KACO new energy.

KACO blueplanet gridsave 50.0TL3-S

Basic, M, L, XL

Manual

■English translation of German original

⚠ Authorised electrician

Important safety instructions

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

Legal provisions

KACO warranty

For current warranty conditions contact your system integrator.

Definitions on product designations

In these operating instructions, the product "Bidirectional feed-in inverter" is referred to as "device" for ease of reading.

Trademarks

KACO new energy.

Manual

bidirectional feed-in inverter

EN

Contents

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 in order to install and use the device safely!

Other applicable documents

Some of the documents which are required to register your system and have it approved are included with the operating instructions.

English translation of German original

This document has been produced in several languages. The German-language version is the original version. All other language versions are translations of the original version.

This document is valid for the following types of device from firmware version V5.56 onwards

Type designation	blueplanet gs 50.0TL3-S B1 WM OD IIGB	[1001742]
[KACO art. no.]	blueplanet gs 50.0TL3-S B1 WM OD IIGM	[1001743]
	blueplanet gs 50.0TL3-S B1 WM OD IIGL	[1001732]
	blueplanet gs 50.0TL3-S B1 WM OD IIGX	[1001741]

1.2 More information

Links to more detailed information can be found at www.kaco-newenergy.com

Document title	Document type
Technical data sheet	Product flyer
Remote access via web interface	Application note - operation
Modbus© protocol	Application note (EN)

1.3 Layout of Instructions

1.3.1 Symbols used

	General hazard		Fire and risk of explosion
	Electrical voltage		Risk of burns
	Earthing - ground conductor		

1.3.2 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.

EN

⚠ 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.

1.3.3 Additional information symbols

NOTE

Useful information and notes

Information that is important for a specific topic or objective, but that is not safety-relevant.

1.3.4 Symbols for instructions

↻ Prerequisite for use

1 Carry out the next step

2 Additional action sequence

⇨ Interim result of the action

» End result

1.4 Identification

You will find the name plate with the following data for service and other requirements specific to installation on the right side panel of the product:

- Product name
- Part no.
- Serial number
- Date of manufacture
- Technical data
- Disposal information
- Certification marking, CE marking.

Fig. 1: Name plate

1.5 Warnings on the device

A warning sticker is affixed to the device. Read the warnings carefully.

Do not remove the sticker. If the sticker is missing or is illegible, please contact a KACO representative or distributor.

- Article number: 3009476

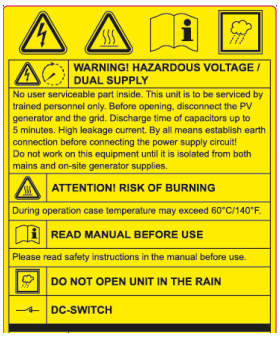


Fig. 2: Warning sticker

1.6 Target group

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

- Knowledge on the function and operation of a bidirectional feed-in inverter.

- Training in the handling of hazards and risks during the installation and operation of electrical devices and systems.
- Education concerning the installation and start-up of electrical devices and systems.
- Knowledge of applicable standards and directives.
- Knowledge and adherence to this document with all safety notices.

2 Safety

Before using the product for the first time, please read through the safety instructions carefully.

⚠ DANGER

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

If the load on the DC side is disconnected (e.g. by shutting down the battery), the device does not shut down. DC voltage is still present at the connections. Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched.

- › Comply with all safety regulations and current technical connection specifications of the responsible power supply company.
- › The device is only permitted to be opened or serviced by a qualified electrician.
- › Switch off the grid voltage by turning off the external circuit breakers.
- › Check that all AC and DC cables are completely free of current using a clip-on ammeter.
- › For work on the device, ensure complete isolation from the power supply on the AC and DC connections.
- › Do not touch the cables and/or terminals/busbars when switching the device on and off.
- › An AC- and DC- disconnecter unit must be provided during the final installation stage.
- › Do not make any modifications to the device.
- › Keep the device closed when in operation.

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

- Keep unauthorised persons away from the device and/or system.
- Ensure operational safety by providing proper grounding, conductor dimensioning and appropriate protection against short circuiting.
- Observe all safety instructions on the product 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 on the live device:
  - Do not touch the electrical connections
  - Remove all jewellery from wrists and fingers
  - Ensure that the testing equipment is in safe operating condition.
- Modifications to the surroundings of the device must comply with the applicable national and local standards.
- When working on the battery, it is also necessary to switch off the DC voltage with the DC isolator switch in addition to disconnection from the grid.

2.1 Proper use

The device has been developed for use with a battery system. The device converts the DC voltage provided by the battery into AC voltage, so that it can be fed into the grid or the battery can be charged. The device is built using state-of-the-art technology and in accordance with the recognised safety rules. Nevertheless, improper use may cause lethal hazards for the operator or third parties, or may result in damage to the device and other property. This relates to the following operation and connection:

- Operate the device only with a permanent connection to the public power grid.
- Operation in accordance with the appended EU Declaration of Conformity envisages up to 4 bidirectional feed-in inverters per battery.
- Approval from KACO new energy is required for a parallel DC circuit with more than 4 bidirectional feed-in inverters.

Any other or additional use is not considered proper or intended use and can lead to an annulment of the product guarantee. This includes:

- Mobile use
- Use in rooms where there is a risk of explosion

- Use of the device in direct sunlight, rain or a storm or other harsh environmental conditions
- Use in an outdoor area that does not meet the environmental conditions set down in the Environmental data [See section 4.3 Page 12]
- Operation of devices with an inconsistent performance in DC parallel operation
- Operation of devices with an inconsistent firmware version in DC parallel operation
- Operation outside the specifications intended by the manufacturer
- Overvoltage of over 1050 V on the DC connection
- Modifying the device
- Off-grid operation

2.2 Protection features

The following monitoring and protection functions are built-in:

- Overvoltage conductor / varistor to protect the power semiconductors from high-energy transients on the grid and generator sides.
- Device temperature monitoring system
- EMC filter to protect the inverter from high-frequency grid interference
- Grid-side varistors grounded to earth to protect the product against burst and surge pulses
- Anti-islanding detection according to the current standards.

NOTE

Information on other applications / system set ups (e.g. parallel operation / multiple bidirectional feed-in inverter) is provided project specific as an application note. For further details, please contact our KACO sales team pv-projects@kaco-newenergy.de.

NOTE

If the device is connected, the overvoltage conductors / varistors contained in the device have an impact on the electrical system insulation resistance test as per HD 60364-6 / IEC 60364-6 Low-voltage installations- Part 6: Verification.

IEC 60364-6 6.4.3.3 describes two options for this case. The first option is to disconnect devices with an overvoltage conductor or, if this is not practicable, then the test voltage can be reduced to 250V.

3 Description of the device

3.1 Mode of operation

An external EMS/PMS [1] is required to operate the device. The EMS/PMS must be provided by the customer/system integrator. Modbus TCP is the sole means of communication with the device.

The necessary commands and data points are described in the SunSpec Protocol description About this document [See section 1.1 Page 4].

The shutdown threshold (DC-Min.) is dynamically determined by the device on the basis of the current grid voltage. After shutting down the device, it is therefore not possible to guarantee reconnection as there may be a change in the grid voltage.

After a continuous operation period >23 days, the device disconnects from the grid at midnight and performs a restart including a self-test.

3.2 Device diagram

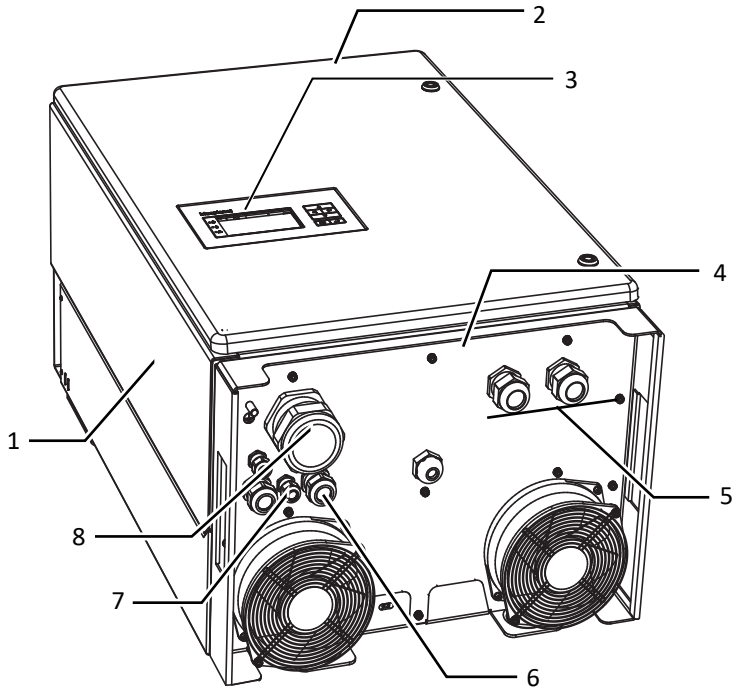


Fig. 3: Device diagram

1	Housing	5	DC connection / cable feed-through
2	Housing door	6	Interfaces / cable feed-through
3	Status indicator with display and operator panel	7	Communication - USB port / cable feed-through
4	Mount with fan	8	AC connection / cable feed-through

3.2.1 Electrical functions

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

Potential-free relay

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

[1] Energy management system/power management system

3.2.2 Interfaces

You can configure the interfaces and the web server in the Settings menu. The device has the following interfaces for communication and remote monitoring.

Ethernet interface

Communication with the EMS/PMS is carried out via the Ethernet interface.

The local web server can be used to configure the device and perform updates.

USB interface

The USB connection of the device is a type A socket. This is located on the communication circuit board on the inside of the housing doors. The USB connection is specified to draw 100 mA of current. Use the USB interface to perform software updates using a FAT32-formatted USB stick.

3.3 System layout

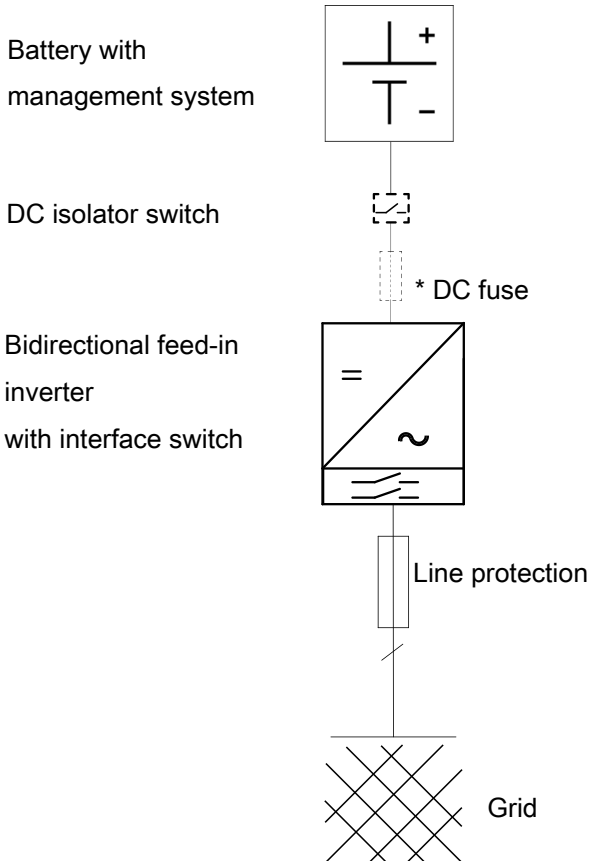


Fig. 4: Circuit diagram for a system with one bidirectional feed-in inverter

Key	Definition / information on the connection
Battery	Intrinsically safe battery system
DC isolator switch	An external DC isolator switch is required outside the device; this can also be integrated into the battery housing.
DC fuse*	**NOTE: Device variant only:** A 160A gPV fuse is required in the DC connection line.
Bidirectional feed-in inverter	The connection from the battery unit is carried out on the device's DC connection.
Line protection	Safety fuse or circuit breaker.

4 Technical data

4.1 Electrical data

	blueplanet gs 50.0TL3-S B1 WM OD IIGB	blueplanet gs 50.0TL3-S B1 WM OD IIGM	blueplanet gs 50.0TL3-S B1 WM OD IIGL	blueplanet gs 50.0TL3-S B1 WM OD IIGX
DC Input levels	Input levels (DC)			
Working range	662 V [@230/400V]; 633 V [@220/380V]-1,050 V			
Rated voltage	765 V			
Starting voltage	662 V [@230/400V]; 633 V [@220/380V]			
Open circuit voltage	1050 V			
Max. input current	90 A			
Number of strings	1			
Input source feedback current	90 A			
Polarity safeguard	no		yes	
Ripple current	5.0 %			

	blueplanet gs 50.0TL3-S B1 WM OD IIGB	blueplanet gs 50.0TL3-S B1 WM OD IIGM	blueplanet gs 50.0TL3-S B1 WM OD IIGL	blueplanet gs 50.0TL3-S B1 WM OD IIGX
AC Output levels	Output levels (AC)			
Nominal power	50.0 kVA [@ 220V]; 50.0 kVA [@230V]			
Rated voltage	230 / 400 V [3/N/PE] 220 V / 380 V [3/N/PE]			
Voltage range: continuous operation	165 V - 288 V [PH-N]			
Rated current	3 x 72.2 A [@400V]; 3 x 76.0 A [@380V]			
Max. continuous current	3 x 76.5 A			
Rated frequency	50/60 Hz			
Frequency range	42-68 Hz			
Reactive power	0-100 % Snom			
cos phi	1 - 0.3 ind/cap			
Number of feed-in phases	3			

4.2 General Data

	blueplanet gs 50.0TL3-S B1 WM OD IIGB	blueplanet gs 50.0TL3-S B1 WM OD IIGM	blueplanet gs 50.0TL3-S B1 WM OD IIGL	blueplanet gs 50.0TL3-S B1 WM OD IIGX
General electrical data				
Max. efficiency	Charge 97.9 / discharge 98.4 %			
European efficiency	Charge 97.5 / discharge 98.2 %			
Self consumption: Standby	<= 3 W		<= 5 W	
Transformer unit	no			
Grid monitoring	Country-specific			
Operation mode	Grid-dependent (charge/discharge)			
Battery type	All intrinsic battery types, e.g. lithium ions			
Clock frequency	16 kHz			

	blueplanet gs 50.0TL3-S B1 WM OD IIGB	blueplanet gs 50.0TL3-S B1 WM OD IIGM	blueplanet gs 50.0TL3-S B1 WM OD IIGL	blueplanet gs 50.0TL3-S B1 WM OD IIGX
Power factor	-1.0 | 1.0			
Protection class / over voltage category	I / III			

	blueplanet gs 50.0TL3-S B1 WM OD IIGB	blueplanet gs 50.0TL3-S B1 WM OD IIGM	blueplanet gs 50.0TL3-S B1 WM OD IIGL	blueplanet gs 50.0TL3-S B1 WM OD IIGX
General Data				
Display	Graphical display 240 x 128 pixels + LEDs			
Controls	4-way button + 2 buttons			
Menu languages	DE; EN; FR; IT; ES; PL; NL; PT; CZ; HU; SL; TR; RO			
Interfaces	2 x Ethernet, USB, digital output: Fault signal relay (30V potential free contact) digital input: InverterOFF - only for external system protection Powador-protect			
Communication	TCP/IP, Modbus TCP, Sunspec			
Potential-free relay	yes			
DC isolator switch	no			
AC isolator switch	no			
Cooling	temp. controlled fan, max air flow 218 m³/h per fan			
Max. power dissipation to room air [2]	1.5 kW			
Number of fans	2			
Noise emission	61 db(A)			
Housing material	Alu			
HxWxD	760 mm x 500 mm x 390 mm			
Weight	70 kg	71 kg	75 kg	76 kg
Certifications	Overview: see homepage / download area			

4.3 Environmental data

	blueplanet gs 50.0TL3-S B1 WM OD IIGB	blueplanet gs 50.0TL3-S B1 WM OD IIGM	blueplanet gs 50.0TL3-S B1 WM OD IIGL	blueplanet gs 50.0TL3-S B1 WM OD IIGX
Item number	1001742	1001743	1001732	1001741
Installation distance from coast	>2000 m			
Installation height	3000m (derating from 2000m)			
Ambient temperature	-20 °C to +60 °C*			
Ambient temperature (storage)	-25 °C - +85 °C			
Power derating from	40 °C			
Protection rating (KACO installation location)	IP65			
Humidity range (non-condensing) [%]	100%			

[2] Highest power dissipation for U_{max} and S_{max}. More operation points can be derived from the efficiency diagram.

5 Transportation and Delivery

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

5.1 Scope of delivery

- Bidirectional feed-in inverter
- Mount
- Installation kit
- 1 insulating tube (for interface cables)

Check the equipment included

1. Inspect the device thoroughly.
2. Immediately notify the shipping company in case of the following:
   - Damage to the packaging that indicates that the device may have been damaged.
   - Obvious damage to the device.
3. Send a damage report to the shipping company immediately.
4. The damage report must be received by the shipping company in writing within six days following receipt of the device. We will be glad to help you if necessary.

5.2 Transporting the device

⚠ CAUTION

Hazard due to impact; risk of breakage to the device!

› Pack the device securely for transport.

› Transport the device using the intended carrying handles of the packaging box.

› Do not expose the device to any shocks.

For safe transportation of the product, use the hand recesses in the carton.

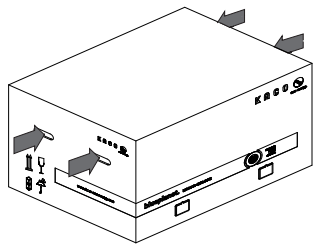


Fig. 5: Transporting the device

Device version	Dimensions HxWxD	Total weight including packaging
50.0TL3-S B1 WM OD IIGB	818x591x537 mm	78 kg
50.0TL3-S B1 WM OD IIGM	818x591x537 mm	79 kg
50.0TL3-S B1 WM OD IIGL	818x591x537 mm	83 kg
50.0TL3-S B1 WM OD IIGX	818x591x537 mm	84 kg

5.3 Installation tool

The codes given in the table below are used in all usage instructions for assembly/installation/maintenance and disassembly for the tools and tightening torques being used.

Code (s)	Shape of the connector
W	External hexagon
A	Internal hexagon
T	Torx
S	Slot

Tab. 1: Key and description of tool codes

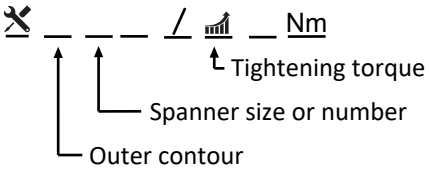


Fig. 6: Form pattern

6 Assembly and preparation

6.1 Choosing the installation location

⚠ DANGER

Risk of fatal injury due to fire or explosions!

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

› Do not mount the inverter in potentially explosive atmospheres or in the vicinity of highly flammable materials.

⚠ 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 device housing can be seriously damaged due to gases in combination with air humidity resulting from weather conditions (e.g. ammonia, sulphur).

› If the device is exposed to gases, the installation must be carried out at observable locations.

› Perform regular visual inspections.

› Immediately remove any moisture from the housing.

› Ensure adequate ventilation at the installation location.

› Immediately remove dirt, especially on vents.

› Failure to observe these warnings may lead to device damage which is not covered by the manufacturer warranty.

NOTE

Access by maintenance personnel for service

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

Installation space

- As dry as possible, climate-controlled, the waste heat must be dissipated away from the device.
- Unobstructed air circulation.
- Close to the ground, accessible from the front and sides without requiring additional resources.
- Protected on all sides against direct weather exposure and sunlight (thermal heating) in outdoor areas. Implementation where necessary via constructional measures, e.g. wind breaks.
- For easy operation during installation, ensure that the display is slightly below eye level.

