

KACO new energy.

Powador
XP200-HV TL
XP250-HV TL
XP350-HV TL

Operating Instructions

■ English Version

KACO new energy.

Operating Instructions

for Installers and Operators

Powador
XP200-HV TL
XP250-HV TL
XP350-HV TL

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1 General notes

1.1 About this documentation

WARNING

Improper handling of the inverter can be dangerous

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

1.1.1 Other applicable documents

During installation, observe all assembly and installation instructions for components and other parts of the system. These instructions are delivered together with the respective components and other parts of the system.

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

1.1.2 Retention of documents

These instructions and other documents must be stored near the system and be available whenever they are needed.

1.2 Design characteristics

1.2.1 Symbols used in this document

General danger symbol

Risk of fire or explosion

High voltage

Risk of burns

Electrician — If indicated, only electricians are allowed to execute the work.

1.2.2 Description of safety instructions

DANGER

Imminent danger

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

WARNING

Potential danger

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

CAUTION

Low-risk hazard

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

CAUTION

Hazard with risk of property damage

Failure to observe this warning will lead to property damage.

1.2.3 Depiction of additional information

NOTE
Useful information and notes.

DE **Country-specific functions**
Functions that are limited to one or more countries are indicated with country codes according to ISO 3166-1.

1.2.4 Description of actions

a) One-step instruction or instruction steps that can be performed in any order.

Action
↻ Prerequisite(s) for performing an action (optional)
☞ Perform this action
☞ (Possibly additional actions)
» The result of your action(s) (optional)

b) Multi-step instruction with specified order.

Action
↻ Prerequisite(s) for performing an action (optional)
1. Perform first action
2. Perform second action
3. (Possibly additional actions)

» The result of your action(s) (optional)

1.2.5 Abbreviations

BDEW	Bundesverband der Energie- und Wasserwirtschaft (German Energy and Water Association)
CB	Circuit Breaker
DSP	Digital Signal Processor
FPGA	Integrated circuit for digital technology (Field Programmable Gate Array)
FRT	Capability of a PV system to remain on the grid during short circuits (Fault Ride Through)
IGBT	Semiconductor device (Insulated Gate Bipolar Transistor)
MC	Magnetic Contactor
MMI	User interface (Man Machine Interface)
MPP	Point of the current-voltage diagram of a solar cell at which the maximum amount of power can be drawn (Maximum Power Point)
MPPT	The MPP tracker adjusts the voltage to the MPP value.
NVSRAM	Permanent memory in which fixed parameters are stored (Non-Volatile Static Random Access Memory)
PEBB	Power electronics module (Power Electronics Building Block)
PLL	Phase-synchronising circuit (Phase-Locked Loop)
PSIM	Master control for the interfaces in the unit (PEBB Signal Interface Master)
PWM	Pulse Width Modulation
SELV	Safety Extra-Low Voltage
SPD	Surge Protection Device

2 Safety instructions



DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator are allowed to open, install and maintain the inverter.

› Keep all doors and covers closed when the unit is in operation.

› Do not touch the lines and terminals when switching the unit on and off.

› Do not modify the inverter.

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

- Hold unauthorised persons away from the inverter and from the PV system.
- Above all, be sure to observe standard IEC 60364-7-712:2002, "Requirements for Special Installations or Locations – Solar Photovoltaic (PV) Power Supply Systems".
- Ensure operational safety by providing for proper grounding, conductor dimensioning and appropriate protection against short circuit.
- Observe the safety instructions located on the inner sides of the doors.
- Switch off all voltage sources and secure them against being inadvertently switched back on before performing visual inspections and maintenance.
- When taking measurements while the inverter is live:
  - Do not touch the electrical connections.
  - Remove jewellery from your wrists and fingers.
  - Make sure that the testing equipment is in good and safe operating condition.
- Stand on an insulated surface when working on the inverter.
- Modifications to the surroundings of the inverter must comply with national and local standards.

2.1 Intended use

The inverter converts the DC voltage generated by the photovoltaic (PV) modules into AC voltage and feeds this into the power grid. The inverter is built according to the state of the art and recognised safety rules. Nevertheless, improper use may cause lethal hazards for the operator or third parties, or may result in damage to the unit and other property.

The inverter may be operated only with a permanent connection to the public power grid.

Any other or additional use is not considered the intended use. Examples of **unintended use** include:

- Mobile use
- Use in rooms where there is a risk of explosion
- Use in rooms where the humidity is higher than 95%

2.2 Standards and directives

The inverter is labelled with the CE sign and fulfils the appropriate EMC standards and guidelines.



NOTICE

The declaration of conformity with the applicable standards and guidelines can be found in the appendix.

Information about country-specific standards and safety settings as well as additional application notes are available at our website http://www.kaco-newenergy.de.

3 Unit description

3.1 Dimensions

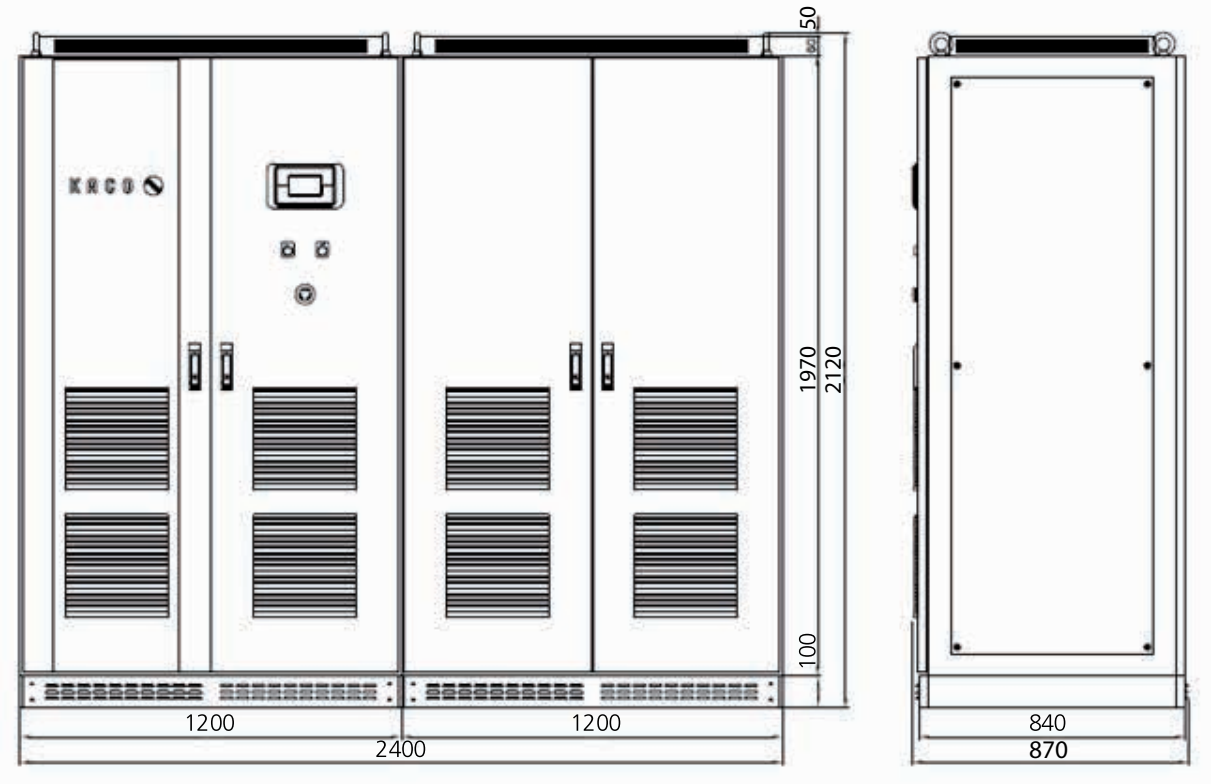


Figure 1: Dimensions of the inverter [mm]

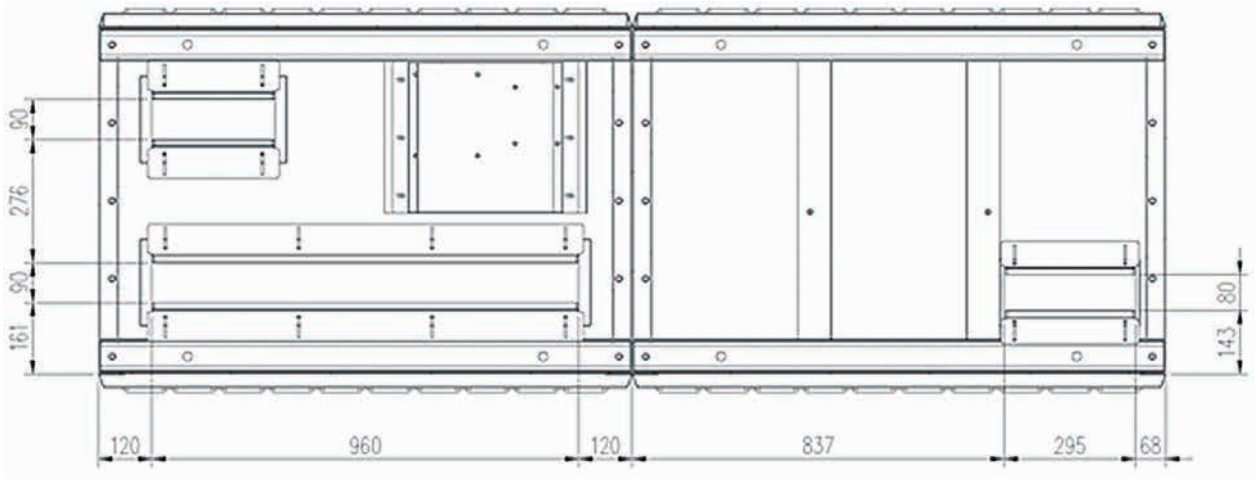


Figure 2: Dimensions of the inverter base [mm]

3.2 Overview circuit diagram

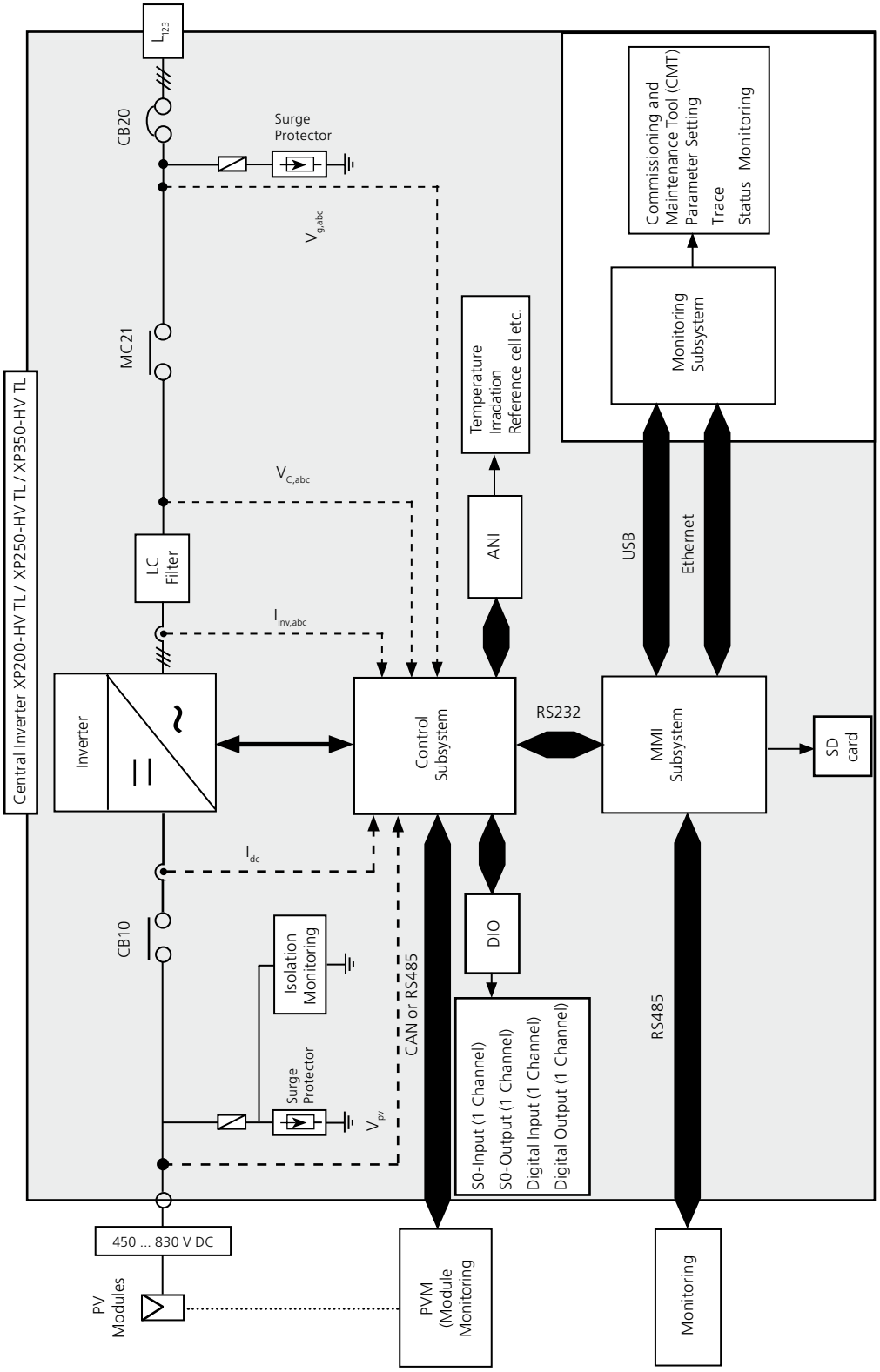


Figure 3: Configuration of the Powador XP200-HV TL / XP250-HV TL / XP350-HV TL

3.3 Components inside the inverter

The inverter components are installed inside two cabinets.

Components inside the left cabinet

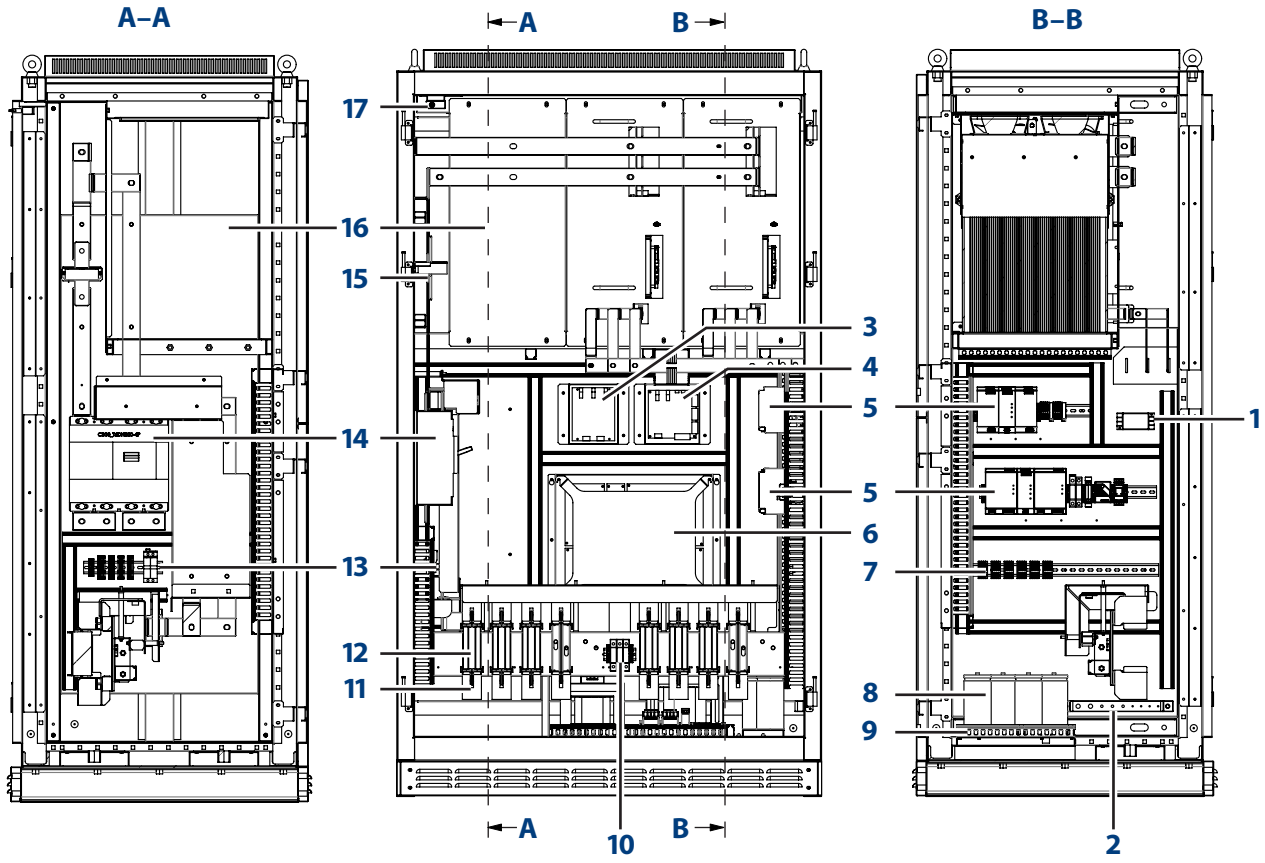


Figure 4: Components inside the left cabinet (XP200-HV)

Key

1	24 V voltage supply EMC filter for the MMI	10	DC overvoltage protection
2	Grounding bar	11	DC connection (left side DC+, right side DC–)
3	Ground fault detection	12	DC fuses (number of fuses depends on inverter type)
4	PSIM (master control for interfaces)	13	Terminals for user connector
5	24 V voltage supply	14	DC disconnector
6	Control system (XCU)	15	DC current measurement
7	Fuse protection for voltage supply and measuring equipment; overvoltage protection for the voltage supply for the controller	16	PEBB (IGBT block)
8	Auxiliary transformer	17	Door sensor
9	FRT components		

Components inside the right cabinet

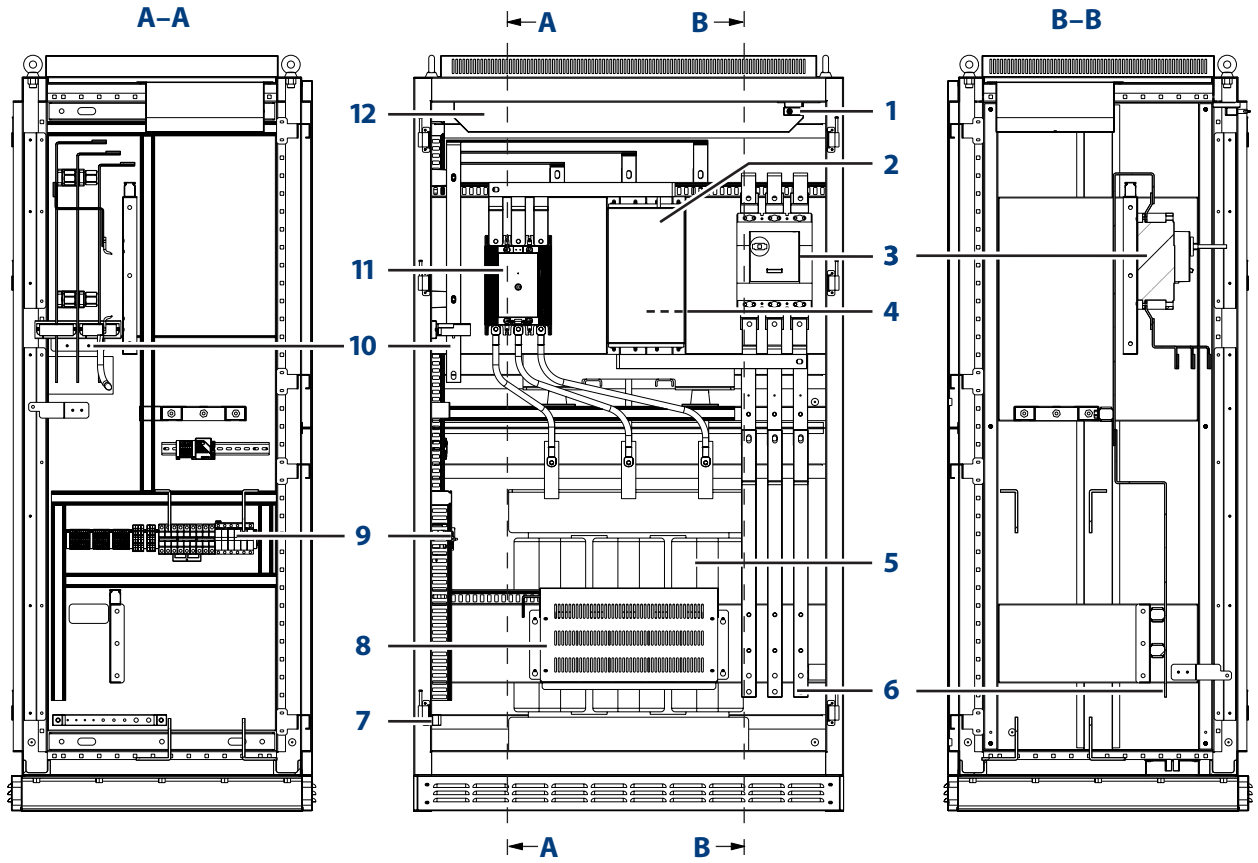


Figure 5: Components inside the right cabinet

Key

1	Door sensor	7	Grounding bar
2	EMC filter	8	LC filter (capacitor)
3	AC switch	9	AC overvoltage protection and fuse protection
4	LC filter (line choke)	10	AC current measurement
5	Transformer	11	AC contactor
6	AC connection to the external transformer	12	AC fans

4 Technical data

4.1 Electrical data

Input levels	XP200-HV TL	XP250-HV TL	XP350-HV TL
Max. PV generator power [kW]	240	300	420
MPPT range [V]		450 ... 830	
No-load voltage [V]		1000*	
Monitoring of input voltage [V]		Stand-by from V_{on} > 300 Night shutdown from V_{off} < 250 MPP starting voltage V_{start} > 600	
Voltage ripple [%]		< 3	
Current ripple [%]		< 4	
Max. input current [A]	467	611	856
Output levels	**XP200-HV TL**	**XP250-HV TL**	**XP350-HV TL**
Rated power [kW]	200	250	350
Max. power [kW]	200	250	350
Line voltage		In accordance with country-specific guidelines	
Output voltage [V]		290 (±10%)	
Rated current [A]	398	498	697
Max. current [A]	398	498	697
Rated frequency [Hz]		50/60	
cos phi		0.80 inductive ... 0.80 capacitive	
Distortion factor [%]		< 3 at rated power	
Fault signal relay		Potential-free NO contact, max. 30 V/1 A	
S0 output		Open collector output, max. 30 V/50 mA	
General electrical data	**XP200-HV TL**	**XP250-HV TL**	**XP350-HV TL**
Max. efficiency [%]	98.2	98.1	98.3
European efficiency [%]	97.8	97.8	98.0
Internal consumption in standby mode [W]		< 80	
Internal consumption in operation [W]		< 360	
Min. grid feed power [W]		10000	
Grid monitoring		In accordance with country-specific guidelines	
CE conformity		yes	

Table 1: Electrical data of the inverter

* *To protect the hardware, the inverter starts up only at voltages <950 V*

4.2 Mechanical data

	XP200-HV TL	XP250-HV TL	XP350-HV TL
Display		TFT LCD touchscreen	
Interfaces		RS485/Ethernet/USB 4 x analogue inputs 1 x digital input 1 x S0 input 1 x digital output 1 x S0 output	
Memory [GB]		SD card, up to 8	
Operating temperature range [°C]		–20 ... +50 full rated power, no derating	
Storage temperature range [°C]		–20 ... +70	
Relative humidity [%]		0 ... 95	
Cooling [m^3/h]	Fan, max. 4040	Fan, max. 4040	Fan, max. 5460
• part A	max. 2840	max. 2840	max. 4260
• part B	max. 1200	max. 1200	max. 1200
Protection rating		IP 21 (in accordance with DIN EN 60529:2000) Intended for indoor use only in accordance with IEC 62103:2003	
Noise emission [dB (A)]		< 70	
Housing		Upright, steel housing	
H x W x D [mm]		2120 x 2400 x 870	
Base [mm]		2400 x 840	
Total weight [kg]	1170	1200	1370

Table 2: Mechanical data of the inverter

5 Transportation and Delivery

5.1 Delivery

The inverters leave our factory in proper electrical and mechanical condition. Special packaging ensures that they are transported safely. The shipping company is responsible for any damage that occurs during transportation.

Scope of delivery

- Powador XP200-HV / Powador XP250-HV
- Documentation
- Material for electrical connection

Identification

The inverters are transported and delivered in two separate parts.

Each part is equipped with a name plate mounted on the inside of the left cabinet door. The name plates identify the inverter.

Check your delivery

- ☞ Make sure that both parts of the inverter are delivered, part A and part B.
- ☞ Make sure that the serial numbers of part A and part B are identical. The serial numbers are to be found on the name plates.
  Only inverters with the same serial number for parts A and B are to be used together.
- ☞ Inspect the inverter thoroughly.
- ☞ Notify the shipping company immediately if you discover any damage to the packaging which indicates that the inverter may have been damaged or if you discover any visible damage to the inverter.
- ☞ Send the damage report to the shipping company right away. It must be received by them within six days following receipt of the inverter. We will be glad to help you, if necessary.
- ☞ Notify Kaco new energy GmbH if the inverter cabinets have different serial numbers.

5.2 Transportation



DANGER

Danger by falling objects, impact or tipping of the inverter

Falling objects may hit persons or damage the inverter.

› When transporting the inverter, make sure that nobody stands beneath the inverter.

› Transport the inverter in an upright position. Do not tilt the inverter.

› Only use lifting devices with a load capacity sufficient for lifting the inverter.

› Transport the inverter only in its original packaging.

CAUTION

Risk of damage to the inverter

The inverter cabinets are very heavy. The eyebolts on the top of the cabinets may break when using lifting straps without a lifting frame.

› At installation site transport the inverter only with:

  – forklift or lift truck,

  – crane fork,

  – crane with lifting frame attached to the eyebolts.

