.4 Menu structure

### 8.4.1 Display on the LCD

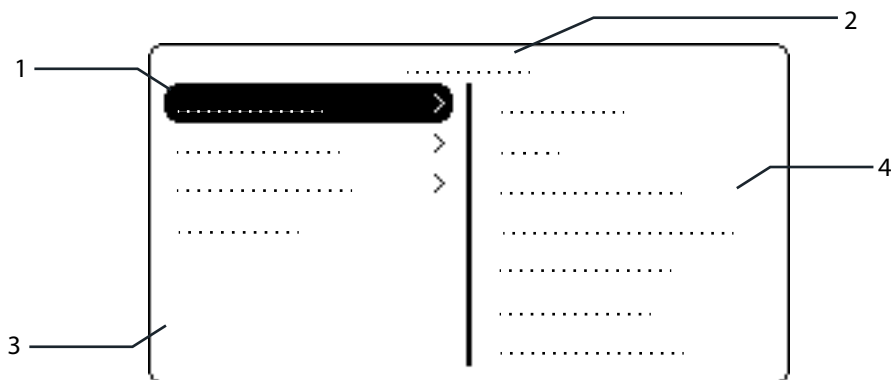



Figure 46: Main menu






















#### Key






























1	Display of the menu level (0, 1, 2, 3)	3	Active menu (example: main menu)
2	Designation of the active menu	4	Menu items of the next lower menu level
































### 8.4.2 Menu structure













#### Icons used:






































	Menu level (0, 1, 2, 3)		Password-protected menu
	Display menu		Submenu available
	Option menu		

Menu level	Display/settings	Action in this menu/meaning
Desktop	<b>Desktop</b>	  Press the right arrow key.
	<b>"Measurements" menu</b>	  Open the menu: Press the right arrow key or the OK key.
	<b>Generator</b>	 Displays the DC-side voltage, amperage and power dependent on the available number of MPP trackers.
	<b>Grid</b>	 Displays the AC-side voltage, amperage and power dependent on the grid grid monitoring selection. (See Parameter menu <b>"Grid mon. 3-ph."</b> )
	<b>Unit temperature</b>	 Displays the temperature in the inverter housing.
	<b>Yield counter</b>	 Displays the yield in kWh.   Reset the counter using the "Reset" key.
	<b>Yield today</b>	 Displays the yield of the current day up to now.
	<b>Total yield</b>	 Displays the total yield up to now.
	<b>CO2 savings</b>	 Displays the calculated CO <sub>2</sub> savings (in kg).

Menu level	Display/settings	Action in this menu/meaning
	<b>Oper. hours counter</b>	 Displays the duration of operation in hours.  Reset the counter using the "Reset" key.
	<b>Oper. time today</b>	 Displays the duration of operation on the current day.
	<b>Total op. time</b>	 Displays the total operating time.
	<b>Log data view</b>	 Open the menu: Press the right arrow key or the OK key. Displays the recorded operating data graphically. 1. Select the measured value to be displayed. Supported measured values: <ul style="list-style-type: none"> <li>• Grid power P(grid)</li> <li>• DC power per string P(PV) 1-2</li> <li>• DC voltage per string U(PV) 1-2</li> <li>• Unit temperature</li> </ul> 2. Select a day. 3. Press the OK key. » The display shows the selected data.  Press any key to return to the previous menu.
	<b>Daily view</b>	 
	<b>Monthly view</b>	 
	<b>Yearly view</b>	 
	<b>Save to USB</b>	 <p>In this menu, you can export the saved operating data to a connected USB storage device.</p> <p> You have connected a USB storage device to the inverter.</p> 1. Select the data to be exported (year, month or day) with the 4-way key. 2. Press the OK key. » The inverter writes the data to the USB storage device.
	<b>"Settings" menu</b>	 Open the menu: Press the right arrow key or the OK key.
	<b>Language</b>	 Select the desired language for the user interface.
	<b>Define total yield</b>	 <p>You set the total yield to a freely selectable value, for example, when you have received a replacement unit and want to continue the recording from the present value.</p> <p> Select the "Save" button and confirm with the OK button.</p>