Installation surface

- Must have adequate load-bearing capacity
- Must be accessible for installation and maintenance
- Must be made out of heat-resistant material (up to 90 °C)
- Must be flame resistant
- Minimum clearances to be observed during installation: [See figure 12] [▶ Page 17]

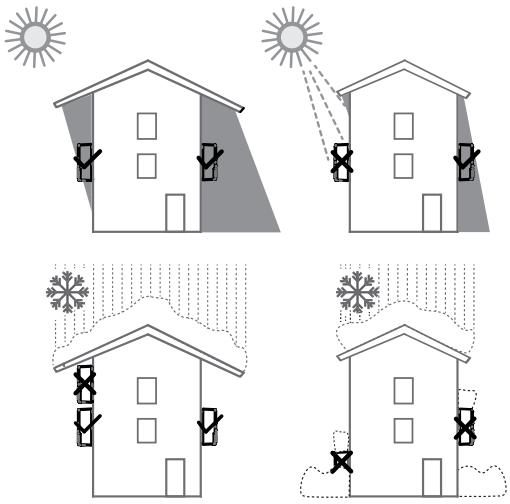


Fig. 7: Device for outdoor installation

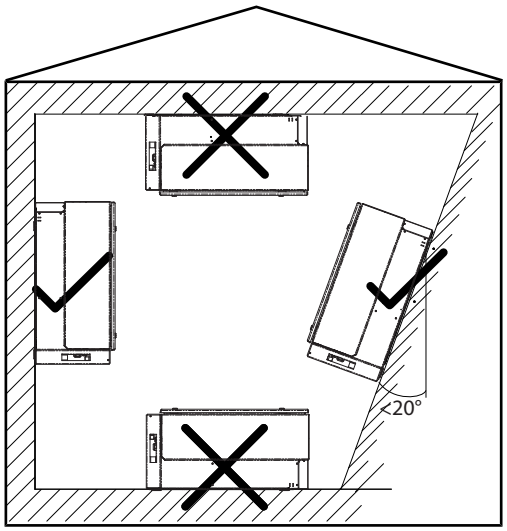


Fig. 8: Intended installation location

6.2 Unpacking the device

⚠ CAUTION

Risk of injury caused by excessive physical strain.

Lifting the device, for transport, relocation and assembly, can result in injuries (e.g. back injuries).

› Only lift the device using the openings provided.

› The device must be transported and installed by at least 2 persons.

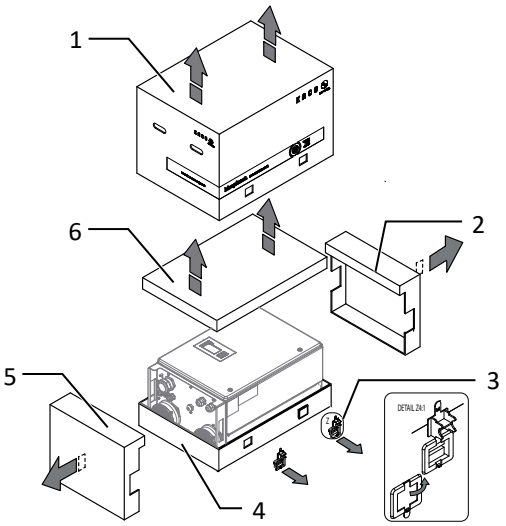


Fig. 9: Open the package

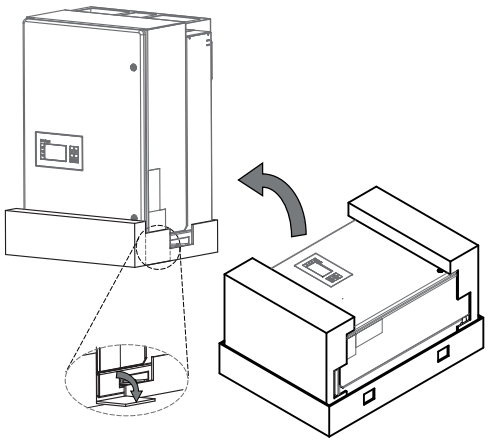


Fig. 10: Setting the device upright

Legend			
1	Cover	4	Base
2	Side section - upper	5	Side section - lower
3	Clamp (4x)	6	Cardboard packaging with mount and mounting kit

↻ The device is transported to the installation location.

1 Remove the plastic band from the pallet and packaging.

2 Pull the clamp off the packaging.

3 Pull the hood upwards to remove it and place the cardboard packaging to one side together with the mount and accessories.

4 Set the unit with base and side sections upright.

5 Remove the top side section and base from the device.

» If the unit is in the correct installation position: Proceed with the installation of the mount.

6.3 Fastening the mount

⚠ CAUTION

Hazard when using unsuitable fixing materials!

If unsuitable fixing materials are used, the device could fall and persons in front of the device may be seriously injured.

› Use only fixing materials that are suitable for the mounting base. The fastening materials supplied are only suitable for masonry and concrete.

› Only install the device in an upright position.

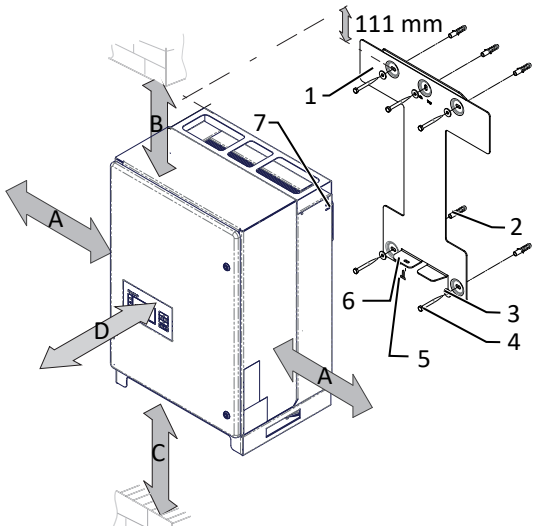


Fig. 11: Minimum clearances for wall mounting

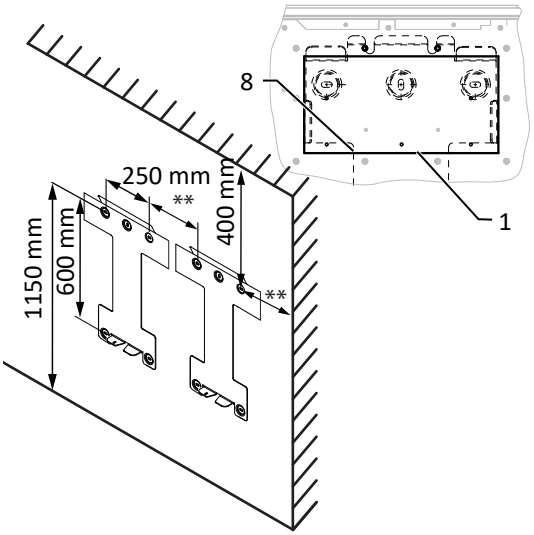


Fig. 12: Wall mounting

Key			
1	Mount	5	Screw for securing purposes (1x)
2	Fixings for mounting [S12 – Ø 12mm/ 90mm]	6	Bracket to prevent device displacement
3	Lock washer	7	Marking as installation aid
4	Screws for mounting (5x) [SW 13 / Fastening the mount [See section 6.3 Page 17]]	8	Seating recess
A	Minimum clearance: 120 mm (without device370 mm) recommended distance400 mm (without device 550 mm *)	C	Minimum clearance: 500 mm
B	Minimum clearance: 300 mm	D	Recommended clearance: 550 mm

↻ Cardboard packaging with mount and mounting kit removed from the packaging and opened.

1 Mark the mounting position on the wall surface according to the position of the mount by drawing a line.

2 Mark the positions of the drill holes using the slot in the mount.

NOTE: The minimum clearances between two devices, or the device and the ceiling or floor have already been taken into account in the diagram.

3 Fix the mount to the wall using suitable mounting fixtures from the mounting kit.

NOTE: Make sure that the mount is oriented correctly.

» Proceed with the installation of the device.

6.4 Installing and securing the device

⚠ CAUTION

Risk of injury from improper lifting and transport.

If the device is lifted improperly, it can tilt and result in a fall.

› Always lift the device vertically using the openings provided.

› Use a climbing aid for the chosen installation height.

› Wear protective gloves and safety shoes when lifting and lowering the device.

NOTE

Power reduction due to heat accumulation!

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

› Observe minimum clearances and provide for sufficient heat dissipation.

› All objects on the device housing must be removed during operation.

› Ensure that no foreign bodies prevent heat dissipation following device installation.

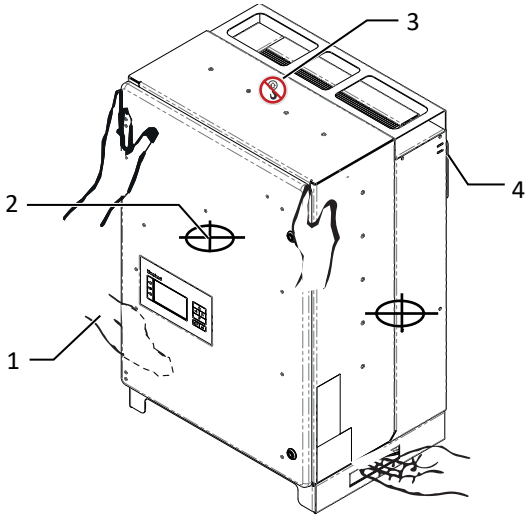


Fig. 13: Lift the device using the opening

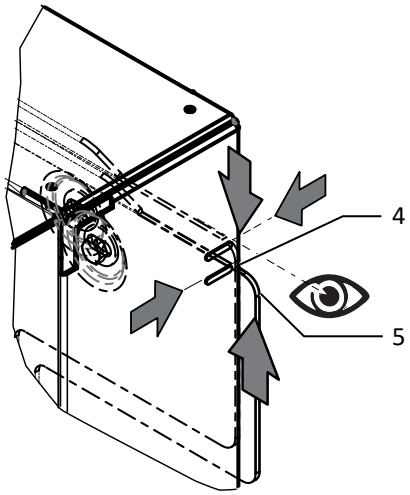


Fig. 14: Insertion aid in mount

Key			
1	Opening	4	Marking for insertion into mount
2	Centre of gravity	5	Outer contour of the mount
3	Warning sign (attachment prohibited)		

Lifting and installing the device

↻ The mount has been installed.

1 Lift the device using the side recesses. Observe the device's centre of gravity!

NOTE: Do not lift the device by the lid or cover!

2 Suspend the device in the mount using the recess on the rear of the device. ([See figure 12] [▶ Page 17]).

NOTE: Keep in mind that the lower marking on the housing must protrude over the upper outer contour of the mount. Ensure that the upper marking is flush with the upper edge of the outer contour when lowering the device. The outer contour of the mount must be flush with the outer contour of the housing.

NOTE: Alternatively: At this point, the screw described above can be replaced by a special screw as anti-theft protection.

» Device is installed. Proceed with the electrical installation.

⚠ CAUTION

Property damage as a result of condensation

During pre-assembly of the device, moisture can penetrate into the interior via the dust-protected threaded connections. The resulting condensate can cause damage to the device during installation and start-up.

✓ Keep the device closed during pre-assembly and do not open the connection area until you perform installation.

› Seal off the screw connections using sealing covers.

› Prior to installation, check the inner area for condensation and if necessary, allow it to dry sufficiently before installation.

› Immediately remove any moisture from the housing.

7 Installation

7.1 Opening the device

↻ Mount the device to the wall.

↻ Wipe off any moisture on the housing door frame to nullify any potential liability this could cause.

1 Open the housing door by unlocking the upper and lower lock with the double-bit key provided.

2 Open the housing door carefully.

» Proceed with the installation of the device.

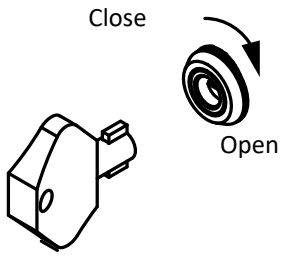


Fig. 15: Open the door lock

7.2 Surveying the connection area

The connection for the AC supply is located inside the housing. Die DC-Eingangsquelle wird ebenfalls in jeder Geräteversion (Basis, M, L oder XL) im inneren des Gehäuses angeschlossen.

7.3 Making the electrical connection

NOTE

Select conductor cross-section, safety type and safety value in accordance with the following basic conditions:

Country-specific installation standards; power rating of the device; cable length; type of cable installation; local temperature

NOTE

Due to the fact that the device is unable to limit the short circuit current from the grid in the event of a short circuit, the AC-side fuse in the installation (on-site) provides protection against faults on the DC side.

For device safety, the max. prospective DC current is limited by the internal DC fuse in the event of an error.

Specification of the DC fuse (F1):

- 160Adc nominal current
- Nominal voltage (DC) > max. battery voltage
- Breaking capacity: 50kA

Use of e.g. Bussmann NH1gPV 160A (1000Vdc (Bussmann art. no.: PV-160ANH1)).

7.3.1 Requirement for supply lines and fuse

DC-side	blueplanet gs 50.0TL3-S B1 WM OD IIGB blueplanet gs 50.0TL3-S B1 WM OD IIGM blueplanet gs 50.0TL3-S B1 WM OD IIGL blueplanet gs 50.0TL3-S B1 WM OD IIGX
Max. conductor cross-section	95 mm²
Min. cable cross-section	in accordance with local installation standards
Length of insulation to be stripped off	Depending on the cable lug
Recommended cable type	NSGAFöu
Fuse size (electrical data)	- NH1 gPV 160A M, L, XL device version
Fuse size (mechanical data)	- mm 65 (NH1) mm M, L, XL device version

DC-side	blueplanet gs 50.0TL3-S B1 WM OD IIGB blueplanet gs 50.0TL3-S B1 WM OD IIGM blueplanet gs 50.0TL3-S B1 WM OD IIGL blueplanet gs 50.0TL3-S B1 WM OD IIGX
Cable diameter for cable fitting	15 - 21 mm
Fitting for DC connection	M32
Tightening torque	6 - 12

Tab. 2: Requirement for supply lines and DC fuses

AC-side	blueplanet gs 50.0TL3-S B1 WM OD IIGB blueplanet gs 50.0TL3-S B1 WM OD IIGM blueplanet gs 50.0TL3-S B1 WM OD IIGL blueplanet gs 50.0TL3-S B1 WM OD IIGX
Max. conductor cross-section	95 mm²
Min. cable cross-section	35mm² [3]
Length of insulation to be stripped off	25 mm
Tightening torque	10 Nm
Connection type	Screw terminal/PE bolt
Ground conductor connection	M8
Fuse protection for installation provided by customer	min. 100 A / max.125 A
Fitting for AC connection	M63
Cable diameter for cable fitting	32 - 42 mm

Tab. 3: Requirement for supply lines and AC fuses

Interfaces	blueplanet gs 50.0TL3-S B1 WM OD IIGB blueplanet gs 50.0TL3-S B1 WM OD IIGM blueplanet gs 50.0TL3-S B1 WM OD IIGL blueplanet gs 50.0TL3-S B1 WM OD IIGX
Cable diameter for cable fitting	11 - 17 (M25) 5 - 9.5 (M16) mm
Ethernet connection type	RJ45
Ethernet cable cross-section	0.25 - 0.5 mm²

Tab. 4: Requirement for supply lines and DC fuses - interfaces

[3] The loop impedance at any point between the installation field and the battery must be Zs <Un / Ia (Un: nominal AC voltage, Ia: current for triggering device protection within 200 ms).

7.4 Connecting the device to the power grid

7.4.1 Prepare the grid connection

TN-S-System, TN-C-S-System, TT-System

↻ Connection cable with 5 strands is provided on the device.

↻ Nominal grid voltage matches the VAC nom name plate details.

1 Unfasten the cable fitting for the AC connection [W_68].

2 Remove the outer cladding of the AC cables.

3 Push an M8 cable lug onto the PE line.

4 Remove the cover of the AC filter using the 4 screws[T_15].

5 Unscrew the screws on the contact bridge and remove the contact bridge[_T20].

6 Insert the AC cables through the cable fitting into the connection area.

7 Strip the AC lines [approx. 25 mm].

» Make the grid connection.

TN-C system

↻ Connection cable with 4 wires is provided on the device.

↻ Nominal grid voltage matches the VAC nom name plate details.

1 Unfasten the cable fitting for the AC connection [W_68].

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 AC lines [approx. 25 mm].

» Make the grid connection.

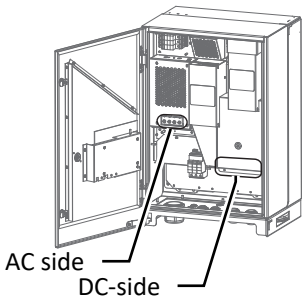


Fig. 16: Terminals

7.4.2 Make the grid connection

NOTE

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

NOTE

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

For questions regarding the appropriate type, please contact the installer or the system manufacturer's service department.

NOTE

When the line resistance is high, i.e. long cables on the grid side, the voltage drop on the line increases, and the terminal voltage is higher or lower than the country-specific limit value, the device shuts down.

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

7.5 Connecting the battery to the device

⚠ DANGER

Risk of fatal injury due to electric shock!

When connecting the batteries and installing supply lines, arcs may occur that may cause serious injury and property damage.

- Insert internal fuse before connecting the DC voltage.
- Repair damage to the DC line without delay.
- Batteries must be fitted with potential equalisation in protection class I and with double-insulated DC cable in protection class II.

⚠ CAUTION

Danger caused by reverse polarity at the DC connection.

The device does not have reverse polarity protection on the DC connection. This can lead to destruction of the device.

- Check polarity using suitable measuring equipment before connecting the DC cable.
- Failure to observe these warnings may lead to device damage which is not covered by the manufacturer warranty.

7.5.1 With preload unit

Blueplanet gs 50.0TL3-S B1 WM OD IIGL &

Blueplanet gs 50.0TL3-S B1 WM OD IIGX

↻ Connection cable with 2 x 1 strands already on the device.

1 Unfasten the protective cover using the 4 screws and place to one side [T15].

2 Undo the cable fitting [W_36]

3 Remove the outer cladding of the DC cables.

4 Pass the DC cables through the cable fittings into the connection compartment.

5 Fit DC lines with an M10 ring cable lug [max. width b 25 mm].

6 Screw the negative (-) cable end onto the DC connection according to the polarity of the battery [W_17 / 10 -20 Nm].

7 Screw the positive (+) cable end onto the DC+ fuse holder according to the polarity of the battery [W_16 / 16 Nm].

8 Check secure fit of all connected cables.

9 Ensure that the polarity is correct.

10 Fit the protective cover and secure using the 4 screws [T15 / 2.3 Nm].

11 Tighten the cable fittings [W_36 / 4 Nm].

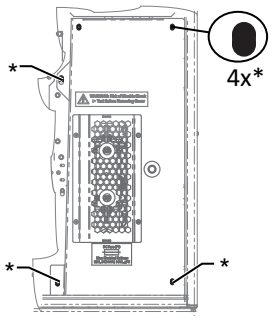


Fig. 17: Remove protective cover

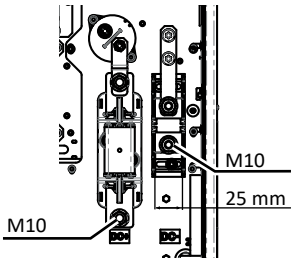


Fig. 18: DC connection L version

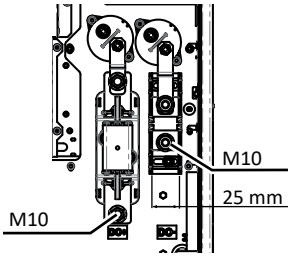


Fig. 19: DC connection XL version

NOTE

Device variant L: The insulation is 1-pin.
Device variant XL: The isolation is on all pins.

