KACO new energy.

Powador
7700 | 7900
8600 | 9600

Operating Instructions

- Operator
- Authorised electrician

The Next Generation of Transformerless Inverters with Integrated DC Disconnect

The installation instructions for authorised electricians begin after the operating instructions.

For the operator

Operating Instructions

Powador 7700 / 7900 / 8600 / 9600

General Notes

By purchasing an inverter from KACO new energy GmbH, you have opted for reliable, high-performance technology and you will benefit from our many years of experience in the field of current inverter technology and power electronics.
Powador 7700, 7900, 8600 and 9600 inverters are transformerless, fanless, robust, high-efficiency inverters.

1 About this Documentation

The following notes guide you through the entire documentation. Additional documents are applicable in conjunction with these operating and installation instructions.
We assume no liability for any damage caused by failure to observe these instructions.

ATTENTION

Read the manual
We assume no liability for any damage caused by failure to observe these instructions.

Other applicable documents

When installing the inverters, be sure to 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.

1.1 Retention of documents

Please pass these operating and installation instructions on to the system operator. These documents must be stored near the system and must be available at all times.

1.2 Symbols used in this document

When operating the inverter, observe the safety instructions provided in these operating instructions.

DANGER

Failure to observe a warning indicated in this manner will lead directly to serious bodily injury or death.

WARNING

Failure to observe a warning indicated in this manner may lead directly to serious bodily injury or death.

CAUTION

Failure to observe a warning indicated in this manner may directly lead to minor or moderate bodily injury.

ATTENTION

Failure to observe a warning indicated in this manner may lead to damage to property.

NOTICE

Useful information and notes.

ACTION

This symbol indicates that a certain action is required.

IMPORTANT

Failure to observe this information may result in reduced convenience or impaired functionality.

High voltage

Read the manual

1.3 CE marking

The CE marking is used to document that the Powador inverter shown on the name plate fulfils the fundamental requirements of the following relevant directives:
Directive relating to electromagnetic compatibility
(Council Directive 2004/108/EC)
Low voltage directive
(Council Directive 2006/95/EC)

1.4 Name plate

The name plate showing the exact designation of the unit is located on the support plate on the underside of the housing.

2 Safety Instructions and Regulations

DANGER

Danger due to lethal voltages.

Lethal voltages are present within the unit and on the power supply lines. Therefore, only authorised electricians may install and open the unit.

Even when the unit is disconnected, high contact voltages may still be present within the unit.

Accident prevention regulations

The inverter must be installed by an authorised electrician who is responsible for observing existing standards and regulations.

The proper and safe operation of this unit requires proper transportation, storage, assembly and installation, as well as careful operation and maintenance.

The inverter may only be operated by persons who have read and understood the operating instructions.

Modifications

It is generally not permitted to modify the inverter. Always consult an authorised electrician for modifications to the surroundings of the inverter, as they are qualified to undertake such work.

CAUTION

Risk of damage due to improper modifications. Never modify or manipulate the inverter or other components of the system.

Transportation

The inverter is subjected to extensive testing and inspection in our test field. Only by doing so can we ensure the high quality of our products. Our inverters leave our factory in proper electrical and mechanical condition. Special packaging ensures safe and careful transportation. However, damage may still occur during transport. The shipping company is responsible in such cases.
Thoroughly inspect the inverter upon delivery. Immediately notify the responsible shipping company 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.

If necessary, your solar installer or KACO new energy GmbH will assist you. Damage reports must be received by the shipping company in writing within six days following receipt of the goods.

When transporting the inverter, the original or equivalent packaging is to be used, as this ensures safe transport.

3 Notes on Installation and Operation

3.1 Intended use

The unit converts the DC voltage generated by the photovoltaic (PV) modules into AC voltage and feeds this into the power grid.
Powador inverters are 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 units and other property.
The inverter may be operated only with a permanent connection to the public power grid.
The inverter is not intended for mobile use.

Any other or additional use is not considered the intended use. The manufacturer/supplier is not liable for damage caused by such unintended use. This risk is borne solely by the operator.

Intended use also includes adherence to the operating and installation instructions. Your authorised electrician undertakes the registration with your power supply company and obtains approval for your photovoltaic system from the supply grid operator on your behalf. Some of the documents that you require in order to register your photovoltaic system and have it approved are included in the installation instructions.

3.2 Factory warranty and liability

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.

3.3 Service

We place special emphasis on the quality and longevity of our inverters, starting 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. In such a case, contact our service department directly.

Telephone: +49(0)7132-3818-660

4 Operation

CAUTION

Incorrect use is prohibited.

The feed-in process begins in the morning if sufficient insolation is available, and, therefore, if a certain minimum voltage is present in the inverter.
If, as nightfall approaches, the voltage drops below the minimum voltage value, feed-in mode ends and the inverter switches off.

4.1 Overview of controls and displays

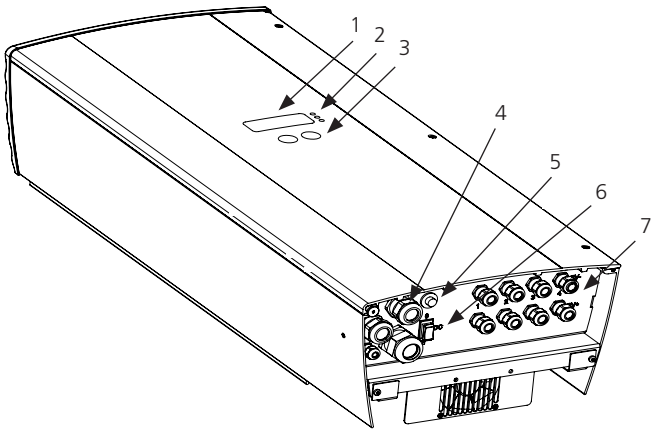


Figure 4.1: **Overview of the Powador**

Key

1 Display
Used to display measured values and configuration parameters

2 LED indicators
Used to display the operating state

3 Control keys
Used to switch between display and configuration of parameters

4 Cable fittings for AC connection and interface cable

5 Night start-up key
Used to activate the displays after nightfall

6 Manual DC disconnect
Used to disconnect the inverter from the PV generator

7 Plug connections and cable feedthroughs for DC connection

4.2 LED indicators

The inverter is equipped with three LEDs that provide information about the various operating states as follows:

Figure 4.2: **LED indicators**

LED (1) (green):

The LED begins to light up as soon as the minimum voltage of a photovoltaic module has been reached and goes out again when the module voltage has fallen below this value.
The LED signals that the inverter is in standby mode. The inverter is ready for operation.

LED (2) (green):

The LED always lights up when the inverter is feeding into the grid.

LED (3) (red):

The LED displays when feed-in has been interrupted due to a fault or when the potential-free contact is connected in "Relay 33" mode.

Wait approximately 10 minutes to see if the fault is only temporary in nature. If this is not the case, notify your authorised electrician.

IMPORTANT

If the feed-in phase fails (power failure on the public grid), LED (3) does not light up. If this happens, all LEDs and the display go out. The inverter is shut down completely.
The inverter can only resume its normal operation when the feed-in phase is available once again.

Check whether the fault in question relates to a general power failure or whether the fuse between the counter and the inverter has blown. If the fuse has blown, notify your authorised technician. If there was a power failure, simply wait until the fault has been cleared. The system automatically restarts.

IMPORTANT

The potential-free contact can also be used in "Relay 33" mode (section 4.4). In this case, LED (3) is not used to indicate faults. If the contact is connected in "Relay 33" mode, LED (3) illuminates to indicate this status. The LED (3) remains lit as long as the contact is connected.
If the inverter then experiences an error, it is not indicated by the LED (3). Instead, it only appears as an error message on the display.

4.3 Keys "1" and "2"

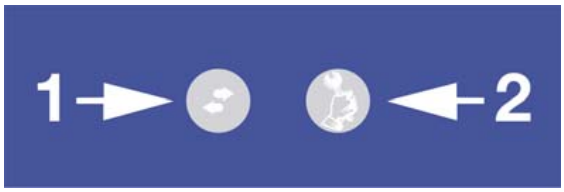


Figure 4.3: **Powador control buttons**

Key "1" is used to switch between the various displays for measured values and data. Key "2" can be used to configure settings. Here, menu navigation is divided into two levels. In level 1 (display mode), measured values such as the PV array voltage can be read. Here, only key "1" is activated. In level 2 (configuration mode), key "1" is also used to navigate through the individual displays. Settings, such as interface selection, are configured with key "2".

ACTION

By pressing key "1" you can choose which measured value is to be displayed.
The menus are continuous, which means that when you arrive at the last entry in a menu, the first entry is displayed once again the next time key "1" is pressed (see figure 4.4).

4.4 Relay 33 (DE)

The new version of the German Renewable Energies Act (EEG), which took effect on 1 January 2009, now includes compensation for personal consumption of self-generated PV energy (§ 33). This applies to systems up to a maximum of 30 kW.
The energy that is provided by the PV system can be directly put to use by the appliances that are connected in your home. In order to reap the benefits of this function, it is a good idea to operate large appliances (e.g. washing machines, air conditioning units, clothes dryers, dishwashers, etc.) when the required amount of PV energy is available.

NOTICE

When delivered, the "Relay 33" function is not active. You have to order the function separately from your specialist dealer. It can be activated on the device after payment has been received.

Activation

Before you can use the "Relay 33" function, you have to enter a special activation code on the device. This can be obtained from your specialist dealer.

ACTION

Activation is performed using the display and the control keys.
- Press keys "1" and "2" simultaneously to access menu level 2.
- Use key "1" to access the menu item "Relay 33 active yes/no".
- You can activate the function by selecting "yes" with key "2".
- When you then press key "1", you reach the input screen for the activation code, "Please enter code xxxx".
- This is where you enter the activation code that you obtained after your payment was received.
- Use key "1" to select the digit positions (1-4).
- Use key "2" to enter. Press key "2" to select the correct value to be entered (0-9, A-F).
- Press key "1" to confirm.

The "Relay 33" function is now active.
You can use the menu item "Relay 33 active yes/no" to switch between the fault signal relay function and the "Relay 33" function at any time.
You will not have to enter the activation code for the next activation.

Additional menu items are now available in menu level 2 (section 4.6). These menu items enable you to change the AC switch-on threshold and the relay switch-on time.

Setting the parameters

In "Relay 33" function, the potential-free contact is connected when AC power is constantly above the set AC switch-on threshold for a period of 30 minutes. The AC switch-on threshold can be adjusted in increments of 250 W, up to the maximum AC power of the inverter in question. When delivered, the AC switch-on threshold is set to 250 W.

ACTION

You set the AC switch-on threshold in menu level 2 (section 4.6).
- Press keys "1" and "2" simultaneously to access menu level 2.
- Use key "1" to access the menu item "Relay 33 from".
- Use key "2" to set the desired AC switch-on threshold in increments of 250 W, up to the maximum AC power of the inverter.

The relay switch-on time refers to the period of time that the potential-free contact remains connected after it has been switched on. This time can be adjusted in increments of one hour, from one hour to a maximum of 10 hours.
When delivered, the relay switch-on time is set to one hour.

ACTION

You set the relay switch-on time in menu level 2.
- Press keys "1" and "2" simultaneously to access menu level 2.
- Use key "1" to access the menu item "Relay switch-on time".
- Use key "2" to select the desired relay switch-on time in increments of 1 hour from a range of 1 to 10 hours.

After it has been switched on, the remaining time for the relay is displayed under the menu item "Remaining relay time" in menu level 1. As long as the potential-free contact is connected, LED (3) remains illuminated to indicate this status.
After the remaining relay time has elapsed, the contact is disconnected and the red LED goes out. To reconnect it, the set switching conditions (AC switch-on threshold exceeded constantly for a period of 30 minutes) have to be met again.

4.5 Level 1 menu – Display mode

The display menu is shown once the Powador inverter starts up. Measured values and all of the counters are displayed here. Key "1" is used to navigate through the individual menu items.

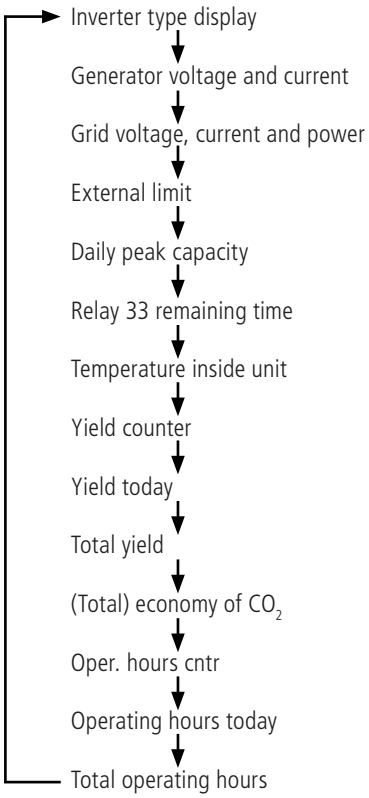


Figure 4.4: **Display mode menu**

Explanation of the individual menu items:

Inverter type display

Display of the inverter type
Powador 7700 / 7900 / 8600 / 9600

Generator voltage and current

The current voltage and current of the PV array that is connected to the inverter.

Grid voltage, current and power

The current grid voltage, grid current and the power that is currently being fed into the grid.

External limit

Power regulation according to the specifications of the German Renewable Energies Act (EEG) to 60%, 30% or 0%.

Daily peak capacity

The peak power of the day in question that was fed into the grid for a short time.