Menu level	Display/settings	Action in this menu/meaning
 0 1 2 3	<b>Interface</b>	 If the inverter is a terminal unit: Activate termination ("Bus termination" menu item)  Assign a unique RS485 bus address to the inverter ("proLOG address" menu item). The address must not coincide with that of another inverter or a proLOG unit.
 0 1 2 3	<b>S0 pulse rate</b>	 Set the pulse rate of the S0 connection.
 0 1 2 3	<b>Logging interval</b>	 Set the time between two log data recordings.
 0 1 2 3	<b>Log data backup</b>	<p>The inverter supports the backing up of all recorded yield data to a connected USB storage device.</p>  Activate or deactivate log data backup.
 0 1 2 3	<b>Display</b>	 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 backlighting by selecting "On" or "Off".
 0 1 2 3	<b>Date &amp; time</b>	 Set the time and date. <b>NOTICE:</b> 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.
 0 1 2 3	<b>Ethernet</b>	 Assign a unique IP address.  Assign a subnet mask.  Assign a gateway.
 0 1 2 3	<b>Webserver</b>	 Activate or deactivate the integrated webserver.
 0 1 2 3	<b>"Parameters" menu</b>	 Press the right arrow key or the OK key. <b>NOTICE:</b> The inverter does not display the "Parameters" menu in the standard configuration. To display the menu: 1. Open the menu. 2. Simultaneously hold down the up and down keys for several seconds.
 0 1 2 3	<b>Country</b>	<p><b>WARNING:</b> Non standard anti islanding trip points could damage connected devices.</p> <p>› Any changes to the default anti-islanding frequency and voltage trip limits must be approved by the connecting electric utility.</p>  1. Input the four-character password via the 4-way key. The password is unit-specific.  2. Confirm the entry with the OK key.  3. Set the desired country setting. <b>NOTICE:</b> This option influences the country-specific operating settings of the inverter. Please consult KACO service for further information.
 0 1 2 3	<b>Grid type / guideline</b>	 Select the type of grid applicable to the use of the inverter.
 0 1 2 3	<b>neutral conductor</b>	 Select if neutral conductor is connected.

Menu level	Display/settings	Action in this menu/meaning
0 1 2 3	<b>Overvoltage shutd.</b>	 <ul style="list-style-type: none"> <li>Specify the shutdown threshold for fast and slow overvoltage shutdown.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>
0 1 2 3	<b>Undervoltage shutd.</b>	 <ul style="list-style-type: none"> <li>Specify the shutdown threshold for fast and slow undervoltage shutdown.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>
0 1 2 3	<b>Overfreq. shutd.</b>	 <ul style="list-style-type: none"> <li>Set limit value for overfrequency shutdown.</li> </ul>
0 1 2 3	<b>Underfreq. shutd.</b>	 <ul style="list-style-type: none"> <li>Set limit value for fast and slow underfrequency shutdown.</li> </ul>
0 1 2 3	<b>DC starting volt.</b>	 <ul style="list-style-type: none"> <li>The inverter begins feed-in as soon as this PV voltage is present.</li> <li>Set the starting voltage.</li> </ul>
0 1 2 3	<b>Constant volt. control</b>	 <ul style="list-style-type: none"> <li>Offers the possibility of deactivating the MPP seek mode in order to operate the inverter with a constant DC voltage.</li> <li>Activate or deactivate MPP seek mode.</li> <li>Set value for constant voltage control (125 - 550 V).</li> <li><b>NOTICE:</b> The possible input power is reduced at voltages lower than 350 voltage. The input current is limited to 11 A per input.</li> </ul>
0 1 2 3	<b>Power limitation</b>	 <ul style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>1. Activate password protection if necessary.</li> <li>2. Specify the activation status.</li> <li>3. Specify the limit value for maximum feed-in power.</li> <li>4. Confirm the entry with the OK button.</li> </ul>
0 1 2 3	<b>Iso.resistor</b>	 <ul style="list-style-type: none"> <li>Set threshold value (in 1 kOhm steps) at which the insulation monitor reports a fault.</li> </ul>
0 1 2 3	<b>cos-phi specification</b>	 <ul style="list-style-type: none"> <li>Configure power factor.</li> <li>If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited/over-excited).</li> </ul>
0 1 2 3	<b>Q const.</b>	 <ul style="list-style-type: none"> <li>Set the idle power Q (in %) to a fixed value.</li> <li>Select the type of phase shift (under-excited/over-excited).</li> </ul>
0 1 2 3	<b>cos-phi(P/Pn)</b>	 <ul style="list-style-type: none"> <li>Open the menu: Press the right arrow button or the OK button.</li> </ul>
0 1 2 3	<b>Number of nodes</b>	 <ul style="list-style-type: none"> <li>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.</li> <li>Specify the number of support points for the idle power characteristic curve.</li> </ul>

