Instruction Manual

- Authorized Electricians

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KACO blueplanet 32.0 TL3
KACO blueplanet 40.0 TL3
KACO blueplanet 50.0 TL3

KACO
new energy.

Installation Instructions

for authorized electricians

Contents

1 General Information

1.1 About this document

WARNING

Improper handling of the inverter can be hazardous

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

1.1.1 Other applicable documents

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

1.1.2 Storing the documents

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

1.2 Layout of Instructions

1.2.1 Symbols used


General hazard


Risk of fire or explosion


High voltage!


Risk of burns

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

1.2.2 Safety warnings symbols guide

DANGER

High risk

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

WARNING

Potential risk

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

CAUTION

Low-risk hazard

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

CAUTION

Risk of damage to property

Failure to observe this warning will lead to property damage.

ACTIVITY

Risk of damage to property

Failure to observe this warning will lead to property damage.

1.2.3 Additional information symbols

NOTE

Useful information and notes

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 may occur 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 unauthorized persons away from the inverter and PV system.
- In particular, be sure to observe IEC-60364-7-712:2002 "Requirements for special types of business premises, rooms and installations - Solar-Photovoltaic-(PV) Power Supply Systems.
- Ensure operational safety by providing proper grounding, conductor dimensioning and appropriate protection against short circuiting.
- Observe all safety instructions on the inverter and in these operating instructions.
- Switch off all voltage sources and secure them against being inadvertently switched back on before performing visual inspections and maintenance.
- When taking measurements while the inverter is live:
  - Do not touch the electrical connections
  - Remove all jewellery from 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 Intended use

The ISO-inverter converts clean renewable DC energy into AC energy for export into the utility. The inverter was designed in accordance with UL 1741, CSA-C22.2 No. 107.1.01 and the NFPA 70. Authorized personnel who are qualified for the VAC and VDC voltage ratings are the only people who should install or maintain this equipment. Lethal hazards exist which may result in serious injury.

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

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

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

2.2 Protection features

For your safety, the following monitoring and protective functions are integrated into blueplanet 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 IEEE 1547

2.3 Standards and regulations

Electrical conformity according to U.S., Canadian and international safety operating standards and code requirements:

- UL 1741-2nd Ed 2010
- NEC (2011)
- CSA 22.2 No. 107-1:2001 Rev 2011
- IEEE Std. 1547-2003
- IEEE Std. 1547.1-2005
- FCC Part 15 Class B
- NFPA 70
- Wiring method is accordance with the National Electrical Code ANSI/NFPA 70
- Directive concerning Electromagnetic Compatibility with Class B (Council Directive 2004/108/EC)
- Low Voltage Directive (Council Directive 2006/95/EC)
- The Inverter has a on-board overcurrent protection for **DC** circuit.
- The inverter has **no** internal overcurrent protection for **AC** circuit. The overcurrent protection for **AC** circuit must be installed by authorized electricians.
- The Inverter has a over-temperature and anti-islanding protection.

3 Description

3.1 Mode of Operation

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

3.2 Description of the unit

3.2.1 Inverter as part of a PV system

3.2.1.1 System layout

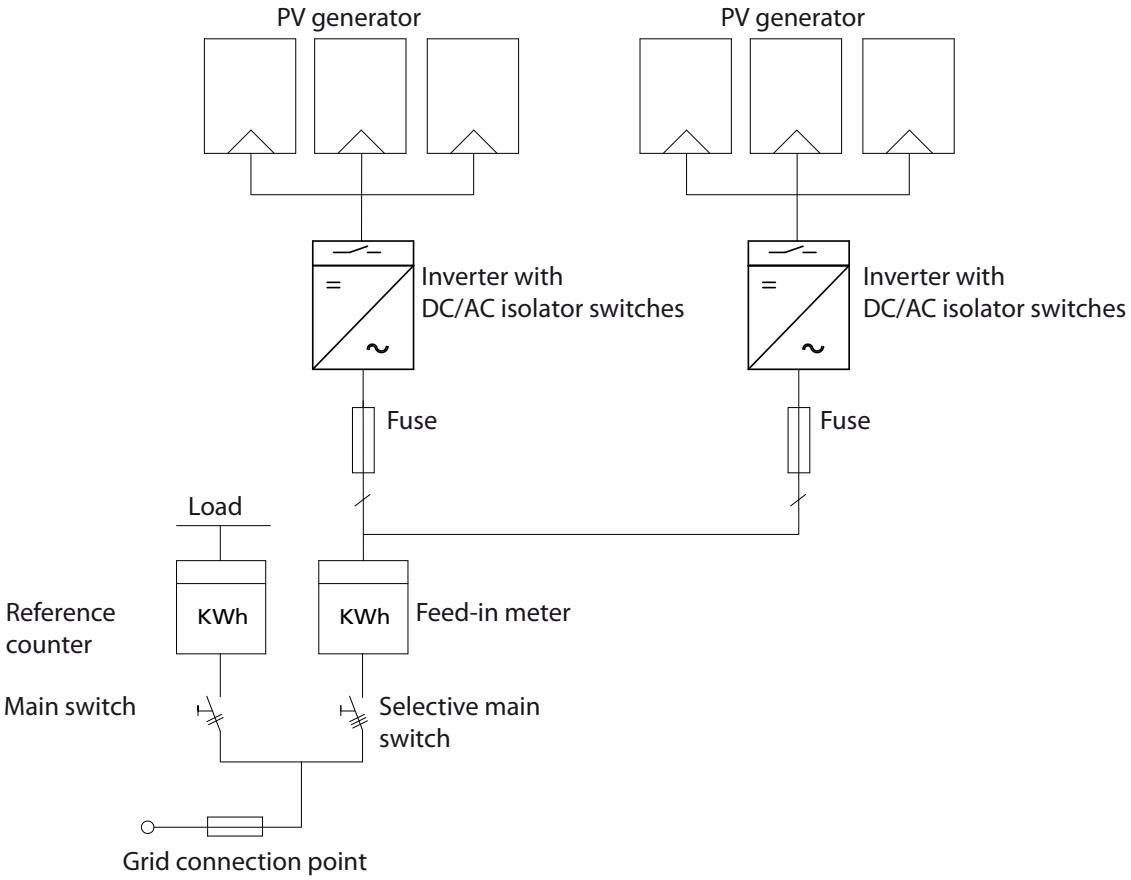


Figure 1: Circuit diagram of a system with two inverters

3.2.1.2 Summary of the components

PV generator

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

DC terminal point

Options for parallel connections of several generator strings:

- To a DC terminal point between the DC generator and inverter,
- directly on the inverter (one terminal per 1-line is included on the inverter for each device model (with one or three MPP trackers)),
- directly to the PV generator with a positive and negative lead to the inverter.

DC isolator switch (2-pole (Model M1 devices) / 6-pole (Model M3 devices))

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

AC isolator switch (3-pole)

Use the AC isolator switch to disconnect the inverter from all power sources on the grid side.

Feed-in meter

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

3.2.2 Inverter diagram

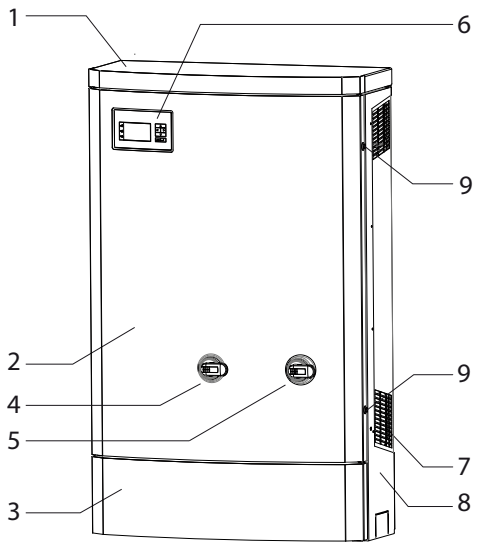


Figure 2: Inverter diagram

Key			
1	Upper housing cover	6	Control panel
2	Doors	7	Fan cover
3	Cover for the connection area	8	Side housing cover
4	AC isolator switch	9	Door locks
5	DC isolator switch		

3.2.3 Mechanical components

DC/AC isolator switches

One DC isolator switch (right) and one AC isolator switch (left) are located at the front of the inverter housing. The DC isolator switch is used to disconnect the inverter from the PV generator in order to carry out service activities. The AC isolator switch is used to disconnect the inverter from the power supply in order to carry out service activities.