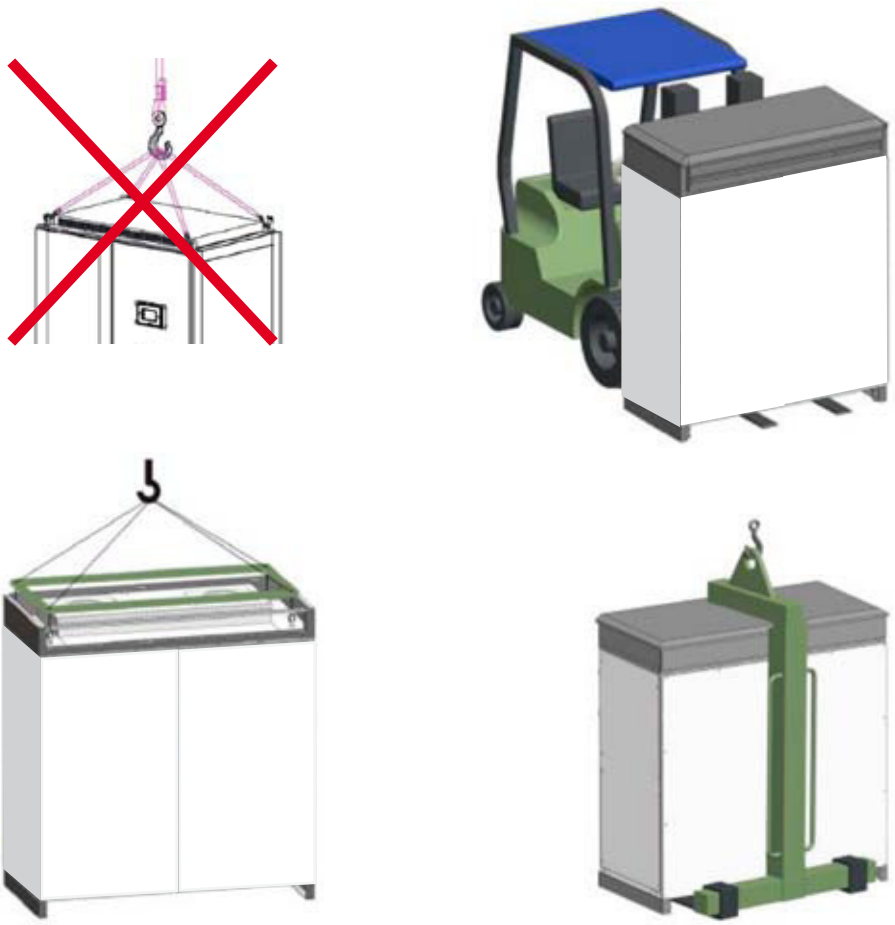


Figure 6: Lifting the inverter

5.3 Storage conditions

The inverter is for indoor use only. The packaging of the inverter protects the unit against dust and moisture during transportation and storage. However, the packaging is not suitable for outdoor storage.

CAUTION

Risk of damage to the inverter by incorrect storage

› Store the inverter:
  – at temperatures between –20°C and 70°C,
  – in the packaging used for delivery,
  – in dry, protected locations only.

› Avoid humidity in storage locations.

⚠ Electrician

6 Mounting the inverter

6.1 Selecting the installation location

NOTE

The maximum flow rate of the cooling air is different for each inverter type:

- Powador XP200-HV TL: 4040 m^3/h
- Powador XP250-HV TL: 4040 m^3/h
- Powador XP350-HV TL: 5460 m^3/h

› Keep this value in mind when you select the installation location.

Floor

- The floor must have adequate load-bearing capacity (a separate, solid basement may be necessary).
- The building material must meet the requirements of building material class B1 (“Flame-resistant Building Materials”, in accordance with DIN EN 13501-1).
- The floor must consist of non-cracked concrete.

Room

- Permanent access to the installation location for installation and service purposes must be possible.
- The room must provide enough space to work at the inverter in case of maintenance (e.g. exchange of filter mats).
- The room must provide operating conditions according to the technical specification.
- The necessary amount of cooling air must be available at the installation location.
- Adequate air circulation through the inverter must be guaranteed. Air inlets and outlets must not be blocked.
- Thermal short circuits must be excluded.

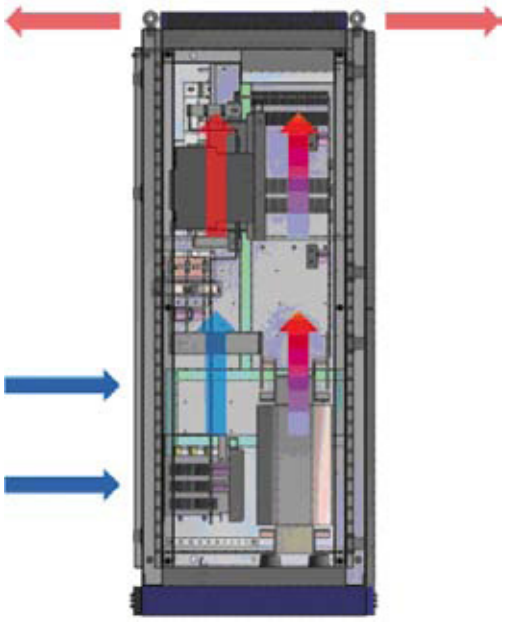


Figure 7: Ventilation for the inverter

☞ Ensure that all regulations for emergency situations are considered.

☞ Make sure that the escape routes (according to local requirements) are not blocked in any circumstance.

☞ Do not install the inverter in a room where there is a risk of explosion.

Electrician

6.2 Preparing the installation site

NOTE

The serial numbers of the left and the right inverter cabinet must be identical (see inside of the left cabinet doors).

Do not connect two inverter cabinets with different serial numbers.

Setup of the inverter

Each inverter cabinet is equipped with 6 bore holes on the mounting side (Figure 8). The corresponding screws, nuts and washers are delivered in a plastic bag inside the left inverter cabinet.

↻ The serial numbers of the left and the right inverter cabinet are identical.

1. Connect the two inverter cabinets through the 6 bore holes with the supplied screws, nuts and washers.
2. Tighten the screws (tightening torque: 25 ... 30 Nm).

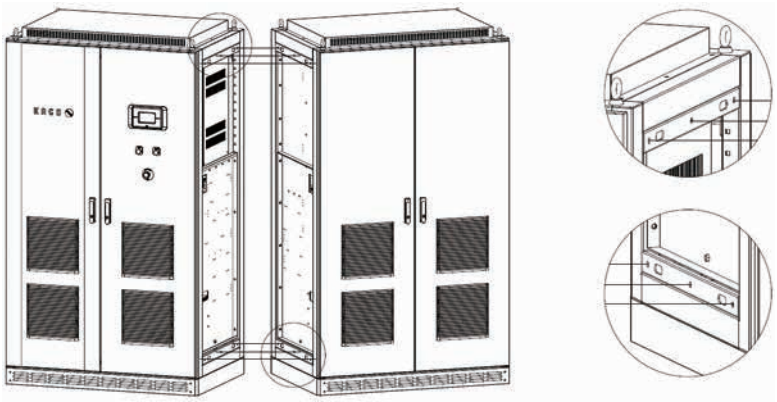


Figure 8: Mechanical connection between left and right cabinets

Cable routing

- ☞ Lay AC power cables, DC power cables and communication cables separately to avoid interferences.
- ☞ Make the same grounding potential available for all communication cables.
- ☞ Ensure proper grounding of all communication cables at the same potential.
- ☞ If possible, allow communication cables to be routed close to ground potential.

Requirements for auxiliary supply

- ☞ In case the inverter is used with an external power supply, dimension the external power supply properly. The following values of power consumption serve as reference values.

⚠ Electrician

XP200-HV TL

Measurand	Internal consumption in standby	Internal consumption in operation
I_{trms} [A]	0.53	2.35
V_{trms} [V]	216.6	214.9
P [W]	77.3	346.3
S [VA]	114.5	504.0
Q [Var]	84.5	366.2

Table 3: Power consumption data of XP200-HV

XP250-HV TL

Measurand	Internal consumption in standby	Internal consumption in operation
I_{trms} [A]	0.53	2.41
V_{trms} [V]	219.0	217.7
P [W]	79.9	351.8
S [VA]	115.7	525.2
Q [Var]	83.7	390.0

Table 4: Power consumption data of XP250-HV

XP350-HV TL

Measurand	Internal consumption in standby	Internal consumption in operation
I_{trms} [A]	0.80	3.41
V_{trms} [V]	216.9	215.0
P [W]	99.4	486.0
S [VA]	174.5	732.5
Q [Var]	143.5	548.1

Table 5: Power consumption data of XP350-HV TL

Electrician

7 Installation

7.1 Connecting the inverter cabinets electrically



DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator may open, install and maintain the inverter.

› Be extremely cautious when working on the unit.

› Disconnect the AC and DC sides.

› Secure them against being inadvertently switched back on.

Connect the inverter only after the aforementioned steps have been taken.

NOTE

Only inverters with the same serial number for parts A and B are to be used together.

› Before connecting the inverter cabinets electrically, make sure that the serial numbers of part A and part B are identical.

An electrical connection must be made between the inverter cabinets. This applies to the controller as well as to the busbars. The busbars are delivered in a plastic bag inside the left inverter cabinet.

Connecting the busbars (Figure 9, item 1)

1. Remove the plexiglas covers and store them for re-installation after the electrical installation.
2. Slide the two busbars through the upper opening in each of the cabinets.
3. Use the screws that are supplied to screw down the busbars on both sides (tightening torque: 30... 40 Nm)

Connecting the controller cables (Figure 9, item 2)

1. Pull the cables for the controller from the left cabinet through the lower opening in each of the cabinets and into the right cabinet.
2. Connect the cables for the controller in the right cabinet. The plug connectors are appropriately marked.

NOTE

The inverter will not operate with incorrect cable connections.

› Make sure that the controller cables are plugged in correctly.

⚠ Electrician

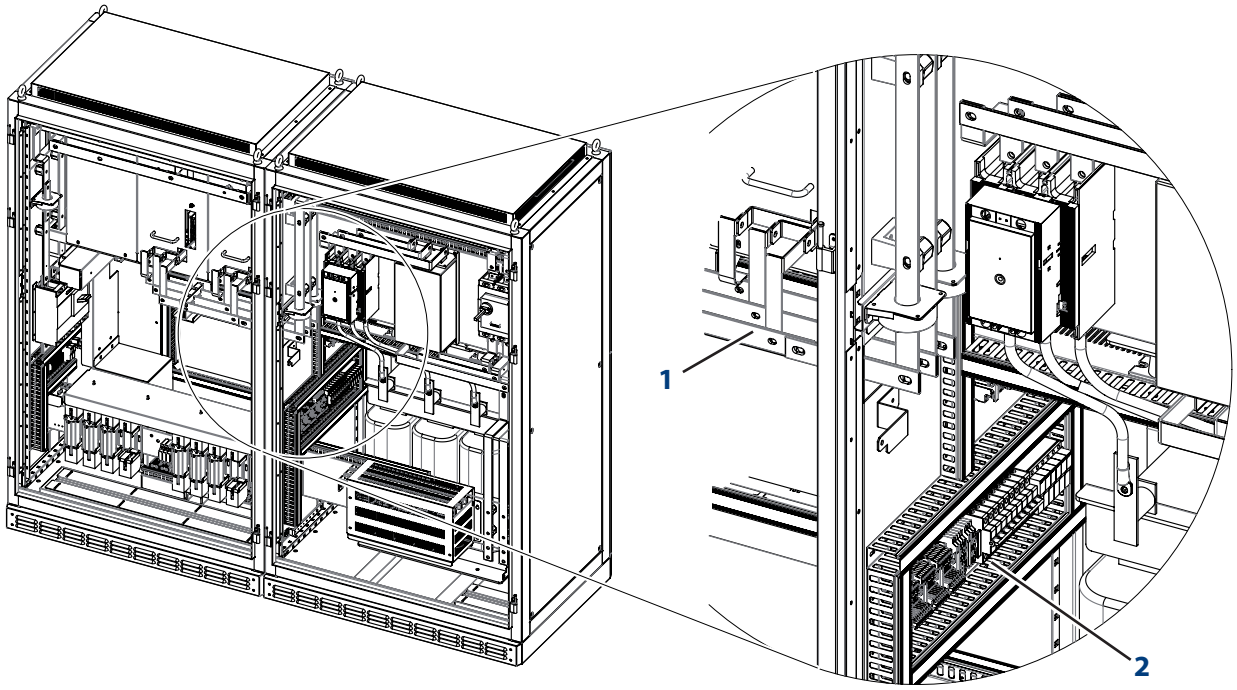


Figure 9: Electrical connection for the cabinets

Key

1	Busbar connection	2	Controller connection on the right side

7.2 Connecting protective earth

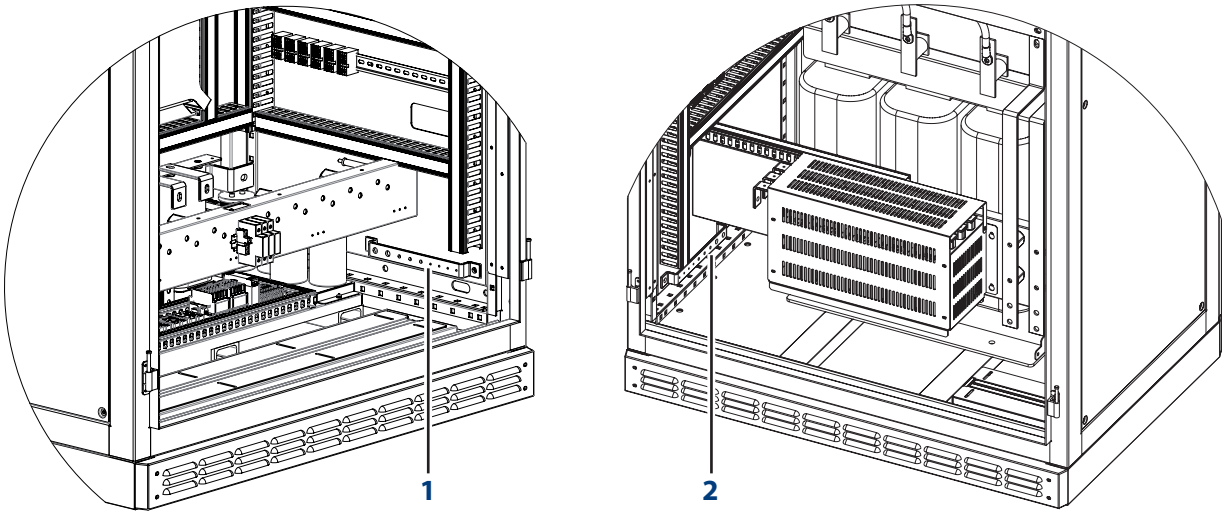


Figure 10: Protective earth connections

Key

1	PE busbar in the left inverter cabinet	2	PE busbar in the right inverter cabinet

Connecting the PE busbars

The PE (protective earth) busbars are located on the right side of the left inverter cabinet (Figure 10, item 1) and on the left side of the right inverter cabinet (Figure 10, item 2).

☞ Connect the wires for both PE busbars.

⚠ Electrician

Grounding the inverter

- ☞ Determine the lay-out of the permanent wiring.
- ☞ Secure the protective earth cables:
  - – Max. cross-section: according to regulations
  - – Connection bolt: M10
  - – Tightening torque: 25 ... 30 Nm
- ☞ Do not use plug connections.
- ☞ Check whether all connected cables are securely attached and protected from mechanical forces.

7.3 Connecting to the external transformer (grid connection)

The inverter is connected to the power grid via an external transformer using a 3-phase connection. The connection for the power grid is located at the bottom of the right cabinet.

7.3.1 Selecting the external transformer

With an appropriate transformer, the inverters of the XP-HV TL series can be connected both to the low voltage grid and the medium voltage grid.

- ☞ Choose the appropriate transformer voltage level depending on the grid connection of the PV plant (low voltage or medium voltage)

NOTE

The XP-HV TL inverters may not operate properly if an inappropriate transformer is used. Especially on the medium voltage level, the inverters require special transformers.

› Use only transformers that are manufactured according to the specification of KACO.

- ☞ When choosing the transformer for the medium voltage level check the transformer specification available on the KACO-website.
- ☞ In case of questions regarding the specification please contact KACO for assistance.

NOTE

The inverters can be operated with more than one inverter on a single transformer (e.g. 3 XP350-HV TL operating as a Megawatt station).

› Do not connect the inverters in parallel on one coil.

› Refer to the transformer specification for details.

7.3.2 Grid type

NOTE

Only an IT grid is suitable for the XP-HV TL inverters.

› Connect only an IT grid to the inverter.

› Do not ground the grid between the inverter and the medium voltage transformer.

Electrician

DANGER

Lethal voltages may be present in an IT grid!

Under operating conditions voltages up to 1200 V can be present between phase and ground.

› Ensure proper dimensioning of the cable between inverter and transformer in terms of voltage resistance (minimum dimensioning voltage: 1200 V)

› Make sure that no ground faults or short-circuits can occur. Otherwise the inverter may be damaged.

7.3.3 Connecting the transformer

Connection data

Max. cable cross-section	300 mm²
Connection bolt	M10
Tightening torque for AC terminal connections	40 ... 50 Nm

NOTE

If the cables are connected to the wrong terminals, the inverter does not operate.

Connecting the cables

Each cable corresponds to one phase.

☞ Guide the cables through the opening. Be sure to connect each of the cables to the correct terminal.

☞ Screw down the cables.

☞ Check to make sure that all of the cables are securely attached.

NOTE

If larger diameters are necessary, it is also possible to use two cables for one phase (e.g. 2 x 240 mm²)

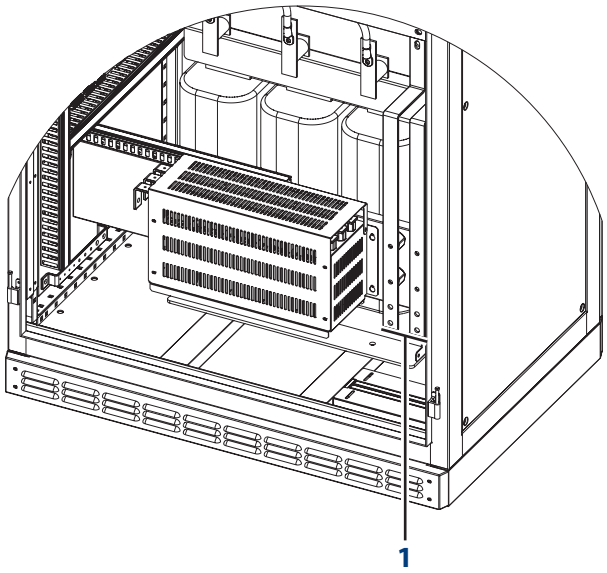


Figure 11: Bottom of the right cabinet

1	AC connections

Electrician

7.4 Connecting the PV generator (DC connection)

The DC connection is located at the bottom of the left inverter cabinet (Figure 12).

Connection data

Max. cable cross-section	300 mm²
Connection bolt	M10
Tightening torque for DC terminal connections	40 ... 50 Nm
Fuse protection for DC connection	XP200-HV TL: 2 fuses each for DC+/DC– XP250-HV TL: 3 fuses each for DC+/DC– XP350-HV TL: 4 fuses each for DC+/DC–

Ensuring that there is no ground fault

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

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

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

Low resistance (< 2 MΩ) indicates a high-ohm ground fault of the DC generator.

4. Rectify any faults before connecting the DC generator.

Connecting the cables



DANGER

Lethal voltages in the PV system

Lethal voltages are present in the PV system.

› Make absolutely sure that the plus and minus poles are properly insulated.

Each cable corresponds to a specific pole.

1. Connect the cables to the poles.
   Make sure the polarity is correct (Figure 12):
   - Left side (item 1): Positive (DC+)
   - Right side (item 2): Negative (DC–)
2. Screw down the cables.
3. Make sure that all of the cables and seals are securely attached.



NOTE

If positive or negative grounding of the PV generator is necessary, the use of an optional grounding kit for the XP inverters is mandatory.

› Do not ground the inverter without the grounding kit.

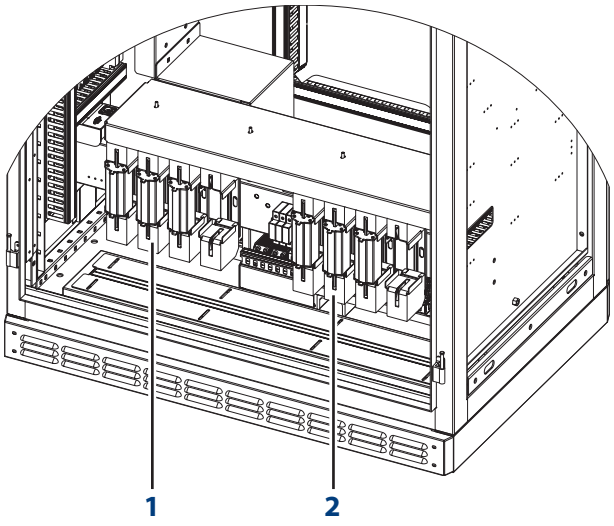


Figure 12: DC connections (XP-250 HV)

1	DC+ connections
2	DC– connections

Electrician

7.5 Connecting the power supply

Without auxiliary power, the inverter is not able to start up and supply the necessary power to the MMI, the fans, measurement equipment, etc. The inverter offers two ways to supply the necessary power:

- Internal power supply (see section 7.5.1 on page 23)
- External power supply (see section 7.5.2 on page 24)

CAUTION

Internal short circuit by incorrect connection

› Do not use the external and the internal power supply at the same time.

NOTE

In delivery status, the inverter is set for using the external power supply.

For the power consumption of the inverter see section 6.2 on page 16

7.5.1 Connecting the internal power supply

NOTE

The use of internal power is subject to the following restrictions:

- The inverter can not be operated when no PV power is present.
- The inverter is not able to fulfil any communication tasks without power supply.
- Software updates or external access to the inverter is not possible without power supply.
- The use of internal power reduces the feed-in power and this finally reduces the yield of the PV plant.

No additional terminal connections have to be made for using the internal power supply.

1. Make sure that the circuit breaker CB33 (1) is switched off.
2. Secure the circuit breaker CB33 with the lock clip (2).

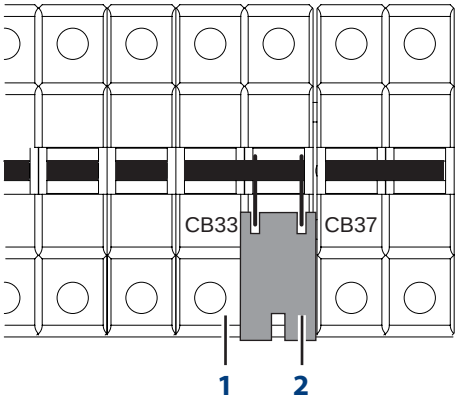


Figure 13: Securing the circuit breaker CB33 for the use of the internal power supply

⚠ Electrician

7.5.2 Connecting the external power supply

In the standard setting, the inverter is meant to be used with external power supply.

1. Make sure that the circuit breaker CB37 (1) is switched off.
2. Secure the circuit breaker CB37 with the lock clip (2).

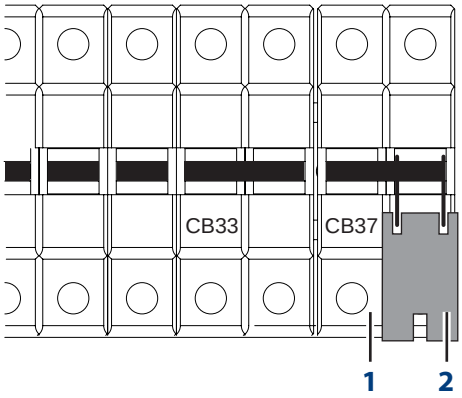


Figure 14: Securing the circuit breaker CB37 for the use of the external power supply

NOTE

Cables with a cross-section up to 2.5 mm² may be used for the connection of the external power supply.

Depending on the selected cable cross-section, choose an appropriate protection device (e.g. a C16A circuit breaker is recommended for a 1.5 mm² cross-section).

Connecting the external power supply (Figure 15)

The connection for the external power supply is located in the left inverter cabinet.

☞ Connect the external power supply to the terminals marked “TO” using single-phase 230 V.

Electrician

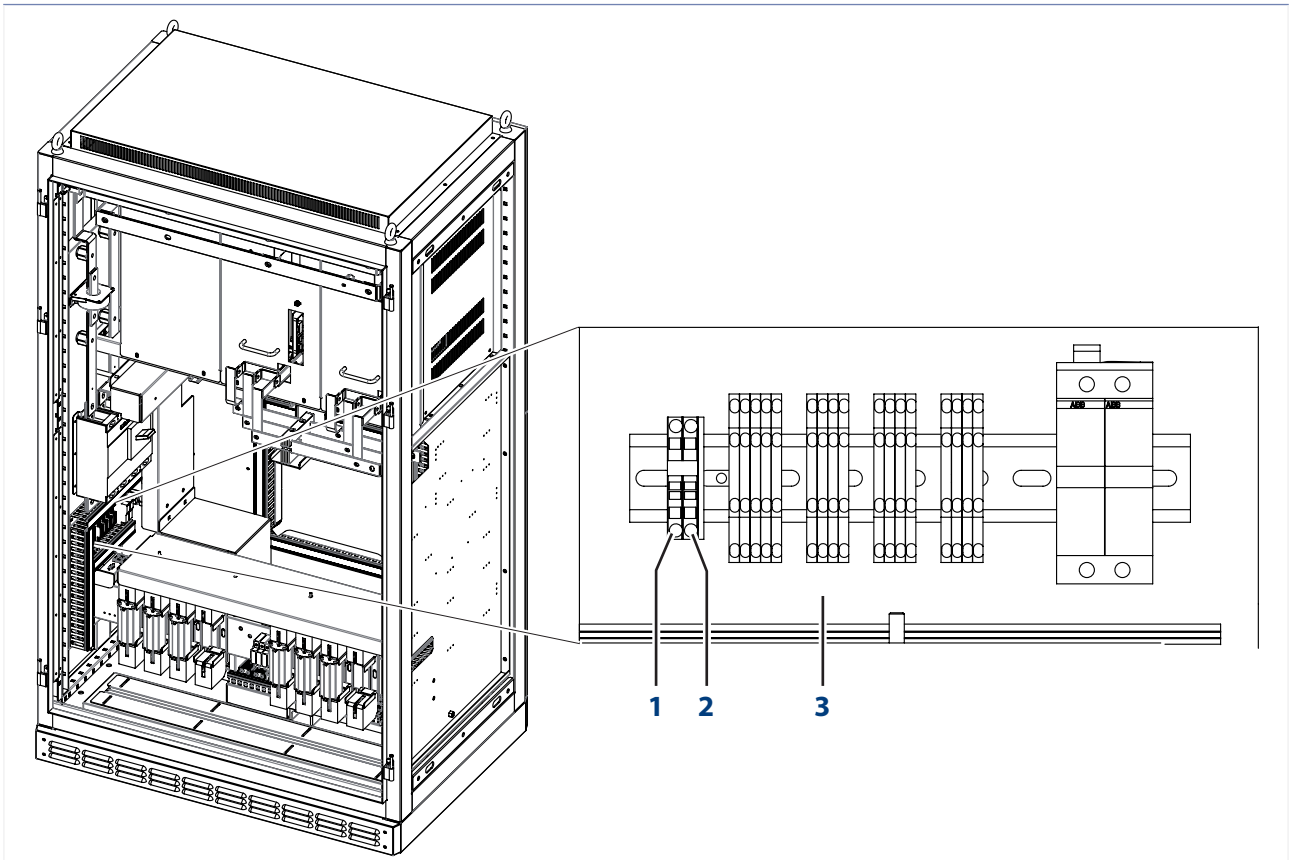


Figure 15: Connecting the external power supply (XP250-HV)

Key

1	230 V L connection (TO L)	3	User interface
2	230 V N connection (TO N)		

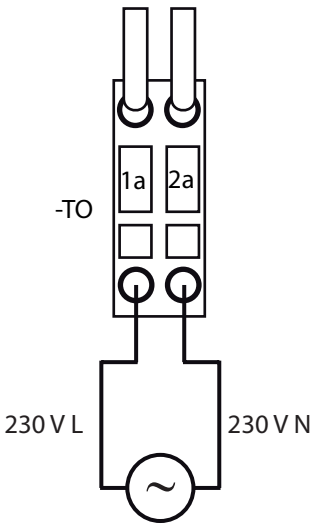


Figure 16: TO AC connection

Terminal number	Terminal designation	Specification	Wire cross-section, max.
1a	TO L	230 V L	AWG 14 (2.5 mm²)
2a	TO N	230 V N	

Table 6: Connections for external power supply

CAUTION

Damage to the inverter due to incorrect connections

Do not use the TO terminals as power supply for external devices.

