KACO new energy.

Powador
2002 | 3002
4202 | 5002
6002

Operating Instructions

- **English translation of German original**

Operating Instructions

for Installation Engineers and Operators

EN

Powador
2002 | 3002
4202 | 5002
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Contents

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1 General information

1.1 About this document

WARNING

Improper handling of the inverter can be hazardous

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

1.1.1 Other applicable documents

During installation, observe all assembly and installation instructions for components and other parts of the system. These instructions also apply to the equipment, related components and other parts of the system.

1.1.2 Storing the documents

These instructions and other documents must be stored near the system and be available at all times.

1.2 Layout of Instructions

1.2.1 Symbols used

General hazard

Risk of fire or explosion

High voltage

Risk of burns

Authorised electrician — Only authorised electricians may carry out tasks indicated with this symbol.

1.2.2 Safety warnings symbols guide

DANGER

High risk

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

WARNING

Potential risk

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

CAUTION

Low-risk hazard

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

CAUTION

Risk of damage to property

Failure to observe this warning will lead to property damage.

ACTIVITY

Risk of damage to property

Failure to observe this warning will lead to property damage.

1.2.3 Additional information symbols

NOTE

Useful information and notes

Country-specific function

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

1.2.4 Instructions symbols guide

a) Single step instructions or instructions that can be carried out in any sequence:

Instructions

↻ Prerequisites before carrying out the following instructions

☞ Carry out step.

☞ (Additional steps, if applicable)

» Result of the step(s) (optional)

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

Instructions

↻ Prerequisite(s) for the steps (optional)

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

» Result of the steps (optional)

1.3 Standards and directives

NOTE

The EU Declaration of Conformity can be found in the appendix.

For information on grid coupling, grid protection and safety parameters along with more detailed instructions see our web site at http://www.kaco-newenergy.de/

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2 Safety

DANGER

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

Severe injuries or death if the cables and/or terminals in the inverter are touched. Only appropriately qualified and authorised electricians may open, install or maintain the inverter.

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

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

› Do not make any modifications to the inverter.

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

- Keep unauthorised persons away from the inverter and PV system.
- In particular, be sure to observe IEC-60364-7-712:2002 "Requirements for special types of business premises, rooms and installations - Solar-Photovoltaic-(PV) Power Supply Systems.
- Ensure operational safety by providing proper grounding, conductor dimensioning and appropriate protection against short circuiting.
- Observe all safety instructions on the inverter and in these operating instructions.
- Switch off all voltage sources and secure them against being inadvertently switched back on before performing visual inspections and maintenance.
- When taking measurements while the inverter is live:
  - Do not touch the electrical connections.
  - Remove all jewellery from your wrists and fingers.
  - Ensure that the testing equipment is in safe operating condition.
- Stand on an insulated surface when working on the inverter.
- Modifications to the surroundings of the inverter must comply with the applicable national and local standards.
- When working on the PV generator, it is also necessary to switch off the DC voltage with the DC isolator switch in addition to disconnecting the PV generator from the grid.

2.1 Proper use

The inverter is built according to the latest technological standards and safety regulations. Nevertheless, improper use may cause lethal hazards for the operator or third parties, or may result in damage to the unit and other property.

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

Any other or additional use of the device is deemed improper. This includes:

- Mobile use
- Use in potentially explosive atmospheres,
- Use in rooms where the humidity is higher than 95%
- Operation outside of the specifications intended by the manufacturer
- Islanding operation.

2.2 Protection features

For your safety, the following monitoring and protective functions are integrated into Powador inverters:

- Overvoltage conductors/varistors to protect the power semiconductors from high-energy transients on the grid and generator side,
- Temperature monitoring of the heat sink,
- EMC filters to protect the inverter from high-frequency grid interference,
- Grid-side grounded varistors to protect the inverter against burst and surge pulses,
- Islanding detection according to VDE 0126-1-1.

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3 Description

3.1 Mode of Operation

The inverter converts the DC voltage generated by the PV modules into AC voltage and feeds it into the grid. The feed-in process begins when there is sufficient sunlight and a specific minimum voltage is present in the inverter. If, as it gets dark, the voltage drops below the minimum voltage value, the feed-in mode ends and the inverter switches off.

3.2 Description of the unit

3.2.1 Powador inverter as part of a PV system

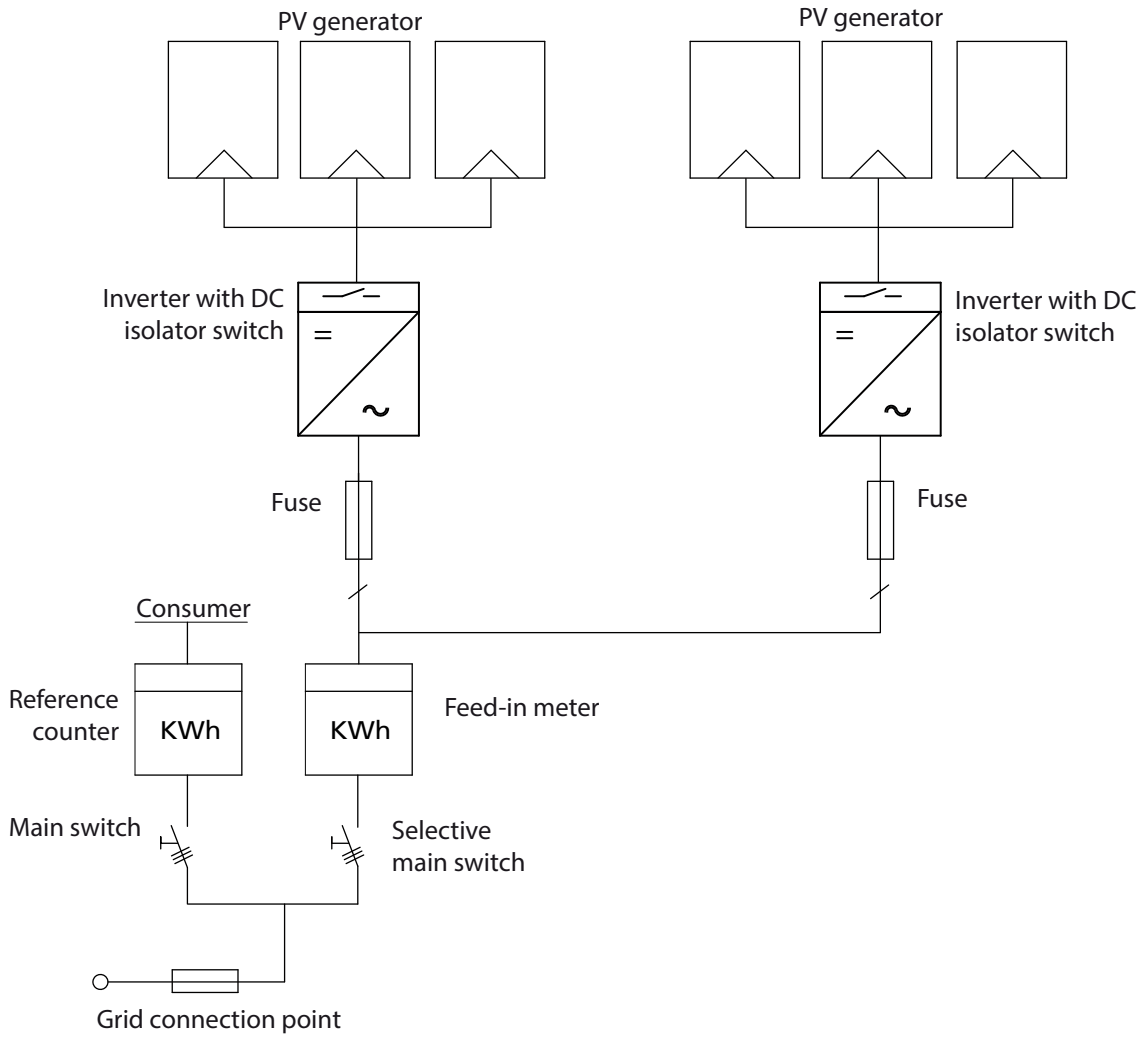

Figure 1: Overview circuit diagram for a system with two inverters

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3.2.2 System with multiple inverters

3.2.2.1 Asymmetric feed-in

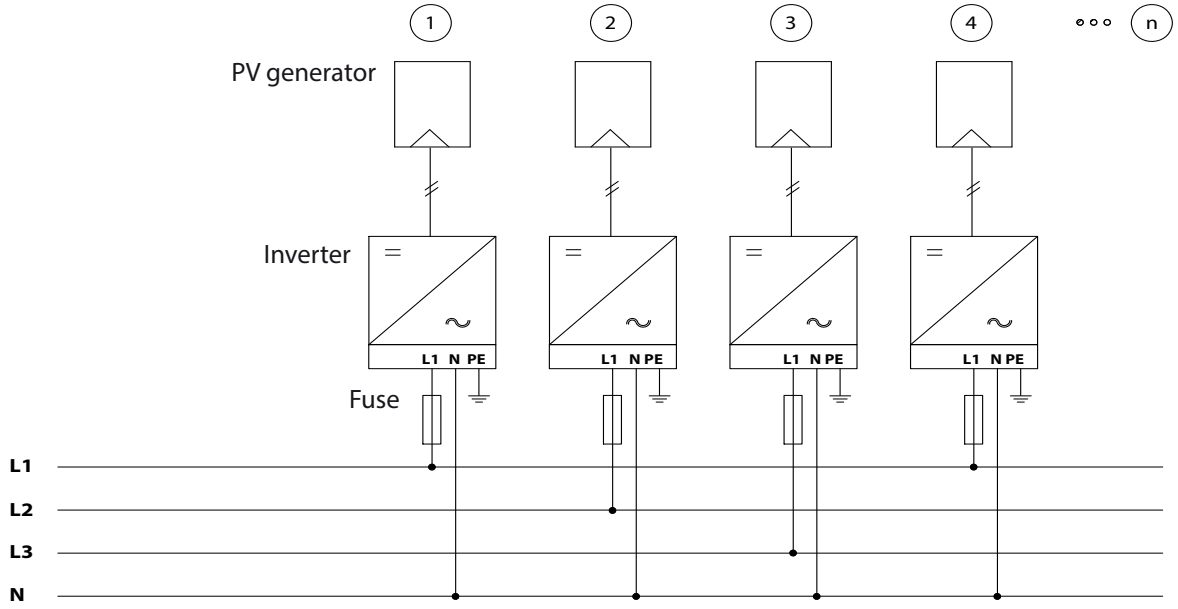

Figure 2: Grid-side connection for systems with multiple inverters with single-phase grid monitoring

3.2.3 Electrical connection

NOTE

Note the grid-type-specific connection conditions (see section 7.2 on page 18).

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3.2.4 Summary of the components

PV generator

The PV generator, i.e. the PV modules, converts the radiant energy of sunlight into electrical energy.

DC terminal point

Options for parallel connections of several generator strings:

- To a DC terminal point between the DC generator and inverter,
- Directly to the inverter (terminals for 3 strings are provided on the inverter),
- Directly to the PV generator with a positive and negative lead to the inverter.