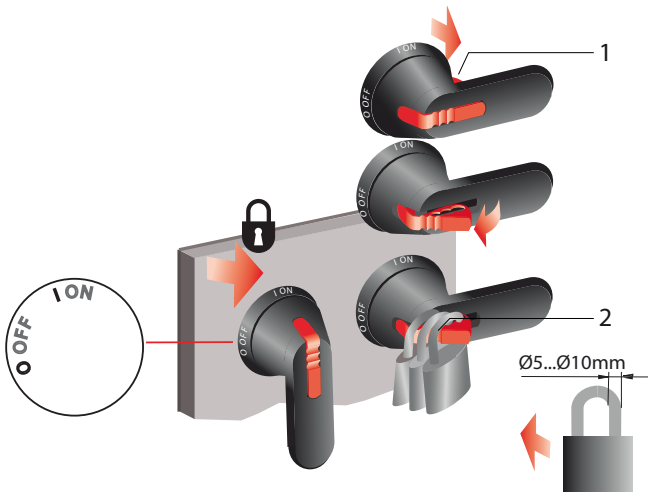


Figure 3: DC/AC isolator switches

Key

1 Safety catch

2 Hanging lock

Disconnecting the inverter from the PV generator and/or power supply

- ☞ Switch the DC/AC isolator switch from 1 (ON) to 0 (OFF).
- ☞ Press in the safety catch from behind.
- ☞ Attach the hanging lock to the safety catch.
- ☞ Lock the hanging lock.
- » The inverter is now disconnected from the PV generator and/or power supply.

Connecting the inverter to the PV generator / power supply

- ☞ Open the hanging lock.
- ☞ Remove the hanging lock from the safety catch.
- ☞ Press in the safety catch from the front.
- ☞ Switch DC/AC isolator switch from 0 (OFF) to 1 (ON).
- » The inverter is now connected to the PV generator and/or power supply.

3.2.4 Interfaces

The following interfaces are used for communication or remote monitoring or the inverter and are configured in the settings menu. (Section 8.3 on page 30).

3.2.4.1 RS485 interface and Modbus interface

Use this system monitoring function 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 and modbus interface, contact your authorised electrician.

For monitoring your PV system using the RS485 interface, KACO new energy GmbH offers monitoring devices:

3.2.4.2 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.

3.2.4.3 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.

3.2.4.4 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).

4 Technical Data

4.1 Electrical Data

Product models	32.0 TL3 M1 32.0 TL3 M3	40.0 TL3 M1 40.0 TL3 M3	50.0 TL3 M1 50.0 TL3 M3
DC electrical specifications			
DC max. input voltage (VDC)	600	1000	1000
DC peak power operating range (MPP) (VDC)	310 to 550	380 to 850	480 to 850
DC operating range (VDC)	200 to 600*	200 to 850*	200 to 850*
DC minimum start voltage (VDC)		250	
DC maximum operating current per channel (ADC)		108 (M1) / 36 (M3)	
DC maximum short circuit current per channel (ADC)		165 (M1) / 55 (M3)	
Maximum input source backfeed current (ADC)		0	
DC input overload production		Voltage and current limiting during operation	
DC input terminals / conductor size per channel A - B		1 Pos and 1 Neg / 8-14 AWG CU	
DC polarity safeguard		Short circuit diode	
Numbers of MPP-tracker		M1 (1 MPPT) / M3 (3 MPPT)	
** possible input power is reduced at voltages lower than ... (VDC)*	*310*	*390*	*480*
AC electrical specifications			
AC max. continuous output power [VA]	32,000	40,000	50,000
CE weighted eff. [%]	97	97.5	97.5
AC nominal voltage / operating range L to Neutral (VAC)		480 / 243 to 304	
AC Continuous output current (A) 480 / 600	38	48	60
Frequency nominal / range (Hz)		60 / 60.5 to 59.3	
Power factor		> .99	
Total harmonic distortion %		<5%	
Standby losses (W)		< 1.5	
Internal consumption standbye (W)		30	
Feed In Starts (W)		120	
AC branch circuit protection		Current limiting inverter, OCPD provided by branch circuit breaker	
AC input terminals and conductor		4 / 2-10 AWG AL CU	
AC Maximum output fault current (A), RMS, and duration ms		625 A (P-P), 18.25 A (RMS), 36.5ms	
Utility Connection		H4 -Wye 4 wire (A,B,C,N)	
Utility monitoring		Country specific options	

Table 1: Electrical data

PV system disconnect	
Integrated AC/DC disconnect	Yes
AC /DC disconnection means	Rotary switch accessible from outside of enclosure
AC disconnection ratings	100 A VAC Break L1-L2-L3
AC LOTO Provision	LOTO in OPEN
AC input terminals / conductor size	L1-L2-L3 N PE / 4-10 AWG AL CU
DC disconnection ratings	150 A breaking positive and negative
DC Over current protection devices (OCPD)	Not provided inside the inverter
DC LOTO Provision	LOTO in OPEN
DC input terminals / conductor size per channel	1 Pos and 1 Neg / 6-24 AWG AL CU

Table 1: Electrical data

4.2 Mechanical

Mechanical and environmental specifications	
Mechanical integration	Ground mount
Enclosure construction	Cast steel
Unit weight lbs / kg	381 / 173
Unit dimensions HxWxD In / mm	33 x 14 x 53.5/ 840 x 355 x 1360
Operating temp range (°F / °C)	(-13 to 140 / -25 to 60) possible derating above 113 °F / 45 °C
Storage temp range (°F / °C)	(-22 to 158 / -30 to 70)
Noise emissions	<58 db(A)
Humidity %	0 to 95 non condensing
Enclosure rating Inverter / PV system disconnect	NEMA 3R
Cooling	Forced convection with variable speed fan
Altitude (ft / m)	8000 / 2400
Communications and user interface	
User interface	Graphical user interface with 3 LED status indicators
Connectivity	Ethernet (Modbus (TCP IP)), USB, RS485, S0 output
Safety features and regulatory compliance	
UL / IEEE / CSA / FCC	UL 1741 2nd Ed 2010 / CSA C22.2No 107.1 / IEEE 1547 / FCC Class B / UL1998
Fault signal relay	Potential free normally open contact
Polarity safeguard	Short circuit diode
CE conformity	Yes
GFDI compliant with NEC 690.35 for use with ungrounded PV system arrays.	UL1741 listed for residual ground fault current isolation monitor and interrupter function.

Table 2: Mechanical data

5 Transportation and Delivery

5.1 Delivery

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

5.1.1 Scope of delivery

- Inverters
- Housing covers: Cover plates right and left, cover
- Installation kit
- DC and AC isolator switches
- Connection set
- Documentation

5.2 Transportation

WARNING

Impact hazard, risk of breakage to the inverter

› Pack the inverter securely for transport.

› Carefully transport the inverter using the built-in eyebolts.

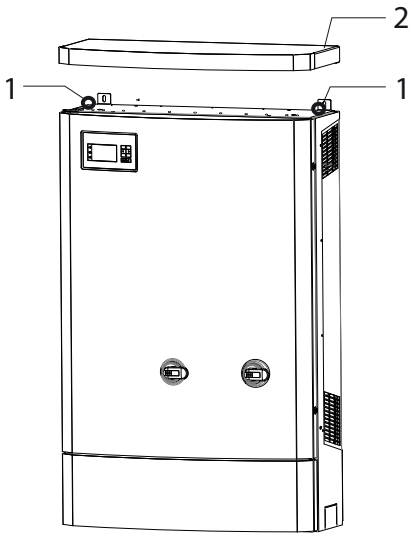


Figure 4: Transportation of the inverter

Key			
1	Eyebolts	2	Cover

6 Mounting the inverter

DANGER

Risk of fatal injury from fire or explosions

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

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

CAUTION

Risk of burns from hot housing components.

