



**K A C O**   
new energy.

**Powador**

**36.0 TL3 M1 | 39.0 TL3 M1**

## Operating Instructions

- English translation of German original



# Operating Instructions

## Contents

<b>1</b>	<b>General information .....</b>	<b>4</b>	<b>8</b>	<b>Configuration and Operation.....</b>	<b>27</b>
1.1	About this document.....	4	8.1	Controls.....	27
1.2	Layout of Instructions.....	4	8.2	Initial start-up .....	30
<b>2</b>	<b>Safety .....</b>	<b>5</b>	8.3	Menu structure.....	30
2.1	Proper use.....	6	8.4	Monitor inverter.....	39
2.2	Protection features .....	6	8.5	Performing a software update .....	41
2.3	Trademark.....	6	<b>9</b>	<b>Maintenance/Troubleshooting .....</b>	<b>42</b>
2.4	Additional information.....	6	9.1	Visual inspection.....	42
<b>3</b>	<b>Description .....</b>	<b>7</b>	9.2	External cleaning.....	42
3.1	Mode of Operation .....	7	9.3	Shutting down for maintenance and troubleshooting .....	42
<b>4</b>	<b>Technical Data .....</b>	<b>10</b>	9.4	Faults.....	43
4.1	Electrical Data.....	10	9.5	"Fault" messages on the display/LED.....	45
4.2	Mechanical data.....	11	<b>10</b>	<b>Service.....</b>	<b>49</b>
<b>5</b>	<b>Preparation.....</b>	<b>12</b>	<b>11</b>	<b>Shutdown/Disassembly.....</b>	<b>50</b>
5.1	Delivery.....	12	11.1	Shutting down the inverter .....	50
5.2	Unpacking the inverter .....	12	11.2	Uninstalling the inverter.....	50
5.3	Transporting the inverter .....	13	11.3	Dismantling the inverter.....	51
<b>6</b>	<b>Mounting the inverter .....</b>	<b>14</b>	<b>12</b>	<b>Disposal .....</b>	<b>51</b>
6.1	Installing and securing the inverter .....	16	<b>13</b>	<b>Appendix .....</b>	<b>52</b>
<b>7</b>	<b>Installing the inverter .....</b>	<b>17</b>	13.1	EU Declaration of Conformity.....	52
7.1	Opening the connection area.....	17			
7.2	Lay the electrical lines .....	18			
7.3	Making the electrical connection.....	18			
7.4	Connecting the interfaces.....	22			
7.5	Sealing the connection area .....	26			
7.6	Starting up the inverter.....	26			

# 1 General information

## 1.1 About this document

 **WARNING**



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

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

### 1.1.1 Other applicable documents

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

### 1.1.2 Storing the documents

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

## 1.2 Layout of Instructions

### 1.2.1 Symbols used



General hazard



Risk of fire or explosion



High voltage



Risk of burns

 **Authorized electrician**

Only authorised electricians are permitted to carry out tasks indicated with this symbol.

### 1.2.2 Safety warnings symbols guide

 **DANGER**



**High risk**

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

 **WARNING**



**Potential risk**

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

 **CAUTION**



**Low-risk hazard**

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

**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

#### 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 for the step
- 1. Carry out step.
- 2. (Additional steps, if applicable)
- » Results of the step

## 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 result if the cables and terminals in the inverter are touched.

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

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

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

- Keep unauthorised persons away from the inverter and PV system.
- Pay particular attention to 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.
- 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 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 device 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 potentially explosive atmospheres,
- Use in rooms where the humidity is higher than 95%,
- Use in outdoor areas if the inverter is exposed to direct sunlight, rain or a storm,
- Use less than 100 m distant from the coast,
- Operation outside the specifications intended by the manufacturer,
- Islanding operation.

## 2.2 Protection features

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

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

## 2.3 Trademark

The software of the inverter uses the MD5 Message Digest algorithm of RSA Data Security, Inc.

## 2.4 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 feed-in process begins when there is sufficient sunlight and a specific minimum voltage is present in the inverter. If, as nightfall approaches, the voltage drops below the minimum voltage value, feed-in mode ends and the inverter switches off.

#### 3.1.1 Inverter diagram

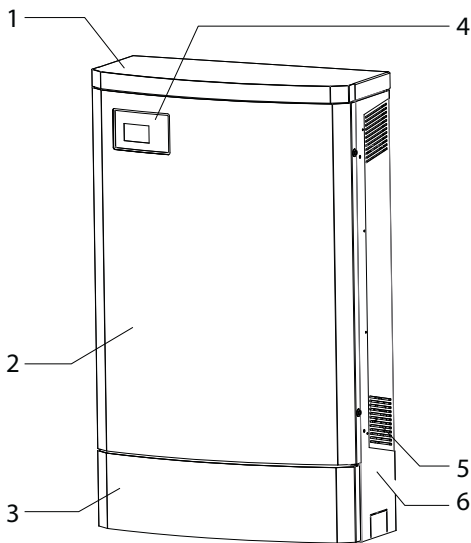


Figure 1: Inverter diagram

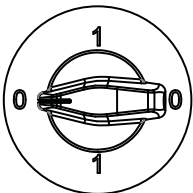
#### Key

1	Upper housing cover	4	Control panel
2	Doors	5	Fan cover
3	Cover for the connection area	6	Side housing cover

#### 3.1.2 Mechanical components

##### DC isolator switch

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



##### Disconnecting the inverter from the PV generator

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

##### Connecting the inverter to the PV generator

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

### 3.1.3 Interfaces

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

- RS485 interface
- Ethernet interface
- USB interface
- S0 interface

You configure the interfaces and the web server in the Settings menu (see section 8.3 on page 30).

#### 3.1.3.1 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:

#### 3.1.3.2 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.

#### 3.1.3.3 USB interface

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

#### 3.1.3.4 S0 interface

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



#### NOTE

The S0 interface sends a specific number of pulses per kilowatt-hour output.

The number of pulses per kilowatt-hour output that can be sent by the S0 interface depends on the maximum feed-in power of the inverter and can be set in the menu.

36.0-39.0 TL3	500 or 1000 pulses/kWh
---------------	------------------------

#### 3.1.3.5 Digital input "inverter off"

If Powador protect is installed as a central grid and system protection, the fail-safe disconnection of suitable Powador inverters from the public grid can be initiated by a digital signal instead of tie circuit-breakers. This requires the inverters in the photovoltaic system to be connected to the Powador protect. For information on the installation and use see this manual, the Powador protect manual and the instructions for use of the Powador protect on the KACO web site.



### 3.1.4 Inverter as part of a PV system

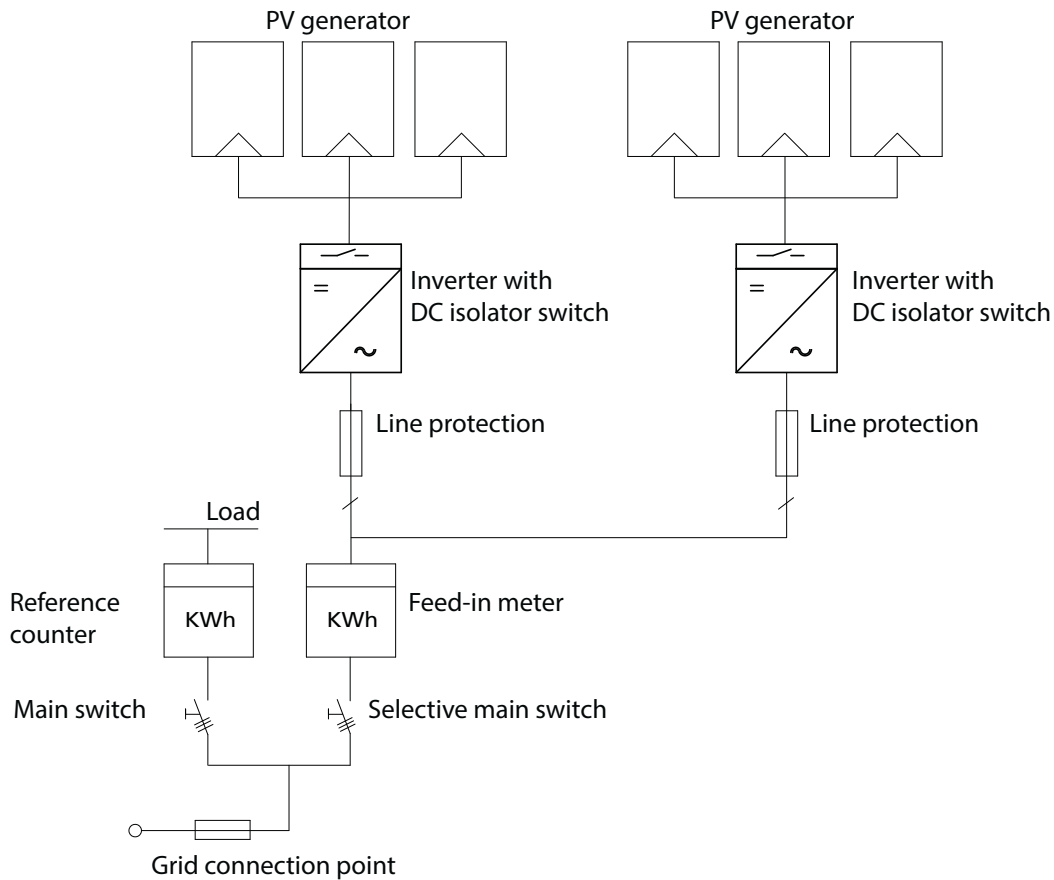


Figure 2: Circuit diagram of a system with two inverters

#### 3.1.4.1 Summary of the components

##### PV generator

The PV generator converts sunlight radiation into electrical energy.

##### DC terminal point

Options for parallel connections of several generator strings:

- To a DC terminal point between the DC generator and inverter
- Directly to the PV generator with a positive and negative lead to the inverter

##### DC isolator switch

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

##### Grid fuses

Use only specific PV rated fuses.