DC isolator switch

Use the DC isolator switch to disconnect the inverter from all power sources on the PV generator side.

Grid fuses

Use only specific PV rated fuses.

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.

Selective main switch

If you have any questions about the selective main switch, contact your power supply company.

3.2.5 Inverter diagram

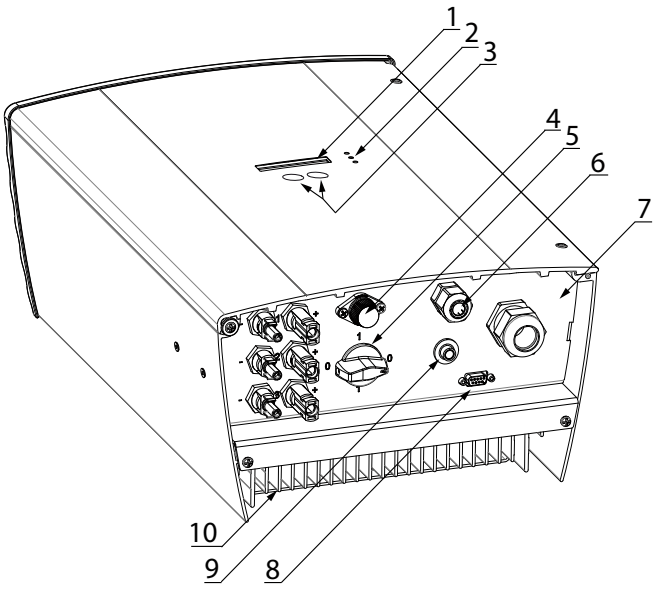

Figure 3: Inverter diagram

Key			
1	Display	6	Cable fitting for interface cable
2	LED indicators	7	Connection board
3	Control buttons	8	RS232 port
4	Fuse for generator grounding (optional)	9	Night start button
5	DC isolator switch	10	Mounting plate

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3.2.6 Mechanical components

3.2.6.1 DC isolator switch

There is one DC isolator switch in the inverter housing. The DC isolator switch is used to disconnect the inverter from the PV generator in order to carry out service.

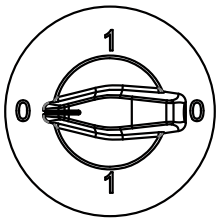

Figure 4: DC isolator switch

Disconnecting the inverter from the PV generator

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

Connecting the inverter to the PV generator

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

3.2.6.2 Night start button

The unit switches off in the evening as nightfall approaches. At this point, nothing is shown on the display. In order to retrieve the values from the current day (daily yield, daily hours of operation and max. feed-in power) after the display switches off, the unit can also be activated during the night by pressing the night start-up button on the underside of the inverter.

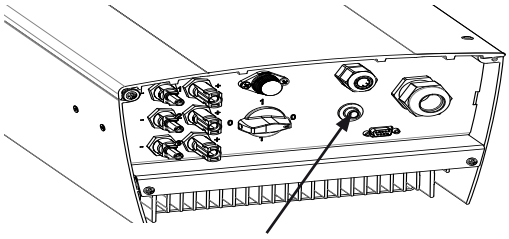

Figure 5: Night-start button on the inverter

3.2.7 Interfaces

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

- RS232 port
- RS485 interface
- S0 interface

You configure the interfaces in the Settings mode (see section 8.3 on page 33).

3.2.7.1 RS232 port

Use this monitoring option if you wish to manage system operating data directly on a computer. The data can be processed with standard spreadsheet programs.

The inverter and computer are connected with a serial 1:1 interface cable.

The cable length should not exceed 20 metres.

The data from the inverter is sent unidirectionally as pure ASCII text via the serial interface. The data is not checked for errors.

The RS232 interface has the following parameters:

Baud rate	Data bits	Parity	Stop bits	Protocol
9600 baud	8	None	1	None

The table below shows an example of a few lines of data transmitted over the RS232 interface.

Spalte 1	2	3	4	5	6	7	8	9	10
00.00.0000	00:05:30	3	363.8	0.37	134	226.1	0.53	103	23
00.00.0000	00:05:40	3	366.0	0.39	142	226.1	0.53	112	23
00.00.0000	00:05:50	3	359.5	0.41	147	226.1	0.53	116	23

Table 1: Excerpt from the RS232 interface transmission log

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Key			
Column	Meaning	Column	Meaning
1	Placeholder	6	Generator power in W
2	Daily running time	7	Line voltage in V
3	Operating status (see section 8.1 on page 13)	8	Line current, feed-in current in A
4	Generator voltage in V	9	Power fed into the grid in W
5	Generator current in A	10	Temperature of the unit in °C

3.2.7.2 Software for direct monitoring

Together with the Powador inverter, KACO-viso takes over the role of a data logger. It saves the data from the inverter and displays it in various diagram types as a daily or monthly representation.

The PC, however, must also run continuously. Because of the amount of energy used, this type of monitoring only makes sense over limited periods, such as during a fault analysis. For permanent system monitoring, we recommend the optional accessories. (Powador proLog)

3.2.7.3 RS485 interface

Use this monitoring option if you cannot check the functioning 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 GmbH offers the following data loggers:

Powador-proLOG S to XL (optional)

Powador-proLOG allows you to monitor up to 31 inverters simultaneously. Depending on the product model, Powador-proLOG sends yield and operating data by SMS or e-mail.

Powador-piccoLOG (optional)

Powador-piccoLOG allows you to monitor up to 3 inverters up to 20 kWp simultaneously. With this self-learning data logger, yield and operating data as well as error messages are transferred to monitoring devices via Ethernet. System errors are also issued optically and acoustically. A ripple control receiver can be connected via the integrated digital input.

Powador-link RS485 (optional)

Use the Powador-link RS485 to bridge long distances between several inverters or between an inverter and the Powador-proLOG or Powador-piccoLOG by means of wireless radio transmission.

3.2.7.4 S0 interface

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).

NOTE

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

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4 Technical Data

4.1 Electrical data

Input levels	2002	3002	4202	5002	6002
Max. recommended PV generator power [W]	2 000	3 000	4 200	5 000	6 000
DC MPP range from [V] to [V]	125 ... 510		200 ... 510		
Starting voltage [V]	125		200		
Open circuit voltage [V]*			600		
Max. input current [A]	14.3	13.5	18.5	22.4	26.5
Number of strings			3		
Number of MPP controls			1		
Polarity safeguard			Short-circuit diode		
* To protect the electronic system, the grid-feed is made at < 550 V.					
Output levels					
Rated power [VA]	1 650	2 500	3 500	4 200	4 600 (DE) 5 000 (INT)
Grid voltage [V]			184 ... 264		
Rated current [A]	7.2	10.9	15.2	18.3	20.0
Rated frequency [Hz]			50		
Cos phi			0.80 inductive ... 0.80 capacitive		
Number of feed-in phases			1		
Distortion factor [%]			<3		
General electrical data					
Maximum efficiency	95.9 %	96.0 %	95.9 %	95.9 %	95.9 %
European Efficiency	95.3 %	95.4 %	95.1 %	95.3 %	95.3 %
Internal consumption: Night [W] / Standby [W]			0.4 / < 5		
Feed-in starts at [W]	10	15	25	25	25
Circuit design	Galvanically isolating high-frequency DC/DC converter with down-stream self-commutated inverter				
Clock frequency			17 kHz		
Grid monitoring	Automatic disconnection device in accordance with DIN VDE 0126-1-1:2006-02				
CE conformity			Yes		

Table 2: Electrical data

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4.2 Mechanical data

	2002	3002	4202	5002	6002
Visual displays	LCD (2 x 16 characters) LEDs: PV generator (green), supply (green), fault (red)				
Controls	2 keys for operating display				
DC isolator switch	Integrated DC isolator switch with rotary switch				
DC connections	6 (2 x 3) MC-4 compatible solar plug connections				
Ambient temperature	-20 °C to +60 °C (Powador 2002 / 3002) -25 °C to +60 °C (Powador 4202 / 6002) (> +40 °C Power derating at high ambient temperatures)				
Temperature monitoring	> 75 °C > 85 °C		> 70 °C (temperature-dep. power matching) > 80 °C (disconnection from the grid)		
Max. humidity	95% (non-condensing)				
Maximum installation elevation [m above sea level]	2 000				
Cooling	Free convection (no fan)			Fan	
Protection class	IP54 according to EN 60529				
Degree of contamination	2				
Noise emission	< 35 dB			< 45 dB (fan operation)	
Housing	Aluminium wall-mounted housing				
H x W x D [mm]	450 x 340 x 200	500 x 340 x 200	600 x 340 x 240	600 x 340 x 240	600 x 340 x 240
Total weight [kg]	14.5	20	26	28	28

Table 3: Mechanical data

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5 Transportation and Delivery

5.1 Delivery

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

5.1.1 Scope of delivery

- Powador inverter
- Wall bracket
- Installation kit
- Documentation

5.2 Transportation

WARNING

Impact hazard, risk of breakage to the inverter

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

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

Figure 6: Transportation of the inverter

Authorised electrician

6 Mounting the inverter

DANGER

Risk of fatal injury from fire or explosions

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

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

CAUTION

Risk of burns from hot housing components.

Coming into contact with the housing can cause burns.

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

Installation space

- As dry as possible, well-ventilated, with the waste heat dissipated away from the inverter,
- Unobstructed air circulation,
- When installing the unit in a control cabinet, provide forced ventilation so that the heat is sufficiently dissipated,
- Easily accessible from the front and sides,
- Protected from direct sunlight and moisture (rain and wind) in outdoor areas,
- For easy operation, ensure during installation that the display is slightly below eye level.

Wall

- With sufficient load-bearing capacity
- Protected against high winds,
- Accessible for installation and maintenance,
- Made from heat-resistant material (up to 90 °C)
- Flame resistant,
- Minimum clearances to be observed during assembly: see Figure 10 and Figure 11 on page 17.

CAUTION

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

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

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

› Perform regular visual inspections.

› Immediately remove any moisture from the housing.

› Take care to ensure sufficient ventilation of the inverter.

› Immediately remove dirt, especially on vents.

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

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6.1 Unpacking the inverter

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CAUTION

Risk of injury due to high weight of the inverter (approx. 14.5-28 kg) !

› Observe the weight of the inverter during transport.
› Select suitable mounting location and mounting base.
› Use mounting material corresponding to or included with the base for mounting the inverter.
› Only mount the inverter with the help of a second person.

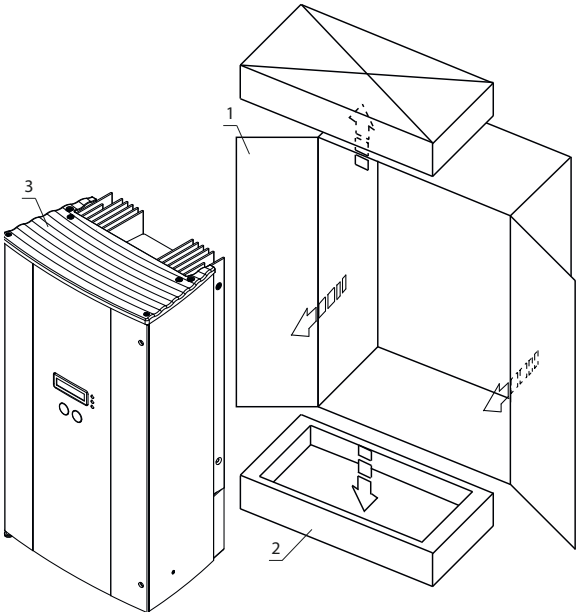

Figure 7: Unpacking the inverter

Figure 8: Setting up the inverter

Key			
1	Carton	3	Inverters
2	Protective packaging		

Unpacking the inverter

1. Open carton at the front.
2. Remove installation material and documentation.
3. Slide inverter carefully out of the carton with the protective packaging.
4. Place the protective packaging back into the carton during mounting.