Relay 33 remaining time

Displays the remaining time for the Relay 33 function. This is displayed only when the "Relay 33" function is activated and the potential-free contact is connected and functioning in "Relay 33" mode. The display format is hh:mm.

Temperature inside unit

Displays the current heat sink temperature in °C. The unit switches off if it becomes too hot.

Yield counter

This counter totals all yields until it is reset again. The customer can configure the time periods for this counter, e.g. as a monthly counter. The counter can be cleared in the "Clear yield" configuration mode.

Yield today

The power that has been fed into the grid during the current day.

Total yield

The power that has been fed into the grid since start-up of the inverter. The initial value can be set in the configuration mode.

(Total) economy of CO_2

Shows the CO_2 savings of this PV system compared to the German electricity mix. The CO_2 savings are calculated from the total yield and can also be cleared with this counter (1 kWh corresponds to 0.56 kg of CO_2 savings).

Oper. hours cntr

This counter totals all yields until it is reset again. The customer can configure the time periods for this counter, e.g. as a monthly counter. It can be cleared in the "Clear yield" configuration mode.

Operating hours today

Today's hours of operation. As soon as the inverter is in standby mode (i.e. when LED (1) lights up), the running time is added up.

Total operating hours

The hours of operation since start-up of the inverter. As soon as the inverter is in standby mode (i.e. when LED (1) lights up), the running time is added up.

In addition, all status messages are integrated into this level: As long as they are present, they are a part of the menu, which means that they appear again after you have scrolled completely through level 1. They are automatically

- cleared when the DSP shows a fault-free status, or
- replaced when the DSP transmits a status that results in another message.

They appear only in level 1. If they occur while the menu system is in another level, they are saved and displayed when you have returned to level 1 as long as they are still present.

4.6 Level 2 menu – Configuration mode

ACTION

To access the configuration mode, press both keys at the same time. The software version is displayed. Pressing key "1" now switches to the next menu item. Changes can be made in the respective menu item by pressing key "2". The setting value increases each time key "2" is pressed. If the maximum value has been reached, the value returns to the minimum setting option.

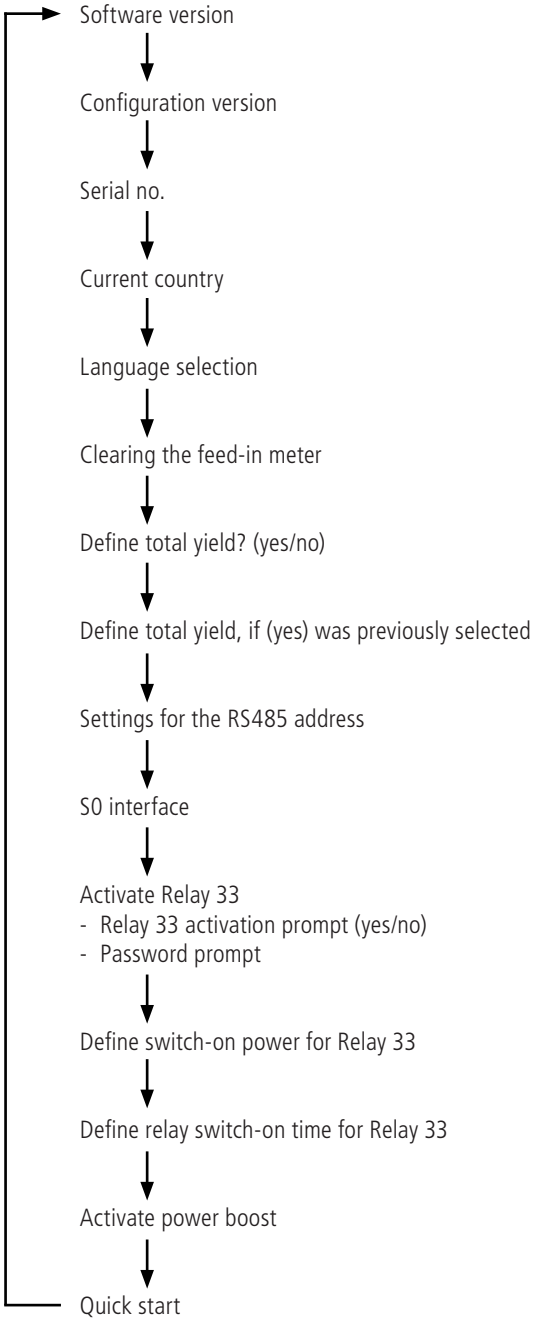


Figure 4.5: **Configuration mode menu**

Explanation of the individual menu items:

Software version
The current software version is displayed here.

Configuration version
The configuration version is displayed here.

Serial no.
Display of the serial number specific to the unit.

Current country
Display of the current country settings.

Language selection
The language of the configuration interface can be selected here.

Clearing the feed-in meter
When the feed-in meter is cleared, all counters ("Counter yield" and "Counter oper. hours") are reset to zero.
To clear the counters, select "Yes" with key "2", and confirm your selection by pressing the "1" key. The required code is "2", and is entered using key "2". After confirming again with key "1", all counters are cleared. "Feed-in meter cleared!" is shown to confirm that the counters have been cleared.
"Counter yield" and "Counter oper. hours" can be cleared separately from the other counters. These counters are cleared in the configuration menu using key "2" and the code "2". "Counter yield" and "Counter oper. hours" are always cleared together.

Set total yield
Choose whether the total yield should be defined (yes/no).

Set total yield
Specify the counter reading for the total yield so that the counter does not begin at zero after start-up.

Setting for the RS485 address
By pressing key "2", the address can be set in a consecutive manner from 1 to 32.
The address then jumps back to 1. The RS485 interface is used to communicate with the Powador-proLOG. If several inverters are connected to a Powador-proLOG, each address may only be used once. This makes it possible to monitor 32 Powador inverters with one Powador-proLOG.
To connect the RS485 interface, please contact your installer.

S0 interface pulse rate
The S0 interface is designed as a galvanically isolated transistor output. This interface is designed according to DIN EN 62053-31:1999-04 (Pulse output devices for electromechanical and electronic meters).
The S0 interface pulse rate can be chosen in three unit intervals: 500, 1,000 and 2,000 pulses/kWh.
To connect the S0 interface, please contact your installer.

Relay 33 active yes/no

You can use this menu item to switch the potential-free contact between the "Relay 33" mode and the fault signal relay mode (see Installation Instructions for Authorised Electricians, section 5, Installation and Start-Up).

Entering the activation code for Relay 33

You have to enter an activation code when you activate the "Relay 33" function for the first time. You only have to enter this code for the first activation. Once the function has been activated, you can activate and deactivate it without having to re-enter the activation code.

Switch-power for Relay 33

This menu item is displayed only when the potential-free contact is switched to "Relay 33" mode. You can use this menu item to set the minimum switch-on power that must be present for 30 minutes so that the contact connects (see Installation Instructions for Authorised Electricians, section 5, Installation and Start-Up).

Relay switch-on time for Relay 33

This menu item is only displayed when the potential-free contact is switched to "Relay 33" mode. Use this menu item to set how long the contact will remain active after connecting (see Installation Instructions for Authorised Electricians, section 5, Installation and Start-Up).

Power Boost

Power Boost mode can be activated by pressing key "2" twice. This changes the frequency of IGBT bridge from 17 kHz to 9 kHz. When this change occurs, note that 9 kHz is within the range of audible frequencies.
The Power Boost mode improves the degree of efficiency and can be used where the operating noise from the inverter is acceptable.

Quick start

The inverter can also be started up without any waiting period for the purpose of testing or for the purpose of acceptance by your power supply company.
If the inverter is already feeding into the grid, this menu item is not available.
If there is insufficient PV array power, the inverter stops feeding into the grid after a short period of time.

ACTION

Keep key "2" pressed down for a short time until the inverter switches on (relays switch audibly) and the green feed-in LED (2) lights up. If there is insufficient PV array power, the inverter stops feeding into the grid after a short period of time.

ACTION

Settings are saved only upon exiting configuration mode. If two minutes elapse without a button being pressed, configuration mode is exited automatically. Configuration mode can also be exited immediately by pressing both keys. As a confirmation, "Settings saved" appears on the display. The settings are now permanently saved in the Powador inverter.

4.7 DC disconnect

The inverters have an automatic internal all-pole DC disconnect which separates the inverters from the photovoltaic generator at all poles in case of fault. In order to also use this function manually, there is a toggle switch on the bottom of the inverter with which the internal relay can be switched off at all poles.

IMPORTANT

In normal mode, the switch must be switched on. If not, power cannot be fed into the grid.

4.8 Night start-up key

The unit switches off in the evening as nightfall approaches. At this point, nothing is shown on the display. In order to retrieve the values from the current day (daily yield, daily hours of operation and max. feed-in power) after the display switches off, the unit can also be activated during the night by pressing the night start-up key on the underside of the inverter.

ACTION

Press the "night start-up" key (see figure 4.1 - (5)) on the underside of the unit for approximately 5 seconds until a display appears.

You can now scroll through the menu and retrieve the saved values. If over one minute elapses without a key being pressed, the unit switches off automatically once again.
The "Counter oper. hours ", "Total operating hours", "Counter yield" and "Total yield" data are permanently saved and totalled. This data is not lost even if the inverter is switched off for a long time. The daily yield, daily hours of operation and the max. daily feed-in power are available until the following morning and are cleared when PV generator voltage is present again.

4.9 The RS485 interface

Powador inverters are also equipped with an RS485 interface in order to enable remote monitoring of your photovoltaic system. Several inverters can be monitored over this interface at the same time. Using the Powador-proLOG series, you can receive yield and operating data as well as error messages by SMS (text message) or e-mail. This monitoring option is especially recommended for situations where you are unable to check the functionality of the system on-site at regular intervals, e.g. if you live far away from the system site. In addition, you can use the Powador-link within your system to bridge long distances between several inverters or between an inverter and the Powador-proLOG using wireless radio transmission. Contact your installer if you wish to add remote monitoring to your system.

NOTICE

Calculating efficiency by measuring the current and voltage values leads to unusable results due to the tolerances of the measuring units.

The sole purpose of these values is to monitor the basic operation of the system.

4.10 External limiting (DE)

As of 01/01/2009, the German Renewable Energies Act (EEG) requires power regulation for systems larger than 100 kW. In principle, each individual unit in a network with other units can become a system of this size. Therefore, each inverter must have an option for reducing power, even if this is not needed in a system that is smaller than 100 kW.

KACO uses a ripple control receiver to implement this power reduction. The power supply company can use this unit to reduce the system's power via the Powador-proLOG XL, as necessary. For this, the following levels are possible: 0 %, 30 %, 60 % or 100 % of AC power. With a setting of 30 % or 60 %, the inverter limits the power to 30 % or 60 %. With a setting of 0 %, the inverter disconnects from the grid. Normal feed-in mode occurs at 100 %.

When the power supply company requests a reduction in the power, the Powador-proLOG receives the corresponding signal via the ripple control receiver. The Powador-proLOG then forwards the information to all connected inverters, which reduce power as prescribed by the power supply company. After a specified period of time without any signal from the power supply company, the inverters return to normal operation.
For the duration of the power reduction, the display shows the power reduction with a corresponding message (e.g "External limit xxx %") and the LED (2) flashes once a second. You can still use the other display functions as usual during a power reduction.

The ripple control receiver is connected to the Powador-proLOG XL, which is mandatory for the use of power limitation (power control). You do not have to make any changes to the inverter in order to use power limitation, since it is integrated in the inverter as standard. It is activated via the Powador-proLOG XL.

A group of up to a total of 32 inverters can be symmetrised in this way. All inverters of a group must be assigned a unique SYM bus address within the range of 1 to 32. In addition, the feed-in phase and the maximum asymmetry for any inverter must be set so that the correct symmetrisation can result.

4.11 Display

Inverters in the Powador series are equipped with a back-lit LCD (see figure 4.1 - (1)) that displays measured values and data.
In normal mode, the backlight is switched off. As soon as you press one of the buttons, the backlight is activated. If no key is pressed after about one minute, it switches off once again.

IMPORTANT

Due to measuring tolerances, the measured values may not always correspond to the actual values. The measuring elements on the inverter have been selected to ensure maximum solar yields.
Due to these tolerances, the daily yields displayed on the inverter may deviate from the values on your supply grid operator's feed-in meter by up to 15 %.

Operating states

For the status, consult the data that is logged via the RS485 interface.

Status	Explanation	Comment
0	Inverter has just switched on	Only for a brief period after being first switched on in the morning.
1	Waiting to start	Grid parameters and generator voltage are being checked.
2	Waiting to switch off	Insufficient generator voltage and generator power. The status before it switches over to night shutdown mode.
3	Constant volt. control	The inverter continues to operate with minimum MPP voltage when the feed-in power is low.
4	Feed-in mode	The inverter is feeding into the grid.
8	Self test	The line relay and the shutdown of the power electronics are tested prior to the commencement of feed-in mode.
9	Test mode	For internal operation only.
11	Power limitation	If the generator is producing too much power, the inverter limits itself to the maximum power. This can occur in the midday hours if the generator has been too largely dimensioned. This is not a malfunction.
60	PV voltage too high for feed-in	The inverter can only begin feeding into the grid once the PV voltage falls below a specified value.
61	Power Control	Power Control was activated by the grid operator. The inverter limits its power.
62	Standalone mode	The inverter was switched to standalone mode by the Powador GridSave. The inverter is disconnected from the public low-voltage grid.
63	P(f) frequency-dependent power reduction	Frequency-dependent power reduction is activated with the activation of the BDEW Medium Voltage Directive (“Mittelspannungsrichtlinie”). Power reduction starts at 50.2 Hz.
64	Output current limiting	The AC current is limited once the specified maximum value has been reached.