Electrician

7.6 Connecting the interfaces

Overview

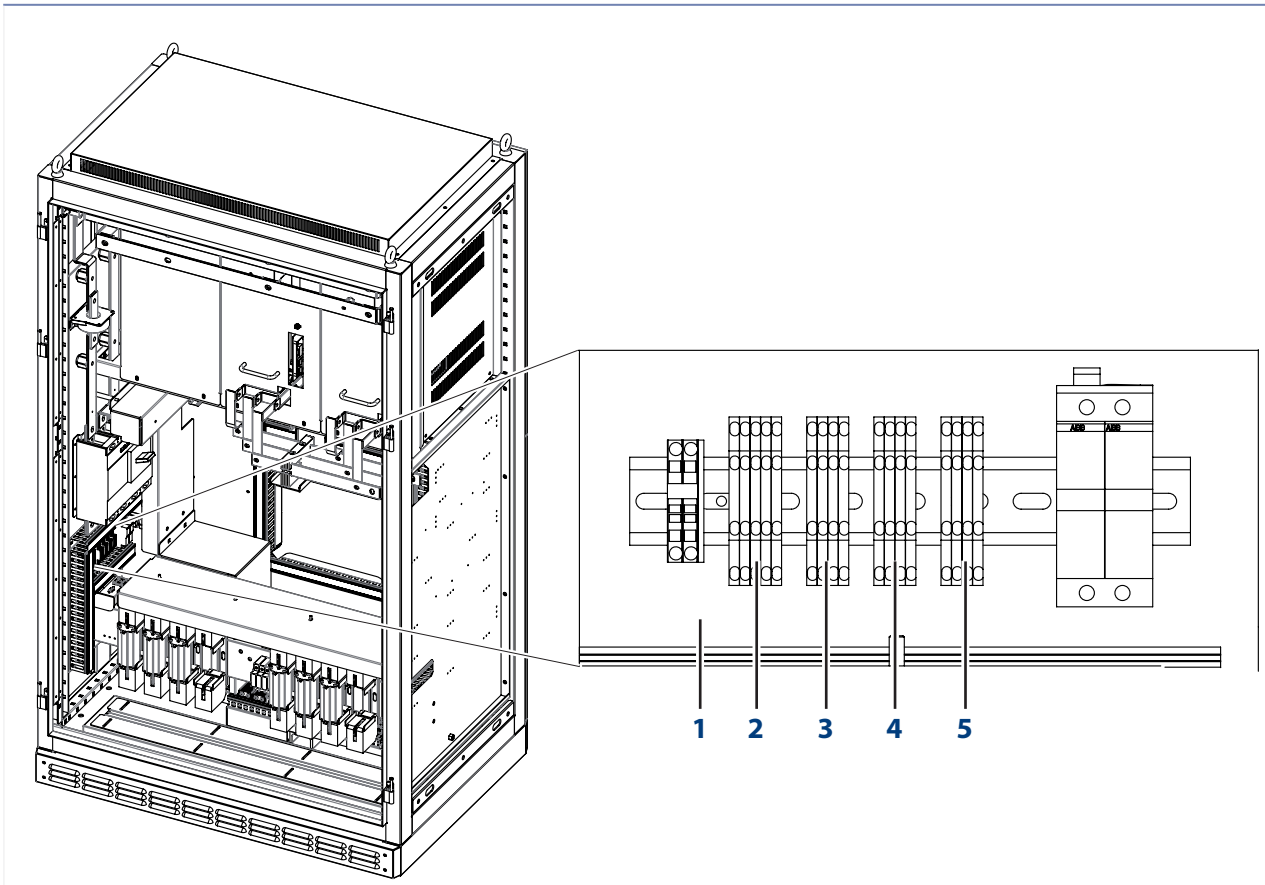


Figure 17: Interface connections (XP250-HV)

Key

1	User interface	4	Analogue user input (UAI)
2	Digital user input/output (UDIO)	5	Remote power control (RPC) for managing grid feed-in
3	RS485		

NOTE

The digital, analogue, RS485 and Ethernet connections are designed for SELV.

NOTE

› Use shielded communication cables to improve the resistance of the communication against interferences.

› Connect the shield to ground potential.

CAUTION

Damage to the inverter due to energized terminals

› Connect only communication cables to the interface connections.

› Use the communication cables only for communication signals.

Electrician

7.6.1 Connecting the digital input/output

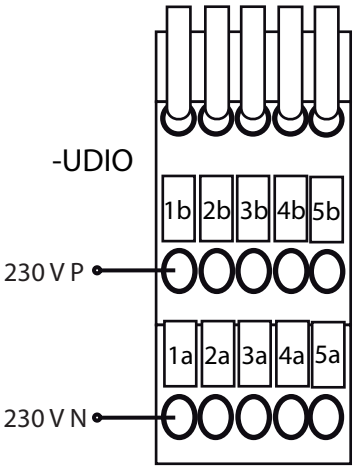


Figure 18: UDIO connection

Terminal number	Terminal designation	Specification	Wire cross-section, max.
1a	UDI1 N	Potential-free input contact, max. 27 V, 27 mA	AWG 20 (0.75 mm²)
1b	UDI1 P		

Table 7: Connections for digital input

7.6.1.1 S0 input

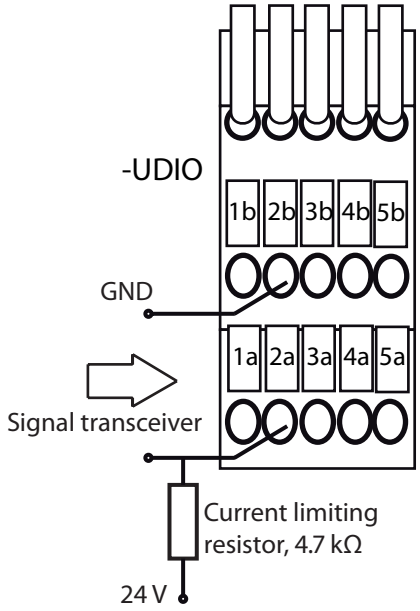


Figure 19: Connection for S0 input

Terminal number	Terminal designation	Specification	Wire cross-section, max.
2a	$S0_{in}$ N	Max. 27 V, 27 mA	AWG 20 (0.75 mm²)
2b	$S0_{in}$ P		

Table 8: Connections for S0 input

Electrician

7.6.1.2 S0 output

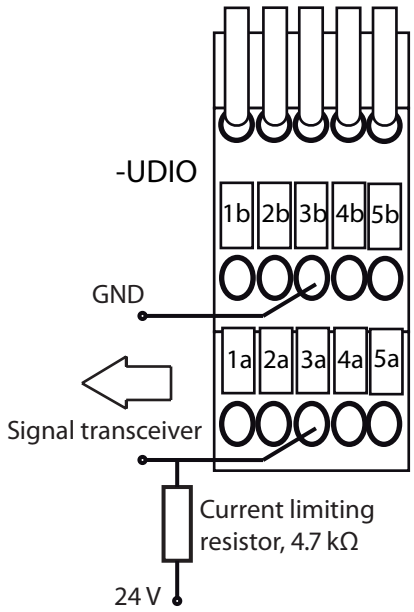


Figure 20: Connection for S0 output

Terminal number	Terminal designation	Specification	Wire cross-section, max.
3a	$S0_{out}$ N	Max. 27 V, 27 mA	AWG 20 (0.75 mm²)
3b	$S0_{out}$ P		

Table 9: Connections for S0 output

7.6.1.3 Digital output

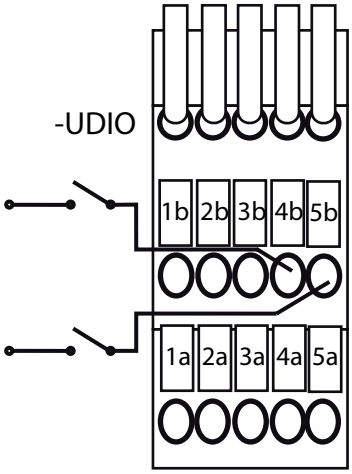


Figure 21: Connection for digital output (N/O contact)

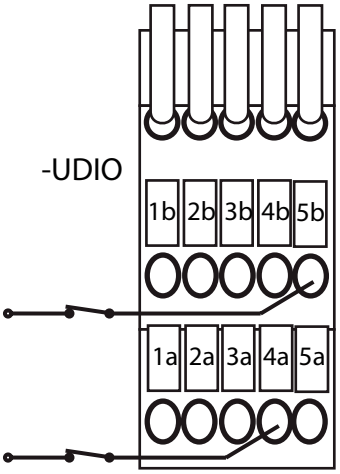


Figure 22: Connection for digital output N/C contact)

Terminal number	Terminal designation	Specification	Wire cross-section, max.
4a	UDO1 B	Dry contact output B	AWG 20 (0.75 mm²)
4b	UDI1 A	Dry contact output A	
5a	Reserve		
5b	UDI1 C	Dry contact output common	

Table 10: Connections for digital user output

⚠ Electrician

7.6.2 Connecting the RS485-1 interface

The RS485-1 interface is the interface for the Powador Argus.

Powador Argus settings

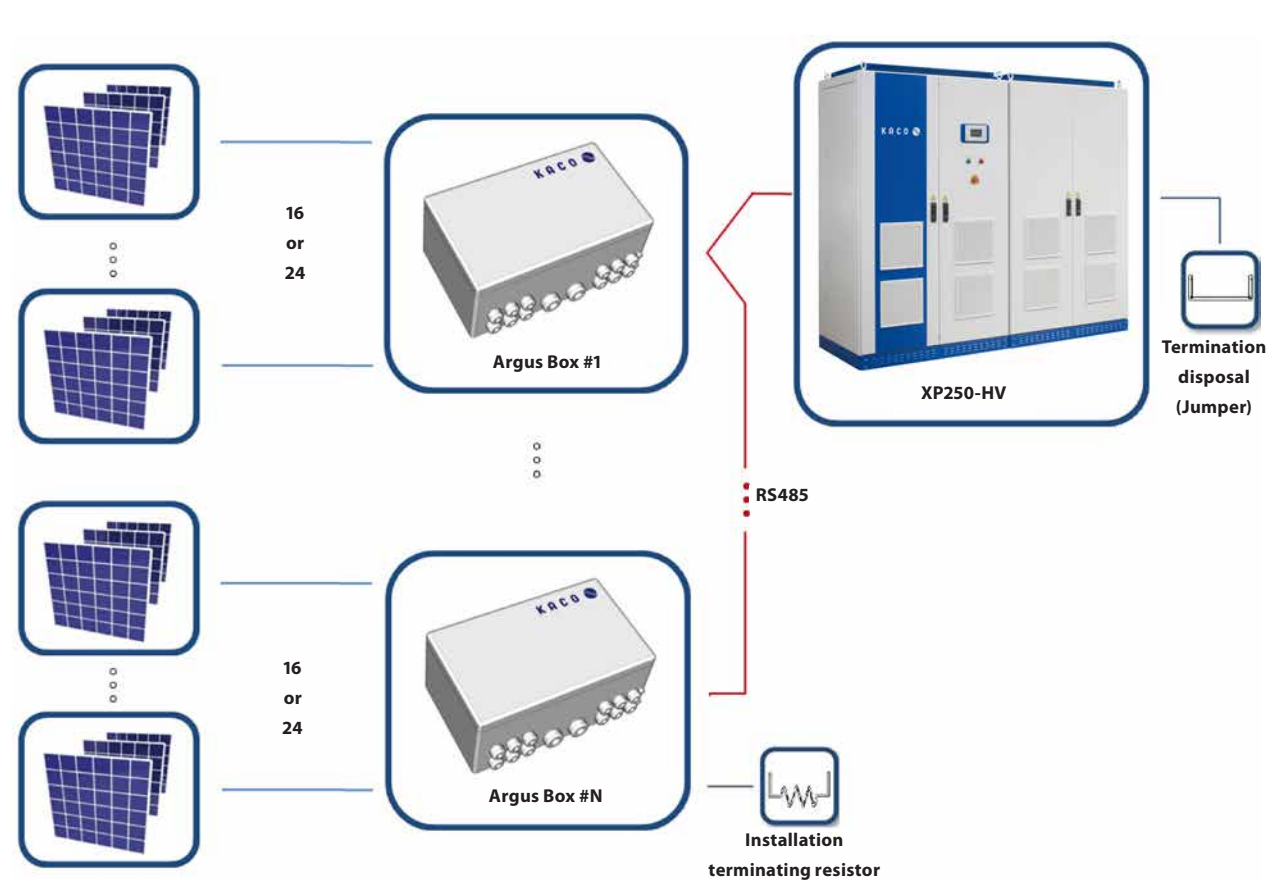


Figure 23: Powador Argus in RS485 network (XP250-HV)

Terminal connections

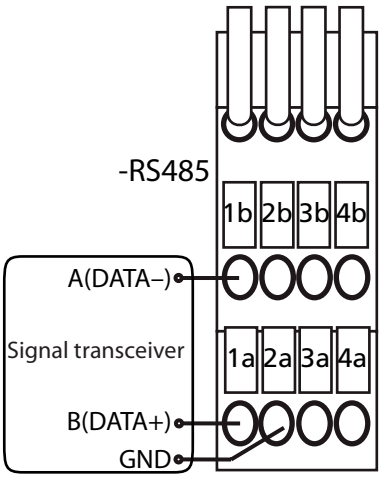


Figure 24: RS485-1 connection

Terminal number	Terminal designation	Specification	Wire cross-section, max.
1a	RS485 A1	RS485 signal A1 (DATA +)	AWG 20 (0.75 mm²)
1b	RS485 B1	RS485 signal B1 (DATA –)	
2a	RS485 G1	RS485 data transmission GND 1	
2b	RS485 C1	Terminal for terminating resistor	

Table 11: Connections for RS485-1

Electrician

☞ A terminating resistor (120 Ω, 0.5 W, 1 %) is installed on the main control board (XCU).
For termination disposal use a jumper between RS485 A1 (1a) and RS485 C1 (2b).

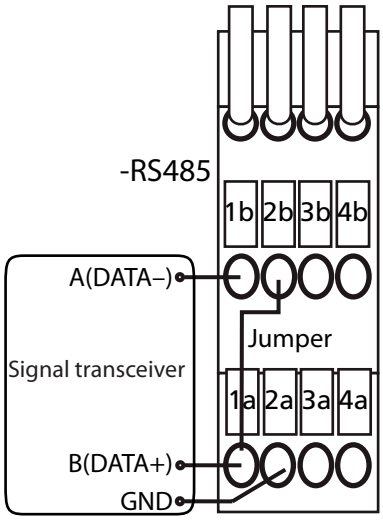


Figure 25: RS485-1 termination disposal

NOTE

Terminating resistors need to be installed at both ends of the device within the communication railroad.

⚠ Electrician

7.6.3 Connecting the RS485-2 interface

The RS485-2 interface is the interface for the MMI's internal data logger, or for the external Powador-proLOG data logger.

Powador-proLOG settings



Figure 26: Powador-proLOG in RS485 network (XP250-HV)

Terminal connections

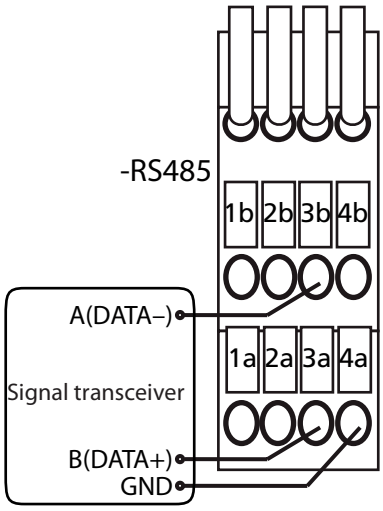


Figure 27: RS485-2 connection

Terminal number	Terminal designation	Specification	Wire cross-section, max.
3a	RS485 A2	RS485 signal A2 (DATA +)	AWG 20 (0.75 mm²)
3b	RS485 B2	RS485 signal B2 (DATA –)	
4a	RS485 G2	RS485 data transmission GND 2	
4b	RS485 C2	Terminal for terminating resistor	

Table 12: Connections for RS485-2

☞ A terminating resistor (120 Ω, 0.5 W, 1 %) is installed on the main control board (XCU).
For termination disposal use a jumper between RS485 A2 (3a) and RS485 C2 (4b).

Electrician

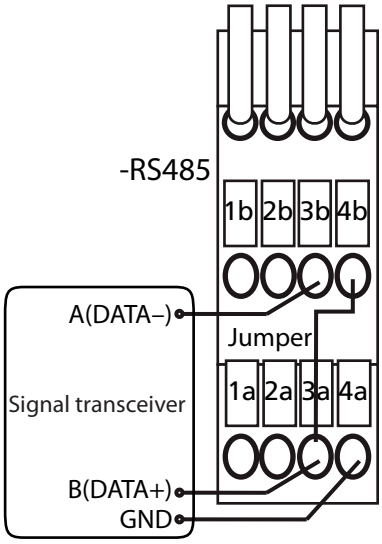


Figure 28: RS485-2 termination disposal

NOTE

Terminating resistors need to be installed at both ends of the device within the communication railroad.

7.6.4 Connecting the analogue input

The inverter has four analogue connections.

1a, 1b, 2a, 2b	Solar sensor
3a, 3b	PT 1000 ambient temperature sensor
4a, 4b	Reserve
Input range	0 ... 10 V

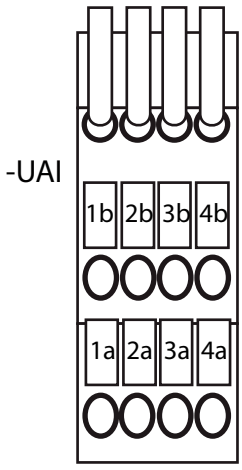


Figure 29: Analogue user input

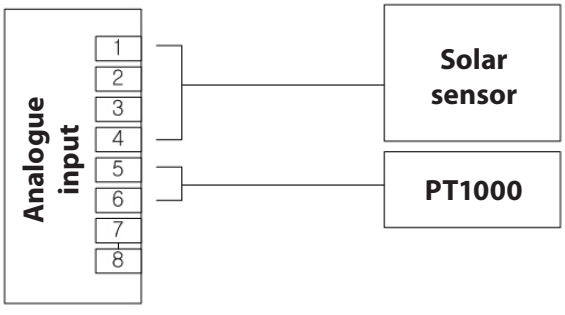


Figure 30: Connection diagram of the analogue interface

Electrician

7.6.4.1 Solar sensor

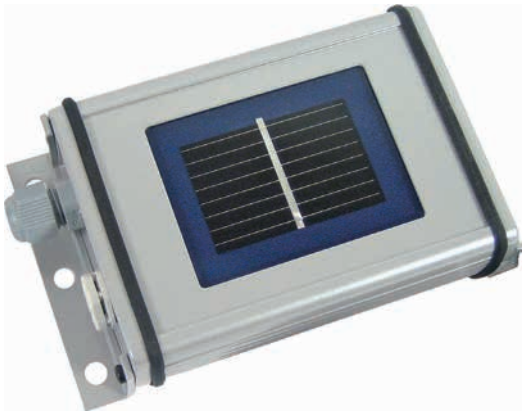


Figure 31: Si-12TC solar sensor

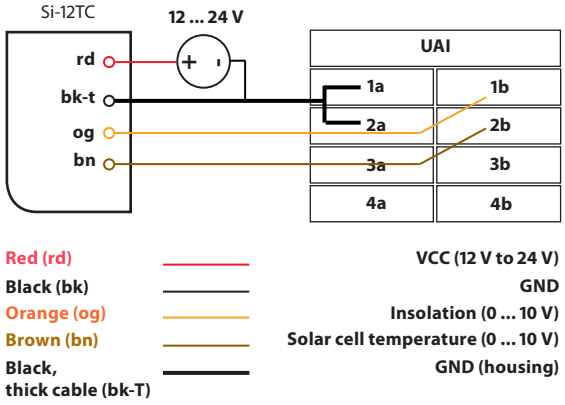


Figure 32: Connection diagram for solar sensor

Terminal number	Terminal designation	Specification	Wire cross-section, max.
1a	IRN	0 ... 10 V DC	AWG 20 (0.75 mm²)
1b	IRP		
2a	CTN	0 ... 10 V DC	
2b	CTP		

Table 13: Connections for analogue user input – solar sensor

7.6.4.2 PT 1000



Figure 33: PT 1000

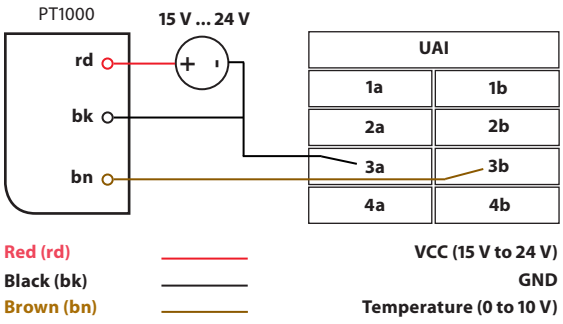


Figure 34: Wiring of the PT 1000

Terminal number	Terminal designation	Specification	Wire cross-section, max.
3a	PTN	0 ... 10 V DC	AWG 20 (0.75 mm²)
3b	PTP		
4a	RSVN	Reserve	
4b	RSVP		

Table 14: Connections for analogue user input – PT 1000

Electrician

7.6.5 Connecting the remote power control

Remote power control (RPC) to connect grid feed-in management

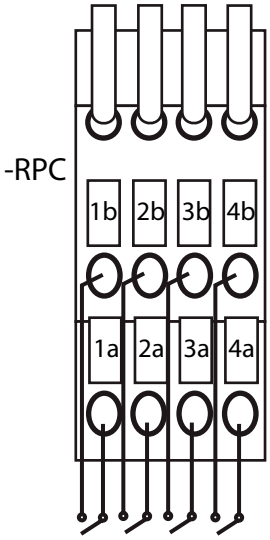


Figure 35: RPC connection and wiring

Terminal number	Terminal designation	Specification	Wire cross-section, max.
1a	RPC1 N	100% generation of electrical power	AWG 20 (0.75 mm²)
1b	RPC1 P		
2a	RPC2 N	60% generation of electrical power	
2b	RPC2 P		
3a	RPC3 N	30% generation of electrical power	
3b	RPC3 P		
4a	RPC4 N	0% generation of electrical power	
4b	RPC4 P		

Table 15: Connections for remote power control (RPC)

NOTE

› After the successful electrical installation of the inverters and the connection of all interfaces mount the plexiglas covers to ensure safe operation.

7.7 Preparing the start-up

After the electrical connection and the connection of the interfaces, the inverter, especially the settings for the interfaces, must be configured. The inverter has to be started-up for configuration.

DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator may open, install and maintain the inverter.

› Keep all doors and covers closed when the unit is in operation.

› Do not touch the lines and terminals when switching the unit on and off.

CAUTION

Internal short circuit by incorrect connection

› Do not use the external and the internal power supply at the same time.

⚠ Electrician

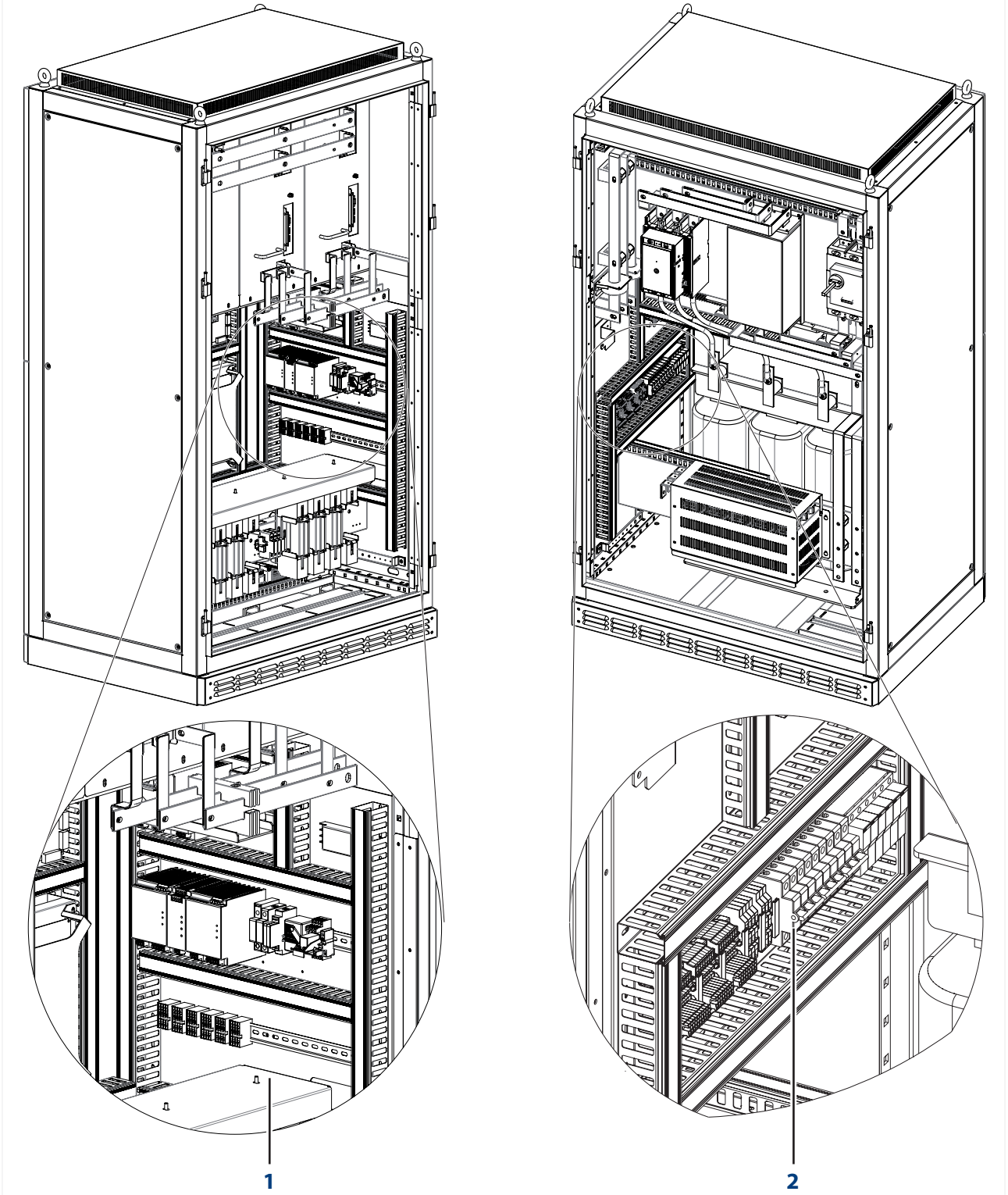


Figure 36: Cabinet, interior view (XP250-HV)

Key

1	Circuit breakers CB33 and CB37 for line voltage and CB30 ... CB35 (PV side)
2	Circuit breakers MCB21 and MCB24 (grid side)

⚠ Electrician

Checking the circuit breakers on PV side and grid side

1. Ensure that circuit breakers CB30 ... CB35 are switched on.
2. Ensure that circuit breakers MCB21 and MCB24 are switched on.