7.5.2 Without precharge unit

⚠ CAUTION

Danger caused by exceeding the inrush current.

The device does not have a inrush current limiter on the DC side. Exceeding the maximum permissible inrush current of 100A can lead to destruction of the device.

- The inrush current must be limited to a max. current of 100A using external means. The DC input capacity of the device is approx. 2mF.
- DC link may still be charged link after disconnecting the device from the battery. The limitation of the inrush current must also be ensured in this scenario.
- Failure to observe these warnings may lead to device damage which is not covered by the manufacturer warranty.

Blueplanet gs 50.0TL3-S B1 WM OD IIGM

↻	Connection cable with 2 x 1 strands already on the device.
1	Undo the cable fitting [W_36]
2	Remove the outer cladding of the DC cables.
3	Pass the DC cables through the cable fittings into the connection compartment.
4	Fit DC lines with an M10 ring cable lug [max. width b 25 mm].
5	Close the accidental contact cover on the DC- connection.
6	Open the fuse holder on the DC+ connection.
7	Screw the negative (-) cable end onto the DC connection according to the polarity of the battery [W_17 / 10 -20 Nm].
8	Screw the positive (+) cable end onto the DC+ fuse holder according to the polarity of the battery [W_16 / 16 Nm].
9	Check secure fit of all connected cables.
10	Close the accidental-contact cover on the DC- connection.
11	Make sure that the polarity is correct, and that the precharge is ensured at max. 100A.
12	Tighten the cable fittings [W_36 / 4 Nm].

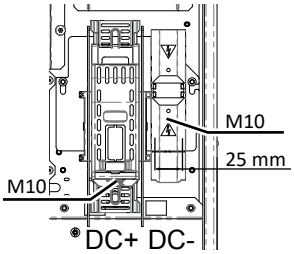


Fig. 20: DC_connection M version

Blueplanet 50.0TL3 B1 WM OD IIGB

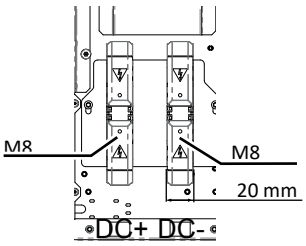


Fig. 21: DC connection B version

↻ Connection cable with 2 x 1 strands already on the device.

1 Unscrew the cable fitting [W_ 36].
2 Remove the outer cladding of the DC cables.
3 Pass the DC cables through the cable fittings into the connection compartment.
4 Fit DC lines with an M8 ring cable lug [max. width b 20 mm].
5 Open the contact protection cover on the DC- / DC+ connection.
6 Screw the negative (-) cable end onto the DC connection according to the polarity of the battery [W_13 / 6 -12 Nm].
7 Screw the positive (+) cable end onto the DC connection according to the polarity of the battery [W_13 / 6 - 12 Nm].
8 Check secure fit of all connected cables.
9 Close the contact protection cover on the DC- / DC+ connection.
10 Make sure that the polarity is correct, and that the inrush current is ensured at max. 100A.
11 Fit the protective cover and secure using the 4 screws [T15 / 2.3 Nm].
12 Tighten the cable fittings [W_36 / 4 Nm].

7.6 Creating equipotential bonding

↻ The device has been installed on the mount.

1 Strip the insulation from the equipotential bonding cable.
2 Check that the connected cable is fitted securely.

» The housing is included in the equipotential bonding.

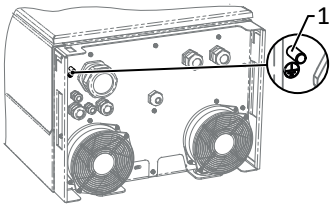


Fig. 22: Additional grounding point

1	Earthing bolt

7.7 Connecting the interfaces

7.7.1 Overview

⚠ 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.

⚠ CAUTION

Damage to the device from electrostatic discharge

Components inside the device can be damaged beyond repair by static discharge.

› Note the ESD protective measures.
› Earth yourself before touching a component by touching a grounded object.

NOTE

Due to the installation position of the communication circuit board, this must be specially safeguarded against moisture and exposure to dust.

› Make sure that no moisture or dust impacts on the circuit board during installation. Moisture and dust particles must be removed immediately. In doing so, disassembly of the circuit board may be necessary.

All interfaces are located on the communication circuit board on the inside of the housing door.

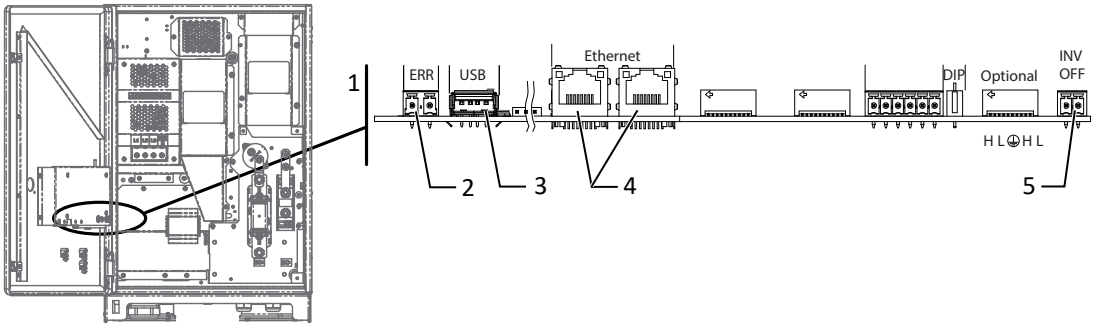


Fig. 23: Communication circuit board: Connection and assignment of the interfaces

1	Communication circuit board	4	Ethernet – Connection for communication
2	ERR – Connection for fault signal relay	5	INV OFF – connection for KACO "powador-protect"
3	USB – Connection for update		

7.7.2 Insert and lay the cables

DANGER

Risk of fatal injury due to electric shock!

Touching damaged insulation on the grid and battery connection leads results in severe injury or death.

› Check the connection leads for damage.

› All signal cables for interfaces must be correctly encased up to the connection using the insulation tube provided before fitting the cable.

Insert the interface cables

1 Unfasten and remove the cover on the cable fitting [W_29/W_20].

2 Remove the sealing insert.

3 Pass the connection cable through the cover of the cable fitting and the sealing insert.

4 Insert the sealing insert into the cable fitting.

5 Feed the connection cables into the connection area.

» Proceed with the connection.

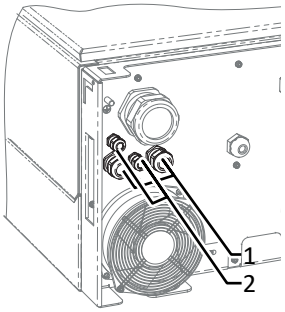


Fig. 24: Insert the Ethernet cable

1	Cable fitting for pass the Ethernet cable
2	Cable fitting for pass the signal cable

↻ Housing doors open.

↻ Lay the signal line as per the illustration above.

1 Fix the encased signal cable to the threaded stud bolts.

2 Lay all the interface cables so that they are not under tension and the housing door has a full range of motion.

3 Secure the cable pass for feeding through the Ethernet cable [W_20 / 4 Nm].

4 Secure the cable pass for feeding through the signal cable [W_20 / 1.5 Nm].

» Proceed with the connection of the cables.

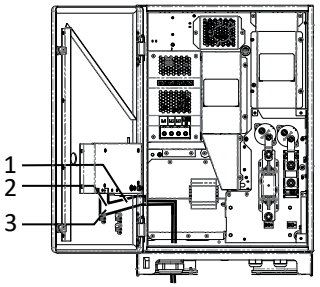


Fig. 25: Lay the cables for interfaces

1	Ethernet cables
2	Threaded stud bolts
3	Cable ties

7.7.3 Ethernet connection

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 device supports auto-sensing. You can use both crossed and 1:1 protectively-wired Ethernet connection cables.

Connecting the device to the network

↻ Connect the Ethernet cable to the device.

1 Connect the Ethernet cable to the network or a computer.

2 Configure the Ethernet settings and the web server in the Settings menu.

Connecting the Ethernet cable

↻ Connecting cable inside the device.

1 Plug in an Ethernet cable at one of the two Ethernet ports on the communication circuit board.

2 Check that the connecting cable is fitted securely.

3 Tighten the cable fittings [W_29 / 4 Nm]

» Connect additional signal cables.

7.7.4 Connecting external grid protection components

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

Maximum contact load	
DC	30 V / 1 A

↻ Housing door opened.

1 Loosen the cable fitting to pass the signal cable through [W_20]

2 Thread the connection cables through the cable fitting.

3 Attach the connection cables to the terminals.

4 Tighten the cable fitting [W_20 / 1.5 Nm]

7.7.5 Inverter Off connection

NOTE

The digital input of the device is intended for connection of a Powador-protect. When using devices from other manufacturers or in combination with KACO inverters, interface switches as a minimum must be used for shutting down devices from other manufacturers.

↻ Only suitable KACO inverters can be used.

↻ Housing doors open.

1 Undo the cable fittings [W_20]

2 Pass the connecting cable through the cable fittings.

3 Connect wire A (+) to the terminal marked "EVU+" on the first device via the "DO1" terminal of the Powador-protect.

4 Connect wire B (-) to the terminal marked "EVU-" on the first device via the "GND" terminal of the Powador-protect.

5 Connect the other devices to one another as follows:
- wire A (+) to wire A (+) and wire B (-) to wire B (-).

6 Tighten the cable fitting [W_20 / 1.5 Nm]

7 After commissioning: Activate the support for Powador protect in the parameter menu under the "Powador-protect" menu option.

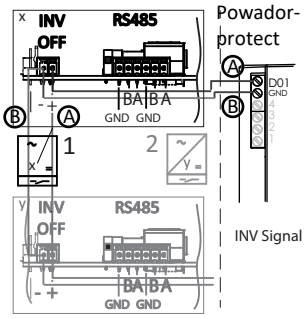


Fig. 26: Connect the device to Powador-protect

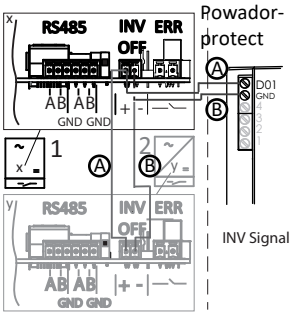


Fig. 27: Connect the device to Powador-protect

7.8 Sealing the connection area

1 The requirements of protection class IP65 are met by closing the unused cable fittings with blind caps.

2 Close the housing door and lock it with a control cabinet key.

» The device has been mounted and installed.

8 Commissioning

8.1 Requirements

⚠ DANGER

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

Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched.

› The device is only permitted to be commissioned by a qualified professional.

› Unauthorised persons must be kept away from the device.

⚠ WARNING

Risk of burns from hot surface.

Heat sinks become very hot when in operation.

› Never touch the heat sinks after commissioning the device.

› Allow the heat sinks at least 10 minutes to cool down before cleaning.

↻ The device has been mounted and electrically installed.

↻ The battery supplies a voltage above the configured start voltage.

1 Connect the grid voltage using the external circuit breakers.

2 Activate the battery and connect via the external DC isolator switch.

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

» Following an interruption in operation Device waits for the prompt of the EMS/PMS

9 Configuration and operation

9.1 Initial start-up

When started for the first time, the device 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 device is re-started. 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.

1 In order to select a setting, press the `Up` and `Down` buttons.

2 To select the next menu option, press the `Enter button`.

3 To return to the most recently selected menu option, press the `ESC button`.

4 Set the required settings.

5 In the last menu option, press the `Enter button`.

Configuration assistant

1 Select the menu language.

2 Select the country of operation with grid type.

3 Set the date and time.

4 To store the set operator country and grid type permanently, confirm with "`Yes`".

» You have completed the initial configuration. The device begins operation.

9.2 Controls

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

The 3 LEDs on the device control panel show the different operating states. The LEDs can display the following states:

LED illuminated | LED flashing | LED not illuminated

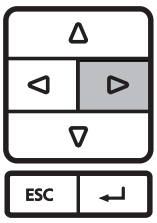
Operating status	LED	Icon	Display	Description
Start				The green "`Operation`" LED is on when the AC voltage is present, independent of the DC voltage.
Start grid operation			Charging /discharging current	The green "`Operating`" LED is lit. The green "`grid operation`" LED is lit after the country-specific waiting period*. Ready for grid operation. The interface switch engages audibly.
Grid operation			Charging /discharging current	The green "`Operating`" LED is lit. The green "`Grid operation`" LED is lit. The "`charging/discharging current`" icon appears on the LD display. The device feeds into the grid.

Operating status	LED	Icon	Display	Description
No grid operation			Status message	The display shows the corresponding message.
Fault			Fault message	The display shows the corresponding error message. The red "Fault" LED is lit.

Control buttons

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

Opening the menu

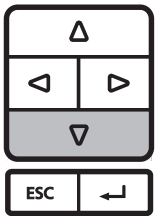


↻ The device is in operation and the LCD is showing the desktop.

☞ Press the right arrow button.

» The menu moves over the desktop from left to right.

Displaying the daily output



↻ The device is in operation and the LCD is showing the desktop.

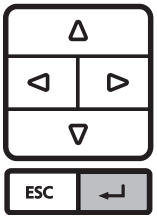
☞ Press the down arrow button.

» The LCD displays the daily yield in a diagram.

☞ To return to the desktop, press any button.

Device menu

Saving changed setting



☞ Press the Enter button.

9.3 Menu structure

Display on the LCD

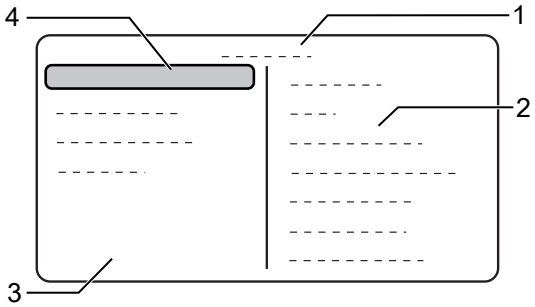


Fig. 28: Main menu

1	Selected menu option	3	Menu options in the active menu level
2	Name of the active menu level	4	Menu options of the next lower menu level

EN

NOTE

The menu options displayed on screen are dependent on the country and network settings, and may vary according to the type of device. Functions restricted to one or more countries are labelled with country codes in accordance with ISO 3166-1.

Symbols used			
1 2 3 4	Menu level (0,1,2,3)		Password-protected menu (password can be requested from KACO customer service)
	Display		Submenu
	Option menu		Option box
			Setting range

9.3.1 Menu

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Desktop	☞ Press `Right` arrow button.
	1 2 3 4	Measured values	☞ Open the menu: Press the `right arrow button` or the `OK button`.
	1 2 3 4	Battery power	Displays the current measurements of the battery in voltage, amperage and power.
	1 2 3 4	Battery status	Displays the following measurements of the battery Charge status (SoC) Service life (SoH) Temperature (°C)
	1 2 3 4	Grid	Displays the AC-side voltage, amperage and power.
	1 2 3 4	cos-phi	Displays the reactive power factor cos φ of the node.
	1 2 3 4	Unit temperature	Displays the temperature inside the housing.
	1 2 3 4	Energy counter	Displays the energy in kWh. ☞ Reset the counter using the `RESET` button.
	1 2 3 4	Energy today	Displays the previous energy for the current day.
	1 2 3 4	Energy total	Displays the total energy yield up to now.
	1 2 3 4	Oper. hrs cntr	**NOTE: Displays the operating time in hours.** ☞ Reset the counter using the `RESET` button.
	1 2 3 4	Oper. time today	Displays the duration of operation on today's date.
	1 2 3 4	Total oper. time	Displays the total operating time
	1 2 3 4	Log data view	**NOTE: Measurement data can be transferred hierarchically to a connected USB stick by individual selection.** ☞ Open the menu: Press the `Right arrow button` or `Enter button`.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Day display	**NOTE: Displays the recorded operating data graphically.** ☞ Select the measured value to be displayed. Supported measured values: 1. Grid power P(grid) 2. DC power of the string P 3. DC voltage of the string U 1 Select a day. 2 Press the Enter button. ⇨ The display shows the selected data. 3 Press any button to return to the previous menu.
	1 2 3 4	Month display	Displays the recorded operating data graphically. 1 Select a month. 2 Press the Enter button. » The display shows the selected data. ☞ Press any button to return to the previous menu.
	1 2 3 4	Year display	Displays the recorded operating data graphically. 1 Select a year. 2 Press the Enter button. ⇨ The display shows the selected data. » Press any button to return to the previous menu.
	1 2 3 4	CSV log data	☞ Open the menu: Press the Right arrow button or Enter button.
	1 2 3 4	Decimal separator	☞ Select decimal sign for export of saved operating data.
	1 2 3 4	Save to USB	**NOTE: Opportunity to export the operating data to a connected USB storage device.** ↻ You have connected a USB storage device to the device. 1 Select the data to be exported (year, month or day). 2 Press the Enter button. » The device writes the data to a connected USB storage device.
	1 2 3 4	Settings	☞ Open the menu: Press the Right arrow button or Enter button.
	1 2 3 4	Language	☞ Select the required language for the user interface.
	1 2 3 4	Changing the total energy	**NOTE: You can set the total energy to any value, for example, when you have received a replacement device and want to continue the recording from the present value.** ☞ Select the Save button and confirm with the Enter button.
	1 2 3 4	Interface	**NOTE: The address must not be the same as the address of another device or a Powador-proLOG device**. ☞ Assign a unique RS485 bus address to the device.
	1 2 3 4	Priwatt	☞ Open the menu: Press the Right arrow button or Enter button.