Table 4.1: **Explanation of the operating states**

Fault messages

When these error messages are displayed, the feed-in is interrupted, the red LED (3) lights up and the fault signal relay is switched. This error correction takes a country-specific length of time. Afterwards, the red fault LED (3) goes out, the fault signal relay drops out again, and the display signals that it is ready to feed into the grid once again. Once the fault is gone, the Powador inverter feeds into the grid again after a country-specific time period. Many of these fault signals point to a fault in the grid, and are, therefore, not an operational fault on the part of the Powador inverter. The minimum triggering levels are determined by applicable standards (e.g. VDE0126-1-1), and the inverter must switch off if the permitted values are exceeded.

When the **Relay 33** function is activated, LED (3) is not used to indicate faults. If the contact is connected in “Relay 33” mode, LED (3) illuminates to indicate this status. The LED remains lit as long as the contact is connected.
If the inverter then experiences an error, it is not indicated by the LED (3). Instead, it only appears as an error message on the display.

Status	Display	Explanation
10	Temperature inside unit too high	If the inverter overheats due to a lack of air circulation, the inverter switches off. This can occur if the ambient temperature is too high, the cooling fins are covered, or if the inverter is defective.
18	Error current switch-off	The residual current is too high. The integrated AC/DC-sensitive residual current circuit breaker registered an impermissibly high leakage current going to PE.
19	Generator insulation fault	Insulation resistance from PV-/PV+ to PE is too low.
30	Error Measurement	The current and voltage measurements in the inverter are not plausible. This can be caused by very dynamic weather conditions if quick changes between low feed-in power and high feed-in power occur.
31	RCD module error	An error has occurred in the AC/DC-sensitive residual current circuit breaker.
32	Fault Self test	The internal grid separation relay test has failed. If this internal error occurs several times, notify your authorised electrician.
33	Fault DC feed-in	The DC feed-in has exceeded the permitted value. This DC feed-in can be impressed from the grid on the Powador inverter so that no inverter fault exists. If this error occurs several times, notify your authorised electrician.
34	Fault Communication	A communication error has occurred in the internal data transmission. Notify your authorised electrician to check the data cable.
35	Protection shutdown (SW)	Protection shutdown of the software (AC overvoltage, AC overcurrent, DC link overvoltage). This is not an error, but instead a grid-related shutdown.
36	Protection shutdown (HW)	Protection shutdown of the hardware (AC overvoltage, AC overcurrent, DC link overvoltage). This is not an error, but instead a grid-related shutdown.
38	Fault PV overvoltage	The voltage of the PV generator is too high. The PV array is incorrectly dimensioned. Notify your authorised electrician.
41	Line failure Undervoltage L1	The voltage of a grid phase L1 is too low, the grid cannot be fed into.
42	Line failure Overvoltage L1	The voltage of a grid phase L1 is too high, the grid cannot be fed into.
43	Line failure Undervoltage L2	The voltage of grid phase L2 is too low, the grid cannot be fed into (only for active 3-phase monitoring).
44	Line failure Overvoltage L2	The voltage of grid phase L2 is too high, the grid cannot be fed into (only for active 3-phase monitoring).
45	Line failure Undervoltage L3	The voltage of grid phase L3 is too low, the grid cannot be fed into (only for active 3-phase monitoring).
46	Line failure Overvoltage L3	The voltage of grid phase L3 is too high, the grid cannot be fed into (only for active 3-phase monitoring).
47	Line failure Line-to-line voltage	The phase angle between the individual phases and the three-phase supply network is not correct (only for active 3-phase monitoring).
48	Line failure: underfreq.	The line frequency is too low. This error can be grid-related.
49	Line failure: overfreq.	The line frequency is too high. This error can be grid-related.
50	Line failure Average voltage	The grid voltage measurement according to EN 50160 has exceeded the maximum permitted limit value. This error can be grid-related.
57	Waiting for reconnect	After a fault, the inverter waits a defined country-specific time period before it can switch back on.
58	Overtemperature Control board	The temperature inside the unit was too high. The inverter switches off to prevent damage to the hardware. Provide sufficient ventilation.
59	Self test error	An error occurred during the buffer inspection.
	Error (EEPROM) no parameters	An error occurred in the EEPROM.
	ERROR no parameters	An error with no parameters.

Table 4.2: **Fault messages**

5 Troubleshooting

In line with our continuously expanding quality assurance system, we endeavour to eliminate all errors and faults. You have purchased a product which left our factory in proper condition. Each individual unit has successfully passed an endurance test as well as extensive tests for the purpose of assessing the operating behaviour and the protective equipment.
If your photovoltaic system does not function properly despite these measures, we suggest the following troubleshooting procedures:
The first step is to check that the PV array and grid connections are properly connected to the Powador. In doing so, observe all the safety instructions specified in this manual. Monitor the inverter closely and, where applicable, make a note of the displays and LEDs.
The following faults may occur and should be remedied as described.

Fault	Cause of fault	Remedy/explanation
Inverter displays an impossible daily peak value.	Faults in the grid voltage.	The inverter continues to operate as normal without losses to the yield, even when an erroneous daily peak value is displayed. The value is reset overnight. To immediately reset the value, the inverter must be switched off and switched on again by disconnecting it from the grid and switching off the DC.
Daily energy yields do not correspond with the yields on the energy supply company's feed-in meter.	Tolerances of the measuring elements in the inverter	The measuring elements on the inverter have been selected to ensure maximum solar yields. Due to these tolerances, the daily yields displayed on the inverter may deviate from the values on your supply grid operator's feed-in meter by up to 15%.
The display is blank and the LEDs do not light up.	– The unit is in night shutdown mode. – There is no grid voltage. – The PV array voltage is too low.	The inverter switches to night shutdown mode as soon as the PV array voltage is below the minimum feed-in voltage for a longer period of time. In this case, the display will also switch off. In order to still be able to view the currently measured values, you can switch on the inverter via the night start-up key. A grid failure will also cause the display to go blank and feed-in to stop. Wait until the public low-voltage grid is available again. If the display does not light up during normal daytime hours, please contact your solar installer.
The inverter is active but does not feed into the grid.	– Insufficient generator voltage available – The line voltage or the PV array voltage is not stable.	After sunrise, at sunset and when there is not enough solar insolation due to bad weather conditions or due to the solar modules being covered with snow, the generator voltage or the generator power that comes from the roof may be too low to be able to feed in. Before the feed-in process begins, the inverter has to check the line parameters for a certain period of time. The length of time it takes to switch back on again differs by country according to applicable standards and regulations and can take several minutes.
The inverter is active but does not feed into the grid. The insolation is sufficient.	The inverter has interrupted the feed-in due to a fault.	After a feed-in interruption due to a fault (line failure, overtemperature, overload, etc.), the inverter checks the line parameters for a certain period of time. The length of time it takes to switch back on again differs by country according to applicable standards and regulations and can take several minutes. Interruptions can occur during the day when the grids are faulty. Notify your solar installer if the inverter shuts down regularly over a period of several weeks (more than 10 times per day). For an explanation of the individual display error texts, please see the fault signals.

Fault	Cause of fault	Remedy/explanation
The inverter stops supplying power to the grid shortly after being switched on, even though there is sufficient sunlight.	Faulty grid separation relay in the inverter.	Although there is sufficient sunlight, the inverter feeds into the grid only for a few seconds before switching off again. During the short feed-in period, the inverter shows that the power being fed into the grid is between 0 and 5 W. If the inverter is definitely receiving sufficient generator power, the grid separation relay is presumably faulty, thus preventing the inverter from connecting. Please contact your solar installer.
The line fuse trips.	– The line fuse capacity is too low. – Damage to the inverter's hardware.	In cases of high insolation, the inverter can – depending on the PV array – exceed its rated current for a short period. For this reason, the capacity of the inverter's pre-fuse should be somewhat higher than the maximum feed-in current. If the line fuse immediately trips when the inverter switches to feed-in mode (after the start-up period is complete), the inverter's hardware is probably damaged. Contact your solar installer.
Noise emission from the inverter.	Particular ambient conditions Power Boost mode is activated.	When there are certain ambient conditions, the units may emit audible noises. The following causes may be determining factors in this regard: – Line interference or line failure caused by particular loads (motors, machines, etc.) which are either connected to the same point on the grid or located in the vicinity of the inverter. – In cases of dynamic weather conditions (frequent switching between sunny and cloudy conditions) or strong insolation, a light hum may be audible due to the increased power. – With particular grid conditions, resonances may form between the unit's input filter and the grid, which may be audible even when the inverter is switched off. – People with very sensitive hearing (particularly children) may be able to hear the high-frequency hum caused by the inverter's operating frequency of approximately 17 kHz. Such noise emissions do not affect the operation of the inverter. Nor can they lead to loss of efficiency, failure, damage or to a shortening of the unit's service life. When Power Boost mode is activated, noise emission is normal. The Power Boost mode should be activated only in environments where the operating noise is acceptable.
In spite of high insolation, the inverter does not feed in the maximum power into the low-voltage grid.	The device is too hot and the power is reduced.	The temperature inside the unit became too high. The inverter reduced the power to prevent damage to the unit. Starting from an internal temperature of 75 °C, the inverter limits the power and levels off between 75 °C and 80 °C. An internal temperature of 85 °C is only reached if convection cooling is impeded by external factors, e.g. by covering the cooling fins. Provide for sufficient cooling of the unit.
Additional devices that are connected via the potential-free contact suddenly start up, even though the "Relay 33" function is deactivated and the inverter indicates an error.	The potential-free contact connects to indicate an error.	If the "Relay 33" function is not activated, the potential-free contact functions as a fault signal relay and therefore indicates errors. However, if additional devices that are provided for the "Relay 33" function are connected to the inverter via the contact, they can still start up when the inverter experiences an error, because the contact is connected at that point in time. If you deactivate the "Relay 33" function, we recommend that you disconnect devices from the inverter that were connected for this function.

Table 5.1: **Troubleshooting**

If the measures described in this guide do not assist in clearing the fault, please notify your installer.

In order for our factory customer service department to respond in an appropriate and expeditious manner, some details are necessary:

Inverter details

- Unit serial number
- Model
- A short description of the error
- Is the error reproducible? If yes, how?
- Does the error occur sporadically?
- Describe the prevailing insolation conditions when the error occurred.
- Time

Details pertaining to the photovoltaic module

- Module type, manufacturer (if available, also send the data sheet)
- The number of modules in series
- The number of strings
- Generator power

6 Recycling and Disposal

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

Unit

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

Packaging

Ensure that the transport packaging is disposed of properly.

KACO new energy.

For authorised electricians

Installation Instructions

Powador 7700 / 7900 / 8600 / 9600

1 About this Documentation

The following notes guide you through the entire documentation. Additional documents are applicable in conjunction with these operating and installation instructions.

We assume no liability for any damage caused by failure to observe these instructions.

Other applicable documents

When installing the inverters, be sure to 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.

ATTENTION

Read the manual
We assume no liability for any damage caused by failure to observe these instructions.

1.1 Retention of documents

Please pass these operating and installation instructions on to the system operator. The system operator retains the documents. The instructions must be available whenever they are needed.

1.2 Symbols used in this document

When installing the inverter, observe the safety instructions included in these installation instructions.

DANGER

Failure to observe a warning indicated in this manner will lead directly to serious bodily injury or death.

WARNING

Failure to observe a warning indicated in this manner may lead directly to serious bodily injury or death.

CAUTION

Failure to observe a warning indicated in this manner may directly lead to minor or moderate bodily injury.

ATTENTION

Failure to observe a warning indicated in this manner may lead to damage to property.

NOTICE

Useful information and notes.

ACTION

This symbol indicates that a certain action is required.

IMPORTANT

Failure to observe this information may result in reduced convenience or impaired functionality.

High voltage

Risk of fire or explosion

Risk of burns

Disconnect before starting work

Read the manual

1.3 CE marking

The CE marking is used to document that the Powador inverter shown on the name plate fulfils the fundamental requirements of the following relevant directives:

– Directive relating to electromagnetic compatibility (Council Directive 2004/108/EC)
– Low voltage directive (Council Directive 2006/95/EC)

1.4 Name plate

The name plate showing the exact designation of the unit is located on the support plate on the underside of the housing.

2 Safety Instructions and Regulations

DANGER

Danger due to lethal voltages.

Lethal voltages are present within the unit and on the power supply lines. Therefore, only authorised electricians may install and open the unit.

Even when the unit is disconnected, high contact voltages may still be present within the unit.

Standards and regulations

IEC 60364-7-712:2002:
Requirements for special systems or locations – Solar photovoltaic (PV) power supply systems.

Technical rules

The installation must be suited to the on-site conditions and comply with local regulations and technical rules.

Accident prevention regulations

The inverter must be installed by an authorised, specialist electrician who is approved by the supply grid operator. The electrician is responsible for observing existing standards and regulations.

The proper and safe operation of this unit requires proper transportation, storage, assembly and installation, as well as careful operation and maintenance.

Only authorised electricians who have read and fully understood all of the safety instructions contained in these operating and installation instructions, as well as other instructions concerning assembly, operation and maintenance, may work on this unit.