NOTE

The use of internal power is subject to the following restrictions:

- The inverter can not be operated when no PV power is present.
- The inverter is not able to fulfil any communication tasks without power supply.
- Software updates or external access to the inverter is not possible without power supply.
- The use of internal power reduces the feed-in power and this finally reduces the yield of the PV plant.

Switching on the internal power supply

1. Ensure that the circuit breaker CB33 is switched off and secured with the lock clip.
2. Switch on the circuit breaker CB37.

or

Switching on the external power supply.

1. Ensure that the circuit breaker CB37 is switched off and secured with the lock clip.
2. Switch on the circuit breaker CB33.

» The display of the inverter starts up and the initial configuration is possible.

» On the MMI the “Language & Country” screen is shown (Figure 37).

NOTE

Improper parameters will render the system inoperable.

Select only the country-specific settings for your country.

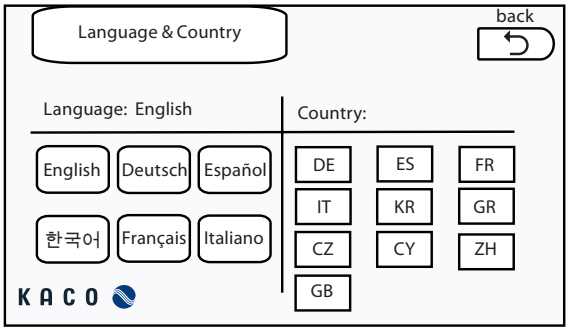


Figure 37: “Language & Country” screen

NOTE

After successful completion of the language and country settings, the configuration assistant does not appear again when the inverter is restarted.

You can then change the language and country settings only in the setup submenu “Language & Country” (see section 8.4.8.4 on page 48).

Selecting the language

☞ Press the appropriate button for your language. This sets the display language for the MMI.

» The selected language is shown above the selection buttons.

Available languages: English, German, Spanish, Korean, French, Italian.

Electrician

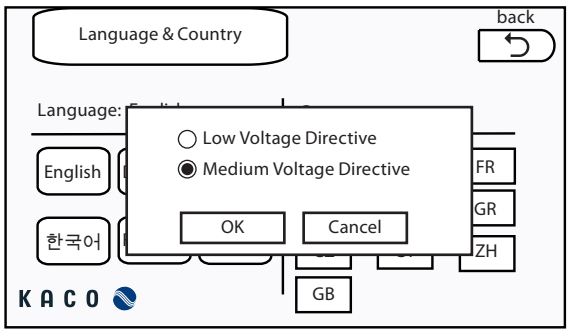
Selecting the country-specific setting

☞ Press the button that shows the flag of your country.

DE

Country-specific functions

If the german flag was selected on the “Country” screen the user is prompted for the selection of the applicable directive.



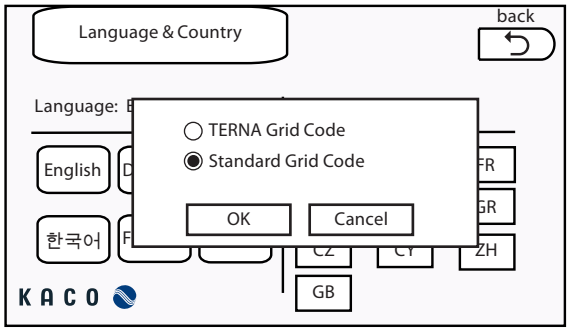
☞ Press the radio button for the applicable directive.

☞ Press the “OK” button.

» The german flag is shown above the selection buttons.

IT

If the italian flag was selected on the “Country” screen the user is prompted for the selection of the applicable grid code.



☞ Press the radio button for the applicable grid code.

☞ Press the “OK” button.

» The italian flag is shown above the selection buttons.

The parameters for the country-specific power grids are stored.

The main menu is shown (see section 8.3 on page 41).

8 User interface

8.1 User interface (MMI)

The MMI has a graphic interface used to monitor and control the inverter. The MMI has the following functional features:

- The LCD screen displays the operating states, along with voltages, currents, frequencies, temperatures, output powers, status of errors/warning messages and events. Pressing the MMI touchscreen switches on the LCD backlight. If the display is not activated within five minutes, the LCD backlight switches automatically off.
- Touchscreen for navigating through the menus
- SD card: the MMI continually records data to the SD card. When recording once every 10 minutes (around the clock), the maximum amount of data per year is 360 KB. When the SD card is full, the oldest data is overwritten.
- Configuration of country-specific settings (power grid standard, maximum/minimum voltage/frequency)
- Ethernet interface for monitoring and service, network connection for remote use
- RS485 interface for logging and transfering data
- USB interface for connecting external units (e.g. laptop computer)

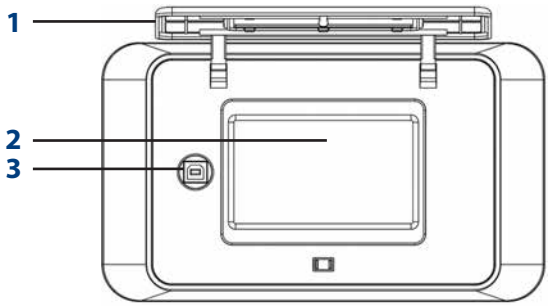


Figure 38: Front of the MMI

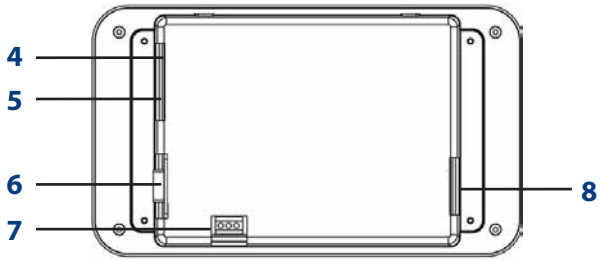


Figure 39: Rear of the MMI

Key

1	Protective cover	5	Ethernet interface
2	MMI touchscreen, LCD	6	RS232 interface (internal interface)
3	USB interface	7	RS485 interface
4	Power connection	8	SD card

8.2 MMI menu structure

Used symbols:

0 1 2 3 4	Menu level (0, 1, 2, 3)		Password-protected menu
	Display menu		Submenu available
	Options menu	DE	Country-specific setting

Country-specific	Menu level	Display/ Setting	Menu type	Action in the menu/Meaning
All countries	0 1 2 3 4	**Main menu**		Opening submenu and starting function by pressing the corresponding button (see section 8.3 on page 41).
	0 1 2 3 4	**Fault**		Displays current faults and warnings (see section 8.4.5 on page 47). Press “Fault reset” to correct current faults.
	0 1 2 3 4	**History**		Displays a list with a maximum of 100 faults, warnings and events that most recently occurred in the inverter (see section 8.4.6 on page 47).
	0 1 2 3 4	**Statistics**		Displays the data that was recorded on the SD card as a diagram (see section 8.4.7.1 on page 45). Selecting a specific date.
	0 1 2 3 4	**Calendar**		Press the calendar icon to select the date with a calendar.
	0 1 2 3 4	**Year**		Displays the annual statistics.
	0 1 2 3 4	**Month**		Displays the monthly statistics.
	0 1 2 3 4	**Day**		Displays the daily statistics.
	0 1 2 3 4	**Setups**		Open setup submenu by pressing the corresponding button.
	0 1 2 3 4	**Date/Time**		Setting the current date and local time (see section 8.4.8.1 on page 47).
	0 1 2 3 4	**Digital**		Setting the digital I/O parameters.
	0 1 2 3 4	**Analog**		Setting the analogue sensor parameters.
	0 1 2 3 4	**Recording**		Setting the recording interval (see section 8.4.8.2 on page 47). Press “Delete All Statistics” to delete the statistical data.
	0 1 2 3 4	**RS485**		Setting the RS485 interface parameters.
	0 1 2 3 4	**Language & Country**		Setting the language (see section 8.4.8.4 on page 48). Setting country-specific parameters (see section 7.7 on page 34).
DE	0 1 2 3 4	**Germany**		Selecting “low-voltage directive” or “medium-voltage directive”.
IT	0 1 2 3 4	**Italy**		Selecting “TERNA grid code” or “standard grid code”.

Country-specific	Menu level	Display/ Setting	Menu type	Action in the menu/Meaning
All countries	0-1-[2]-3-4	**User Configuration**	☰ ↳	Configuring user settings.
	0-1-2-[3]-4	**Email Server**	☰ ↳	Configuring the e-mail server (see section 9.4 on page 70).
	0-1-[2]-3-4	**Network**	☰	Setting the network parameters (see section 8.4.8.5 on page 48).
	0-1-[2]-3-4	**Service**	☰ ↳	Selecting the service parameter groups.
	0-1-2-[3]-4	**Grid**	☰	Setting the grid parameters.
	0-1-2-[3]-4	**Inverter**	☰	Setting the inverter parameters.
	0-1-2-[3]-4	**PV array**	☰	Setting the PV generator parameters.
	0-1-2-[3]-4	**Controller**	☰	Operating the system in test mode.
	0-1-[2]-3-4	**Software Upgrade**	↳	Performing a software upgrade from SD card (see section 8.4.8.6 on page 49).
	0-1-2-[3]-4	**MMI**	☰	Updating the MMI software.
	0-1-2-[3]-4	**C6x**	☰	Updating the C6x software.
	0-1-[2]-3-4	**Information**	👁	Displays the following information: • Type designation of the inverter • Installed software version • Selected country setting • Grid type, if selected
	0-[1]-2-3-4	**PV Array**	👁 ↳	Displays measured values of the PV generator (see section 8.4.1 on page 42). Activating the string monitoring.
	0-1-[2]-3-4	**Strings**	👁	Displays the current values recorded by string monitoring (see section 8.4.2 on page 43).
	0-[1]-2-3-4	**Inverter**	👁	Displays measured values of the inverter (see section 8.4.3 on page 43).
	0-[1]-2-3-4	**Grid**	👁	Displays measured values of the power grid (see section 8.4.4 on page 43).
	0-[1]-2-3-4	**Start Inverter**	☰	Starting the inverter.
	0-[1]-2-3-4	**Stop Inverter**	☰	Stopping the inverter.
	0-[1]-2-3-4	**Stop speaker**	☰	Switching on/off the speaker (see section 8.3.2 on page 42).
	0-[1]-2-3-4	**SD card safe-remove**	👁	Displays the SD card status (see section 8.3.1 on page 41). Acknowledging the “SD card in slot” status.

8.3 MMI main menu

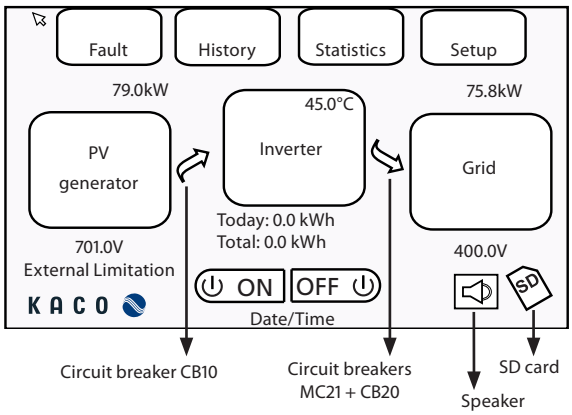


Figure 40: Display when the MMI starts up

Displayed button colours

Colour	Meaning
Green	Normal operation
Red	Fault (not for switches CB10, MC21 and CB20)
Grey	Not in use

8.3.1 Changing the SD card, status display

DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator may open, install and maintain the inverter.

› Shut down the inverter before opening it.

› Do not touch the lines and terminals when switching the unit on and off!

Insert the SD card

"No SD in slot" icon

1. Shut down the inverter.
2. Open the inverter.
3. Slide the SD card into the slot until it locks into place.
4. Close the inverter.
5. Press the "ON" button. The inverter starts up.

"SD card in slot" icon

The inverter checks the card. If the SD card was detected, the "SD card in slot" icon appears in the lower right-hand corner of the display.

1. Press the SD card icon.
2. Wait until the SAFE icon is displayed.

Remove the SD card

“Data was saved to the SD card” icon

You can remove the SD card. The icon is displayed for one minute.

1. Shut down the inverter.
2. Open the inverter.
3. Remove the SD card by gently pressing and then releasing it. The SD card will pop out slightly. You can now remove it.
4. Close the inverter and start it up.

NOTE

Do not remove the SD card until the SAFE icon is displayed so that it will be detected by the MMI when you reinsert it.

8.3.2 Status display for speaker

ON	Audible signal when you press the LCD screen
OFF	No signal

NOTE

This setting does not affect the alarm tone that sounds when faults occur (see section 12 on page 83).

8.4 MMI submenus

8.4.1 PV generator

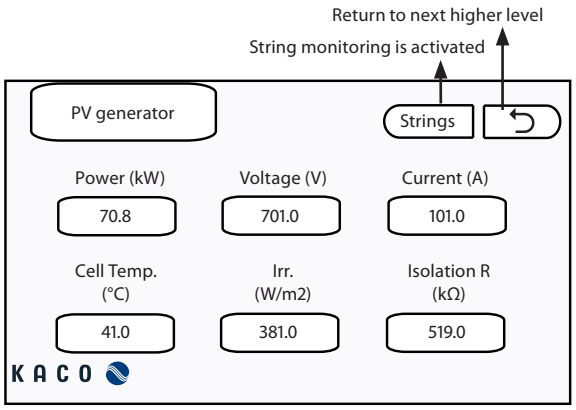


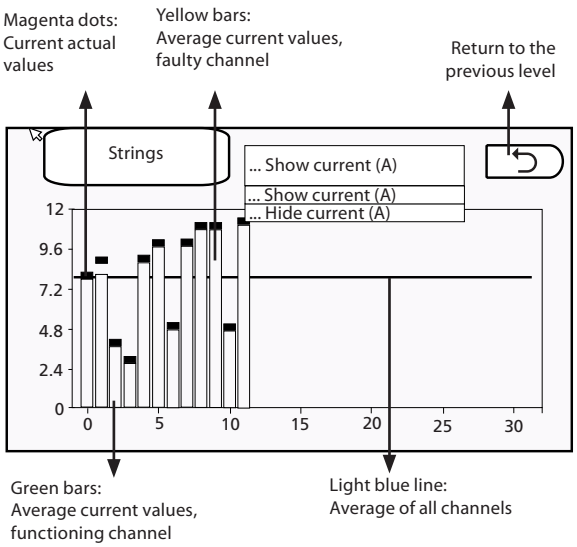
Figure 41: “PV generator” screen

Buttons

Display	Meaning
Measured values	Current measured values for the PV generator
Strings	String monitoring is activated

8.4.2 String monitoring

Changes to the configuration for the current sensors first become effective after five minutes.



Current actual values	Only current actual values are displayed during the first five minutes after the function has been activated.
Average current values of the channels	The actual values for the last five minutes are recorded (sampling period: every 30 seconds).
Average of all current values (channels)	The average of all current values is recalculated every five minutes based on the averages of all channels.

Figure 42: "String monitoring" screen

If the average of one channel deviates from the average of all channels by more than the specified range of tolerance and if this persists for longer than a specified delay period, this channel is assumed to be defective.

8.4.3 Inverter

Display of measured values for the inverter

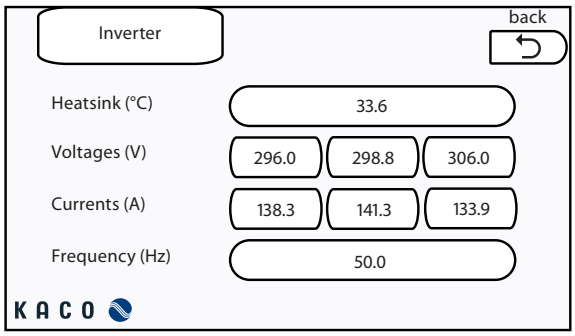


Figure 43: "Inverter" screen

8.4.4 Power grid

Display of measured values for the power grid

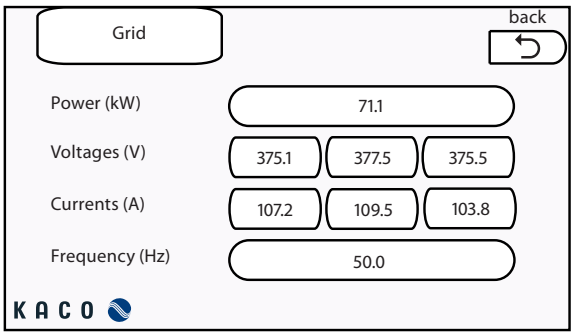


Figure 44: "(Power) Grid" screen

NOTE

Due to measuring tolerances (up to 10%), the measured values may not always correspond to the actual values. Therefore, these values cannot be used to calculate the efficiency of the inverters.

8.4.5 Faults and warnings

Display current faults and warnings

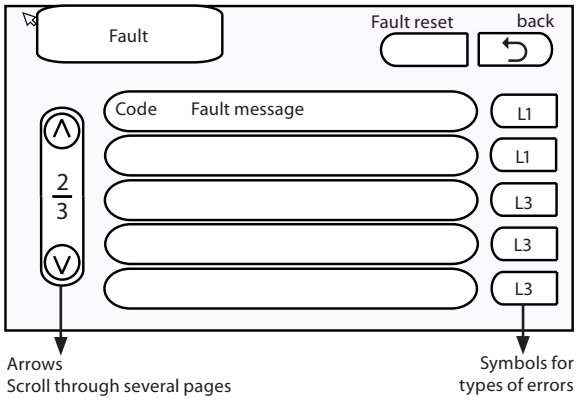


Figure 45: "Fault" screen

Correct current faults

☞ Press "Fault reset".

The control unit is instructed to correct current faults. After a few seconds have passed, the fault list is empty.

Icon	Fault type
L1 (yellow)	Warning
L2	Reserved, currently unassigned
L3 (red)	Serious fault

8.4.6 History

This screen displays a list with a maximum of 100 faults, warnings and events that most recently occurred in the inverter.

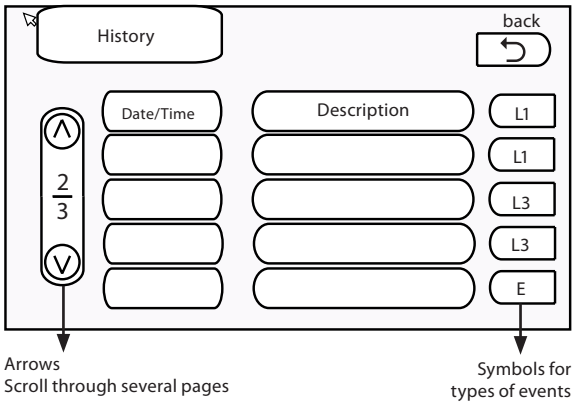


Figure 46: "History" screen

Icon	Event type
L1 (yellow)	Warnings
L2	Reserved, currently unassigned
L3 (red)	Serious fault
E	Event

8.4.7 Statistics

The statistics function displays the data that was recorded on the SD card as a diagram.

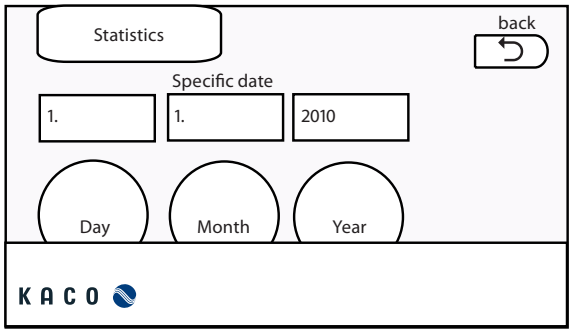


Figure 47: "Statistics" screen

Select time period

- ☞ Select one of the three combination fields.
  Day (daily statistics)
  Month (monthly statistics)
  Year (annual statistics)
- ☞ Select a specific date.

8.4.7.1 Statistics display

Parameter	Day	Month	Year
Grid power	x	x	x
PV power	x	x	x
PV voltage	x		
PV current	x		
PV temperature	x		
Insolation	x		
Line voltage	x		

Daily statistics

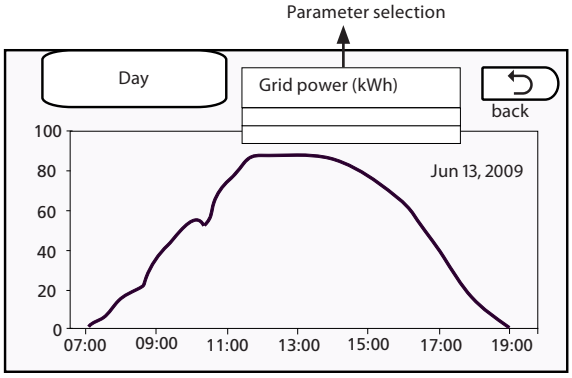


Figure 48: "Day" screen with daily statistics

Statistics are available as long as the relevant parameters were recorded. Recording is activated for all values by default. Monthly and annual statistics are recorded over the time period as cumulative values.

Monthly statistics

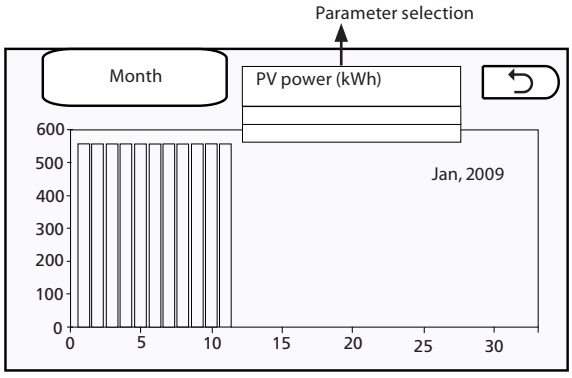


Figure 49: "Month" screen with monthly statistics for the last nine months

Annual statistics

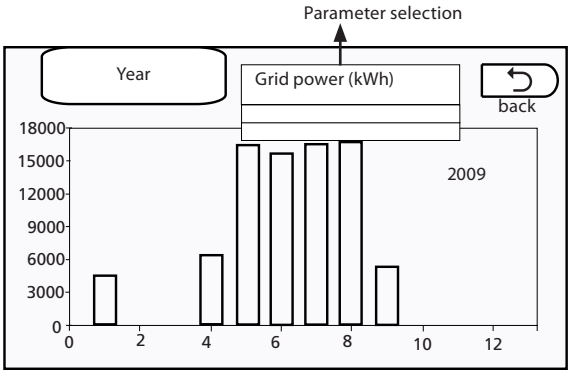


Figure 50: "Year" screen with annual statistic

8.4.8 Settings

Changing settings

- ☞ Use the “Setup” menu to change the settings that influence how the inverter operates.
- ☞ Use the buttons in the upper right-hand corner to switch between the two screens.

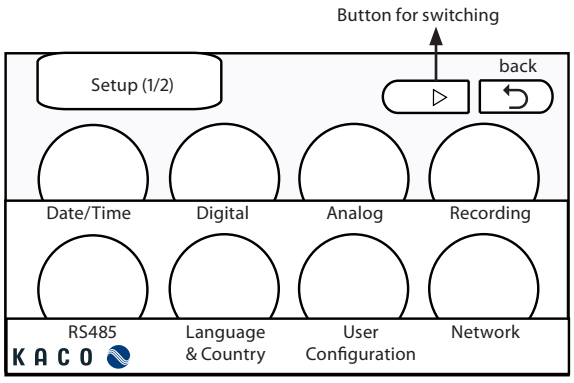


Figure 51: “Setup (1/2)” screen

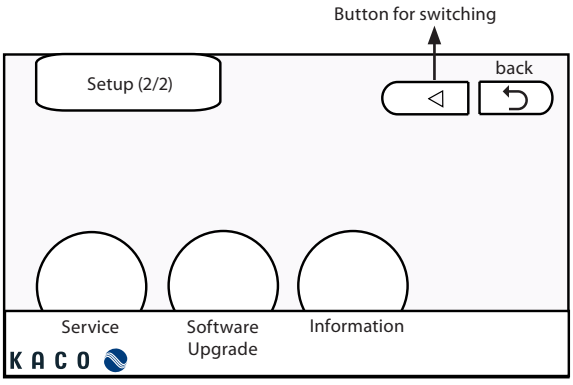
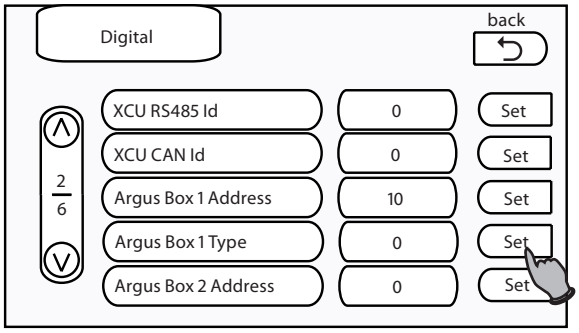
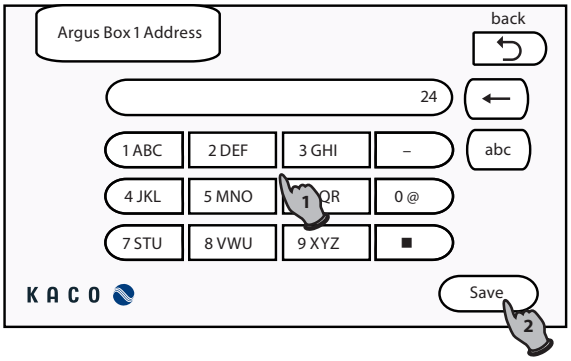


Figure 52: “Setup (2/2)” screen

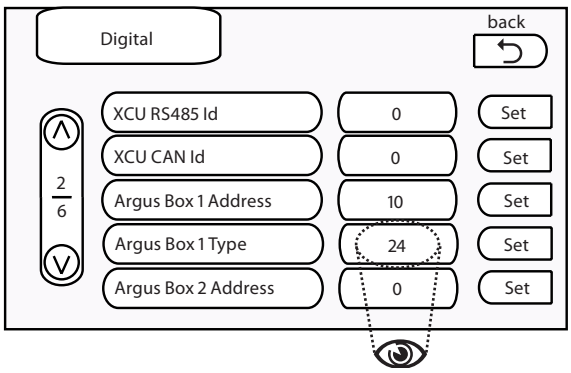
Entering parameters

In the submenus of the “Setup” menu parameters can be entered as follows (example: changing the “Argus Box 1 Type” parameter on the “Digital” screen):





5. On the “Digital” screen press the “Set” button for “Argus Box 1 Type”.
6. On the “Argus Box 1 Type” screen input a value within the range of values (example: 24).
7. Press the “Save” button.



8. On the “Digital“ screen check if the “Argus Box 1 Type” value was changed to the set value.

8.4.8.1 Date/Time

NOTE

Set the current date and local time. This setting affects the logging functions (event log and statistics).

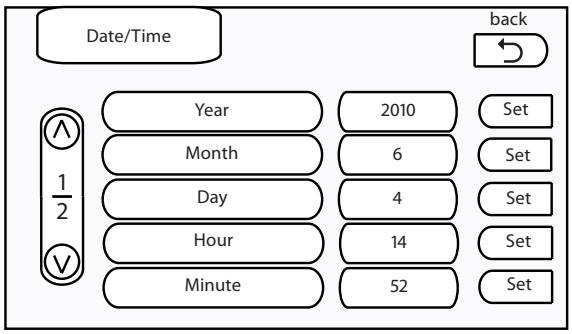


Figure 53: "Date/Time" screen

Changing system time

☞ This is where you set the current date and local time.