Coming into contact with the housing can cause burns.

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

Installation space

- As dry as possible, climate-controlled, with the waste heat dissipated away from the inverter,
- Unobstructed air circulation,
- When installing the unit in a control cabinet, provide forced ventilation so that the heat is sufficiently dissipated,
- Close to the ground, accessible from the front and sides without requiring additional resources
- Protected from direct sunlight and moisture (rain) in outdoor areas,
- For easy operation, ensure during installation that the display is slightly below eye level.

Wall

- With sufficient load-bearing capacity,
- Accessible for installation and maintenance,
- Made from heat-resistant material (up to 194°F/90 °C),
- Flame resistant,
- Minimum clearances to be observed during assembly: see Figure 6 on page 14 and Figure 7 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.

NOTICE

Power reduction due to heat accumulation.

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

› Maintain minimum clearances.

› Ensure sufficient heat dissipation.

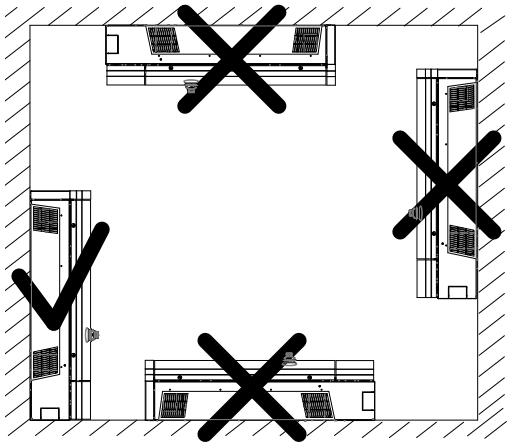


Figure 5: Instructions for wall mounting

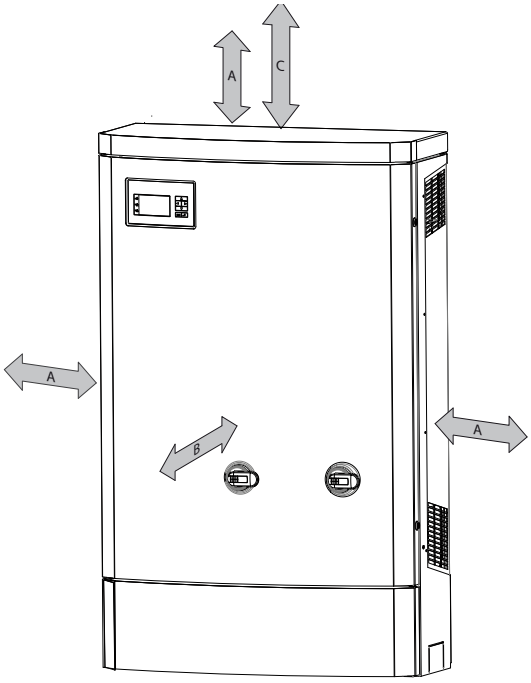


Figure 6: Minimum clearances

Key

A	horizontal distance between the two inverters / vertical distance between inverter and the ceiling	16.7 In / 50 cm
B	Distance in front	39.4 In / 100 cm
C	Vertical distance to an additional inverter suitable for wall mounting	27.6 In / 70 cm

CAUTION

Select a proper foundation conditions.

› Use only the supplied mounting parts.

› Only install inverter in an upright position.

› If you mount the inverter to a wall, only mount it to a vertical wall.

CAUTION

Use suitable mounting parts.

› Use only the supplied mounting parts.
› Only install inverter in an upright position.
› If you mount the inverter to a wall, only mount it to a vertical wall.

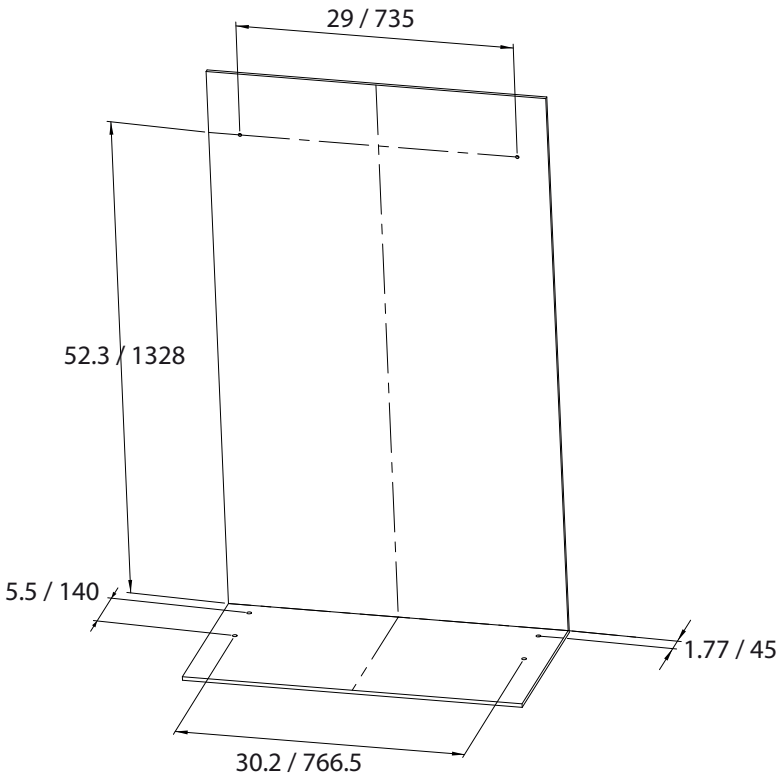


Figure 7: Drilling separation (in In/mm)

6.1 Installing and securing the inverter

Drilling the holes

1. Mark (4x) drill holes on bottom.
2. For additional wall mounting: Mark position of (2x) drill holes on wall.
3. Drill the holes.
4. For additional wall mounting: countersink the anchor in the wall.

» 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 additional wall mounting: use the 2 screws to secure the inverter to the wall.

» Install the housing.

6.2 Installing the DC and AC isolator switches

NOTE

To prevent damage to the DC and AC isolator switches during transport, both isolator switches are enclosed with the unit in an installation bag.

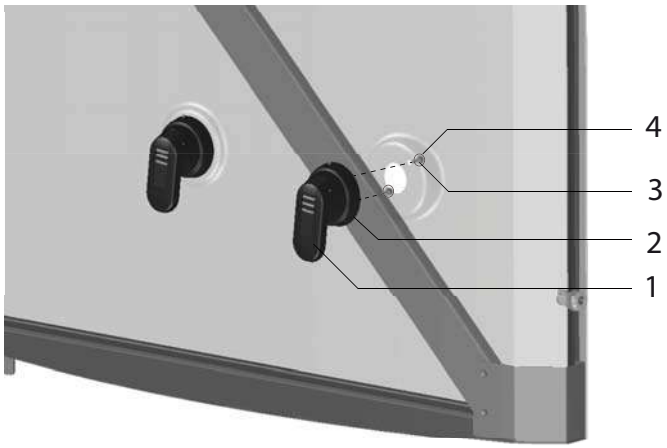


Figure 8: Installing the DC and AC isolator switches

Key			
1	DC and AC isolator switches	3	Screws (M4x8)
2	Sealing ring with ON / OFF label	4	Plain washer

Installing the DC and AC isolator switches

↻ You have set up the unit and secured it.

1. Open both door locks with a suitable slotted-head screwdriver. (Blade width (8 mm) cf. ISO 2380-2)
2. Slowly open the doors.
3. Remove and open the installation bag containing the DC/AC isolator switches from the unit.
4. Press the back of the DC/AC isolator switches to the intended opening of the doors so that the switch is pointing down and the label "ON" is up.

↻ The sealing ring with the label ON / OFF must be attached flush against the door wall.