When this unit is operating, it is unavoidable that certain parts of the unit carry hazardous voltages, which can lead to death or serious bodily injury. The precautions listed below must be followed in order to minimise the risk of death or injury.

– The unit must be installed in compliance with safety regulations, as well as all other relevant national or local regulations. To ensure operational safety, proper grounding, conductor dimensioning and appropriate protection against short circuits must be provided.
– Keep all covers on the unit closed during operation.
– Prior to performing any visual inspections or maintenance, ensure that the power supply has been switched off and is prevented from being inadvertently switched back on.
– Never touch the electrical connections when you have to take measurements while the power supply is switched on.
– Remove all jewellery from your wrists and fingers.
– Make sure that the testing equipment is in good and safe operating condition.
– When working on the unit while it is switched on, stand on an insulated surface, ensuring that there is no grounding connection.
– Follow the instructions contained in these operating and installation instructions and observe all danger, warning and safety information.
– This list does not constitute a complete listing of all measures required for the safe operation of the unit. Contact your specialist dealer if any specific problems arise which are not sufficiently covered for the purposes of the buyer.

Modifications

It is generally not permitted to modify the inverter. Modifications to the surroundings of the inverter are permitted only if they comply with national standards.

CAUTION

Risk of damage due to improper modifications. Never modify or manipulate the inverter or other components of the system.

Information on the following topics can be found in the Operating Instructions:

- **Transportation**
- **Intended use**
- **Factory warranty and liability**
- **Service**

3 Technical Data

Electrical data	7700	7900
Input levels		
Max. PV generator power	7700 W	7900 W
MPP range	350 V ... 600 V	350 V ... 600 V
No-load voltage	800 V	800 V
Max. input current	19.0 A	19.7 A
Number of strings	4	4
Number of MPP controls	1	1
String fuses	4 x 10 A	4 x 10 A
Polarity safeguard	Short-circuit diode	Short-circuit diode
Output levels		
Rated power	6400 W	6650 W
Grid voltage	190 V ... 264 V	190 V ... 264 V
Rated current	27.8 A	28.9 A
Rated frequency	50 Hz	50 Hz
cos phi	≈ 1	≈ 1
Number of feed-in phases	1	1
General electrical data		
Max. efficiency	96.5%	96.5%
European efficiency	95.8%	95.8%
Internal consumption: Night shutdown mode	0 W	0 W
Circuit design	Self-commutated, transformerless	Self-commutated, transformerless
Grid monitoring	Monitoring in accordance with VDE 0126-1-1:2006-02, conforms to VDEW, can be switched between single-phase and three-phase	
Mechanical Data		
Display	LCD 2 x 16 characters	LCD 2 x 16 characters
Controls	2 buttons for operating display	2 buttons for operating display
Interfaces	RS485, S0, Sym bus	RS485, S0, Sym bus
Fault signal relay	Potential-free NO contact max. 30 V/3 A 250 V/1 A	Potential-free NO contact max. 30 V/3 A 250 V/1 A
Connections	AC connection: PCB terminals inside the unit (max. cross section: 10 mm²) cable connection via cable fitting (M32). DC connection: 4 strings via PCB terminals (max. cross section: 6 mm²) cable connection via cable fitting (M16). Optional DC connection: 1 x positive, 1 x negative without string fuses via PCB terminals (max. cross section: 10 mm²).	
Ambient temperature	-20°C to +60°C*	-20°C to +60°C*
Temperature monitoring of the output stage	Temperature-dependent impedance matching with shutdown if the temperature is too high	
Cooling	Free convection	Free convection
Protection rating	IP54	IP54
Noise emission	< 35 dB (A)	< 35 dB (A)
DC disconnect	Built-in	Built-in
Housing	Aluminium	Aluminium
H x W x D	810 x 340 x 220 mm	810 x 340 x 220 mm
Weight	38 kg	38 kg

Electrical data	8600	9600
Input levels		
Max. PV generator power	8600 W	9600 W
MPP range	350 V ... 600 V	350 V ... 600 V
No-load voltage	800 V	800 V
Max. input current	21.4 A	24.0 A
Number of strings	4	4
Number of MPP controls	1	1
String fuses	4 x 10 A	4 x 10 A
Polarity safeguard	Short-circuit diode	Short-circuit diode
Output levels		
Rated power	7200 W	8000 W
Grid voltage	190 V ... 264 V	190 V ... 264 V
Rated current	31.3 A	35.0 A
Rated frequency	50 Hz	50 Hz
cos phi	≈ 1	≈ 1
Number of feed-in phases	1	1
General electrical data		
Max. efficiency	96.5%	96.5%
European efficiency	95.8%	95.8%
Internal consumption: Night shutdown mode	0 W	0 W
Circuit design	Self-commutated, transformerless	Self-commutated, transformerless
Grid monitoring	Monitoring in accordance with VDE 0126-1-1:2006-02, conforms to VDEW, can be switched between single-phase and three-phase	
Mechanical Data		
Display	LCD 2 x 16 characters	LCD 2 x 16 characters
Controls	2 buttons for operating display	2 buttons for operating display
Interfaces	RS485, S0, Sym bus	RS485, S0, Sym bus
Fault signal relay	Potential-free NO contact max. 30 V/3 A 250 V/1 A	Potential-free NO contact max. 30 V/3 A 250 V/1 A
Connections	AC connection: PCB terminals inside the unit (max. cross section: 10 mm²) cable connection via cable fitting (M32). DC connection: 4 strings via PCB terminals (max. cross section: 6 mm²) cable connection via cable fitting (M16). Optional DC connection: 1 x positive, 1 x negative without string fuses via PCB terminals (max. cross section: 10 mm²).	
Ambient temperature	-20°C to +60°C*	-20°C to +60°C*
Temperature monitoring of the output stage	Temperature-dependent impedance matching with shutdown if the temperature is too high	
Cooling	Free convection	Free convection
Protection rating	IP54	IP54
Noise emission	< 35 dB (A)	< 35 dB (A)
DC disconnect	Built-in	Built-in
Housing	Aluminium	Aluminium
H x W x D	810 x 340 x 220 mm	810 x 340 x 220 mm
Weight	38 kg	38 kg

4 Unit Description

CAUTION

Incorrect use is prohibited.

The transformerless Powador units are currently available in nine different power ratings. The appropriate inverter type is selected according to the maximum output of the installed photovoltaic modules. The maximum output values can be found in the data sheet (see Technical Data, section 3).

You can find the name of your inverter on the name plate.

4.1 Scope of delivery

– Powador
– Wall bracket
– Installation kit
– Documentation

4.2 Dimensioning the PV generator

The selection of the PV generator is of central importance when dimensioning a PV system. When doing so, you must ensure that the PV array is also compatible with the inverter.
Observe the data provided in the data sheet (see section 3, Technical Data) when dimensioning the PV array.

NOTICE

KACOCALC Pro, a dimensioning program for the easy selection of PV modules, can be downloaded at no cost at the following address http://www.kaco-newenergy.de

Dimensioning the PV generator:

The number of PV modules connected in series must be selected in such a way that the output voltage of the PV generator stays within the permitted input voltage range of the inverter – even during extreme outside temperatures. In Central Europe, module temperatures between -10 °C and +70 °C should be assumed. Depending on the way in which the modules are installed and the geographic location, +60 °C or +70 °C should be used when calculating the voltage. The temperature coefficients of the solar modules should be taken into account. The following criteria must be met for calculating the voltage of the PV generator:

– V_0 (-10 °C) < max. input voltage (open circuit voltage, section 4, Technical Data). Even at very low outside temperatures (-10 °C), the open circuit voltage of the connected string must lie within the permitted input voltage range. If the temperature falls from +25 °C to -10 °C, the open circuit voltage in 12 V modules increases by approx. 2.8 V per module (5.6 V for a 24 V module). The open circuit voltage of the entire string must be less than the open circuit voltage of the inverter.

– V_{Mpp} (+60 °C) > min. input voltage (open circuit voltage, section 4, Technical Data). Even at very high module temperatures (+60 °C), the MPP voltage of the connected string should lie within the permitted input voltage range. If the temperature increases from +25 °C to +60 °C, the MPP voltage in 12 V modules decreases by approx. 3.6 V per module (7.2 V for a 24 V module). The MPP voltage of the entire string must then always be greater than the lower MPP voltage of the inverter.

If the MPP voltage moves outside of the permitted input range, the system still functions properly. In this situation, the maximum possible amount of power is not fed into the grid, but rather slightly less.

Provided that the input voltage is within the permitted input voltage range, the inverter will not be damaged if a connected PV generator provides current that is above the maximum usable input current.
If the PV generator briefly provides more than the inverter's max. PV generator power, especially with changing cloud cover and relatively low module temperatures, the inverter may switch off due to safety reasons and automatically switch on again after a country-specific waiting period (see section 4, "Technical Data"). The overload status is shown by a red LED and as plain text on the display. Under normal circumstances, the dynamic control of the inverter ensures that the inverter continues to operate without interruption.

The PV array still represents the largest factor in the cost of a PV system. For this reason, it is extremely important to obtain maximum energy yields from the solar generator. To achieve this, solar generators in central Europe should be oriented to the south at a 30° angle of inclination. Positioning in the shade should be avoided at all costs.

This orientation is quite often not possible due to structural reasons. In order to achieve the same energy yield as an optimally oriented PV array (south, 30° angle of inclination), the PV array power can be increased.
For roofs with an east-west orientation, we recommend a PV system with two separate strings. These two strings should be assigned to the individual MPP inputs or inverters. The output of the solar generator can be expected to be higher in exposed areas in the mountains or in southern regions. For this reason, an inverter with an output that is correspondingly higher is required. Please consult with us or your specialty dealer about this.

4.3 Protection concepts

The following monitoring and protective functions are integrated into Powador inverters:
– Overvoltage conductors/varistors to protect the power semiconductors from high-energy transients on the grid side
– Temperature monitoring of the heat sink
– EMC filters to protect the inverter from high-frequency grid interference
– Grid-side grounded varistors to protect the inverter against burst and surge pulses
– Islanding detection according to VDE 0126-1-1
– AC/DC-sensitive residual current circuit breaker (**RCD**) type B (**R**esidual **C**urrent protective **D**evice), which monitors the leakage current from the Powador's grid connection to the PV generator and interrupts the feed to the grid when the residual current exceeds 30 mA. The RCD type B triggers when a cable has a fault in the insulation, a frame fault or a ground fault.
– DC disconnect for positively disconnecting the photovoltaic generator from the inverter
– DC fuses (10 A)

5 Installation and Start-Up

WARNING

Risk of fatal injury from fire or explosions. The Powador's housing may become hot during operation.
– **Do not mount the Powador on flammable materials.**
– **Do not install the Powador in areas which contain highly flammable materials.**
– **Do not install the Powador in areas where there is a risk of explosion.**

CAUTION

Risk of burns from hot housing components. Install the Powador so that unintentional contact with it is not possible.

5.1 Selecting an appropriate place for installation

NOTICE

Powador inverters meet the requirements of protection rating IP54 if all cable feedthroughs are used or suitably closed off.

In spite of measures taken to seal the units, the units should be installed in areas that are as dry as possible in order to extend their service life. Furthermore, in order to protect the units from overheating, ensure that they are installed in a climate-controlled area. This also extends their service life.

The following items are important when you select the place of installation for the inverter:
– Ensure good access to the unit for installation or any service work that may later be required.
– Maintain the following minimum clearances around the unit:
  200 mm between inverters,
  700 mm clearance to stacked inverters,
  500 mm to cabinets, ceilings, etc.
– The unit is designed for vertical wall mounting.
– Air must be allowed to circulate freely around the housing and through the heat sink on the rear side.

– If the inverter is built into a switching cabinet or similar, provide forced ventilation to ensure that heat is sufficiently dissipated.
– The heat sink may reach a max. temperature of 90°C. Therefore, mount the inverter only on walls made from heat-resistant material.
– Ensure that the wall has adequate load-bearing capacity and use appropriate installation material.
– Be sure to install the inverter in a sufficiently elevated place, especially in areas prone to flooding.
– Installation at eye level makes it easier to read the display.

IMPORTANT

Due to the high system voltage, the current that flows on the DC side is lower than that flowing on the AC side. This means that losses on the AC-side lead are higher than those on the DC-side lead at identical cable cross-sections. For this reason and due to thermal factors, it makes sense to position the inverter near the counter.

5.2 Installing the inverter

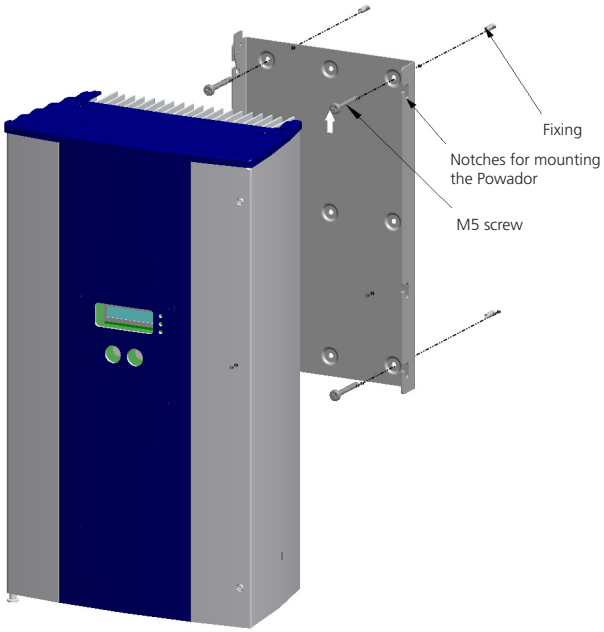


Figure 5.1: **Powador wall bracket**

An installation kit consisting of four fixings and four 70 mm Spax screws is supplied with the inverters. Check the composition and condition of the wall before installation. If necessary, use an installation kit other than the one supplied with the inverter.