##### Feed-in meter

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

##### Selective main switch

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

## 4 Technical Data

### 4.1 Electrical Data

Input levels	36.0 TL3 M1	39.0 TL3 M1
DC MPP range from [V] to [V]	200 ... 300* ... 800	200 ... 350* ... 800
Starting voltage [V]**		250
Open circuit voltage [V]		1,000
Rated current max. [A]		102
Max. power of the tracker [W]	36,000	39,000
Number of strings		1
Number of MPP trackers		1
Polarity safeguard	Short-circuit diode	
Output levels		
Rated power [VA]	30,000	33,300
Grid voltage [V]		230 / 400
Rated current [A]	3 x 43.5	3 x 48.3
Rated frequency [Hz]		50 / 60
cos phi	0.80 inductive to 0.80 capacitive	
Number of feed-in phases		3
Distortion factor [%]		< 3
General electrical data		
Max. efficiency [%]		98.0
European efficiency [%]		97.8
Make current [A] / ON duration [ms]		98 / 4.4
Internal consumption: standby [W]		< 30
Internal consumption: night [W]		~1.5
Feed-in starts at [W]		120
Circuit design	Transformerless	
Grid monitoring	Country-specific	
Overvoltage protection	Built-in	
CE conformity	Yes	

Table 1: Electrical data

\*At DC voltages below this MPP range the maximum rated current reduces the maximum input power.

\*\*For PV generators with MPP voltages below the MPP range of the inverter: set the start voltage in the menu.

## 4.2 Mechanical data

<b>36.0-39.0 TL3 M1</b>	
Display	Graphical LCD, 3 LEDs
Controls	4-way button, 2 buttons
Interfaces	Ethernet, USB, RS485, S0, Digital output "Inverter off"
Fault signal relay	Potential-free NO contact, 30 V / 1 A
AC connection terminals	Screw terminals inside the unit min. cross section: 16 mm <sup>2</sup> rigid/flexible max. cross-section: 50 mm <sup>2</sup> rigid/flexible
AC cable connection	Cable connection via M50 cable fitting
DC connection terminals	Connection terminals directly at the DC isolator switch 70 mm <sup>2</sup> with M8 ring cable lug
Connections for DC cable connection	Cable connection via 2 M40 cable fittings
Connection for Ethernet cable connection	Cable connection via M25 cable fitting
Ambient temperature range [°C]	-20 ... 60
Maximum installation elevation (m above mean sea level)	2000
Temperature monitoring	Yes
Cooling (free convection (K)/fan (L))	L
Protection rating according to EN 60529	IP54
Degree of contamination	PD2
DC isolator switch	Built-in
Housing	Steel plating
H x W x D [mm]	1360 x 840 x 355
Total weight [kg]	<b>151</b>

Table 2: Mechanical data

## 5 Preparation

### 5.1 Delivery

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

### 5.2 Unpacking the inverter

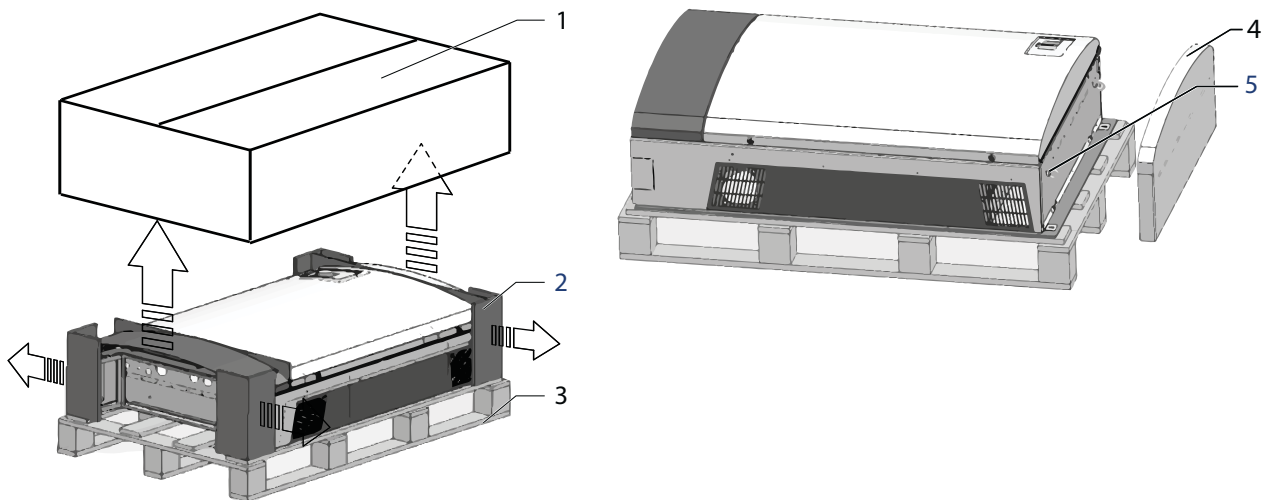


Figure 3: Unpack inverter/ transport device

#### Key

1	Cardboard box cover	4	Cover
2	Protective corners	5	Eyebolts
3	Pallet		

#### Unpacking

1. Loosen packaging tape from cardboard box.
2. Lift down the cardboard box cover.
3. Remove protective corners.
4. Remove the cover.

#### 5.2.1 Scope of delivery

- Inverter
- Housing covers: Cover plates right and left, cover
- Installation kit
- Documentation

#### 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 six days following receipt of the inverter. We will be glad to help you if necessary.

## 5.3 Transporting the inverter

### **WARNING**



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

- › Pack the inverter securely for transport.
- › Carefully transport the inverter using the built-in eyebolts!

### **CAUTION**



#### **Risk of injury if the inverter tips over!**

Risk of tipping due to high centre of gravity, particularly with the housing doors open.

- › Anchor the inverter securely to the ground immediately after positioning it and, if possible, fasten it to the wall.
- › Do not open the housing doors until the inverter has been securely anchored.

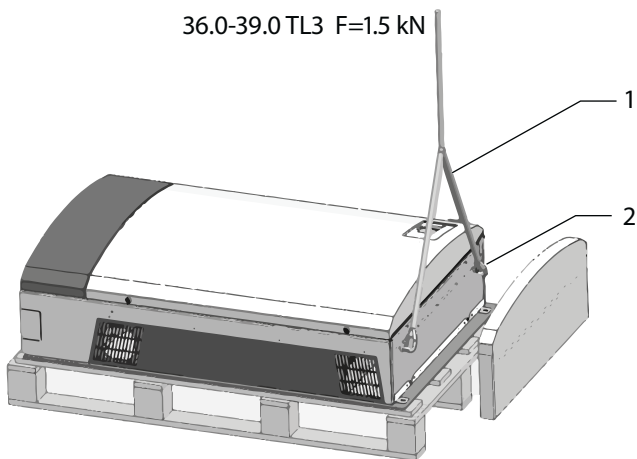


Figure 4: Transport device

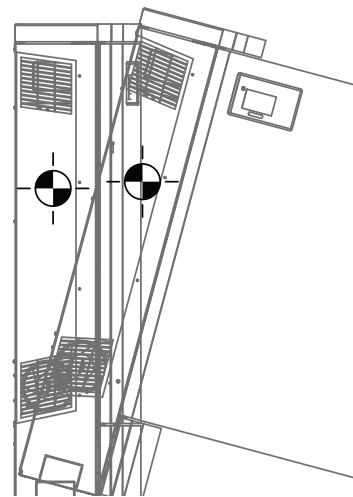


Figure 5: Transportation of the inverter

#### **Key**

1	Shackle	3	Centre of gravity
2	Transportation rope		

#### **Lifting up**

1. Heave the eyebolts for the hoist.
  2. Connect the shackles to the eyebolts.
  3. Hang the transportation rope through the shackle.
  4. Attach a transportation rope to a stable hoist. (> 2 kN)
  5. Lift the inverter.
  6. Transport the inverter to the place of assembly (keep an eye on the centre of gravity!)
- » Mount the inverter.

## 6 Mounting the inverter



### DANGER



#### Risk of fatal injury from fire or explosions

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

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

### Installation space

- 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
- Close to the ground, accessible from the front and sides without requiring additional resources
- Protected on all sides against heavy rain and direct sunlight (thermal heating) in outdoor areas. Implementation where necessary via constructional measures, e.g. wind breaks.
- For easy operation, ensure during installation that the display is slightly below eye level.

### Floor and wall

- With sufficient load-bearing capacity
- Accessible for installation and maintenance
- Made from heat-resistant material (up to 90 °C),
- Flame resistant
- Minimum clearance during installation: Figure 6 on page 15.



### 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.

 **Authorised electrician**

**EN**



**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.

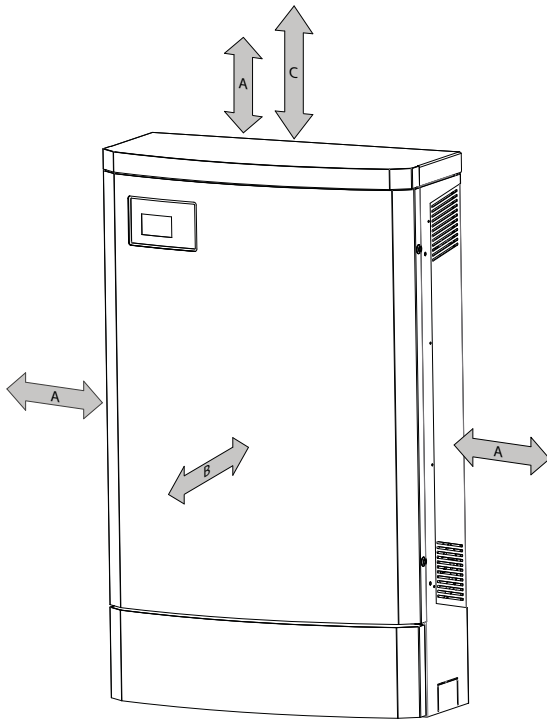


Figure 6: Minimum clearances

**Key**

A	horizontal distance between the two inverters / vertical distance between inverter and the ceiling	50 cm
B	Distance in front	100 cm
C	Vertical distance to an additional inverter suitable for wall mounting	70 cm

**CAUTION**

**Use suitable mounting parts.**

- › Use only the supplied mounting parts.
- › Only install inverter in an upright position.
- › For wall mounting: Mount the inverter on a vertical wall only.
- › For upright installation outdoors: Weather-proof base required