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Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Activation mode	**NOTE: Re-activation depends on the operating mode selected and on the activation conditions.** ☞ Activate function for a cycle
	1 2 3 4	Monitoring time	☞ Set time span during which the power threshold must be exceeded without interruption.
	1 2 3 4	Power threshold	☞ Set power threshold from which the monitoring time up to activation begins.
	1 2 3 4	Operation mode	☞ Power-dependent: the function remains active until below the set power threshold.
	1 2 3 4	Operation time	**NOTE: The menu option is only available in "Time-dependent" operation mode.** ☞ After connection, the function is active for the set operation time.
	1 2 3 4	Quick start	☞ Reduce the waiting times during the self-test by pressing the`Activate` button.
	1 2 3 4	Logging interval	☞ Specify the time period between 2 log data recordings.
	1 2 3 4	Log data backup	**NOTE: The device supports the backing up of all recorded yield data to a connected USB storage device.** ☞ Activate or disable log data backup.
	1 2 3 4	Display	1 Configure the contrast setting for the display. 2 Set the length of time without user input after which the backlighting of the LCD switches off. 3 Alternatively: Permanently activate or disable the backlighting by selecting "`On`" or "`Off`".
	1 2 3 4	Date & time	**NOTE: For self-diagnostics, the device performs a restart on a daily basis at 0:00 hours. To avoid having a restart occur during feed-in operation and to always obtain reliable log data, ensure that the time is correctly set.** ☞ Set the date and time.
	1 2 3 4	Network	Open the menu: Press the `Right arrow button` or `Enter button`.
	1 2 3 4	DHCP ☑ On / Off	**NOTE: The "IP address", "Subnet mask", "Gateway" and "DNS-Server" menu options are only displayed with DHCP disabled.** ☞ Activate or deactivate DHCP. On: Once the DHCP server becomes available, the IP address, subnet mask, gateway and DNS server are automatically applied and the aforementioned menu options are hidden. Off: Apply settings manually.
	1 2 3 4	IP address	☞ Allocate a unique IPv4 address in the network.
	1 2 3 4	Subnet mask	☞ Assign a subnet mask.
	1 2 3 4	Gateway	☞ Enter IPv4 address of the gateway.
	1 2 3 4	DNS server	☞ Enter IPv4 address of DNS server.
	1 2 3 4	Web server	☞ Open the menu: Press the `Right arrow button` or `Enter button`.
	1 2 3 4	Operation mode	☞ Activate or disable the integrated web server.
	1 2 3 4	Port	☞ Set the port at which the web server can be reached.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Remote config On / Off	☞ If necessary, activate the remote configuration.
	1 2 3 4	Remote update On / Off	☞ If necessary, activate the remote update.
	1 2 3 4	Portal Connection test Off | Meteocontrol | User-defined 1-4:	↻ Your IT infrastructure must be adequately protected. ☞ Select operating mode. Off: The connection to the portal is deactivated. Meteocontrol: The device attempts to connect to the Webportal blueplanet web of meteocontrol. User defined 1-4: The device attempts to log on via a user-defined portal that was set up by way of remote access.
	1 2 3 4	Modbus TCP	☞ Activate/disable function.
	1 2 3 4	Activation	**NOTE: The menu options "Write access" and "Port" are only displayed with TCP activated.** 1 Activate Modbus TCP.
	1 2 3 4	Write access	☞ Allow Modbus TCP write access.
	1 2 3 4	Port	☞ Set network port.
	1 2 3 4	Connection status	Indicates the status of the network connection.
	1 2 3 4	Parameters	☞ Press the `Right arrow button` or `Enter button`. **NOTE: The device does not display the "Parameters" menu in the standard configuration. To display the Parameters menu:** 1 Open the menu. 2 Simultaneously hold down the `Up` and `Down buttons` for several seconds.
	1 2 3 4	Country	**NOTE: This option influences the country-specific operating settings of the device. Please consult the service department of the system manufacturer for further information.** 1 Enter the four-digit password using the 4-way button. The password is device-specific. 2 Confirm the entry with the `Enter` button. 3 Set the desired country setting.
CH, DE, ES, FR, GB, GR, IT, JO, JP, LU, TH, ZA	1 2 3 4	Grid type/guideline	☞ Select the grid type for the device's installation location.
UD	1 2 3 4	Nominal grid voltage	☞ Set the specified grid voltage for the site where the unit is used (please contact the service department of the system manufacturer).
	1 2 3 4	Grid parameter	☞ Open the menu: Press the `Right arrow button` or `Enter button`.
AT, BG, CZ, FR-OLD, FR-VFR13, FR-VFR14, IE, JP, NL, PL, PT, TR, TW, UD	1 2 3 4	Overvoltage shutd. Average value over ten minutes	1 Specify the shutdown threshold for overvoltage shutdown. ⇨ The 10-minute average for the measured voltage as per EN50160 is used. 2 Set period from occurrence of the fault to shutdown of the device.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
BE CH-NS CY DE-NS DK LU-NS	1 2 3 4	Overvoltage shutd. Average value over ten minutes Password protection	1 Activate or disable password protection. 2 Specify the shutdown threshold for overvoltage shutdown. ⇨ The 10-minute average for the measured voltage as per EN50160 is used. 3 Set period from occurrence of the fault to shutdown of the device.
AT FR-OLD FR-VFR13 FR-VFR14 JP-50HZ JP-60HZ UD	1 2 3 4	Voltage drop	**NOTE: The voltage drop between the device 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 to 0-11 Volt increments.** ☞ Specify the shutdown value for the voltage drop (0-11 Volt).
BE CH-NS CY DE-NS DK LU-NS	1 2 3 4	Switch-off volt.	**NOTE: The device is equipped with redundant 3-phase monitoring. If the grid voltage exceeds or drops below the configured values, the device switches off. The minimum switch-off threshold can be set in 1 Volt increments.** 1 Configure the switch-off values for undervoltage and overvoltage. 2 Where applicable, set period from occurrence of the fault to shutdown of the device.
AT, AU, BG, CH—MS, CZ, DE-MS, ES, FR, GB, GR, HR, HU, IE, IL, IN, IT, JO, JP, KR, NL,PL, PT, RO, TH, TR,TW, DU, ZA	1 2 3 4	Overvoltage shutd.	1 Specify the shutdown threshold for fast and slow overvoltage shutdown. 2 Set period from occurrence of the fault to shutdown of the device.
See Overvoltage shutd.	1 2 3 4	Undervoltage shutd.	1 Specify the shutdown thresholds for fast and slow overvoltage shutdown. 2 Set period from occurrence of the fault to shutdown of the device.
AT, AU, BG, CD-MS, CZ, DE-MS, ES, FR, GB, GR, HR, HU, IE, IL, IN, IT, JO, JP, KR, NL, PL, PT, RO, TH, TR, TW, DU, ZA	1 2 3 4	Overfreq. shutd.	☞ Set limit value for the slow and fast overfrequency shutdown.
▸ Page 000]	1 2 3 4	Underfreq. shutd.	☞ Set limit value for the slow and fast underfrequency shutdown.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Grid parameter (further information)	 If the value U< (slow undervoltage shutdown) is set to a value which is greater than the value of $U_{con, min}$ (minimum restart voltage) using the LC display, then the value of $U_{con , min}$ is automatically set to the value of U>. If the value U> (slow overvoltage shutdown) is set to a value which is smaller than the value of $U_{con, max.}$ (maximum restart voltage) using the LC display, then the value of $U_{con, max.}$ is automatically set to the value of U>. If the value f< (slow underfrequency shutdown) is set to a value which is greater than the value of $f_{con, min.}$ (minimum restart frequency) using the LC display, then the value of $f_{con, min.}$ is automatically set to the value of f<. If the value f> (slow overfrequency shutdown) is set to a value which is smaller than the value of $f_{con, max.}$ (maximum restart frequency) using the LC display, then the value of $f_{con, max.}$ is automatically set to the value of f>.
BE CH-NS CY DE-NS DK LU-NS	1 2 3 4	Switch-off freq.	 **NOTE: The device continuously monitors the grid frequency. If the grid voltage exceeds or drops below the configured values, the device switches off.** 1 Set limit values for underfrequency and overfrequency in 0.1 Hz increments. 2 Set period from occurrence of the fault to shutdown of the device.
	1 2 3 4	Check surge protection device	 **NOTE: Please refer to the application note on our website if you install the overvoltage protection yourself.** **NOTE: Allows the monitoring of the overvoltage protection.** ☞ Activate overvoltage protection. **NOTE: By activating, an overvoltage protection test is carried out with an appropriate status messages**
	1 2 3 4	Power limitation.	↳ **NOTE: The output power of the device can be set permanently to a lower value than the maximum output power by the power limitation. 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.** **NOTE: The value can be protected from the very first power limitation entry. After setting a limitation, the value can only be changed by entering a device-specific password.** **NOTE: Only the external power limitation can be adjusted on the device. The internal power limitation can only be set via the web interface.** Configuration via web user interface [See section 9.3.2 Page 41]
	1 2 3 4	Power limitation. external	↳ **NOTE: External power limitation is possible with the extension module (KACO accessories).** 1 Specify the activation status (`on / off`). 2 Select the activation threshold (Active Low / Active High) from digital input 1, 2, 3 or 4 (only if activation status = on). 3 Specify the power limitation stages (only if activation status = on) a.) Specify stage 0-3 b.) Specify stage 4-7 c.) Specify stage 8-11 d.) Specify stage 12-15 4 Confirm the entry with the `Enter` button.

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Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Powador-protect Auto | On | Off	**NOTE: Configures the support for grid shutdown by a Powador-protect connected to the digital input of the device.** ↻ Auto/On: A Powador-protect is operating in the photovoltaic system and is connected to the device at the digital input/output. ☞ Set the operating mode for Powador-protect. Auto: The device automatically detects a Powador-protect integrated into the photovoltaic system. On: The digital signal of the Powador-protect must be present at the digital input of the device for the device to begin feed-in. Off: The device does not check whether a Powador-protect is integrated into the PV system.
	1 2 3 4	Iso.resistor	☞ Set threshold value (in 1kOhm increments) at which the insulation monitor reports a fault.
	1 2 3 4	Power reduction P(f)	**NOTE: The unit supports the internal power factor correction after P(f).** 1 Open the menu: Press the `Right arrow button` or `Enter button`. Note: All the parameters are configurable here and via the WEB interface**NOTE: .** Configuration via web user interface [See section 9.3.2 Page 41]
	1 2 3 4	Fault ride-through	**NOTE: The device supports dynamic grid stabilization (Fault Ride-Through).** ☞ Further parameterisation is possible via the web interface
	1 2 3 4	Reactive power	1 Open the menu: Press the `Right arrow button` or `Enter button`. 2 Activating reactive power process: Select process a press the `Enter button`. The active process is highlighted.
	1 2 3 4	cos-phi const. 1- 0.3	More detailed information about the procedure can be found at: 1 Reactive power control [See section 10.1 Page 52] 2 Determine the specified displacement factor.
		Over-excited | under-excited	☞ If a power factor not equal to 1 is selected: Select the type of phase shift: under-excited (inductive load), over-excited (capacitive load).
	1 2 3 4	Q constant 0 – 100%	More detailed information about the procedure can be found at:Reactive power control [See section 10.1 Page 52] ☞ Set the idle power Q (in %) to a fixed value.
		Under-excited | over-excited	☞ Select the type of phase shift. **NOTE: Under-excited relates to inductive load, over-excited relates to capacitive load.**
	1 2 3 4	cos-phi(P/Plim)	**NOTE: More detailed information about the procedure can be found at:** Reactive power control [See section 10.1 Page 52] ☞ Open the menu: Press the `Right arrow button` or `Enter button`.
	1 2 3 4	Settling time 1s – 120 s	☞ Set the settling time in the event of an abrupt change in the reactive power target value (e.g. caused by a voltage jump). The transient response corresponds to a first-order filter (PT-1) with settling time = 5Tau.

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Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Lock-in voltage 23V – 287V	☞ Set the voltage above which control is activated.
	1 2 3 4	Lock-out voltage 23V – 287V	☞ Set the voltage below which control is deactivated.
	1 2 3 4	Number of nodes 2 - 10	**NOTE: The maximum number of configurable nodes depends on the selected grid type.** ☞ Specify the number of nodes for the cos φ /(p/pn).
	1 2 3 4	1st node … 10th node Voltage | Reactive power | Excitation 0-100%	☞ Power factor for 1st ,10th ... node as a percentage of the maximum power.
		1 – 0.3	☞ Specify the **NOTE: cos φ** of the node.
		Over-excited | under-excited	☞ If a reactive power not equal to 1 is selected: Select the type of phase shift.
	1 2 3 4	Q(U) 10 nodes	☞ Open the menu: Press the `Right arrow button` or `Enter button`. **NOTE: More detailed information about the procedure can be found at:** Reactive power control [See section 10.1 Page 52]
	1 2 3 4	Settling time 1s – 120 s	☞ Set the settling time in the event of an abrupt change in the reactive power target value (e.g. caused by a voltage jump). The transient response corresponds to a first-order filter (PT-1) with settling time = 5Tau.
	1 2 3 4	Lock-in power 0 – 100% S_{max}	☞ Set the active power as % of rated power above which control is activated.
	1 2 3 4	Lock-out power 0-100% S_{max}	☞ Set the active power as % of rated power below which control is deactivated.
	1 2 3 4	Lock-in time 0 s – 60 s	☞ Set the length of time that the active power must remain below the lock-in power level before control is activated.
	1 2 3 4	Lock-out time 0 s – 60 s	☞ Set the length of time that the active power must remain below the lock-out power level before control is deactivated.
	1 2 3 4	Downtime 0 s – 10 s	☞ Set the intentional delay for the start of the Q(U) function. **NOTE: If the voltage switches from a characteristic curve section with Q=0 to a characteristic curve section with Q≠0 under active control, then the reactive power setting process is delayed by the set dead time. Once the dead time has expired, the control circuit is no longer subject to a delay and the set settling time determines the transient behaviour.**
	1 2 3 4	Rise Outg. grad. & Fall. Outg. grad. increasing | decreasing 1 %-60000 %/min	**NOTE: In addition to configuring the transient behaviour using the settling time corresponding to a first-order filter, the reactive power setting can be determined by a maximum gradient - maximum change in the reactive power per time period.** ☞ Maximum change in the reactive power %Smax/min in the event of a change to over-excited mode.
		1 %-60000 %/min	☞ Maximum change in the reactive power %Smax/min in the event of a change to under-excited mode.

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Country-spec. Settings	Menu level	Display/ Setting		Action in this menu/meaning
		Min. cos-phi Q1 - Min. cos-phi Q4		**NOTE: In the event of a significant voltage deviation, the maximum reactive power adjustment range can be limited by a minimum cos ϕ in order to prevent an excessive reactive power supply and, as a result, a significant reduction in the maximum active power that can be fed in.**
				☞ Enter the minimum cos φ factor for quadrants 1 and 4.
				☞ Enter the minimum cos φ factor for quadrants 2 and 3.
		Priority mode Q priority | P priority		☞ Set priority for reactive power – Q or active power – P. **NOTE: When it comes to P priority, the reactive power adjustment range is limited subject to the active power that is currently available and fed in.**
		Active curve 1 - 4		☞ Select active curve. **NOTE: Up to 4 characteristic curves can be configured independently and one of them can be activated for regulation each time.**
		Reset the curve		☞ Reset active curve to the default setting.
		Number of nodes 2 - 10		**NOTE: The maximum number of configurable nodes depends on the selected grid type.** ☞ Specify the number of nodes for the Q(U) characteristic curve.
		1st node … 10th node Voltage | Reactive power | Excitation 0 - max. voltage in continuous operation		☞ Enter the voltage of the node in volts.
		0-100% [% S_{max}]		☞ Set the reactive power of the node as a percentage of the maximum power.
		Over-excited | under-excited		☞ If a reactive power not equal to 1 is selected: Select the type of phase shift.
		Exten. standalone grid		**NOTE: Grid operators require shutdown of the device with standalone grid detection.** ☞ Further parameterisation is possible via the web interface.
BE CH-NS CY DE-NS DK JP-50HZ JP-60HZ LU-NS TW UD		Line error		**NOTE: Display of grid faults.** ☞ To show the last 5 grid fault messages, press the `Show button`.
		Advanced features		☞ Further parameterisation is possible via the web interface
		Information		Open the menu: Press the right arrow button or the OK button.
		Inv. type		Displays the type designation of the device. If feed-in power is actively limited: display maximum power in kW.
		SW version		Displays the installed software version.
		Serial number		Displays the serial number of the device.
		Display country		Displays the selected country setting. Optional: Displays the grid type if a grid type has been selected.
		Precharge Unit		**NOTE: Displays the status according to the SunSpec protocol and the error status for the existing unit.**

Country-spec. Settings	Menu level	Display/ Setting		Action in this menu/meaning
		Precharge Unit		Displays the total battery voltage Displays the DC voltage connected to the device Temperature of the unit Status of the unit Error status of the unit
		Vendor		The display shows information about the device manufacturer.

9.3.2 Configuration via web user interface

NOTE

In addition to the parameters in the chapterMenu [See section 9.3.1 Page 32], additional parameters are available and accessible via the web user interface. To do so, enable `Remote config` in `Network` under `Webserver` and enter the device IP address into your browser.

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
		Minimum battery voltage ⚙ 500 – 700 [V]		**NOTE: The minimum battery voltage is specified automatically in accordance with the country-specific GridCode.** ☞ Apply the settings in accordance with the specifications of the system integrator.
		Operating settings		**NOTE: Options for advanced setting of the operating parameters.**
		Iso.resistor		☞ Set threshold value (in 1kOhm increments) at which the insulation monitor reports a fault.
		FRT (Fault Ride Through)		**NOTE: The device supports dynamic grid stabilization (Fault Ride-Through).**
		Operation mode – On | Off		☞ Select a control process. On: Activates dynamic grid support using dynamic reactive current. Off: Deactivates dynamic grid support using dynamic reactive current. Dynamic grid support remains active on account of immunity to interference.
		Setting | Manual |Predefined zero current		☞ Select a control process.
		Priority – Reactive current limitation | Active current priority		☞ Select a control process.
		Constant k positive sequence dip & Constant k positive sequence swell ⚙ k 0 – 10 ⚙ 2		☞ Set amplification factor k for the pos. sequence for drop and increase in the grid voltage.

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
	1 2 3 4	Constant K negative sequence dip Constant k negative sequence swell k 0 – 10 2		☞ Set amplification factor k for the neg. sequence for drop and increase in the grid voltage.
	1 2 3 4	Dead band 0 - 100 [% Uref] 10.0		☞ Set dead band in %.
	1 2 3 4	Dynamic reactive current only Off | On		**NOTE: With FRT mode activated, the pre-fault reactive current can be added.** ☞ If necessary, activate pre-fault reactive current.
	1 2 3 4	Dead band mode Mode 1 | Mode 2		☞ Select dead band mode for the active control process.
	1 2 3 4	Reference voltage U< - U>		☞ Set reference voltage for the active control process.
	1 2 3 4	Minimum operating voltage 45 – 125.0 [% Unom] & Maximum operating voltage 45 – xxx [% Unom] Password protection Status		☞ Set voltage range for the active control process.
	1 2 3 4	Zero current undervoltage threshold Zero current overvoltage threshold 0 – 184 V / 253 – 340 V		☞ Set the voltage threshold for zero current mode.
	1 2 3 4	Reactive current limitation 0 – 100 % [% Imax]		☞ Set the reactive power limitation.
	1 2 3 4	Minimum support time 1000 – 15000 ms		☞ Set the minimum support time.
	1 2 3 4	Connection cond.		**NOTE: The device checks the grid voltage and grid frequency. The grid feed-in mode begins if the measurements are within the set ranges.** ☞ Set minimum and maximum values for connection.
	1 2 3 4	Min. conn. voltage after grid failure Max conn. voltage after grid failure		☞ Set min. and max. switch-on voltage after grid monitoring.

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
	1 2 3 4	Min. conn. frequency after grid failure Max. conn. frequency after grid failure		☞ Set min. and max. switch-on frequency after grid monitoring.
	1 2 3 4	Waiting time after grid failure		☞ Set wait time for grid monitoring.
	1 2 3 4	Enhanced Island Detection		NOTE: Grid operators require shutdown of the device with standalone grid detection Advanced islanding detection [See section 10.5 Page 68]
	1 2 3 4	Exten. ROCOF		☞ Activate active grid influence by additional reactive power feed-in.
	1 2 3 4	Frequency shift Off | On		☞ Activate frequency shift.
	1 2 3 4	Pulse period repetition time 40 – 6000 [ms]		☞ Define period for detection.
	1 2 3 4	ROCOF threshold stage 1 value 0.1 – 6.0 [Hz / s] ROCOF threshold stage 2 value 0.1 – 6.0 [Hz / s]		☞ Define threshold for ROCOF
		ROCOF threshold stage 1 time 0.10 – 5.00 [s] ROCOF threshold stage 2 time 0.10 – 5.00 [s]		☞ Define time value for ROCOF.
	1 2 3 4	ROCOF proportionality factor -5000 – 5000 [‰ / Hz] Status		1 Define the proportionality factor. 2 Confirm the action field.
	1 2 3 4	Change password for “installer” Password of the logged-on user | New password for the “installer” access | Confirm new password		1 Enter old password. 2 Enter a new, secure password. 3 Confirm and apply new password.
	1 2 3 4	Change password for "user" Password of the logged-on user | New password for the "user" access | Confirm new password		1 Enter old password. 2 Enter a new, secure password. 3 Confirm and apply new password.