ACTION

– Drill the holes for the fixings at the selected installation position to match the cut-outs in the mounting plate.
– Place the fixings into the holes.
– Use the Spax screws to mount the wall bracket onto the wall at the selected location. When doing so, be sure that the arrow cut into the mounting plate points upwards.
– Mount the inverter on the mounting bracket so that the pegs in the heat sink rest in the notches.
– Lock the safety catch. To do this, slide the upper end of the safety catch towards the wall until the groove runs parallel to the wall (see figure 5.3).

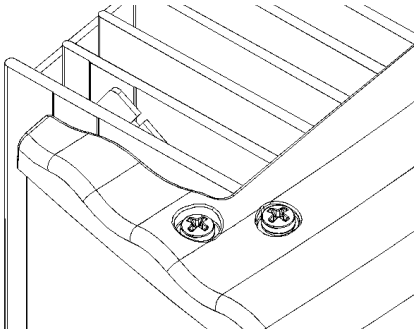


Figure 5.2: **Safety catch (open)**

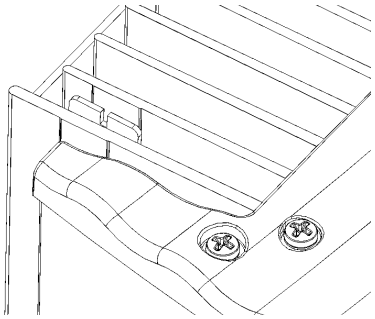


Figure 5.3: **Safety catch (closed)**

5.3 Electrical connection

General
After the inverter has been installed in its fixed location, the electrical connection to the unit can be established.

DANGER

The Powador may be installed only by trained and authorised specialists.

All mandatory safety regulations, the currently required technical connection specifications of the responsible power supply company, as well as other generally applicable regulations are to be adhered to.

WARNING

Before you connect the inverter, disconnect the AC and DC sides from all power sources and secure them against being inadvertently switched back on.

The connection of the PV generator and the grid connection are established via PCB terminals in the connection box of the inverter (see figure 5.4).

ACTION

The door of the housing must be opened to do this. The door is held shut with two Phillips recessed-head screws on the right side of the housing.

NOTICE

At the AC connection terminals, the maximum conductor cross-section that can be connected is 16 mm² (rigid) or 10 mm² (flexible). Length of insulation to be stripped off: 10 mm.
The max. cross-section for leads to be connected to these DC connection terminals is 6 mm². Length of insulation to be stripped off: 15 mm.
A screwdriver (slotted, 3.5 mm) is to be used for the DC terminals in the inverter. Put the screwdriver into the cut-out provided. Press the screwdriver upwards slightly. Feed the cable into the spring terminal. Put the screwdriver back into the original position. Remove the screwdriver. The spring terminal is closed and the cable is held in place.

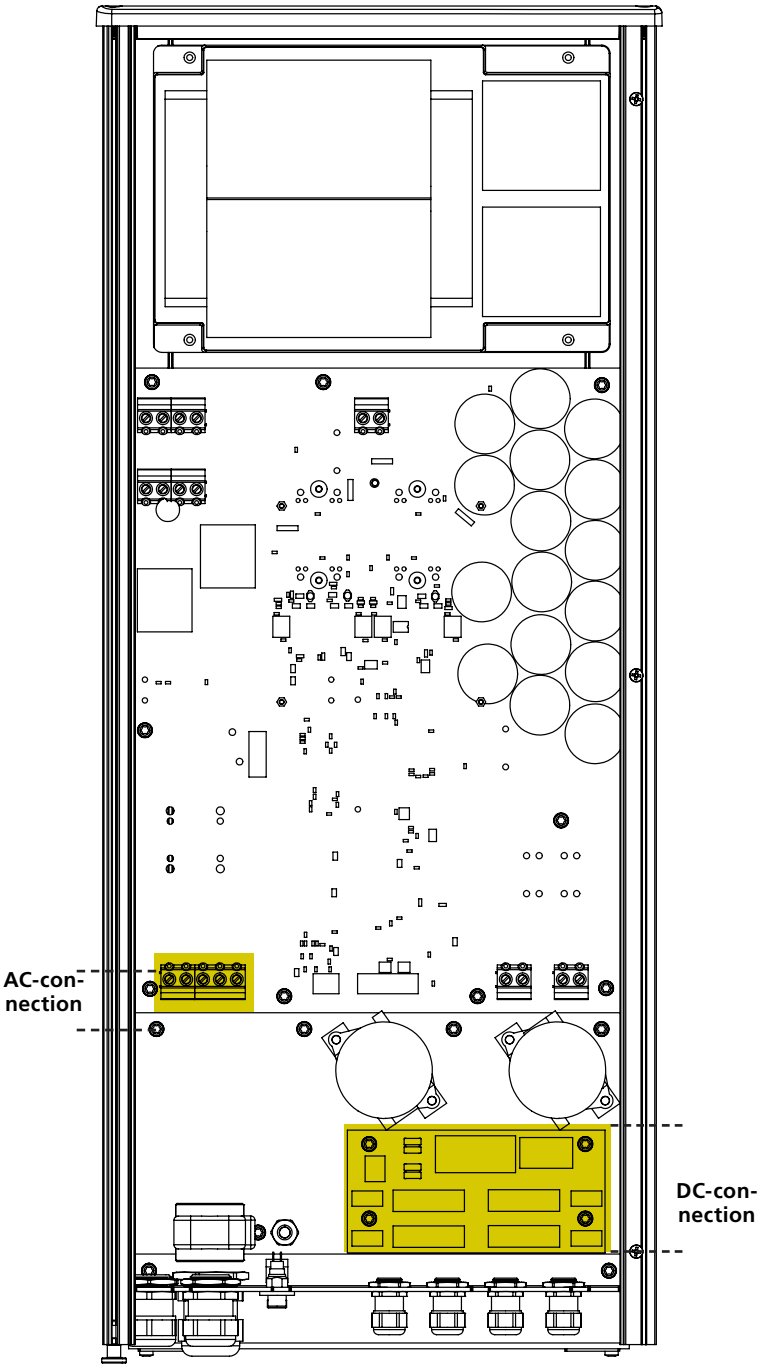


Figure 5.4: **Overview of the Powador**

Grid connection

The inverter feeds in single-phased at terminal L1. The grid connection is made using 3 conductors (L1, N, PE) or 5 conductors (L3, L2, L1, N, PE). The 5-conductor connection is only required when 3-phase grid monitoring is used. This is only necessary with certain systems. There is an appropriate cable fitting on the underside of the housing for inserting the leads.

We recommend the following conductor cross-sections for cable lengths up to 20 m: 10 mm²

Larger cross-sections should be used for longer leads. The maximum clamping range of the cable fitting is 21 mm.

VDE 0100 part 430, "Protection of cables and lines against overcurrent", specifies that NYM cables with fixed wiring are to be protected as follows:
Installation type B2 (multi-conductor lead in pipe or duct, either on or in walls or flush-mounted) at an ambient temperature of +25 °C: 10 mm², 40 A.

NOTICE

The largest fusing allowed is a B50 automatic circuit breaker, even if the cross-section of the cable that has been laid would allow a larger fusing. Always follow the applicable regulations regarding the cross section and the manner of laying the cable.

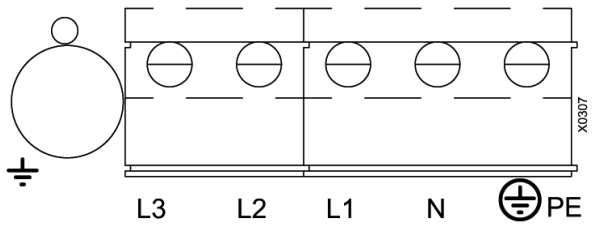


Figure 5.5: **AC connection**

NOTICE

Be sure to use cables with a sufficiently large cross-sections to avoid excessive line impedance between the building's distribution box and the respective Powador unit.

When the line impedance is high (i.e. long AC-side leads), the voltage at the grid terminals of the inverter increases during feed-in to the grid. The inverter measures this voltage. If the voltage at the grid terminals exceeds the line overvoltage limit, the inverter will switch off due to line overvoltage. This condition must be taken into consideration when wiring the AC and dimensioning the AC lead.

Even when multiple inverters are distributed across the individual grid phases, the cross section of the N conductor must correspond with the cross section of the individual phases. It cannot be made smaller.

DANGER

Risk of electric shock at live connections.
Check that the power lead is voltage-free before inserting it into the unit.

ACTION

Guide the lead, which has been stripped of its jacket and insulation, through the cable fitting.
Connect the lead, which has been stripped of its jacket and insulation, as shown on the label on the right side of the PCB terminal.

CAUTION

Check that the leads are properly connected.

ACTION

Once again, ensure that all connected leads are firmly connected.
Tighten the cable seal of the cable fitting.

Circuit board fuse

WARNING

Always replace a defective fuse with one of the same type. Failure to observe this may cause arcing, which results in a hazard to health and to the unit.

WARNING

Disconnect the inverter completely from all power sources before replacing the fuses.

The power section has one internal circuit board fuse. This is labelled F0901 on the PCB.

F0901 Model: 179200 5x20 time-lag 250V/1.6 A
Manufacturer: SIBA

PV generator connection

The PV generator leads are connected directly to the spring-type terminal on the fuse board in the connection box. The maximum cable cross-section that can be connected is 6 mm^2. As an option, the connection can also be established using plug connections on the unit's base plate.

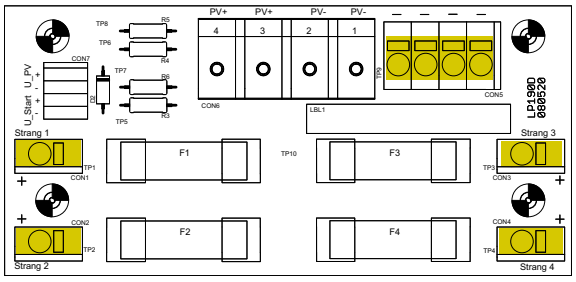


Figure 5.6: **DC connection of the Powador**

DANGER

To ensure maximum protection against hazardous contact voltages while installing photovoltaic systems, both the positive and the negative leads must be strictly isolated electrically from the protective earth (PE).

CAUTION

Risk of damage.
Be sure that the polarity is correct when you make the connection. Connecting it incorrectly will damage the inverter.

ACTION

Before connecting the PV generator to the Powador, check that the PV generator is not grounded.

- Measure the DC voltage between the protective earth (PE) and the positive lead and between the protective earth (PE) and the negative lead of the PV generator.
- If stable voltages can be measured, this indicates an ground fault in the PV generator or its wiring. The ratio between the measured voltages gives an indication as to the location of this fault. Rectify this fault before taking any further measurements.
- Measure the electrical resistance between the protective earth (PE) and the positive lead and between the protective earth (PE) and the negative lead of the PV generator.
- Low resistance (< 2 MΩ) indicates a high-impedance ground fault of the PV generator, which must be fixed prior to continuing with the installation.

CAUTION

The voltage of the PV array must be measured before connecting the DC leads to the inverter terminals. The DC voltage must not exceed the maximum generator voltage of the inverter. Connecting to a higher voltage will destroy the unit.

The PV generator can be connected in the following ways:
– Spring-type terminals (through cable fittings)
– Tyco plug connectors
– MC plug connectors
The cable fittings are already installed upon delivery. As an option, Tyco and MC plug connectors can be delivered with the inverter.

Connecting the PV generator using cable fittings

ATTENTION

Meet the requirements of protection rating IP54 by closing the unused cable fittings with blind caps.

ACTION

To do this, unscrew the cable fittings until you can insert the cables through the fitting, then screw the ends of the cables into place in the connection terminals labelled "PV+" and "PV-". When doing this, ensure that the polarity is correct. Tighten the cap of the cable fitting.

Connecting the PV generator using MC or Tyco plug connectors (optional)

As an option, MC or Tyco plug connectors can be delivered with the inverter. These can be used instead of the cable fittings that were already installed upon delivery. These pre-installed cable fittings must first be removed before installing the appropriate plug connectors.

WARNING

Always disconnect the inverter from the PV generator by operating the integrated DC disconnect before pulling out the plug connector. Failure to observe this may cause arcing, which can result in a hazard to health and to the unit.

ACTION

Unscrew the cable fittings from the cut-outs in the base plate of the inverter.
Insert the Tyco or MC sockets from the outside through the cut-outs, and secure them from the inside using the black plastic nuts.

The assembly of the Tyco and MC plug connectors is shown in figure 5.7 and figure 5.8 respectively.

Figure 5.7: **Assembling the Tyco plug connectors**

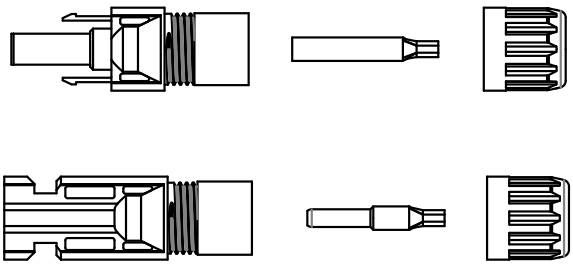


Figure 5.8: **Assembling the MC plug connectors**

External combiner box

When an external combiner box is used, two plug connectors must be replaced with suitable plastic fittings on the units with plug connections. The PV generator connection leads of the combiner box are fed through these into the inverter. Connect these two leads to the terminals labelled PV+ and PV- on the fuse board (Figure 5.9).