After the values have been changed, it takes up to one minute for the time data that is displayed in the main menu to be updated.

8.4.8.2 Recording

Specifying which values will be recorded

☞ Set the recording interval (in minutes).

☞ On pages 1 and 2 specify which values are to be recorded.

You can use this menu item to delete all of the statistics data on the SD card (if necessary).

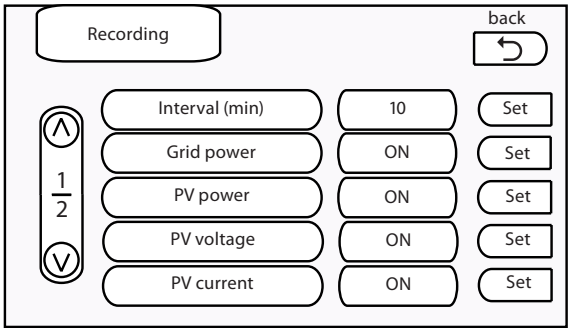


Figure 54: "Recording" screen

8.4.8.3 Recording settings

ID	Name	Unit	Factory setting	Min.	Max.
0	Recording interval	minute	10	10	60
1	Grid power		ON	OFF	ON
2	PV power		ON	OFF	ON
3	PV voltage		ON	OFF	ON
4	PV current		ON	OFF	ON
5	PV temperature		OFF	OFF	ON
6	Insolation		OFF	OFF	ON
7	Statistics		Clear	-	-

Table 16: Recording settings

8.4.8.4 Language and country settings

NOTE

Improper parameters will render the system inoperable. Select only the country-specific settings for your country.

Setting the language

☞ Press the appropriate button for your language. This sets the display language for the MMI.

Available languages: English, German, Spanish, Korean, French, Italian.

Setting country-specific parameters

☞ Press the button that shows the flag of your country.

» The parameters for the country-specific power grids are stored.

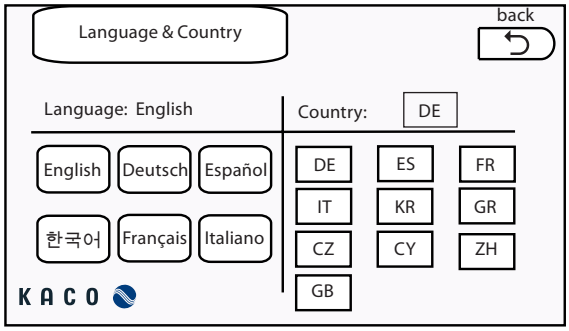


Figure 55: "Language & Country" screen"

8.4.8.5 Network

Configuring the network for the MMI

☞ Select static and dynamic IP addresses via DHCP service requests.

☞ Change the Web port used for monitoring the inverter via the Web.

☞ Open the Web monitoring service using the MMI's IP address and Web port (e.g. http://192.168.10.11:82).

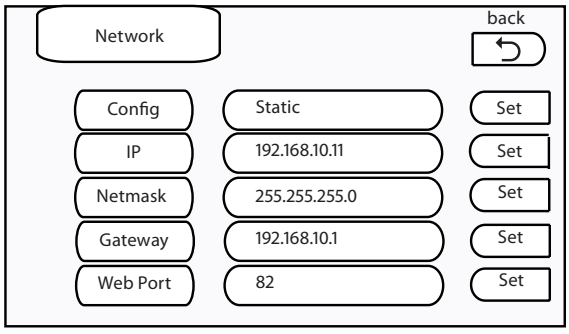


Figure 56: "Network" screen

8.4.8.6 Performing a software update

If a software update is available (for example, when new functions are added), use the SD card to update the inverter software.

Updating the software for the MMI

NOTE

Do not remove the SD card until the SAFE icon is displayed so that it will be detected by the MMI when you reinsert it.

1. Copy the software image file (*.img) to the SD card.
2. Insert the SD card into the MMI.
3. Select “Setup” → “Software upgrade”.

» The “Software upgrade” screen is displayed (Figure 57).

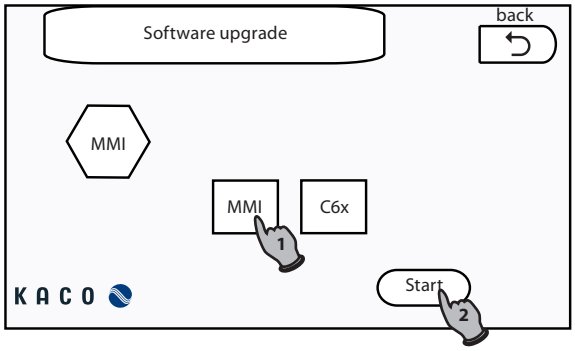


Figure 57: Software upgrade screen

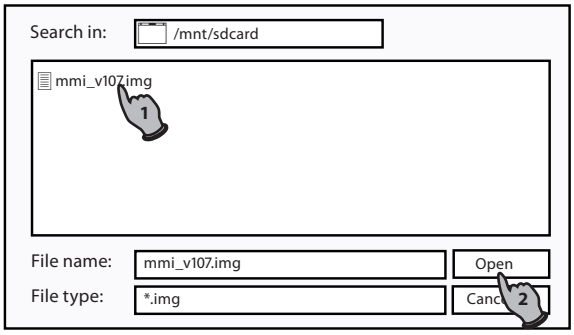


Figure 58: Dialogue box for opening files

4. Select “MMI” and press “Start”.

» A dialogue box is displayed.

5. Confirm the message to indicate that you understand that this process cannot be undone.

» A dialogue box for opening files is then displayed (Figure 58).

6. Select the image file that you copied earlier.
7. Press the “Open” button.

» The MMI displays the progress of the upgrade (Figure 61).

» After a short period of time, the system is restarted (Figure 62)

NOTE

If the image file is faulty, an error message is displayed and normal operation is resumed.

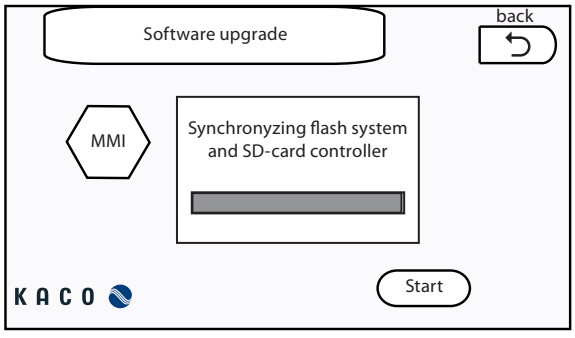


Figure 59: Upgrade process progress bar

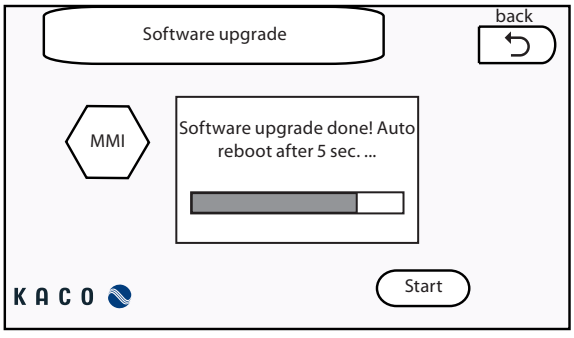


Figure 60: Restart dialogue box

CAUTION

Software damage due to an interruption of the synchronisation process

If the synchronising of the flash file system and the content of the SD card is interrupted (e.g. due to a power failure), the software can be damaged and the MMI may not be able to restart.

Updating the C6x software



NOTE

Do not remove the SD card until the SAFE icon is displayed so that it will be detected by the MMI when you reinsert it.

1. Make sure that the RS232 cable between the MMI and the control unit is connected.
2. Switch off the inverter by pressing the “OFF” button in the main menu.
3. Copy the software file (*.hex) to the SD card.
4. Insert the SD card into the MMI.
5. Select “Setup” → “Software upgrade”.

» The “Software upgrade” screen is displayed (Figure 61).

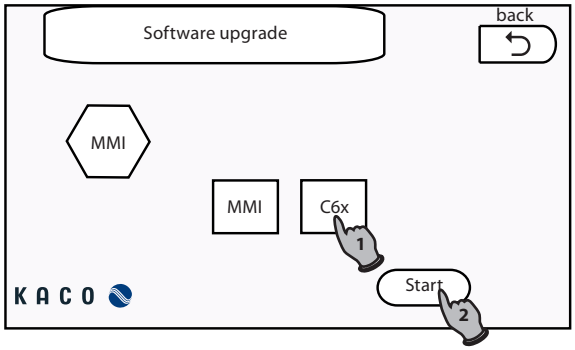


Figure 61: Software upgrade screen

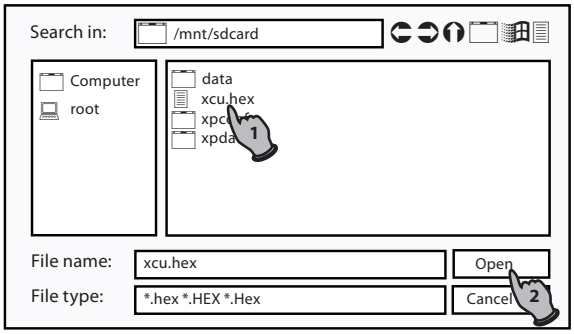


Figure 62: Dialogue box for opening files

6. Select “C6x” and press “Start”.

» A dialogue box for opening files is displayed (Figure 62).

7. Select the file that you copied earlier.
8. Press the “Open” button.

» The MMI transfers the file to the control unit (Figure 63).

» If the file transfer was successful, the message “MMI has finished upgrading XCU.” (Figure 64) will appear.

» The control unit has now been successfully upgraded.

» An error message indicates that the process was not successfully completed.

9. Press the “ON” button in the main menu to activate system operation.

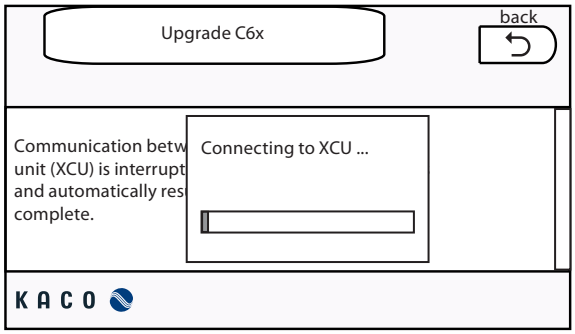


Figure 63: C6x upgrade screen

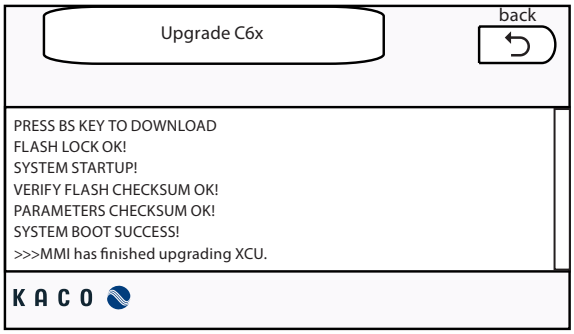


Figure 64: C6x upgrade screen (complete)

NOTE

Communication between the MMI and the control unit (XCU) is interrupted during the upgrade process and automatically resumes once the download is complete.

8.4.9 Other menus and details

Further menus are described in the “Configuration” chapter (see section 9 on page 61).

Some menus can only be accessed by service technicians from KACO new energy GmbH and are therefore not described in this manual.

8.5 Parameters

8.5.1 PvArray parameters

Parameter	Unit	Range	Description	Factory settings
MPPT Enable	–	On(1), Off(0)	"On" represents that MPPT is operating	1
MPPT V Maximum	V DC	0 ... 900	Maximum voltage to run MPPT	830
MPPT V Start	V DC	450 ... 800	MPPT wake-up voltage	600
MPPT T Start	s	0 ... 600	Time delay for MPPT wake-up	Device-specific
MPPT P Stop	W	0 ... 10000	MPPT power point to begin sleep test timer	Device-specific
MPPT T Stop	s	0 ... 3600	Time delay for MPPT sleep test	Device-specific
MPPT V Minimum	V DC	200 ... 800	Minimum voltage to run MPPT	410
DC Over Voltage Level	V DC	300 ... 950	Upper limit for PV over voltage fault	Device-specific
DC Over Current Level	%	0 ... 150	Upper limit for PV over current fault	130
MPP Factor	–	0 ... 1	Maximum power point factor	0.8
MPP Range Upper	V DC	10 ... 300	Upper limit of maximum power point	80
MPP Range Lower	V DC	10 ... 300	Lower limit of maximum power point	80
PV Operation Level	V DC	900 ... 950	Maximum PV operation level	Device-specific

Table 17: PvArray parameters

8.5.2 Inverter parameters

Parameter	Unit	Range	Description	Factory settings
Inverter Transformer	–	Yes(1), No(0)	"Yes" represents that inverter transformer is operating	Device-specific
Inverter Capacity	kW	100 ... 500	Power value that inverter can deal with	Device-specific
Inverter Over Current Level	%	0 ... 200	Upper limit for inverter over current fault	130
Current Limit	%	0 ... 150	Limit of current which enters to the inverter	100
Cabinet Temp. Maximum	°C	30 ... 70	Upper limit for cabinet over temperature warning	55
Cabinet Temp. Minimum	°C	–25 ... 10	Lower limit for cabinet under temperature warning	–15

Table 18: Inverter parameters

8.5.3 Grid parameters

Parameter	Unit	Range	Description	Factory settings
Rated Grid Voltage	V	208 ... 400	Rated value of the grid voltage	Device-specific
Rated Grid Frequency	Hz	50 ... 60	Rated value of the grid frequency	60
Grid Over Voltage Level 1	%	105 ... 125	Upper limit expressed as a percentage of the rated grid voltage for grid overvoltage level 1	110
Grid Under Voltage Level 1	%	75 ... 110	Lower limit expressed as a percentage of the rated grid voltage for grid under voltage Level 1	90
Grid Over Frequency Level 1	Hz	0.0 ... 3.0	Upper limit for grid over frequency level 1	0.2
Grid Under Frequency Level 1	Hz	0.0 ... 3.0	Lower limit for grid under frequency level 1	2
Frequency Dependant Power Reduction Enable	–	On(1), Off(0)	"On" means that the frequency-dependant power reduction is working	0
Power Gradient Enable	–	On(1), Off(0)	"On" means tat the power gradient is working	1
Power Gradient Ramp	s	0.0 ... 600	Time for power gradient ramp The inverter must generate the active power slowly with specific slope when its operation stops. In this case, the active power supply cannot be >10 % of the rated active power per minute.	600
Time shift	s	0.0 ... 6000	Delay time for inverter start	0
Gate-way Enable	–	0.0 ... 1.0	Reserved parameter	0
Grid Level 2 Protection Enable	–	On(1), Off(0)	"On" means that grid level 2 protection is working	1
Grid Over Voltage Level 2	%	105 ... 130	Upper limit expressed as a percentage of the rated grid voltage for grid overvoltage level 2	120
Grid Under Voltage Level 2	%	75 ... 100	Lower limit expressed as a percentage of the rated grid voltage for grid under voltage Level 2	80
Grid Under Frequency Level 2	Hz	0.0 ... 3.0	Lower limit for grid under frequency level 2	2.5
Grid Over Voltage Level 1 Trip time	ms	1000 ... 10000	Time for grid over voltage level 1 trip	5000
Grid Over Voltage Level 2 Trip time	ms	40 ... 2000	Time for grid over voltage level 2 trip	100
Grid Under Voltage Level 1 Trip time	ms	1000 ... 10000	Time for grid under voltage level 1 trip	5000

Parameter	Unit	Range	Description	Factory settings
Grid Under Voltage Level 2 Trip time	ms	40 ... 2000	Time for grid under voltage level 2 trip	100
Grid Under Frequency Level 1 Trip time	ms	1000 ... 20000	Time for grid under frequency level 1 trip	10000
Grid Under Frequency Level 2 Trip time	ms	40 ... 2000	Time for grid under frequency level 2 trip	100
Grid Over Frequency Level 1 Trip time	ms	40 ... 2000	Time for grid over frequency level 1 trip	100
FRT Enable	–	On(1), Off(0)	"On" means that FRT is working	0
Grid Over Voltage FRT Enable	–	On(1), Off(0)	"On" means that the grid overvoltage FRT is working	0
Power Reduction Gradient Level	%/Hz	0.0 ... 100	Gradient level for frequency-dependant power reduction	40
Power Reduction Deactivation Frequency	Hz	0.0 ... 0.3	Frequency limit for power reduction deactivation	0.05
Grid Over Frequency Level 2	Hz	0.0 ... 3.0	Upper limit for grid over frequency level 2	1.5
Grid Over Frequency Level 2 Trip time	ms	40 ... 2000	Time for grid over frequency level 2 trip	100

Table 19: Grid parameters

8.5.4 Date and time parameters

Parameter	Unit	Range	Description	Factory settings
Year	–	2000 ... 3000	Current year	–
Month	–	1 ... 12	Current month	–
Day	–	1 ... 31	Current day	–
Hour	–	0 ... 23	Current hour	–
Minute	–	0 ... 59	Current minute	–
Second	–	0 ... 59	Current second	–

Table 20: Parameters for date/time

8.5.5 Digital interface parameters

Parameter	Unit	Range	Description	Factory settings
DI1 select	–	0 ... 20	Selection for digital input 1	0
DO1 select	–	0 ... 20	Selection for digital output 1	0

RPC mode select	–	0 ... 2	Remote power control: • 0: Disable • 1: Master • 2: Slave (for cosphi control operation)	0
Power meter	kWh	0 ... 99999999	PV generation amount check	0
RS485 protocol	–	0 ... 999	0: ACI protocol 1: Protocol for Powador-proLOG 2: Protocol for Powador-go	0 0 0
RS485 ID	–	0 ... 999	ID for communication with RS485	0
CAN ID	–	0 ... 999	ID for communication with CAN	0
Argus box 1 address	–	0 ... 99999	Argus box 1 address and type setup	0
Argus box 2 address	–	0 ... 99999	Argus box 2 address and type setup	0
Argus box 3 address	–	0 ... 99999	Argus box 3 address and type setup	0
Argus box 4 address	–	0 ... 99999	Argus box 4 address and type setup	0
Argus box 5 address	–	0 ... 99999	Argus box 5 address and type setup	0
Argus box 6 address	–	0 ... 99999	Argus box 6 address and type setup	0
Argus box 7 address	–	0 ... 99999	Argus box 7 address and type setup	0
Argus box 8 address	–	0 ... 99999	Argus box 8 address and type setup	0
Prolog Positive Sequence Enable	–	0 ... 1	Provide positive sequence for grid voltage as proLOG	0
Prolog Expanded Total Yield	–	0 ... 1	Provide expanded total yield to proLOG	0

Table 21: Parameters for the digital interface

8.5.6 Analogue interface parameters

Parameter	Unit	Range	Description	Factory settings
AI1 offset	–	–300 ... +300	Offset value for analogue input 1	0
AI1 gain	–	–300 ... +300	Gain value for analogue input 1	120
AI2 offset	–	–300 ... +300	Offset value for analogue input 2	20
AI2 gain	–	–300 ... +300	Gain value for analogue input 2	10.87
AI3 offset	–	–300 ... +300	Offset value for analogue input 3	50
AI3 gain	–	–300 ... +300	Gain value for analogue input 3	10
AI4 offset	–	–300 ... +300	Offset value for analogue input 4	0
AI4 gain	–	–300 ... +300	Gain value for analogue input 4	6

Table 22: Parameters for the analogue interface

8.5.7 Controller Parameters

Parameter	Unit	Range	Description	Factory settings
VC P gain	–	0 ... 999.99	P gain of PV voltage controller	5
VC I gain	–	0 ... 999.99	I gain PV voltage controller	10
Voltage detection LPF	Hz	0 ... 9999	Grid voltage and inverter voltage filter of dq axis	100
CC P gain	–	0 ... 999.99	P gain of inverter output current controller	Device-specific
CC I gain	–	0 ... 999.99	I gain of inverter output current controller	Device-specific
CC di/dt	p.u.	1 ... 9999	Slope of inverter rated current generation	500
Ramp	ms	0 ... 99999	Slope of PV voltage generation (time for 100 V change)	2500
Li	µH	0 ... 99999	Inductance value of inverter output LC filter	Device-specific
Vdc Reference	V DC	0 ... 999.9	DC voltage reference when it is not in MPPT range	Device-specific
CC Period	µs	100 ... 400	Inverter switching frequency	333
PLL P Gain	–	0 ... 999.99	P Gain if grid voltage PLL	0.05
PLL I Gain	–	0 ... 999.99	I Gain if grid voltage PLL	0.02
Auto Fault Reset Count	times	0 ... 20	Maximum count of auto reset function	7
Heatsink OT Level	°C	50 ... 150	Maximum value of PEBB temperature	85
Power Compensation	-	0 ... 1	Power compensation for MPPT control	0
Test mode	–	0 ... 99999	Value for function test mode	0
Options	–	0 ... 99999	Outside option board setup	0
Deviation Tolerance Time	20 ms	0 ... 25	Level 1 trip time when level 2 protection is disabled	3
Reactive Power Compensation	%	–30 ... 30	Control value for reactive power degree of accuracy	0
Variable MPP Vmin Enb	–	On(1), Off(0)	Setup value for inverter operation rage maximisation	1
T_CLOUD	s	0 ... 3600	Time for declines of PV generation due to cloud	Device-specific
T_CLOUD_CNT	–	0 ... 20	Count for declines of PV generation due to cloud	3
Remote Power Control	%	0 ... 100	Inverter active power which can be controlled from outside device	100
PEBB2 Temperature	°C	0 ... 150	PEBB2 temperature (read only)	
PEBB3 Temperature	°C	0 ... 150	PEBB3 temperature (read only)	–

Parameter	Unit	Range	Description	Factory settings
Unbalanced Current Limit	%	0 ... 100	Unbalanced current level	20
Cabinet FAN PWM	–	0 ... 100	Reserved parameter	100
Remote Power Control Ramp	s	0 ... 600	Slope of inverter output active poser when remote power is controlled	10
Total Yield	kWh	0 ... 99999999	Total yield of generation (read only)	–
Today Yield	kWh	0 ... 99999999	Day yield of generation (read only)	–
IIVCD P Gain	–	0 ... 99999	P gain of inverter output voltage controller D-axis for initial operation voltage	0.2
IIVCQ I Gain	–	0 ... 99999	I gain of inverter output voltage controller Q-axis for initial operation voltage	5
Anti-Islanding Enable	–	0 ... 99999	Usage of anti-islanding controller • 0: no • 1: yes If the anti-islanding function is activated and a grid failure occurs, the inverter automatically disconnects itself from the power grid within a few seconds. If the anti-islanding function is not activated, the inverter generates power to load during grid failure.	0
APS Line Deadband	–	0 ... 99999	Setup value for anti-islanding control	0.11
Reactive Power Limit	–	0 ... 99999	Setup value for anti-islanding control	0.06
Wind Speed	–	0 ... 99999	Reserved parameter	–
Power Derating Enable	–	0 ... 1	Usage of power decline controller according to PEBB temperature • 0: no • 1: yes	0
Power Derating Enable Temperature	–	50 ... 100	Temperature level which starts decreasing power according to PEBB temperature	70
Power Derating Disable Temperature	–	40 ... 90	Temperature level which stops decreasing power according to PEBB temperature	50
Power Derating Reference Temperature	–	45 ... 95	PEBB temperature reference value	60
Power Derating P Gain	–	0 ... 10	P gain of power declining controller according to PEBB temperature	2
Grid IIR Filter Cutoff Frequency	Hz	0 ... 10	Filter cut-off frequency used for RMS value detection of grid voltage	1.5

Parameter	Unit	Range	Description	Factory settings
Asynchronous Fault Count	–	0 ... 100	Reserved parameter	10
Asynchronous Fault Enable	–	0 ... 1	Reserved parameter	0
Grid Positive Sequence	0	999.9	Positive sequence value of grid	0
COSPHI Control Mode	–	0 ... 5	Reactive power supply method in internal mode and RPC mode • 0: disabled • 1: fixed P • 2: fixed cosφ • 3: fixed Q • 4: cosφ(P/Pn) • 5: Q(U)	0
COSPHI Internal Power Factor	–	–0.999 ... 1	Power factor reference in internal mode	1
COSPHI Internal Reactive Power	%	–99.9 ... 99.9	Reactive power reference in internal mode (percent for rated one)	0
COSPHI Actual Power Factor	–	–0.999 ... 1	Actual power factor value that is applied (read only)	1
COSPHI RPC Power Factor	–	–0.999 ... 1	Power factor reference in RPC mode	1
COSPHI RPC Reactive Power	%	–99.9 ... 99.9	Reactive power reference in RPC mode (percent for rated one)	0
COSPHI Stray Ratio	–	0 ... 2	Setup value for COSPHI control	Device-specific
Positive Sequence PLL Enable	–	On(1), Off(0)	Usage of grid voltage of positive sequence at PLL	1
FRT K Factor	–	0 ... 10	Setup constant during FRT control	2
FRT IQ Ramp	ms	0 ... 99999	Time to change the current from 0 A to rated current. This time determines the slope of the active current after grid fault detection.	4000
FRT IQ Ramp Time	ms	0 ... 99999	Total time that the FRT IQ ramp function is activated	2000
FRT Overcurrent Protection Time	ms	0 ... 99999	Time that the inverter is stopped after grid fault clearance	200
Positive Sequence LPF	Hz	0 ... 100	Cut-off frequency for RMS value of positive sequence	100
PLL Freq LPF	Hz	0 ... 100	Cut-off frequency for frequency value detection of PLL	100
Q(V) Control Target Voltage	V	208 ... 440	Value of Q(V) Control Target Voltage	Device-specific
Q(V) Control K Factor	–	0 ... 50	Setup constant for voltage control of BDEW	3.1

Parameter	Unit	Range	Description	Factory settings
Q(V) Control Dead-band	%	0 ... 100	Non-applicable voltage range during voltage control of BDEW	1
Q(V) Control Ramp Time	s	0 ... 99999	Slope of reactive current increase during voltage control of BDEW	60
FRT Asynchronous Level	V	0 ... 100	The inverter recognises asynchronism if the difference between inverter sensing output voltage and RMS value of positive value is less than this parameter value.	10
COSPHI (P/Pn) Ramp Time	s	0 ... 99999	Slope setup value for answering time of PF in cosφ (P/Pn)	10
COSPHI_1	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_1.	1
P_1	%	0 ... 100	Active power setup conference for COSPHI_1	0
COSPHI_2	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_2.	1
P_2	%	0 ... 100	Active power setup conference for COSPHI_2	50
COSPHI_3	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_3.	0.5
P_3	%	0 ... 100	Active power setup conference for COSPHI_3.	20
COSPHI_4	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_4.	1
P_4	%	0 ... 100	Active power setup conference for COSPHI_4.	50
COSPHI_5	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_5.	1
P_5	%	0 ... 100	Active power setup conference for COSPHI_5.	50
COSPHI_6	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_6.	1
P_6	%	0 ... 100	Active power setup conference for COSPHI_6.	50
COSPHI_7	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_7.	1
P_7	%	0 ... 100	Active power setup conference for COSPHI_8	50
COSPHI_8	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_8.	1
P_8	%	0 ... 100	Active power setup conference for COSPHI_8	50

Parameter	Unit	Range	Description	Factory settings
COSPHI_9	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_9.	1
P_9	%	0 ... 100	Active power setup conference for COSPHI_9.	50
COSPHI_10	–	–0.999 ... –0.95 and 0.95 ... 1	Variable power factor reference according to active power P_10.	1
P_10	%	0 ... 100	Active power setup conference for COSPHI_10.	50