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
		Average value over ten minutes		☞ Set the voltage via averaging.
		⚙ Overvoltage averaging		
		⚙ Counter / inverter voltage drop		☞ Set the voltage.
		Modbus		**NOTE: Option to set the Modbus port.**
		Power Limitation		**NOTE: The output power of the device can be set permanently to a lower value than the maximum output power by the internal power limitation. 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.**
		Internal		**NOTE: Opportunity to limit the power internally**
		Power Limitation		☞ Specify the activation status.
		Status		
		Maximum apparent power Slim		**NOTE: The max. apparent power limits the internal power of the device.**
		⚙ 1000 – S_{max} [VA]		More detailed information at:
				Other grid-supporting functions that are effective in the case of active power [See section 10.4 Page 67]
				☞ Enter the value or set the value using the slider.
				The apparent power is limited globally to the configured value in VA. All active and reactive power control values use S_{lim} instead of S_{max} as 100 %, if S_{lim} is configured.
		Maximum active power Plim		More detailed information at:
		⚙ 1.0 - 100.0 [% Slim]		Other grid-supporting functions that are effective in the case of active power [See section 10.4 Page 67]
		Password protection		☞ Enter the value or set the value using the slider.
		Status		Active power is limited globally to the configured value in % S_{lim} or S_{max}.
				1 Optional: Activate password protection.
				2 Confirm the action field.
		Output gradient limitation increase & Output gradient limitation decrease		☞ Specify the increasing and decreasing output gradient.
		⚙ 1 - 65534 [% / min]		
		Settling time		1 Specify the settling time.
		⚙ 200 – 30000 [ms]		2 Activate optional password protection.
		Password protection		3 Confirm the action field.
		Status		

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
	1 2 3 4	Power rampup active		**NOTE: Power ramp-up is used to ramp up the power gradually**
		Power rampup gradient 1 – 600 [% / min]		☞ Set increase.
		Rampup on every connect Status		1 Activate option. 2 Activate optional password protection. 3 Confirm action field
		Rampup on first connect Status		
		Rampup after grid failure Status		
		Password Protection Status		
	1 2 3 4	Settling time 200 - 60000 [ms] 1000		1 Set the settling time in the event of an abrupt change in the reactive power target value (e.g. caused by a voltage jump). The transient behaviour corresponds to a first-order filter (PT-1) with transient time = 5Tau.
		Password protection Status		2 Activate optional password protection. 3 Confirm the action field.
	1 2 3 4	Settling time 200 - 60000 [ms] 1000		1 Set the settling time in the event of an abrupt change in the reactive power target value (e.g. caused by a voltage jump). The transient behaviour corresponds to a first-order filter (PT-1) with transient time = 5Tau.
		Password protection Status		2 Activate optional password protection. 3 Confirm the action field.
	1 2 3 4	Priority mode Q-Priority | P-Priority		☞ Set priority for reactive power – Q or active power – P. **NOTE: When it comes to P priority, the reactive power adjustment range is limited subject to the active power that is currently available and fed in.**
	1 2 3 4	Node 1- Node 10 Power / Excitation / Voltage		☞ Set the reactive power of the node as a percentage of the maximum power.
		0 – 100 [%]		
		Over-excited | under-excited		☞ Select the type of phase shift. **NOTE: Over-excited relates to a capacitive load, under-excited relates to an inductive load.**
		0 – 100 [% Unom]		☞ Enter the voltage of the node in volts. **NOTE: The voltage values of the nodes must increase continuously. At voltages below the 1st node and voltages above the last node, the reactive power value of the 1st or last node is used each time.**
Not for IL, IT	1 2 3 4	P(f) operation mode Off | Mode 1 | Mode 2		☞ Specify the operation mode.

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
	1 2 3 4	Power reference mode with overfrequency Actual power | Nominal power Power reference mode with underfrequency Actual power | Nominal power		1 Specify control method with overfrequency. 2 Specify control method with underfrequency.
	1 2 3 4	Activation threshold with overfrequency 50.2 – 70 (Hz) Activation threshold with underfrequency 40 – 45 (Hz)		1 Set frequency thresholds for activating the power limitation with overvoltage. 2 Set the frequency thresholds for activating the power limitation with undervoltage.
	1 2 3 4	Gradient with overfrequency – feed-in 0 – 200 (%/Hz) 40 (%/Hz) Gradient with underfrequency – feed-in 0 – 200 (%/Hz) 40 (%/Hz)		1 Specify gradient for feed-in with overfrequency. 2 Specify gradient for feed-in with underfrequency.
	1 2 3 4	Gradient with overfrequency – charging 0 – 200 (%/Hz) ; 40 (%/Hz) Gradient with underfrequency – charging 0 – 200 (%/Hz) ; 40 (%/Hz)		1 Specify gradient for charging with overfrequency. 2 Specify gradient for charging with underfrequency.
	1 2 3 4	Frequency of the maximum deactivation threshold 45 -50.2 (Hz) Frequency of the minimum deactivation threshold 45 -50.2 (Hz)		1 Set frequency of the maximum deactivation threshold. 2 Set frequency of the minimum deactivation threshold.
Not for IL, IT	1 2 3 4	P(f) deactivation time 0 – 3600 [s]		☞ Specify time for power reduction (if mode 1 is active).
	1 2 3 4	P(f) deactivation gradient 0 – 60000 [% / min]		☞ Determine the deactivation gradient.
	1 2 3 4	Dynamic gradient mode On | Off		☞ Activate dynamic gradient.

Country-spec. Settings	Level	Display/ Setting		Action in this menu/meaning
	1 2 3 4	Maximum dynamic gradient frequency ⚙ 50.22 – 70.5 [Hz] Minimum dynamic gradient frequency ⚙ 45 – 50 [Hz]		☞ Specify dynamic gradient frequency in Hz.
	1 2 3 4	P(f) settling time ⚙ 200 – 2000 [ms] Password protection ☑≡ Status		1 Set the P(f) settling time mode. 2 Activate optional password protection. 3 Confirm the action field.
	1 2 3 4	Output gradient limitation increase & Output gradient limitation decrease ⚙ 1 - 65534 [% / min]		☞ Specify the increasing and decreasing output gradient.
	1 2 3 4	Power reduction P(U)		**NOTE: To prevent the device from shutting down due to overvoltage protection, the active power can be regulated in addition to reactive power control in order to reduce the active power feed-in whereby the output voltage is reduced.**
	1 2 3 4	Reference power ☑≡ Actual power | Nominal power		☞ Select the power-dependent control method.
	1 2 3 4	Evaluated voltage ☑≡Maximum phase voltage | Positive phase sequence voltage		☞ Select the voltage to be rated. Specifies which voltage is evaluated in a three-phase system.
	1 2 3 4	Hysteresis mode ☑≡Off | On		**NOTE: Hysteresis mode affects the shutdown response of P(U).** ☞ Activate the mode.
	1 2 3 4	Deactivation gradient ⚙ 0 – 65534 [% / min]		☞ Set the gradients for the power limitation.
	1 2 3 4	Deactivation time ⚙ 0 – 60000000 [ms]		☞ Specify the time for voltage reduction.
	1 2 3 4	Output gradient limitation increase & Output gradient limitation decrease ⚙ 1 - 65534 [% / min]		☞ Specify the increasing and decreasing output gradient.
	1 2 3 4	Active curve ⚙ 1 - 5		☞ Select active curve. **NOTE: Up to 5 characteristic curves can be configured independently and one of them can be activated for regulation each time.**

Country-spec. Settings	Level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Upload/download	**NOTE: Opportunity to save log files and save and import parameter data**
		Download service log data	☞ Save service log data to external storage media.
		Download service log data without yields	☞ Save log data without yields to external storage media.
		Download a set of parameters	☞ Save a set of parameters to external storage media.
		Document a set of parameters	☞ Issue or print documentation of a set of parameters as a PDF.
		Transfer a set of parameters	☞ Load a set of parameters from external storage media.
	1 2 3 4	EMS communication timeout	**NOTE: The menu item is only available in the EMS in the battery.**
	1 2 3 4	Operation mode ☑ ON | OFF	☞ Switch on the function for monitoring the system.
	1 2 3 4	Time 30 s ⚙ 1 – 600 [s]	☞ Specify the interruption period by which time the signal must appear.
	1 2 3 4	Analyze Log Data	**NOTE: All measurement data can be transferred to a USB stick by making individual and multiple selections.**
		User logs ☑ cosPhi | fac (Hz) | lac 1 (A) | lac2 (A) | lac3 (A) | idc (A) | Qac (var)	1 Select a date in the calendar. 2 Select measurement data from the dropdown field. 3 Update the measurement data. 4 Move the selected measurement data to the storage device or move the data selectively.

NOTE

With regard to the selection of country settings, KACO new energy attests:

› that the relevant certificates are only valid if the corresponding country settings have been selected.

› that all configured grid parameters must be configured in accordance with the requirements of the grid operators.

› that the configuration of parameters using IEEE 1547: 2003 table 1 is possible but is only permitted if it is requested by the grid operators.

9.4 Monitoring the device

The device has an integrated web server. This permits the monitoring and configuration of the device.

USB interface

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

Web server

This device 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 device, the web server uses the menu language set in the device.

↻ You have connected the device to your network.

1 When using a DHCP server: Activate DHCP.

2 For manual configuration (DHCP off):

3 Open the Settings/Network menu.

4 Assign a unique IP address.

5 Assign a subnet mask.

6 Assign a gateway.

7 Assign DNS server.

8 Save your settings.

Using the web server

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

NOTE

You can also access the web server of the device via the Internet. To do this, additional settings of your network configuration, particularly your internet router, are required. Note that communication with the device is carried out over an unsecured connection, particularly in the case of a connection via the internet.

↻ 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 device and open the site.

» The internet browser displays the home screen of the web server.

After it has opened, the web server displays information about the device as well as the current yield data.

· Grid power	· Battery power
· Status	· Generator voltage
· Grid power	· Unit temperature
· Grid voltage	·

Tab. 5: Measurement data display

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 selecting one of the buttons: `daily view`, `monthly view`, `yearly view` or `overview`.

Filtering the display period (only possible with daily view)

1 Open the web server.

2 Select the daily view.

3 To show or hide measurements, select or deselect the corresponding checkboxes in the “Choose view” 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 “Choose view” area, an export file always contains all measurement data and yield data available for the selected period.

9.5 Performing a firmware update

You can update the software of the device 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).

New functions can be added to the device via firmware updates.

NOTE

Ensure the active DC power supply of the device

It is only possible to update all of the device’s components to the most current firmware version in this operating state.

⚠ CAUTION

Damage to the device from faulty power supply

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

› Never disconnect the DC and AC power supply for or during a firmware update.

› Do not remove the USB stick during the firmware update.

Preparing a firmware update

1 Obtain a device-specific firmware update from the system manufacturer and store on your hard drive.

2 Extract the complete firmware update file to a USB stick.

» Perform the firmware update.

NOTE

The firmware update can take several minutes. The "Operating" LED flashes during the update process. The device may restart several times as required.

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

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

Performing a firmware update

↻ Ensure that the power supply is connected.

1 Connect the USB stick to the device.

⇨ The message appears on the display: "Software found. Load?"

2 If you would like to perform the update, press the "Yes" button. If "No", pressing the "Enter" button cancels the update process and the device goes into feed-in mode.

⇨ The device begins the update.
- The update has been imported in full when the inverter menu appears.
- If the update fails, the message "Software update incomplete" appears.

3 When an error occurs, the update process must be repeated.

You can check to see if the update was successful in the menu:

Displaying the firmware version

☞ Open the Information / SW version menu.

» The device will display the versions and checksums of the software that is currently loaded.

9.6 Access via Modbus

NOTE

In order to make use of the Modbus functionality, we recommend using the “SunSpec-Modbus-Interface” specification we have made available for the firmware version installed on your device.

Follow the description in the document “Modbus-Protokol.pdf” in order to use the two Excel files with a high level of process reliability.

10 Specifications

10.1 Reactive power control

Reactive power can be used in electrical energy supply networks to bolster the level of voltage. As such, feed-in inverters can contribute to statistical voltage stability. Reactive power brings about a voltage drop at the inductive and capacitive components of the equipment which can either bolster or reduce the level of voltage. If the generating plant draws inductive reactive power while active power is being fed in, part of the voltage swing caused by the active power feed can be compensated for by the supply of reactive power.

This reactive power mode and the respective control process are specified by the grid operator. If no control process has been specified, then the system should be operated using a reactive power specification of 0%.

10.1.1 Operating power range depending on grid voltage

The device can be operated within the respective fixed voltage range provided. The maximum apparent power is stated in the following table. In the event of undervoltage determined by the maximum continuous current subject to the grid voltage.

The following figures show the reactive power-active power operating range for devices with a nominal voltage of U_N 220/380, 230/400, 240/415.

Voltage - devices with U_N: 220 V / 380 V; 230 V / 400 V; 240 V / 415 V	Maximum apparent power [p.u.]
≥ 395	1.04
380	1.0
360	0.95

Tab. 6: Maximum continuous apparent power depending on grid voltage

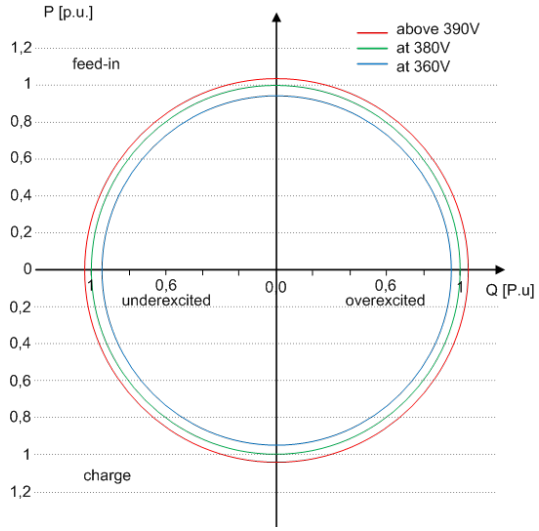

Fig. 29: P-Q operating range for storage devices with U_N 220/380 V, 230/400 V, 240/415 V (Qmax=Smax)

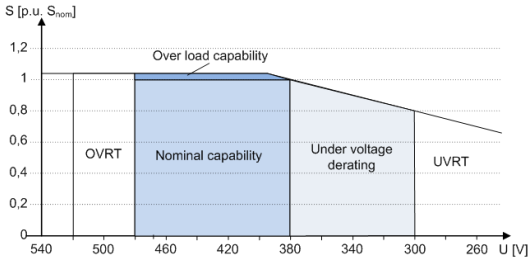

Fig. 30: Grid voltage-dependent apparent power for storage devices with U_N 220/380, 230/400, 240/415 V

10.1.2 Dynamics and accuracy

In all control methods the specified target value at the inverter's connection terminals is adjusted using a stationary deviation of the reactive power of maximum 2% S_N. This maximum deviation always relates to the specified value as reactive power. If the shift factor cos φ is specified in the control method, then the deviation relates to the reactive power value brought about by the current power level.

The transient response of the control methods is determined by a PT-1 filter. In this case, the settling time corresponds to 5 Tau, or in other words, achieving approx. 99% of the final value for a PT-1 filter. Subject to the control method selected, there are also other parameters that determine dynamic behaviour.

10.1.3 Reactive power functions

The following functions for controlling the reactive power are implemented in the devices listed above:

- cos ϕ constant
- Q constant
- cos ϕ /(p/pn)
- Q(U) 10 nodes
- Reactive power is prioritised in each method. The maximum possible active power that can be fed in is reduced in line with the P-Q operating range when a specific reactive power level is specified.

cos ϕ constant

When there is a cos ϕ constant, the specified shift factor cos ϕ is set permanently by the inverter. In doing so, the reactive power level is set in line with Q=P*tan ϕ dependent on power output such that the specified shift factor cos ϕ is calculated on an ongoing basis. If the specification is changed, the new value is adopted by way of a filter in a muted manner. The settling time is 1s with the transient response of a first-order filter (PT-1) with a time constant of Tau = 200 ms. The specified shift factor can be configured on the display or by way of communication via the RS485 protocol of KACO and MODBUS/SunSpec.

If the applicable grid connection guidelines call for cos ϕ to be adjusted to the target value with a defined gradient or a defined settling time that is shorter than the configured Tau = 200 ms, then this gradient or settling time must be implemented on the plant controller.

Q constant

When there is a Q constant, the specified reactive power value is set permanently by the inverter. If the specification is changed, the new value is adopted by way of a filter in a muted manner. The settling time is 1s with the transient response of a first-order filter (PT-1) with a time constant of Tau = 200 ms. The specified reactive power can be configured on the display or by way of communication via the RS485 protocol of KACO and MODBUS/SunSpec.

If the applicable grid connection guidelines call for the reactive power to be adjusted to the target value with a defined gradient or a defined settling time that is shorter than the configured Tau = 200 ms, then this gradient or settling time must be implemented on the plant controller.

cos ϕ /(p/pn)

When it comes to cos ϕ (p/pn), the cos ϕ and, deduced from this, the reactive power target value are calculated continuously as a function of the current power level. This function ensures that grid support is provided by the reactive power when a significant voltage boost is anticipated due to a high feed level. In this case, a characteristic curve is specified which can be used to configure up to 10 nodes, value pairs for active power and cos ϕ. The active power is entered as a % in relation to the nominal power. Other parameters allow you to limit functionality and to limit activation to certain voltage ranges.

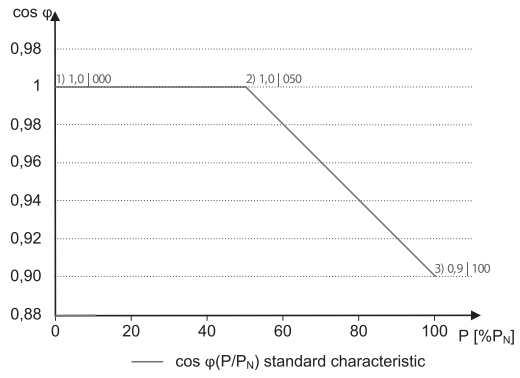

Fig. 31: cos ϕ / (P/Pn) standard characteristic curve with 3 nodes

Q(U) 10 nodes

When it comes to Q(U) with 10 nodes, the reactive power target value is calculated continuously as a function of the grid voltage. This function ensures that grid support is provided by the reactive power as soon as the voltage actually deviates from the target voltage. In this case, a characteristic curve is specified which can be used to configure up to 10 nodes, value pairs for voltage and reactive power. Other parameters allow you to limit functionality and to limit activation to certain voltage ranges as well as parametrise the transient response.

The positive phase sequence voltage is used to calculate the reactive power target value for three-phase devices.