ATTENTION

Risk of damage.
Ensure that the polarity is correct when connecting the unit.

IMPORTANT

The internal DC fuses of the Powador 7700/7900/8600/9600 do not function in this situation. Provide an external string fuse.

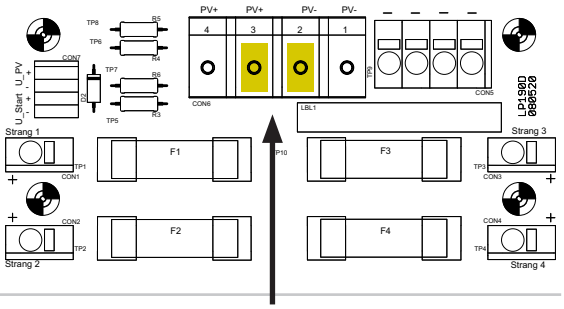


Figure 5.9: **DC connection area for external combiner box**

5.4 DC disconnect

The inverter has an automatic internal all-pole DC disconnect that separates the inverters from the photovoltaic generator at all poles in case of a fault. There is a toggle switch on the underside of the Powador 7700/7900/8600/9600 so that this function can also be used manually. This can also be used to switch off the internal relays at all poles.

IMPORTANT

In normal mode, the switch must be switched on. If not, power cannot be fed into the grid.

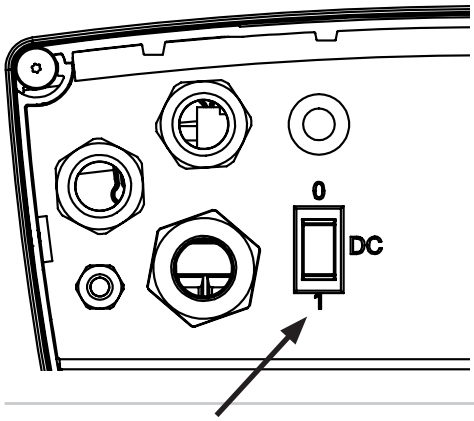


Figure 5.10: **DC disconnect**

5.5 DC string fuse

Fuse type: Size: 10 x 38 mm, PV fuse DC 900 V, 10 A,
item no. 5021506, manufacturer: SIBA

The Powador 7700/7900/8600/9600 has four integrated string fuses to protect your module from overcurrents if faults occur. Each of these is designed for a 10 A current. This values can be used with the majority of commercially available modules. If the module's manufacturer specifies a different type of fuse, replace the standard fuse with the one specified.
As an option, you can order fuses (8 A and 12 A) from KACO new energy GmbH.

DANGER

Disconnect the inverter from all power sources before replacing the fuse.

WARNING

Only replace a defective fuse with one of the same type.

All 4 fuses must be of the same type.

Failure to observe this may cause arcing, which results in a hazard to health and to the unit.

5.6 Interfaces

All interfaces are connected on the board located on the inner side of the doors.

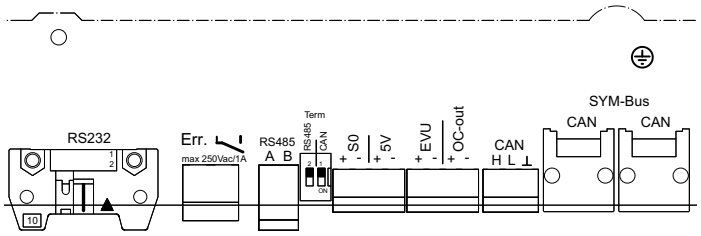


Figure 5.11: **Interface terminals**

(A) Connecting the fault signal relay/ relay 33

The inverter is equipped with a potential-free relay contact as standard (**Err.**). This contact can be used for two differing functions.

1. **Fault signal relay**
2. **Relay 33**

Only one of the two functions can be active at any given moment. You cannot use both functions simultaneously.

1. Fault signal relay

When functioning as a fault signal relay, the potential-free contact closes as soon as a fault in operation arises. The contact is designed as a NO contact and marked as "ERR" on the circuit board.

Maximum contact load

- DC: 30 V/3 A
- AC: 250 V/1 A

IMPORTANT

In the event of failure of the feed-in phase (power failure on the public grid), the relay will not trigger. If this happens, all LEDs and the display go out. The inverter is shut down completely. A fault signal cannot be sent.

2. Relay 33 (DE)

In "Relay 33" mode, the potential-free contact performs this function in the inverter. If sufficient PV energy is available for a period of 30 minutes, the contact is closed. In the simplest case, this can be indicated in menu level 2 by a visible signal (e.g. signal light) or an audible signal (e.g. siren).
The potential-free contact can be used to switch larger appliances (e.g. air conditioning units) on and off. This requires an external power supply and an external load relay. These optional accessories can also be obtained as an "R33 switch" from your specialist dealer.

Please consult the operator's manual for information on how to operate it.

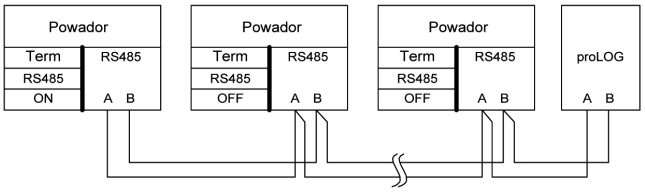
(B) Connecting the S0 output

The inverter is equipped with an S0 pulse output. Items such as a large display can be connected to it. The pulse rate is adjustable (see section 5.8, "Parameter programming").

(C) Connecting the RS485 interface

In order to connect several Powador units using the RS485 interface, you can use either a commercial patch cable with an RJ45 plug or a two-core cable that is suited for a field bus. When the two-core cable is used, terminals RS485 A and RS485 B are connected to one another.

When a patch cable with an RJ45 plug is used, a CAN bus connection, which is required for the Sym bus, is established at the same time. In either case, the connection to the Powador-proLOG is established using terminals RS485 A and B of the inverter, in the same manner as the inverters are connected to each other. Figure 5.10 shows a connection diagram.



Connection diagram for RS485 interface

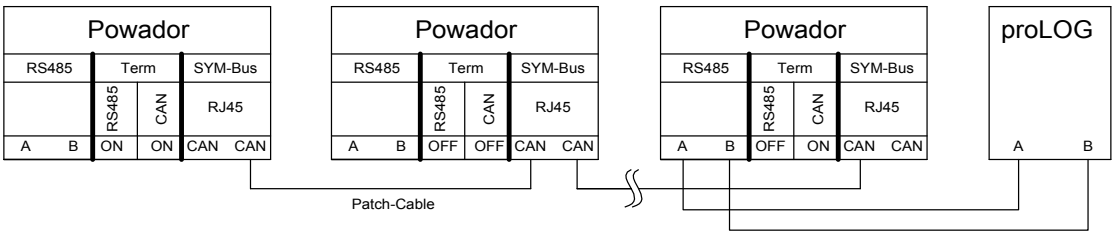


Figure 5.12: **Connection diagram for RS485 interface and Sym bus using a patch cable**

For correct signal transmission, terminating switch "Term RS485" on the first unit in the chain must be set to ***ON***. On the other inverters in the chain, terminating switch "Term RS485" must be set to ***OFF*** (see figure 5.10).
This termination does not depend on the manner of cabling that is used. The switch is found on the board next to the terminal block (figure 5.9).
With a bus system such as RS485, each unit sharing this bus must possess a unique address, regardless of whether it is an inverter or a current sensing unit. For inverters, the address range can be selected between 1 and 32. You can define the address for each inverter using the configuration menu (see Operating Instructions).

IMPORTANT

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

5.7 Limiting during asymmetric feed-in

In order to limit the asymmetry between the phases during feed-in to the maximum permissible value, the units are equipped with an additional communication interface. The feed-in powers of all inverters connected to the grid are recorded using this interface. From this, the inverters calculate their maximum permitted feed-in power (taking the maximum asymmetry into account).

The inverters must be connected to each other via the CAN bus interface so that they can communicate with one another. You can use either a patch cable with an RJ45 plug or a two-core cable that is suited for a field bus to do this. When the two-core cable is used, terminals CAN H and CAN L are connected to one another. The inverters are cascaded. On the first and last inverters (each of which has only one cable attached), terminating switch "Term CAN" must be set to ***ON***.

Terminating switch "Term CAN" must be set to ***OFF*** on the other inverters. This termination does not depend on the manner of cabling that is used. When a patch cable with an RJ45 plug is used, an RS485 connection, which is required for a Powador proLOG connection, is established at the same time. (Figure 5.10+5.11)

Recommendations for the cables used in the CAN bus connection:
We recommend a standard commercial patch cable (CAT5) for cable lengths up to 120m. A two-core, twisted, shielded data cable, which is suited for a field bus, can also be used. Up to 500 m: 0.75 mm^2 cross-section minimum. Correspondingly larger cross-sections should be used for longer distances.

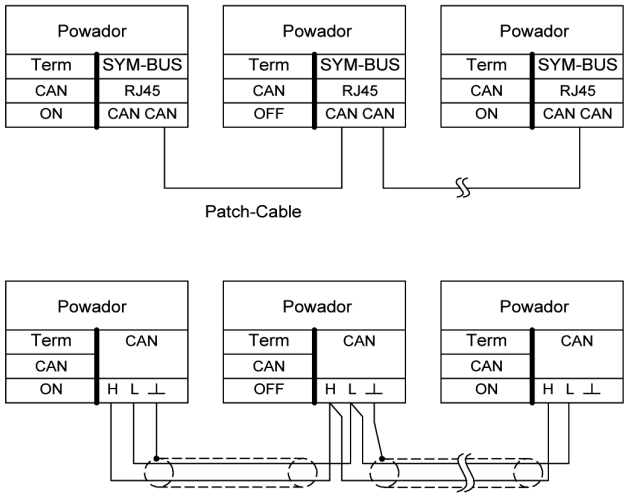


Figure 5.13: **SYM bus connection diagram**

A group of up to a total of 32 inverters can be symmetrised in this way. All inverters of a group must be assigned a unique SYM bus address within the range of 1 to 32. In addition, the feed-in phase into which the inverter feeds must still be entered into every inverter. The red LED flashes until a feed-in phase has been entered.

The maximum permitted asymmetry must still be entered so that symmetrisation can take place properly. The value for the maximum asymmetry is usually the same for all inverters in a group. Thus, if the maximum permitted asymmetry in the grid is 4,600 W, that same value (4,600 W) must be entered into all inverters.

5.8 SYM bus test

The inverters have an integrated SYM bus test to test the wiring and the software settings of the inverters that are connected together. This can only be activated if the SYM bus is activated.

In order to begin the SYM bus test, use key "2" to select "***yes***" in the "SYM bus test active" menu on one inverter. After this, the displays on all of the inverters in the group show the following: the feed-in phase that has been set, the number of inverters on this feed-in phase and the sum of all rated powers of inverters connected to this feed-in phase. These values make it easy to check the configuration.

5.9 Power Boost

In order to change the frequency of the IGBT bridge from 17 kHz to 9 kHz, the Power Boost mode must be activated in menu level 2.

Note the following as this change is made: 9 kHz is within the range of audible frequencies.

The Power Boost mode improves the degree of efficiency and can be used where the operating noise from the inverter is acceptable.

5.10 Grid monitoring

The inverters are normally connected to one phase only. In this case, single-phase grid monitoring is active; this prevents islanding. It may be useful to establish three-phase grid monitoring in special system configurations. In this case, three-phase grid monitoring can be activated in menu level 3. The inverter must all be connected to three phases. The feed-in phase is always the terminal on the inverter marked L1.

5.11 Starting up the inverter

After completing the mechanical and electrical installation, the inverter is put into operation as follows:

NOTICE

The inverter can only be put into operation under daylight conditions (i.e. when the PV array voltage is present). If no daylight or PV array voltage is present, the inverter can be activated by pressing the night start-up key (see section 4.8 in the Operating Instructions). However, normal operation is not possible in this condition. Only the values can be read off the display.

ACTION

– Switch on the grid voltage (via the external circuit breakers).
– Switch on the PV array via the DC disconnect (0 ⟶ 1).

During the initial start-up, the appropriate country and language must be selected.
The green "PV-Generator" LED lights up when in non-feed-in mode and indicates that it is ready to be put into operation. The display now indicates the current generator voltages "Start from xxx V, meas.: xxx V". If the measured voltage is greater than the starting voltage, the unit will start the feed-in after a country-specific waiting time. This start-up period is required in order to ensure that the generator voltage is continuously above the power delivery limit.
A quick start routine is provided for startup and test purposes. This routine circumvents the start-up period. This quick start routine is found in the configuration mode menu (see Operating Instructions).

During the normal start-up procedure, the line relays audibly switch on after a country-specific time period and the feed-in starts. This is indicated by the green LED "Grid-feed". The display now shows the power being fed into the grid. The "Display" key can now be used to display the various measured values (see Operating Instructions).

