



blueplanet 3.0 TL1 | 3.5 TL1 3.7 TL1 | 4.0 TL1 4.6 TL1 | 5.0 TL1

# **Operating Instructions**

English translation of German original

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

The copyright for these operating instructions is held solely by KACO new energy GmbH.



# **Operating Instructions**

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General information

# 1.1 About this document

### WARNING



#### Improper handling of the device can be hazardous!

> You must read and understand the operating instructions in order to install and use the device safely!

## 1.1.1 Other applicable documents

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

### 1.1.2 Storing the documents

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

## 1.1.3 English translation of German original

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

# 1.2 Layout of Instructions

### 1.2.1 Symbols used



General hazard

High voltage!

Risk of fire or explosion!

Risk of burns

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

symbol!

# 1.2.2 Safety warnings symbols guide



# A DANGER

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



## <u> W</u>ARNING

#### **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.

### 1.2.3 Additional information symbols



### NOTE

Useful information and notes

#### **EN** Country-specific function

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

### 1.2.4 Instructions symbols guide

#### Instructions

- Prerequisite(s) before carrying out the following step(s) (optional)
- 1. Carry out step.
- 2. (Additional steps, if applicable)
- » Result of the step(s) (optional)

# 1.3 Target group

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

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

# 2 Safety



#### DANGER

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

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

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

- > Keep the inverter closed when the unit is in operation.
- > 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 the standard IEC-60364-7-712:2002 "Requirements for special installations or locations – solar photovoltaic (PV) power supply systems".
- Ensure operational safety by providing proper grounding, conductor dimensioning and appropriate protection against short circuiting.



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

# 2.1 Proper use

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

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

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

# 2.2 Protection features

The following monitoring and protection functions are built-in:

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

# 2.3 Additional information



#### NOTE

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

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



# 3 Description

# 3.1 Mode of Operation

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

# 3.2 Diagram



Figure 1: Inverter diagram

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

## 3.2.1 Mechanical components

### DC isolator switch

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



#### 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).

Figure 2: DC isolator switch

# 3.2.2 Electrical functions

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



### Fault signal relay/priwatt

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

#### Priwatt

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

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

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

### 3.2.3 Interfaces

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

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

#### **Ethernet interface**

Monitoring can occur directly on the unit using the integrated Ethernet interface. A local web server is installed in the unit for this purpose.

For monitoring a system comprising several inverters, we recommend you use an external data logging and monitoring system.

#### **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 monitoring devices.

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

#### **USB interface**

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

#### "Inverter Off" input

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

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

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

#### S0 interface (optional)

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

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

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



# 3.2.4 SGI inverter as part of a PV system



*Figure 3: Circuit diagram of a system with two inverters* 

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



# 4 Technical Data

# 4.1 Electrical data

Product: KACO blueplanet	3.0 TL1 M1	3.0 TL1	3.5 TL1	3.7 TL1		
Input levels						
Recommended maximum DC power [kW]	3.6	3.6	4.15	4.4		
MPP@Pnom from [V] to [V]	280 510	140 510	165 510	170 510		
Operating range from [V] to [V]		125 .	550			
Starting voltage [V]*		15	50			
No-load voltage (U <sub>OC max</sub> ) [V]		600 (start to 550)				
Max. input current [A]	11	2 x 11	2 x 11	2 x 11		
Max. power per MPP tracker [W]	3100	3100	3600	3800		
Number of DC connections	1	2	2	2		
Number of MPP controls	1	2	2	2		
max. short-circuit current [A] (I <sub>SC max</sub> ) [A]		2	5			
max. input source feedback current [A]		(	)			
Polarity safeguard		Short-circ	cuit diode			
Output levels						
Rated power [VA]	3000	3000	3450	3680		
Grid voltage [V]	230 (1/N/PE)					
Rated current [A]	13.0	13.0	15.0	16.0		
Max. rated current [A]	14.5	14.5	16.6	17.7		
contribution to maximum peak current lp (îp)	27,0					
Short circuit current (Ik" First cycle RMS value)	20,2					
Start-up current [A]	1.61					
Rated frequency [Hz]		50				
cos phi		0.30 inductive	. 0.30 capacitive			
Number of feed-in phases		1				
Distortion factor (THD) [%]	1.42	1.42	0.79	0.79		
General electrical data						
Max. efficiency [%]	97.2	97.2	97.2	97.2		
European efficiency [%]	96.5	96.5	96.5	96.5		
Make current [A] [RMS (20 ms)]		1.3	82			
Power consumption: Night [W]		3	3			
Feed-in starts at [W]		2	0			
Circuit design	Transformerless					
Grid monitoring		Country	-specific			
Table 1: Electrical data						



Product: KACO blueplanet	4.0 TL1	4.6 TL1	5.0 TL1		
Input levels					
Recommended maximum DC power [kW]	4.8	5.5	6.0		
MPP@Pnom DC from [V] to [V]	185 510	215 510	235 510		
Operating range from [V] to [V]		125 550			
Starting voltage [V]*		150			
No-load voltage (U <sub>OC max</sub> ) [V]		600 (start to 550)			
Max. input current [A]		2 x 11			
Max. power per tracker [W]	4100	4700	5140		
Number of DC connections		2			
Number of MPP controls		2			
max. short-circuit current [A] (I <sub>SC max</sub> ) [A]		25			
max. input source feedback current [A]		0			
Polarity safeguard	Short-circuit diode				
Output levels					
Rated power [VA]	4000	4600	5000		
Grid voltage [V]	230 (1/N/PE)				
Rated current [A]	17.5	20.0	21.7		
Max. rated current [A]	19.5	22.0	22.0		
contribution to maximum peak current lp (îp)		27,0			
Short circuit current (Ik" First cycle RMS value)		20,2			
Start-up current [A]	1.61	1.64	1.64		
Rated frequency [Hz]		50			
cos phi	0.30 inductive 0.30 capacitive				
Number of feed-in phases		1			
Distortion factor [%]		0.79			
General electrical data					
Max. efficiency [%]	97.2	97.2	97.2		
European efficiency [%]	96.6	96.6	96.6		
Make current [A]		1.82			
Power consumption: Night [W]		3			
Feed-in starts at [W]		20			
Circuit design		Transformerless			
Grid monitoring		Country-specific			
Table 2: Electrical data					



# 4.2 Mechanical data

Product: KACO blueplanet	3.0 TL1 M1	3.0 TL1	3.5 TL1 - 5.0 TL1	
Display		Graphical LO	CD, 3 LEDs	
Controls		4-way button	+ 2 buttons	
Interfaces	2x Ethernet, USB, RS485 optional via additional module: S0, 4-DI, 4-D0			
Fault signal relay	Potent	ial-free NO cor	ntact, max. 30 V/1 A	
AC connection		5-pole co	nnector	
DC connections		SUNCLIX c	onnector	
Ambient temperature range [°C]	-25	. +60, power d	erating from +40	
Humidity range (non-condensing) [%]	0 95			
Maximum installation elevation [m above sea level]	2,000			
Temperature monitoring	Yes			
Cooling: free convection (K) / fan (L)	No far natural conv	n vection	Maintenance-free interior fan	
Protection rating according to EN 60529	IP54			
Degree of contamination	2			
Noise emission [dB(A)]	< 35			
DC isolator switch	Built-in		-in	
Housing	Plastic (ASA/PC), aluminium		C), aluminium	
H x W x D [mm]	560 x 367 x 227			
Total weight [kg]	15	16.5	18	
CE conformity		Ye	S	

Table 3: Mechanical data

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

# 4.3 Identification

#### Identifying the unit

- You will find the name plate with product-specific data for service and other requirements specific to installation on the right side panel of the inverter. This data includes:
- Product name
- Part no.
- Serial no.
- Date of manufacture
- Technical Data
- Disposal information
- Certification marking, CE marking.