Menu level	Display/settings	Action in this menu/meaning
 1, 2. ...Support point		 Specify the power factor for the 1st, 2nd (etc.) support point  If a power factor not equal to 0 is selected: Select the type of phase shift (under-excited/over-excited).
 Q(U) 5 Samples		 Open the menu: Press the right arrow button or the OK button.
 Lock-in power		 Power range set as % of rated power, in which the network support process is active.
 Lock-out power		
 Time constant		 Set the response speed of the control.
 Number of support points		 Specify the number of support points for the idle power characteristic curve.
 1., 2. ...Support point		 Specify the support points for voltage, power and nature of the phase shift
 "Information" menu		 Open the menu: Press the right arrow key or the OK key.
 Inverter type		Displays the type designation of the inverter.
 AFCI module		Displays quantity of monitored trackers, parameter version and status information.
		<b>NOTICE:</b> In case of Arc fault it is necessary to check PV-system and confirm to clear the operation stop.
 SW version		Displays the installed software version.
 Serial number		Displays the serial number of the inverter.
 Display country		Displays the selected country setting. Optional: Displays the grid type if a grid type has been selected.
 "Vendor" menu		» The display shows information about the unit manufacturer.

## 8.5 Monitoring the 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 via:

- The integrated LCD
- The integrated web server using an Internet-capable device connected to the Ethernet interface of the inverter

You can read the recorded data using a storage medium connected to the USB interface of the inverter, e.g. a USB stick.

## 8.5.1 USB interface

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

### Reading log data



#### NOTICE

The USB interface is approved solely for usage with USB flash memories ("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.

#### Reading log 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 the "Save to USB" item.
  4. Select the desired log data using the 4-way key.
  5. Press the OK key.
- » The inverter saves the selected log data to the USB storage device.

## 8.5.2 Web server

The inverter has an integrated web server. After configuration of the network and activation of the web server in the configuration menu, you can open the web server from an Internet browser. The language version of the web site delivered by the browser is dynamically adapted, based on 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

- U 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.



#### NOTICE

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 call up the site.
- » The Internet browser displays the start screen of the web server.

After it has been called up, the web server displays information about the inverter as well as the current yield data. The web server supports the display of the following measurement data and yield data:

- |                 |                        |
|-----------------|------------------------|
| • Feed-in power | • Generator power      |
| • Status        | • Generator voltage    |
| • Grid power    | • Unit temperature     |
| • Grid voltage  | • Grid monitoring mode |

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

### Select the display period

1. Call up the web server.
2. Select the display period by choosing one of the keys: day view, month view, year view or overall view.

### Filtering display data (day view only)

1. Call up the web server.
2. Select the day view.
3. To show or hide measured values, select or deselect the corresponding checkboxes in the "Select display" area.

### Exporting data

1. Filter the display data if necessary.
2. Select the display period if applicable (day, month, year or overall view).
3. Click the "Export data" key.
4. Save the file.



### NOTICE

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

## 8.6 Reset a arc event

To reset an arc event change into the "Parameter menu". The menu item "Arc event" is added in this menu when an arc occurred. After confirming the event the "Arc event" menu item disappears and the inverter starts feeding in again. It is always necessary to reset the event in this way, there is no automatically reset possible.

## 8.7 Performing a software update

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



### NOTICE

Ensure that the power supply of the AC and DC sides is active. It is only possible to update all components of the inverter 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.

- » Do not interrupt the DC and AC power supply during the update process.
- » Do not remove the USB stick during the update process.

#### 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) completely onto the USB stick.
- » Perform software update.

#### Perform software update.

- ⌚ Prepare for the software update.
- ⌚ Ensure supply of DC and AC power.
- 1. Connect USB stick to the inverter.
- » The message "Firmware found. Would you like to load it?" appears on the display.
- 2. If you would like to perform the update, select the "Yes" button.
- » The inverter begins the update.

The update can take several minutes. The "Operating" LED flashes during the update process. The inverter may restart several times. The update is completely loaded when the display screen shows the desktop.