Frequency-dependent power reduction

If the grid operator requires frequency-dependent power reduction in accordance with the BDEW Medium Voltage Directive ("Mittelspannungsrichtlinie"), this must be activated via the display.
You can find the relevant menu item in the parameter menu under "Activate BDEW" (menu level 3, page 19).
Power reduction starts at 50.2 Hz. Overfrequency shutdown occurs at 51.5 Hz.
At the moment that 50.2 Hz is exceeded, the current power is "frozen" and used to calculate the power reduction.
The power is reduced with a gradient of 40% power reduction per 1 Hz increase in frequency. The inverter then has status 11 (power reduction). No other information is shown on the display.
The active power may not be increased again until after the frequency has returned to a value of f ≤ 50.05 Hz.
Underfrequency shutdown occurs at 47.5 Hz.

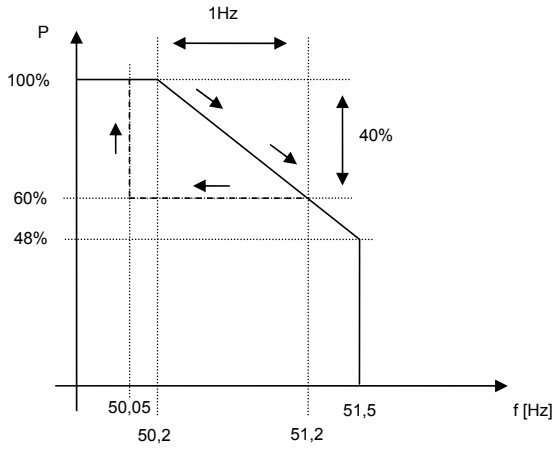


Figure 5.14: **Frequency-dependent power reduction**

5.12 Programming parameters

Various operating parameters can be set in the parameter mode menu of Powador units.

WARNING

Incorrect parameter settings can lead to loss of functionality as well as render your safety certificate ["Unbedenklichkeitsbescheinigung"] invalid. Modifications may only be made in exceptional cases and after prior consultation with the manufacturer and power supply company.

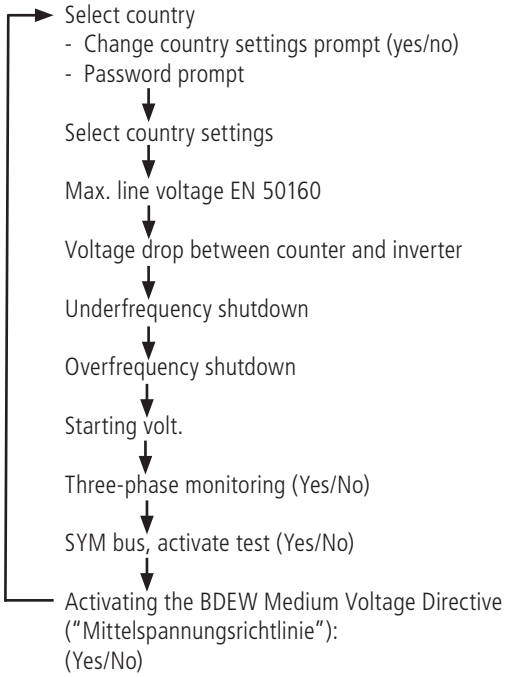
ACTION

To switch to programming mode, hold down key "2" for approx. 20 seconds. Use key "1" to scroll through the various menu items. The menu is continuous. When you reach the end, the display automatically returns to the first item.

ACTION

Use the "Settings" key to change the parameter that is shown. The value then either increases or decreases, depending on the parameter. The values here are also continuous, i.e. after you reach the maximum value, they return to the minimum value.

Menu level 3 – Parameter programming



Explanation of the individual parameters:

Select country:

On the German version, the country-specific parameters for Germany are already preset. You need a device-specific password to change these parameters.

Select country settings:

You enter the country settings here after you have activated the "Select country" option.

Max. line voltage EN 50160

The line voltage is averaged over 10 minutes. If the value that has been set is exceeded, the inverter is disconnected from the grid. This voltage threshold can be set under "MAX. LINEVOLTAGE EN 50160".

Voltage drop between counter and inverter

The limit value can be set under "VOLTAGE DROP BETWEEN INV AND METER". This voltage drop between the inverter and the feed-in counter is added to the limit value under "MAX. LINEVOLTAGE EN 50160". The inverter switches off if the average line voltage exceeds this value.

Minimum and maximum line frequency:

The line frequency is monitored. If the frequency drops below the value set in "MINIMUM LINE FREQUENCY" or exceeds the value set in "MAXIMUM LINE FREQUENCY", the inverter switches off. Both limit values can be set in 0.1 Hz increments.

Starting voltage for feed-in:

The inverter begins the feed-in in the morning from the set starting voltage onwards. (Display: "Start from XXX V"). The minimum MPP voltage is preset as standard. At a high generator voltage, the starting voltage may be increased to ensure that the inverter does not switch itself on and off too often with low power. The starting voltage can be set in the range between 370 V and 500 V in increments of 10 V.

Three-phase monitoring

It may be useful to establish three-phase grid monitoring in special system configurations. In this case, three-phase grid monitoring can be activated. When this is done, single-phase monitoring is deactivated. Both types of grid monitoring conform to VDE 0126-1-1.

Activating the SYM bus

The SYM bus must be activated in order to symmetrise a group of inverters. The following items are added to the menu when the SYM bus is active:
SYM bus, CAN address (1-32)
SYM bus, phase (none, L1, L2, L3)
SYM bus, asymmetry (4,600 W – 100 W in 100 W steps)
SYM bus, activate test (Yes/No)

Activating the BDEW Medium Voltage Directive ("Mittelspannungsrichtlinie"):

Once the BDEW Medium Voltage Directive ("Mittelspannungsrichtlinie") is activated, VDEW 0126-1-1 4.3 is no longer complied with.

ACTION

To leave the parameter menu, press both keys at once. Upon leaving the menu, the settings are saved.

6 Maintenance

6.1 Visual inspection

Inspect the inverter and the leads for visible damage and pay attention to the operating status display of the inverter.
In case of damage, notify your installer. Repairs may only be carried out by electricians.

NOTICE

Have your installer check for proper operation of the inverter at regular intervals.

6.2 Cleaning the heat sink

Do not use compressed air. Use a vacuum cleaner or a soft brush to remove loose dust from the top side of the inverter (heat sink) on a regular basis. Remove any dirt from the ventilation inlets if necessary.

7 Switching the Inverter Off

The inverter must be switched off prior to performing adjustment, maintenance and repair work. This is done as follows:

DANGER

Risk of fatal injury by electric shock at live connections. Lethal voltages remain present in the inverter even after the electrical connections have been disconnected.

Wait five minutes before working on the inverter.

When working on photovoltaic modules, in addition to disconnecting from the grid, the DC main switch on the generator junction box (or the DC plug connectors) must always be disconnected at all poles.

Disconnecting the grid voltage is not enough.

ATTENTION

The work sequence must be adhered to at all times, particularly when using DC plug connectors as DC disconnects. Otherwise, arcing may occur when disconnecting DC plug connectors under load. This will destroy the plug connectors.

ACTION

– Disconnect the line voltage (deactivate the external circuit breakers).
– Disconnect the photovoltaic module using the DC disconnect.
– Ensure that the inverter's grid connection terminals are voltage-free.

8 Powador as Part of a PV System

8.1 System layout

A sample design of a grid-connected PV system using a Powador is shown in the following overview circuit diagrams.

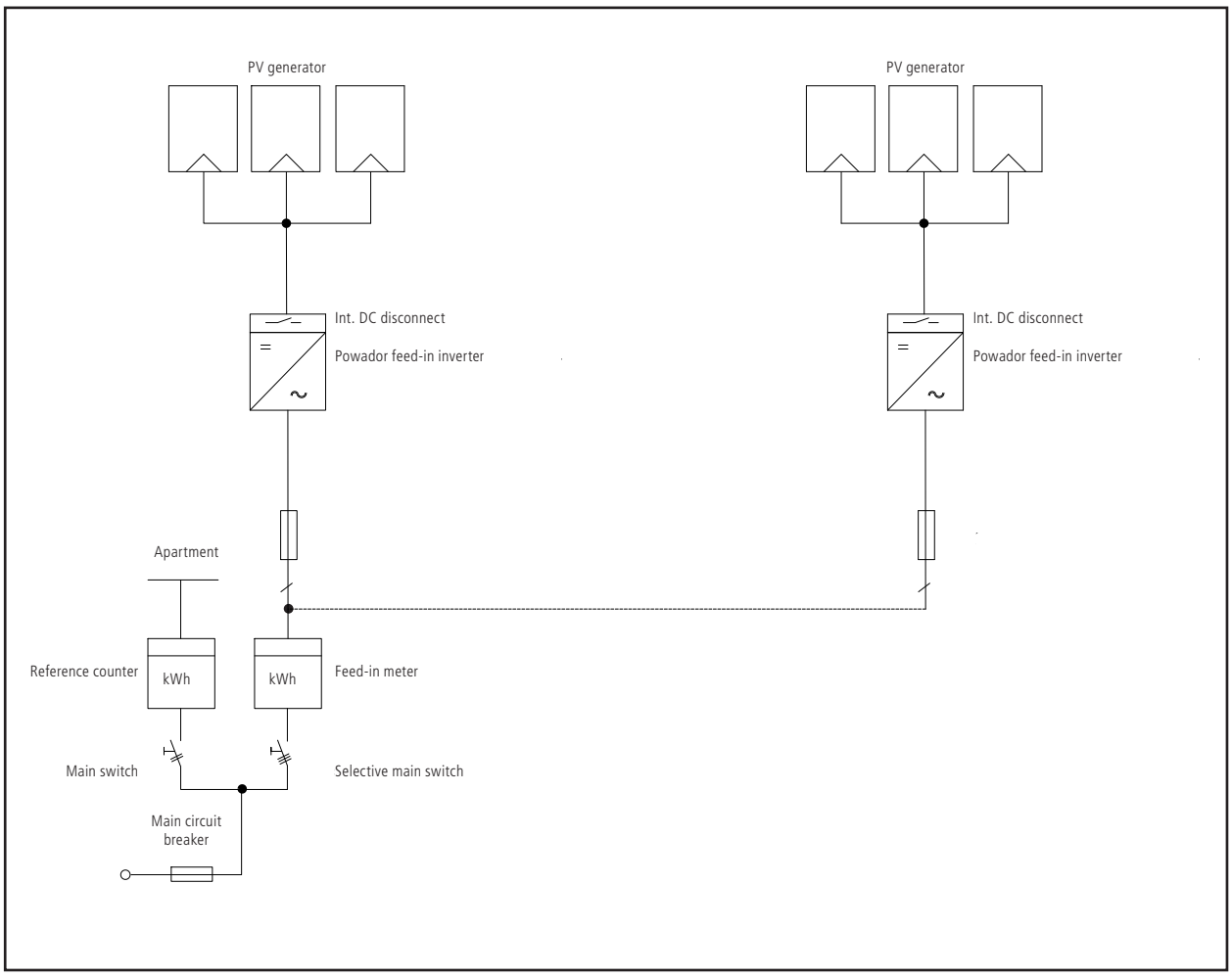


Figure 8.1 **Single-pole overview circuit diagram for a system with two inverters**

A summary of the components:

DC terminal point:

Two generator strings are connected in parallel either at a DC terminal point between the PV array and the inverter or directly on the inverter (terminals for three strings are provided on the inverter). Of course, you can also connect the strings directly to the PV array and then run just one negative and one positive lead to the inverter.

DC disconnect:

In order to be able to disconnect the inverter on the generator side from sources of voltage, the inverter comes equipped with an integrated DC disconnect. As a result, the installation of an external DC disconnect is not required.

Line fuses:

For grid-side fuse protection of the Powador 7700 / 7900 / 8600 / 9600, the largest fusing allowed is a B50 automatic circuit breaker, even if the cross-section of the cable that has been laid would allow a larger fusing. We recommend a cross section of 10 mm^2 for cable lengths up to 20 m. Larger cross-sections should be used for longer leads. The maximum clamping range of the cable fitting is 21 mm (5.3: Electrical connection - grid connection). VDE 0100 part 430, "Protection of cables and lines against overcurrent", specifies that NYM cables with fixed wiring are to be protected as follows: Installation type B2 (multi-conductor lead in pipe or duct, either on or in walls or flush-mounted) at an ambient temperature of +25 °C: 10 mm^2, 40 A.

Feed-in meter:

The required feed-in meter is specified and installed by the responsible power supply company. Some power supply companies also allow the installation of your own calibrated meters. In this case, you do not need to pay rent for the meter, but the power supply company may require that the meter be periodically calibrated.

Selective main switch:

Contact your power supply company if you have questions concerning the required main switch.

8.2 System with multiple inverters

Observe the following regarding systems with multiple inverters:

Asymmetric feed-in:
The power should be distributed as equally as possible over the three phases. In Germany, the asymmetry between the phases may be a maximum of 4.6 kW (according to the VDEW guidelines concerning the connection and parallel operation of independent power generating systems on the low-voltage grid, 4th edition, 2001).