 **Authorised electrician**

EN

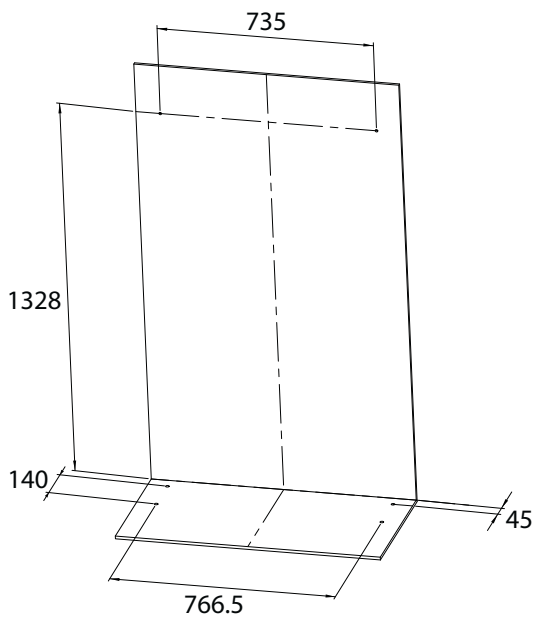


Figure 7: Drilling separation (in mm)

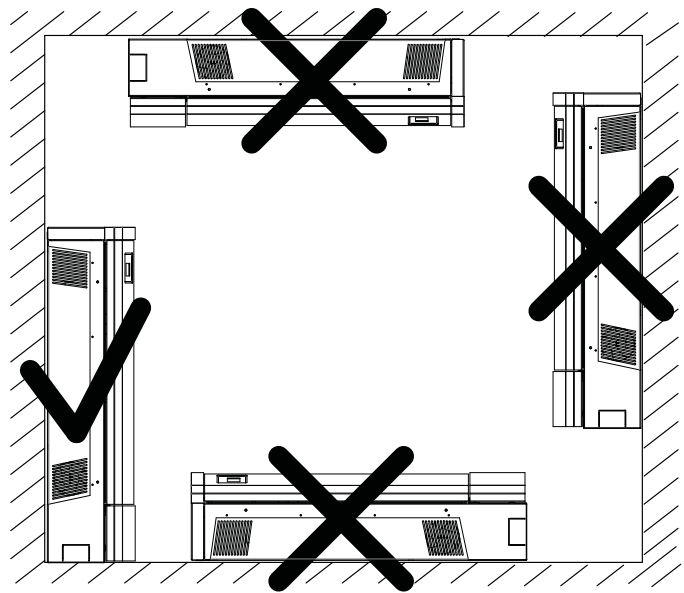


Figure 8: Instructions for wall mounting

## 6.1 Installing and securing the inverter

### Drilling the holes

1. Mark (4x) drill holes on bottom.
  2. For wall mounting: Mark the position of the holes on the wall (2x) and insert the wall anchors in the wall for additional security.
  3. Drill the holes. Floor: 12 mm diameter, wall: 9 mm diameter.
- » Install and secure the inverter.

### Securing the inverter

1. Position the inverter above the drill holes.
  2. Use the four anchoring bolts to secure the inverter to the floor.
  3. For installations at a wall: secure the inverter to the wall with two screws.
- » Install the housing.

### 6.1.1 Installing the housing

#### Removing the EMC sheet metal

1. Unscrew the 4 M4 x 10 screws from the EMC sheet metal.
  2. Remove and store the EMC sheet metal.
- » Install the hood.

#### Installing the hood

- ⊖ Remove the EMC sheet metal.
1. Place the hood on the top side of the housing.
  2. Secure the hood to the inverter housing from the inside using the enclosed fastening screws.
- » Install the side housing covers.



**⚠️ Authorised electrician****Installing the side housing covers**

- ⤷ Remove the EMC sheet metal.
- 1. Place the left housing cover on the inverter housing.
- 2. Secure the left housing cover to the inverter housing from the inside using the 2 enclosed M4 x 10 screws.
- 3. Place the right housing cover on the inverter housing.
- 4. Secure the right housing cover to the inverter housing from the inside using the 2 enclosed M4 x 10 screws with a Torx T30 screw driver.
- » Place the EMC sheet metal on the housing.

**Placing the EMC sheet metal on the housing**

- 1. Place the EMC sheet metal on the inverter housing.
- 2. Secure the EMC sheet metal to the inverter housing using the enclosed 25 M4 x 10 screws.
- » The mounting of the inverter is complete.
- » Continue with the installation.

## 7 Installing the inverter

**⚠️ DANGER**

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

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

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

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

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



### 7.1 Opening the connection area

**Opening the connection area**

- ⤷ You have completed assembly.
- 1. Unlock the two door locks with the control cabinet key.
- 2. Open the doors.
- 3. Remove the cover of the connection area.
- » Make the electrical connection.

**⚠️ Authorised electrician**

## 7.2 Lay the electrical lines

The pre-punched perforations on the side-mounted housing base enable all electrical lines to be inserted properly in the interior of the inverter.

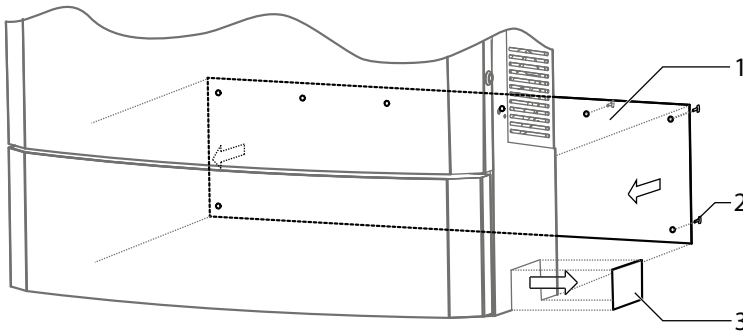


Figure 9: Perforation on the housing base /rear plinth panel

### Key

1	Plinth panel (optional)	3	Pre-punched perforation (for cable duct [72 x 110 mm])
2	Fixing screw (8x) (optional)		



### NOTE

If the device is going to be installed outdoors, we recommend that an additional plinth panel is fitted in the socket area at the back end of the housing. (accessory item from KACO new energy)

## 7.3 Making the electrical connection

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

	AC connection	DC connection
Max. conductor cross-section	50 mm <sup>2</sup>	-
Max. conductor cross-section with appropriate cable shoe	-	70 mm <sup>2</sup> with M8 ring cable lug
Tightening torque	4-4.5 Nm	15-22 Nm
Length of insulation to be stripped off	24 mm	25 mm

<b>String fuses</b>	To be provided externally on-site
<b>Overvoltage conductor</b>	Integrated type 2 surge protection
<b>Combiner box</b>	To be provided externally on-site
<b>Overvoltage safety class</b>	DC: III, AC: III
<b>Overvoltage category</b>	DC: II, AC: III
<b>DC connection terminals</b>	1

**⚠️ Authorised electrician**

### 7.3.1 Connecting the inverter to the power grid

The power connection wires are connected to the AC terminal on the left of the connection area (see Figure 10).

**⚠️ DANGER**



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

- Severe injury or death will result if the live connections are touched.
- › Switch off all power sources to the inverter before you insert the grid power cable into the unit.
- › Isolate before carrying out work on the public power supply and the system power supply.

**Prepare the grid connection**

- Use 5 core cable (L1 brown, L2 black, L3 grey, N blue, PE green/yellow) or 4 core cable (L1 brown, L2 black, L3 grey, PE green/yellow).
1. Loosen cable fitting for AC connection.
  2. Remove the outer cladding of the AC cables.
  3. Insert the AC cables through the cable fitting into the connection area.
  4. Strip the insulation from the AC cables.
  5. Making the grid connection

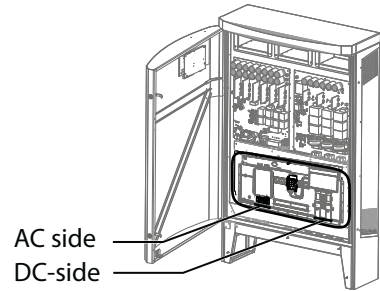


Figure 10: Connection terminals

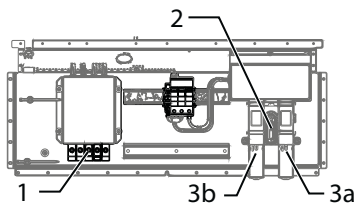


Figure 11: Powador 36.0-39.0 TL3 M1

**Key**

1	AC connection terminals	3	DC connection terminals
		3a)	Connection terminal (DC+)
		3b)	Connection terminal (DC-)
2	DC isolator switch		

**Recommended conductor cross-sections and fuse protection of NYM cables for fixed wiring according to VDE 0100 part 430**

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

Equipment types	Conductor cross-section	Fuse protection: gL safety fuses
Powador 36.0 - 39.0 TL3 M1	16 mm <sup>2</sup>	63 A for 16 mm <sup>2</sup> conductor cross-section

Table 3: Recommended conductor cross-sections and fuse protection of NYM cables



**NOTE**

When selecting installation material, please consider the suitability of the product to the mains voltage (36.0-39.0 TL3 M1, 230/400 V).

**⚠️ Authorised electrician**

EN



**NOTE**

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

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

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



**NOTE**

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

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

**Make the grid connection (5 core connection, TN-S system)**

6. Connect the cables in accordance with the label on the PCB terminals (Figure 12 on page 20).
  7. Connect terminal "PE" to the equipotential bonding of your lightning protection system using a 16 mm<sup>2</sup> wire.
  8. Check that all connected cables are securely fitted.
  9. Tighten the cable fitting.
- » The inverter is now connected to the power grid.

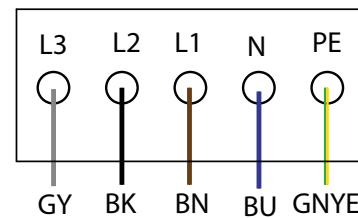


Figure 12: 5-core connection

**Make the grid connection (4 core connection, TN-S system)**

1. Fit the PE terminal (not supplied) to the hat rail. Note the cable cross-sections.
  2. Connect the cables in accordance with the label on the PCB terminals (Figure 13 on page 20).
  3. Check that all connected cables are securely fitted.
  4. Tighten the cable fitting.
- » The inverter is now connected to the power grid.