5. Place the screws with washers in the holes of the doors and start the threads of the isolator switch.
6. Use a suitable cross- or slotted-head screwdriver to tighten the screws. (Tightening torque is 1.5 Nm)
7. Check that the switch works and is sealed properly. (Protection class IP54)
8. Move the switch to the OFF position.
9. Check the positioning of the switch for the DC/AC isolator switch and to make sure it is properly seated.
10. Close doors slowly so that the switching bar is inserted directly in both isolator switch.
11. Secure the door locks on the housing.

» Install the inverter.

7 Installing the inverter

DANGER

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

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

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

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

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

NOTICE

The doors can only be opened by switching off both DC/AC isolator switches and then unlocking both door latches.

7.1 Opening the connection area

Opening the connection area

↻ You have mounted the inverter.
↻ Switch the DC/AC isolator switches to OFF.
» Power has been disconnected from the unit.
1. Open both door locks with a suitable slotted-head screwdriver.
2. Slowly open the doors.
3. Remove the cover of the connection area.
» Make the electrical connection.

7.2 Drilling holes for electrical and interface connections

The Inverter is shipped with a connection board. You are required to drill holes into the board to accommodate the AC, DC and interface connection leads.

To avoid interference between current-carrying leads and interface cables, adhere to the following drawings:

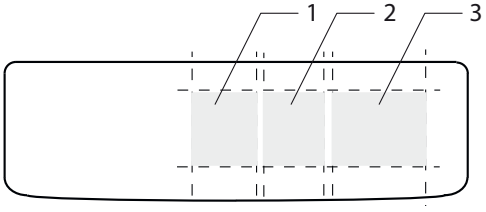


Figure 9: Connection board

Key			
1	Connection area for AC leads	3	Connection area for DC leads
2	Connection area for interface and grounding leads		

7.3 Making the electrical connection

ACTIVITY

Cables to the AC and DC screw terminals must be re-tightened at regular intervals to the required torque.

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 conductor cross-sections:

	AC connection (M1/M3)	DC connection (M1)	DC connection (M3)
Max. conductor cross-section without wire sleeves	1 AWG / 50 mm²	-	8 AWG / 10 mm²
Min. conductor cross-section with wire sleeves	3 AWG / 35 mm²	-	8 AWG / 10 mm²
Max. conductor cross-section with cable shoe	-	0 AWG / 70mm² with M8 ring cable lug	-
Length of insulation to be stripped off	0.944 In / 24 mm	0.984 In / 25 mm	0.984 In / 25 mm
Tightening torque	2.5-4 Nm	2.5 Nm	2.5 Nm

Fuses	
Overvoltage conductor	Built-in, type II

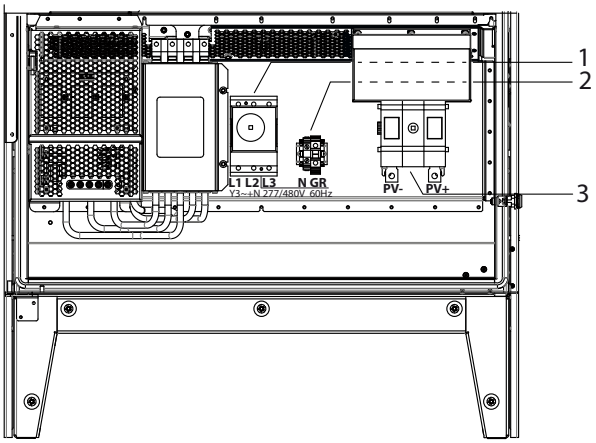


Figure 10: Electrical connection (M1 Model)

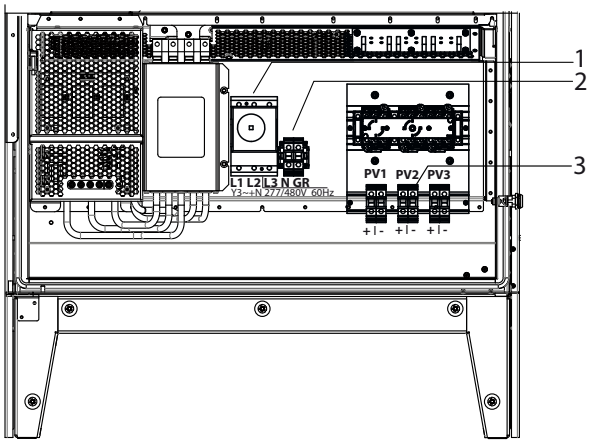


Figure 11: Electrical connection (M3 Model)

Key			
1	AC connection terminals	3	DC connection terminals
2	N; Ground, (HOT,GND)		

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 on page 18).

DANGER

Risk of fatal injury due to electric shock

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

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

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

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

For cable lengths up to 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
32.0 - 40.0 TL3	5 AWG / 16 mm²	63 A
50.0 TL3	2 AWG / 35 mm²	100 A

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.

NOTICE

The installation must be performed in accordance with NFPA 70 and Canadian electrician code part I and additional local requirements.

NOTICE

Use copper conductors only.

NOTICE

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

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

Prepare the grid connection

↻ Drill a hole for the AC leads into the connection board.

1. Remove the outer cladding of the AC leads.
2. Insert the AC leads through the hole into the connection area through the conduit pipe.
3. Strip the insulation from the AC leads.
4. Open the locks of the PCB terminals.
5. Connect the leads according to the labels on the PCB terminals.
6. Close the locks of the PCB terminals.
7. Check that all connected leads are tightly seated.
8. The inverter is now connected to the power grid.

Making the grid connection

1. Route L1, L2 and L3 through the enclosed ferrite clip.
2. Connect the cables in accordance with the label on the PCB terminals (Figure 12 on page 19).
3. Connect the ground and N-terminal to the specified connection terminal. Note the cable cross-sections.
4. Check that all connected cables are securely fitted.
5. Tighten the cable fitting.

» The inverter is now connected to the power grid.

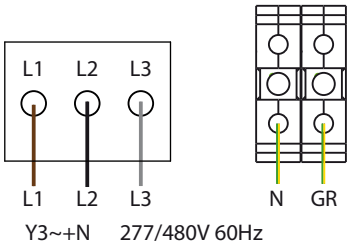


Figure 12: Connection

7.3.2 Connecting the PV generator

Connect the PV generator on the right of the connection area (see Figure 10 on page 18).

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

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

   are identified.

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

   are identified.

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.

NOTICE

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 sunlight present, there is DC voltage on the open ends of the DC cables.

› Do not touch the exposed ends of the cables.

› Avoid short circuits.

Connecting the PV generator

1. Remove 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. Connect the ends of the cables to the DC connections per string (+/-).
5. Check that all connected cables are securely fitted.

» The inverter is connected to the PV generator.

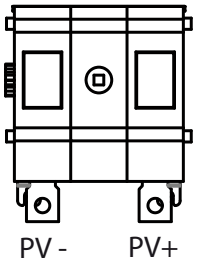


Figure 13: PV connection (M1)

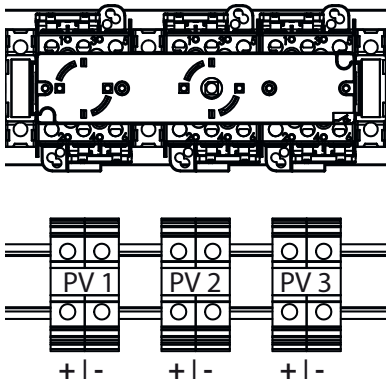


Figure 14: PV connection (M3)

7.3.3 Grounding the housing

An optional grounding of the housing is possible at the grounding point provided for that purpose in the connection area of the inverter. Please observe any national installation regulations in this regard.

Ground the housing of the inverter, if necessary, at the grounding point provided for that purpose in the connection area of the inverter. It is marked with the ⏚ symbol.