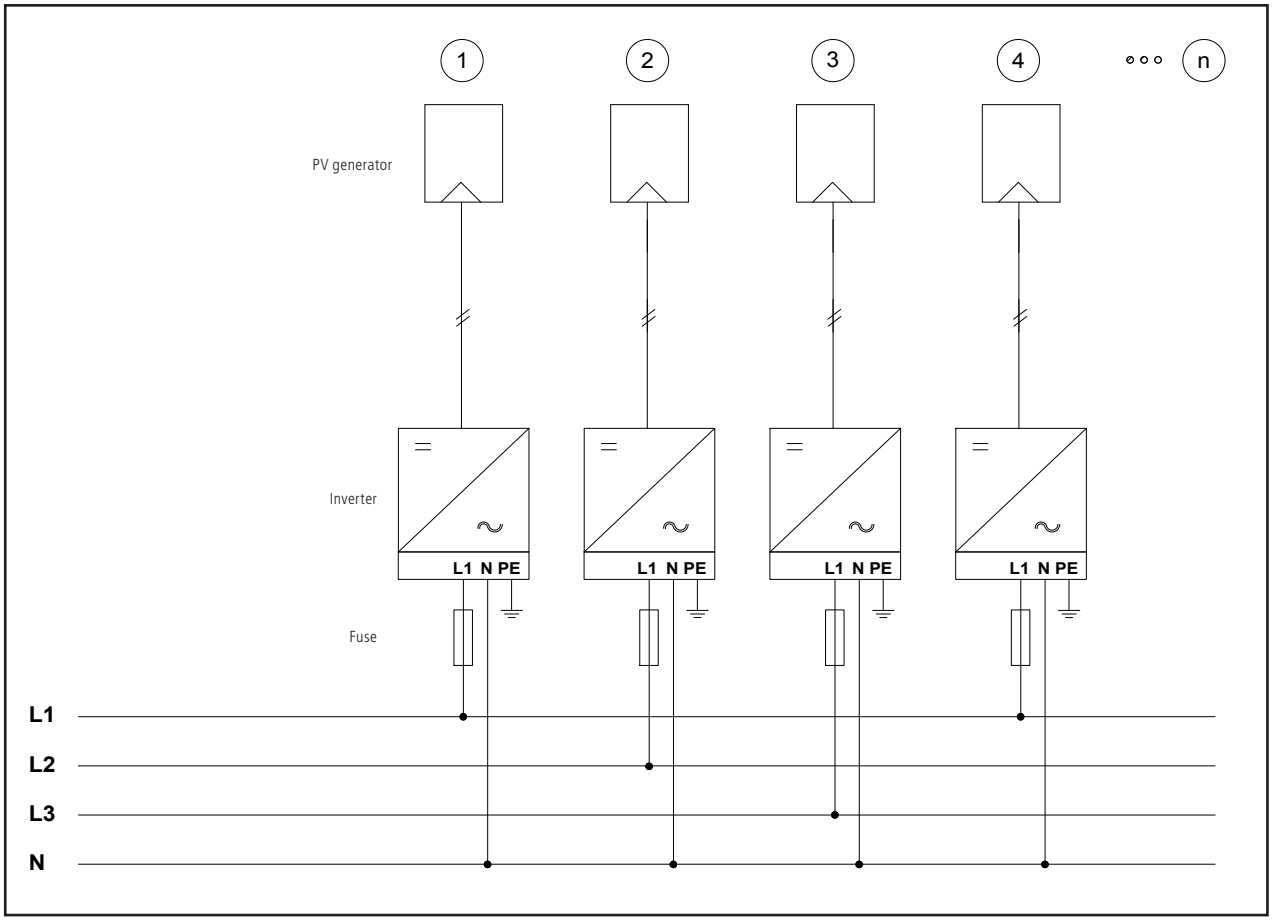


Figure 8.2: **Grid-side connection for systems with multiple inverters with single-phase grid monitoring**

Three-phase grid monitoring

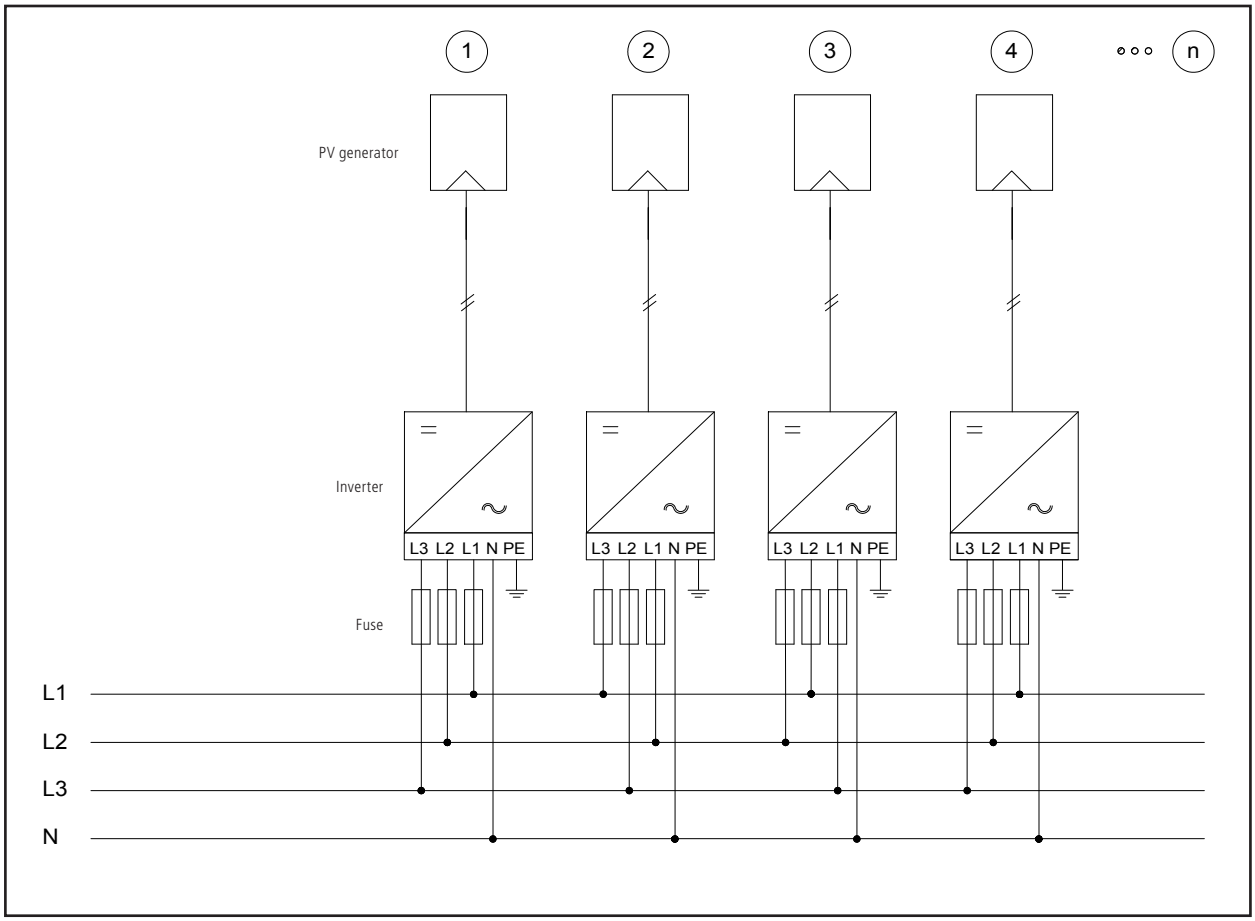


Figure 8.3: **Grid-side connection for systems with multiple inverters with three-phase grid monitoring**

Electrical connection:

The Powador feeds in on one phase only. In order to avoid asymmetries in the grid, systems with multiple inverters should be designed so that the inverters feed into the grid in differing phases. The inverter feeds into the phase that is labelled L1 on the inverter's terminals

If you have multiple inverters, connect phase L1 to terminal L1 on the first unit. On the second unit, connect phase L2 to terminal L1. On the third unit, connect phase L3 to terminal L1. Continue as above. This distributes the power optimally.

Connections L2 and L3 only need to be connected when 3-phase grid monitoring is used (Section 5.3).

9 Troubleshooting

In line with our continuously expanding quality assurance system, we endeavour to eliminate all errors and faults. You have purchased a product which left our factory in proper condition. Each individual unit has successfully passed an endurance test as well as extensive tests for the purpose of assessing the operating behaviour and the protective equipment.

If your photovoltaic system does not function properly despite these measures, we suggest the following troubleshooting procedures: The first step is to check that the PV array and grid connections are properly connected to the Powador. In doing so, observe all the safety instructions specified in this manual. Monitor the inverter closely and, where applicable, make a note of the displays and LEDs.

The following faults may occur and should be remedied as described.

Fault	Cause of fault	Remedy/explanation
The display is blank and the LEDs do not light up.	– There is no grid voltage. – The PV array voltage is too low.	The inverter switches to night shutdown mode as soon as the PV array voltage is below the minimum feed-in voltage for a longer period of time. For this reason, check first to see if the PV array voltage is sufficiently high. The inverter changes to stand-by status once 80% of the minimum feed-in voltage is reached. Also check the AC voltage. The permissible voltage ranges for the feed-in can be found in the technical data. If the display continues to remain blank, please contact KACO new energy GmbH service.
The inverter stops supplying power to the grid shortly after being switched on, even though there is sufficient sunlight.	Faulty grid separation relay in the inverter.	Although there is sufficient sunlight, the inverter feeds into the grid only for a few seconds before switching off again. During the short feed-in period, the inverter shows that the power being fed into the grid is between 0 and 5 W. If the inverter is definitely receiving sufficient generator power, the grid separation relay is presumably faulty, thus preventing the inverter from connecting. Please contact KACO new energy GmbH service.
The inverter is active but does not feed into the grid. The display indicates a line failure.	The inverter has interrupted the feed-in due to a line failure.	Due to a line failure (line impedance too high, over/undervoltage, over/underfrequency), the inverter stopped the feed-in and disconnected from the low-voltage grid for safety reasons. Many grid parameters can be changed within the permissible operating limits. More information can be found in the section “Starting up the inverter”. If the line failure exists for a long time, please contact the grid operator.
The line fuse trips.	The line fuse capacity is too low.	In cases of high irradiance, the inverter can – depending on the PV array – exceed its rated current for a short period. For this reason, the capacity of the inverter’s pre-fuse should be somewhat higher than the maximum feed-in current. You can find a dimensioning of the line fuse in the section “Installation and Start-Up”.
The line fuse trips.	Damage to the inverter’s hardware.	If the line fuse immediately trips when the inverter switches to feed-in mode (after the start-up period is complete), the inverter’s hardware is probably damaged. Please contact KACO new energy GmbH service.

Table 9.1: **Reasons for faults**

If the measures described in this guide do not assist in clearing the fault, please notify your installer.

In order for our factory customer service department to respond in an appropriate and expeditious manner, some details are necessary:

Inverter details

- Unit serial number
- Model
- A short description of the error
- Is the error reproducible? If yes, how?
- Does the error occur sporadically?
- Describe the prevailing insolation conditions when the error occurred.
- Time

Details pertaining to the photovoltaic module

- Module type, manufacturer (if available, also send the data sheet)
- The number of modules in series
- The number of strings
- Generator power

10 Documents

10.1 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 7700 / 7900 / 8600 / 9600**

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 approximation 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).

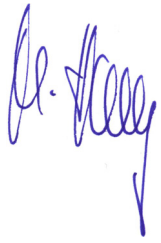
The units are compliant with the following standards:

2006/95/EC "Directive relating to electrical equipment designed for use within certain voltage limits"	**Safety of the unit** EN 50178:1997 **Interference immunity** EN 61000-6-1:2007 EN 61000-6-2:2005
2004/108/EC "Directive relating to electromagnetic compatibility"	**Emitted interference** EN 61000-6-3:2007 EN 61000-6-4:2007 **Secondary effects on the grid** EN 61000-3-2:2006** EN 61000-3-12:2005*** EN 61000-3-3:2008** EN 61000-3-11:2000*** ** applicable for models ≤ 16 A *** applicable for models ≥ 16 A

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

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

Neckarsulm, 20.10.2010
KACO new energy GmbH



Matthias Haag
CTO

10.2 Certificate of compliance

Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96
86842 Türkheim
Germany
+ 49 (0) 8245 96810-0
cps-tuerkheim@de.bureauveritas.com

Certificate of compliance

Applicant: **Kaco new energy GmbH**
Carl-Zeiss-Str. 1
74172 Neckarsulm
Germany

Product: **Automatic disconnection device between a generator and the public low-voltage grid**

Model: **Powador 7700; Powador 7900;**
Powador 8600; Powador 9600;
Powador 7700 supreme; Powador 7900 supreme;
Powador 8600 supreme; Powador 9600 supreme

Use in accordance with regulations:

Automatic disconnection device with single-phase mains surveillance in accordance with DIN V VDE V 0126-1-1:2006-02 for photovoltaic systems with a single-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with insulating function which the distribution network provider can access at any time.

Applied rules and standards:

DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02 and „Generator at the public low-voltage grid, 4th edition 2001, guideline for connection and parallel operation of generators in the public low-voltage grid" with VDN additions (2005) from the German Electricity Association (VDEW) and Association of network operator (VDN).

The safety concept of an aforementioned representative product corresponds at the time of issue of this certificate to the valid safety specifications for the specified use in accordance with regulations.

Report number: **10TH0365-VDE0126**
Certificate number: **U11-161**
Date of issue: **2011-02-22** **Valid until:** **2014-02-22**

Achim Hänchen

31001123-02-110308

KACO new energy.

Carl-Zeiss-Strasse 1 · 74172 Neckarsulm · Germany · Tel. +49 7132 3818-0 · Fax +49 7132 3818-703 · info@kaco-newenergy.de · www.kaco-newenergy.de