» Continue setting up the inverter.

6.2 Setting up the inverter

NOTE

Power reduction due to heat accumulation.

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

› Maintain minimum clearances.
› Ensure sufficient heat dissipation.

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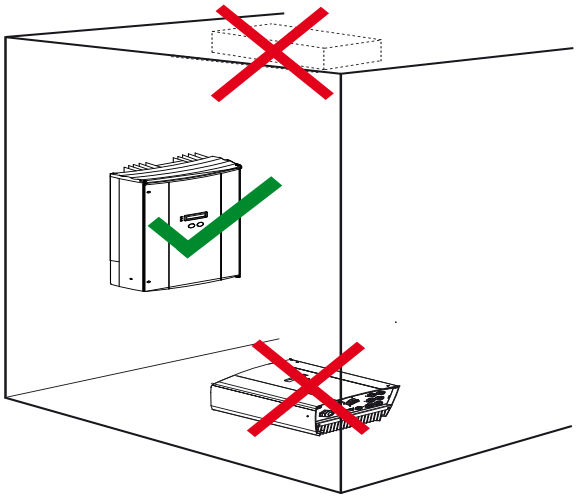


Figure 9: Instructions for wall mounting

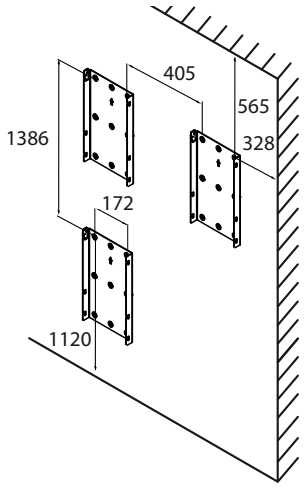
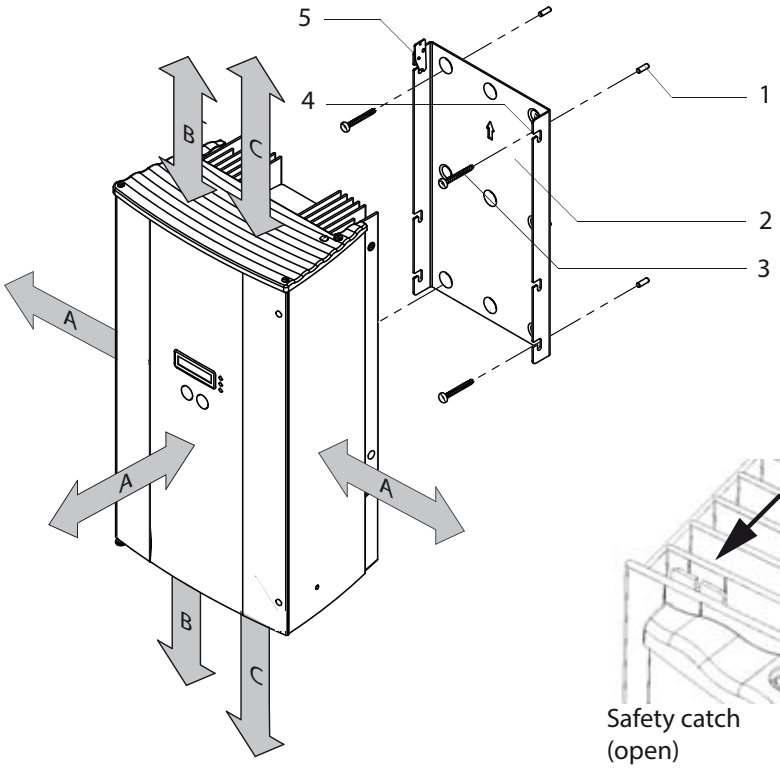
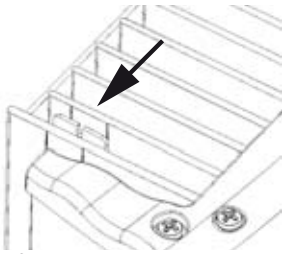


Figure 10: Drill stencil for wall mounting with minimum clearances (in mm)

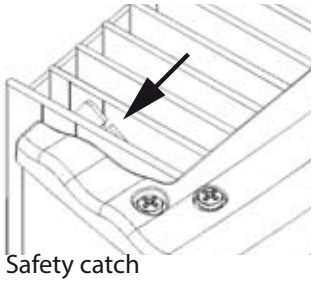
Fasten wall holder to mounting location

5. Mark the positions of the drill holes using the cut-outs in the wall holder.
   NOTE: The minimum clearances between two inverters, or the inverter and the ceiling/floor have already been taken into account in the diagram (see Figure 10).
6. Fix wall holder to the wall with the mounting fixtures.
   Make sure that the wall holder is oriented correctly.





Safety catch (open)



Safety catch (closed)

Figure 11: Minimum distances of inverter

Key		
A	• horizontal distance between the two inverters / inverter and the wall	25 cm
	• Distance in front	

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B	Distance between the inverter and the ceiling / floor		50 cm
C	vertical distance between the two inverters		70 cm
1	Fixings for mounting	4	Suspension bracket
2	Wall bracket	5	Safety catch
3	Screws for mounting		

Securing the inverter

7. Secure the inverter with a second person and with both hands on the housing side and base plate, and move to the mounting location. (See Figure 9 on page 17)
8. Hang the inverter on the wall holder using the suspension brackets on the back of the housing.
9. Secure the inverter with safety catch. (See Figure 11 on page 17)

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

7 Installing the inverter

DANGER

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

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

Only appropriately qualified and authorised electricians may open and install the inverter.

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

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

7.1 Opening the connection area

Opening the connection area

↻ You have completed assembly.

1. Unscrew the two Philips screws on the right-hand side of the housing.
2. Open the housing door.

» Make the electrical connection.

7.2 Making the electrical connection

Make the connection to the PV generator as well as the grid connection via the PCB terminals in the connection area of the inverter. Note the following cable cross-sections:

	AC connection	DC connection
Max. conductor cross-section without wire sleeves	6 mm²	MC4 solar plug connection
Max. conductor cross-section with wire sleeves	4 mm²	
Length of insulation to be stripped off	12 mm	
Tightening torque (Powador 4202-6002 only)	1.2 Nm - 1.5 Nm	

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The power section has two internal circuit board fuses. These are labelled F701 or F801 and F861 on the circuit board.

	2002 / 3002	4202 / 5002 / 6002
Fuse	F801 type 179120 5x20 slow-blow 250 V / 0.4 A	
Vendor	SIBA	
Fuse	F861 type TR5 fuse, series 372 slow-blow 250 V / 125 V / 1 A	F701 type 179200 5x20 slow-blow 250 V / 0.4 A
Vendor	Littelfuse/Wickmann	SIBA
Overvoltage safety class	DC: III, AC: III	
Overvoltage safety category	DC: II, AC: III	

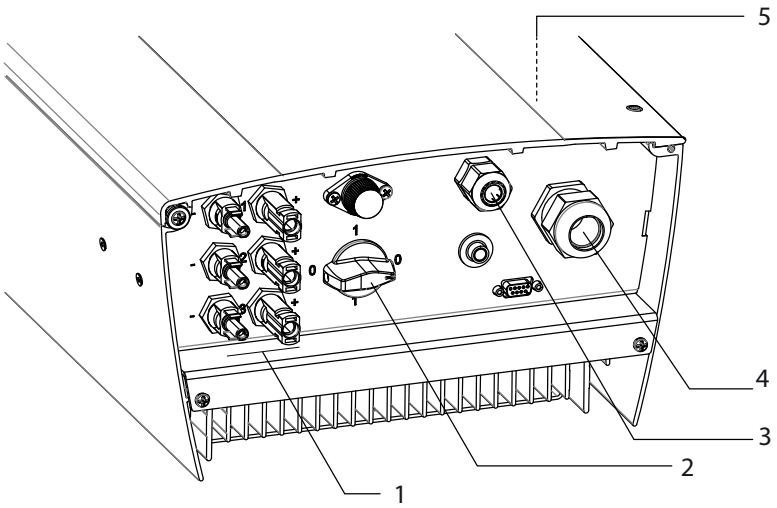

Figure 12: Connection area

Key			
1	6 (2 x 3) MC4-compatible DC plug connectors for PV generator	4	Cable fitting (M40) for AC connection
2	DC isolator switch	5	AC connection terminals
3	Cable fittings (M16) for housing ground connection		

7.2.1 Connecting the inverter to the power grid

The power connection wires are connected on the right of the connection area.

A screwdriver (slotted, 3.5 mm) is to be used for the terminals in the inverter.

DANGER

Risk of fatal injury due to electric shock

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

› Switch off all power sources to the inverter before you insert the grid power cable into the unit.

› 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 NYM cables for fixed wiring according to VDE 0100 part 430

For cable lengths up to 20 m, use the conductor cross-sections specified in Table 4. Longer cable lengths require larger conductor cross-sections.

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Model	Conductor cross-section	Fuse protection: gL safety fuses
Powador 2002	1.5 mm²	16 A for 1.5 mm² conductor cross-section
Powador 3002	2.5 mm²	20 A for 2.5 mm² conductor cross-section
Powador 4202	4.0 mm²	25 A for 4.0 mm² conductor cross-section
Powador 5002	4.0 mm²	25 A for 4.0 mm² conductor cross-section
Powador 6002	6.0 mm²	35 A for 6.0 mm² conductor cross-section

Table 4: Recommended conductor cross-sections and fuse protection of NYM 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 it 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.

Figure 13: Insert AC leads into the connection area

Figure 14: AC leads wound around the ferrite cores

Making the grid connection

↻ Use cables with three wires (L1, N, PE).

1. Loosen cable fitting for AC connection.
2. Remove the outer cladding of the AC cables.
3. Insert the AC leads through the cable fitting into the connection area. (See Figure 13 on page 20)
4. Strip the insulation from the AC cables.
5. Guide the AC leads through the ferrite cores.
6. Wrap the AC leads once around the ferrite cores. (See Figure 14 on page 20)

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Variants: Spring terminal (Powador 2002-3002)

7. Insert screwdriver into the spring terminal and press it lightly upwards.
8. Insert AC lines completely into the spring terminal as specified by the labels. (Figure 15 on page 21)
9. Move screwdriver to the initial position.
10. The spring terminal is closed and the cable is held in place.

Variants: Screw clamp (Powador 4202-6002)

11. Connect lines to the PCB terminal as specified by the labels (Figure 15 on page 21) with the specified tightening torque (chapter 7.2 on page 18).
12. Check that all connected cables are securely fitted.
13. Tighten the cable fitting.