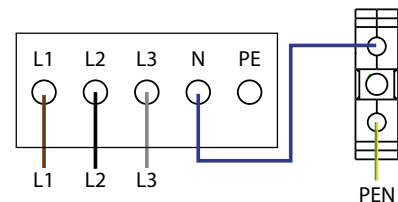


Figure 13: 4-core connection

**7.3.2 Connecting the PV generator**

Connect the PV generator on the right of the connection area (see Figure 10 on page 19). Use the provided cable fittings.

**⚠️ DANGER**

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



- › During installation: Electrically disconnect the DC positive and DC negative from the protective earth (PE).
- Removing the plug connection without first disconnecting the inverter from the PV generator may lead to injuries and damage the inverter.
- › Disconnect the inverter from the PV generator using the integrated DC isolator switch.
  - › Remove the plug connector.



**NOTE**

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

**⚠️ Authorised electrician**
**7.3.2.1 Before connecting**
**Ensure that there is no ground fault**

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

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

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

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

4. Rectify any faults before connecting the DC generator.


**NOTE**

The threshold value from which the insulation monitor reports a fault can be set in the "Parameter" menu.

**7.3.2.2 Connecting the PV generator**

**DANGER**

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

Severe injury or death will result if the live connections are touched. When there is 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 the outer cladding of the DC cables.
2. Route the DC cables into the connection area.
3. Strip the insulation from the DC cables.
4. Attach ring cable lug (M8) to DC cables.
5. Attach the DC cables to the DC terminals with a tightening torque of 10 Nm each string (+/-) and the following fasteners:
  - Screw with nut (M8)
  - Lock washer (under screw head)
  - Tensioner (under nut)
6. Check that all connected cables are securely fitted.
  - » The inverter is connected to the PV generator.

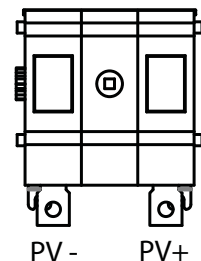



Figure 14: PV connection

**⚠️ Authorised electrician**

### 7.3.3 Grounding the housing

The housing in the connection area of the inverter can be grounded. While doing this, please observe the national installation regulations.

If necessary, ground the housing from the intended grounding point. The grounding point is marked with the ground symbol .

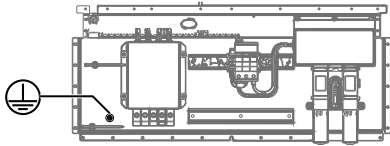


Figure 15: Grounding point in the connection area

#### Grounding the housing

- ⊖ Main grounding point connected to ground cable.
- 1. Strip the grounding cable for the grounding of the housing.
- 2. Insert the grounding cable into the connection area via the cable conduit.
- 3. Remove the insulation from the grounding cable.
- 4. Attach ring cable lug (M8) to grounding cable.
- 5. Attach grounding cable to the intended grounding point with a nut (M8) and a lock washer.
- » Housing successfully grounded.

## 7.4 Connecting the interfaces

All interfaces are located on the connection circuit board in the upper area of the inverter door. Use the cable fittings provided and connect the connection cables to the circuit board.

### DANGER

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



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

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



#### NOTE

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

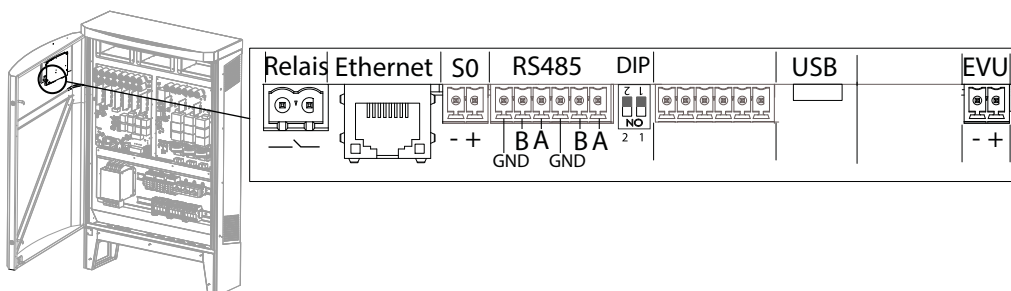


Figure 16: Connection area: connecting the interfaces

**⚠ Authorised electrician**

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

### 7.4.2 Connecting the Ethernet interface

**NOTE**

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

**NOTE**

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

**Connecting an Ethernet cable to the inverter**

1. Loosen and remove the cover of the cable fitting.
2. Remove the sealing insert.
3. Thread the connection cable through the cover of the cable fitting and the sealing insert.
4. Insert the sealing insert into the cable fitting.
5. Connect the connection cable to Ethernet interface.
6. Attach and tighten the cover of the cable fitting.
7. Connect the provided ferrite clip above the cable fitting to the Ethernet cable.

**Connecting the inverter to the network**

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

### 7.4.3 Connecting the S0 output

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

**⚠️ Authorised electrician**

**Connecting the S0 output**

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



**NOTE**

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

**7.4.4 Connecting the RS485 bus**



**NOTE**

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



**NOTE**

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



**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.

**7.4.4.1 Wiring diagram**

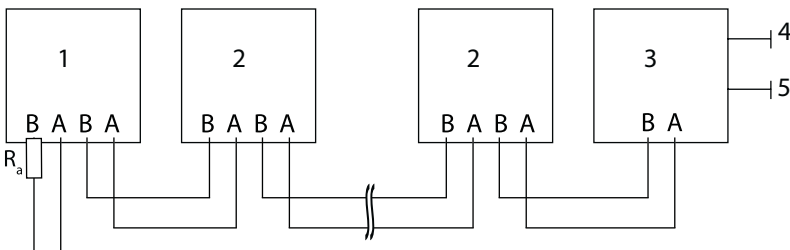


Figure 17: RS485 interface wiring diagram

**Key**

1	Inverter, terminal unit	4	Communication
2	Inverter	5	230 V AC
3	Powador-proLOG		

**Properties of the RS485 data line**

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



**⚠️ Authorised electrician**

**7.4.4.2 Connecting the RS485 bus**

- Connecting the RS485 bus**
- ☞ To prevent interference during data transmission:
    - Observe the wire pairing when connecting DATA+ and DATA- (siehe FigureFigure 18)
    - 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 16 on page 22).
  4. The following must be connected to all inverters and to the data monitor unit in the same way:
    - Wire A (-) to wire A (-) and
    - Wire B (+) to wire B (+) (see Figure 17 on page 24)
  5. Tighten the cable fitting.
  6. Activate the terminating resistor on the terminal unit.

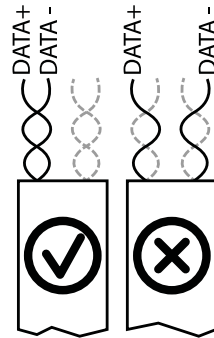


Figure 18: Assignment of twisted-pair wires

EN



**NOTE**

When using the RS485 bus system, assign a unique address to every bus device (inverter, sensor) and terminate the terminal units (see the “Settings” menu).



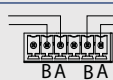

**7.4.4.3 activate the terminating resistor with the switches on the circuit board**

Activate the terminating resistor in the inverter that represents the terminal unit within your wiring diagram.



**NOTE**

Always activate the RS485 terminating resistor in the terminal using DIP switch 2.

	Sample connection	DIP switch	Switch 1	Switch 2
The inverter is the terminal unit: ☞ Activate switch 2			OFF	ON
The inverter is not the terminal unit: ☞ Deactivate switch 2			OFF	OFF

**7.4.5 Connecting "Inverter off" digital input (optional)**



**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.

**⚠️ Authorised electrician**
**Connecting and activating "Inverter off" digital input**

- ⊖ Can only be used with suitable KACO inverters.
- 1. Unscrew the cable fitting.
- 2. Thread the connection cables through the cable fitting.
- 3. Connect wire A (+) to the "EVU+" or the marked terminal on the first inverter via the "DOI" terminal of the Powador-protect.
- 4. Connect wire B (-) to the terminal marked "EVU-" on the first inverter via the "GND" terminal of the Powador-protect.
- 5. Connect the other inverters to one another as follows:
  - wire A (+) to wire A (+) and wire B (-) to wire B (-).
- 6. Tighten the cable fitting.
- 7. After commissioning: Activate the support for Powador protect in the parameter menu under the "Powador-protect" menu item.

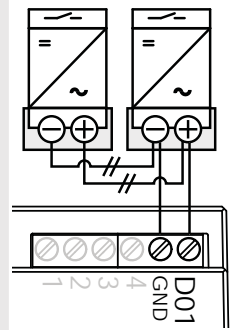


Figure 19: Powador-protect

## 7.5 Sealing the connection area

1. The requirements of protection rating IP54 are met by closing the unused cable fittings with blind caps.
2. Put on the lid for the connection area.
3. Close the housing door and lock it with a control cabinet key.
  - » The inverter has been mounted and installed.
  - » Start up the inverter.

## 7.6 Starting up the inverter

**⚠️ DANGER**


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

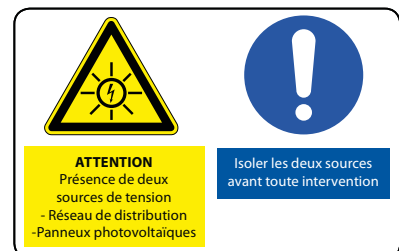
Severe injuries or death result if the cables and terminals in the inverter are touched. Only appropriately qualified and authorised electricians may start up the inverter.

(FR)

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

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

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



### 7.6.1 Switching on the inverter

- ⊖ The inverter has been mounted and electrically installed.
- ⊖ The 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 DC isolator switch (0 → 1).
  - » The inverter begins to operate.
  - » During the initial start-up: Follow the instructions of the New Connection Wizard.