The inverter then returns to feed-in mode. You can check the success of the update in the menu:

#### Display software version

- ☞ Open the Information/SW version menu
- » The inverter will display the versions and checksums of the currently loaded software.

## 9 Maintenance/Troubleshooting

### 9.1 Visual inspection

Inspect the inverter and the leads for visible damage and pay attention to the operating status display of the inverter. In case of damage, notify your installer. Repairs may only be carried out by authorised electricians.



#### NOTICE

Have your installer check for proper operation of the inverter at regular intervals.

### 9.2 Cleaning the inverter externally



#### DANGER



#### Lethal voltages in the inverter

Serious injuries or death if moisture enters the inverter.

- › Only use objects that are free of moisture to clean the inverter.
- › The inverter should only be cleaned on the outside.

#### Cleaning the inverter

- ☞ Do not use compressed air.
- ☞ Use a vacuum cleaner or a soft brush to remove dust from the fan cover and from the top side of the inverter on a regular basis.
- ☞ Remove dust from the ventilation inlets if necessary.

 **Authorised electrician**

### 9.3 Shutting down for maintenance and troubleshooting



#### DANGER

**Lethal voltages are still present in the terminals and leads of the inverter even after the inverter has been switched off and disconnected.**

Severe injuries or death if the leads and terminals in the inverter are touched.

When there is irradiance, DC voltage is present on the open ends of the DC leads. Arcing may occur if the DC leads are disconnected while under a load.

Only authorised electricians who are approved by the supply grid operator may open and maintain the inverter.



- › Observe all safety regulations and the currently applicable technical connection specifications of the responsible power supply company.
- › Disconnect the AC and DC sides.
- › Secure the AC and DC sides from being switched on again.
- › Do not touch the open ends of the leads.
- › Avoid short circuits.
- › Open the inverter only after these two steps are complete.
- › After shutdown, wait at least 30 minutes before working on the inverter.

## CAUTION

### Destruction of the DC connection

The connection terminals can be destroyed by arcing if disconnected under load.

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

### Shutting down the inverter

1. Switch off the grid voltage by deactivating the external circuit breakers.
2. Disconnect the PV array using the DC disconnect.

### DANGER! The DC leads remain live.

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

## 9.4 Faults

### 9.4.1 Procedure



### DANGER

**Lethal voltages are still present in the terminals and leads of the inverter even after the inverter has been switched off and disconnected.**

Severe injuries or death if the leads and terminals in the inverter are touched.

- ☞ When a fault occurs, notify an authorised electrician approved by the supply grid operator or KACO new energy, Inc. 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.

### 9.4.2 Rectifying faults

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

Table 5: Troubleshooting

**O = Action of the operator**

**E = The indicated work must only be carried out by an authorised electrician.**

**K = The indicated work must only be carried out by a service employee of KACO new energy, Inc.**

Fault	Cause of fault	Explanation/remedy	By
The inverter is active but does not feed 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 grid-feed and disconnected from the grid for safety reasons.	
		☞ Change the line parameters within the permitted operating limits (see the "Start-Up" section).	<b>E</b>
The line fuse trips.	The line fuse capacity is too low.	In cases of high irradiance, the inverter exceeds its rated current for a short period, depending on the PV array.	
		☞ Select the capacity of the inverter's pre-fuse to be somewhat higher than the maximum feed-in current (see the "Installation" section).	<b>E</b>
		☞ Contact the grid operator if the grid failure constantly occurs.	<b>E</b>
	Damage to the inverter's hardware.	If the line fuse immediately trips 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.	<b>E</b>
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 immediately reset the value, switch the inverter off and on again by disconnecting it from the grid and switching off the DC.	<b>E</b>
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 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 does not feed into the grid. Display: "Waiting for feed-in"	<ul style="list-style-type: none"> <li>• Array voltage too low</li> <li>• Grid voltage or PV array voltage unstable.</li> </ul>	<ul style="list-style-type: none"> <li>• The PV array voltage or power is not sufficient for feed-in (solar irradiance is too low).</li> <li>• The inverter checks the line parameters before the feed-in process begins. The length of the switch-on time differs by country according to applicable standards and regulations and can take several minutes.</li> <li>• The starting voltage may have been set incorrectly.</li> </ul>	
		☞ Adjust starting voltage in the Parameter menu if required.	<b>E</b>

Table 5: Troubleshooting

**O = Action of the operator****E = The indicated work must only be carried out by an authorised electrician.****K = The indicated work must only be carried out by a service employee of KACO new energy, Inc.**