» The inverter is now connected to the power grid.

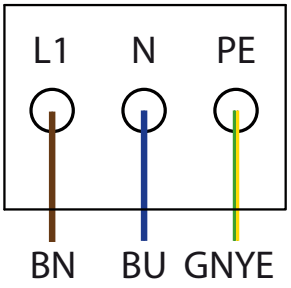

Figure 15: AC connection terminals

ACTIVITY

Cables on the AC screw terminal (Powador 4202-6002 only) must be tightened to the specified torque at regular intervals (see chapter 7.2 on page 18).

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.

7.2.2 Connecting the PV generator

A suitable crimping tool must be used to connect the stripped DC leads to the MC-4 coupling plug and coupling socket (solar plug connection).

Connect the MC-4 coupling plugs to the 3 DC positive and the 3 DC negative mating parts on the underside of the housing (see Figure 16 on page 22).

NOTE

Connected PV modules must be dimensioned for the DC system voltage in accordance with IEC 61730 Class A, but at least for the value of the AC grid voltage

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 plug connection without first disconnecting the inverter from the PV generator may lead to injuries and damage the inverter.

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

› Remove the plug connector.

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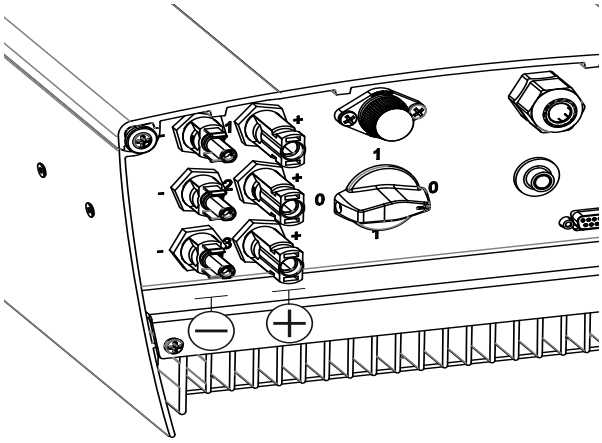

Figure 16: Connections for DC positive and DC negative

7.2.2.1 Before connecting

Ensure that there is no ground fault

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

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

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

7.2.2.2 Connecting the PV generator

DANGER

Risk of fatal injury due to electric shock

Severe injury or death will result if the live connections are touched. When there is sunlight present on the photovoltaic modules, there is DC voltage on the open ends of the DC cables.

› Do not touch the exposed ends of the cables.

› Avoid short circuits.

Connecting the PV generator

1. Remove protective caps from the DC connection plugs.
2. Connect PV generator to the DC plug connectors on the underside of the housing.
3. Meet the requirements of protection rating IP65 by closing the unused plug connectors with protective caps.

» The inverter is connected to the PV generator.

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7.3 Generator grounding (optional)

Some module manufacturers stipulate that the solar modules must be grounded at the generator (especially when applied to thin-film modules). An optional grounding kit for use on galvanically isolated Powador inverters is available for this purpose.

EN

NOTE

When grounding the generator poles, heed the information provided by the module manufacturer.

Installing the grounding kit

1. Remove the fuse holder cover with a screwdriver
2. Attach fuse holder using the available screws
3. Connect black cable in the DC terminal with the label "GFDI" (below)
4. Install green/yellow PE cable to the provided PCB attachment using the cable lug
5. **For Powador 4202-6002** Plug PE cable with wire sleeve into PE terminal
6. Clamp accompanying cable link into upper GFDI terminal to DC+ or DC-
7. Activate grounding monitoring in the parameter menu. (See Section 8.3 on page 33)

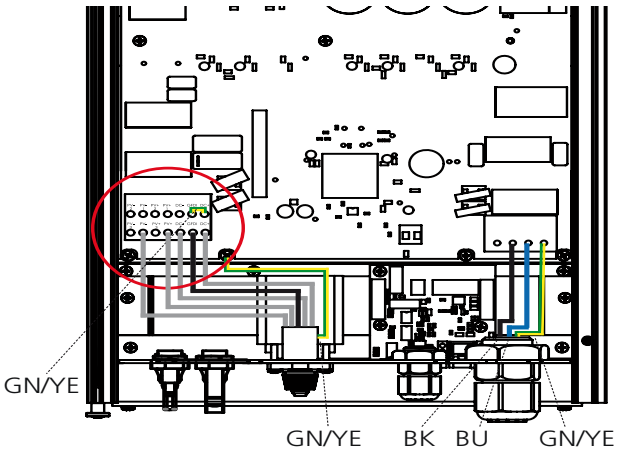

Figure 17: Powador 2002-3002 with generator grounding kit

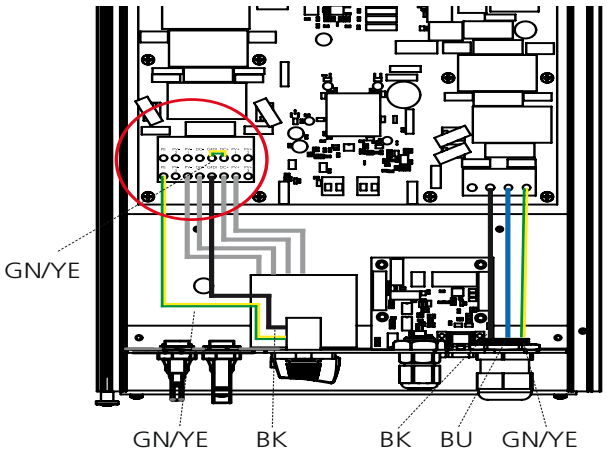

Figure 18: Powador 4202-5002-6002 with generator grounding kit (via PE terminal)

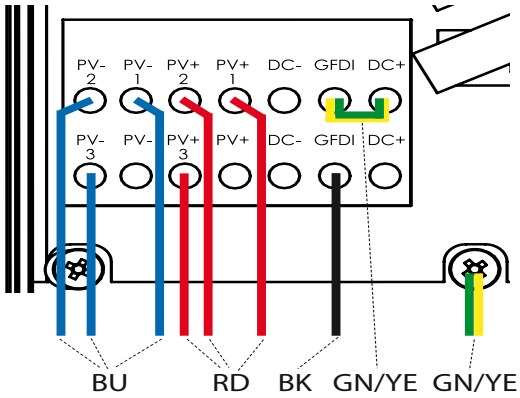

Figure 19: Positive grounding on the Powador 2002-3002

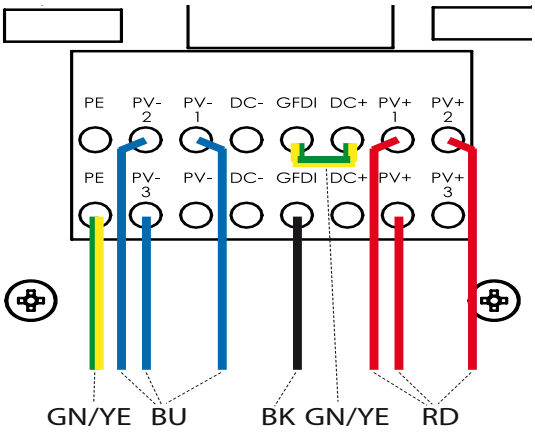

Figure 20: Positive grounding on the Powador 4202-6002 (via PE terminal)

EN

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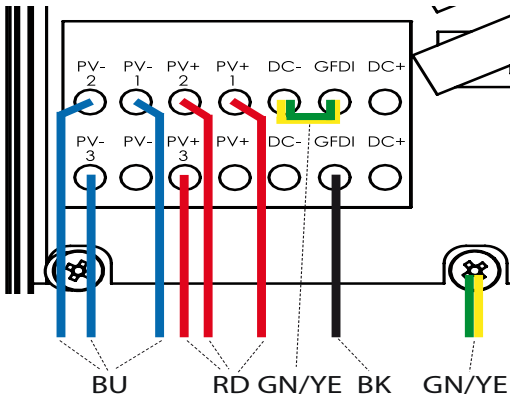

Figure 21: Negative grounding on the Powador 2002-3002

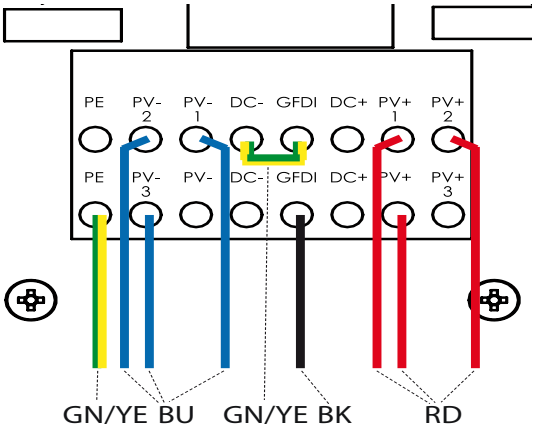

Figure 22: Negative grounding on the Powador 4202-6002 (via PE terminal)

NOTE

The fuse is triggered in the event of a ground fault in the PV system. The inverter interrupts the grid feed-in until the fuse has been replaced.
Only use identical fuses (Littelfuse KLKD1, 600 V, 1 A, fast-acting).

7.4 Connecting the interfaces

All interfaces are connected on the communication circuit board. The circuit board is located directly underneath the terminal block of the cable feed.

DANGER

Risk of fatal injury due to electric shock

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

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

NOTE

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

EN

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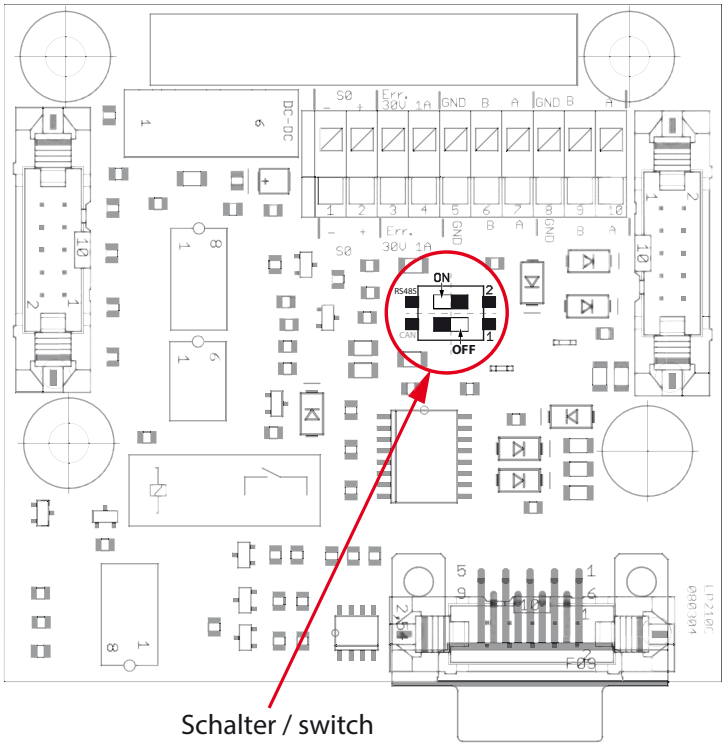

Figure 23: Communication circuit board

Activating the terminating resistor

A terminating resistor (Ra) with a value of 330 Ω is connected at the terminal unit of an inverter chain. (Figure 23).