**⚠️ Authorised electrician**

## 8 Configuration and Operation

### 8.1 Controls

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

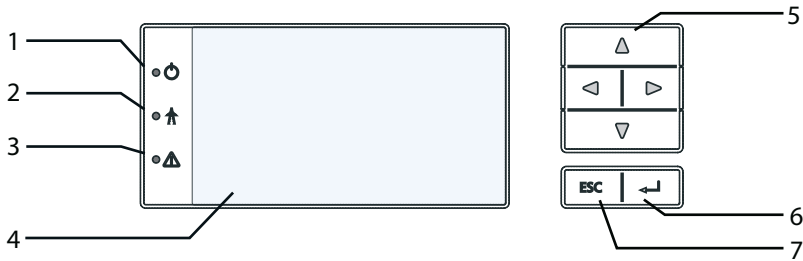


Figure 20: Control panel

**Key**









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

#### 8.1.1 LED indicators

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









The LED indicators show the following operating status:

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

\* The waiting period ensures that the generator voltage continuously remains above the power delivery limit of 200 V. For country-specific waiting periods, see our website at <http://www.kaco-newenergy.de/>.

**⚠️ Authorised electrician**

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

### 8.1.2 Graphical display

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

**NOTE**



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

After being switched on and after 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 two minutes, the inverter returns to the desktop.

For initial commissioning, see section 8.2 on page 30.

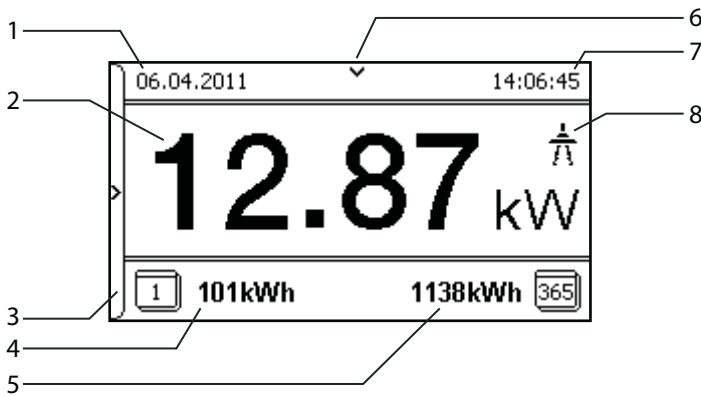


Figure 21: Desktop

**Key**

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

### 8.1.3 Control buttons

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

#### 8.1.3.1 Desktop

##### Opening the menu

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



##### Displaying the daily output

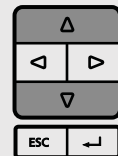
- ⌚ The inverter is operating.
- ⌚ The LCD is showing the desktop.
- ☞ Press the down arrow button.
- » The LCD displays the daily yield in a diagram.
- ☞ To return to the desktop, press any button.



#### 8.1.3.2 Inverter menu

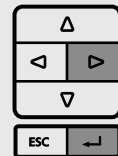
##### Selecting a menu option

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



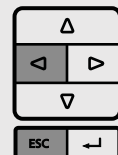
##### Opening a menu item or a setting

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



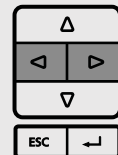
##### Jump to the next higher menu level/discard changes

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



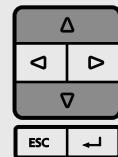
##### Selecting an option

- ☞ Use the right and left arrow buttons.



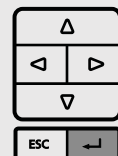
##### Changing an option/the value of an input field

- ☞ Use the up and down arrow buttons.



##### Saving changed settings

- ☞ Press the OK button.



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

**Initial configuration**

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

Press the OK button in the last menu item.

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

## 8.3 Menu structure

### 8.3.1 Display on the LCD

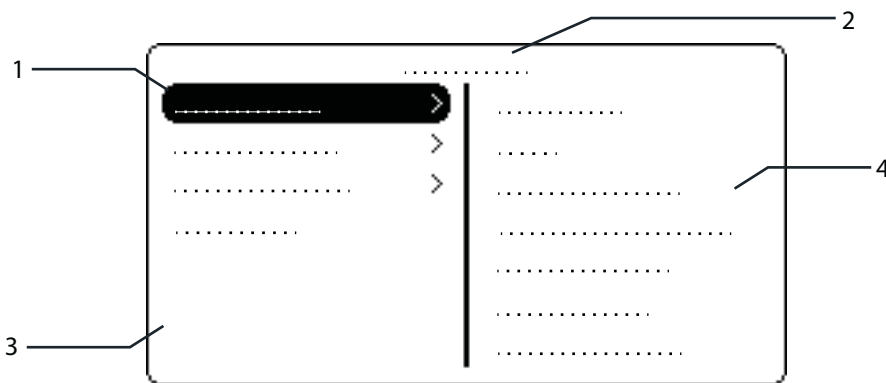


Figure 22: Main menu

**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:**














	Menu level (0, 1, 2, 3)		Submenu available
	Display menu	<b>EN</b>	Country-specific setting
	Option menu	<b>DE MSp.</b>	Country and grid type-specific setting
	Password protected menu (password can be requested from KACO Service)		

Country-spec. setting	menu level	Display/setting	Action in this menu/meaning
All countries	Desktop	<b>Desktop</b>	  Press the right arrow button.
		<b>"Measurements" menu</b>	  Open the menu: Press the right arrow button or the OK button.
		<b>Generator</b>	 Displays the DC-side voltage, amperage and power
		<b>Grid</b>	 Displays the AC-side voltage, amperage and power
AU, BE, DE, ES, IT		<b>Power control</b>	 Displays the current value of the external power limitation by the grid operator.
EN		<b>privatt time remain.</b>	 Displays the current remaining time for the Powador-privatt. After this period elapses, the inverter deactivates the Powador-privatt. This menu item is only available if you have selected the "On" option for the menu item "Activate privatt" in the "Settings" menu.
DE, IT		<b>cos-phi</b>	 Indicates the status of the idle power control.
All countries		<b>Unit temperature</b>	 Displays the temperature in the inverter housing.
		<b>Yield counter</b>	 Displays the yield in kWh.   Reset the counter using the "Reset" key.
		<b>Yield today</b>	 Displays the cumulative yield for the current day.
		<b>Total yield</b>	 Displays the total yield up to now.
		<b>CO2 savings</b>	 Displays the calculated CO <sub>2</sub> savings (in kg).
		<b>Oper. hrs cntr</b>	 Displays the duration of operation in hours.   Reset the counter using the "Reset" key.
		<b>Oper. time today</b>	 Displays the duration of operation on the current day.

















Country-spec. setting	menu level	Display/setting	Action in this menu/meaning
		<b>Total oper. time</b>	 Displays the total operating time.
		<b>Log data display</b>	 Open the menu: Press the right arrow button or the OK button.  Measurement data can be transferred to a USB stick by selecting it and moving it.
<b>All countries</b>		<b>Day display</b>	 Displays the recorded operating data graphically.  <ol style="list-style-type: none"> <li>Select the measured value to be displayed. Supported measured values:                             <ul style="list-style-type: none"> <li>Grid power P(grid)</li> <li>DC power of the string P(PV)</li> <li>DC voltage of the string U(PV)</li> <li>Unit temperature</li> </ul> </li> <li>Select a day.</li> <li>Press the OK button.                             <ul style="list-style-type: none"> <li>» The display shows the selected data.</li> <li> Press any button to return to the previous menu.</li> </ul> </li> </ol>
		<b>Month display</b>	 Displays the recorded operating data graphically.  <ol style="list-style-type: none"> <li>Select a month.</li> <li>Press the OK button.                             <ul style="list-style-type: none"> <li>» The display shows the selected data.</li> <li> Press any button to return to the previous menu.</li> </ul> </li> </ol>
		<b>Year display</b>	 Displays the recorded operating data graphically.  <ol style="list-style-type: none"> <li>Select a year.</li> <li>Press the OK button.                             <ul style="list-style-type: none"> <li>» The display shows the selected data.</li> <li> Press any button to return to the previous menu.</li> </ul> </li> </ol>
		<b>CSV log data</b>	 Open the menu: Press the right arrow button or the OK button.
		<b>Decimal separator</b>	 Select decimal sign for export of saved operating data.
		<b>Save to USB</b>	 In this menu, you can export the saved operating data to a connected USB storage device.  You have connected a USB storage device to the inverter. <ol style="list-style-type: none"> <li>Select the data to be exported (year, month or day).</li> <li>Press the OK button.                         <ul style="list-style-type: none"> <li>» The inverter writes the data to a connected USB storage device.</li> </ul> </li> </ol>



Country-spec. setting	menu level	Display/setting	Action in this menu/meaning
All countries	1-2-3-4	<b>"Settings" menu</b>	 Open the menu: Press the right arrow button or the OK button.
	1-2-3-4	<b>Language</b>	 Select the desired language for the user interface.
	1-2-3-4	<b>Def. total yield</b>	 You can set the total yield to any value, for example, when you have received a replacement unit and want to continue the recording from the present value.  Select the "Save" button and confirm with the OK button.
	1-2-3-4	<b>Interface</b>	 If the inverter is a terminal unit: Activate termination ("Bus termination" menu option)  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.
	1-2-3-4	<b>S0 pulse rate</b>	 Set the pulse rate of the S0 connection.
EN	1-2-3-4	<b>Activate priwatt</b>	 Releases the use of the fault signal relay for internal consumption control of the Powador-priwatt.  <ol style="list-style-type: none"> <li>1. Enter password.</li> <li>2. Confirm the entry with the OK button.</li> <li>3. Activate or deactivate the home feed-in function.</li> </ol> <b>NOTE:</b> Activating this option enables the menu item <b>Set priwatt</b> .
	1-2-3-4	<b>Set priwatt</b>	 Define the switch-on power in kW that needs to be available on an uninterrupted basis for 30 minutes before the home feed-in is activated.  Define the switch-on time (operating time of Powador-priwatt after activation). <b>NOTE:</b> This menu item is only available if you have selected the "On" option for the menu item "Activate priwatt" in the "Settings" menu.
All countries	1-2-3-4	<b>Quick start</b>	 Reduce the waiting times during the self test by pressing the "Activate" key.
	1-2-3-4	<b>Logging interval</b>	 Set the time between two log data recordings.
	1-2-3-4	<b>Log data backup</b>	 The inverter supports the backing up of all recorded yield data to a connected USB storage device.  Activate or deactivate log data backup.
	1-2-3-4	<b>Display</b>	 Configure the contrast setting for the display.  Set the length of time without user input after which the backlighting of the LCD switches off.  Alternatively: Permanently activate or deactivate the backlighting by selecting "On" or "Off".