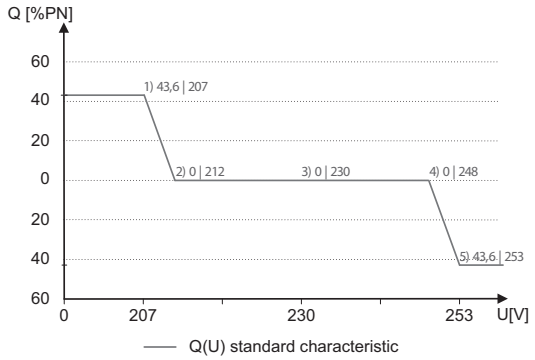

Fig. 32: Q(U) standard characteristic curve with 5 nodes

10.1.4 Parameters for reactive power control

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		cos-phi const. ⚙ 1 – 0.3	Specified displacement factor
		⚙ Over-excited | under-excited	Reactive power mode Under-excited relates to inductive load, over-excited relates to capacitive load.
		Q constant ⚙ 0 – 100 [% S_{max}]	Specification as a % of the maximum power
		☑ Under-excited | over-excited	Reactive power mode Under-excited relates to inductive load, over-excited relates to capacitive load.
		cos-phi(P/Plim)	
		Settling time ⚙ 200 – 30000 [ms]	Determines the dynamic behaviour in the event of a change in the cos ϕ set value. With a change of the active power or the lock-in and lock out voltage, the cos ϕ is changed according to a PT-1 characteristic curve with a settling time of 5 Tau.
		Lock-in voltage 23V – 287V	The control is activated above this voltage.
		Lock-out voltage ⚙ 23V – 287V	The control is deactivated below this voltage.
		Number of nodes ⚙ 2 – 10	Specify the number of nodes for the cos ϕ/(p/pn) characteristic curve
		1st node … 10th node ☑ Voltage | Reactive power | Excitation ⚙ 0 – 100 [% S_{max}]	Power of the node as a percentage of the maximum power. For the 1st node, the power must be 0%; for the last node, the power must be 100%. The power values of the nodes must increase continuously. Note: Storage inverters only for feed-in operation
		⚙ 0 – 100%	cos ϕ of the node

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		Over-excited | under-excited	Reactive power mode Under-excited relates to inductive load, over-excited relates to capacitive load.
		Q(U) 10 nodes	
		Lock-in power 0 – 100 [% S_{max}]	Power threshold, function is activated if limit value is exceeded.
		Lock-out power 0 – 100 [% S_{max}]	Power threshold, function is activated if limit value is undershot.
		Lock-in time 0 – 60 [s]	Length of time that the active power must remain below the lock-in power level before control is deactivated.
		Lock-out time 0 – 60 [s]	Length of time that the active power must remain below the lock-out power level before control is deactivated.
		Downtime 0 s – 10 s	☞ Set the intentional delay for the start of the Q(U) function. **NOTE: If the voltage switches from a characteristic curve section with Q=0 to a characteristic curve section with Q≠0 under active control, then the reactive power setting process is delayed by the set dead time. Once the dead time has expired, the control circuit is no longer subject to a delay and the set settling time determines the transient behaviour.**
		Rise Outg. grad. & Fall. Outg. grad. increasing | decreasing	In addition to configuring the dynamic behaviour using the transient time corresponding to a first-order filter, the reactive power setting can be determined by a maximum gradient - this means the maximum change in the reactive power per time period.
		1 – 60000 [% S_{max}/ min]	Maximum change in the reactive power %S_N/min in the event of a change to over-excited mode **NOTE: The gradient is overlaid with the settling time.**
		Min. cos-phi Q1 - Min. cos-phi Q4	In the event of a significant voltage deviation, the maximum reactive power adjustment range can be limited by a minimum cos ϕ factor in order to prevent an excessive reactive power supply and, as a result, a significant reduction in the maximum active power that can be fed in.
		Q1	Minimum cos ϕ in over-excited operating mode (in-feed).
		Q4	Minimum cos ϕ in under-excited operating mode (in-feed).
		Q2	Minimum cos ϕ in over-excited operating mode (charge).
		Q3	Minimum cos ϕ in over-excited operating mode (charge).
		Priority mode Q priority | P priority	P priority can be selected as an alternative to the standard setting Q priority. When it comes to P priority, the reactive power adjustment range is limited subject to the limited apparent power of the inverter and the active power that is currently available and fed in.
		Active curve 1 – 4	Up to four characteristic curves can be configured independently and one of them can be activated for regulation each time.
		Reset the curve	Reset active curve to the factory setting, depending of the country setting.
		Number of nodes 2 – 10	Specify the number of nodes for the Q(U) characteristic curve.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		1st node … 10th node	Voltage of the node in volts.
		⚙ 0V - Max. voltage in continuous operation	The voltage values of the nodes must increase continuously. At voltages below the 1st node and voltages above the last node, the reactive power value of the 1st or last node is used each time.
		1 – 0.3	Reactive power of the node as a percentage of the maximum power
		Over-excited | under-excited	Reactive power mode Under-excited relates to inductive load, over-excited relates to capacitive load.

10.2 Active power regulation

Methods for regulating the active power of feed-in inverters may be necessary for local management of load flows, for voltage stability in the distribution network and for ensuring the stability of the interconnected grid.

The communication functions `P limit` and `P set` are available for managing load flows in a plant. If necessary, this can be used to reduce the feed of the inverter.

If voltage surges in the upstream distribution network cannot be compensated sufficiently by the absorption of reactive power, it may be necessary to adjust the active power. In this case, P(U) control is available to make optimum use of the absorption capacity of the upstream grid.

Feed-in inverters must participate in frequency maintenance in the interconnected grid. If the grid frequency leaves the normal tolerance band (e.g. ±200 mHz), a critical grid condition exists. Overfrequency is a generation surplus, underfrequency is a generation shortage. With overfrequency, photovoltaic systems and electricity storage systems must reduce their effective feed-in power relative to the frequency increase. The function P(f) is available for this purpose. .

However, depending on the selected country setting, the availability or adjustability of the functions may be limited. This is particularly the case if the applicable grid connection directive requires this restrictiont.

Dynamics / accuracy

In all of the control methods described below the specified target value at the inverter's connection terminals is adjusted using a stationary deviation of the reactive power of maximum $2\%_N$ SN.

The transient response of the control methods is determined by a PT-1 filter. In this case, the settling time corresponds to 5 Tau, or in other words, achieving approx. 99% of the final value for a PT-1 filter. Subject to the control method selected, there are also other parameters that determine dynamic behaviour.

Methods for active power regulation

Methods for regulating the active power of feed-in inverters may be necessary for local management of load flows, for voltage stability in the distribution network and for ensuring the stability of the interconnected grid.

The device makes use of the following functions in order to regulate the active power. These are described in the following section:

- P target value (MPPT/communication) Active power limitation [See section 10.2.1 Page 56]
- P limit (communication) Active power limitation [See section 10.2.1 Page 57]
- P(U) (characteristic curve) Voltage-dependent power reduction P(U) [See section 10.2.2 Page 59]
- P(f) (characteristic curve) P(f) [See section 10.2.3 Page 60]

10.2.1 Active power limitation

The function "P target value" is only available for MODBUS/SunSpec communication, inverter 64201 "WSetPct". The function is used for managing the load flows of the battery and in a plant. If the target value is changed, the new value is adopted by way of a filter and a gradient limitation.

Parameters	Setting	Reference	Description
P target value [WSetPct]	⚙ - 100 – 100 [%]		Defines the target value of the active power.
Settling time [WparamRmpTms]	⚙ 200 – 60000 [ms]		Determines the dynamic behaviour in the event of a change in the active power set value. The active power is changed according to a PT-1 characteristic curve with a settling time of 5 Tau. **NOTE: The settling time is overlaid with the increasing and decreasing gradient.**
Increasing output gradient [WparamRmpDecTmm] Decreasing output gradient [WparamRmpIncTmm]	⚙ 1 – 65524 [%/min]		Determines the dynamic behaviour in the event of a change in the active power set value. The active power is changed with the specified gradient. Note: The gradient is overlaid with the settling time.

P limit

The function “P limit” is available for limiting the maximum feed-in power. If necessary, this can be used to reduce the feed of an inverter, e.g. for managing bottlenecks for the operator of the distribution grid.

P limit is only available via the MODBUS/SunSpec inverter model 123 WMaxLimPct and via RS485 communication. You can find detailed information on the communication protocol at www.kaco-newenergy.de in the “Software” subsection of the “Downloads” section.

When a target value is received for P limit, the output power of the inverter is limited to the specified power value. If the limit value is changed, the new value is adopted by way of a filter and a gradient limitation. The current power may be below the specified limit value because the available power (PV) or the target power value (storage) may be below the specified limit value. Depending on the inverter series, the settling time and gradient limitation may be adjustable.

Parameters	Setting	Reference	Description
Power Limitation [WMaxLimPct]	⚙ 0 – 100 [%]		Specifies the standard power in the event of a communication failure. If no active power command is received within the configured timeout, the inverter sets the power to the configured fallback power.
Timeout [WMaxLimPct_RvrtTms]	⚙ 3 – 100000 [%]		Specifies the timeout time after which the inverter sets the fallback power in the event of a communication failure.
Increasing output gradient [WMaxLimPct_RmpTms] & Decreasing output gradient [OutPFSet_RmpTms]	⚙ 1 – 65534 [% S_{max}/min]		Determines the dynamic behaviour in the event of a change in the active power set value. The active power is changed with the specified gradient. **NOTE: The gradient is overlaid with the settling time.**
Increasing output gradient [WMaxLimPct_RmpTms] & Decreasing output gradient [OutPFSet_RmpTms]	⚙ x [% S_{max}/min]		The gradient limitation is deactivated.

Parameters	Setting	Reference	Description
Settling time [VArPct_RmpTms]	⚙ 200 – 60000 [ms]		Determines the dynamic behaviour in the event of a change in the active power set value. The active power is changed according to a PT-1 characteristic curve with a settling time of 5 Tau. **NOTE: The settling time is overlaid with the increasing and decreasing gradient.**
Settling time [VArPct_RmpTms]	⚙ 1000 [ms]		Non-configurable settings 1 s.

If the applicable grid connection guidelines call for the active power to be adjusted to the target value with a defined gradient or a defined settling time, then the device can be configured in such a way that this gradient is adhered to. In addition, the gradient can also be implemented on the plant controller. This second solution is to be used for all other inverters.

Limitation of power gradients

The power reduction parameters can be adjusted in SunSpec model DID123. During this process, you should also check whether internal and/or external power reduction is active.

Internal power limitation	Parameters for external power limitation	Parameters for power limitation
Status = active	Status = active	Parameters in SunSpec model 123:
Maximum apparent power S_{lim}= 100000 VA		"WMaxLimPct" = 50% P_{lim} (approx. 40000 W) "WMaxLimPct_RvrtTms" = 60 s "WMacLimPct_RmpTms" = 2 s "WMaxLim_Ena" = 1
Maximum active power P_{lim}= 80% (approx. 80000 W)	AC fallback active power Pfb = 75% P_{lim} (approx. 60000 W)	
	PT1 settling time = 1 s	

Tab. 7: Sample parameters for power limitation

If the ramp time "WMacLimPct_RvrtTms" in the SunSpec model is specified as 0 s, then the internal output gradient is used. Otherwise, the set value will be used.

Irrespective of the communication protocol used, the settling time "WMaxLim_Ena" is used in order to transfer the new power value. Otherwise, the internally configured value will be used.

The additional ramp time "WMacLimPct_RmpTms" specifies the jump time from a power value to the new power value.

The following formulae are used to calculate the gradient $S_{lim/min}$:

$$\text{GradientWattPerMin} = \frac{\left(\frac{WMaxLimPct}{100} \times Plim - Pactual\right)}{WMaxLimPct_{RmpTms}} \times 60 \times \frac{100}{Slim}$$

$$\text{GradientWattPerMin} = \frac{\left(\frac{50\%}{100} \times 40000\,W - 60000\,W\right)}{2\,s} \times 60 \times \frac{100}{100000\,VA}$$

$$\mathbf{GradientWattPerMin} = -600\,\%\,\boldsymbol{Slim}\,/\boldsymbol{min}$$

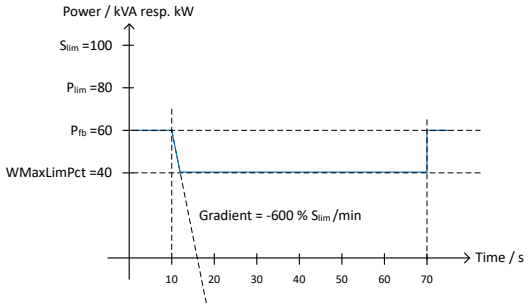

Fig. 33: Power gradient according to sample parameters and calculation

The following formulae are used to calculate the Q filter parameter and cos-phi gradient:

$$\text{GradientVArPerMin} = \frac{\left(\frac{VArMaxPct}{100} \times Slim - Qactual\right)}{VArPct\_RmpTms} \times 60 \times \frac{100}{Slim}$$

Fig. 34: Formula for calculating the Q filter parameter

$$\text{GradientVArPerMin} = \frac{\left(\frac{VArMaxPct}{100} \times Slim - Qactual\right)}{OutPFSet\_RmpTms} \times 60 \times \frac{100}{Slim}$$

Fig. 35: Formula for calculating the cos-phi gradient (internal power gradient)

10.2.2 Voltage-dependent power reduction P(U)

If it is not possible to compensate adequately for increase in voltage in the upstream distribution network by intake on reactive power, it may be necessary to curtail the active power. In this case, P(U) control is available for making optimum use of the capacity of the upstream grid.

P(U) control reduces the active power that is fed in as a function of the grid voltage using a prescribed characteristic curve as a basis. P(U) control is implemented as an absolute power limit. The actual power of the inverter may vary freely below this limit due to a possible fluctuation in the available power or the target value, but at no time increases above the absolute power limit.

[See figure 36] [▶ Page 59] and [See figure 37] [▶ Page 59] are two examples of configuration. In figure 1 without hysteresis, the function is activated as soon as the voltage exceeds the configured voltage of data point 1 (dp1). The power limit follows the characteristic curve, a straight line between dp1 and dp2. The function is deactivated as soon as the voltage falls below dp1. In [See figure 37] [▶ Page 59], the function is activated as soon as the voltage exceeds the configured voltage of dp2. In this case, dp1 does not result in activation of the function because the power limit remains at 100%. The power limit follows the characteristic curve, a straight line between dp2 and dp3. However, because hysteresis is activated, the power limit is not increased when the voltage drops. The function is deactivated as soon as the voltage falls below dp1.

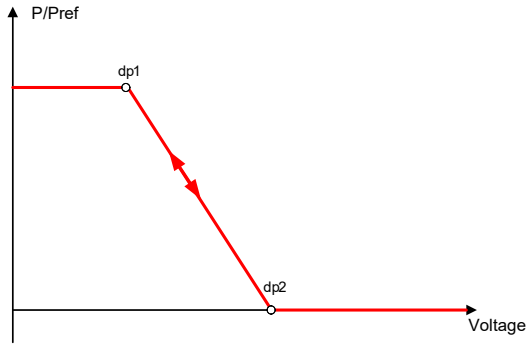

Fig. 36: Example characteristic curve without hysteresis

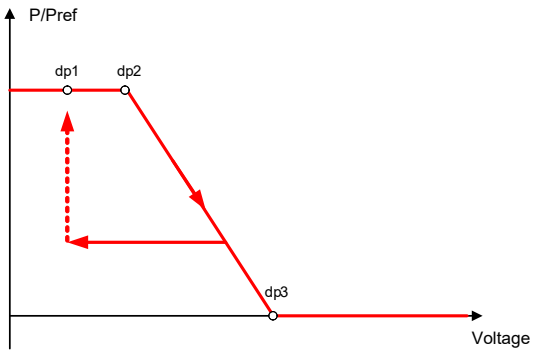

Fig. 37: Example characteristic curve with hysteresis and a deactivation threshold below the activation threshold

In the case of storage inverters, the function is only available in discharge/grid feed-in mode, not in battery charging mode.

10.2.2.1 Parameters for P(U)

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		Reference power Actual power | Nominal power	Specifies the power reference for the characteristic curve. 100 % here corresponds to the nominal power or the actual power at the time the function was activated, the time when the voltage passes the configured node.
	1 2 3 4	Evaluated voltage Maximum phase voltage | Positive phase sequence voltage	☞ Select the voltage to be rated. Specifies which voltage is evaluated in a three-phase system.
		Hysteresis mode Off | On	Off: In non-hysteresis mode, the active power is increased immediately with dropping voltage. On: In hysteresis mode, the power is not increased with dropping voltage. .
		Deactivation gradient 0 – 65534 [% / min]	If the available power is above the actual output at the time of deactivation, the power increase back to the maximum power is limited. The limitation is implemented by an absolute power limitation that increases with a continuous gradient up to the maximum power. The actual power of the inverter may vary freely below this limit due to a possible fluctuation in the available power or the target value, but at no time increases above the absolute power limit.
		Deactivation time 0 – 60000000 [ms]	Only evaluated with activated hysteresis mode: Monitoring time during which the voltage must remain below the lowest configured node before the function is deactivated.
		Settling time 100 – 1200000 [ms]	Determines the dynamic behaviour in the event of a change in the active power set value. With a voltage change, the active power is changed according to a PT-1 characteristic curve with a settling time of 5 Tau. Note: The settling time is overlaid with the increasing and decreasing gradient.
		Number of nodes Power 0,0 – 100,0 [% P_{ref}] Voltage 80 – 125 [% U_{nom}]	Up to five nodes for voltage [V] and power [% Pref] are configurable. The power value of the first and last value pair is also used as the maximum or minimum active power value that is valid across the limits of the characteristic curve.
	1 2 3 4	Active curve 1 - 5	☞ Select active curve. **NOTE: Up to 5 characteristic curves can be configured independently and one of them can be activated for regulation each time.**

10.2.3 P(f)

Adjusting the active power P(f) in the event of overfrequency and underfrequency

Feed-in inverters must assist with frequency stability in the grid. If the grid frequency leaves the normal tolerance range (e.g. ±200 mHz), then the grid will be in a critical state. In the event of overfrequency, there is a generation surplus, in the event of underfrequency, there is a generation deficit.

Power storage systems must adapt their feed-in power relative to the frequency deviation. In the event of overfrequency, the power adjustment is determined by a maximum feed-in limit, in the event of underfrequency, by a maximum charging limit. The actual power of the inverter may vary freely below this limit due to a possible fluctuation in the available power or the target value, but at no time increases above the absolute power limit.

$$P_{max-limit} = P_M + \Delta P$$

Fig. 38: Equation 1

$$\Delta P = g \cdot P_{ref} \cdot (f_1 - f)$$

Fig. 39: Equation 2

Equation 1 [See figure 38] [▶ Page 61] defines the maximum limit with ΔP relevant to 2 [See figure 39] [▶ Page 61], P_M the current power at the time of activation and P_{ref} the configured reference power.

$$\Delta P = \frac{1}{s} \times \frac{(f_1 - f)}{fn} \times Pref$$

Fig. 40: Equation 3

$$g = \frac{1}{s \cdot f_n}$$

Fig. 41: Equation 4

In some standards, the power adjustment is specified by a drop (s) instead of a gradient (g), as shown in equation 3 [See figure 40] [▶ Page 61]. The drop s can be transformed into a gradient g in accordance with equation 4 [See figure 41] [▶ Page 61].

The frequency f remains above the activation threshold f_1 during an overfrequency incident. Consequently, the expression ($f_1 - f$) is negative and ΔP corresponds to a reduction in the feed-in power or an increase in the charging capacity. The frequency f remains below the activation threshold f_1 during an underfrequency incident. Consequently, the expression ($f_1 - f$) is positive and ΔP corresponds to an increase in the feed-in power or an reduction in the charging capacity.

Depending on the operating point of the inverter at the time of activation, the configured power reference and the configured gradient, the inverter may switch from charging to feed-in mode in the event of underfrequency or from feed-in to charging mode in the event of overfrequency (--- FEHLENDER LINK ---).

The measurement accuracy of the frequency is greater than 10 mHz.

The specific mode of operation of the function is specified by the grid operator or the pertinent standards or the grid connection guidelines. The configurability of the function makes it possible to satisfy a wide variety of standards and guidelines. Certain configuration options are not available in some country settings because the pertinent standards or grid connection guidelines prohibit adjustments.

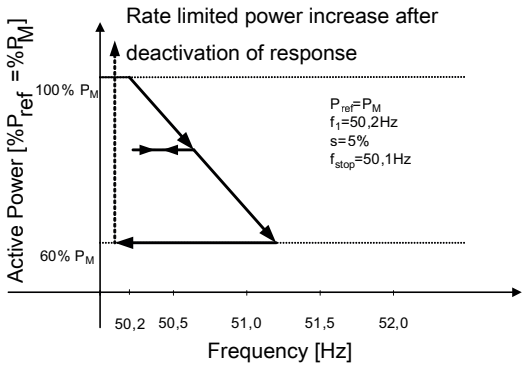

Fig. 42: Example behaviour with hysteresis (mode 1)

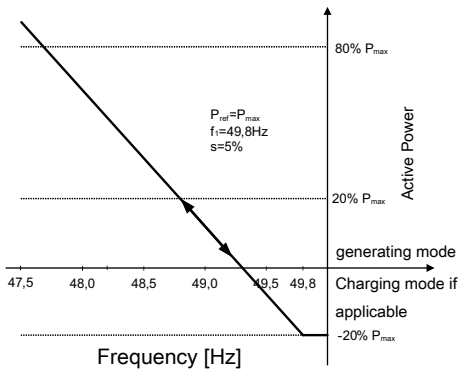

Fig. 43: Example behaviour without hysteresis (mode 2) At the time of activation, the inverter is in charging mode at 20% charging capacity.