Fault	Cause of fault	Explanation/remedy	By
Noise emission from the inverter.	Particular ambient conditions.	<p>When there are certain ambient conditions, the units may emit audible noises.</p> <ul style="list-style-type: none"> <li>• Line 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.</li> <li>• In cases of volatile weather conditions (frequent switching between sunny and cloudy conditions) or strong irradiance, a light hum may be audible due to the increased power.</li> <li>• Under particular grid conditions, resonances may form between the unit's input filter and the grid, which may be audible even when the inverter is switched off.</li> </ul> <p>These noise emissions do not affect the operation of the inverter. They do not lead to loss of efficiency, failure, damage or to a shortening of the unit's service life.</p> <p>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.</p>	
		☞ No action.	
In spite of high irradiance, the inverter does not feed in the maximum power into the grid.	The device is too hot and the power is reduced.	<p>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 unhindered convection cooling from the exterior. Do not cover the cooling fins.</p>	
		☞ Provide for sufficient cooling of the unit. ☞ Do not cover the cooling fins.	<b>O, E</b>
Arc detected	An electric arc occurred in the PV system	<p>Check the PV system</p> <ul style="list-style-type: none"> <li>☞ Improperly connected DC plugs.</li> <li>☞ Defective connection sockets of solar modules.</li> <li>☞ High-resistance brazed joints between the cells of a solar module.</li> <li>☞ Cables connected improperly to the input terminals of an inverter.</li> <li>☞ Defective DC cable, enabling a connection to ground.</li> </ul>	<b>E</b>





Table 5: Troubleshooting

**O = Action of the operator****E = The indicated work must only be carried out by an authorised electrician.****K = The indicated work must only be carried out by a service employee of KACO new energy, Inc.**

## 9.5 Messages on the display and the “Fault” LED

Many fault signals indicate a fault in the grid. They are not operational faults of the inverter. The minimum triggering levels are determined by standards. The inverter must switch off if the permitted values are undershot or exceeded.

### 9.5.1 Display of status and fault messages

Display	Fault LED (red)		
<b>FS (fault status)</b>	 	<b>ON</b>	<ul style="list-style-type: none"> <li>Fault signal relay has switched.</li> <li>Feed-in was ended due to a fault.</li> </ul>
<b>OS (operating status)</b>	 	<b>OFF</b>	<ul style="list-style-type: none"> <li>The fault signal relay deenergizes again.</li> <li>The inverter feeds back into the grid again after a country-specific time period.</li> </ul>

On the display you can find details regarding the fault or operating status or the data that was recorded through the RS485 interface.

### Status and fault signals

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























Status	Display			Explanation	Action	
<b>OS</b> 1	Waiting for feed-in			Self-test: The grid parameters and generator voltage are being checked.	-	-
<b>OS</b> 2	Generator voltage too low			Insufficient generator voltage and power, status before the transition to night shutdown	-	-
<b>OS</b> 8	Self-test			Checks the shutdown of the power electronics as well as the grid relay before feed-in mode	-	-
<b>FS</b> 10	Temperature in unit too high			In case of overheating, the inverter switches off. Possible causes: <ul style="list-style-type: none"> <li>Ambient temperature too high</li> <li>Fans defective</li> <li>Inverter defect</li> </ul>	 Cool off the area around the inverter.  Uncover the fans.  Notify your authorised electrician.	<b>B</b> <b>B</b> <b>E</b>
<b>OS</b> 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).		
<b>FS</b> 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 several times.	<b>E</b>
<b>FS</b> 18	Resid. current shutdown			Residual current was detected. The feed-in was interrupted.	 Notify your authorised electrician.	<b>E</b>