Country-spec. setting	menu level	Display/setting	Action in this menu/meaning
All countries		<b>Date &amp; time</b>	<ul style="list-style-type: none"> <li>☞ Set the date and time.</li> </ul> <p><b>NOTE:</b> For self-diagnostic purposes, the inverter carries out a daily restart at midnight. To avoid having a restart occur during feed-in operation and to always obtain reliable log data, ensure that the time is correctly set.</p>
		<b>Network</b>	<ul style="list-style-type: none"> <li>☞ Open the menu: Press the right arrow button or the OK button.</li> </ul>
		<b>DHCP</b>	<ul style="list-style-type: none"> <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>
		<b>IP address</b>	<ul style="list-style-type: none"> <li>☞ Allocate a unique IPv4 address in the network.</li> </ul>
		<b>Subnet mask</b>	<ul style="list-style-type: none"> <li>☞ Allocate a network mask</li> </ul>
		<b>Gateway</b>	<ul style="list-style-type: none"> <li>☞ Enter IPv4 address of gateway.</li> </ul>
		<b>DNS server</b>	<ul style="list-style-type: none"> <li>☞ Enter IPv4 address of DNS server.</li> </ul>
		<b>Web server</b>	<ul style="list-style-type: none"> <li>☞ Activate or deactivate the integrated web server.</li> <li>☞ Set the port at which the web server can be reached.</li> </ul>
		<b>Powador-web</b>	<ul style="list-style-type: none"> <li>☞ On: The inverter attempts to connect to the Powador-web web portal.</li> <li>☞ Off: The connection to Powador web is deactivated.</li> </ul>
		<b>Connection status</b>	<ul style="list-style-type: none"> <li>☞ Indicates the status of the network connection:</li> </ul>
		<b>"Parameters" menu</b>	<ul style="list-style-type: none"> <li>☞ Press the right arrow button or the OK button.</li> </ul> <p><b>NOTE:</b> The inverter does not display the "Parameters" menu in the standard configuration. To display the Parameters menu:</p> <ol style="list-style-type: none"> <li>1. Open the menu.</li> <li>2. Simultaneously hold down the up and down buttons for several seconds.</li> </ol>
		<b>Country</b>	<ol style="list-style-type: none"> <li>1. Enter the four-digit password using the 4-way button. The password is unit-specific.</li> <li>2. Confirm the entry with the OK button.</li> <li>3. Set the desired country setting.</li> </ol> <p><b>NOTE:</b> This option influences the country-specific operating settings of the inverter. Please consult KACO service for further information.</p>
		<b>Grid type/guideline</b>	<ul style="list-style-type: none"> <li>☞ Select the grid type for the inverter's installation location.</li> </ul>

Country-spec. setting	menu level	Display/ setting	Action in this menu/meaning
AU, BG, FR, GR, PT, ES, CZ, KR	1-2-3-4	Switch-off volt.	<p>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.</p> <ul style="list-style-type: none"> <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>
DE, AU, BG, FR, GR, HU, IL, PT, ES, CZ, KR	1-2-3-4	Switch-off freq.	<p>The inverter continuously monitors the grid frequency. If the grid frequency exceeds or drops below the configured values, the inverter switches off.</p> <ul style="list-style-type: none"> <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-NSp, BE, FR, IT, AT, PL, UD	1-2-3-4	Overvoltage shudt.	<ul style="list-style-type: none"> <li>Activate or deactivate password protection.</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>
DE-MSp, FR, GB59/3, HU, IL, IN, IT, AT, PL, RU, ES, TH, ZA, UD			<ul style="list-style-type: none"> <li>Specify the shutdown threshold for fast and slow overvoltage shutdown.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>
BG, FR, CZ, UD	1-2-3-4	Voltage drop	<p>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 to 11 V in 1 V increments.</p> <ul style="list-style-type: none"> <li>Specify the switch-off value for the voltage drop (0 to 11 V).</li> </ul>
DE-MSp, FR, GB, HU, IL, IN, IT, AT, PL, RU, ES, TH, ZA, UD	1-2-3-4	Undervoltage shudt.	<ul style="list-style-type: none"> <li>Specify the shutdown threshold for fast and slow undervoltage shutdown.</li> <li>Set period from occurrence of the fault to shutdown of the inverter.</li> </ul>
DE-MSP, FR, GB, IN, IT, AT, PL, RU, ES, TH, ZA, UD	1-2-3-4	Overfreq. shudt.	<ul style="list-style-type: none"> <li>Set limit value for overfrequency shutdown.</li> </ul>
	1-2-3-4	Underfreq. shudt.	<ul style="list-style-type: none"> <li>Set limit value for the underfrequency shutdown.</li> </ul>
FR, IL, IN, IT, AT, PL, RU, TH, ZA, UD	1-2-3-4	Activation condition	<p>The inverter checks mains voltage and frequency. The grid feed operation begins if the measured values are within the set ranges.</p> <ul style="list-style-type: none"> <li>Set minimum and maximum values for the switching on.</li> </ul>

Country-spec. setting	menu level	Display/ setting	Action in this menu/meaning
DE, BE, FR, GB, IL, IN, IT, AT, PL, RU, ES, TH, ZA, UD		<b>Connect time</b>	  <p>☞ Set period for grid observation (in seconds) when switching on and reconnection after a fault.</p>
IL, IT, ZA		<b>P(f) Gradient</b>	 <p>☞ Set gradient of power limit function with increasing frequency in % / Hz. This percentage relates to the nominal frequency of 50 Hz</p>
		<b>P(f) thresholds</b>	 <p>☞ Set the frequency thresholds for activating and deactivating the power limitation in Hz.</p>
		<b>DC starting volt.</b>	 <p>The inverter begins feed-in as soon as this DC voltage is present. ☞ Set the starting voltage.</p>
		<b>DC-OVP-Monitor.</b>	 <p>Allows the monitoring of the integrated overvoltage protection. ☞ Activate overvoltage protection. <b>NOTE:</b> By activating, an overvoltage protection test is carried out with an appropriate status message.</p>
		<b>Const. volt. ctrl.</b>	 <p>Lets you deactivate the MPP seek mode in order to operate the inverter with a constant DC voltage. ☞ Activate or deactivate the constant voltage controller. ☞ Set value for constant voltage control (200 - 800 V). <b>NOTE:</b> For voltages below the minimal MPP voltage the possible input power is reduced. The input current is limited to 102 A per input.</p>
		<b>Power limitation</b>	  <p>The output power of the inverter can be set permanently to a lower value than the maximum output power by the internal power limiting. This may be necessary in order to limit the maximum power rating of the system at the grid connection point, upon the grid operator's request. The value can be protected from the very first output limitation entry. After setting a limitation, the value can only be changed by entering a device-specific password. 1. Activate password protection if necessary. 2. Specify the activation status. 3. Specify the limit value for maximum feed-in power. 4. Confirm the entry with the OK button.</p>

Country-spec. setting	menu level	Display/ setting	Action in this menu/meaning
	<b>1-2-3-4</b>	<b>Powador-protect</b>	<p>Configures the support for grid shutdown by a Powador protect connected to the digital input of the inverter.</p> <ul style="list-style-type: none"> <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> <li>☞ Auto: The inverter automatically detects a Powador-protect integrated into the photovoltaic system.</li> <li>☞ 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.</li> <li>☞ Off: The inverter does not check whether a Powador protect is integrated in the photovoltaic system.</li> </ul>
	<b>1-2-3-4</b>	<b>Iso.resistor</b>	<ul style="list-style-type: none"> <li>☞ Set threshold value (in 1 kOhm steps) at which the insulation monitor reports a fault.</li> </ul>
<b>DE-MSp, FR, AT, PL, RU, ES, TH, ZA</b>	<b>1-2-3-4</b>	<b>Activate FRT</b>	<p>The inverter supports dynamic grid stabilisation (Fault Ride-Through).</p> <p>The following parameters can be set:</p> <ul style="list-style-type: none"> <li>☞ Operation mode</li> <li>☞ Dead band</li> <li>☞ Dead band mode</li> <li>☞ Constant k</li> <li>☞ Dynamic blind current</li> </ul>
<b>DE, BE, FR, GB, IL, IT, AT, PL, RU, ES, KR, TH, ZA</b>	<b>1-2-3-4</b>	<b>Reactive power</b>	<ul style="list-style-type: none"> <li>☞ Open the menu: Press the right arrow button or the OK button.</li> <li>☞ Activating idle power process: select process and press OK. The active process is highlighted.</li> </ul>
	<b>1-2-3-4</b>	<b>cos-phi specification</b>	<ul style="list-style-type: none"> <li>☞ Configure power factor.</li> <li>☞ If a power factor is selected which is not equal to 1: Select the type of phase shift (under-excited/over-excited).</li> </ul>
<b>DE-MSp, FR, GB, IL, IT, AT, PL, RU, ES, KR, TH</b>	<b>1-2-3-4</b>	<b>Q const.</b>	<ul style="list-style-type: none"> <li>☞ Set the idle power Q (in %) to a fixed value.</li> <li>☞ Select the type of phase shift (under-excited/over-excited).</li> </ul>
<b>DE, BE, GB, IT, AT, ES, KR, UD</b>	<b>1-2-3-4</b>	<b>cos-phi(P/Pn)</b>	<ul style="list-style-type: none"> <li>☞ Open the menu: Press the right arrow button or the OK button.</li> </ul>
<b>GB, IT, AT, ES, KR</b>	<b>1-2-3-4</b>	<b>Lock-in voltage</b>	<ul style="list-style-type: none"> <li>☞ Power range set as % of rated voltage, where the network support process is active.</li> </ul>
	<b>1-2-3-4</b>	<b>Lock-out voltage</b>	