This resistor is required for correct RS485 signal transmission.

1. Switch "2" must be set to "ON" on the terminal unit.
2. Switch "1" must be set to "OFF".

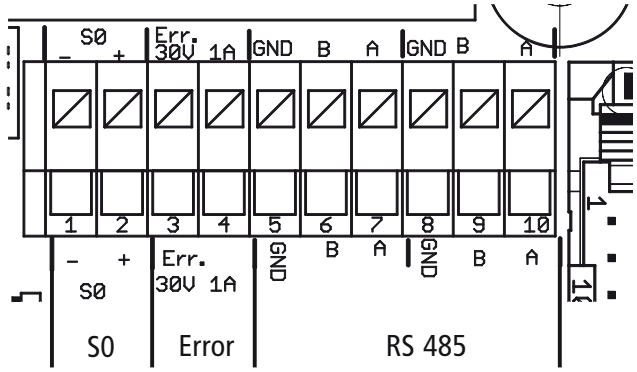

Figure 24: Interface terminals

7.4.1 Connecting the fault signal relay

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

Maximum contact load
30 V / 1 A

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Connecting the fault signal relay

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

EN

7.4.2 Connecting the S0 output

An S0 pulse output is located on the communication board. Use this output to control accessories such as a large display, for example. The pulse rate of the output is adjustable.

Connecting the S0 output

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

NOTE

Ensure that the wires are properly connected. Communication is not possible if the wires are reversed.

7.4.3 Connecting the RS485 bus

NOTE

Ensure that the A and B wires are properly connected. Communication is not possible if the wires are reversed.

7.4.3.1 Wiring diagram

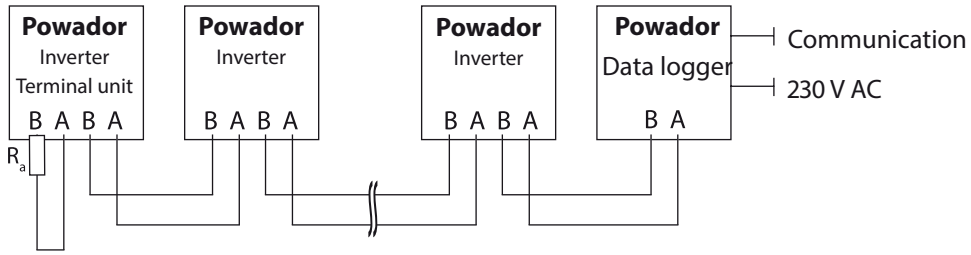

Figure 25: RS485 interface wiring diagram

Properties of the RS485 data line	
Maximum length of the RS485 bus line	The maximum allowed length of the RS485 bus is 1200 m. This length can be reached only under optimum conditions. Cable lengths exceeding 500m generally require a repeater or a hub.
Maximum number of connected bus devices	31 inverters + 1 data monitoring unit
Data line	Twisted, shielded. Recommendations: LI2YCYv (twisted pair) black for laying cable outside and in the ground, 2 x 2 x 0.5 LI2YCY (twisted pair) grey for dry and moist indoor spaces, 2 x 2 x 0.5

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NOTE

Different manufacturers do not always interpret the standard on which the RS485 protocol is based in the same way. Note that the wire designations (- and +) for wires A and B can vary between manufacturers.

EN

NOTE

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

Connecting the RS485 bus

☞ To prevent interference during data transmission:

- Observe the wire pairing when connecting DATA+ and DATA- (see Figure 26)
- Do not install RS485 bus lines in the vicinity of live DC/AC cables.

1. Unscrew the cable fitting.
2. Thread the connection cables through the cable fitting.
3. Connect the connection cables to the corresponding connection terminals (see Figure 24 on page 25).
4. The following must be connected to all inverters and to the data monitor unit in the same way:
   – Wire A (-) with wire A (-) and
   – Wire B (+) with wire B (+) (see Figure 25 on page 26)
5. Tighten the cable fitting.
6. Activate the terminating resistor on the terminal unit.

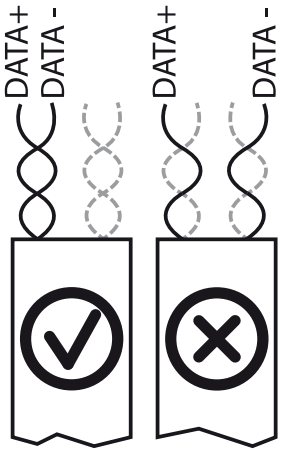

Figure 26: RS485 bus: Assignment of twisted-pair wires

NOTE

When using the RS485 bus system, assign a unique address to every bus device (inverter, sensor) and terminate the terminal units (see the "Settings" 8.3 on page 33 menu) .

7.5 Sealing the connection area

1. The requirements of protection rating IP54 are met by closing the unused cable fittings with blind caps.
2. Put on the lid for the connection area.
3. Close and lock the housing door.

» The inverter has been mounted and installed.

» Start up the inverter.

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7.6 Starting up the inverter

EN

DANGER

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

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

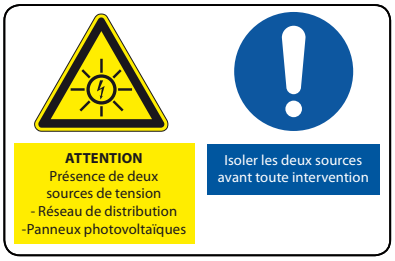
Only appropriately qualified and authorised electricians may start up the inverter.

FR

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

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

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



7.6.1 Switching on the inverter

↻ The inverter has been mounted and electrically installed.

↻ The cover for the connection area is grounded and closed.

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

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

» The inverter begins to operate.

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

EN

8 Configuration and Operation

8.1 Controls

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

Figure 27: LED indicators

Key	
1	"Operating" LED
2	“Feed-in” LED
3	"Fault" LED

8.1.1 LED indicators

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

●	LED illuminated	✺	LED flashing	○	LED not illuminated

Operating status	LEDs	Display	Description
Start	● ok		The green “Operating” LED is on when AC voltage is present, independent of the DC voltage.
Feed-in start	● ok ● ⌂	Power fed into the grid or measured values	The green "Operating" LED is lit. The green "Feed-in" LED is illuminated after the country-specific waiting period*. The inverter is ready to feed in, i.e. is on the grid. You can hear the grid relay switch on.
Feed-in start	● ok ✺ ⌂	Power fed into the grid or measured values	The green "Operating" LED is lit. The green "Grid feed" LED is illuminated after the country-specific waiting period*. The inverter is internally power-reduced and ready to feed in, i.e. is on the grid. (as per VDE-AR-N-4105) **Alternatives** 1. Internal/external power limiting or start-up limiting is active 2. The inverter is operating in standalone mode

* The waiting period ensures that the generator voltage continuously remains above the power delivery limit of 200 V.

EN

Non-grid feed mode	ok	Status message	The display shows the corresponding message.
Fault	!	Fault message	The display shows the corresponding message. The red "Fault" LED is illuminated. The inverter is not ready for grid feed, i.e. no longer on the grid.

8.1.2 Display

The display shows measured values and data and allows the configuration of the inverter. In normal operation, the backlighting is switched off. As soon as you press one of the control buttons, the backlighting is activated. If no button is pressed for a minute, it switches off again.

In sleep mode, the inverter deactivates the display regardless of the selected setting.

NOTE

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

After being switched on and after the initial start-up is complete, the inverter displays the unit name.

Figure 28: Display (shows the unit name or menu item)

8.1.3 Control buttons

Operate the inverter with the two control buttons

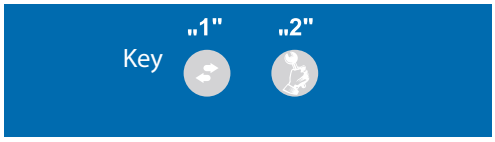


Figure 29: Control buttons

Key		
1	Shift button	Navigation to the next menu item
2	Setting key	Make settings or selection

EN

8.1.4 Inverter menu

Opening the menu

↻ The inverter is in feed-in mode.
↻ The LCD is showing the grid parameters.
☞ Press the "1" key.
» The power and configuration values are displayed in succession by pressing key "1" multiple times or by pressing and holding it.

Displaying the daily output

↻ The inverter is operating.
↻ The LCD is showing the unit name.
☞ Press key "1" repeatedly or press and hold until the display shows "Yield today".
» The LCD is showing the daily yield.
☞ To return to the base display, press key "1" repeatedly or press and hold or wait for one minute without pressing a key.

Setting display language

↻ The LCD is showing menu level "2".
↻ The "Language" menu option is displayed.
☞ Press "2" to select the language.
☞ Press "1" to change the language.
» Menu level "1" is shown after the selection.

Selecting a menu option

↻ The inverter is operating.
↻ The inverter displays a selection menu option.
☞ Press "2" to make a selection.
☞ Press "1" to confirm a selection.
» The next menu option is displayed.

Making settings

↻ The inverter is operating.
↻ The LCD is showing a setting menu option.
☞ Press "1" to navigate to the setting position.
☞ Press key "2" repeatedly or press and hold until the setting value is correctly shown.
» After running though all setting positions the value is saved and the next menu item is displayed.

Selecting menu level "2"

↻ The inverter is operating.
↻ The LCD is showing the unit name.
☞ Press keys "1" and "2" simultaneously.
» The LCD is showing the software version.
☞ Press key "1" repeatedly or press and hold.
» The display runs through menu level "2" and returns to the start point.
☞ To return to menu level "1", press keys "1" and "2" simultaneously or wait for one minute without pressing a key.

EN

Selecting menu level "3" (service technician)

↻ The inverter is operating.
↻ The LCD is showing the unit name.
☞ Press key "2" for 15 seconds.
» The LCD is showing the country-specific parameters.
☞ Press key "1" repeatedly or press and hold.
» The display runs through menu level "3".
☞ To return to menu level "1", press keys "1" and "2" simultaneously or wait for one minute without pressing a key.




Entering password or unlock code

☞ Key "1" selection of items (1-4).
↻ The LCD shows the selected digits by underlining them.
☞ Press key "2" to set the value. (0-9, A-F).
↻ The LCD shows the set digits or letters.
☞ Press "1" to check password.
↻ If the password is correct, the unlocked menu option is displayed.



Saving changed settings

☞ Press keys "1" and "2" simultaneously to save settings or wait one minute after setting.
» The LCD jumps back to menu level "1".


8.2 Starting up for the first time

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

NOTE

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

NOTE

The sequence of the settings required for initial commissioning is preset in the configuration assistant.

Initial configuration

↻ You are in the first start-up.
☞ Select the menu language.
☞ Select the country of operation with grid type.
☞ Press key 1 and confirm with "Yes" that you want to permanently save the country set.
» You have completed the initial configuration. The inverter begins to operate.

EN

8.3 Menu structure

Icons used:

1 2 3	Menu level (1, 2, 3)	⌙	Submenu available
	Display menu	EN	Country-specific setting
	Option menu	DE-NSP	Country and grid type-specific setting
	Password protected menu (password can be requested from KACO Service) Enter the four-digit password using key "2". The password is unit-specific.		