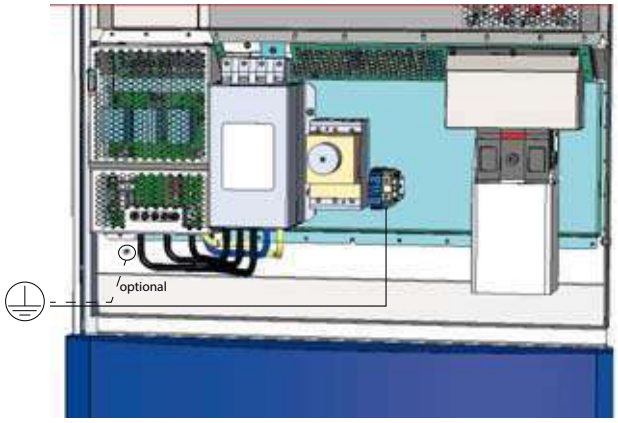


Figure 15: Grounding point in the connection area

Grounding the housing

↻ Drill a hole for the grounding lead into the connection board.

1. Remove the outer cladding from the grounding lead.
2. Insert the grounding lead into the connection area through the conduit pipe.
3. Remove the insulation from the grounding lead.
4. Furnish the stripped lead with an M6 ring cable lug.
5. Screw the ring cable lug to the grounding point with an M6x16 screw.
6. Check for firm seating of the lead.

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.

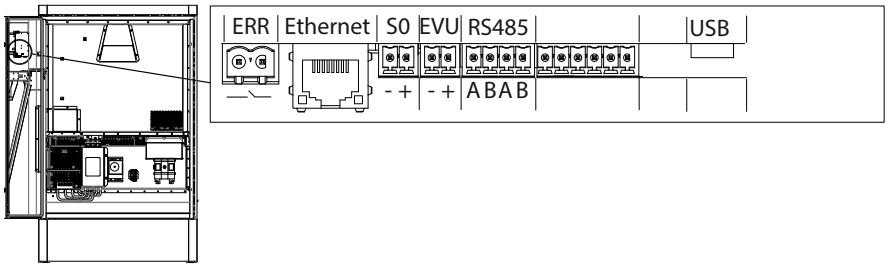


Figure 16: Connection area: connecting the interfaces.

7.4.1 Routing the interface cables

The cables for the interfaces are routed through the doors as in the following section.

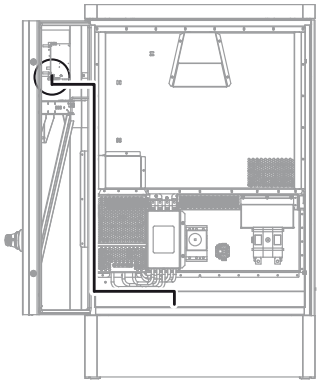


Figure 17: Routing the interface cable

7.4.2 Connecting the fault signal relay

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

Maximum contact load	
DC	30 V / 1 A
AC	277 V / 1 A

Connecting the fault signal relay

1. Route the connection cables into the connection area.
2. Connect the connection cables to the connection terminals.

7.4.3 Connecting the Ethernet interface

NOTICE

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.

NOTICE

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

Connecting an Ethernet cable to the inverter

1. Route the connection cables into the connection area.
2. Connect the connection cable to Ethernet interface.
3. 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.

7.4.4 Connecting the S0 output

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

Connecting the S0 output

1. Route the connection cables into the connection area.
2. Connect the connection cables to the connection terminals.

NOTICE

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

7.4.5 Connecting the RS485 bus (Modbus)

NOTE

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

NOTICE

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.

NOTICE

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.

7.4.5.1 Wiring diagram

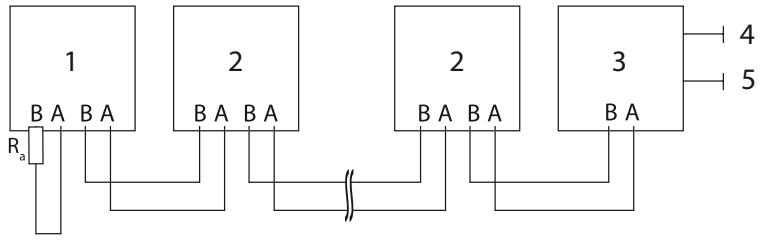


Figure 18: RS485 interface wiring diagram

Key

1	Inverter, terminal unit	4	Communication
2	Inverters	5	230 V AC
3	data logger		

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. Lengths exceeding 500m generally require a repeater or a hub.
Maximum number of connected bus devices	31 inverters + 1 data monitoring unit
Data line	Twisted, shielded. Recommendations: LI2YCYv (twisted pair) black for laying cable outside and in the ground, 2 x 2 x 0.5 LI2YCY (twisted pair) grey for dry and moist indoor spaces, 2 x 2 x 0.5

Connecting the RS485 bus

☞ To prevent interference during data transmission:

- Observe the wire pairing when connecting DATA+ and DATA- (see Figure 19 on page 25)
- Do not install RS485 bus lines in the vicinity of live DC/AC cables.

1. Route the connection cables into the connection area.
2. Connect the connection cables to the corresponding connection terminals (see Figure 16 on page 22).
3. The following must be connected to all inverters and to the data monitor unit in the same way:
   – Wire A (-) with wire A (-) and
   – Wire B (+) with wire B (+) (see Figure 18 on page 24)
4. Activate the terminating resistor on the terminal unit.

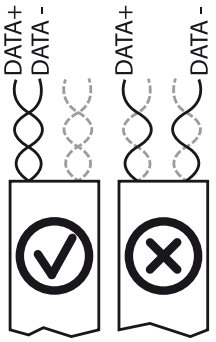


Figure 19: Assignment of twisted-pair wires

NOTICE

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) .

7.4.5.2 activate the terminating resistor in the settings menu

1. Open the menu.
2. Select "Settings"/"Interface."
3. Activate terminating resistor in the "Bus termination" menu entry.
4. Confirm with "OK".

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.

7.5 Sealing the connection area

↻ All connections have been installed by specialists.
↻ All plug connections have been checked to ensure they are secure.
5. Put on the lid for the connection area.
6. Check the positioning of the switch for the DC/AC isolator switch and to make sure it is properly seated.
7. Close doors slowly so that the switching bar is inserted directly in both isolator switch.
8. Secure the door with both door locks.
» 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 may occur if the cables and terminals in the inverter are touched.

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

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 (OFF → ON).

» The inverter begins to operate.

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

8 Configuration and Operation

8.1 Controls

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

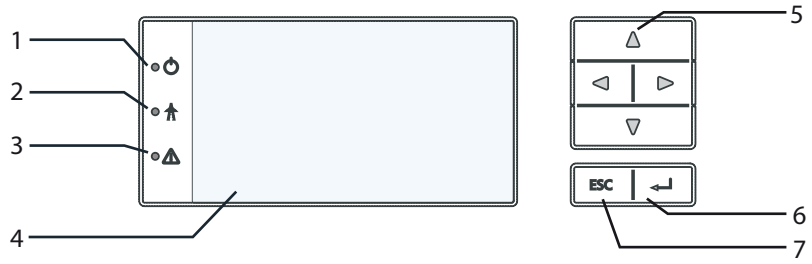


Figure 20: Control panel

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

8.1.1 LED indicators

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

●	LED illuminated	✳	LED flashing	○	LED not illuminated

The LED indicators show the following operating states:

Operating state	LEDs	Display	Description
Start	●		The green "Operating" LED is illuminated if an AC voltage is present, independently of the DC voltage.
Feed-in start Feed-in operation	● ●	Power fed into the grid or measured values	The green "Operating" LED is illuminated. The green "Feed-in" LED is illuminated after the country-specific waiting period*. The inverter is ready to feed in, i.e. is on the grid. You can hear the line relay switch on.
Feed-in operation	● ✳	Power fed into the grid or measured values	The green "Operating" LED is illuminated. The green "Grid feed" LED is flashing. The inverter is internally power-reduced and ready to feed in, i.e. is on the grid. **Alternatives** 1. Internal/external power limiting or start-up limiting is active 2. The inverter is operating in standalone mode

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

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

8.1.2 Graphical display

The graphical display shows measured values and data and allows the configuration of the inverter using a graphical menu. In normal operation, the backlighting is switched off. As soon as you press one of the control 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.

NOTICE

Depending on the tolerances of the measuring elements, the measured and displayed values are not always the actual values. However, the measuring elements ensure maximum solar yield. Due to these tolerances, the daily 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.