KΟ	C O 🔊	KACO blu	eplanet 5.0 TL1 M2 WM OD II90	
KHOU S		Part number 1001393		
KACO ne	w energy	Serial number	0000000012345678 Year Q2 / 16	
Carl-Zeiss-Straß 74172 Neckarsul Made in Ge	en m armany			
	Vmax PV / Isc I	PV (max) / Inom F	PV 600 Vdc / 2x 13,2 A / 2x 11 A	
Input	V-MPP at Pnon	n / V- range	235 V - 510 V / 125 V - 550 V	
			230 V (1/N/PE)	
	Nominal voltage			
Outrast	ľ			
Output				
	Voltage range continuous operation		tion 166 Vac - 276 Vac	
Current (maximu		ium continous)	22 A	
	Frequency range		45 Hz - 65 Hz	
	Snom at 230 V Unom		5000 VA	
Output				
Power				
	Reactive nower	l cos nhi	0-95 % Snom 1 - 0.3 ind/can	
Environ-	Temperature ra	inge	-25°C+60°C/-13°F+140°F	
ment	Protection class / Ingress protection		tion 1/IP54	
ARC fault circuit protection NON				
Interface protection according to country specific requirements, details see manual				
No galvar	nic separation			

Figure 4: Name plate



# 5 Transportation and Delivery

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

# 5.1 Scope of delivery

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

#### **Checking your delivery**

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

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

# 5.2 Transportation

#### CAUTION

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

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

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



Figure 5: Transportation of the inverter

Table 4: Dimensions and weight



# 6 Mounting

## DANGER



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.



#### 

#### Risk of burns from hot housing components!

Risk of fatal injury from fire or explosions!

Coming into contact with the housing can cause burns.

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

# Installation location

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

# Wall surface

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



### NOTE

#### Access by maintenance personnel for service

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

### CAUTION

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

# The inverter housing can be severely damaged by gases (ammonia, sulphur, etc.) if it comes into

#### contact with ambient humidity caused by weather conditions.

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

- > Perform regular visual inspections.
- > Immediately remove any moisture from the housing.
- > Take care to ensure sufficient ventilation of the inverter.
- > Immediately remove dirt, especially on vents.
- Failure to observe these warnings may lead to inverter damage which is not covered by the KACO new energy GmbH manufacturer warranty.





Figure 6: Instructions for wall mounting

Figure 7: Inverter for outdoor installation

# CAUTION

### Use suitable mounting parts.

- > Use mounting material corresponding to or included with the base.
- > Mount the inverter upright on a vertical wall only.
- > For a free-standing mounting an incline of 20° is allowed.

# 6.1 Unpacking





Figure 9: Lifting the inverter

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





# CAUTION

#### Risk of injury if the body is overloaded.

- Lifting the device for transportation or to change location can lead to injuries (e.g. back injuries).
- > The unit should only be lifted using the openings provided or a transportation device.
- ightarrow The unit must be transported and installed by at least 2 persons.

#### Unpacking the unit

- ${\mathbb O}$   $\$  The unit is transported to the installation location.
- 1. Open carton at the front.

Æ

- 2. Remove installation material and documentation.
- 3. Pull up top protective packaging for removal.
- 4. Remove inverter from the packaging.
- 5. Place the protective packaging back into the carton.
- 6. Lift the inverter at the intended areas (see Figure 9).
- » Continue mounting the inverter.

# 6.2 Installing the unit



Figure 10: Minimum distances/mounting of inverter

ĸey	1		
1	Cover for the connection area	4	Wall plug (3x)
2	Screws for mounting (2x Torx)	5	Screws for mounting (x3)
3	Suspension brackets	6	Hole for securing the inverter

...



#### Installing the unit

- Mark the position of the upper boreholes on the wall in accordance with the dimensions in Fig. 8 or using the suspension brackets on the back of the housing.
   NOTE: Observe the minimum clearances between inverters (700 mm), or the inverter and the ceiling/floor (500 mm) as well as the side clearances (150 mm and 250 mm).
- 2. Fit wall plugs.
- 3. Screw in the top screws for assembly in accordance at the specified distance (3 mm) from the wall.
- 4. Suspend the inverters on the suspension brackets from the screws.
- 5. Unscrew and remove the fixing screws from the cover of the connection area.
- 6. Lower the cover of the connection area.
- 7. Variant 1: Mark the position of the bottom hole.
- 8. Remove the inverter and fit wall plug to secure the inverter.
- 9. Fit the inverters back onto the top screws and fasten to the wall using the bottom screw.
- 10. Variant 2: Remove the slider. (See Figure 13 on page 18)
- 11. Drill hole according to dowel size and mount on the wall by fastening screw.
- 12. Insert slider.
- 13. Fit the cover onto the housing.
- 14. Screw in the screws to fasten the cover.
- » The mounting of the inverter is complete. Continue with the installation.



# NOTE

#### Power reduction due to heat accumulation.

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

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

# 7 Electrical connection

#### 🚹 DANGER

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

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

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.



**EN** 

#### 7.1 **Preparing the AC connection**

#### 7.1.1 **Open connection area**



3

# **Open connection area**

1

○ You have mounted the inverter on the wall.

- 1. Switch the DC isolator switch to "0" in order to remove the slider.
- 2. Unscrew the fixing screws from the cover of the connection area.
- 3. Remove cover.
- 4. Pull slider off the housing.
- Survey the connection area. >>

#### Surveying the connection area 7.1.2



Figure 14: Connection area: Electrical connection

Key	Кеу		
1	DC isolator switch		
2	DC connector for PV generator		
3	AC device connector		



# 7.1.3 Configure AC connection plug



#### NOTE

If your grid operator or power supply company requests 3-phase power monitoring, a 3-phase (five-pin) power supply is required. The 3-phase monitoring must be also activated in the "Parameters" menu (see Chapter 8.3 on page 32). Before installation, ask your grid operator or power supply company about the necessary grid connection.



#### **Configure AC connection plug**

- Connection area opened.
- 1. Slide the cable fitting over the cable.
- 2. Select seal according to cable diameter used (8 ... 12 mm/ 12 ... 16 mm/ 16 ... 21 mm).
- 3. Slide the housing and seal over the cable.
- 4. Remove 50 mm of the outer cladding.
- 5. Shorten the wires N, L1 by 8 mm if a single-phase connection is present **or** shorten the wires N, L1, L2, L3 by the same length in case of a 3-phase connection.
- 6. Strip the wires (N, L1, **PE** in case of a single-phase connection **or** N, L1, L2, L3 in case of a 3-phase connection) by 12 mm.
- 7. Flexible wires must be fitted with wire sleeves in accordance with DIN 46228.
- 8. Insert wires into the contacts in accordance with the markings on the contact carrier.
- 9. Tighten the screws on the contact carrier with 1 Nm.



- EN
- 10. Press contact carriers into the housing with an audible "click".
- 11. Secure the housing with a screwdriver (size 30). Tighten the cable fitting using a torque of 6.5 Nm.
- » Make the electrical connection.



### NOTE

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

### 7.1.4 Cable and fuse requirements



# NOTE

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

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

		AC connection	<b>DC</b> connection	
Max. conductor cross-section without wire sleeves		2.5 - 6.0 mm <sup>2</sup>	2.5-6 mm <sup>2</sup> (DC plug connector)	
Max. conductor cross-section with wire sle	eeves	4.0 mm <sup>2</sup>	-	
Length of insulation to be stripped off		12 mm		
Tightening torque   1 Nm (on contact carrier)				
Table 5:         Recommended conductor cross-s	ection			
String fuses	max. 25	5 A internal, fuse size depends	s on connection	
Overvoltage conductor	Dvervoltage conductor Installed internally, Type III, 1 per MPP tracker			
Combiner box	Installed internally			
Protection class	3			
Overvoltage category	III			
Table 6: Recommended conductor cross-s	ection/protec	tion device		

### 7.1.5 Connection within the distribution system



#### NOTE

KACO new energy assumes no liability for damages and consequential damages arising from other connections in the distribution system.



Figure 21: 400/230 V connection for TN-C-S system and TN-S system



Figure 22: 400/230 V connection for TT system

# 400/230 V connection for TN-C-S system and TN-S system

- $\bigcirc$  Preconfigured AC connection plug.
- Connect the protective conductor to the contact with the earth symbol.
- The connection for feed-in and grid monitoring is single-phase via contact "1" and contact "N".
- » The inverter is now connected to the power grid.

# 7.2 Connection to the power grid

The power connection wires are connected on the right of the connection area (see Figure 14 on page 18).

#### Making the grid connection

- AC connector configured.
- 1. Connect the configured plug connectors to the device connector by fitting into place.
- 2. Lay the lead correctly and in accordance with the following rules:
  - Lines around the enclosure are installed with a distance of more than 20 cm
  - Do not lay line above or behind the cooling element.
  - Excessive bending force may negatively impact the protection rating. Lay the lead with a bending radius of at least 4 times the cable diameter.
- » The inverter is now connected to the power grid.