Table 6: Operating statuses and fault messages on the display





































Status	Display	 	Explanation	Action	
FS 19	Generator insulation fault	 	There is an insulation fault on the PV generator. The feed-in was interrupted.	 Notify your authorised electrician if the fault occurs several times.	<b>E</b>
FS 30	Instrument transformer fault	 	The current and voltage measurements in the inverter are not plausible.	-	-
FS 32	Fault Self-test	 	The internal grid separation relay test has failed.	 Notify your authorised electrician if the fault occurs several times.	<b>E</b>
FS 33	Fault DC feed-in	 	The DC feed-in has exceeded the permitted value. This DC feed-in can be adopted from the grid onto the inverter so that no fault occurs.	 Notify your authorised electrician if the fault occurs several times.	<b>E</b>
FS 34	Internal communication error	 	A communication error has occurred in the internal data transmission.	 Notify your authorised electrician.  Check the data cable.	<b>E</b>
FS 35	Protect. 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.	
FS 36	Protect. shutdown HW	 	Protective shutdown of the hardware (AC overvoltage, AC overcurrent, DC link overvoltage).	Not a fault Grid-related shutdown, the grid connects again automatically.	
FS 38	Generator overvoltage error	 	The voltage of the DC generator is too high. The PV generator is configured incorrectly.	 Notify your authorised electrician.	<b>E</b>
FS 41	Line failure: Under voltage L1, Over voltage L1	 	The voltage of a grid phase is too low or high; the grid cannot be fed into. The phase experiencing failure is displayed.	 Notify your authorised electrician.	<b>E</b>
FS 43	Under voltage L2, Over voltage L2	 			
FS 45	Under voltage L3, Over voltage L3	 			
FS 47	Line failure: line-to-line voltage	 	The measured line-to-line voltage is outside of the tolerance limits.		
FS 48	Line failure: Under frequency	 	Grid frequency is too low. This fault may be grid-related.	 Notify your authorised electrician.	<b>E</b>

Table 6: Operating statuses and fault messages on the display










































Status	Display	 	Explanation	Action	
<b>FS</b> 49	Line failure: Over frequency	 	Grid frequency is too high. This fault may be grid-related.	 Notify your authorised electrician.	<b>E</b>
<b>FS</b> 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.	 Notify your authorised electrician.	<b>E</b>
<b>FS</b> 57	Waiting for reactivation	 	Waiting time of the inverter after a fault.	Inverter does not switch on again until the country-specific time has elapsed.	
<b>FS</b> 58	Control board overtemperature	 	The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware.	 Provide for sufficient ventilation.	<b>E</b>
<b>FS</b> 59	Self test error	 	A fault occurred during a self-test.	 Notify your authorised electrician.	<b>E</b>
<b>OS</b> 60	Generator voltage too high	 	The inverter does not begin feeding into the grid until the PV voltage falls below a specified value.	-	-
<b>OS</b> 61	External limit (%)	 	The external limit <i>Power control</i> was activated by the grid operator. The inverter limits its power.		
<b>OS</b> 64	Measured values	 	Output current limiting: The AC current is limited once the specified maximum value has been reached.		
<b>FS</b> 67	Fault at power section 1	 	There is a fault in the power section.	 Notify your authorised electrician.	<b>E</b>
<b>FS</b> 70	Fan error	 	Fan 1 is malfunctioning.	 Replace defective fan	<b>E</b>
<b>FS</b> 73	Standalone grid err.	 	Standalone mode was detected.	-	-
<b>OS</b> 74	External idle power requirement	 	The grid operator limits the feed-in power of the inverter.	-	-
<b>OS</b> 79	Insulation measurement	 	PV generator's insulation is being measured	-	-
<b>FS</b> 80	Insulation meas. not possible	 	The insulation measurement cannot be performed because the generator voltage is too volatile.	-	-
<b>FS</b> 81, 82, 83	Protect. 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.	<b>E</b>

Table 6: Operating statuses and fault messages on the display










































Status	Display			Explanation	Action	
FS 84	Protect. 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.	<b>E</b>
FS 85	Protect. shutdown overvolt. DC link					<b>E</b>
FS 86	Protect. shutdown DC link asymmetry			Overvoltage 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.	<b>E</b>
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.	<b>E</b>
FS 93, 94	Buffer 1, buffer 2 self test error			The control board is defective.	 Notify authorised electrician / KACO Service	<b>E/K</b>
FS 95, 96	Relay 1, relay 2 self test error			The power section is defective.	 Notify KACO Service	<b>K</b>
FS 97	Protect. shutdown overcurrent HW			Too much power has been fed into the grid. Complete disconnection of the device.	 Notify authorised electrician / KACO Service	<b>E/K</b>
FS 98	Protect. shutdown HW gate driver			An internal protective mechanism has disconnected the device to protect it against damage. Complete disconnection of the device.	 Notify authorised electrician / KACO Service	<b>E/K</b>
FS 99	Protect. shutdown: HW buffer free			An internal protective mechanism has disconnected the device to protect it against damage. Complete disconnection of the device.	 Notify authorised electrician / KACO Service	<b>E/K</b>
FS 100	Protect. shutdown HW overtemp.			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>B</b> <b>E</b>
FS 101 to 106	Plausibility error temperature, efficiency, DC link, AFI module, relay, DC/DC converter			The unit has shut down because of implausible internal measured values.	 Notify KACO Service	<b>K</b>
FS 130	Self-test AFCI-Modul fault			The repeated feeding of an arc test spectrum in the sensor was not recognized. Self-testing function of AFCI is permanently active.	 Notify authorised electrician / KACO Service	<b>E/K</b>
FS 131-133	Arc fault detected on DC1/DC2/DC3			The Arc detection has been triggered by faulty electrical connection or flashover with faulty insulation.	 Notify authorised electrician	<b>E</b>