Table 23: Controller parameters

8.5.8 Network parameters

Parameter	Unit	Range	Description	Factory settings
Configuration	–	0 ... 10	0: DHCP 1: Static	1
IP	–		IP address (format: xxx.xxx.xxx.xxx)	1
Netmask	–		The subnet mask used for the network (format: 255.255.255.0)	0
Gateway	–		Router address (format: xxx.xxx.xxx.xxx)	1

Table 24: Network parameters

8.5.9 Recording parameters

Parameter	Unit	Range	Description	Factory settings
Recording interval	minute	10 ... 60	Time period for the recording of parameters	10
Grid power	–	ON (1) OFF (0)	If deactivated, the grid power is not recorded.	ON (1)
PV power	–	ON (1) OFF (0)	If deactivated, the PV power is not recorded.	ON (1)
PV voltage	–	ON (1) OFF (0)	If deactivated, the PV voltage is not recorded.	ON (1)
PV current	–	ON (1) OFF (0)	If deactivated, the PV current is not recorded.	ON (1)
PV temperature	–	ON (1) OFF (0)	If deactivated, the PV temperature is not recorded.	ON (1)
Irradiation	–	ON (1) OFF (0)	If deactivated, the irradiation (insolation) is not recorded.	ON (1)
Statistics reset	–	–	All statistical data is reset.	–

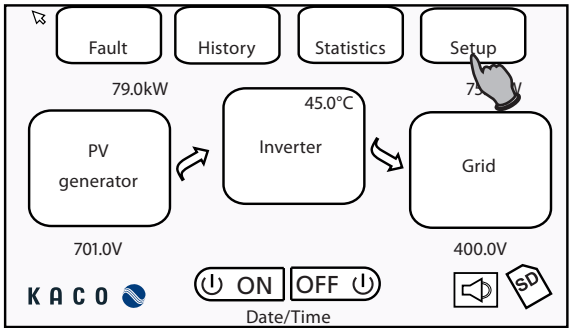
Table 25: Recording parameters

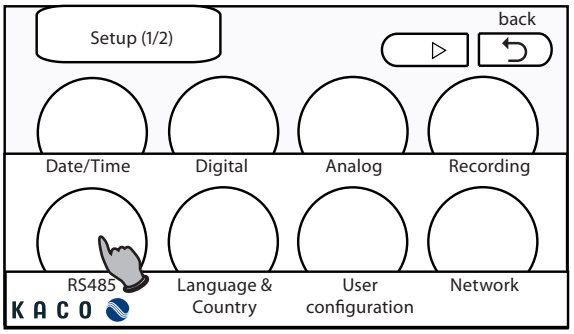
9 Configuration

9.1 Configuring the interfaces

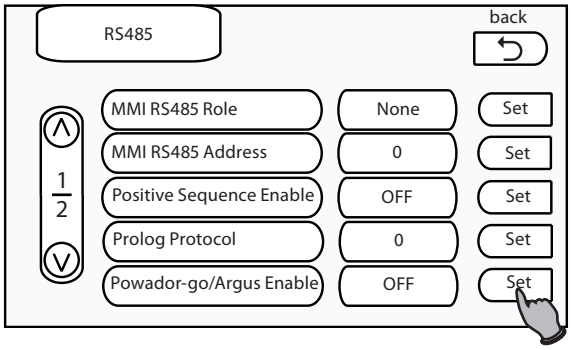
9.1.1 Configuring the RS485-1 interface (Powador Argus)

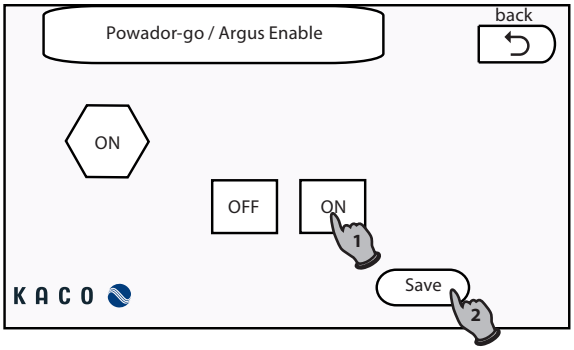
↻ The RS485-1 interface is connected (see section 7.6.2 on page 29).



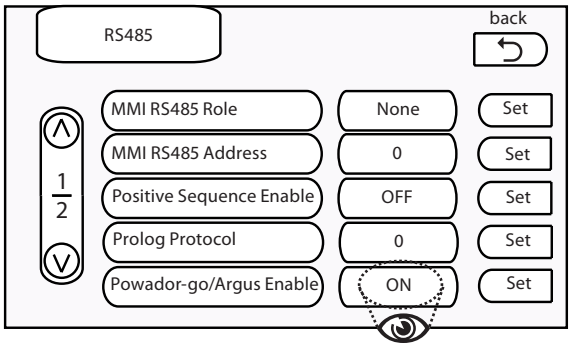


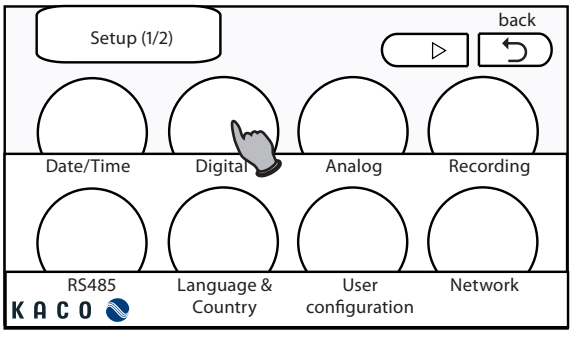
1. On the main screen press the “Setup” button.
2. On the “Setup“ screen press the “RS485“ button.



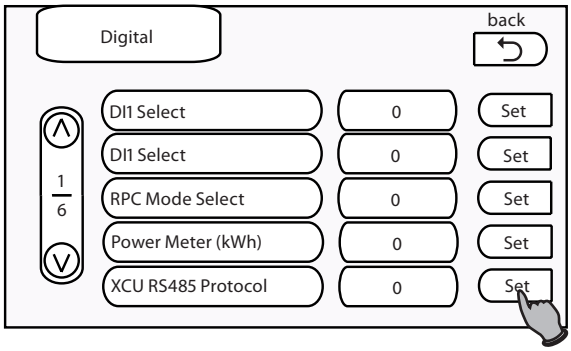


3. On the “RS485“ screen press the “Set“ button for “Powador-go / Argus Enable“.
4. On the “Powador-go / Argus Enable“ screen press the “ON“ button.
5. Press the “Save“ button.



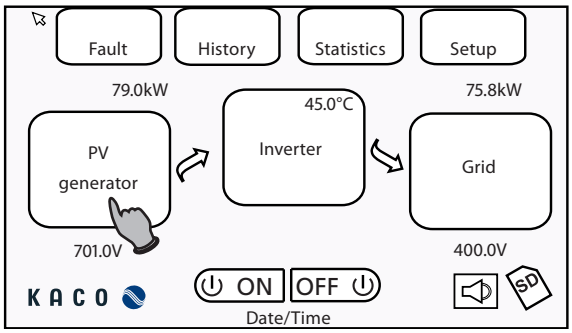


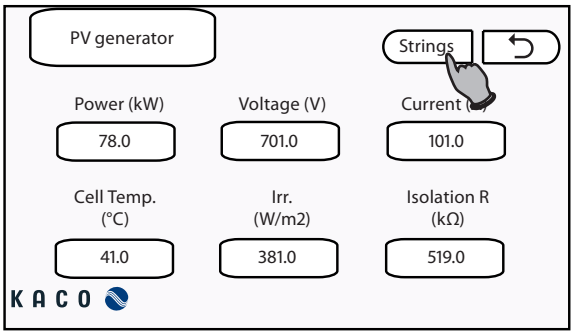
6. On the “RS485“ screen check if the “Powador-go / Argus Enable” status was changed from “OFF” to “ON”.
7. On the “Setup“ screen press the “Digital” button.



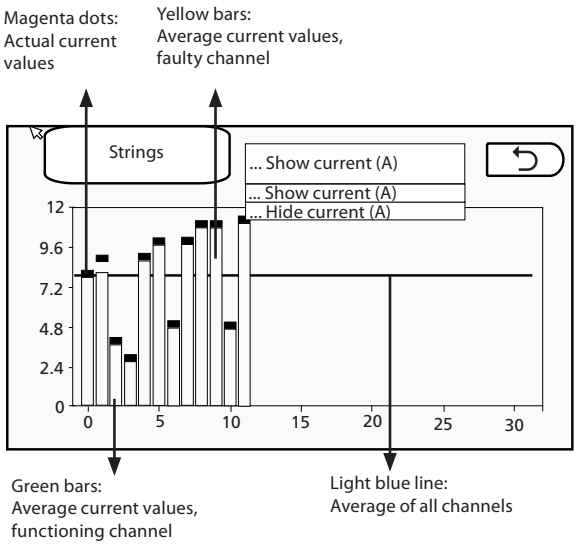
8. On the “Digital” screens change the following parameters (see section 8.4.8 on page 46):
   - “Digital (1/6)” screen: For “XCU RS485 Protocol” input value 3.
   - “Digital (2/6)” screen: For each “Argus Box X Address” input a value between 0 and 99.
   - “Digital (2/6)” screen: For each “Argus Box X Type” input 16 or 24.

Checking the configuration



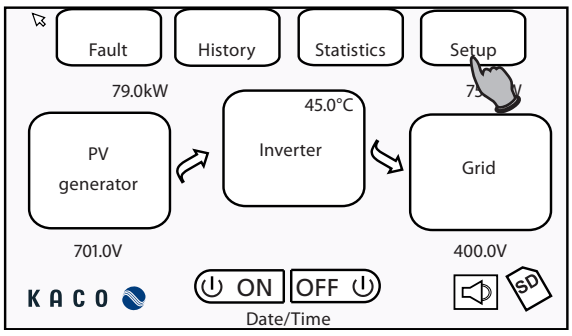


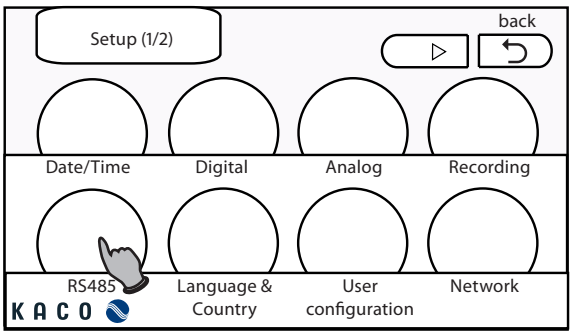
1. On the main screen press the “PV generator” button.
2. Wait 20 seconds.
3. On the “PV generator“ screen press the “Strings“ button.



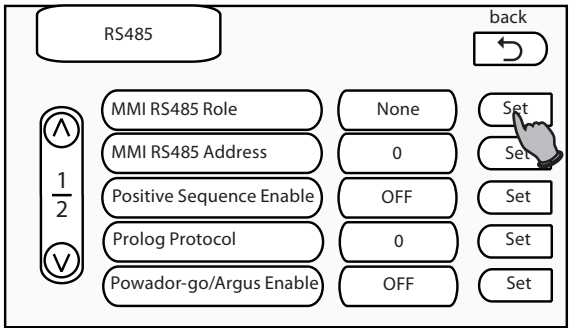
4. Check the display on the “Strings” screen.

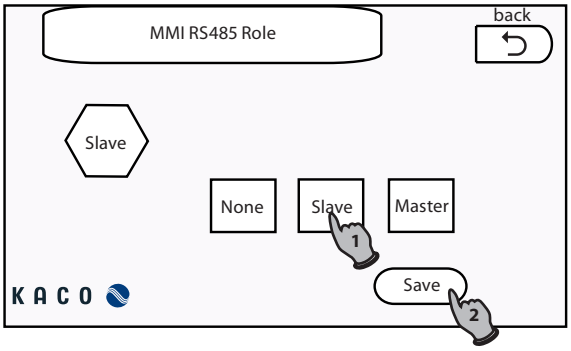
9.1.2 Configuring the RS485-2 interface (Powador-proLOG)



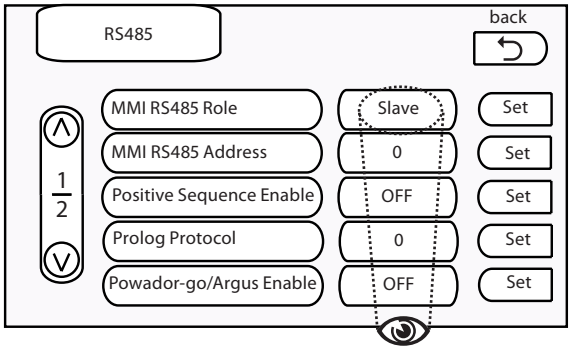


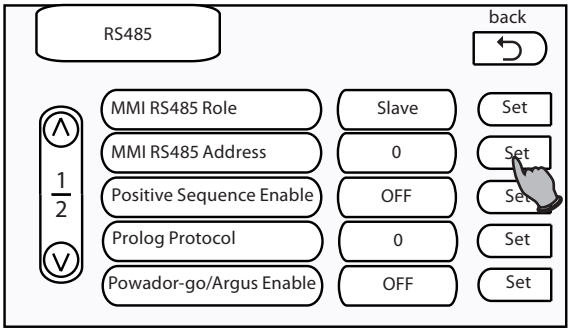
5. On the main screen press the “Setup” button.
6. On the “Setup“ screen press the “RS485“ button.





7. On the “RS485“ screen press the “Set“ button for “MMI RS485 Role“.
8. On the “MMI RS485 Role“ screen press the “Slave“ button.
9. Press the “Save“ button.





10. On the “RS485“ screen check if the “MMI RS485 Role” status was changed to “Slave”.
11. Press the “Set“ button for “MMI RS485 Address“ and input 0 or a value between 2 and 99.

NOTE

Do not set 1 for “MMI RS485 Address” because the role of ProLOG is Master.

12. Press the “Set“ button for “Prolog Protocol“ and input a value between 0 and 2:

Prolog Protocol mode	Role	Country
0	Prolog Protocol (original)	EU
1	Prolog Protocol + extended total yield	KR
2	Prolog Protocol + extended total yield + today yield (Wh → kWh)	KR

Table 26: Prolog Protocol mode

13. Press the “Save” button.

Checking the configuration

☞ Refer to the Powador-proLOG manual.

9.1.3 Settings for RS485 interfaces

ID	Name	Unit	Default value	Min.	Max.
0	Activate Powador-proLOG		OFF	OFF	ON
1	MMI address		0	0	31
2	Change Powador-go address		–	–	–
3	Activate Powador-go		OFF	OFF	ON
4	Diff. tolerance	%	10	10	100
5	Fault trigger time	minutes	120	10	240
6	Address 0 string number		0	0	4
7	Address 1 string number		0	0	4
8	Address 2 string number		0	0	4
..	..		0	0	4
..	..		0	0	4
36	Address 30 string number		0	0	4
37	Address 31 string number		0	0	4

Table 27: RS485 interface settings

9.1.4 Configuring the analogue input

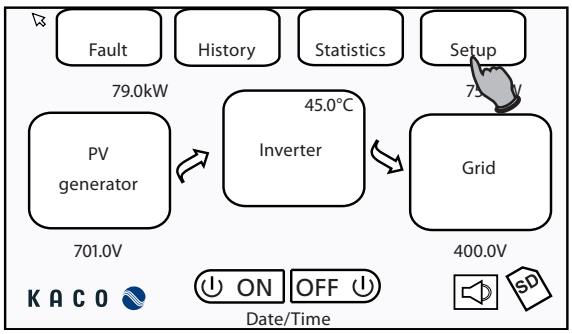
In order to determine measured values using the analogue sensors, you have to set the “Options” parameter. The options are calculated and set by a service technician from KACO new energy GmbH.

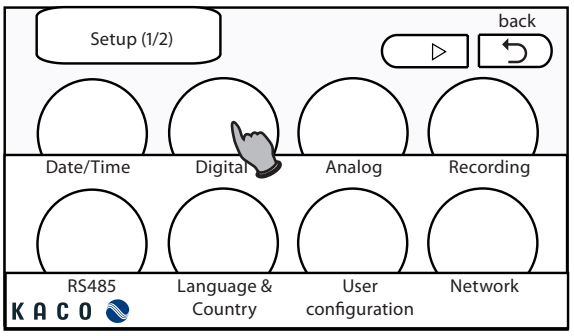
CAUTION

Be careful not to destroy the sensor's measuring input!

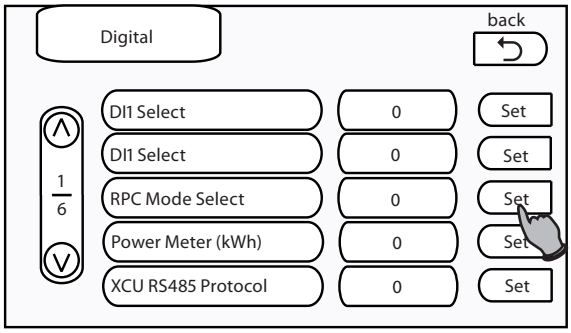
Avoid using voltages > 10 V and make sure that the polarity is correct.

9.1.5 Configuring the remote power control





1. On the main screen press the “Setup” button.
2. On the “Setup“ screen press the “Digital“ button.



3. On the “Digital” screen press the “Set” button for “RPC Mode Select” and input a value between 0 and 2 (see section 8.4.8 on page 46):
   - 0: None
   - 1: Master
   - 2: Slave

9.2 Medium voltage guideline

DE MSp.

Country-specific functions

The functions and paramaters described in this section are set to comply with the BDEW Medium Voltage Directive (“Mittelspannungsrichtlinie”). They are activated for inverters that are operated with “Germany” as the country setting and “Medium Voltage Directive” as the grid type.

If the “Medium Voltage Directive” is selected as the grid type the MMI displays a warning message when the user attempts to change the default settings used to comply with the BDEW Medium Voltage Directive.

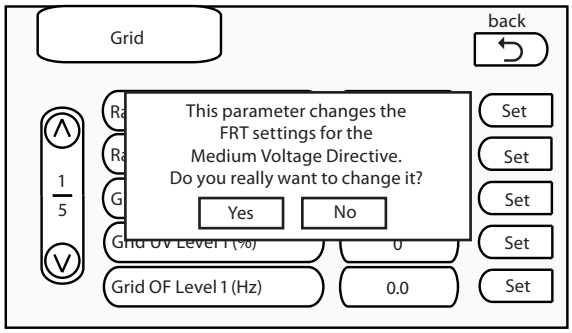


Figure 65: Message warning against violation of the Medium Voltage Directive (example)

9.2.1 Configuring the cosphi control

Cosphi control

The cosphi control function is for controlling active and reactive power which is infused from the inverter to the grid with Powador-proLOG, MMI, and XCU at long distance.

Communication between components

Cosphi control enables remote control of reactive and active power by setting the reference of reactive and active power.

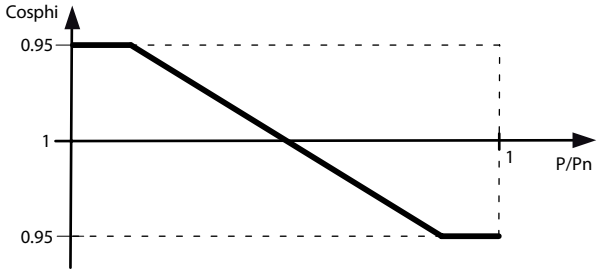
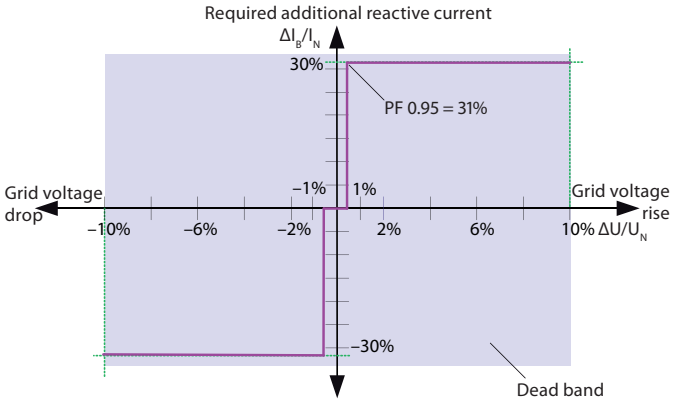
Communication between cosphi components:

- User activates cosphi control by Powador-proLOG.
- Powador-proLOG sends a cosphi control massage at two-minute intervals.
- MMI interprets the cosphi control message from Powador-proLOG to modify parameters of XCU.
- XCU operates according to the modified parameter by MMI.
- Cosphi (limited to Fixed cosphi and Fixed Q) has two overlapping parameters for RPC and internal modes. MMI modifies the parameter for RPC mode only. If the relative RPC mode parameter remains longer than five minutes unmodified, XCU will operate according to the parameter for internal mode.

Cosphi control ways

Cosphi control operates with five reactive and active power control ways according to COSPHI Control Mode parameter setting.

Power control	Description	Relative parameters
Fixed P	Control the maximum active power with Remote Power Control parameter value (% of max. rated power).	• Remote Power Control

Power control	Description	Relative parameters
Fixed cosphi	Control the maximum active power with Remote Power Control parameter value (% of max. rated power). Control power factor with parameter value of COSPHI Internal Power Factor or COSPHI RPC Power Factor according to present RPC status.	• Remote Power Control • COSPHI Internal Power Factor • COSPHI RPC Power Factor
Fixed Q	Control the maximum active power with Remote Power Control parameter value (% of max. rated power). Control reactive power with parameter value of COSPHI Internal Reactive Power or COSPHI RPC Reactive Power according to the present RPC status.	• Remote Power Control • COSPHI Internal Reactive Power • COSPHI RPC Reactive Power
Cosphi(P/Pn)	Control power factor to match the graph of maximum 10 continuous COSPHI_n and P_n pairs. The cosphi (P/Pn) function allows the inverter to send a changeable PF (power factor) according to the active power to grid. The maximum setup point of both PF and active power is 10 points. 	• COSPHI_n • P_n (n = 1 ... 10) • COSPHI (P/Pn) • Ramp Time
Q(V)	Control reactive power infusion from inverter to grid when grid voltage is between rated range. The grid voltage range where Q(V) function is possible is determined by Q(V) Control Deadband and Q(V) Control K Factor.  The Q(V) control function is used to feed reactive power, even if the grid is in normal range (90 ... 110%). Q(V) Control K Factor = ΔQ/ΔU • ΔQ = cosφ = 0.95 • φ = 18.2° • sinφ = 0.31 Example: To feed ΔQ in U_N±10% range and U_{Target} = 400 V, the K value would be 0.31/0.1=3.1.	• Q(V) Control Deadband • Q(V) Control K Factor • Q(V) Control Ramp Time

Transition between RPC mode and internal mode

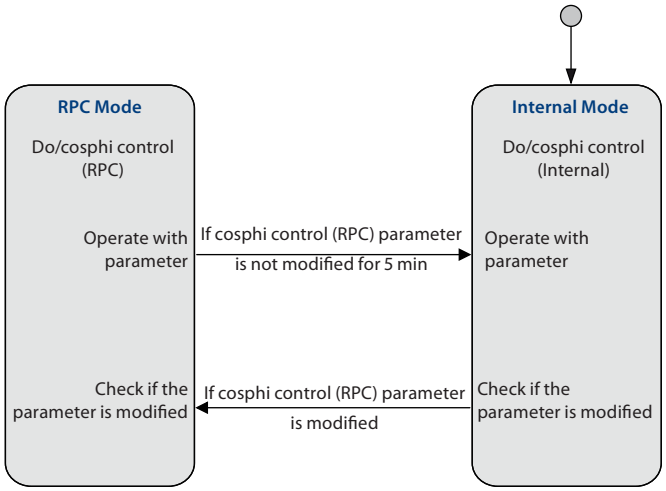


Figure 66: Transition between RPC Mode and Internal Mode

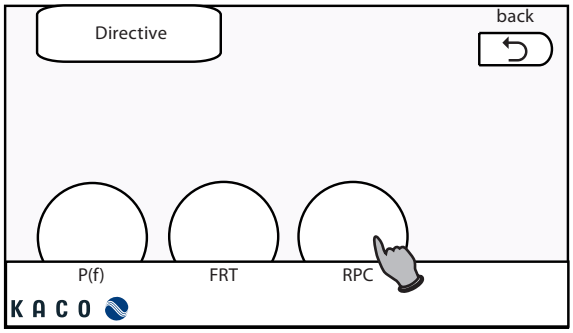
RPC mode

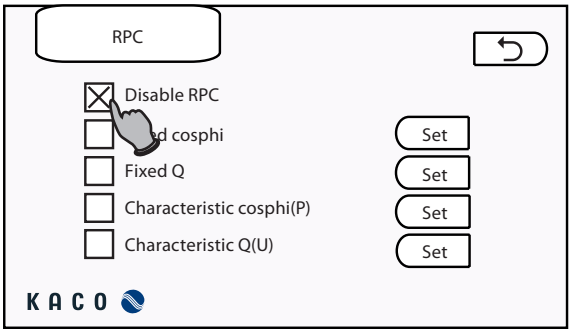
While MMI is modifying the parameters Remote Power Control, COSPHI RPC Reactive Power and COSPHI RPC Power Factor at two-minute intervals, cosphi control operates in RPC mode. In RPC mode, it operates according to the parameters Remote Power Control, COSPHI RPC Reactive Power and COSPHI RPC Power Factor.

Internal mode

If the RPC mode parameters such as Remote Power Control, COSPHI RPC Reactive Power and COSPHI RPC Power Factor are not modified within five minutes, XCU will operate in internal mode. In Internal mode, cosphi control operates according to the internal mode parameters COSPHI Internal Reactive Power and COSPHI Internal Power Factor. The parameter Remote Power Control does not influence the active power.

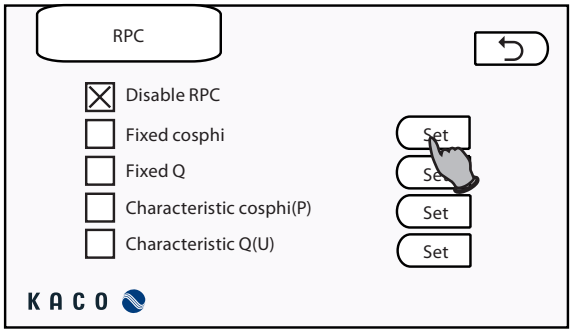
Disabling RPC

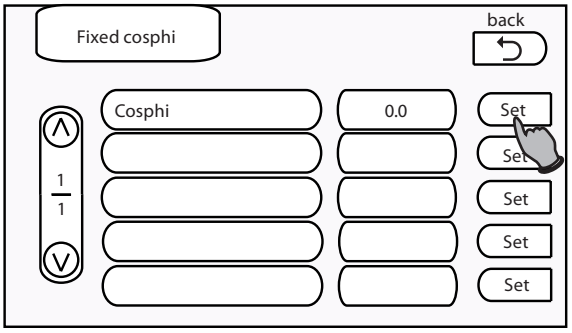




1. On the “Directive” screen press the “RPC” button.
2. On the “RPC” screen press the check box for “Disable RPC”:

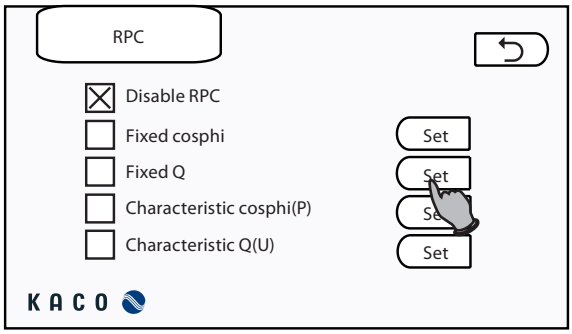
Configuring Fixed cosphi

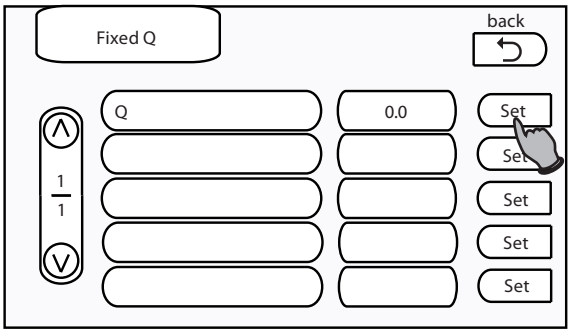




1. On the “RPC” screen press the “Set” button for “Fixed cosphi”.
2. On the “Fixed cosphi” screen press the “Set” button for “Cosphi” and input a value between -0.8 and 1.