Country-spec. setting	menu level	Display/ setting	Action in this menu/meaning
DE, BE, FR, GB, IL, IT, AT, PL, RU, ES, KR, TH, UD	1-2-3-4	<b>Number of nodes</b>	<p>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.</p> <ul style="list-style-type: none"> <li>Specify the number of support points for the idle power characteristic curve.</li> </ul>
	1-2-3-4	<b>1., 2. ...Support point</b>	<ul style="list-style-type: none"> <li>Specify the power factor for the 1st, 2nd (etc.) support point</li> <li>If a power factor that is not equal to 1 is selected: Select the type of phase shift (under-excited/ over-excited).</li> </ul>
DE-MSp, FR, PL, RU, ES, TH, UD	1-2-3-4	<b>Q(U) characteristic</b>	<ul style="list-style-type: none"> <li>Specify the target voltage.</li> <li>Specify gradient.</li> <li>Specify change time.</li> </ul>
GB, IT, AT, KR	1-2-3-4	<b>Q(U) 5 Supports</b>	<ul style="list-style-type: none"> <li>Open the menu: Press the right arrow button or the OK button.</li> </ul>
	1-2-3-4	<b>Lock-in power</b>	<ul style="list-style-type: none"> <li>Power range set as % of rated power, in which the network support process is active.</li> </ul>
	1-2-3-4	<b>Lock-out power</b>	
	1-2-3-4	<b>Time constant</b>	<ul style="list-style-type: none"> <li>Set the response speed of the control.</li> </ul>
	1-2-3-4	<b>Number of support points</b>	<ul style="list-style-type: none"> <li>Specify the number of support points for the idle power characteristic curve.</li> </ul>
GB, IT, KR	1-2-3-4	<b>1., 2. ...Support point</b>	<ul style="list-style-type: none"> <li>Specify the support points for voltage, power and nature of the phase shift</li> </ul>
	1-2-3-4	<b>Q(U) 2-point</b>	<ul style="list-style-type: none"> <li>Open the menu: Press the right arrow button or the OK button.</li> </ul>
	1-2-3-4	<b>Lock-in power</b>	<ul style="list-style-type: none"> <li>Power range set as % of rated power, in which the network support process is active.</li> </ul>
	1-2-3-4	<b>Lock-out power</b>	
	1-2-3-4	<b>Time constant</b>	<ul style="list-style-type: none"> <li>Set the response speed of the control.</li> </ul>
DE-NSp, BE	1-2-3-4	<b>1.-4. Support point</b>	<ul style="list-style-type: none"> <li>Specify the support points for voltage, power and nature of the phase shift</li> </ul>
	1-2-3-4	<b>Line error</b>	<p>Display of grid faults.</p> <ul style="list-style-type: none"> <li>To show the last 5 grid fault messages, select the "Display" key.</li> </ul>
DE-NSp, GB, AT	1-2-3-4	<b>Protection parameters</b>	<p>Display of essential protection parameters.</p> <ul style="list-style-type: none"> <li>To show the protection parameters, select the "Display" key.</li> </ul>
	1-2-3-4	<b>"Information" menu</b>	<ul style="list-style-type: none"> <li>Open the menu: Press the right arrow button or the OK button.</li> </ul>
	1-2-3-4	<b>Inv. type</b>	<p>Displays the type designation of the inverter.</p> <ul style="list-style-type: none"> <li>If feed-in power is actively limited: display maximum power in kW.</li> </ul>
	1-2-3-4	<b>SW version</b>	<ul style="list-style-type: none"> <li>Displays the installed software version.</li> </ul>

Country-spec. setting	menu level	Display/setting	Action in this menu/meaning
		<b>Serial no.</b>	 Displays the serial number of the inverter.
		<b>Display country</b>	 Displays the selected country setting. Optional: Displays the grid type if a grid type has been selected.
		<b>"Manufacturer" menu</b>	 The display shows information about the unit manufacturer.

## 8.4 Monitor inverter

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

You can display the recorded data using:

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

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.

#### 8.4.1.1 Reading log data



#### NOTE

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

#### Reading log data

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

### 8.4.2.1 Setting up the web server

#### Configuring the Ethernet interface

- ⌚ You have connected the inverter to your network.
- ☞ When using a DHCP server: Activate DHCP.
- ☞ For manual configuration (DHCP off):
- 1. Open the Settings/Network menu.
- 2. Assign a unique IP address.
- 3. Assign a subnet mask.
- 4. Assign a gateway.
- 5. Assign DNS server.
- 6. Save your settings.

### 8.4.2.2 Using the web server

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



#### NOTE

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

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

#### Calling up the web server

- ⌚ Configure the Ethernet interface.
- ⌚ Connect the Ethernet cable.
- 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. Press the "Export data" button.
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 a 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 (for example: an external hard disk).

**NOTE**

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

**CAUTION****Damage to the inverter**

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

- » 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. Extract the update file (.ZIP) completely onto the USB stick.
- » Perform software update.

**Performing the software update**

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

The update can take several minutes. The "Operating" LED flashes during the update process. The inverter may restart several times. The update has been imported in full once the "Configuration found. Load? message appears again. Select "No" and confirm using the Enter key. The inverter then returns to feed-in mode. You can check to see if the update was successful in the menu:

**Displaying the software version**

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

## 9 Maintenance/Troubleshooting

### 9.1 Visual inspection

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



#### NOTE

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

### 9.2 External cleaning



#### DANGER



#### Lethal voltages in the inverter

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

- › Only use completely dry objects to clean the inverter.
- › Only the exterior of the inverter should be cleaned.

#### Cleaning the inverter

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

#### Authorised electrician

### 9.3 Shutting down for maintenance and troubleshooting



#### DANGER



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

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

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

- › Observe all safety regulations and the current technical connection specifications from the relevant power supply company.
- › Disconnect the AC and DC sides.
- › Secure the AC and DC sides from being inadvertently switched back on.
- › Do not open the inverter until these two steps are complete.
- › After shutdown, wait at least 30 minutes before working on the inverter.

#### CAUTION

#### Destruction of the DC connection

The connection terminals can be destroyed by arcing if disconnected while still live.

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

**Shutting down the inverter**

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

**DANGER! The DC cables are still live.**

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

## 9.4 Faults

### 9.4.1 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 result if the cables and terminals in the inverter are touched.

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

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

### 9.4.2 Troubleshooting

**B = Action of the operator**

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

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

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

Table 4: Troubleshooting

Fault	Cause of fault	Explanation/remedy	By
		☞ Select the capacity of the inverter's pre-fuse to be somewhat higher than the maximum feed-in current (see the "Installation" section).	<b>E</b>
		☞ Contact the grid operator if the grid failure continues to occur.	<b>E</b>
	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.	<b>E</b>
The inverter displays an impossible daily peak value.	Faults in the grid.	The inverter continues to operate as normal without losses to the yield, even when an erroneous daily peak value is displayed. The value is reset overnight.	
		☞ To reset the value immediately, switch the inverter off by disconnecting it from the grid and switching off the DC, then switch it back on.	<b>E</b>
Daily yields do not correspond to the yields on the feed-in meter.	Tolerances of the measuring elements in the inverter.	The measuring elements of the inverter have been selected to ensure maximum yields. Due to these tolerances, the daily yields shown may deviate from the values on the feed-in meter by up to 15%.	
		☞ No action	-
The inverter is active but is not feeding into the grid. Display: "Waiting for feed-in"	<ul style="list-style-type: none"> <li>• Generator voltage too low</li> <li>• Grid voltage or PV generator voltage unstable.</li> </ul>	<ul style="list-style-type: none"> <li>• The PV generator voltage or power is not sufficient for feed-in (solar radiation is too low).</li> <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> <li>• The starting voltage may have been set incorrectly.</li> </ul>	
		☞ Adjust starting voltage in the Parameter menu if required.	<b>K</b>
Noise emission from the inverter.	Particular ambient conditions.	<p>When there are certain ambient conditions, the units may emit audible noises.</p> <ul style="list-style-type: none"> <li>• 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> <li>• In cases of volatile weather conditions (frequent switching between sunny and cloudy conditions) or strong solar radiation, a light hum may be audible due to the increased power.</li> <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> <p>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.</p> <p>People with very sensitive hearing (particularly children) are able to hear the high-frequency hum caused by the inverter's operating frequency of approximately 17 kHz.</p>	
		☞ No action	

Table 4: Troubleshooting







Fault	Cause of fault	Explanation/remedy	By
In spite of high radiation levels, the inverter does not feed the maximum power into the grid.	The device is too hot and the system limits the power.	Because the temperatures inside the unit are too high, the inverter reduces its power to prevent damage to the unit. Note the technical data. Ensure that the convection cooling is not impeded from the exterior. Do not cover the cooling fins.	
		<ul style="list-style-type: none"> <li> Ensure sufficient cooling of the unit.</li> <li> Do not cover the cooling fins.</li> </ul>	<b>B, E</b>

Table 4: Troubleshooting

## 9.5 "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.

### 9.5.1 Display of status and fault messages

Display	Fault LED (red)		
<b>FS (fault status)</b>	 	<b>ON</b>	<ul style="list-style-type: none"> <li>• Fault signal relay has switched.</li> <li>• Feed-in was ended due to a fault.</li> </ul>
<b>OS (operating status)</b>	 	<b>OFF</b>	<ul style="list-style-type: none"> <li>• The fault signal relay 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.