Table 6: Operating statuses and fault messages on the display

## 10 Service

We place special emphasis on the quality and longevity of our inverters, starting even in the product development phase. More than 60 years of experience in the field of power converters support us in this philosophy.

However, in spite of all quality assurance measures, faults may occur in rare cases. In such cases, KACO new energy, Inc. will provide you with the maximum possible support. KACO new energy, Inc. will make every effort to remedy such faults in an expeditious manner and without a great deal of bureaucracy.

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:

- Inverter type/serial number
- 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
- Date of installation/Start-up report
- Consignment identification/Delivery address/Contact person (with telephone number)

You will find our warranty conditions on our website.

<http://www.kaco-newenergy.com/service/warranty>

From there, you can easily navigate to our international websites by clicking on the appropriate flag.

Please use our website to register your unit within 24 months:

<http://www.kaco-newenergy.com/service/warranty/online-warranty-registration>

On this page as well, you can click on the appropriate flag to easily reach the website for your own nation.

In this manner, you can assist us in providing you with the quickest service possible.

We have prepared a form for complaints. It is located at

<http://www.kaco-newenergy.com/service/technical-support>

### Hotlines

Technical problem resolution	Technical consultation
+1 866 KACO SOLAR	+1 866 KACO SOLAR

## 11 Shutdown/Disassembly

### 11.1 Shutting down the inverter



#### **DANGER**

**Lethal voltages are still present in the terminals and leads of the inverter even after the inverter has been switched off and disconnected.**

Severe injuries or death if the leads and terminals in the inverter are touched.

When there is irradiance, DC voltage is present on the open ends of the DC leads. Arcing may occur if the DC leads are disconnected while under a load.



- › It is absolutely necessary that the shutdown sequence be carried out in the correct order.
- › After shutdown, wait at least 30 minutes before working on the inverter.
- › When working on photovoltaic modules, in addition to disconnecting from the grid, always disconnect the DC main switch.  
Disconnecting the grid voltage is not enough.

#### **Shutdown sequence**

1. Switch off the grid voltage by deactivating the external circuit breakers.
2. Disconnect the PV array using the DC disconnect.

**DANGER! The DC leads remain live.**

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

### 11.2 Removing the inverter

- ☞ Shut down the inverter.
  1. Open the connection area.
  2. Remove the interface cables.
  3. Detach DC connection plugs.
  4. Detach AC connection leads from the connection terminals.
  5. Pull out the leads.
- » The deinstallation of the inverter is complete. Continue with dismantling.

### 11.3 Dismantling the inverter

- ☞ Shut down the inverter.
- ☞ Remove the inverter.
  1. Detach screw from the detachment protector.
  2. Remove the inverter from the mounting plate.
  3. Securely pack the inverter if it is to be further used,  
or  
have the inverter professionally disposed of.

## 12 Recycling and disposal

For the most part, both the inverter and the corresponding transport packaging are made from recyclable materials. KACO does its best to ensure our vendors follow a low carbon manufacturing process as we do ourselves. It is not always possible but if you have questions about our products or the components in our products don't hesitate to call +1 866 KACO SOLAR and ask.

### Device

Do not dispose of faulty inverters or accessories together with household waste. Ensure that the old unit and, where applicable, any accessories are disposed of in a proper manner. Most areas have public electronic waste disposal and/or recycling plants. Feel free to contact KACO at +1 866 KACO SOLAR to request information about e-waste recycling in your area.

### Packaging

Ensure that the transport packaging is recycled.





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