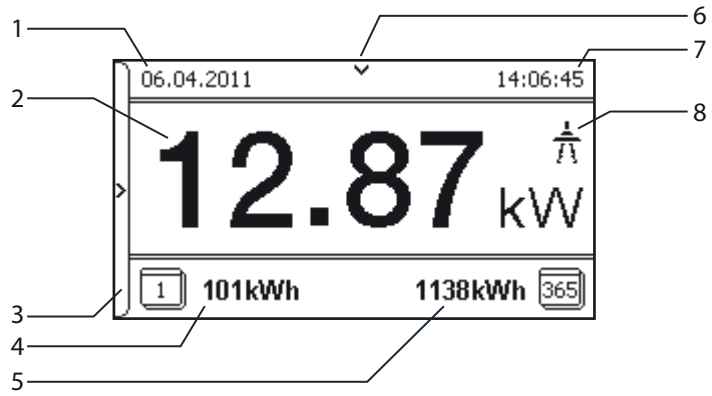


Figure 21: Desktop

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		

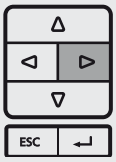
8.1.3 Control buttons

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

8.1.3.1 Desktop

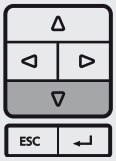
Opening the menu

↻ 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

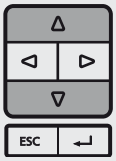
↻ The inverter is operating.
↻ The LCD is showing the desktop.
☞ Press the down arrow button.
» The LCD displays the daily yield in a diagram.
☞ To return to the desktop, press any button.



8.1.3.2 Inverter menu

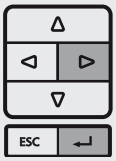
Selecting a menu item

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



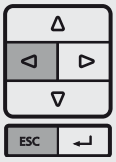
Opening a menu item or a setting

☞ Use the right arrow button and the OK button.



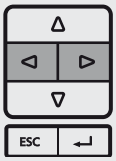
Jump to the next higher menu level/discard changes

☞ Press the left arrow button or the ESC button.



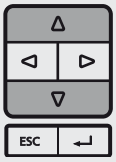
Selecting an option

☞ Use the right and left arrow buttons.



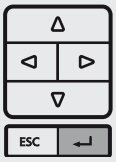
Changing an option/the value of an input field

☞ Use the up and down arrow buttons.



Saving changed settings

☞ Press the OK button.



8.2 Initial commissioning

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.

NOTICE

The sequence of the settings required for initial commissioning 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

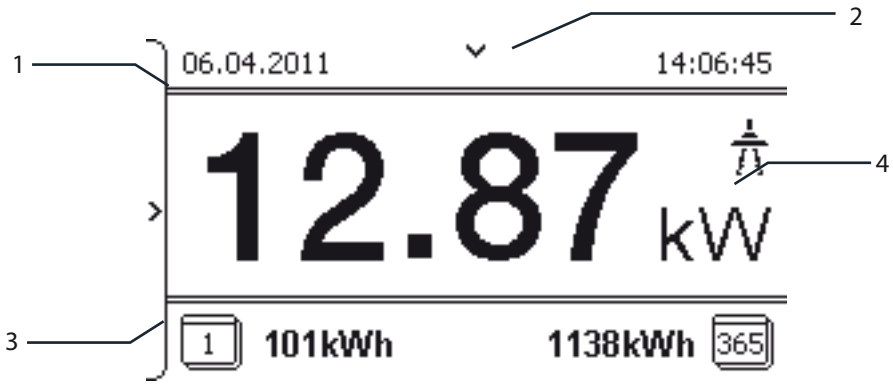


Figure 22: Main menu

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

Icons used:

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

Menu level	Display/settings		Action in this menu/meaning
Desktop	**Desktop**	↳	☞ Press the right arrow key.
0 1 2 3	**"Measurements" menu**	↳	☞ Open the menu: Press the right arrow key or the OK key.
0 1 2 3	**Generator**		Displays the DC-side voltage, amperage and power.
0 1 2 3	**Grid**		Displays the AC-side voltage, amperage and power.
1 2 3 4	**Power control**		Displays the current value of the external power limitation by the grid operator.
1 2 3 4	**cos-phi**		Indicates the status of the reactive power control.
0 1 2 3	**Unit temperature**		Displays the temperature in the inverter housing.
0 1 2 3	**Yield counter**		Displays the yield in kWh. ☞ Reset the counter using the "Reset" key.
0 1 2 3	**Yield today**		Displays the cumulative yield for the current day.
0 1 2 3	**Total yield**		Displays the total yield up to now.
0 1 2 3	**CO_2 savings**		Displays the calculated CO_2savings (in kg).
0 1 2 3	**Oper. hours counter**		Displays the duration of operation in hours. ☞ Reset the counter using the "Reset" key.
0 1 2 3	**Oper. time today**		Displays the duration of operation on the current day.
0 1 2 3	**Total op. time**		Displays the total operating time.
0 1 2 3	**Log data view**	↳	☞ Open the menu: Press the right arrow key or the OK key.
0 1 2 3	**Daily view**		Displays the recorded operating data graphically. 1. Select the measured value to be displayed. Supported measured values: • Grid power P(grid) • DC power per string P(PV) 1-2 • DC voltage per string U(PV) 1-2 • Unit temperature 2. Select a date. 3. Press the OK key. » The display shows the selected data. ☞ Press any key to return to the previous menu.

Menu level	Display/settings		Action in this menu/meaning
0 1 2 3	**Monthly view**		Displays the recorded operating data graphically. 1. Select a date. 2. Press the OK key. » The display shows the selected data. ☞ Press any key to return to the previous menu.
0 1 2 3	**Yearly view**		Displays the recorded operating data graphically. 1. Select a date. 2. Press the OK key. » The display shows the selected data. ☞ Press any key to return to the previous menu.
1 2 3 4	**CSV log data**	⮡	☞ Open the menu: Press the right arrow button or the OK button.
1 2 3 4	**Decimal separator**		☞ Select decimal sign for export of saved operating data.
0 1 2 3	**Save to USB**		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. 1. Select the data to be exported (year, month or day) with the 4-way key. 2. Press the OK key. » The inverter writes the data to the USB storage device.
0 1 2 3	**"Settings" menu**	⮡	☞ Open the menu: Press the right arrow key or the OK key.
0 1 2 3	**Language**		☞ Select the desired language for the user interface.
0 1 2 3	**Define total yield**		You set the total yield to a freely selectable value, for example, when you have received a replacement unit and want to continue the recording from the present value. ☞ Select the "Save" button and confirm with the OK button.
0 1 2 3	**Interface**		☞ If the inverter is a terminal unit: Activate termination ("Bus termination" menu item) ☞ Assign a unique RS485 bus address to the inverter ("proLOG address" menu item). The address must not coincide with that of another inverter or a proLOG unit.
0 1 2 3	**S0 pulse rate**		☞ Set the pulse rate of the S0 connection.
1 2 3 4	**Quick start**		☞ Reduce the waiting times during the self test by pressing the "Activate" key.
0 1 2 3	**Logging interval**		☞ Set the time between two log data recordings.
0 1 2 3	**Log data backup**		The inverter supports the backing up of all recorded yield data to a connected USB storage device. ☞ Activate or deactivate log data backup.