Country-spec. Settings	Menu level	Display/ setting		Action in this menu/meaning
All countries	1 2 3	**Display**	⌙	☞ Press keys "1" or "2".
	1 2 3	**"Display" menu**	⌙	☞ Press key "1" to run through the following menu level "1".
	1 2 3	**Unit name**		Displays the unit name of the inverter.
	1 2 3	**Generator parameters**		Displays the current voltage and current of the PV array that is connected to the inverter.
	1 2 3	**Grid parameters**		Shows the current grid parameters that the unit is feeding into the grid. (Nominal power [W], nominal voltage [V], grid frequency [Hz] and current [A]).
DE-NSP BE	1 2 3	**Mode**		Shows the currently selected reactive power mode. Following modes: - cos phi (P) : specific characteristic - cos phi (P) : standard characteristic - cos phi : x.xxx u (under excited) / o (over excited) (const) - Q: xx.x % u (under excited) / o (over excited) (const) - Q=f(U) standard characteristic
IT-CEI021		**Additional modes:**		- Q=f(U) specific characteristic with 5 nodes - Q=f(U) specific characteristic with two-state controller
All countries	1 2 3	**External limitation (power control)**		Menu option is displayed with external active power limitation. Displays the power control in % steps (0%, 30%, 60%). In accordance with the requirements of the German renewable energy act (EEG)
	1 2 3	**Status of the Powador-priwatt**		Menu item is displayed with active Powador priwatt function and potential-free contact switched. Displays the active status.
DE-NSP DE-MSP DE_VDN	1 2 3	**priwatt time remain.**		Menu option is displayed with active Powador-priwatt function and potential-free contact switched. Shows the remaining runtime in hours and minutes alternating.
		priwatt power remain.		Displays the power available over the threshold range.
IT-CEI021	1 2 3	**SPI status**		Status display of the specific "System Protection Interface" (Remote tripping/External signal/local control)
All countries	1 2 3	**Ramp-up limitation**		Menu option is displayed with active ramp limitation. (power ramp-up)

EN

Country-spec. Settings	Menu level	Display/ setting		Action in this menu/meaning
All countries	1 2 3	**Temperature inside unit**		Displays the temperature of the heat sink in °C. If the unit overheats, power is automatically reduced until it is shut down completely.
	1 2 3	**Yield meter**		Shows the total yield back to the last reset. Press "2" to reset the yield meter.
	1 2 3	**Yield today**		Displays the cumulative yield for the current day.
	1 2 3	**Total yield**		Displays the previous yield. Yield meter, "Yield today" and "Total yield" can be reset in menu level "2" "Feed-in meter".
	1 2 3	**CO2 savings**		Displays the calculated CO_2 savings (in kg).
	1 2 3	**Operating hours counter**		Shows the total operating time since the last reset. Press "2" to reset the yield meter.
	1 2 3	**Operating hours today meter**		Displays the duration of operation on the current day.
	1 2 3	**Operating hours total meter**		Displays the total operating time.
	1 2 3	**Date/Time**		With an additional PCB installed (real-time module RTC), displays the current time and the date.
	1 2 3	**Displaying grid error**		The five most recent grid errors in last 1000 operating hours are displayed. ☞ If "Yes" is selected, the corresponding fault messages are displayed. Navigate through the fault messages with the navigation button. ☞ After displaying the grid errors, the device runs through the menu level and begins when key "1" is pressed again with the display of the unit name.
All countries	1 2 3	**"Configuration mode" menu**		☞ Press keys "1" and "2" to run through the following menu level "2".
	1 2 3	**Software version**		Displays the installed software version.
	1 2 3	**Configuration version**		Displays the installed configuration version.
	1 2 3	**Serial no.**		Displays the serial number of the inverter.
	1 2 3	**Country and grid-type display**		Displays the selected country setting and grid type.
	1 2 3	**Language**		☞ Select the desired menu language.
	1 2 3	**Clear grid-feed meter**		Allows the grid-feed meter to be cleared. ("Yield" meter and "Operating hours" meter) ☞ If "yes" is selected the password is requested. ☞ Setting required password number "2" If the code number is valid, the grid-feed meter is cleared and a confirmation is displayed with "Grid meter cleared!".

EN

Country-spec. Settings	Menu level	Display/ setting	Action in this menu/meaning
All countries	1 2 3	**Defining total yield**	You can set the total yield to any value, for example, when you have received a replacement unit and want to continue the recording from the present value. ☞ Select "yes" to set the total yield.
	1 2 3	**Interface**	Select the RS232 or RS485 interface for data transmission ☞ The interface is changed by pressing "2".
	1 2 3	**Inverter address**	Every inverter must have a unique address. The interface is used to communicate with the Powador-proLog. ☞ By pressing key "2", the RS485 address can be set consecutively from 1 to 32.
	1 2 3	**S0 interface**	Selection of pulse rate for the S0 interface 500, 1000 and 2000 pulses/kWh ☞ Set pulse rate.
	1 2 3	**Activate priwatt**	Enables the use of the fault signal relay for the Powador-priwatt internal consumption control relay. ☞ Activate or deactivate the home feed-in function. **NOTE:** Activating this option enables the **Set priwatt** menu option.
	1 2 3	**Set priwatt**	☞ Define the switch-on power in kW that needs to be available on an uninterrupted basis for 30 minutes before the home feed-in is activated. ☞ Define the switch-on time (operating time of Powador-priwatt after activation). **NOTE:** This menu item is only available if you have selected the "On" option for the "Activate priwatt" menu item in the "Settings" menu.
	1 2 3	**Quick start**	Menu item is displayed only when waiting for grid feed and during ramp-up limiting. Offers the option of ramping up the inverter faster for inspection or testing. If there is insufficient PV array power, the inverter stops feeding into the grid after a short period of time. ☞ If the function is disabled, the display runs through the menu level and when key "1" is pressed again it shows the software version.

EN

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Country-spec. Settings	Menu level	Display/ setting	Action in this menu/meaning
All countries	1 2 3	"Parameters" menu	Only service technicians are permitted to make changes in the parameter menu. ↳ ↻ You are in menu level "1". ↻ The unit name is displayed. ☞ Press "2" for at least 15 seconds to run through menu level 3.
	1 2 3	Select country	The default setting is used if "no" is selected. 1. Set the desired country setting. **NOTE:** This option influences the country-specific operating settings of the inverter. Please consult KACO service for further information.
All countries	1 2 3	Set grid parameters	☞ Provides the option to set the grid parameters. 1. Confirm "Yes" input using "1" key. 2. Set the required grid parameters in the next menu. ☞ If "No" is selected, the defined country-specific parameters will be used.
ES, ,GB-G59, IT-CEI021, UD,IL	1 2 3	Overvoltage shutdown	☞ Specify the shutdown threshold for fast and slow overvoltage shutdown. ☞ Set period from occurrence of the fault to shutdown of the inverter.
DE-NSP, BE	1 2 3	Overvoltage shutdown	☞ Activate or deactivate password protection. ☞ Specify the shutdown threshold for overvoltage shutdown. The 10-minute average for the measured voltage as per EN50160 is used. ☞ Set period from occurrence of the fault to shutdown of the inverter.
ES , GB-G59, IT-CEI021, UD, IL	1 2 3	Undervoltage shutdown	☞ Specify the shutdown threshold for fast and slow undervoltage shutdown. ☞ Set period from occurrence of the fault to shutdown of the inverter.
BG, CZ, FR,PF, DE-VDN	1 2 3	Max. line voltage EN 50160	The grid voltage is averaged over ten minutes. If the defined value is exceeded, the inverter is disconnected from the grid. ☞ Enter the four-digit password using key "2". The password is unit-specific. ☞ Set voltage threshold.
BG, CZ, FR , PF, DE-VDN	1 2 3	Voltage drop between meter and inverter	The voltage drop between the inverter and the grid-feed meter is added to the limit value that was set for grid shutdown according to EN 50160. The limit value can be set from 0 to 11 V in 1 V increments. ☞ Specify the switch-off value for the voltage drop (0 to 11 V).
AT	1 2 3	Undervoltage shutdown Overvoltage shutdown	Displays the limit values for undervoltage or overvoltage shutdown. ☞ Define limit values for undervoltage or overvoltage shutdown.

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Country-spec. Settings	Menu level	Display/ setting	Action in this menu/meaning
AU,DK, GR-(M/I), GB-G83, PT, KR, SI		**Line undervoltage/ overvoltage switch-off**	If the grid frequency exceeds or drops below the configured values, the inverter switches off. The minimum switch-off threshold can be set in 1 V increments. ☞ Configure the switch-off values for undervoltage and overvoltage.
ES, UD, IT-CEI021, GB-G59, IL		**Minimum/ maximum grid frequency**	The inverter continuously monitors the grid frequency. If the grid frequency exceeds or drops below the configured values, the inverter switches off. ☞ Set limit values for fast and slow underfrequency shutdown in 0.1 Hz increments ☞ Enter the shutdown threshold for fast and slow overvoltage shutdown.
DE-NSP, DE-VDN, BE, AU,DK, GR-(M/I), BG, CZ, FR, PF, PT, KR, SI			Shows the minimum/maximum allowable grid frequency. ☞ Set limit values for underfrequency and overfrequency switch-off in 0.1 Hz increments
All countries	1-2-3	**Minimum/ maximum connection voltage**	☞ Set the shutdown threshold for the minimum and maximum connection voltage: **NOTE:** The limit values cannot be edited for **DE-NSP, DE-VDN and BE**.
All countries		**Minimum/ maximum connection frequency**	Shows the minimum/maximum allowable grid frequency. ☞ Set limit values for minimum and maximum connection frequency in 0.1 Hz increments. **NOTE:** The limit values cannot be edited for **DE-NSP, DE-VDN and BE**.
DE-NSP, BE, IL, UD		**Connect time**	☞ Set connect time for grid monitoring after fault or device start in 1 sec. increments.
All countries		**Selection P(f)**	Offers the option of regulating the active power depending on the frequency by two different processes. ☞ Activate P(f) mode 1 or mode 2. **NOTE:** For **DE-NSP** and **BE**, only **Mode 2** is permitted. For **IT-CEI021** and **DE-MSP** is, only **Mode 1** is permitted. P(f) parameter for the countries/mains types shown in **bold** cannot be edited.
			☞ Set f_rise gradient. ☞ Set f_fall gradient. **NOTE:** Set gradients for power limitation with rising and falling mains frequency in %/Hz. This percentage relates to the nominal frequency of 50 Hz
			☞ Set f_act. **NOTE:** Set the current shutdown frequency.