### 9.5.2 Status and fault signals

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

**BS = operating status, FS = fault status;**

**B = Action of the operator**

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

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









Status	Display	 	Explanation	Action
<b>OS 1</b>	Waiting for feed-in	 	Self-test: The grid parameters and generator voltage are being checked.	-
<b>OS 2</b>	Generator voltage too low	 	Insufficient generator voltage and power, status before the transition to night shutdown	-
<b>OS 8</b>	Self-test	 	Checks the shutdown of the power electronics as well as the grid relay before feed-in mode.	-

Table 5: Operating status and fault messages on the display



























Status	Display			Explanation	Action	
<b>FS</b> 10	Temperature in unit too high			In case of overheating, the inverter switches off. Possible causes: <ul style="list-style-type: none"> <li>• Ambient temperature too high</li> <li>• Fans covered</li> <li>• Inverter defective</li> </ul>	<ul style="list-style-type: none"> <li>☞ Cool off the area around the inverter.</li> <li>☞ Uncover the fans.</li> <li>☞ Notify your authorised electrician.</li> </ul>	<b>B</b> <b>B</b> <b>E</b>
<b>OS</b> 11	Measured values			Power limitation: If the generator power is too high, the inverter limits itself to the maximum power (e.g. around noon if the generator capacity is too large).		
<b>FS</b> 17	Shutting down Powador-protect			The activated grid and system protection has been tripped.	<ul style="list-style-type: none"> <li>☞ Wait for reactivation.</li> <li>☞ Notify your authorised electrician if the fault occurs several times.</li> </ul>	<b>E</b>
<b>FS</b> 18	Resid. current shutdown			Residual current was detected. The feed-in was interrupted.	☞ Notify your authorised electrician.	<b>E</b>
<b>FS</b> 19	Generator insulation fault			There is an insulation fault on the PV generator. The feed-in was interrupted.	☞ Notify your authorised electrician if the fault occurs several times.	<b>E</b>
<b>FS</b> 30	Fault Transformer fault			The current and voltage measurements in the inverter are not within acceptable range.	-	-
<b>FS</b> 32	Fault Self-test			The internal grid separation relay test has failed.	☞ Notify your authorised electrician if the fault occurs several times.	<b>E</b>
<b>FS</b> 33	Fault DC feed-in			The DC feed-in has exceeded the permitted value. This DC feed-in can be caused by grid conditions and may not necessarily indicate a fault.	☞ Notify your authorised electrician if the fault occurs several times.	<b>E</b>
<b>FS</b> 34	Internal communication error			A communication error has occurred in the internal data transmission.	<ul style="list-style-type: none"> <li>☞ Notify your authorised electrician.</li> <li>☞ Check the data cable.</li> </ul>	<b>E</b>
<b>FS</b> 35	Protection shutdown SW			Protective shutdown of the software (AC overvoltage, AC overcurrent, DC link overvoltage, DC overvoltage, DC overtemperature).	Not a fault Grid-related shutdown, the grid connects again automatically.	
<b>FS</b> 36	Protection shutdown HW			Protective shutdown of the hardware (AC overvoltage, AC overcurrent, DC link overvoltage).	Not a fault Grid-related shutdown, the grid connects again automatically.	
<b>FS</b> 38	Generator overvoltage error			The voltage of the DC generator is too high. The PV generator is configured incorrectly.	☞ Notify your authorised electrician.	<b>E</b>

Table 5: Operating status and fault messages on the display











































Status	Display			Explanation	Action	
FS 41-46	Line failure: undervoltage L1, overvoltage L1, undervoltage L2, overvoltage L2, undervoltage L3, overvoltage L3			The voltage of a grid phase is too low; the grid cannot be fed into. The phase experiencing failure is displayed.	 Notify your authorised electrician.	<b>E</b>
FS 47	Grid failure: phase-to-phase voltage			The measured line-to-line voltage is outside of the tolerance limits.		
FS 48	Line failure: Underfrequency			Grid frequency is too low. This fault may be grid-related.	 Notify your authorised electrician.	<b>E</b>
FS 49	Line failure: Overfrequency			Grid frequency is too high. This fault may be grid-related.	 Notify your authorised electrician.	<b>E</b>
FS 50	Line failure: average voltage			The grid voltage measurement according to EN 50160 has exceeded the maximum permitted limit value. This fault may be grid-related.	 Notify your authorised electrician.	<b>E</b>
FS 57	Waiting for reactivation			Waiting time of the inverter after a fault.	Inverter does not switch on again until the country-specific time has elapsed.	
FS 58	Overtemperature Control card			The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware.	 Provide for sufficient ventilation.	<b>E</b>
FS 59	Self test error			A fault occurred during a self-test.	 Notify your authorised electrician.	<b>E</b>
OS 60	Generator voltage too high			The inverter does not begin feeding into the grid until the PV voltage falls below a specified value.	-	-
OS 61	External limit (%)			The external limit <i>Power control</i> was activated by the grid operator. The inverter limits its power.		
OS 63	Measured values			P(f)/frequency-dependent power reduction: Frequency-dependent power reduction will be activated when the BDEW (German Association of Energy and Water Industries) Medium Voltage Directive goes into effect. Power reduction starts at a frequency of 50.2 Hz.		
OS 64	Measured values			Output current limiting: The AC current is limited once the specified maximum value has been reached.		
FS 67	Fault at power section 1			There is a fault in the power section.	 Notify your authorised electrician.	<b>E</b>
FS 70	Fan error			The fan is malfunctioning.	 Replace defective fan	<b>E</b>
FS 73	Standalone grid err.			Standalone mode was detected.	-	-
OS 74	External idle power requirement			The grid operator limits the feed-in power of the inverter via the transmitted reactive power factor.	-	-

Table 5: Operating status and fault messages on the display








































Status	Display			Explanation	Action	
OS 79	Insulation measurement			PV generator's insulation is being measured	-	-
FS 80	Insulation meas. not possible			The insulation measurement cannot be performed because the generator voltage is too volatile.	-	-
FS 81, 82, 83	Protection shutdown line volt. L1 L2, L3			Overvoltage has been detected on a conductor. An internal protective mechanism has disconnected the device to protect it against damage.		In case of repeated occurrence: Notify your authorised electrician. <b>E</b>
FS 84	Protection shutdown undervolt. DC link			A voltage deviation has been found in the DC link. An internal protective mechanism has disconnected the device to protect it against damage.		In case of repeated occurrence: Notify your authorised electrician. <b>E</b>
FS 85	Protection shutdown overvolt. DC link					<b>E</b>
FS 86	Protection shutdown: DC link asymmetry			Overvoltage has been found in the DC link. An internal protective mechanism has disconnected the device to protect it against damage.		In case of repeated occurrence: Notify your authorised electrician. <b>E</b>
FS 87, 88, 89	Protection shutdown overcurrent L1, L2, L3			A current that has been found on a conductor is too high. An internal protective mechanism has disconnected the device to protect it against damage.		In case of repeated occurrence: Notify your authorised electrician. <b>E</b>
FS 93, 94	Self test error Buffer 1, Buffer 2			The control board is defective.		Notify authorised electrician / KACO Service <b>E/K</b>
FS 95, 96	Self test error Relay 1, Relay 2			The power section is defective.		Notify KACO Service <b>K</b>
FS 97	Protection shutdown overcurrent HW			Too much power has been fed into the grid. Complete disconnection of the device.		Notify authorised electrician / KACO Service <b>E/K</b>
FS 98, 99	Protection shutdown HW gate driver/ HW buffer-free.			An internal protective mechanism has disconnected the device to protect it against damage. Complete disconnection of the device.		Notify authorised electrician / KACO Service <b>E/K</b>
FS 100	Protect. shutdown HW overheating			The device has been switched off because the temperatures in the housing were too high.	 	Check to make sure that the fans are working. <b>B</b> Replace fan if necessary. <b>E</b>
FS 101, 106	Temperature plausibility error, efficiency, DC link, AFI module, relay, DC/ DC converter			The unit has shut down because of implausible internal measured values.		Notify KACO Service <b>K</b>

Table 5: Operating status and fault messages on the display









Status	Display	 	Explanation	Action	
FS 121	Door open	 	The door is open. The unit has interrupted the feed-in.	<ul style="list-style-type: none"> <li> Close door.</li> <li> Check the contact switch for free movement.</li> </ul>	<b>E</b>

Table 5: Operating status and fault messages on the display

## 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,
  - the option for registering your device with us. 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.

### Hotlines

	Technical troubleshooting	Technical consultation
Inverter / energy storage technology	+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 from 8:00 till 12:00 a.m and 1:00 p.m. to 5:00 p.m. (CET)	

## 11 Shutdown/Disassembly

### 11.1 Shutting down the inverter

 **DANGER**

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

- Severe injuries or death result if the cables and terminals in the inverter are touched.
- › After shutdown, wait at least 5 minutes before working on the inverter.

 **DANGER**

**Destruction of the DC plug**

DC plugs may be destroyed by arcing if disconnected under load.

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

#### Shutdown sequence

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

**DANGER! The DC cables are still live.**

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

### 11.2 Uninstalling the inverter

- ☪ Shut down the inverter.
- 1. Unlock and open the housing door.
- 2. Open the connection cover connection area.
- 3. Remove the interface cable.
- 4. Release the DC and AC cables from the connection terminals.
- 5. Open the cable fittings.
- 6. Pull out the cables.
- » The uninstallation of the inverter is complete. Continue with dismantling.

## 11.3 Dismantling the inverter



### CAUTION



#### Risk of injury if the inverter tips over!

Risk of tipping due to high centre of gravity, particularly with the door open.

- › Secure the inverter to prevent tipping before disassembly.
- › Close and lock the doors of the inverter.
- › Only then remove the wall and floor fastenings.

- ↻ Shut down the inverter.
- ↻ Uninstall the inverter.
- 1. Remove the inverter fastening.
- 2. Securely pack up the inverter if it is to be used later  
or  
have the inverter disposed of professionally.

## 12 Disposal

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.

## 13 Appendix

### 13.1 EU Declaration of Conformity

<b>Manufacturer's name and address</b>	<b>KACO new energy GmbH</b> Carl-Zeiss-Strasse 1 74172 Neckarsulm, Germany	
<b>Product description</b>	<b>Photovoltaic feed-in inverter</b>	
<b>Type designation</b>	<b>Powador 36.0 TL3 - M 1</b>	<b>Powador 39.0 TL3 - M 1</b>

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 15th December 2004 on the harmonisation of the laws of the member states relating to Electromagnetic Compatibility (2004/108/EC) and the Low Voltage Directive (2006/95/EC).

The units conform to the following standards:

#### 2006/95/EC

"Directive relating to electrical equipment designed for use within certain voltage limits"

#### 2004/108/EC

"Directive relating to electromagnetic compatibility"

#### Safety of the unit

IEC 62109-1:2010  
IEC 62109-2:2011

#### Interference immunity

EN 61000-6-1:2007  
EN 61000-6-2:2005

#### Emitted interference

EN 61000-6-3:2007 + A1:2011

#### Secondary effects on the grid

EN 61000-3-11:2000  
EN 61000-3-12:2011

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, 09.10.2014

KACO new energy GmbH



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