10.2.3.1 Parameters for P(f)

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		P(f) operation mode Off | Mode 1 | Mode 2	Activate or deactivate function. Mode 1: With hysteresis activated. See figure 3. Mode 2: Without hysteresis activated. --- FEHLENDER LINK ---
		Power reference mode with overfrequency Actual power | Nominal power Power reference mode with underfrequency Actual power | Nominal power	Power reference with overfrequency: Power reference for power adjustment as in equation 6 and equation 7 for overfrequency incidents. Power reference with underfrequency: Power reference for power adjustment as in equation 6 and equation 7 for overfrequency incidents.
		Activation threshold with overfrequency 50.2 – 70 (Hz) Activation threshold with underfrequency 40 – 45 (Hz)	Activation threshold (f1) overfrequency: Determines the frequency threshold for activating the function in case of overfrequency incidents. The active power adjustment is activated if the frequency rises above the configured value and mode 1 or 2 is activated. In mode 2, the function is deactivated if the frequency falls below the configured value. Activation threshold (f1) underfrequency: Determines the frequency threshold for activating the function in case of underfrequency incidents. The active power adjustment is activated if the frequency falls below the configured value and mode 1 or 2 is activated. In mode 2, the function is deactivated if the frequency rises above the configured value.
		Gradient with overfrequency – feed-in 0 – 200 (%/Hz) 40 (%/Hz) Gradient with underfrequency – feed-in 0 – 200 (%/Hz) 40 (%/Hz)	Gradient with overfrequency (feed-in): Determines the active power adjustment in accordance with equation 2 and equation 3, subject to the frequency. Gradient for overfrequency incidents if the incident begins in feed-in mode. Gradient with underfrequency (feed-in): Determines the active power adjustment in accordance with equation 2 and equation 3, subject to the frequency. Gradient for underfrequency incidents if the incident begins in feed-in mode.
		Gradient with overfrequency – charging 0 – 200 (%/Hz) ; 40 (%/Hz) Gradient with underfrequency – charging 0 – 200 (%/Hz) ; 40 (%/Hz)	Gradient with overfrequency (charging): Determines the active power adjustment in accordance with equation 2 and equation 3, subject to the frequency. Gradient for overfrequency incidents if the incident begins in charging mode. Gradient with underfrequency (charging): Determines the active power adjustment in accordance with equation 2 and equation 3, subject to the frequency. Gradient for underfrequency incidents if the incident begins in charging mode.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		P(f) intentional delay ⚙ 0 – 5000 [ms]	The activation of the function based on the activation threshold is delayed by the configured time. Note 1: This function is regarded as critical for the stability of the transmission grid and is therefore prohibited by several national grid connection regulations. Note 2: This function is stipulated as a requirement by some domestic grid connection directives in order to prevent any negative impact on island detection. However, P(f) has no negative impact on KACO's enhanced island detection.
		Frequency of the maximum deactivation threshold ☑ 45 - 50.2 (Hz) Frequency of the minimum deactivation threshold ☑ 45 – 50.2 (Hz)	Deactivation range lower limit: Only evaluated in mode 1. The function is deactivated if the frequency returns to the deactivation range and remains in this range for the duration of the deactivation time. Deactivation range upper limit: Only evaluated in mode 1. The function is deactivated if the frequency returns to the deactivation range and remains in this range for the duration of the deactivation time.
		P(f) deactivation time ⚙ 0 – 3600 [s]	Only evaluated in mode 1. The function is deactivated if the frequency returns to the range between the minimum and maximum deactivation threshold and remains in this range for the duration of the deactivation time.
		P(f) deactivation gradient ⚙ 0 – 65534 [% / min]	If the available power is above the actual output at the time of deactivation, the power increase back to the maximum power is limited. The limitation is implemented by an absolute power limitation that increases with a continuous gradient up to the maximum power. The actual power of the inverter may vary freely below this limit due to a possible fluctuation in the available power or the target value, but at no time increases above the absolute power limit.
	1 2 3 4	Dynamic gradient mode ☑ On | Off	☞ Activate dynamic gradient.
		Maximum dynamic gradient frequency ⚙ 50.22 – 70.5 [Hz] Minimum dynamic gradient frequency ⚙ 45 – 50 [Hz]	Dynamic gradient maximum frequency: If dynamic gradient mode is activated, the gradient is calculated in order to guarantee a linear power adjustment and reach the maximum charging power if the frequency rises to the maximum configured frequency. Dynamic gradient minimum frequency: If dynamic gradient mode is activated, the gradient is calculated in order to guarantee a linear power adjustment and reach the maximum feed-in power if the frequency drops to the minimum configured frequency.
		P(f) settling time ⚙ 200 – 2000 [ms]	Determines the dynamic behaviour in the event of a change in the active power limit. In the event of a change in frequency, the active power is altered subject to a PT-1 characteristic curve using a settling time of 5 Tau. The settling time is overlaid with the increasing and decreasing gradient.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	Output gradient limitation increase & Output gradient limitation decrease 1 - 65534 [% / min]	☞ Specify the increasing and decreasing output gradient. Specifies the dynamic response on changing the active power for power increase and decrease. With a voltage change, the active power is changed with the specified gradient. Note: The gradient is overlaid with the settling time.
	1 2 3 4	Output gradient limitation increase & Output gradient limitation decrease 1 - 65534 [% / min]	☞ Specify the increasing and decreasing output gradient. Specifies the dynamic response on changing the active power for power increase and decrease. With a voltage change, the active power is changed with the specified gradient. Note: The gradient is overlaid with the settling time.

10.3 FRT

A storage plant's ability to remain immune to voltage drops and voltage spikes in the supply system is a key element in establishing a reliable energy supply. Immunity to interference ensures that brief disruptions do not result in a loss of generation capacity in a larger range of an interconnected grid. Grid support by a fast feeding of residual current also limits the spatial extent of the incident.

The KACO battery inverters blueplanet gs 50.0 TL3-S have the following characteristics with regard to dynamic grid support by way of immunity. The ability to remain on the grid is particularly relevant. The actual behaviour of the inverter is also determined by the disconnection protection settings. This determines whether an inverter is disconnected from or remains on the grid. The protective settings take precedence over interference immunity against drops and spikes.

10.3.1 Dynamic grid support by way of immunity to interference

Interference immunity against undervoltage

Voltage drop above the limit curve in [See figure 44] [▶ Page 64] can be overcome without the need for shutdown from the grid. The feed-in power remains constantly within the limits of the maximum continuous current of the inverter.

If a reduction in power occurs, the power is brought back up to the pre-fault level within 100 ms of the voltage returning.

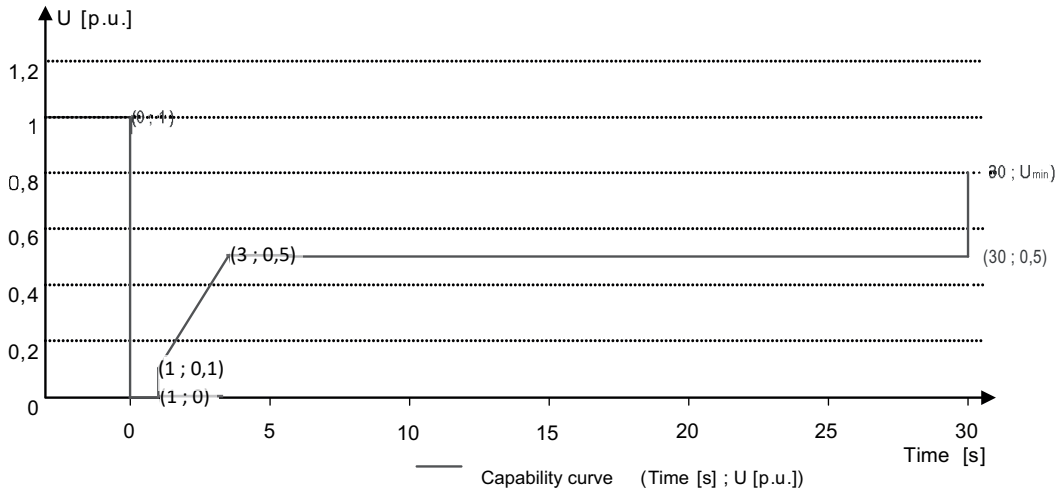

Fig. 44: Characteristic curve of the interference immunity against voltage drops based on the grid voltage

10.3.2 Dynamic grid support using a fast feeding of residual current

When dynamic grid support using a fast feeding of residual current is activated, then residual current is fed in in addition to the immunity to interference properties against drops and spikes described above.

The inverter adapts its current feed as soon as a drop or spike incident occurs in order to bolster the grid voltage. The support takes place in the event of voltage drop in the form of over-excited reactive current (corresponds to a capacitive load), in the event of voltage spike in the form of over-excited reactive current (corresponds to an inductive load). In the reactive current priority mode, the effective current is reduced to the extent necessary to comply with the limits of the maximum continuous current of the inverter.

A dip or swell is detected if either the normal operating voltage range setting is exceeded by at least one phase-phase or phase-neutral voltage, or if a step in the positive or negative sequence component of the voltage greater than the dead-band setting occurs. The magnitude of the voltage step of the positive and negative sequence voltage equates to the difference between the pre-fault voltage and the actual voltage based on the reference voltage. The pre-fault voltage is calculated as a 50-periods mean value.

$$\Delta u = \frac{U - U50per}{Uref}$$

Fig. 45: Formula no. 1

The reactive current is adapted using a response time of <20 ms and a transient time of <60 ms after the incident has occurred. Responses to changes in the voltage during the incident or to the voltage recovery at the end of the incident take place with the same dynamic.

The formula for calculating the dynamic reactive current that is fed for the positive or negative phase sequence voltage is:

$$I_b = \Delta u * k * I_N$$

Fig. 46: Formula no. 2, depending on the nominal current IN of the inverter

For the positive and negative phase sequence voltage, *Δu* equates to the difference between the pre-fault voltage and the current voltage based on the reference voltage. The pre-fault voltage is calculated as a 1-min mean value.

$$\Delta u = \frac{U - U1min}{Uref}$$

Fig. 47: Formula no. 3

On account of the definition of a voltage jump in pre-norm EN50549-2 and in VDE-AR-N 4120 and VDE-AR-N 4110, it is typically the case that another voltage jump is detected when the incident is at an end, when the fault is rectified and when the voltage returns to a normal state. The result of this is that in an active operation mode a dynamic grid support using a fast feeding of residual current remains active even after the incident has passed and that reactive current is fed in according to the formulae (2) and (3). Dynamic grid support using fast feeding of residual current is then deactivated after a configured minimum support time, usually 5 s.

$$I_b = (\Delta u_1 - tb) * k * I_N$$

Fig. 48: Formula no. 4

10.3.3 Extract from FRT menu

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
	1 2 3 4	FRT (Fault Ride Through)	**NOTE: The device supports dynamic grid stabilization (Fault Ride-Through).**
		Operation mode – On | Off Setting | Manual |Predefined zero current	Setting: Manual All parameters can be configured independently. Setting: Predefined zero current Dynamic grid support active on account of immunity to interference and zero current feed-in. During a voltage incident, the current in the inverter is reduced to zero. All parameters are pre-configured, only the activation threshold for zero current has to be configured.

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		Priority – Reactive current limitation | Active current priority	Priority: Reactive current priority Dynamic grid support active on account of immunity to interference and fast feeding of residual current. The inverter feeds additional reactive current according to the formulae (2) and (4). Priority: Effective current priority Dynamic grid support active on account of immunity to interference and fast feeding of residual current with dynamic reactive current. The inverter feeds in as much active power as available. If, as a result of this, the maximum continuous current is not achieved, the device supplies additional reactive current according to the formulae (2) and (4) up to the limit of continuous current.
		Zero current undervoltage threshold Zero current overvoltage threshold 0 – 184 V / 253 – 340 V	If one or more phase/phase or phase/neutral conductor voltages move above the configured threshold, the inverter changes to zero current mode. The total current is regulated to virtually zero.
		Reference voltage U< - U>	Nominal value of the phase/neutral conductor voltage used as a reference voltage for formula (1) and (3). Adjustable in the range from level 1 undervoltage protection to level 1 overvoltage protection.
		Constant K negative sequence dip Constant k negative sequence swell k 0 – 10 2	Amplification factor for the negative sequence used in the calculation of the reactive current using formulae (2) and (4) Can be configured independently for drops and spikes.
		Constant k positive sequence dip & Constant k positive sequence swell k 0 – 10 2	Amplification factor for the negative sequence used in the calculation of the reactive current using formulae (2) and (4) Can be configured independently for drops and spikes.
		Dead band 0 - 100 [% Uref] 10.0	Dynamic grid support through fast feeding of residual current activated in the case of voltage events with a voltage change greater than the dead band.
		Dynamic reactive current only Off | On	Standard: The reactive current according to the formulae (2) and (4) is fed as additional reactive current. The means that sum of the pre-fault and additional reactive current is fed in. Only dynamic: The reactive current according to the formulae (2) and (4) is fed in as absolute reactive current. This means that regardless of the reactive current before the voltage event, only the reactive current is fed in according to the formulae (2) and (4) is fed in during the voltage event.
		Dead band mode Mode 1 | Mode 2	Mode 1: When calculating the reactive current, the value of the dead band is not subtracted from the amount of voltage change. As such, formula (2) applies to overvoltage and undervoltage incidents. Mode 2: When calculating the reactive current, the value of the dead band is subtracted from the amount of voltage change. For overvoltage and undervoltage events, formula (4) therefore applies: $I_b=(\Delta u_1-tb)*k*I_N$

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		Minimum operating voltage 45 – 125.0 [% Unom] & Maximum operating voltage 45 – 125.0 [% Unom]	Dynamic grid support via fast feeding of residual current is activated on voltage events with at least one phase/phase or phase/neutral conductor voltage outside the configured normal operating voltage range. Dynamic grid support via fast feeding ore residual current is deactivated when the voltage returns to the normal operating voltage range.
		Reactive current limitation 0 – 100 % [% Imax]	The reactive power component of the fast feeding of residual current is limited to permit a defined proportion of active power components.
		Minimum support time 1000 – 15000 ms	If due to a voltage jump in accordance with formula (1) and the configured dead band is activated, the dynamic grid support is deactivated via fast feeding of residual current after the minimum support time elapses.

10.4 Other grid-supporting functions that are effective in the case of active power

10.4.1 Permanent power limitation

The maximum active and apparent power to be installed for a generation plant is agreed between the grid operator and plant operator. The device capacity of a plant can be set to the exact agreed value using the S_{lim} and P_{lim} settings. To ensure that the load on the devices in the plant is uniform, we recommend distributing the performance reduction evenly across all devices.

Some grid connection rules insist that the agreed reactive power be supplied from every operating point of the plant without a reduction in the actual active power. Considering the fact that all KACO TL3 inverters have a semi-circular P-Q operating range, a reduction in the active power is, however, required during operation at maximum active power because an apparent power reserve is not available. By adjusting P_{lim}, the maximum active power can be restricted in order to establish an apparent power reserve and ensure that the agreed reactive power can be delivered from any active power operating point. Displays the appropriate P-Q operating range with a required example active power of 48% of the maximum apparent power of the plant or 43% of the maximum active power of the plant.

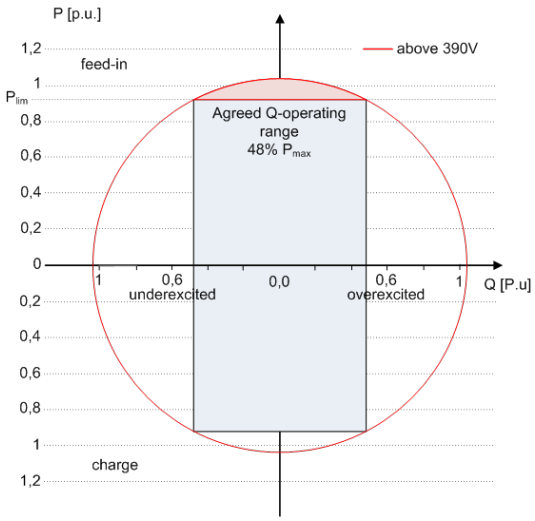

Fig. 49: P-Q operating range with limited active power (Qmax=Smax≠Pmax) Storage inverter

10.4.1.1 Parameter for permanet power limitation

Country-spec. Settings	Menu level	Display/ Setting	Action in this menu/meaning
		Power limitation Check activation	Activate or disable the power limitation.
		Maximum apparent power 1000 – S_{max} [VA]	The apparent power is limited globally to the configured value in VA. As soon as $S_{lim\ has\ been\ configured}$, all of the active and reactive power control values will use S_{lim} as 100% instead of S_{max}.
		Maximum active power 1 – 100 [% S_{lim}]	Active power is limited globally to the configured value in % Slim or Smax.

10.4.2 Soft start-up / Power rampup

A soft start-up function is available to prevent the grid from being negatively impacted by a sudden increase in feed-in power from the inverters.

When the inverter is activated or switched on, the increase in power is restricted by the set gradient. It is possible to configure whether the soft start-up should occur every time the device is switched on, only upon initial start-up each day or only upon start-up after the device has been switched off by grid protection. Due primarily to the fact that there is the risk that many plants could increase their power levels simultaneously after they have been switched off by grid protection, a soft start-up is usually only required for start-up after a device has been switched off by grid protection.

The soft start up is implemented by an absolute power limitation that increases with a continuous gradient up to the maximum power. The actual power of the inverter may vary freely below this limit due to a possible fluctuation in the available power or the target value, but at no time increases above the absolute power limit.

10.4.2.1 Parameter for power ramp

	1 2 3 4 Power ramp		**NOTE: The power ramp allows a moderate increase of the Performance possible**
		Gradient 1 – 600 [% / min]	Gradient of power limit. The maximum power limit increase to 100% of nominal power with the gradient specified.
		After every connect	Soft start ramp up is activated for every connection of the inverter to the grid
		After first connect	Soft start ramp up is activated for the first connection of the inverter to the grid on a particular day or after complete reboot of the inverter (AC and DC disconnected)
		After grid error	Soft start ramp up is activated for connection of the inverter to the grid after trip of the internal interface protection or via the external grid protection port (Powador-protect)

10.5 Advanced islanding detection

Due to decentralized generation, there is the possibility that a deactivated part of the grid will remain live in an unintended island due to the balance of load and generation in this part of the grid. The detection of unintended island formation is an important function of decentralized generating units and is related to the prevention of damage to equipment as well as safety of personnel.

Depending on the structure and the operation of the distribution grid several dangers exist:

- In case of maintenance work in a distribution grid, personnel may be placed in danger if the deactivated part of the grid remains live as an island. This is especially the case if not all safety rules are followed.
- If fast auto-reclosure is used in a distribution grid and the deactivated part of the grid remains live as an island, reclosure will likely happen during phase displacement which might cause damage to rotating machinery on the grid.

- In the event of a fault in a medium voltage grid, the faulty part of the grid is disconnected. If the fault has a significant resistance, the deactivated part of a medium-voltage grid remains live as an island. Depending on the type of fault, but explicitly in case of a fault in the transformer, dangerous medium voltage might be accessible or even present in low-voltage appliances.