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Country-spec. Settings	Menu level	Display/ setting	Action in this menu/meaning
			☞ Set min f_deact. ☞ Set max f_deact. **NOTE:** Set shutdown frequency for the power limitation with rising and falling mains frequency in Hz.
			☞ Set T_deact **NOTE:** Set minimum period (1- 1800s) during which the inverter must remain within one frequency range until P(f) is deactivated.
All countries	1 2 3	**Activate or deactivate password protection.**	☞ Activate password protection for mains parameter setting. **NOTE:** After activation, only read access is available to the mains parameter settings.
All countries	1 2 3	**Starting voltage**	The inverter begins feed-in as soon as this PV voltage is present. ☞ Set the starting voltage.
All countries	1 2 3	**Grnd flt monitor**	One pole of the PV generator is grounded in the unit using a fuse. Ground fault monitoring is triggered in the event of an ground fault in the generator. This prevents possible damage to the modules. **NOTE:** Activate ground fault monitoring only if you have grounded one pole of the PV generator. (See Section 7.3 on page 23) ☞ Activate or deactivate the ground fault monitoring function.
All countries	1 2 3	**Internal power limitation**	Power reduction is password-protected in some countries. Power is reduced in 10 W steps and is limited to 50% of the nominal unit power. ☞ Set power limiting. ☞ Password protection can be re-activated.
All countries	1 2 3	**Set default power**	Provides the option of maintaining the pre-configured power limitation even in the event of a fault halting communication. ☞ Set power in xxxx / 1000 in ‰ (promille). ☞ Set internal fall-back time to set default power if external power reduction is not pending.
IT-CEI021	1 2 3	**Activate self-test**	With an active self-test and feed-in operation, the switch-off values for grid voltage and grid frequency are displayed.

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Country-spec. Settings	Menu level	Display/ setting		Action in this menu/meaning
DE-NSP , BE	1 2 3	**Reactive power setting**		The following control methods can be set. At least one mode must be active. - cos phi (P) : specific characteristic - cos phi (P) : standard characteristic - cos phi : x.xxx u (under excited) / o (over excited) (const) - Q: xx.x % u (under excited) / o (over excited) (const) - Q=f(U) standard characteristic
IT-CEI021		**Additional processes**		☞ Q=f(U) specific characteristic with 5 nodes ☞ Q=f(U) specific characteristic with two-state controller
IT-CEI021, UD, IL	1 2 3	**Q specification active**		☞ Set the idle power Q (in % of device nominal power) to a fixed value. ☞ Select the type of phase shift (under-excited (u) / over-excited (o)).
DE-NSP, BE, IT-CEI021, IL, UD	1 2 3	**cos phi specification active**		☞ Configure power factor. ☞ If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited (u) /over-excited (o)).
	1 2 3	**cos phi (P/Pn) active**		The selection enables display, resetting or editing the nodes. (min. 2 / max. 10) ☞ Displays: All nodes are displayed in succession. ☞ Reset: Press "1" to activate default characteristic and a confirmation message is shown. ☞ Edit: Specify the number of nodes for editing. – Increment P/Pn in % with key "2" and confirm with key "1". – Increment cos phi with key "2" and confirm with key "1". **NOTE:** If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited/over-excited). **NOTE:** After running through all selected nodes, all values are saved by pressing "1" and this characteristic then is checked for consistency. NOTE**:** In the event of an error, the characteristic that was previously active is restored and the error message "Characteristic invalid" appears. You then have the option of correcting the characteristic.
IT-CEI021	1 2 3	**cos phi (P/Pn) parameter?**		Additional parameters can be set when cos phi (P/Pn) function is active. ☞ Specify gradient k. (Default value: 01000/1000) ☞ Specify change time. (ms) ☞ U_Lock In and U_Lock Out power range set as ‰ of rated power, in which the network support process is active.
DE-NSP, BE	1 2 3	**Q(U) characteristic**		☞ Specify the target voltage. ☞ Specify gradient. ☞ Specify change time.

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Country-spec. Settings	Menu level	Display/ setting		Action in this menu/meaning
IT-CEI021	1 2 3	**Q=f(U) 5 nodes**		Select the preset control procedure. ☞ The parameters of the selected procedure can be changed by selecting "Yes". ☞ Specify gradient K. (Default value: 01000/1000) ☞ Specify change time. (ms) ☞ U_Lock In and U_Lock Out power range set as ‰ of rated power, in which the network support process is active. **NOTE:** The nodes cannot be edited.
	1 2 3	**Q=f(U) 2-point controller**		
IT-CEI021	1 2 3	**Activate SPI mode**		☞ Provides the option of activating or configuring the specific "System Protection Interface" for Italian. (Additional PCB required!)
All countries	1 2 3	**Set default parameters**		On activation the specified parameters for the selected country are reset to the default values. ☞ Reset default parameters. **NOTE:** When password protection is activated, only the grid operator can make a change.

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9 Maintenance/Troubleshooting

9.1 Visual inspection

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

NOTE

The inverter should be checked for proper operation by a qualified electrician at regular intervals.

9.2 External cleaning

DANGER

Lethal voltages in the inverter

Serious injuries or death may occur if moisture gets into the inverter.

› Only use completely dry objects to clean the inverter.

› Only the exterior of the inverter should be cleaned.

Cleaning the inverter

☞ Do not use compressed air.

☞ Use a vacuum cleaner or a soft brush to remove dust from the bottom fan covers and from the top of the inverter on a regular basis.

☞ Remove dust from the ventilation inlets if necessary.

9.2.1 Cleaning the fan

NOTE

If the fan is only covered with loose dust, it can be cleaned with the help of a vacuum cleaner or a soft brush.

If the fan is very dirty, or if it is defective, it can be removed.

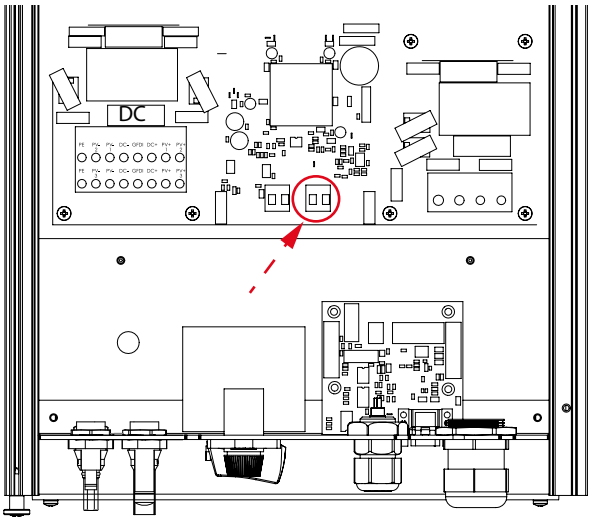

Figure 30: Plug for fan

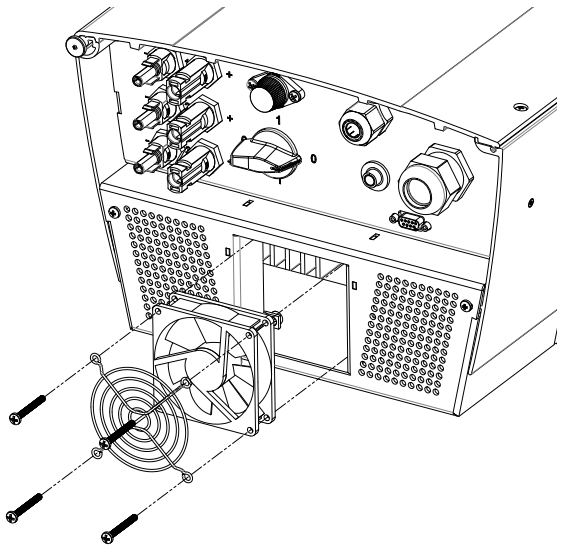

Figure 31: Fan cover

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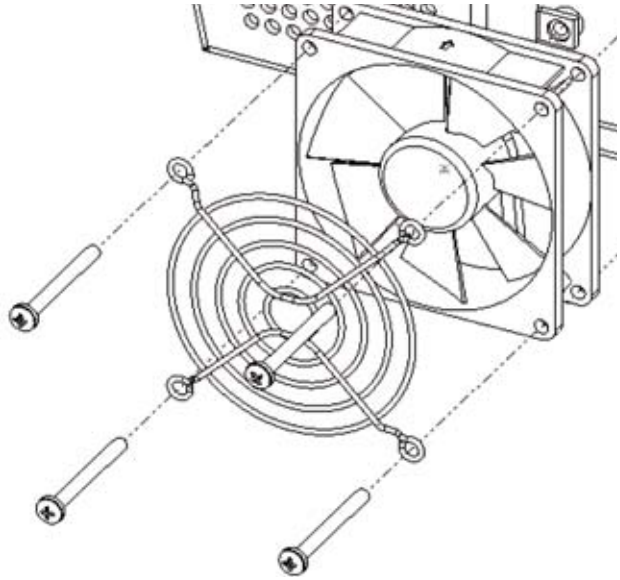

Figure 32: Removing the fan cover

Removing the fans

- ☞ Disconnect the fan from all power sources and wait until the fan no longer turns.
- ☞ Disconnect the fan plug.
- ☞ Loosen four screws on housing floor.
- » Fan can be removed along with cover (see Figure 32). Clean the fan with a soft brush or moist cloth.
- ☞ Install fan after cleaning.

9.3 Shutting down for maintenance and troubleshooting

DANGER

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

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

Only appropriately qualified and authorised electricians may open and maintain the inverter.

- › Observe all safety regulations and the current technical connection specifications from the relevant power supply company.
- › Disconnect the AC and DC sides.
- › Secure the AC and DC sides from being inadvertently switched back on.
- › Do not open the inverter until 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 while still live.

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

Shutting down the inverter

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

DANGER! The DC cables are still live.

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

Authorised electrician

9.4 Faults

9.4.1 Procedure

EN

DANGER

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

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

- ☞ When a fault occurs, notify an appropriately authorised and qualified electrician or KACO new energy GmbH Service.
- ☞ The operator can only carry out actions marked with a B.

- ☞ In case of power failure, wait for the system to automatically restart.
- ☞ Notify your electrician if there is an extended power failure.