- Preconfigured AC connection plug.
- Connect the protective conductor "GND/PE" to a grounding point of the TT systems.
- The connection for feed-in and grid monitoring is single-phase via contact "1" and contact "N".
- » The inverter is now connected to the power grid.

Figure 23: Engage the AC connector with the device connector.

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

#### NOTE

If a residual current circuit breaker is necessary due to the installation specification, a type A residual current circuit breaker must be used. More information can be found in the "RCD compatibility" confirmation, in the "Download" section of our website.

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

#### NOTE

 $(\mathbf{i})$ 

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

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







EN 7.3

# 3 Preparing the DC connection

## 7.3.1 Configuring the DC plug connector





Figure 24: Insert wires

Figure 25: Slide insert into sleeve

Figure 26: Check fastening

#### Key

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

#### Configuring the DC plug connector

NOTE: Before proceeding with the isolation ensure that you don't cut any individual wires.

- 1. Isolate wire for DC connection by 15 mm.
- 2. Insert isolated wire with twisted ends carefully up to the end stop.
- **NOTE:** Wire ends must be visible in the spring.
- 3. Close the spring so that the spring latches.
- 4. Slide insert into sleeve.
- 5. Tighten cable fitting with the help of a 15 mm fork wrench applying a torque of 2 Nm.
- 6. Join insert with contact plug.
- 7. Check latch by lightly pulling on the coupling.
- » Make the electrical connection.



### NOTE

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

- > All mechanical loads must be absorbed in front of the plug connection.
- > Rigid adaptations are not permitted on DC plug connectors.

### 7.3.2 Checking the PV generator for a ground fault

### 🚹 DANGER

#### Danger to life from electric shock!



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

- > Only touch the PV generator cables on the insulation. Do not touch the exposed ends of the cables.
- > Avoid short circuits.
- > Do not connect any strings with a ground fault to the unit.





### Risk of fatal injury due to contact voltage!

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

#### Checking the PV generator for a ground fault

DANGER

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

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

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

6. Rectify any faults before connecting the DC generator.

## 7.3.3 Designing the PV generator

### NOTE

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

# 7.4 Connecting the PV generator

### DANGER

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

Injuries and damage to the unit may result if the connector is unplugged before disconnecting the inverter from the PV generator.

- > During installation: Electrically disconnect the DC positive and DC negative from the protective earth (PE).
- > Disconnect the inverter from the PV generator using the integrated DC isolator switch.
- > Remove the plug connector.

Connect the PV generator to the DC positive and the DC negative connectors beneath the housing (see Figure 27). The inverter detects these typical configurations automatically. In individual cases, you need to set the selected DC connection after installation in the menu.



Figure 27: Connections for DC positive and DC negative



Key			
А	MPP tracker A	В	MPP tracker B
1	DC plus/DC minus connection	2	DC plus/DC minus connection

### 7.4.1 Maximum generator power

### DANGER

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



### NOTE

The overall power of the unit continues to be limited. If one input is connected to more than P<sub>max</sub> per MPP tracker, the maximum input power of the second input is reduced.

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

# 7.4.2 Connection



Figure 28: Two generators each on one MPP tracker



Figure 29: One generator on 1st tracker, second tracker deactivated

1.) Two generators each on one MPP tracker	2.) One generator parallel on one tracker, 2nd tracker deactivated
The MPP voltages of the two DC lines can be different. They are tracked by separate, independently operating MPP trackers (MPP trackers A and B).	If one of the MPP trackers (A or B) is not used, then it must be short-circuited, otherwise faults can occur during the self-test of the unit and the feed-in operation is not guar- anteed. The short-circuiting of an MPP tracker does not result in the device being damaged.

#### **Electrical data**

 $I_{max}$  Depending on PV generator. The input current per  $\leq 2 * max$ . rated current (DC) tracker must not be exceed 11A.

#### 7.4.3 Connecting the PV generator

#### **DANGER**

#### Danger to life from electric shock!



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

- > Do not touch the exposed ends of the cables.
- > Avoid short circuits.

#### **Connecting the PV generator**

- 1. Remove protective caps from the DC connection plugs.
- 2. Connect PV generator to the DC plug connectors on the underside of the housing.
- 3. Ensure that the unused plug connectors are sealed with protective caps.
- » The inverter is connected to the PV generator.

# 7.5 Connecting the interfaces

All interfaces are located on the connection circuit board underneath the cover for the connection area. For connection, use the cable fittings and plug connections provided (see Figure 30 on page 25).



Figure 30: Connection area: Connection and assignment of the interfaces

Ke	у		
1	Interface connections / pin assignment	4	Slider
2	Cable anchoring rails with notches for strain relief and fastening the connection lines for the interfaces	5	DIP switch for terminating resistor R <sub>a</sub>
3	Connection line interfaces		

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### NOTE

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

### 7.5.1 Connecting the RS485 bus

#### NOTE



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

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



Figure 31: RS485 interface wiring diagram

Properties of the RS485 dat	ta line
Maximum length of the RS485 bus line	The maximum permitted length of the RS485 bus is 1200 m. This length can be reached only under optimum conditions. Cable lengths exceeding 500m generally require a repeater or a hub.
Maximum number of connected bus devices	30 inverters + 1 data monitoring unit
Data line	Twisted, shielded. Recommendations:
	LI2YCYv (twisted pair) black for laying cable outside and in the ground, $2 \times 2 \times 0.5$
	LI2YCY (twisted pair) grey for dry and damp indoor spaces, 2 x 2 x 0.5

#### **Connecting the RS485 bus**

- To prevent interference during data transmission:
- When connecting wire A (-) and wire B (+), observe the wire pairing (Figure 32)
- Do not lay RS485 bus lines in the vicinity of live DC/AC cables.
- 1. Unscrew the cable fitting.
- 2. Thread the connection cables through the cable fitting.
- 3. Connect the connection cables to the corresponding connection terminals (see Figure 30 on page 25).
- 4. Connect to all inverters and to the data monitoring device in this manner:
  - Wire A (-) to wire A (-)
  - Wire B (+) to wire B (+) and
  - GND with GND (see Figure 31 on page 26)
- 5. Tighten the cable fitting.
- 6. Activate the terminating resistor on the terminal unit. (See Figure 30 on page 25)



Figure 32: Assignment of twisted-pair wires

#### 7.5.2 Connecting the Ethernet interface



### NOTE

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

#### Connecting an Ethernet cable to the inverter

- 1. Place the line over a notch on the cable anchoring rails (see Figure 30 on page 25).
- 2. Attach cable ties around the line and notch and tighten gently.
- 3. Connect the connection cables to one of the corresponding Ethernet interface (see Figure 30 on page 25).
- 4. Relieve the stress on the line by pressing inwards and tighten the cable tie.

#### Connecting the inverter to the network

- U Connect the Ethernet cable to the inverter.
- U Configure the Ethernet interface in the configuration menu.
- Connect the Ethernet cable to the network or a computer.
- Configure the Ethernet settings and the web server in the Settings/Network menu.

## 7.5.3 Connecting the fault signal relay

The contact is designed as an N/O contact and is labelled "Relay" on the circuit board. Maximum contact load: 30 V / 1 A.

#### Connecting the fault signal relay

- 1. Place the line over a notch on the cable anchoring rails (see Figure 30 on page 25).
- 2. Attach cable ties around the line and notch and tighten gently.
- 3. Attach the connection cables to the terminal clamps.
- 4. Relieve the stress on the line by pressing inwards and tighten the cable tie.

## 7.5.4 Connecting "Inverter Off"



### NOTE

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

#### Connecting and activating "Inverter Off" digital input

- $\circlearrowright$   $\,$  Can only be used with suitable KACO inverters.
- 1. Place the line over a notch on the cable anchoring rails (see Figure 30 on page 25).
- 2. Attach cable ties around the line and notch and tighten gently.
- 3. Connect wire A (+) to the terminal marked "INV OFF+" on the first inverter via the "DO1" terminal of the Powador-protect.
- 4. Connect wire B (-) to the terminal marked "INV OFF-" 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. Relieve the stress on the line by pressing inwards and tighten the cable tie.
- 7. After commissioning: Activate the support for the Powador protect in the parameter menu under the "Powador-protect" menu item.



Figure 33: Powador-protect

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# 7.6 Sealing the connection area

- 1. Insert the slider (see Figure 30 on page 25).
- 2. Place the connection cover on the connection area of the inverter.
- 3. Screw in both Torx screws on the front side of the connection cover (blue).