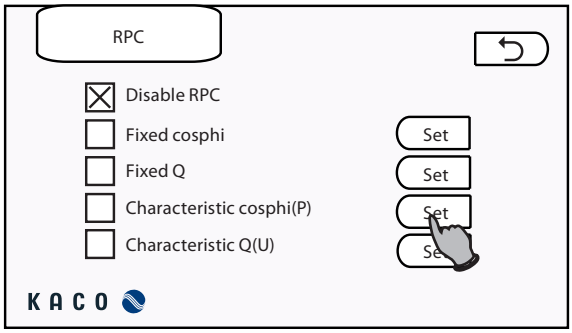
Configuring Fixed Q

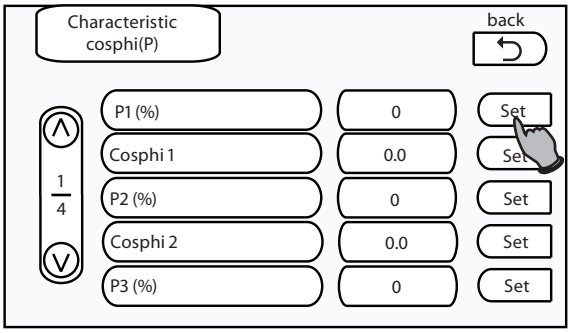




1. On the “RPC” screen press the “Set” button for “Fixed Q”.
2. On the “Fixed Q” screen press the “Set” button for “Q” and input a value between -99.9 and 99.9.

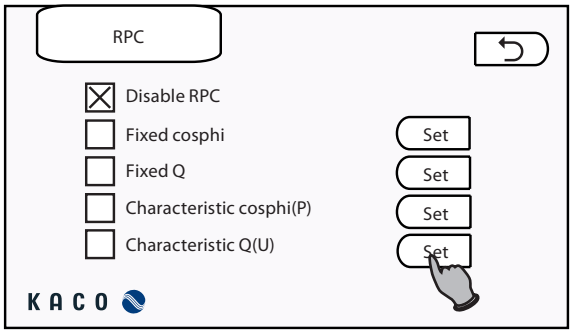
Configuring cosphi (P/Pn)

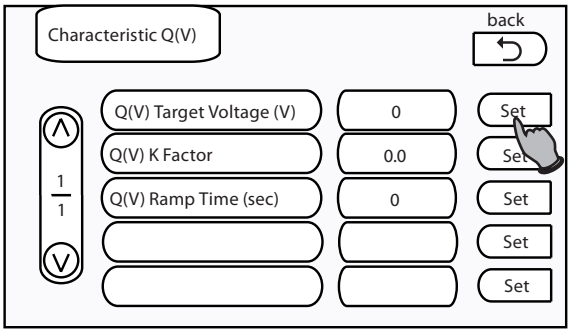




1. On the “RPC” screen press the “Set” button for “Characteristic cosphi(P)”.
2. On the “Characteristic cosphi(P)” screens change the following parameters (see section 8.4.8 on page 46):
   - For “PX (%)” (X = 1) input a value between 0 and 100.
   - For “Cosphi X” (X = 4) input a value between –0.999 and –0.95 or between 0.95 and 1.

Configuring Q(V)





1. On the “RPC” screen press the “Set” button for “Characteristic Q(V).
2. On the “Characteristic Q(V)” screen change the following parameters (see section 8.4.8 on page 46):
   - For “Q(V) Target Voltage” input a value between 208 and 440.
   - For “Q(V) K Factor” input a value between 0 and 50.
   - For “Q(V) Ramp Time (sec)” input a value between 0 and 99999.

9.3 Temperature dependent power derating

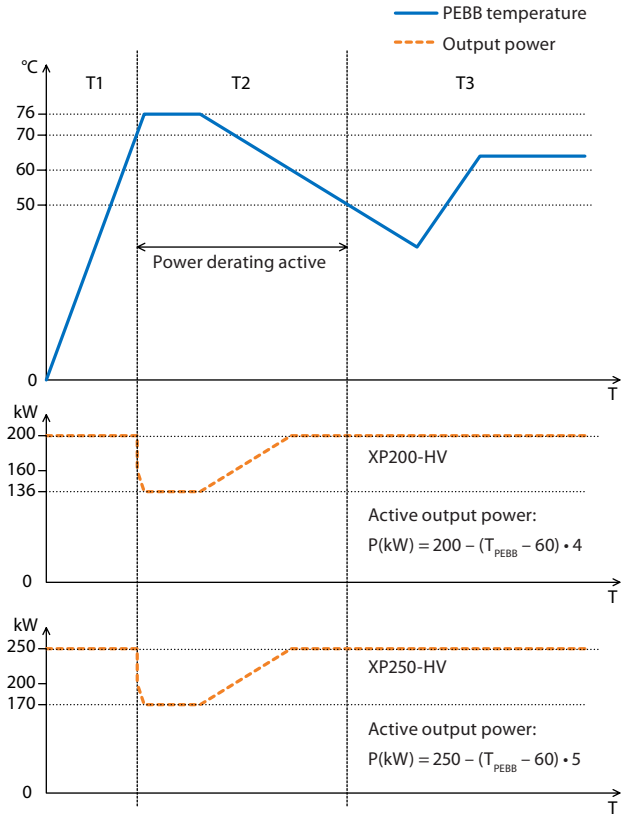


Figure 67: Power derating examples

The diagrams show examples for power derating.
The depicted temperature ranges have the following meaning:

T1: The inverter produces energy and the PEBB temperature rises.

T2: When the PEBB temperature is higher than 70%, the power derating is activated.
The inverter controls the output power according to the equations given in the diagrams until the power derating is deactivated.

T3: The output power decreases and the PEBB temperature drops.
When the PEBB temperature is lower than 50%, the power derating is deactivated.
The inverter does not decrease the output power.

9.4 Configuring the e-mail server

The e-mail server is used to transmit general data (PV power, grid power, PV voltage, PV current, PV temperature) periodically to the Powador Web or to other e-mail addresses configured by the user.

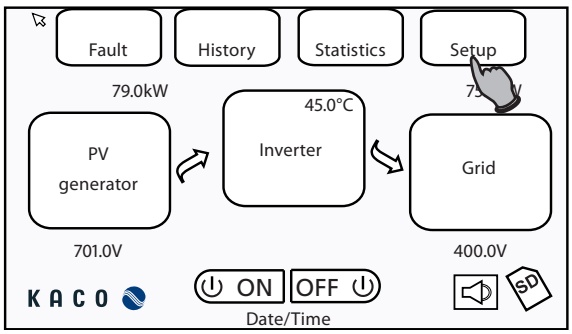
E-mail server parameters

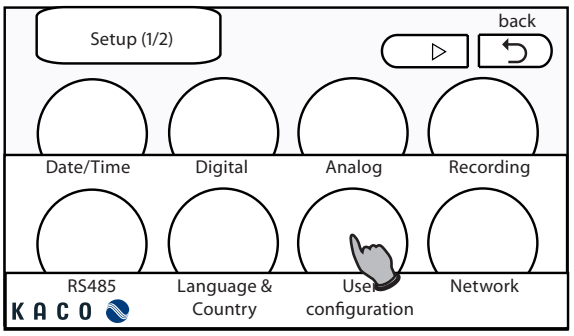
The following parameters have to be set for configuration (✓):

Parameter	Description	Powador Web	Individual Server
Enable	Enable/disable e-mail function	✓	✓
Interval	Set the transmission interval	✓	✓
SMTP IP Address	Address of the e-mail server	–	✓
SMTP Username	E-mail account at the e-mail server	–	✓
SMTP Password	Password for the e-mail account	–	✓
Plant Name	Optional name for the inverter	✓	✓
Serial Number	Specific serial number for the inverter	✓	✓
Sender Address	Sender e-mail address	–	✓
Receiver Address	Receiver e-mail address	–	✓

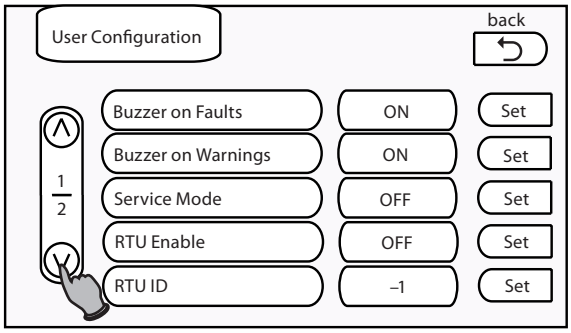
Table 28: E-mail server parameters

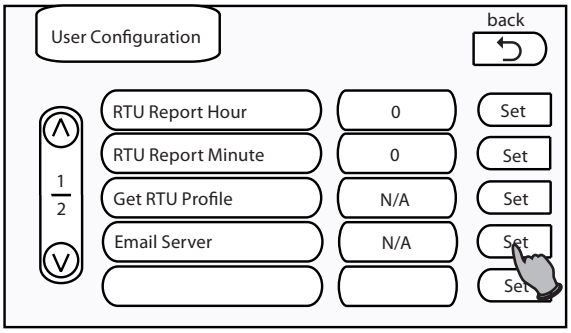
9.4.1 Configuring the Powador Web



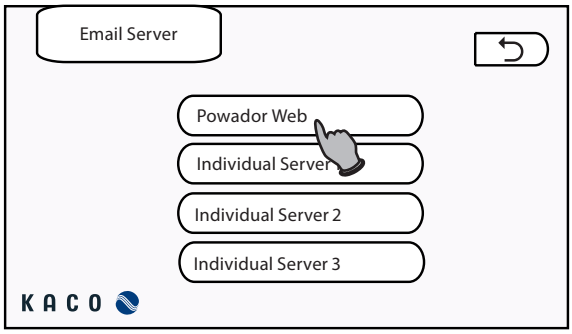


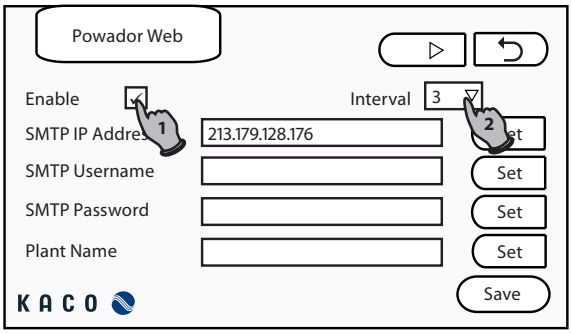
1. On the main screen press the “Setup” button.
2. On the “Setup“ screen press the “User Configuration“ button.



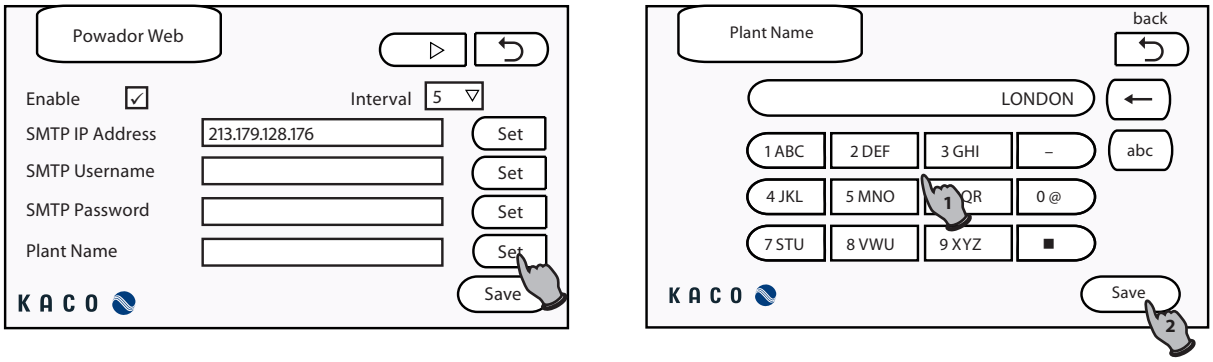


3. On the “User Configuration“ screen press the down arrow to select the second page.
4. Press the “Set“ button for “Email Server“.



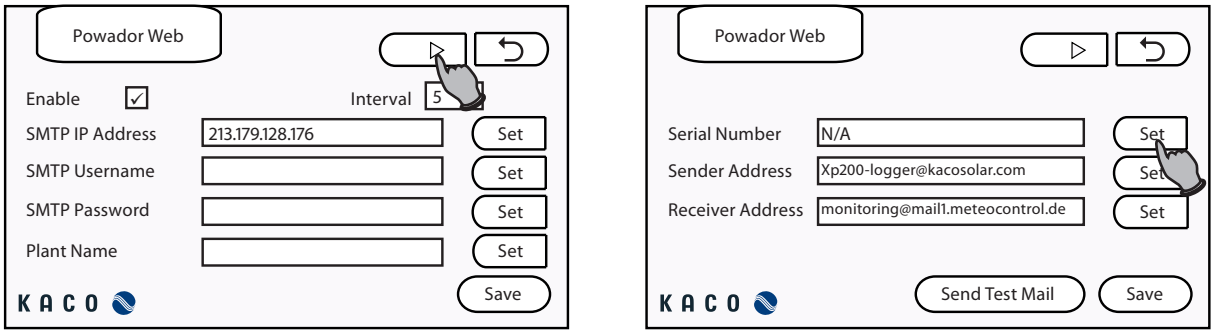


5. On the “Email Server“ screen press the “Powador Web” button.
6. On the “Powador Web” screen press the “Enable“ check box.
7. Press the “Interval” drop-down combo box and select the transmission interval (example: 5).

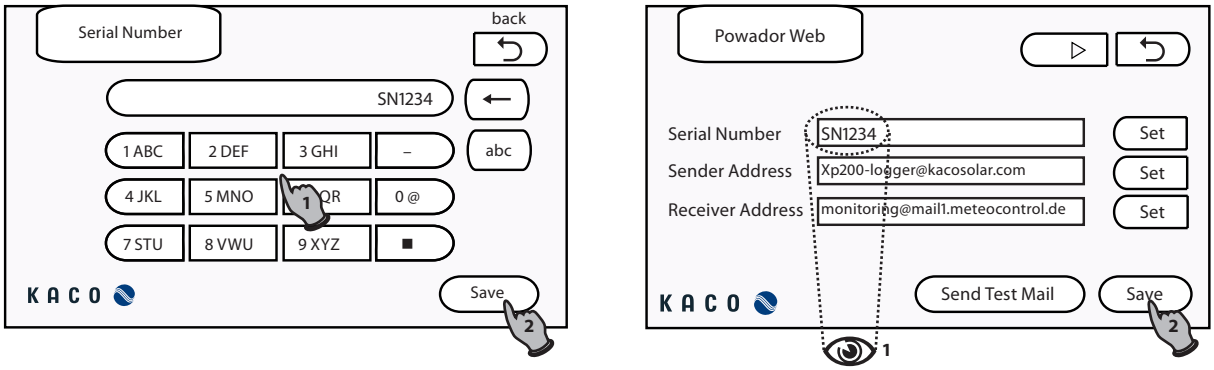


☞ If you do not want to set a name for the inverter, continue with step 11.

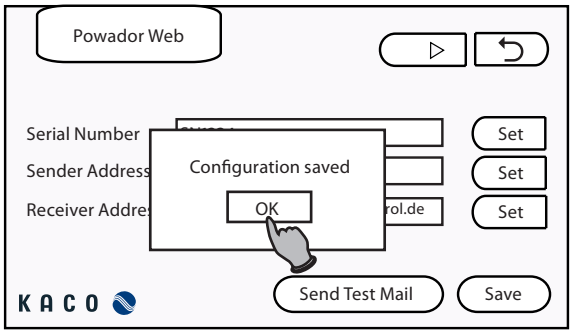
8. Press the “Set” button for “Plant Name”.
9. On the “Plant Name“ screen input the name for the inverter (example: LONDON).
10. Press the “Save” button.



11. Press the switching button to open the next page of the “Powador Web” screen.
12. Press the “Set” button for “Serial Number”.

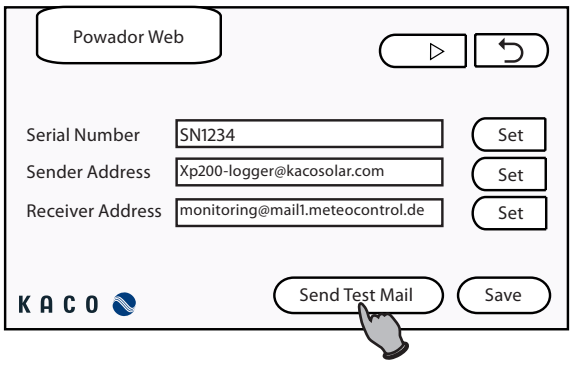


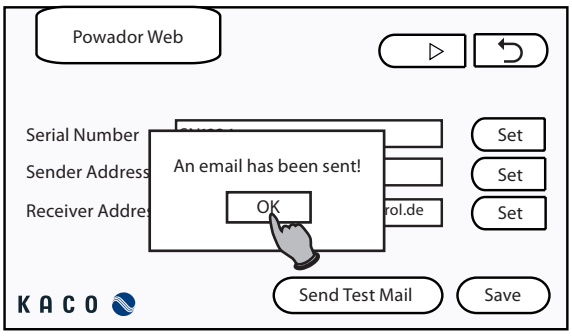
13. On the “Serial Number“ screen input the serial number of the inverter (example: SN1234).
14. Press the “Save” button.
15. On the “Powador Web“ screen check if “Serial Number” was changed to the set value.
16. Press the “Save” button.



17. Acknowledge the “Configuration saved” message by pressing the “OK“ button.

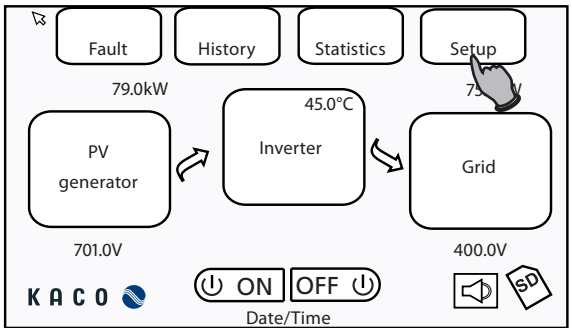
Checking the configuration

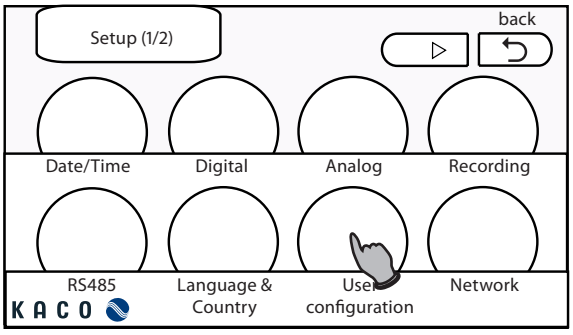




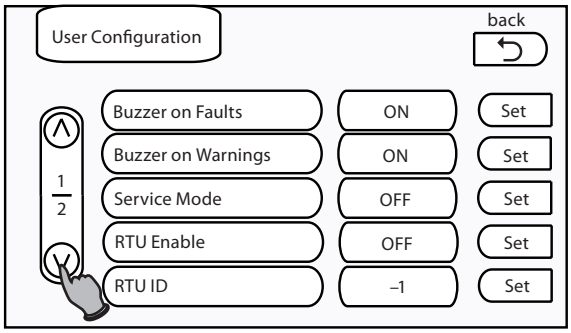
18. Press the “Send Test Mail“ button.
19. Acknowledge the “An email has been sent!” message by pressing the “OK“ button.

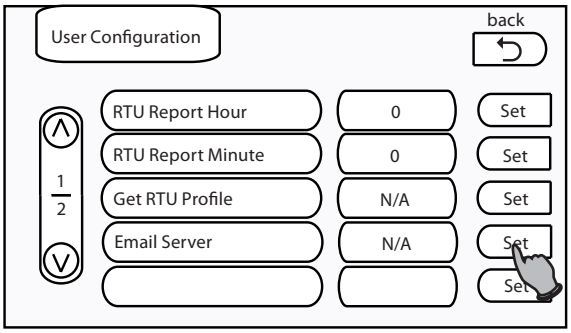
9.4.2 Configuring the individual e-mail server



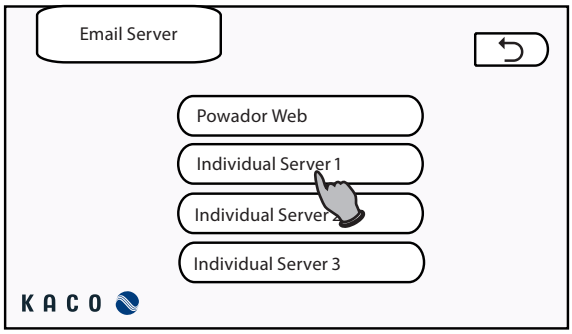


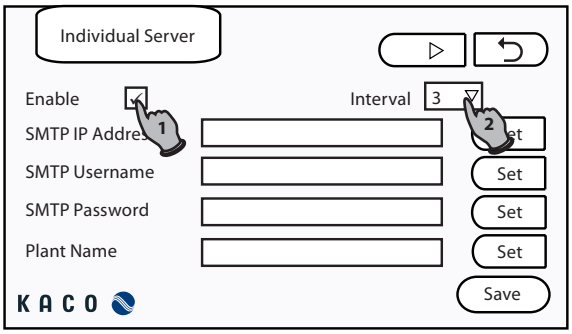
1. On the main screen press the “Setup” button.
2. On the “Setup“ screen press the “User Configuration“ button.



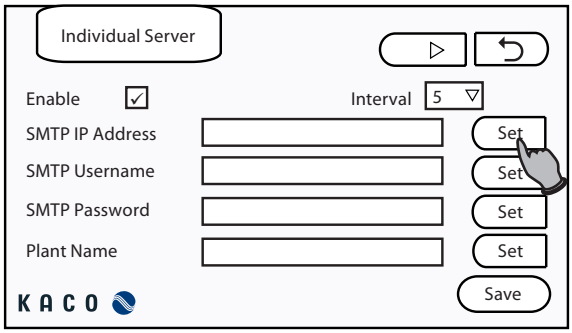


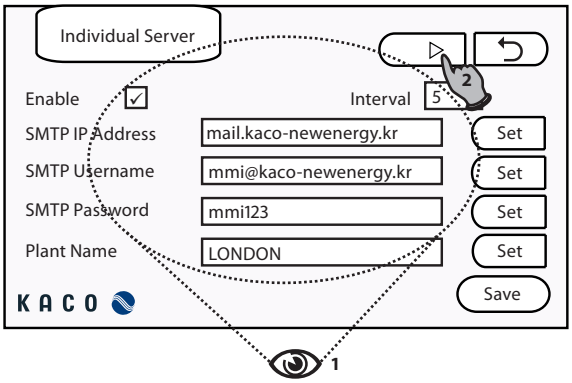
3. On the “User Configuration“ screen press the down arrow to select the second page.
4. Press the “Set“ button for “Email Server“.



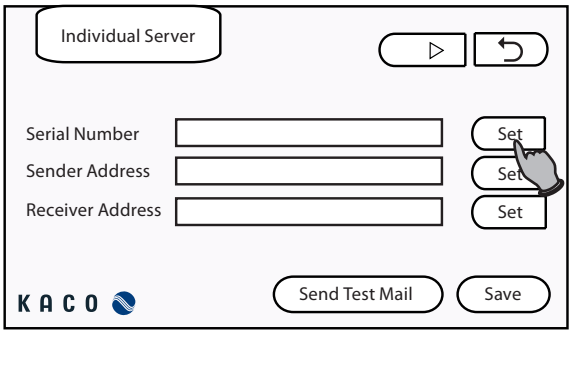


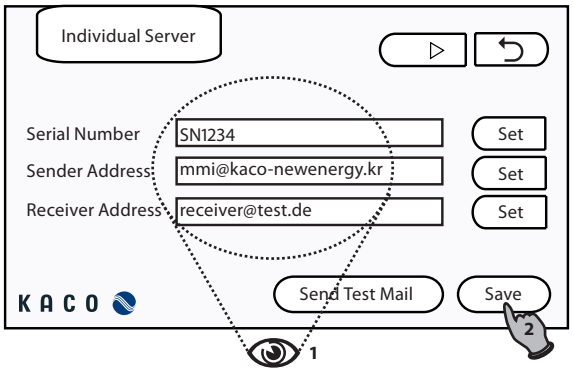
5. On the “Email Server“ screen press one of the “Individual Server X” buttons.
6. On the “Individual Server” screen press the “Enable“ check box.
7. Press the “Interval” drop-down combo box and select the transmission interval (example: 5).



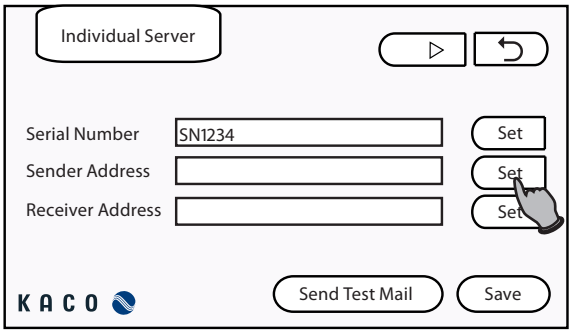


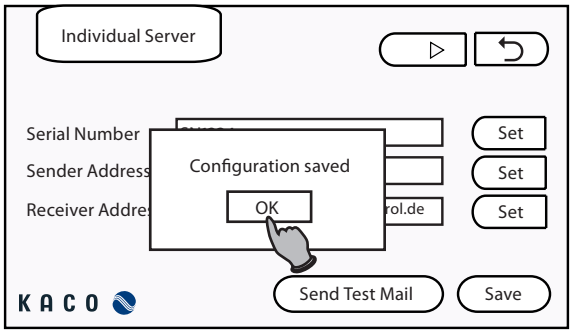
8. On the “Individual Server” screen change the following parameters (see section 8.4.8 on page 46):
   - For “SMTP IP Address” input the address of the e-mail server.
   - For “SMTP Username“ input the SMTP username .
   - For “SMTP Password“ input the password for the SMTP user.
   - If you want to set a name for the inverter: For “Plant Name“ input the name for the inverter.
9. Check if the parameters were changed to the set values.
10. Press the switching button to open the next page of the “Individual Server” screen.