9.4.2 Troubleshooting

B = Action of the operator

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

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

Fault	Cause of fault	Explanation/remedy	By
The display is blank and the LEDs are not lighting up.	Grid voltage not available	☞ Check whether the DC and AC voltages are within the permitted limits (see Technical Data).	E
		☞ Notify KACO Service.	E
The inverter stops feeding into the grid shortly after being switched on, even though there is sunlight present.	Faulty grid separation relay in the inverter.	If the grid separation relay is defective, the inverter will recognise this during the self-test.	
		☞ Ensure that there is sufficient PV generator power.	E
		☞ If the grid separation relay is defective, have it replaced by KACO Service. ☞ Notify KACO Service.	E
The inverter is active but is not feeding into the grid. The display indicates a line failure.	Grid-feed is interrupted due to a grid fault.	Due to a grid fault (grid impedance too high, over/undervoltage, over/underfrequency), the inverter stopped the feed-in process and disconnected from the grid for safety reasons.	
		☞ Change the line parameters within the permitted operating limits (see the "Start-Up" section).	E
The grid fuse trips.	The grid fuse capacity is too low.	In cases of high solar radiation, the inverter exceeds its rated current for a short period, depending on the PV generator.	
		☞ Select the capacity of the inverter's pre-fuse to be somewhat higher than the maximum feed-in current (see the "Installation" section).	E
		☞ Contact the grid operator if the grid failure continues to occur.	E

Table 5: Troubleshooting

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Fault	Cause of fault	Explanation/remedy	By
The grid fuse trips.	Damage to the inverter's hardware.	If the line fuse trips immediately when the inverter goes into feed-in mode (after the start-up period is complete), the inverter's hardware is probably damaged.	
		☞ Contact KACO Service to test the hardware.	**E**
Daily yields do not correspond to the yields on the feed-in meter.	Tolerances of the measuring elements in the inverter.	The measuring elements of the inverter have been selected to ensure maximum yields. Due to these tolerances, the daily yields shown may deviate from the values on the feed-in meter by up to 15%.	
		☞ No action	-
The inverter is active but is not feeding into the grid. Display: "Waiting for feed-in"	• Generator voltage too low • Grid voltage or PV generator voltage unstable.	• The PV generator voltage or power is not sufficient for feed-in (solar radiation is too low). • The inverter checks the grid parameters before the feed-in process begins. The length of time it takes to switch back on again differs by country according to applicable standards and regulations and can take several minutes. • The starting voltage may have been set incorrectly.	
		☞ Adjust starting voltage in the Parameter menu if required.	**K**
Noise emission from the inverter.	Particular ambient conditions.	When there are certain ambient conditions, the units may emit audible noises. • Grid interference or grid failure caused by particular loads (motors, machines, etc.) which are either connected to the same point on the grid or located in the vicinity of the inverter. • In cases of volatile weather conditions (frequent switching between sunny and cloudy conditions) or strong solar radiation, a light hum may be audible due to the increased power. • Under certain 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. 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. People with very sensitive hearing (particularly children) are able to hear the high-frequency hum caused by the inverter's operating frequency of approximately 17 kHz.	
		☞ No action	
In spite of high radiation levels, the inverter does not feed the maximum power into the grid.	The device is too hot and the system limits the power.	Because the temperatures inside the unit are too high, the inverter reduces its power to prevent damage to the unit. Note the technical data. Ensure that the convection cooling is not impeded from the exterior. Do not cover the cooling fins.	
		☞ Ensure sufficient cooling of the unit. ☞ Do not cover the cooling fins.	**B, E**

Table 5: Troubleshooting

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Fault	Cause of fault	Explanation/remedy	By
Additional devices that are connected via the potential-free contact suddenly start up, even though the "priwatt" function is deactivated and the inverter indicates an error.	The potential-free contact connects to indicate an error.	If the "priwatt" function is not activated, the potential-free contact functions as a fault signal relay and therefore indicates errors. However, if additional devices that are provided for the "priwatt" function are connected to the inverter via the contact, they can still start up when the inverter experiences an error, because the contact is connected at that point in time. If you deactivate the "priwatt" function, we recommend that you disconnect devices from the inverter that were connected for this function.	

Table 5: Troubleshooting

EN

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 triggering levels are defined in standards, e.g. VDE0126-1-1. The inverter shuts down if the values exceed or fall below the approved levels.

9.5.1 Display of status and fault messages

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

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

9.5.2 Status and fault signals

The following table lists the possible status and fault signals that the inverter shows on the LCD and the LEDs. For the status, consult the data that is logged via the RS485 interface.

BS = operating status, FS = fault status;

B = Action of the operator

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

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

Status	Display	⌂ !	Explanation	Action	By
OS 1	Start from ### V Measurem. ### V	○ ○	Self-test: The grid parameters and generator voltage are being checked.	-	-
OS 2	Voltage too low!	○ ○	Generator voltage and power are too low; situation before transition into night shutdown	-	-
OS 8	Self-test	○ ○	Checks the shutdown of the power electronics as well as the grid relay before feed-in mode.	-	-

Table 6: Operating status and fault messages on the display

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Status	Display	⌂	ⓘ	Explanation	Action	By
FS 10	Temperature in unit too high	○	●	In case of overheating, the inverter switches off. Possible causes: • ambient temperature too high, fan covered, inverter defective.	☞ Clean the fans. ☞ Notify your authorised electrician.	**B** **B** **E**
FS 18	Resid. current shutdown	○	●	Residual current was detected. The feed-in was interrupted.	☞ Notify your authorised electrician.	**E**
FS 29	Ground fault Check fuse	○	●	A ground fault was detected at the PV generator.	☞ Notify your authorised electrician.	E
FS 30	Fault Transformer fault	○	●	The current and voltage measurements in the inverter are not within acceptable range.	-	-
FS 31	RCD module error			An fault has occurred in the AC/ DC-sensitive residual current device.		
FS 32	Fault Self-test	○	●	The internal grid separation relay test has failed.	☞ Notify your authorised electrician if the fault occurs several times.	**E**
FS 33	Fault DC feed-in	○	●	The DC feed-in has exceeded the permitted value. This DC feed-in can be caused by grid conditions and may not necessarily indicate a fault.	☞ Notify your authorised electrician if the fault occurs multiple times.	**E**
FS 34	Communication error	○	●	A communication error has occurred in the internal data transmission.	☞ Notify your authorised electrician. ☞ Check the data cable.	**E**
FS 35	Protection shutdown SW	○	●	Protective shutdown of the software (AC overvoltage, AC overcurrent, DC link overvoltage, DC overvoltage).	Not a fault Grid-related shutdown, the grid connects again automatically.	-
FS 36	Protection 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	Error PV overvoltage	○	●	The voltage of the DC generator is too high. The PV generator is configured incorrectly.	☞ Notify your authorised electrician.	**E**
FS 41	Line failure: undervoltage L1	○	●	The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician.	**E**

Table 6: Operating status and fault messages on the display

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Status		Display	⌂	ⓘ	Explanation	Action	By
FS	42	Line failure: overvoltage L1	○	●	The voltage of a grid phase is too high, the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician.	**E**
FS	43	Line failure: undervoltage L2	○	●	The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician.	**E**
FS	44	Line failure: overvoltage L2	○	●	The voltage of a grid phase is too high, the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician.	**E**
FS	45	Line failure: undervoltage L3	○	●	The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician.	**E**
FS	46	Line failure: overvoltage L3	○	●	The voltage of a grid phase is too high, the grid cannot be fed into. The phase experiencing failure is displayed.	☞ Notify your authorised electrician.	**E**
FS	47	Grid failure: phase-to-phase volt.	○	●	The measured line-to-line voltage is outside of the tolerance limits.		
FS	48	Line failure: underfrequency	○	●	Grid frequency is too low. This fault may be grid-related.	☞ Notify your authorised electrician.	**E**
FS	49	Line failure: overfrequency	○	●	Grid frequency is too high. This fault may be grid-related.	☞ Notify your authorised electrician.	**E**
FS	50	Line failure: average voltage	○	●	The grid voltage measurement according to EN 50160 has exceeded the maximum permitted limit value. This fault may be grid-related.	☞ Notify your authorised electrician.	**E**
FS	57	Waiting for reconnect	○	●	Waiting time of the inverter after a fault.	Inverter does not switch on again until a country-specific time has elapsed.	
FS	58	Overtemperature Control card	○	●	The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware.	☞ Provide for sufficient ventilation.	**E**
FS	59	Self test error	○	●	A fault occurred during a self-test.	☞ Notify your authorised electrician.	**E**
OS	60	Waiting for PV voltage <550V	✳	○	The inverter does not begin feeding into the grid until the PV voltage falls below a specified value.	-	-
OS	61	External limit (%)	✳	○	The external „Power Control“ limit was activated by the grid operator. The inverter limits its power.	-	-

Table 6: Operating status and fault messages on the display

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Status		Display	⌂	ⓘ	Explanation	Action	By
OS	62	Standalone mode PAC ####W (###%)	☀	○	The inverter was switched to islanding operation by the Powador Grid-Save. The inverter is disconnected from the public low-voltage grid. The power indicator percentage refers to the maximum AC power.	-	
OS	63	Measured values	☀	○	P(f)/frequency-dependent power reduction: Frequency-dependent power reduction will be activated when the BDEW (German Association of Energy and Water Industries) Medium Voltage Directive goes into effect. Power reduction starts at a frequency of 50.2 Hz.	-	-
OS	64	Measured values	●	○	Output current limiting: The AC current is limited once the specified maximum value has been reached.	-	-
FS	66	Voltage trans. fault	○	●	Plausibility test of ADC test between ARM and DSP has failed	☞ In case of repeated occurrence: Notify your authorised electrician.	**E**
FS	70	Fan error	●	○	The fan is malfunctioning.	☞ Replace defective fan	**E**
FS		Config. error Invalid CRC	○	●	The checksum of the loaded config. file does not match the checksum in the EEPROM. This means that the EEPROM data originate from a different config. file.	☞ Notify authorised electrician / KACO Service	**E/K**

Table 6: Operating status and fault messages on the display

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10 Service

We place special emphasis on the quality and longevity of our inverters, starting with 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 GmbH will provide you with the maximum possible support. KACO new energy GmbH will make every effort to remedy faults quickly and without requiring a lot of paperwork.
If you need help solving a technical problem with one of our KACO products, please contact our service hotline. Please have the following information ready so that we can help you quickly and efficiently:

- Device name / serial number
- 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)
- Information about the accessibility of the installation site.
  Any additional costs arising from unfavourable structural or mounting conditions shall be billed to the customer.

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

• our current warranty conditions,

• a complaint form,

• a form for registering your unit with us. Please register your unit without delay. This will help us to offer the fastest possible service.

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

We have prepared a template for complaints. It is located at
http://www.kaco-newenergy.de/en/site/service/kundendienst/index.xml.

We have prepared a template for complaints. It is located at
http://www.kaco-newenergy.de/de/site/service/kundendienst

Hotlines

	Technical troubleshooting	**Technical consultation**
Inverters (*)	+49 (0) 7132/3818-660	+49 (0) 7132/3818-670
Data logging and accessories	+49 (0) 7132/3818-680	+49 (0) 7132/3818-690
Construction site emergency (*)	+49 (0) 7132/3818-630	
Customer help desk	Monday to Friday from 7:30 a.m. to 5:30 p.m. (CET)	

(*) Also on Saturdays from 8:00 a.m. to 2:00 p.m. (CET)

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11 Shutdown/Disassembly

11.1 Shutting down the inverter

DANGER

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

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

› After shutdown, wait at least 30 minutes before working on the inverter.

DANGER

Destruction of the DC plug

DC plugs can be destroyed by arcing if disconnected while still live.

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

Shutdown sequence

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

DANGER! The DC cables are still live.

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

11.2 Uninstalling the inverter

↻ Shut down the inverter.

1. Unscrew the two Philips screws on the right-hand side of the housing.
2. Detach DC connection plug.
3. Open the housing door.
4. Remove the interface cable.
5. Detach AC connection cables for the connection terminals.
6. Open the cable fittings.
7. Pull out the cables.

» The uninstallation of the inverter is complete. Continue with the disassembly.

11.3 Dismantling the inverter

↻ Shut down the inverter.

↻ Uninstall the inverter.

1. Remove the inverter fastening.
2. Securely pack up the inverter if it is to be used later or dispose of the inverter in line with regulations.

12 Disposal

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

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

12.1 Packaging

Ensure that the transport packaging is disposed of properly.

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