# 7.7 Switching on the device

### DANGER



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

Severe injuries or death will occur when touching the cables and terminals in the inverter. Only appropriately qualified and authorised electricians may start up the inverter.

#### 



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

- > Do not touch the housing surface or heat sink during and immediately after operation.
- > Allow the device to cool down before touching the housing surface.



#### 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.



#### Switching on the device

- U The inverter has been mounted and electrically installed.
- U 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  $\rightarrow$  1).
- » The inverter begins to operate.
- » During initial start-up: Follow the instructions of the New Connection Wizard.



# 8 Configuration and Operation

# 8.1 Controls

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



Figure 34: Control panel

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

## 8.1.1 LED indicators

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



The LED indicators show the following operating status:

<b>Operating status</b>	LEDs		Display	Description
Start				The green "Operating" LED is illuminated
		$\mathbf{O}$		if an AC voltage is present,
				(independently of the DC voltage).
Feed-in start			Power fed into the grid	The green "Operating" LED is lit.
			or measured values	The green "Feed-in" LED is illuminated after the country-specific waiting period*.
		Π		The inverter is ready to feed in, i.e. is on the grid.
				You can hear the grid relay switch on.
Feed-in operation			Power fed into the grid	The green "Operating" LED is lit.
		$\mathbf{O}$	or measured values	The green "Feed-in" LED is illuminated.
		A		The "Feed-in" icon appears on the desktop.
		Ā		The inverter feeds into the grid.
* The waiting period e	nsures that	at all netw	ork parameters are in the	permissible ranges.



Operating status	LEDs		Display	Description
Non-feed-in opera- tion		Q	Status message	The display shows the corresponding mes- sage.
		Ā		
Fault			Fault message	The display shows the corresponding mes- sage.
				The red "Fault" LED is illuminated.

# 8.1.2 Graphical display

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



#### Figure 35: Desktop

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

After being switched on and after initial commissioning is complete, the inverter displays the start screen (the desktop). If you are in the menu and do not touch the control buttons for 2 minutes, the inverter returns to the desktop. For initial commissioning, see section 8.2 on page 32

#### NOTE

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



### NOTE

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

#### 8.1.3 **Control buttons**

○ The inverter is operating.

» The main menu opens.

○ The LCD is showing the desktop.

Press the right arrow button.

**Opening the menu** 

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

# Displaying the daily output ○ The inverter is operating. ○ The LCD is showing the desktop. Press the down arrow button. » The LCD displays the daily yield in a diagram. To return to the desktop, press any button. Inverter menu Navigating through the menu U You have left the desktop. The inverter displays the menu. Use the up and down arrow buttons. Opening a menu item or a setting Use the right arrow button and the Enter button. Jump to the next higher menu level/discard changes Press the left arrow button or the ESC button. **Opening the parameter menu** Press the up arrow key and down arrow key simultaneously for 5 seconds. Changing a parameter/the value of an input field Use the up and down arrow buttons. Saving changed settings Press the Enter button.



	2	7	
ſ	Δ	Δ	
J	7	7	
[	ESC		









Δ

⊲ Δ ESC





Δ

EN







# 8.2 Initial start-up

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



### NOTE

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



#### NOTE

The DC and AC power supply must be guaranteed during configuration. The sequence of the settings required for initial start-up is preset in the configuration assistant.

#### Navigation

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

#### **Initial configuration**

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

# 8.3 Menu structure

### 8.3.1 Display on the LCD



Figure 36: Main menu

Key
-----

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



### 8.3.2 Menu structure

NOTE



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

Icons used:						
1 2 3 4	<sup>3</sup> Menu level (0, 1, 2, 3)	L	Submenu available			
0	Display menu	EN	Country-specific setting			
	Option menu FR-HTA Country and grid type-specific setting					
	Password protected menu (password can be requested from KACO Service)					

Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
	Desktop	Desktop	L,	Press the right arrow button.
	0-1-2-3	"Measurements" menu	╘	<ul> <li>Open the menu: Press the right arrow button or the Enter button.</li> </ul>
	1 2 3 4	Generator	٢	Displays the DC-side voltage, amperage and power.
	1-2-3-4	Grid	٢	Displays the AC-side voltage, amperage and power.
	1-2-3-4	Power control	0	Displays the current value of the external power limitation by the grid operator.
	1-2-3-4	cos-phi	0	Indicates the status of the reactive power control.
	1 2 3 4	Unit temperature	0	Displays the temperature in the inverter housing.
	1 2 3 4	<sup>4</sup> Yield counter	$\bigcirc$	Displays the yield in kWh.
				Reset the counter using the "Reset" key.
All countries	1-2-3-4	Yield today	0	Displays the cumulative yield for the current day.
	1-2-3-4	Total yield		Displays the total yield up to now.
	1-2-3-4	CO2 savings	0	Displays the calculated CO <sub>2</sub> savings (in kg).
	1-2-3-4	On an han anta	$\bigcirc$	Displays the duration of operation in hours.
		Oper. hrs chtr		Reset the counter using the "Reset" key.
	1-2-3-4	Oper. time today		Displays the duration of operation on today's date.
	1-2-3-4	Total oper. time		Displays the total operating time.
	1-2-3-4	Log data display		<ul> <li>Open the menu: Press the right arrow button or the Enter button.</li> </ul>
	1121314		L.	<ul> <li>Measurement data can be transferred to a USB stick by selecting it and moving it.</li> </ul>



EN	Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
	All countries	0-1-2-3	Day display		<ul> <li>Displays the recorded operating data graphically.</li> <li>1. Select the measured value to be displayed.</li> <li>Supported measured values: <ul> <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> </li> <li>2. Select a day.</li> <li>3. Press the Enter button.</li> <li>The display shows the selected data.</li> <li>Press any button to return to the previous menu.</li> </ul>
		0-1-2-3	Month display		<ul> <li>Displays the recorded operating data graphically.</li> <li>Select a month.</li> <li>Press the Enter button.</li> <li>The display shows the selected data.</li> <li>Press any button to return to the previous menu.</li> </ul>
		0-1-2-3	Year display		<ul> <li>Displays the recorded operating data graphically.</li> <li>Select a year.</li> <li>Press the Enter button.</li> <li>The display shows the selected data.</li> <li>Press any button to return to the previous menu.</li> </ul>
		0-1-2-3	CSV log data	↦	Open the menu: Press the right arrow button or the Enter button.
		0-1-2-3	Decimal separator		<ul> <li>Select decimal sign for export of saved operating data.</li> </ul>
		011213	Save to USB	•••	<ul> <li>In this menu, you can export the saved operating data to a connected USB flash storage device.</li> <li>Vou have connected a USB flash storage device to the inverter.</li> <li>Select the data to be exported (year, month or day).</li> <li>Press the Enter button.</li> <li>The inverter writes the data to a connected USB flash storage device.</li> </ul>
		0 1 2 3	"Settings" menu	╘	<ul> <li>Open the menu: Press the right arrow button or the Enter button.</li> </ul>
		0-1-2-3	Language		Select the desired language for the user interface.
		0 1 2 3	Def. total yield		<ul> <li>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.</li> <li>Select the "Save" button and confirm with the Enter button.</li> </ul>



Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
	0 1 2 3	Interface		Assign a unique RS485 bus address to the inverter ("RS485 address" menu item). The address must not be the same as that of any other inverter or a proLOG unit.
	0 1 2 3	Priwatt	L.	<ul> <li>Open the menu: Press the right arrow button or the Enter button.</li> <li>Select operating mode.</li> </ul>
All countries	0-1-2-3	Activation mode		<ul> <li>Activate function for a cycle.</li> <li><b>NOTE:</b> Re-activation depends on the operating mode selected and on the activation conditions.</li> </ul>
	0-1-2-3	Monitoring time		Set time span during which the power threshold must be exceeded without interruption.
	0-1-2-3	Power threshold		Set power threshold from which the monitoring time up to activation begins.
	0-1-2-3	Operation mode		<ul> <li>Power-dependent: the function remains active until below the set power threshold.</li> <li>Time-dependent: The function is active depending</li> </ul>
	0-1-2-3	Operation time		<ul> <li>NOTE: The menu option is only available in the "Time-dependent" operation mode.</li> <li>After connection, the function is active for the set operating time.</li> </ul>
	0-1-2-3	Quick start	00	Reduce the waiting time during the self-test by press- ing the "Activate" key.
	0-1-2-3	Logging interval	00	<ul> <li>Specify the time period between 2 log data record- ings.</li> </ul>
	0 1 2 3	Log data backup		The inverter supports the backing up of all recorded yield data to a connected USB storage device.
	0-11-2-3	Display	0	<ul> <li>Configure the contrast setting for the display.</li> <li>Set the length of time without user input after which the backlighting of the LCD switches off.</li> <li>Alternatively: Permanently activate or deactivate the backlighting by selecting "On" or "Off".</li> </ul>
	0 1 2 3	Date & time	000	<ul> <li>Set the date and time.</li> <li>NOTE: For self-diagnostic purposes, the inverter carries out a daily restart at midnight. To avoid having a restart occur during feed-in operation and to always obtain reliable log data, ensure that the time is correctly set.</li> </ul>
	0-1-2-3	Network	L	Open the menu: Press the right arrow button or the Enter button.