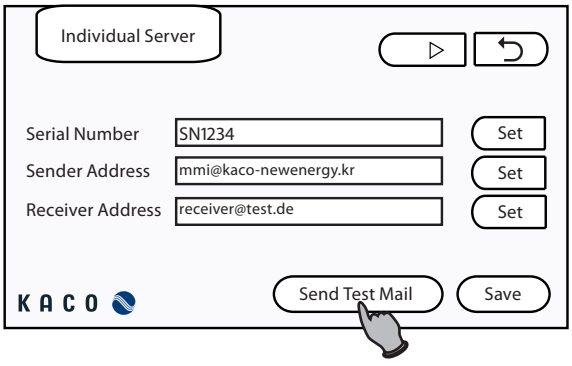
11. Change the following parameters (see section 8.4.8 on page 46):
    - For “Serial Number” input the serial number of the inverter.
    - For “Sender Address“ input the sender address.
    - For “Receiver Address“ input the receiver address.
12. Check if the parameters were changed to the set values.

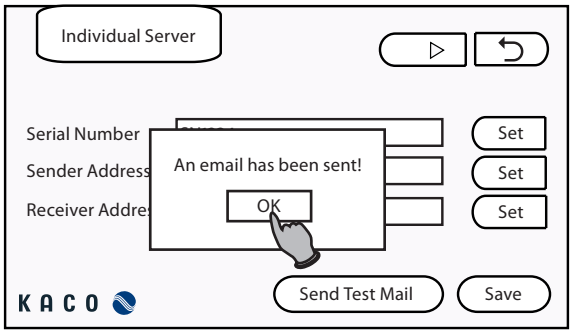




13. On the “Individual Server“ screen press the “Save” button.
14. Acknowledge the “Configuration saved” message by pressing the “OK“ button.

Checking the configuration





15. Press the “Send Test Mail“ button.
16. Acknowledge the “An email has been sent!” message by pressing the “OK“ button.

10 Operation

10.1 Starting up the inverter

Starting up the inverter

↻ The inverter was prepared for start-up (see section 7.7 on page 34).

☞ Use the MMI screen (see section 8 on page 38) to start up the inverter.

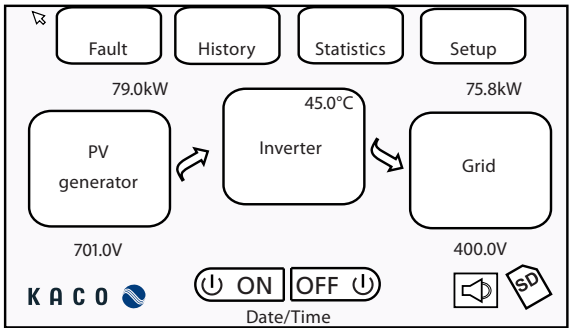


Figure 68: Main screen

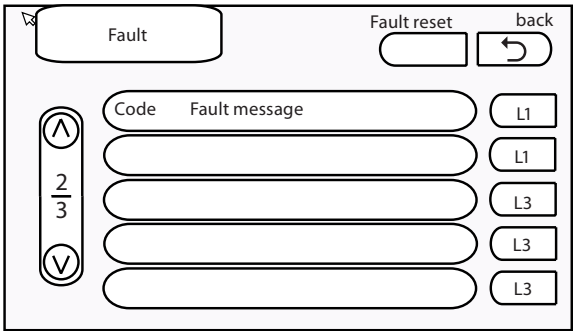


Figure 69: "Fault" screen

Display	Check	Action
Error message on the MMI screen	NO	☞ On the main screen select the "ON" button.
	YES	1. On the main screen press the "Fault" button (see section 12 on page 83). 2. On the "Fault" screen reset the fault using "Fault reset" (see section 8.4.5 on page 44). 3. Press the "back" button. 4. On the main screen press the "ON" button. » The inverter begins operation in a specified sequence (see section 10.2 on page 77).

NOTE

If the fault cannot be reset using "Fault reset", contact our service department.

10.2 Operating states

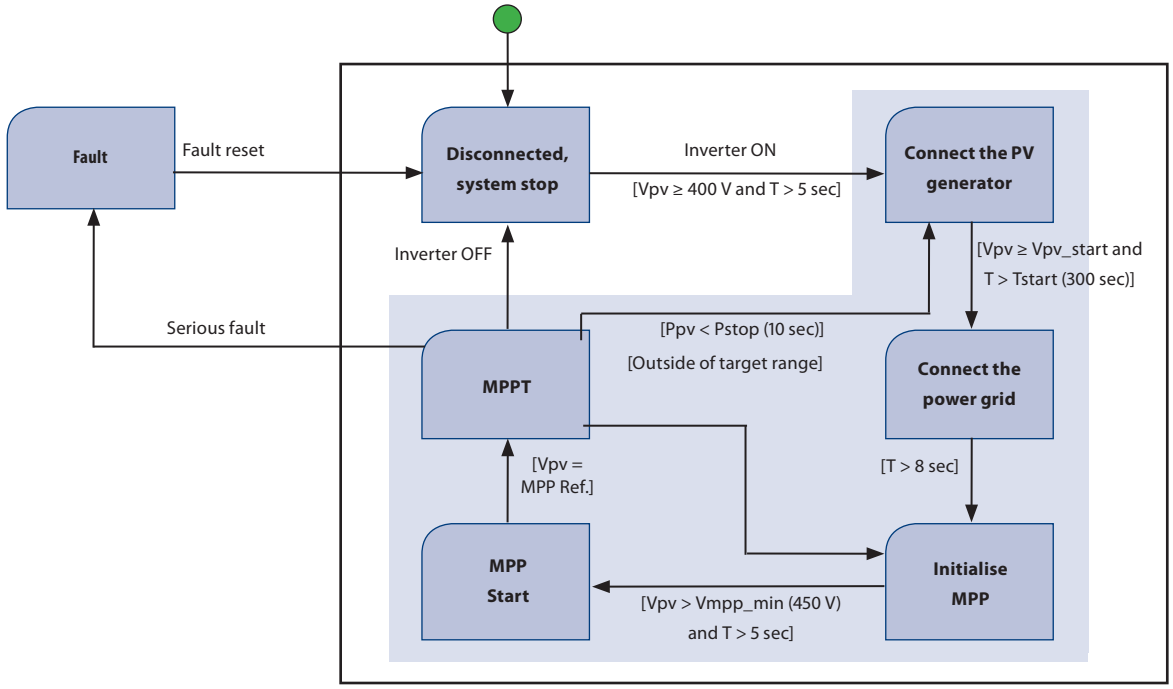


Figure 70: Overview of operating states

Key

MPPT	Maximum Power Point Tracker	Tstart	Minimum time for which Vpv must be greater than Vpv_start
Vpv	Voltage in the PV generator	MPP ref.	PV voltage reference
VMPP min	Minimum voltage of the MPP	Ppv	PV power
Vpv_start	Starting voltage in the PV generator	Pstop	Power level at which the feed-in is interrupted

Operating State	Requirements/Actions	Result
Disconnected	State prior to start-up	The inverter is disconnected from the PV generator. The inverter is disconnected from the grid.
Connect the PV generator	The system is in “disconnected” mode. PV voltage [Vpv] for 5 seconds > 400 V. ☞ Press the “ON” button on the MMI screen.	PV generator side: circuit breaker ON (PV_CB ON)
	PV voltage < 200 V	The inverter switches to “Disconnected” mode
Connect the power grid	The inverter is in “Connected with PV generator” mode. The PV voltage exceeds the value of parameter “MPPT V start” (specified period in parameter “MPPT T start”)	Power grid side: MC switch ON (Grid_MC ON) (holding time of 8 seconds)
Initialise MPP	The inverter calculates the MPP starting voltage Vpv_start (product of the measured values and the value of parameter “MPP factor”).	The system switches to “MPP start” mode (after 5 seconds).
MPP start	The inverter adjusts the PV voltage.	The PV voltage reference (parameter “MPP ref.”) from the no-load voltage is set to the value of parameter “MPPT V start”.
MPPT	The PV voltage approaches the MPP starting voltage (the value of parameter “MPPT V start”).	MPPT starts. The inverter automatically follows the MPP target value. This value varies depending on the radiant intensity of the sunlight.
	The MPP target value is not within the target range.	The system switches to the “Initialise MPP” mode, and then it recalculates the MPPT starting voltage.
System stop	☞ Press the “OFF” button .	PV generator side: circuit breaker OFF Power grid side: MC switch OFF System stop
	The output power of the inverter is below parameter “MPPT P stop” (length of time of parameter “MPPT T stop” is preset).	The connection to the power grid is disconnected. System stop
	PV voltage < 200 V	System stop
Fault	Fault during operation.	System stop The system attempts to reset and correct the fault.
	After successfully correcting the fault.	System start
	Three attempts to reset a fault automatically within 30 minutes .	No system start

Table 29: Operating states

11 Maintenance/Cleaning

Maintenance must be performed on the inverter at regular intervals (Table 30 shows the maintenance schedule).



DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator may open, install and maintain the inverter.

› Keep all doors and covers closed when the unit is in operation.

› Do not touch the lines and terminals when switching the unit on and off.

Switching off the inverter

1. Switch the main ON/OFF switch to OFF (stop the inverter).
2. Switch the power grid switch to OFF (disconnect the inverter from the grid).
3. Switch the DC disconnector to OFF (disconnect the inverter from the PV generator).
4. Make sure that the inverter is disconnected from all voltage sources.
5. Attach locking devices to the circuit breaker of the power grid connection and to the AC and DC disconnectors.
6. Wait at least six minutes before working on the inverter.

Restarting the inverter after maintenance

1. Remove the locking devices.
2. Switch the power grid switch to ON.
3. Switch the AC disconnector to ON.
4. Switch the DC disconnector to ON.
5. Start up the inverter (see section 10.1 on page 76).

11.1 Maintenance intervals



DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator may open, install and maintain the inverter.

› Do not touch the lines and terminals when switching the unit on and off. Do not touch exposed contact connections.

› Always shut down the inverter prior to cleaning or maintenance (see section 11 on page 79).



NOTE

Even between maintenance intervals, pay attention to any unusual behaviour that the inverter displays during operation and fix the problem immediately.

Recommended maintenance intervals	Maintenance work	
6 months*	Cleaning or replacement	Filter mats in the air intake filters
	Cleaning	Inside of the cabinet Fans
6 months	Function check	Emergency stop (OFF)
12 months*	Cleaning	Power section of the heat sink
12 months	Visual inspection	Contact connections Fuses Switches Overvoltage protection Redundant auxiliary power supplies Check all parts in the cabinet for – Heavy dust deposits and soiling – Moisture (especially water that has permeated from the outside)
	Visual inspection (and replacement, if necessary)	All warning labels
	Function check	Fans Door contacts Operating lights and fault lights
*If heavy soiling is present at the installation location, you may need to shorten the maintenance interval.		

Table 30: Maintenance intervals

11.2 Cleaning and replacing the fans

The inverter is equipped with seven fans. All of them are located at the top of the cabinets. Six of the fans are installed in the left cabinet to provide ventilation for the power electronics building block. The fan in the right cabinet is used to ventilate the cabinet. The fans must be cleaned on a regular basis to ensure maximum performance. If there are any problems with the fans, repair or replace them.

11.2.1 Accessing the fans

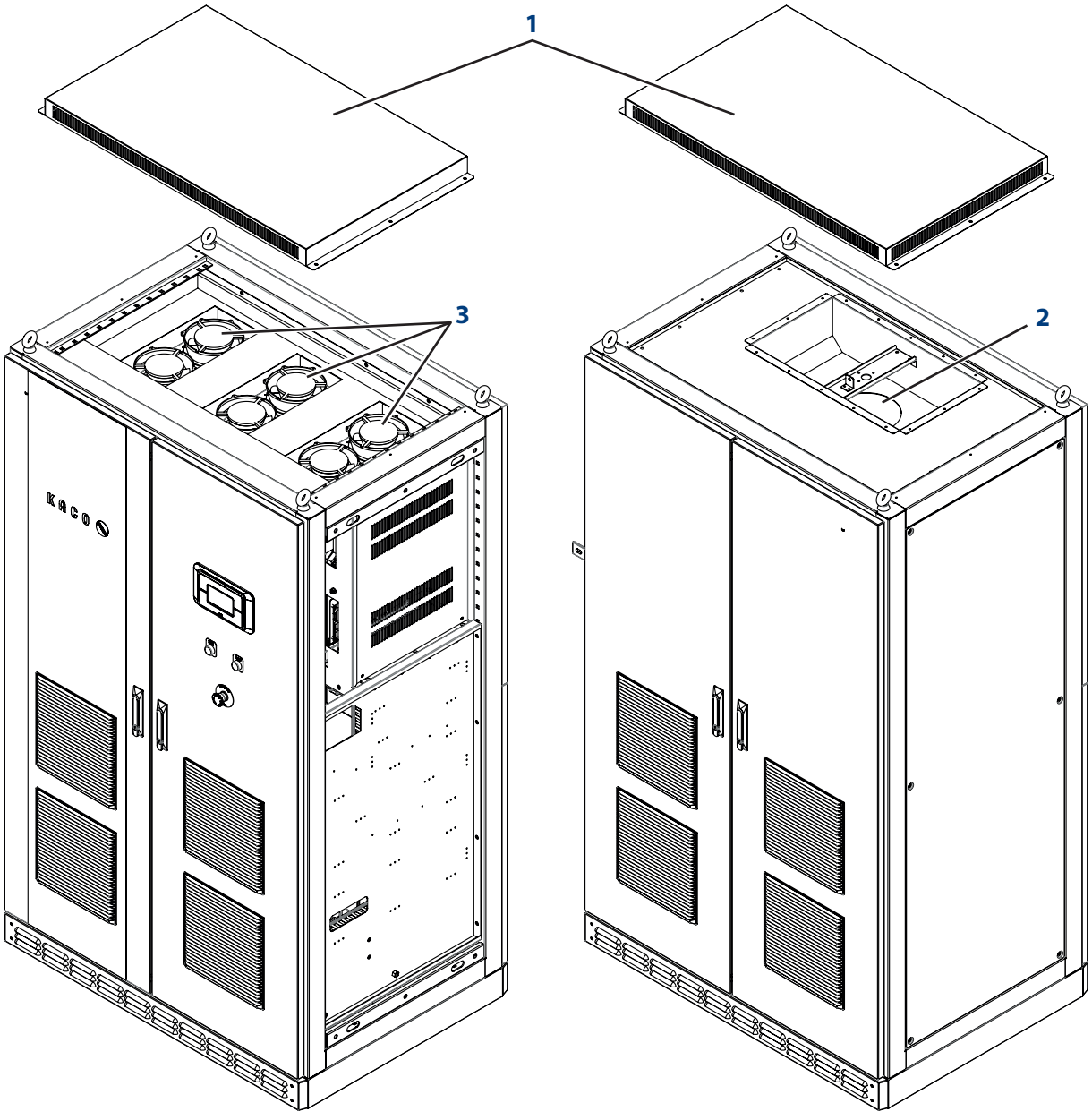


Figure 71: Accessing the fans

Key

1	Upper covers of the inverter cabinets	3	Fans in the left inverter cabinet
2	Fan in the right inverter cabinet		

☞ Switch off the inverter (see section 11 on page 79)

Cleaning the fans

1. Remove the upper covers (Figure 71, item 1) from the inverter cabinets.
2. Clean the fans (Figure 71, items 2 and 3).
3. Attach the upper covers.

Changing the fans

1. Remove the upper covers from the inverter.
2. Disconnect the plug.
3. Replace the fan.
4. When you install a new fan, pay attention to the air flow direction (arrow on the fan housing).
5. Attach the upper covers.

☞ Switch on the inverter (see section 11 on page 79)

11.3 Cleaning and replacing the outlet filters

CAUTION

Damage to the outlet filters

The front and rear covers of the outlet filters are made of plastic and may break under severe stress.

› Do not apply force to the outlet filters.

The outlet filters are installed in the front doors of the inverter.

Checking the filter mat for dirt

1. Switch off the inverter (see section 11 on page 79).
2. Open the front door in which the outlet filter is installed.
3. On the inside of the open front door tap the center of the outlet filter with the palm.
4. If the palm is dirty clean the filter mat.

Cleaning the filter mat (Figure 72)

1. Remove the front cover (item 1) of the outlet filter.
2. Take off the filter mat (item 2) from the rear cover (item 3).
3. Check the condition of the filter mat.

If the filter mat is covered with dirt:

1. Wipe off the dirt.
2. Reassemble the outlet filter.

If the filter mat is in bad condition:

☞ Replace the complete outlet filter.

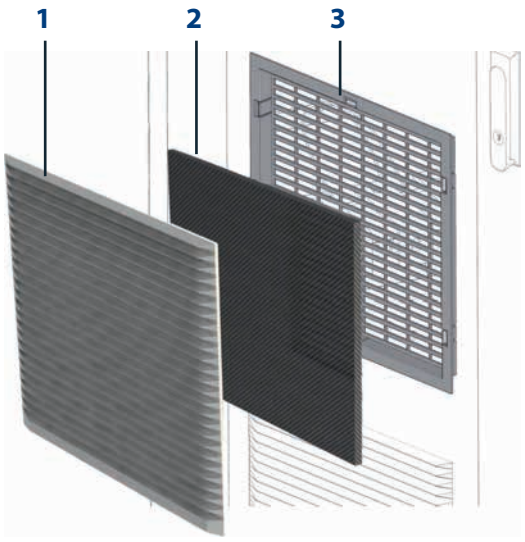


Figure 72: Dismounting the filter mat

Replacing the outlet filter (Figure 73)

1. On the inside of the open front door press the hooks (item 4) of the outlet filter.
2. Push the outlet filter towards the front side of the door.
3. Remove the outlet filter.
4. Mount the new outlet filter in reverse order.
5. Ensure that all hooks of the outlet filter are snapped in.

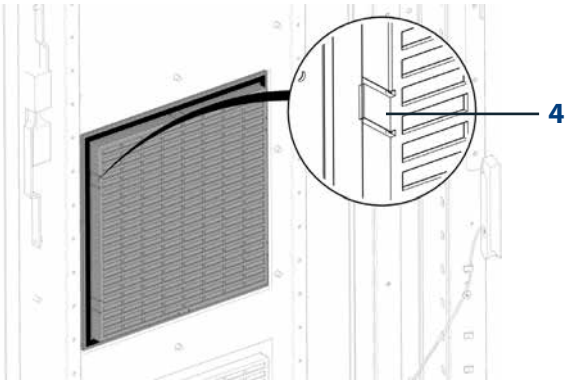


Figure 73: Replacing the outlet filter

Finishing the maintenance of the outlet filter

1. Close the front doors of the inverter.
2. Switch on the inverter (see section 11 on page 79).

12 Faults and Warnings

If a problem occurs in the system, the inverter notifies you using an audible signal and a display using the MMI software. With the Powador XP200-HV or Powador XP250-HV, two types of problems are displayed: faults and warnings.

A fault is a serious problem that causes the inverter to stop. Faults are displayed on the MMI screen and are highlighted in red. A warning represents a more minor problem. When a warning occurs, the system does not cease operation. Warnings are displayed in yellow. Fault types and descriptions are listed in the following tables.

12.1 Warnings

Message	Code	Description
SP1 (PV SP) Failure	W01	Failure of surge (overvoltage) protector SP1 on the PV side
PV Fuse Failure	W03	Fuse failure on the PV side (optional)
Ground Fault Warning	W04	The insulation resistance of the PV module falls below the limit value specified for alert 1 under ground fault monitoring (optional).
PV Over Voltage Warning	W05	PV voltage > parameter [PV Operate Level]
PEBB Over Temp. Warning	W20	Temperature of the heatsink for the PEBB (power electronics building block) >75°C
PEBB Fan Failure	W21	Failure of the fan on the heatsink for the PEBB (power electronics building block)
SP2 (Grid SP) Failure	W30	Failure of surge (overvoltage) protector SP2 on the grid side
ASYNC Warning	W111	Voltage built up at inverter side is asynchronous with the grid
Test Mode	W40	The system is working in test mode.
Watchdog Failure	W41	Watchdog function worked and system rebooted.
Cabinet Over Temp. Warning	W50	The temperature in the cabinet exceeds the parameter [Cabinet temperature maximum].

Table 31: Warnings

Message	Code	Description
Cabinet Under Temp. Warning	W51	The temperature in the cabinet is below the parameter [Cabinet temperature minimum].
SP3 (Control Power SP) Failure	W52	Failure of surge (overvoltage) protector SP3 for the control power
CB32 Open	W53	Circuit breaker CB32 has tripped
SMPS warning	W54	Failure of SMPS (Switched-mode power supply)
CAN Wrong Message	W59	Received CAN message is wrong formatted
CAN Time Out	W60	No CAN message has been received in the last 2 seconds.
CAN Multiple Master	W61	Multiple inverters are working as a master in the CAN network.

Table 31: Warnings

12.2 Errors

Message	Code	Description
PV Over Voltage	F01	PV voltage > parameter [DC over voltage level]
PV Over Current	F02	PV current > parameter [DC over current level]
CB10 (PV CB)Trip	F04	Failure of circuit breaker CB10 on the PV side
PV Polarity Reversal	F05	The polarity (+, -) of the PV side is reversed.
Ground Fault	F06	Ground Fault has been detected
Inverter Over Voltage	F10	Overvoltage on the inverter side
Inv. Under Voltage	F11	Undervoltage on the inverter side
Inv. Over Frequency	F12	Overfrequency on the inverter side
Inv. Under Frequency	F13	Underfrequency on the inverter side
Inv. Over Current	F14	Overcurrent on the inverter side
Inv. MC (MC21) Failure	F15	Magnet contact failure on the inverter side
Inv. Phase Order Failure	F16	Phase order is wrong
Inductor or TR Over Temp.	F18	Temperature of chokes > 150°C
Inv. Current Unbalance	F19	Phase unbalance > 20%
PEBB(1) IGBT Failure	F20	The PEBB for IGBT 1 has failed
PEBB(2) IGBT Failure	F21	The PEBB for IGBT 2 has failed
PEBB(3) IGBT Failure	F22	The PEBB for IGBt 3 has failed
PEBB Over Temp. Analog	F24	Heatsink temperature > 85°C
PEBB Over Temp. Digital	F25	The thermostat switch tripped due to heatsink overtemperature.
Grid Over Voltage	F30	Overvoltage on the grid side
Grid Under Voltage	F31	Undervoltage on the grid side

Table 32: Fault

Message	Code	Description
Grid Over Frequency	F32	Overfrequency on the grid side
Grid Under Frequency	F33	Underfrequency on the grid side
Grid CB Trip	F34	CB20 (grid circuit breaker) was tripped during operation
Parameters Version Error	F40	Version difference between the internal parameter table and the program parameter table
Flash Memory Failure	F41	The flash memory used for programming the DSP C6000 on the control board has failed.
FPGA Failure	F42	FPGA failure in XCU (main control) board
DSP28x Failure	F43	DSP F2000 on the control board has failed
ADC Failure	F44	The analog-digital converter on the control board has failed
NVSRAM Failure	F45	NVSRAM on the XCU (main control) board has failed.
ASYNC Failure	F46	ASYNC Warning (W31) has been repeated more than 10 times
CAN Failure	F47	CAN communication failure in the CAN network
MC22 Failure	F49	MC22 failed.
Emergency Stop	F50	The emergency stop (OFF switch) was pressed.
Cabinet Over Temp.	F51	Cabinet temperature > 55°C
MMI-XCU Communication Error	F63	Communication failure between MMI and XCU board

Table 32: Fault

13 Service

We place special emphasis on the quality and longevity of our inverters, starting even with the product development phase. More than 60 years of experience in the field of power converters support us in this philosophy.

However, despite all quality assurance measures, faults may occur in rare cases. In such cases, KACO new energy GmbH will provide you with the maximum possible support. KACO new energy GmbH will make every effort to remedy such faults in an expeditious manner and without a great deal of bureaucracy.
If you need help solving a technical problem with one of our KACO products, please contact our service hotline. Please have the following information ready so that we can help you quickly and efficiently:

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

You will find our warranty conditions on our website.

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

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

Please use our website to register your unit within 24 months:

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

On this page as well, you can click on the appropriate flag to easily reach the website for your own nation.

In this manner, you can assist us in providing you with the quickest service possible. In return, you receive two additional years of warranty coverage for your unit.

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

A complaint form is available. It is located at http://www.kaco-newenergy.com/service/technical-support

Hotlines

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

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

Electrician

14 Decommissioning/Dismantling



DANGER

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

Coming into contact with the lines and terminals in the inverter will cause serious injury or death.

Only authorised electricians who are approved by the supply grid operator may open, install and maintain the inverter.

› Always shut down the inverter (in the sequence described below) before dismantling the unit.

› Do not touch exposed contact connections.

Switch off the inverter

1. Switch the main ON/OFF switch to OFF (stop the inverter).
2. Switch the power grid switch to OFF (disconnect the inverter from the grid).
3. Switch the DC disconnector to OFF (disconnect the inverter from the PV generator).
4. Make sure that the inverter is disconnected from all voltage sources.
5. Attach locking devices to the circuit breaker of the power grid connection and to the AC and DC disconnectors.
6. Wait at least six minutes before working on the inverter.

Decommission and dismantle the inverter

1. Disconnect all terminals and cable fittings.
2. Remove all DC and AC leads.
3. Disconnect the connections and busbars between the cabinets.

15 Disposal

Dispose of the packaging materials

The packaging for the inverter consists of a wooden pallet, plastic foil made of polypropylene and the shipping container.

☞ Dispose of the packaging materials in accordance with the applicable waste disposal regulations.

Dispose of the inverter

☞ After the inverter has reached the end of its service life, dispose of it in accordance with the applicable disposal regulations for electronic waste or send it back to Kaco new energy GmbH (the address is on the back of these instructions) at your own expense.

16 EU Declaration of Conformity

Manufacturer's name and address	**KACO new energy GmbH** Carl-Zeiss-Straße 1 74172 Neckarsulm, Germany
Product description	**Photovoltaic feed-in inverter**
Type description	**Powador XP200-HV TL** **Powador XP250-HV TL** **Powador XP350-HV TL**

This is to confirm that the units stated above are compliant with the protection requirements set forth in Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (Electromagnetic Compatibility Directive) and Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits (Low Voltage Directive).

The units are compliant with the following standards:

2006/95/EC Directive relating to electrical equipment designed for use within certain voltage limits	**Safety of the unit:** EN 50178:1997
2004/108/EC Directive relating to electromagnetic compatibility	**Interference immunity** EN 61000-6-2:2005
	Emitted interference EN 55011:1998+A1:1999+A2:2002 (Group 1, Class A)
	Secondary effects on the grid EN 61000-3-12:2005 EN 61000-3-11:2000

The unit mentioned above is therefore labelled with the CE marking.

Any unauthorised modifications to the supplied unit and/or any use of the unit that is contrary to its intended purpose shall render this Declaration of Conformity null and void.

Neckarsulm, 01 September 2009
KACO new energy GmbH



Matthias Haag
Head of Grid-Connected Systems Division

3003115-01-120629

The text and figures reflect the current technical state at the time of printing. Subject to technical changes. Errors and omissions excepted.

KACO new energy.

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