Menu level	Display/settings		Action in this menu/meaning
0 1 2 3	**Display**		☞ Configure the contrast setting for the display. ☞ Set the length of time without user input after which the backlighting of the LCD switches off. ☞ Alternatively: Permanently activate or deactivate backlighting by selecting "On" or "Off".
0 1 2 3	**Date & time**		☞ Set the time and date. **NOTICE:** For self-diagnostic purposes, the inverter carries out a daily restart at midnight. To avoid having a restart occur during feed-in operation and to always obtain reliable log data, ensure that the time is correctly set.
1 2 3 4	**Network**	⮡	☞ Open the menu: Press the right arrow button or the OK button.
1 2 3 4	**DHCP**		Activate or deactivate DHCP. ☞ On: Activate DHCP. Once the DHCP server becomes available, the IP address, subnet mask, gateway and DNS server are automatically applied and the aforementioned menu items are hidden. ☞ Off: DHCP deactivated, make settings manually.
1 2 3 4	**IP address**		☞ Allocate a unique IPv4 address in the network.
1 2 3 4	**Subnet mask**		☞ Allocate a network mask
1 2 3 4	**Gateway**		☞ Enter IPv4 address of gateway.
1 2 3 4	**DNS server**		☞ Enter IPv4 address of DNS server.
0 1 2 3	**Web server**		Activate or deactivate Webserver. ☞ On (Default Status): Activate Webserver. Define a port number from 1 to 65535. Default setting 80. ☞ Off: Webserver is deactivated.
1 2 3 4	**Powador-web**		☞ On: The inverter attempts to connect to the Powador-web web portal. ☞ Off: The connection to Powador web is deactivated.
1 2 3 4	**Modbus TCP**		Activate or deactivate Modbus TCP. ☞ On (Default Status): Activate Modbus TCP. Define a port number from 1 to 65535. Default setting 502. ☞ Off: Modbus TCP is deactivated.
1 2 3 4	**Connection status**		Indicates the status of the network connection:
0 1 2 3	**"Parameters" menu**	⮡	☞ Press the right arrow key or the OK key. **NOTICE:** The inverter does not display the "Parameters" menu in the standard configuration. To display the menu: 1. Open the menu. 2. Simultaneously hold down the up and down keys for several seconds.

Menu level	Display/settings		Action in this menu/meaning
0 1 2 3	**Country**		1. Input the four-character password via the 4-way key. The password is unit-specific. 2. Confirm the entry with the OK key. 3. Set the desired country setting. NOTICE: This option influences the country-specific operating settings of the inverter. Please consult KACO service for further information.
0 1 2 3	**Grid type/ Directive**		☞ If available, select the type of grid applicable to the use of the inverter.
0 1 2 3	**Overvoltage shutdown** **Undervoltage shutdown**		The inverter is equipped with redundant 3-phase monitoring. If the grid frequency exceeds or drops below the configured values, the inverter switches off. The minimum switch-off threshold can be set in 1 V increments. ☞ Configure the switch-off values for undervoltage and overvoltage. ☞ Set period from occurrence of the fault to shutdown of the inverter.
0 1 2 3	**Overfrequency shutdown** **Underfrequency shutdown**		The inverter monitors the grid frequency continuously. If the grid frequency exceeds or drops below the configured values, the inverter switches off. ☞ Set limit values for underfrequency and overfrequency in 0.1 Hz increments. ☞ Set period from occurrence of the fault to shutdown of the inverter.
0 1 2 3	**DC starting volt.**		The inverter begins feed-in as soon as this PV voltage is present. ☞ Set the starting voltage.
0 1 2 3	**Const. volt. ctrl**		Offers the possibility of deactivating the MPP seek mode in order to operate the inverter with a constant DC voltage. ☞ Activate or deactivate MPP seek mode. ☞ Set value for constant voltage control (see Chapter 4.1 on page 10). **NOTICE:** The possible input power is reduced at voltages under 350V. The input current is limited to 18.6 A per input.
0 1 2 3	**Power limitation**		The output power of the inverter can be set permanently to a lower value than the maximum output power by the internal power limiting. This may be necessary in order to limit the maximum power rating of the system at the grid connection point, upon the grid operator's request. The value can be protected from the very first output limitation entry. After setting a limitation, the value can only be changed by entering a device-specific password. 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.
0 1 2 3	**Iso. resistance**		☞ Set threshold value (in 1 kOhm steps) at which the insulation monitor reports a fault. **NOTICE:** The PV inverter performs a self detection of RCMU every time before connecting to grid to make sure the RCMU can operation normally. Also the output relays are checked after RCMU self-detection.

Menu level	Display/settings		Action in this menu/meaning
US-277 0 1 2 3	**Activate FRT**		The inverter supports dynamic grid stabilisation (Fault Ride-Through) in accordance with the BDEW Medium Voltage Directive. - Specify constant k. - Specify the dead band. - Activate or deactivate FRT.
US-277 0 1 2 3	**Reactive power**	⌙	☞ Open the menu: Press the right arrow button or the OK button. ☞ Activating reactive power process: select process and press OK. The active process is highlighted.
US-277 0 1 2 3	**cos-phi const.**		☞ Configure power factor. ☞ If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited / over-excited).
	Q const.		☞ Set the reactive power Q (in %) to a fixed value. ☞ Select the type of phase shift (under-excited / over-excited).
	cos-phi(P / Pn)	⌙	☞ Open the menu: Press the right arrow button or the OK button.
US-277 0 1 2 3	**Number of nodes**		This option defines how many support node can be defined in the sub-sequent menu. ☞ up to 10 support nodes can be defined ☞ Specify the number of support nodes for the reactive power characteristic curve.
	1., 2. ...node		☞ Specify the power factor for the 1st, 2nd (etc.) support nodes ☞ If a power factor not equal to 1 is selected: Select the type of phase shift (under-excited / over-excited).
US-277 0 1 2 3	**Q(U) characteristic**		☞ Specify the target voltage. ☞ Specify slope. ☞ Specify change time.
0 1 2 3	**"Information" menu**	⌙	☞ Open the menu: Press the right arrow key or the OK key.
0 1 2 3	**Inverter type**		Displays the type designation of the inverter.
0 1 2 3	**SW version**		Displays the installed software version.
0 1 2 3	**Serial number**		Displays the serial number of the inverter.
0 1 2 3	**Display country**		Displays the selected country setting. Optional: Displays the grid type if a grid type has been selected.
0 1 2 3	**"Vendor" menu**	⌙	» The display shows information about the unit manufacturer.

8.4 Monitoring the inverter

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

You can display the recorded data via:

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

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

8.4.1 USB interface

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

8.4.1.1 Reading log data

NOTICE

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

Reading log data

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

» The inverter saves the selected log data (CSV data format) to the USB storage device.

8.4.2 Web server

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

8.4.2.1 Setting up the web server

Configuring the Ethernet interface

↻ You have connected the inverter to your network.

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

8.4.2.2 Using the web server

To avoid problems with incompatibility, use the most recent version of your Internet browser.

NOTICE

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

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

Calling up the web server

↻ Configure the Ethernet interface.

↻ Connect the Ethernet interface.

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

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

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

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

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

Select the display period

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

Filtering display data (day view only)

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

Exporting data

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

NOTICE

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

8.5 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).

NOTICE

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

CAUTION

Damage to the inverter

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

» Do not interrupt the DC and AC power supply during the update process.

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

↻ Prepare for the software update.

↻ 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 is finished when the desktop is shown on the display screen.

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

☞ 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 can result if moisture enters 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.

Authorized 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 may occur if the cables and terminals in the inverter are touched.

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

› Observe all safety regulations and the currently applicable technical connection specifications of the responsible power supply company.

› Disconnect the AC and DC sides.

› Secure the AC and DC sides from being inadvertently switched back on.

› Do not open the inverter until after these two steps are complete.

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

CAUTION

Destruction of the DC connection

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

› It is absolutely necessary that the shutdown sequence be 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.

NOTE

The screw connections must be checked by installers at regular intervals to ensure they are tightened to required torques (see page 7.3 on page 18).

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 may occur if the cables and terminals in the inverter are touched.