Especially for the last example very fast disconnection of the generating units to cause collapse of the forming island is necessary. At the same time any island formation detection method may cause false tripping. The industry is therefore in constant research to develop methods that are fast and reliable and at the same time reliably prevent false tripping.

Enhanced island detection method

The enhanced island detection of KACO new energy, employs a strategy to reliably detect island formation that is based on the characteristic differences between an interconnected grid and an islanded grid, thus ensuring reliable fast detection and prevention of false tripping.

An interconnected grid is dominated by rotating machinery, as a consequence frequency is proportional to active power balance and voltage is proportional to reactive power balance. In contrast an islanded grid behaves like a resonant circuit, as a consequence frequency is proportional to reactive power balance and voltage is proportional to active power balance. The active enhanced island detection method detects this difference by monitoring the behaviour of the grid. The enhanced island detection is monitoring the natural fluctuation of the grid frequency and injects a minimal reactive power proportional to the rate of change of frequency. In the moment of formation of an island the connected power systems is closing a positive feedback loop what allows the inverter to detect the changed situation and to disconnect. In case of formation of an island, the inverter disconnects within some 100 ms, well below 1000 ms.

- The number of parallel inverters does not affect the reliability of this function.
- This method also ensures that the impact on the distribution grid is kept to a minimum.
- In normal operation no effects on harmonic content, flicker and grid stability are detected.

This detection method is combined with a two stage passive rate of change of frequency (ROCOF) observation. If the ROCOF of the grid exceeds the configured disconnection threshold (stage 1) for the configured disconnection time, the device switches to zero current mode. If the ROCOF of the grid exceeds the configured shutdown threshold (stage 2) for the configured shutdown time, the device shuts down. In case of an island, this will shut down the island instantaneously. If the grid stabilizes, what might be the case if the ROCOF event was due to a short disturbance in the power grid, the inverter will resume normal operation. In the event of active stage 1, the device switches to zero current mode, and restarts the infeed after a few 100ms. At stage 2, the device has shut down and the set reconnection conditions apply.

11 Maintenance and troubleshooting

11.1 Visual inspection

Inspect the product and cables for visible external damage and note the operating status display, where applicable. In the event of damage, notify your installation engineer. Repairs may only be carried out by authorised electricians.

⚠ DANGER

Dangerous voltage due to two operating voltages

Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched. The discharge time of the capacitors is up to 5 minutes.

- Only appropriately qualified electricians authorised by the mains supply network operator are permitted to open and maintain the device.
- Before opening the device: Disconnect the AC and DC sides and wait at least 5 minutes.

NOTE

There are components in the housing of the device which may only be repaired by the customer service team.

Do not attempt to repair faults that are not described here (in the chapter on troubleshooting and fault rectification). Contact our customer service department. Only perform the maintenance work that is described here.

The device should be checked for proper operation by a qualified electrician at regular intervals and if you experience problems, you should always contact the system manufacturer service department.

11.2 Checking that the device is voltage-free

Checking that the device is voltage-free

↻ Grid voltage shut off due to deactivation of the external circuit breakers.

↻ Device switched off on DC isolator switch

↻ Housing door unlocked and open.

1 Device version L and XL: Approach the voltage tester contacts on +pole and -pole of the DC terminal to the contacts through both corresponding holes with contact protection in the protective cover.

2 Check that the device is voltage-free.

3 Device version L and XL: Approach the voltage tester contacts on +pole of the DC terminal, device-side to the + pole of the DC+ terminal, battery-side through both corresponding holes with contact protection in the protective cover.

4 Check that the fuse is voltage-free.

» The protective cover can be opened once it has been ensured that the device is voltage-free.

1 Device versions B and M: Run the voltage tester contacts on +pole and -pole of the DC terminal to the contacts through the corresponding holes on the contact protection.

2 Check that the device is voltage-free.

3 Device version M: Run the voltage tester contacts on +pole of the DC fuse terminal, device-side to the + pole of the DC fuse terminal, battery-side through the corresponding holes on the contact protection.

4 Checking that the device is voltage-free

» The contact protection can be opened once it has been ensured that the device is voltage-free.

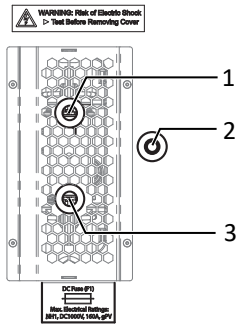

Fig. 50: Ensure that the device is voltage-free

1	DC+ terminal, device-side
2	DC- terminal
3	DC+ terminal, battery-side

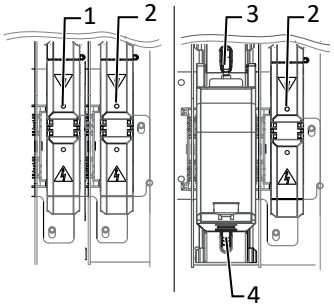

Fig. 51: Ensure that the device is voltage-free: Basic, M-Version

1	DC+ terminal
2	DC- terminal
3	DC+ fuse terminal (device-side)
4	DC+ fuse terminal (battery-side)

⚠ DANGER

Dangerous voltage due to two operating voltages

Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched. The discharge time of the capacitors is up to 5 minutes.

› Only appropriately qualified electricians authorised by the mains supply network operator are permitted to open and maintain the device.

› Before opening the device: Disconnect the AC and DC sides and wait at least 5 minutes.

11.3 Cleaning

11.3.1 Cleaning the housing

⚠ DANGER

Danger of death due to penetrating fluid

Serious injuries or death can result if moisture enters the system.

› Only use completely dry objects to clean the device.

› The device should only be cleaned from the outside.

⚠ CAUTION

Damage to the housing parts when using cleaning agents!

› If the device is contaminated, only clean the housing, cooling fins, housing cover, display and the LEDs with water and a cloth.

WARNING! Do not use compressed air or high-pressure cleaners!

1 Use a vacuum cleaner or a soft brush to remove dust from the fan cover and from the top of the device on a regular basis.

2 Remove dust from the ventilation inlets if necessary.

11.3.2 Cleaning the heat sink

⚠ WARNING

Risk of burns from hot surface.

Heat sinks become very hot when in operation.

› Never touch the heat sinks after commissioning the device.

› Allow the heat sinks at least 10 minutes to cool down before cleaning.

NOTE

Refer to our service and guarantee conditions on our homepage.

✓ The cleaning intervals must be adapted to match the ambient conditions of the installation location.

› In sandy environments, we recommend cleaning the heat sinks and fans every quarter.

↻ If the heat sink is heavily soiled, we recommend that you dismount the fan temporarily.

↻ Switch off the device and secure it against restart.

↻ Have appropriate brushes to hand (120x35 mm and 25x4mm) for cleaning.

1 Clean the free space between the cover and the heat sink using chosen brushes.

2 Clean the heat sink with an appropriately selected brush.

NOTE: Do not use any aggressive cleaning agents and ensure that no other components come into contact with fluids.

» Cleaning completed – if necessary, remount the fans.

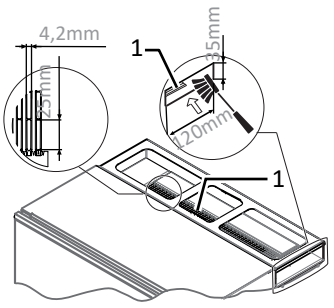

Fig. 52: Clean the cooling fins

1	Heat sink

↻ If the heat sink is heavily soiled, we recommend that you dismount the fan temporarily.

↻ Switch off the device and secure it against restart.

1 Clean the space between the heat sink with a suitable brush.

NOTE: Do not use any aggressive cleaning agents and ensure that no other components come into contact with fluids.

» Cleaning completed – if necessary, remount the fans.

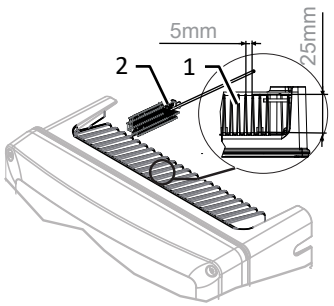

Fig. 53: Clean the cooling fins

1	Heat sink / space between heat sink
2	Brush (max. wire diameter 3 mm)

11.4 Replacing the fan

Dismounting the fan

↻ Lack of current and voltage ensured on the inverter.

1 Wait until both fans are no longer turning.

2 Detach the fastening for the fan safety grille [T_20 & W_7].

3 Detach the fastening for the fan and carefully remove the fan downwards [T_20 & W_7].

4 Carefully disconnect the plug connector for the dismounted fan from inside the housing.

5 Remove the fan from the base plate.

» Install the replacement fan.

Installing the fan

↻ You have removed the defective fan.

↻ **NOTE: Make sure that the fan is positioned correctly when installing!**

1 Insert the connection plug into the corresponding socket inside the housing.

2 Insert the replacement fan into the base plate.

3 Fit the fastening for the fan to the base plate [T_20 / 2.5 Nm].

4 Fit the fastening for the fan safety grille [T_20 & W_ 7 / 2.5 Nm].

5 If required, fit another fan.

» Switching on the device Commissioning [See section 8 Page 29].

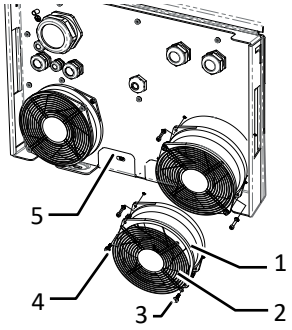

Fig. 54: Dismounting the fan

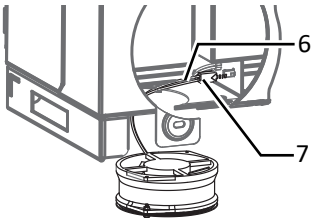

Fig. 55: Unplug the fan plug

1	Fan
2	Protective grating for fan
3	Fastening for protective grating
4	Fastening for fan
5	Base plate
6	Connector plug
7	Connection socket

11.5 Shutting down for maintenance / troubleshooting

⚠ DANGER

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

Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched.

Only appropriately qualified electricians authorised by the mains supply network operator are permitted to open and maintain the device.

› Comply with all safety regulations and current technical connection specifications of the responsible power supply company.

NOTE: Shutdown sequence

1 If possible, shut down the device via EMS.

2 Switch off the grid voltage by turning off the external circuit breakers.

3 Enable the DC side via the external DC switch.

» After shutdown, wait 5 minutes before opening the device.

Shutdown sequence

1 Switch off the grid voltage by turning off the external circuit breakers.

2 Disconnect the DC side using the external DC isolator switch.

DANGER! The DC cables are still live

» After shutdown, wait 5 minutes before opening the device.

11.6 Replace DC fuse

⚠ DANGER

Electric shock due to live parts under the protective cover.

Removing the protective cover can result in potentially fatal consequences due to live components.

› Before removing the DC protective cover - ensure that the device is free of current and voltage Visual inspection [See section 11.1 Page 70].

› Only remove and attach the DC protective cover on the 4 bolts.

↻ Ensure there is no DC voltage present.

1 Variants L, XL: Unfasten the protective cover using the 4 bolts and place to one side [T15].

2 Variant M: Open the contact protection on the fuse holder.

3 Remove a DC fuse (F1) from the terminals with NH plug-in grip.

4 Insert new specified DC fuse with the NH plug-in grip into the fuse holder [size L65 mm].

5 Variants L, XL: Fit the protective cover and secure using 4 bolts [T15 / 2.3 Nm].

6 Variant M: Close the contact protection on the fuse holder.

7 DC fuse replaced. Continue connecting the battery.

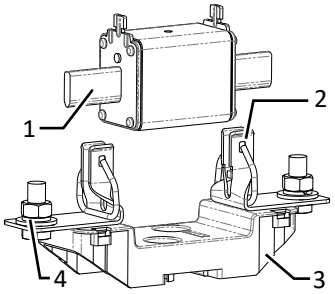

Fig. 56: Insert DC fuse

1	DC fuse (F1)
2	Terminals
3	DC fuse holder
4	DC connection

11.7 Disconnecting connections

11.8 Faults

11.8.1 Procedure

⚠ DANGER

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

Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched.

› If a fault occurs, notify an appropriately authorised and qualified electrician or the customer service department of the system integrator.

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

NOTE

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

11.8.2 Rectifying a fault

Fault	Possible cause	Explanation/remedy	By
The display is blank and the LEDs do not light up	Grid voltage not available	› Check whether the AC voltage is within the permitted limits (see Technical Data)	E
		Please inform your system manufacturer.	E
The device stops charging or discharging the battery shortly after being switched on.	Faulty grid separation relay in the device.	If the grid separation relay is defective, the device will recognise this error during the self-test.	K
		If the grid separation relay is defective, obtain a replacement from the system manufacturer.	K
		Please inform your system manufacturer.	
Device is active but not connected to the grid. The display indicates a grid failure.	Charging or discharging has been interrupted due to a grid fault.	Due to a grid fault (over/undervoltage, over/underfrequency), the device stopped the feed-in process and disconnected from the grid for safety reasons.	
		› Change the grid parameters within the permitted operating limits (see the "Start-Up" section).	E
The grid fuse trips.	The grid fuse capacity is too low.	Select a fuse by referring to Section 7.2.1 Supply line and fuse requirements.	
The grid fuse trips.	Hardware damage on the device.	If the grid fuse trips immediately when the device goes into charging or discharging mode (after the start-up period is complete), the device's hardware is probably damaged.	
		Please inform the system manufacturer in order to test the hardware.	E

Fault	Possible cause	Explanation/remedy	By
Device is active but not connected to the grid. Display : "Waiting for feed-in"	Battery voltage too low; grid voltage or battery voltage unstable.	The battery voltage is too low to connect to the grid. The device checks the grid parameters before the feed-in process. 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. The starting voltage may be set incorrectly.	
		› Adjust starting voltage in the Parameter menu.	E
		Battery is deep discharged. Inform the battery manufacturer in order to test the battery.	B
	The device is not receiving a start command from the EMS. The required parameters have not yet been sent to the device from the EMS.	To operate the device, an EMS is required that controls the bidirectional feed-in inverter and sends the performance data to the device.	
		Check the connection of the device to the EMS.	E
		Please inform your system manufacturer in order to test the EMS.	B
Noise emission from the device.		When there are certain ambient conditions, the devices 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 device. Under particular grid conditions, resonances may form between the device's input filter and the grid; these may be audible even when the device is switched off. These noise emissions do not affect the operation of the device. They do not lead to loss of performance, failure, damage or to a shortening of the device's service life. People with very sensitive hearing (particularly children) are able to hear the high-frequency hum caused by the device's operating frequency of approximately 17 kHz.	
		› No action.	
Despite the power requirement, the device does not charge or discharge the battery with the required power	The device is too hot and the system limits the power.	Because the temperatures inside the device are too high, the device reduces its power to prevent damage to the device. Note the technical data. Ensure that the convection cooling is not impeded from the exterior. Do not cover the cooling fins.	
		› Ensure sufficient cooling of the device.	B
		› Remove any foreign bodies which are present on the device.	B
		› Clean the cooling fins	E
	Device self-limits to protect the battery.	When the max. charging or discharging current parameterised by the EMS is exceeded, and when the end-of-discharge voltage or end-of-charge voltage is exceeded, the device self-limits to protect the battery.	
		No action	
DC breaker is tripped.	DC breaker specifications are too low.	With high charge or discharge output levels, the DC current exceeds the trigger value of the DC breaker.	
		Select a fuse by referring to Section 7.2.1 Supply line and fuse requirements.	E
	Hardware damage on the device	If the DC breaker trips immediately when the device is connected to the battery, there may be hardware damage present.	
		Please inform your system manufacturer in order to test the hardware.	B

Tab. 8: Troubleshooting

B = Operator's responsibility ; E = The indicated work may only be carried out by an authorised electrician. ; K= The indicated work is only permitted to be carried out by the system integrator!

11.9 Fault messages

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

Fault LED (red)	Status	Explanation	LED
	FS (fault status)	• Fault signal relay has been tripped. • Feed-in was ended due to a fault.	To:
	OS (operating status)	• The fault relay releases again. • The device feeds back into the grid again after a country-specific time period.	Off

12 Decommissioning and dismantling

12.1 Switching off the device

⚠ WARNING

Risk of burns caused by hot housing components

Housing components can become hot during operation.

› During operation, only touch the housing cover on the device.

1 Switch off the device on the external DC isolator switch.

2 Use a clip-on ammeter to check that there is no AC and DC voltage present.

» Ensure that the device is completely free of voltage.

» Device can be uninstalled.

12.2 Uninstalling the device

⚠ DANGER

Dangerous voltage due to two operating voltages

Severe injuries or death may occur if the cables and/or terminals/busbars in the device are touched. The discharge time of the capacitors is up to 5 minutes.

› Only appropriately qualified electricians authorised by the mains supply network operator are permitted to open and maintain the device.

› Before opening the device: Disconnect the AC and DC sides and wait at least 5 minutes.

↻ Device shut down and no voltage is present.

↻ AC cable disconnected AC connection.

↻ DC connection disconnected DC connection.

1 Unfasten the cable bolts for Ethernet cables and remove the sealing insert [✕W_29].

2 Unfasten the cable bolts for signal cables [✕W_20].

3 Remove the cable ties on the threaded stud bolts.

4 Disconnect the plug from the communication circuit board.

5 Remove the interface cables from the device.

» The device is uninstalled. Proceed with disassembly.

12.3 Disassembling the device

↻ Unit has been switched off and uninstalled.

1 Remove the screw that prevents the device from being lifted off the mount.

2 Use the lateral openings and lift the device off the mount.

» Device removed. Proceed with the packaging process.

12.4 Packaging the device

↻ Device has been uninstalled.

1 If possible, always pack the device in the original packaging. If this is no longer available, an alternative is to use equivalent packaging.

2 You must be able to close the box completely and it must be able to accommodate the weight and size of the device.

12.5 Storing the device

⚠ CAUTION

Property damage as a result of condensation

Faulty storage can form condensate in the device and impair the device functioning (e.g. storage outside the ambient conditions or temporary relocation from a cold to a hot environment).

✓ Store in accordance with the technical data > Environmental data [See section 4.3 Page 12]

› Prior to installation, check the inner area for condensation and if necessary, allow it to dry sufficiently before installation.

↻ Device packaged.

☞ Store the device at a dry location, in accordance with the ambient temperature range Environmental data [See section 4.3 Page 12].

13 Disposal

⚠ CAUTION

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

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

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

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

14 Service and warranty

Please contact the suppliers of the energy storage system.

15 Appendix

15.1 EU Declaration of Conformity

Manufacturer's name and address	KACO new energy GmbH	
	Carl-Zeiss Straße 1	
	74172 Neckarsulm, Germany, Germany	
Product description	Bidirectional feed-in inverter	
Type designation *[KACO art. no.]*	blueplanet gs 50.0TL3-S B1 WM OD IIGB	[1001742]
	blueplanet gs 50.0TL3-S B1 WM OD IIGM	[1001743]
	blueplanet gs 50.0TL3-S B1 WM OD IIGL	[1001732]
	blueplanet gs 50.0TL3-S B1 WM OD IIGX	[1001741]

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

The devices conform to the following standards:

2014/35/EU	Safety of the device
"Directive relating to electrical equipment designed for use within certain voltage limits"	EN 62109-1:2010 EN 62109-2:2011

2014/30/EU	Interference immunity
"Directive relating to electromagnetic compatibility"	EN 61000-6-1:2007
	EN 61000-6-2:2005+AC:2005
	Emitted interference
	EN 55011:2016+A1:2017 group 1, class B
	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 devices and/or any use of the devices that is contrary to their intended use render this Declaration of Conformity null and void.

This declaration of conformity is issued under the sole responsibility of KACO new energy GmbH.

30127747-05-200918

KACO new energy.

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