EN	Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
		0-1-2-3	DHCP		<ul> <li>Activate or deactivate DHCP.</li> <li>On: Activate DHCP. Once the DHCP server becomes available, the IP address, subnet mask, gateway and DNS server are automatically applied and the aforementioned menu items are hidden.</li> <li>Off: DHCP deactivated, make settings manually.</li> </ul>
					NOTE: The "IP address", "Subnet masks", "Gateway" and "DNS server" menu options are only displayed with the DHCP deactivated.
			IP address		Allocate a unique IPv4 address in the network.
		0-1-2-3	Subnet mask		<ul> <li>Allocate a network mask.</li> </ul>
	All countries		Gateway	-	Enter IPv4 address of gateway.
			DNS server		Enter IPv4 address of DNS server.
		0-1-2-3	Web server		<ul> <li>Activate or deactivate the integrated web server.</li> <li>Set the port at which the web server can be reached.</li> </ul>
		0-1-2-3	Powador-web		<ul> <li>On: The inverter attempts to connect to the Pow- ador-web web portal.</li> <li>Off. The segmention to Deve demusch is deertiseted.</li> </ul>
		0-1-2-3	Modbus TCP		<ul> <li>Off: The connection to Powador web is deactivated.</li> <li>Activate/deactivate function.</li> <li>Set network port.</li> </ul>
		0-1-2-3	Connection status		Indicates the status of the network connection.
		0-1-2-3	"Parameters" menu	Ļ	<ul> <li>Press the right arrow button or the Enter button.</li> <li><b>NOTE:</b> The inverter does not display the "Parameters" menu in the standard configuration. To display the Parameters menu:</li> <li>1. Open the menu.</li> <li>2. Simultaneously hold down the up and down buttons for several seconds.</li> </ul>
		0 1 2 3	Country		<ol> <li>Enter the four-digit password using the 4-way button. The password is unit-specific.</li> <li>Confirm the entry with the Enter button.</li> <li>Set the desired country setting.</li> <li><b>NOTE:</b> This option influences the country-specific operating settings of the inverter. Please consult KACO service for further information.</li> </ol>
	DE, CH, FR, GB GR. IT	0-1-2-3	Grid type/guide- line		Select the grid type for the inverter's installation location.
	IT		Activate self-test		It is only possible to activate the self-test in feed-in mode. The voltage and frequency dependent shutdown limits are checked in the process.



Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning	
AT, AU, BE, DE, CH, FR , GB, GR, IT, IL, JO, NL, UD, CY, TW	0-1-2-3	Grid monitoring		Offers the option of activating or deactivating three- phase grid monitoring. Switching the grid monitoring on or off.	
AT, GB, JO	0 1 2 3	Protection param- eters		<ul> <li>Display of 2-phase protection parameters.</li> <li>To show the protection parameters, select the "Display" key.</li> </ul>	
AU, GR, NL	0-1-2-3	Voltage shutdowns		<ul> <li>The inverter is equipped with redundant 3-phase monitoring. If the grid frequency exceeds or drops below the configured values, the inverter switches off. The minimum switch-off threshold can be set in 1 V increments.</li> <li>Configure the switch-off values for undervoltage and overvoltage.</li> <li>Where necessary, set period from occurrence of the fault to shutdown of the inverter.</li> </ul>	
AU, FR, GR, IL	0-1-2-3	Frequency shut- downs		<ul> <li>The inverter continuously monitors the grid frequency.</li> <li>If the grid frequency exceeds or drops below the configured values, the inverter switches off.</li> <li>Set limit values for underfrequency and overfrequency in 0.1 Hz increments.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>	
DE, CH, BE, FR, IT, AT, CY, UD	0-1-2-3	Overvoltage shut- down		<ul> <li>Activate or deactivate password protection. (optional)</li> <li>Specify the shutdown threshold for overvoltage shutdown. The 10-minute average for the measured voltage as per EN50160 is used.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>	
GB, IL, IT, AT, UD	0-1-2-3	Overvoltage shut- down	00	<ul> <li>Specify the shutdown threshold for fast and slow overvoltage trip-off.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>	
GB, IL, IT, AT, UD	0-1-2-3	Undervoltage shutdown	00	<ul> <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>	
FR, UD	0-1-2-3	Voltage drop		<ul> <li>The voltage drop between the inverter and the feed-in meter is added to the limit value that was set for grid shutdown according to EN 50160. The limit value can be set from 0-11 V in 1 V increments.</li> <li>Specify the switch-off value for the voltage drop (0-11 V).</li> </ul>	



Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
GB59/3, IT, IL, AT, UD	0-1-2-3	Overfrequency shutdown	00	Set limit value for overfrequency shutdown.
·	0-1-2-3	Underfrequency shutdown		Set limit value for the underfrequency shutdown.
IL, IT, AT, UD	0-1-2-3	Activation condition		<ul> <li>The inverter checks mains voltage and frequency. The grid feed operation begins if the measured values are within the set ranges.</li> <li>Set minimum and maximum values for the switching on.</li> </ul>
DE, BE, GB, IL, IT, JO, AT, CY, UD	0-1-2-3	Connect time		Set period for grid observation (in seconds) when switching on and reconnection after a fault.
ZA, UD	1-2-3-4	Power reduction P(f)	00	<ul> <li>Activates the power reduction with selection of an operating mode P(f)</li> <li>For selected mode OFF, 1 or 2 enter P(f) thresholds and gradient.</li> </ul>
IL, IT, UD	0-1-2-3	P(f) Gradient		Set gradient of power limit function with increasing frequency in % / Hz. This percentage relates to the nominal frequency of 50 Hz.
	0 1 2 3	P(f) thresholds		Set the frequency thresholds for activating and deac- tivating the power limitation in Hz.
DE, CH, AU, BE, FR, GB, GR, IL, IT, JO, NL, AT, CY, UD, TW	0-1-2-3	DC starting volt.		The inverter begins feed-in as soon as this DC voltage is present. <ul> <li>Set the starting voltage.</li> </ul>
DE, CH, AU, BE, FR, GB, GR, IL, IT, JO, NL, AT, CY, UD, TW	0+1+2+3	Constant volt. control		<ul> <li>Lets you deactivate the MPP seek mode in order to operate the inverter with a constant DC voltage.</li> <li>Activate or deactivate function.</li> <li>Set value for constant voltage control (125 - 510 V).</li> <li><b>NOTE:</b> For voltages below the minimal MPP voltage the possible input power is reduced. The input current is limited here to 11A per input.</li> </ul>



Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
				The output power of the inverter can be set permanently to a lower value than the maximum output power by the internal power limiting.
				This may be necessary in order to limit the maximum power rating of the system at the grid connection point, upon the grid operator's request.
				The value can be protected from the very first output lim- itation entry. After setting a limitation, the value can only be changed by entering a device-specific password.
				The output power can be regulated using via an external power limitation using an extension module and remote control periphery from the grid operator.
DE, CH, AU,			_	Internal:
GR, IL IT IO	0-1-2-3	Power		1. Activate password protection if necessary.
NL, AT, CY,		limitation		2. Specify the activation status.
UD, TW				3. Specify the limit value for maximum feed-in power.
				4. Confirm the entry with the Enter button.
				External (only possible with additional module LP383):
				1. Specify activation status (on/off)
				<ol> <li>Select the activation threshold (Active Low / Active High) from digital input 1, 2, 3 or 4 (only if activation status = on)</li> </ol>
				<ul> <li>3. Specify the power limitation levels (only if activation status = on)</li> <li>a.) Specify levels 0-3 b.) Specify levels 4-7</li> <li>c.) Specify levels 8-11 d.) Specify levels 12-15</li> </ul>
				Configures the support for grid shutdown by a Powador protect connected to the digital input of the inverter.
DE, CH, AU,		Powador-protect		<ul> <li>For Auto/On: A Powador protect is operating in the photovoltaic system and is connected to the inverter at the digital input/output.</li> </ul>
GR, IL, IT, JO,	0-1-2-3			Auto: The inverter automatically detects a Pow- ador-protect integrated into the photovoltaic system.
UD, TW				On: The digital signal of the Powador protect must be present to the digital input of the inverter for the inverter to start with feed-in.
				Off: The inverter does not check whether a Pow- ador-protect is integrated into the PV system.
DE, CH, AU, BE, FR, GB, GR, IL, IT, JO, NL, AT, CY, UD	0-1-2-3	Insulation resist- ance		Set threshold value (in 1 kOhm steps) at which the insulation monitor reports a fault.



Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
DE, CH, BE,	0-1-2-3	Reactive power	Ļ	<ul> <li>Open the menu: Press the right arrow button or the Enter button.</li> <li>Activating idle power process: select process and press Enter. The active process is highlighted.</li> </ul>
AT, CY, UD	0-1-2-3	cos-phi specifica- tion		<ul> <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>
DE, CH, BE, GB, IL, IT, JO, AT, CY, UD	0 1 2 3	cos-phi(P/Pn)	Ļ	Open the menu: Press the right arrow button or the Enter button.
GB, IL, IT, PL, JO, AT, UD	0 1 2 3	Q const.		<ul> <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>
CH, GB, IT, JO,	0 1 2 3	Lock-in voltage		Voltage range set as % of rated voltage, where the
CY	0-1-2-3	Lock-out voltage		network support process is active.
DE, CH, BE, GB, PL, IL, IT,	0-1-2-3	Number of support points		<ul> <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>
JO, AT, CY, UD	0-1-2-3	1., 2Support point		<ul> <li>Specify the power factor for the 1st, 2nd (etc.) support point</li> <li>If a power factor not equal to 0 is selected: Select the type of phase shift (under-excited/over-excited).</li> </ul>
	0 1 2 3	Q(U) 5 Supports	L	Open the menu: Press the right arrow button or the Enter button.
	0-1-2-3	Lock-in power		Power range set as % of rated power, in which the
CH, GB, IT, PL	0 1 2 3	Lock-out power		network support process is active.
JO, AT, UD	0-1-2-3	Time constant		Set the response speed of the control.
	0-1-2-3	Number of support points		Specify the number of support points for the idle power characteristic curve.
	0-1-2-3	1., 2Support point		Specify the support points for voltage, power and nature of the phase shift.



F	N

Coun- try-spec. setting	Menu level	Display/ setting		Action in this menu/meaning
	0-1-2-3	Q(U) 2-point	╘	Open the menu: Press the right arrow button or the Enter button.
CH, GB, IT, JO, UD	0-1-2-3	Lock-in power		Power range set as % of rated power, in which the
	0-1-2-3	Lock-out power		network support process is active.
	0-1-2-3	Time constant		Set the response speed of the control.
	0-1-2-3	14. Support point		Specify the support points for voltage, power and nature of the phase shift.
				Display of grid faults.
CY,TW	0-1-2-3	Line error		To show the last 5 grid fault messages, select the "Display" key.
		Protection param-		Display of essential protection parameters.
DE-Nsp, DK	0 - 1 - 2 - 3	eters		To show the protection parameters, select the "Dis- play" key.
ІТ	0-1-2-3	SPI		Provides the option of activating or configuring the specific "System Protection Interface" for Italian. (Expansion module required!)
	0-1-2-3	"Information" menu		Open the menu: Press the right arrow button or the Enter button.
				Displays the type designation of the inverter.
	0-1-2-3	Inv. type 💿		If feed-in power is actively limited: display maximum power in kW.
All countries	0 1 2 3	SW version	٢	Displays the installed software versions.
	0-1-2-3	Serial no.		Displays the serial number of the inverter.
	0-1-2-3	Display country	٢	Displays the selected country setting. Optional: Displays the grid type if a grid type has been selected.
	0-1-2-3	"Manufacturer" menu	L,	The display shows information about the unit manufac- turer.

# 8.4 Monitor inverter

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

You can display the recorded data using:

• The integrated LCD

• The integrated web server using an Internet-capable device connected to the Ethernet interface of the inverter You can read the recorded data using a storage medium connected to the USB interface of the inverter, e.g. a USB stick.



## 8.4.1 USB interface

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

#### Reading log data



EN

### NOTE

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

#### **Reading data**

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

### 8.4.2 Web server

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

#### Setting up the web server

#### **Configuring the Ethernet interface**

- $\circlearrowright$  You have connected the inverter to your network.
- 1. Open the Settings/Ethernet menu.
- 2. Assign a unique IP address.
- 3. Assign a subnet mask.
- 4. Assign a gateway.
- 5. Save your settings.

#### Using the web server

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



### NOTE

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

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



#### Calling up the web server

- $\bigcirc$  Configure the Ethernet interface.
- $\bigcirc$  Connect the Ethernet interface.
- 1. Open an Internet browser.
- 2. In the address field of the Internet browser, enter the IP address of the inverter and open the site.
- » The Internet browser displays the start screen of the web server.

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

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

Grid voltage

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

#### Select the display period

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

#### Filtering display data (daily view only)

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

#### **Exporting data**

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



#### NOTE

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

# 8.5 Performing the software update

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



#### NOTE

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



### CAUTION

#### Damage to the inverter

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

- » Never disconnect the DC and AC power supply during a software update.
- » Do not remove the USB stick during a software update.

#### Preparing for the software update

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



# NOTE

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

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

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

#### Performing the software update

- Prepare for the software update.
- 1. Connect the USB stick to the inverter.
- » The message "Software found. Would you like to load it?" appears on the display.
- 2. If you would like to perform the update, select the "Yes" button. In the case of "No", pressing the "Enter" button stops the update process and the unit goes into feed-in mode.
- » The inverter begins the update.
  - The update has been imported in full once the message "Software update successful" appears.
  - The update has failed if the message "Software update incomplete" appears.
- 3. When a fault occurs, the update process must be repeated.

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

#### Displaying the software version

- Open the Information / Software Version menu.
- » The inverter will display the versions and checksums of the software that is currently loaded.

# 9 Maintenance/Troubleshooting

# 9.1 Visual inspection

NOTE

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



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



# 9.2 Cleaning the housing

#### DANGER



#### Lethal voltages in the inverter!

- Serious injuries or death can result if moisture enters the system.
- > Only use completely dry objects to clean the inverter.
- > Only the exterior of the inverter should be cleaned.

#### **Cleaning the inverter**

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

# 9.3 Shutting down for maintenance and troubleshooting

#### DANGER

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

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

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



- 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 touch the exposed ends of the cables.
- > Avoid short circuits.
- > Do not open the inverter until these two steps are complete.
- > After shutdown, wait at least 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 is carried out in the correct order.

#### Shutting down the inverter

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

#### DANGER! The DC cables are still live!

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

 $\wedge$ 



# 9.4 Disconnecting connections

### 9.4.1 Disconnect AC connection plug

# DANGER



### Danger to life from electric shock!

- Never disconnect the connection plug and 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 37: Disconnect the AC connection plug from the device connector

Figure 38: Disconnect AC connection plug

Figure 39: Unfasten the cable

#### **Disconnect AC connection plug**

- Ensure there is no AC/DC voltage present.
- 1. Use a screwdriver (blade with 3.5mm) to press the tab on the housing downwards.
- 2. Unlock the plug connection.
- 3. Unscrew the cable fitting.
- 4. Use a screwdriver to unlock the contact carrier on both sides.
- 5. Remove the contact carrier from the housing.
- 6. Unfasten and remove the screws on the contact carrier.

### 9.4.2 Disconnect DC connector



Figure 40: Disconnect connector

Figure 41: Unfasten DC cable

Key			
1	Screwdriver	3	Insert



#### 2 Latch

#### 4 Sleeve

#### **Disconnect DC plug connection**

- Ensure there is no AC/DC voltage present.
- 1. Use a screwdriver (blade width 3 mm) to push down the latch on the coupling.
- 2. Leave the screwdriver in place.
- 3. Separate socket with plug.