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

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

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

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

9.4.2 Troubleshooting

B = Action of the operator

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

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

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

Table 4: Troubleshooting

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

Table 4: Troubleshooting

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

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

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

9.5.2 Status and fault signals

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

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	
OS	1	Waiting for feed-in	○	○	Self-test: The grid parameters and generator voltage are being checked.	-	-
OS	2	Generator voltage too low	○	○	Insufficient generator voltage and power, status before the transition to night shutdown	-	-
OS	8	Self-test	○	○	Checks the shutdown of the power electronics as well as the grid relay before feed-in mode.	-	-
FS	10	Temperature in unit too high	○	●	In case of overheating (>140°F(60°C)), the inverter switches off. Possible causes: • Ambient temperature too high, • Fans covered, • Inverter defective.	☞ Cool off the area around the inverter. ☞ Uncover the fans. ☞ Notify your authorised electrician.	**B** **B** **E**
OS	11	Power limitation	●	○	If the generator power is too high, the inverter limits itself (e.g. around noon if the generator capacity is too large) or the temperature of the heat sink on the inverter is hotter than 75°C.		
FS	18	Resid. current shutdown	○	●	Residual current was detected. The feed-in was interrupted.	☞ Notify your authorised electrician.	**E**
FS	19	Generator insulation fault	○	●	There is an insulation fault on the PV generator. The feed-in was interrupted.	☞ Notify your authorised electrician if the fault occurs several times.	**E**
FS	30	Fault Transformer fault	○	●	The current and voltage measurements in the inverter are not within acceptable range.	-	-
FS	32	Fault Self-test	○	●	The internal grid separation relay test has failed.	☞ Notify your authorised electrician if the fault occurs several times.	**E**
FS	33	Fault DC feed-in	○	●	The DC feed-in has exceeded the permitted value. This DC feed-in can be caused by grid conditions and may not neccessarily indicate a fault.	☞ Notify your authorised electrician if the fault occurs several times.	**E**

Table 5: Operating status and fault messages on the display

Status		Display			Explanation	Action	
FS	34	Internal communication error	○	●	A communication error has occurred in the internal data transmission.	☞ Notify your authorised electrician. ☞ Check the data cable.	**E**
FS	35	Protection shutdown SW	○	●	Protective shutdown of the software (AC overvoltage, AC overcurrent, DC link overvoltage, DC overvoltage, DC overtemperature).	Not a fault Grid-related shutdown, the grid connects again automatically.	
FS	36	Protection shutdown HW	○	●	Protective shutdown of the hardware (AC overvoltage, AC overcurrent, DC link overvoltage).	Not a fault Grid-related shutdown, the grid connects again automatically.	
FS	38	Generator overvoltage error	○	●	The voltage of the DC generator is too high. The PV generator is configured incorrectly.	☞ Notify your authorised electrician.	**E**
FS	41 42 43 44 45 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.	**E**
FS	47	Line failure: line-to-line voltage	○	●	The measured line-to-line voltage is outside of the tolerance limits. The phase angle between the individual phases of the three-phase supply network is not correct, possibly no three phase connection	☞ Notify your authorised electrician.	**E**
FS	48	Line failure: Under frequency	○	●	Grid frequency is too low. This fault may be grid-related.	☞ Notify your authorised electrician.	**E**
FS	49	Line failure: Over frequency	○	●	Grid frequency is too high. This fault may be grid-related.	☞ Notify your authorised electrician.	**E**
FS	50	Line failure: average voltage	○	●	The grid voltage measurement according to EN 50160 has exceeded the maximum permitted limit value. This fault may be grid-related.	☞ Notify your authorised electrician.	**E**
FS	57	Waiting for reconnect	○	●	Waiting time of the inverter after a fault.	Inverter does not switch on again until the country-specific time has elapsed.	
FS	58	Overtemperature Control card	○	●	The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware.	☞ Provide for sufficient ventilation.	**E**
FS	59	Self test error	○	●	A fault occurred during a self-test.	☞ Notify your authorised electrician.	**E**
OS	60	Generator voltage too high	○	●	The inverter does not begin feeding into the grid until the PV voltage falls below a specified value.	-	-

Table 5: Operating status and fault messages on the display

Status		Display			Explanation	Action	
OS	61	External limit (%)	☀	○	The external limit *Power control* was activated by the grid operator. The inverter limits its power. (SCADA)		
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.	**E**
FS	70	Fan error	●	○	The fan is malfunctioning.	☞ Replace defective fan	**E**
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.	-	-
FS	78	Resid. current shut-down	○	●	Measured AFI fault current was > 180 mA. Fault results in immediate shut-down of the device.	☞ Notify authorised electrician / KACO Service	**E/K**
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.	**E**
FS	84	Protection shutdown undervolt. DC link	○	●	A voltage deviation has been found in the DC link. An internal protective mechanism has disconnected the device to protect it against damage.	☞ In case of repeated occurrence: Notify your authorised electrician.	**E**
FS	85	Protection shutdown overvolt. DC link	○	●			**E**
FS	86	Protect. shutdown DC link asymmetry	○	●	Overvoltage has been found in the DC link. An internal protective mechanism has disconnected the device to protect it against damage.	☞ In case of repeated occurrence: Notify your authorised electrician.	**E**
FS	87, 88, 89	Protection shutdown overcurrent L1, L2, L3	○	●	A current that has been found on a conductor is too high. An internal protective mechanism has disconnected the device to protect it against damage.	☞ In case of repeated occurrence: Notify your authorised electrician.	**E**
FS	93, 94	Self test error Buffer 1, Buffer 2	○	●	The control board is defective.	☞ Notify authorised electrician / KACO Service	**E/K**

Table 5: Operating status and fault messages on the display

Status		Display			Explanation	Action	
FS	95, 96	Self test error Relay 1, Relay 2	○	●	The power section is defective.	☞ Notify KACO Service	**K**
FS	97	Protection shutdown overcurrent HW	○	●	Too much power has been fed into the grid. Complete disconnection of the device.	☞ Notify authorised electrician / KACO Service	**E/K**
FS	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	**E/K**
FS	100	Protect. shutdown HW overheating	○	●	The device has been switched off because the temperatures in the housing were too high.	☞ Check to make sure that the fans are working. ☞ Replace fan if necessary.	**B** **E**
FS	101 to 106	Plausible error temperature, efficiency, DC link, AFI module, relay, DC/DC converter	○	●	The unit has shut down because of implausible internal measured values.	☞ Notify KACO Service	**K**
FS	121	Door open	○	●	The door is open. The unit has interrupted the feed-in.	☞ Close door. ☞ Check the contact switch for free movement.	**E**

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:

- Inverter type / serial number
- Fault message shown on the display / Description of the fault / Did you notice anything unusual? / What has already been done to analyse the fault?
- Module type and string circuit
- Date of installation / Start-up report
- Consignment identification / Delivery address / Contact person (with telephone number)
- 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 our warranty conditions on our website:

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

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

Please use our website to register your unit immediately:

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

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.

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

Hotlines

Technical troubleshooting	+1 866 KACOSOL (1 (866) 522-6765)
Technical consultation	+1 866 KACOSOL (1 (866) 522-6765)

(*) Also on Saturdays from 8:00 a.m. to 2:00 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 may occur 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 can be destroyed by arcing if disconnected while still live.

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

Shutdown sequence

1. Disconnect the mains voltage using the AC isolator switch.
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. Pull out the cables.

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

11.3 Dismantling the inverter

↻ Shut down the inverter.

↻ Uninstall the inverter.

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

12 Recycling and disposal

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

KACO does its best to ensure our vendors follow a low carbon manufacturing process as we do ourselves. It is not always possible but if you have questions about our products or the components in our products don't hesitate to call +1 866 KACOSOL and ask.

Device

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

Packaging

Ensure that the transport packaging is recycled.

13 Appendix

EU Declaration of Conformity

Vendor's name and address	**KACO new energy GmbH** Carl-Zeiss-Straße 1 74172 Neckarsulm, Germany
Product description	**Photovoltaic feed-in inverter**
Type designation	**KACO blueplanet 32.0 TL3 – M1/M3** **KACO blueplanet 40.0 TL3 – M1/M3** **KACO blueplanet 50.0 TL3 – M1/M3**

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	**Safety of the unit**
"Directive relating to electrical	IEC 62109-1:2010
equipment designed for use	IEC 62109-2:2011
within specific voltage limits"	**Interference immunity**
	EN 61000-6-1:2007
2004/108/EC	**Emitted interference**
"Directive relating to electromagnetic	EN 61000-6-3:2007
compatibility"	**Secondary effects on the grid**
	EN 61000-3-12:2005
	EN 61000-3-11:2000

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

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

Neckarsulm, 11/04/2013
KACO new energy GmbH

p.p. Matthias Haag
CTO

3005151-01-130411

KACO new energy

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