#### **Unfasten DC cable**

- 4. Unscrew cable fitting.
- 5. Insert screwdriver on the side (see Figure 41 on page 46).
- 6. Pry open connection and pull apart sleeve with insert.
- 7. Open spring with the screwdriver.
- 8. Remove wires.

# 9.5 Faults

### 9.5.1 Procedure



#### DANGER

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

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

- When a fault occurs, notify an appropriately authorised and qualified electrician or KACO new energy GmbH Service.
- The operator can only carry out actions marked with a B.
- ☞ In case of power failure, wait for the system to automatically restart.
- Notify your electrician if there is an extended power failure.

### 9.5.2 Rectifying a fault

#### **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	Possible cause	Explanation/remedy	Ву
The display is blank and the LEDs do	Grid voltage not available	Check whether the DC and AC voltages are within the per- mitted limits (see Technical Data).	E
not light up		Notify KACO Service.	E
The inverter stops feeding into the grid shortly after	Faulty grid sepa- ration relay in the inverter.	If the grid separation relay is defective, the inverter will rec- ognise this during the self-test.	
being switched on, even though there		Ensure that there is sufficient PV generator power.	Е
is sunlight present.		<ul> <li>If the grid separation relay is defective, have it replaced by KACO Service.</li> <li>Notify KACO Service.</li> </ul>	К



Fault	Possible cause	Explanation/remedy	Ву
The inverter is active but is not feeding into the	Grid-feed is inter- rupted due to a grid fault.	Due to a grid fault (grid impedance too high, over/undervolt- age, over/underfrequency), the inverter stopped the feed-in process and disconnected from the grid for safety reasons.	
grid. The display indicates a line failure.		Change the line parameters within the permitted operat- ing limits (see the "Start-Up" section).	E
The grid fuse trips.	The grid fuse capac- ity is too low.	In case of a high level of solar radiation, the inverter exceeds its rated current for a short period, depending on the PV generator.	
		<ul> <li>Select the capacity of the inverter's pre-fuse to be some- what higher than the maximum feed-in current (see the "Installation" section).</li> </ul>	E
		<ul> <li>Contact the grid operator if the grid failure continues to occur.</li> </ul>	E
The grid fuse trips.	Damage to the inverter's hardware.	If the grid fuse trips immediately when the inverter goes into feed-in mode (after the start-up period is complete), the inverter's hardware is probably damaged.	
		Contact KACO Service to test the hardware.	E
The inverter dis- plays an impos- sible daily peak	Faults in the grid.	The inverter continues to operate as normal without losses to the yield, even when an erroneous daily peak value is dis- played. The value is reset overnight.	
value.		To reset the value immediately, switch the inverter off by disconnecting it from the grid and switching off the DC, then switch it back on.	E
Daily yields do not correspond to the yields on the feed-in meter.	Tolerances of the measuring elements in the inverter.	The measuring elements of the inverter have been selected to ensure maximum yields. Due to these tolerances, the daily yields shown may deviate from the values on the feed-in meter by up to 15%.	
		No action	-
The inverter is active but is not	<ul> <li>Generator voltage too low</li> </ul>	<ul> <li>The PV generator voltage or power is not sufficient for feed-in (solar radiation is too low).</li> </ul>	
feeding into the grid. Display: "Wait- ing for feed-in"	<ul> <li>Grid voltage or PV generator voltage unstable.</li> </ul>	<ul> <li>The inverter checks the grid parameters before the feed-in process begins. The length of time it takes to switch back on again differs from country to country, depending on applicable standards and regulations, and may be several minutes.</li> </ul>	
		The starting voltage may have been set incorrectly.	
		Adjust starting voltage in the Parameter menu if required.	E
In spite of high radiation levels, the inverter does ot feed the max-	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.	
the grid.		<ul><li>Ensure sufficient cooling of the unit.</li><li>Do not cover the cooling fins.</li></ul>	B, E



Fault	Possible cause	Explanation/remedy	Ву
Noise emission from the inverter.	Particular ambient conditions.	When there are certain ambient conditions, the units may emit audible noises.	
		<ul> <li>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.</li> </ul>	
		<ul> <li>In cases of volatile weather conditions (frequent switch- ing between sunny and cloudy conditions) or strong solar radiation, a light hum may be audible due to the increased power.</li> </ul>	
		<ul> <li>Under particular grid conditions, resonances may form between the unit's input filter and the grid; these may be audible even when the inverter is switched off.</li> </ul>	
		These noise emissions do not affect the operation of the inverter. They do not lead to loss of performance, failure, damage or to a shortening of the unit's service life.	
		People with very sensitive hearing (particularly children) are able to hear the high-frequency hum caused by the inverter's operating frequency of approximately 17 kHz.	
		So action	

#### Table 7: Troubleshooting

# 9.6 "Fault" messages on the display/LED

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

### 9.6.1 Display of status and fault messages

Display	Fault LED (red)		
FS (fault status)		ON	<ul><li>Fault signal relay has switched.</li><li>Feed-in was ended due to a fault.</li></ul>
OS (operating status)	$^{\circ}$	OFF	<ul> <li>The fault signal relay releases again.</li> <li>The inverter feeds back into the grid again after a country-specific time period.</li> </ul>

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.

### 9.6.2 Status and fault signals

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

- BS = operating status, FS = fault status;
- **B** = Action of the operator

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

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

Status	Display	Å		Explanation	Action
<b>OS</b> 1	Waiting for feed-in	0	0	Self-test: The grid parameters and generator voltage are being checked.	
Table 8:	Operating status and fau	lt me	ssage	es on the display	



Stat	tus	Display	Å	$\triangle$	Explanation	Action
OS	2	Generator voltage too low	0	0	Generator voltage and power are too low; situation before transition into night shutdown.	
OS	8	Self-test	0	0	Checks the shutdown of the power electronics as well as the grid relay before feed-in mode.	
FS	10	Temperature in unit too high	0	۲	In case of overheating, the inverter switches off. Possible causes:	<ul><li>Cool off the area around the inverter.</li></ul>
					<ul> <li>Excessively high ambient temper- ature,</li> <li>Fan covered,</li> <li>Invortor defective</li> </ul>	<ul> <li>Uncover the fans.</li> <li>Notify your authorised electrician!</li> </ul>
OS	11	Measured values	۲	0	Power limitation: If the generator power itself to the maximum power (e.g. arou ity is too large).	er is too high, the inverter limits nd noon if the generator capac-
FS	17	Shutting down Powador-protect	0	۲	The activated grid and system pro- tection has been tripped.	<ul> <li>Wait for reactivation. E</li> <li>Notify your authorised electrician if the fault occurs several times!</li> </ul>
FS	18	Resid. current shutdown	0	۲	Residual current was detected. The feed-in was interrupted.	Notify your author- E ised electrician!
FS	19	Insulation fault generator	0	۲	There is an insulation fault on the PV generator. The feed-in was inter-rupted.	Notify your author- ised electrician if the fault occurs several times!
FS	21	Protective shutdown PV current 1	0	۲	DC current has exceeded the permis- sible maximum value on PV1 or PV2. A shutdown is carried out to protect	<ul> <li>PV generator may be over-dimen- sioned</li> </ul>
FS	22	Protective shutdown PV current 2	0	۲	the device.	
FS	29	DC side ground fault	0	۲	A ground fault was detected on the DC side.	Check the PV gen- erator after ground fault.
FS	32	Fault Self-test	0	۲	The internal grid separation relay test has failed.	Notify your author- ised electrician if the fault occurs several times!
FS	33	Fault DC feed-in	0	۲	The DC feed-in has exceeded the per- mitted value. This DC feed-in can be caused by grid conditions and may not necessarily indicate a fault.	Notify your author- ised electrician if the fault occurs several times.
FS	35	Protection shutdown SW	0		Protective shutdown of the software (AC overvoltage, AC overcur- rent, DC link overvoltage, DC over- voltage, DC overtemperature).	Not a fault! Grid-related shutdown, the grid connects again automatically.
FS	37	Unknown hardware	0	۲	Device does not detect expansion hardware.	<ul> <li>Additional hardware faulty or not original KACO accessories!</li> </ul>

Table 8: Operating status and fault messages on the display



Stat	tus	Display	Å	⚠	Explanation	Ac	tion	
FS	38	Generator overvolt- age error	0		The voltage of the DC generator is too high. The PV generator is config-ured incorrectly.	G	Notify your author- ised electrician!	E
FS	41 42	Line failure: Under voltage L1, Over voltage L1,	0	۲	The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed.	G	Notify your author- ised electrician!	E
	43 44	Undervoltage L2, Overvoltage L2,						
	45 46	Under voltage L3, Over voltage L3						
FS	47	Grid failure phase-to- phase voltage	0	۲	The measured line-to-line voltage is outside of the tolerance limits.	G	Notify your author- ised electrician.	E
FS	48	Line failure Underfrequency	0	۲	Grid frequency is too low. This fault may be grid-related.	G	Notify your author- ised electrician!	E
FS	49	Line failure Overfrequency	0	۲	Grid frequency is too high. This fault may be grid-related.	Y	Notify your author- ised electrician!	E
FS	50	Line failure Average voltage	0	۲	The grid voltage measurement according to EN 50160 has exceeded the maximum permitted limit value. This fault may be grid-related.	G	Notify your author- ised electrician!	E
FS	51 53	Grid failure: average voltage L1 / L2	0	۲	String voltage L1 / L2 is above the set maximum permissible string voltage	G	Notify your author- ised electrician!	E
FS	52 54	Grid failure: mid-undervoltage L1 / L2	0	۲	String voltage L1 / L2 is below the set maximum permissible string voltage	G	Notify your author- ised electrician!	E
FS	57	Waiting for reactivation	0	۲	Waiting time of the inverter after a fault.	lnv ag tim	verter does not switch o ain until the country-sp ne has elapsed.	on Decific
FS	58	Overtemperature Control card	0	۲	The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware.	G	Provide for sufficient ventilation.	E
OS	60	Generator voltage too high	0	۲	The inverter does not begin feeding into the grid until the PV voltage falls below a specified value.	-		-
OS	61	External limit (%)	*	0	The external limit <i>Power control</i> was ac inverter limits its power.	tiva	ted by the grid operato	or. The
OS	63	Measured values	۲	0	P(f)/frequency-dependent power redu power reduction will be activated when tion of Energy and Water Industries) Ma into effect. Power reduction starts at a	n th ediu freq	n: Frequency-depende e BDEW (German Assoc m Voltage Directive go uency of 50.2 Hz.	nt cia- es
OS	64	Measured values	۲	0	Output current limiting: The AC current maximum value has been reached.	t is l	imited once the specifi	ed
FS	70	Fan error	۲	0	The fan is malfunctioning.	Ŀ	Replace defective fan.	E
Tabl	e 8:	Operating status and fault messages on the display						



Stat	tus	Display	Å	⚠	Explanation	Ac	tion	
OS	74	External idle power requirement	*	0	The grid operator limits the feed-in power of the inverter.	-		-
FS	78	Resid. current shut- down (AFI)	0	۲	The integrated AC/DC-sensitive residual current device registered an non-permissibly high leakage current going to PE.	G	In case of repeated occurrence: Notify your author- ised electrician!	E
OS	79	Insulation measure- ment	0	0	PV generator's insulation is being measured	-		-
FS	81, 82, 83	Protection shutdown line volt. L1, L2, L3	0	۲	Overvoltage has been detected on a conductor. An internal protective mechanism has disconnected the device to protect it against damage.	G	In case of repeated occurrence: Notify your author- ised electrician!	E
FS	84	Protection shutdown undervolt. DC link	0	۲	A voltage deviation has been found in the DC link. An internal protective	G	In case of repeated occurrence:	E
FS	85	Protect. shutdown overvolt. DC link	0	۲	device to protect it against damage.		ised electrician!	E
FS	87	Protect. shutdown overcurrent L1	0	۲	A current that has been found on a conductor is too high. An internal protective mechanism has dis- connected the device to protect it against damage.	Y	In case of repeated occurrence: Notify your author- ised electrician!	E
FS	97	Protection shutdown overcurrent HW	0	۲	Too much power has been fed into the grid. Complete disconnection of the device.	G	Notify authorised electrician / KACO Service!	E/K
FS	100	Protect. shutdown HW overheating	0	۲	The device has been switched off because the temperatures in the housing were too high.	6	Check to make sure that the fans are working. Replace fan if nec- essary.	B E
FS	101 to 106	Temperature plausi- bility error, efficiency, DC link, AFI module, relay, DC/DC con- verter	0	۲	The unit has shut down because of implausible internal measured values.	G	Notify KACO Service!	К
FS	125	AC relay error relay control	0	۲	Release signal for the relay control is fed back. The shutdown is carried out if the level is incorrect.	G	Notify KACO Service!	К
FS	131 132	Arc detected on DC1 / DC2	0	۲	Arc or other external influences generate an interference spectrum. Possible cause: Incorrect connectors, faulty cables or modules.	G	Check the system Error reset possible via menu option.	E B
FS	134	AFCI power supply	0		Supply voltage of the AFCI is outside	G	Notify KACO Service!	Κ

Table 8:Operating status and fault messages on the display

EN



# 10 Service

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

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

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

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

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

Service hotline	Technical troubleshooting	Technical consultation			
Inverter	+49 (0) 7132/3818-660	+49 (0) 7132/3818-660			
Data logging and accessories	+49 (0) 7132/3818-690	+49 (0) 7132/3818-690			
Customer Service	Monday to Friday 08:00 a.m 12:00 p.m. (CET) and 1:00 p.m 5:00 p.m				

# 11 Shutdown/Disassembly

# 11.1 Switching off the unit

### 🚹 DANGER

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



Severe injuries or death will occur when touching the cables and terminals in the inverter. When there is solar radiation, DC voltage will be present at the open ends of the DC cables. Arcing may occur if the DC cables are disconnected while they are still live.

- > It is absolutely essential that the shutdown sequence be carried out in the correct order.
- > After shutdown, wait at least 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 on the generator junction box at all poles (or the DC plug connectors). Disconnecting the grid voltage is not enough.





## DANGER

#### Destruction of the DC plug connectors

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

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

DANGER! The DC cables are still live!

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

# 11.2 Uninstalling the device

- $\cup$   $\;$  Inverter disconnected and secured against restart.
- 1. Open the connection area.

- 2. Remove the interface cable.
- 3. Detach DC connection plug.
- 4. Detach AC connection plug.
- 5. Unfasten cable ties.
- 6. Pull out the cables.
- » The inverter is uninstalled. Proceed with disassembly.

# 11.3 Disassembling the unit

- $\circlearrowright$   $% \ensuremath{\mathbb{C}}$  Inverter has been switched off and uninstalled.
- 1. Unfasten the screw securing the inverter.
- 2. Remove the inverter from the mounting screws.
- 3. Securely pack up the inverter if it is to be used later or dispose of the inverter in line with regulations.

# 11.4 Packaging the unit

- $\circlearrowright$   $% \left( {{\mathbb{C}}} \right)$  The inverter is uninstalled.
- 1. If possible, always pack the inverter in the original packaging. If this is no longer available, an alternative is to use equivalent packaging.
- 2. You must be able to close the box completely and it must be able to accommodate the weight and size of the inverter.

# 11.5 Storing the unit

- $\circlearrowright$  The inverter is packed.
- Store the inverter in a dry place, in accordance with the ambient temperature range

# 12 Disposal

# CAUTION



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

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

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

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

# 13 Appendix

# 13.1 EU Declaration of Conformity

Manufacturer's name	KACO new energy GmbH
and address	Carl-Zeiss-Strasse 1
	74172 Neckarsulm, Germany
Product description	Photovoltaic feed-in inverter
Type designation	KACO blueplanet 3.0 TL1 / KACO blueplanet 3.5 TL1
	KACO blueplanet 3.7 TL1 / KACO blueplanet 4.0 TL1
	KACO blueplanet 4.6 TL1 / KACO blueplanet 5.0 TL1

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

The units conform to the following standards:

<b>2014/35/EU</b> "Directive relating to electrical equipment designed for use within certain voltage limits"	Safety of the unit IEC 62109-1:2010 IEC 62109-2:2011
2014/30/EU	Interference immunity
"Directive relating to electromagnetic	EN 61000-6-1:2007
compatibility"	EN 61000-6-2:2005
	Emitted interference EN 61000-6-3:2007 + A1:2011 Secondary effects on the grid
	EN 61000-3-2:2006* + A1:2009 + A2:2009
	EN 61000-3-3:2008*
	EN 61000-3-11:2000**
	EN 61000-3-12:2011**
	* valid for device types with a nominal current ≤16 A ** valid for device types with a nominal current ≥16 A

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

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

Neckarsulm, 20/04/2016 KACO new energy GmbH

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

