



KACO 
new energy.

Powador 2002
Powador 3002

Operating instructions

- Operator
- Skilled and authorised electrician



product
design
award

2006



The installation instructions for authorised electricians begin after the operating instructions

For the operator

Operating Instructions

Powador 2002/3002


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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 2002 and 3002 inverters are galvanically isolated, fanless, robust, high-efficiency inverters.

1 About This Documentation

The following notes guide you through all of the 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.

	NOTICE
<p>Read the manual! We assume no liability for any damage caused by failure to observe these instructions.</p>	

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 additional 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
<p>Failure to observe a warning indicated in this manner will directly lead to serious bodily injury or death.</p>	

	WARNING
<p>Failure to observe a warning indicated in this manner may lead directly to serious bodily injury or death.</p>	

	CAUTION
<p>Failure to observe a warning indicated in this manner may directly lead to minor or moderate bodily injury.</p>	

	NOTICE
<p>Failure to observe a warning indicated in this manner may lead to damage to property.</p>	

	NOTE
<p>Useful information and notes.</p>	

	ACTION
<p>This symbol indicates that a certain action is required.</p>	

	IMPORTANT
<p>Failure to observe this information may result in reduced convenience or impaired functionality.</p>	

 **Electrical 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 concerning 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
<ul style="list-style-type: none">– 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 make changes to 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 inspections 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, transport damage may still occur. 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 only be operated 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. Damage caused by such unintended use is at the sole risk of 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

KACO new energy GmbH issues a warranty of seven years on the Powador inverter starting from the date of installation, but at most 90 months after shipment.

During this time, KACO new energy GmbH guarantees the proper function of the units and to undertake repairs at the factory free of charge in the event of a defect for which we are responsible.

Contact your specialist dealer or installer if your unit exhibits a defect or fault during the warranty period.

Warranty claims are excluded in the following cases:

- Use of the units in ways not intended
- Improper installation and installation that does not comply with standards
- Improper operation
- Operation of units with defective protective equipment
- Unauthorised modifications to the units or repair attempts
- Influence of foreign objects and force majeure (lightning, overvoltage, severe weather, fire)
- Insufficient ventilation of the unit
- Failure to observe the relevant safety regulations
- Transport damage.

All warranty claims must be handled at the premises of KACO new energy GmbH. Where possible, the unit must be returned in its original or equivalent packaging. The costs for these services cannot be borne by KACO new energy GmbH.

KACO new energy GmbH will perform warranty services only if the defective unit is returned to KACO new energy GmbH together with a copy of the invoice which was issued to the user by the dealer. The name plate on the unit must be fully legible. If these requirements are not fulfilled, KACO new energy GmbH reserves the right to deny warranty services.

The warranty period for repairs or replacement deliveries is six months after delivery. However, it continues at least until the end of the original warranty period for the delivery item.

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 current inverters support us in this philosophy.

However, despite all quality assurance measures, faults may occur in exceptional 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



The grid feed 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, grid feed mode ends and the inverter switches off.

4.1 Overview of controls and displays

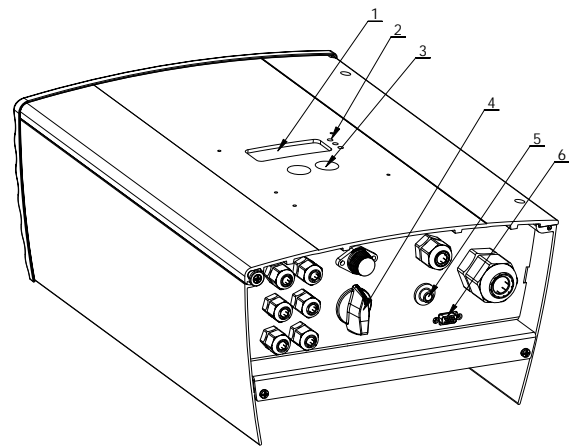


Figure 4.1: Overview of the Powador

Key

- 1 Display**
Used to display measured values and configuration parameters
- 2 LED displays**
Used to display the operating state
- 3 Control keys**
Used to switch between display and configuration of parameters
- 4 DC switch**
- 5 Night time start switch**
Used to activate the displays after nightfall
- 6 RS232 interface**

4.2 LED displays

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



Figure 4.2: LED displays

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 indicates that the grid feed was stopped due to a fault.

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 grid feed 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 grid feed 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.

4.3 Keys "1" and "2"



Figure 4.3: Powador control keys

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 solar generator 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 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.

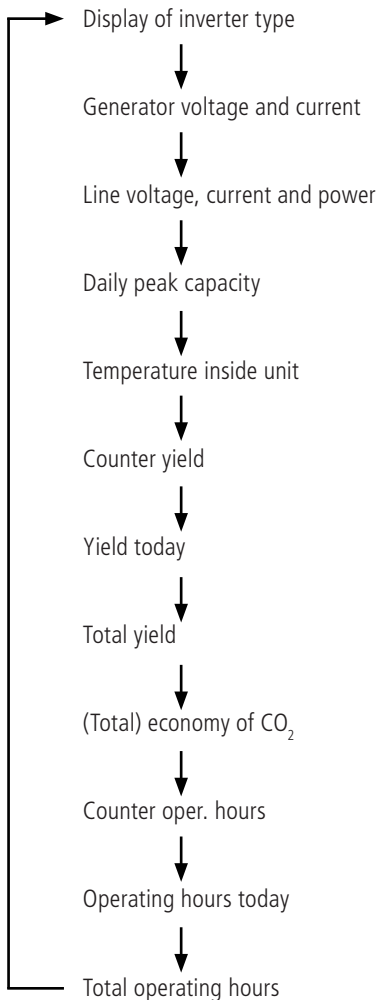


Figure 4.4: **Display mode menu**

Explanation of the individual menu items:

Inverter type display

Display of the inverter type (Powador 2002/3002).

Generator voltage and current

The current voltage and current of the solar generator that is connected to the inverter.

Line voltage, current and power

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

Daily peak capacity

The respective day's peak power that was fed into the grid for a short time.

Temperature inside unit

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

Counter yield

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 CO₂

Shows the CO₂ savings of this PV system compared to the German electricity mix. The CO₂ savings are calculated from the total yield counter and can also be cleared with this counter.

Counter oper. hours

This counter totals all operating hours 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.

4.5 Level 2 menu - Configuration mode

	ACTION
<p>To access 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.</p>	

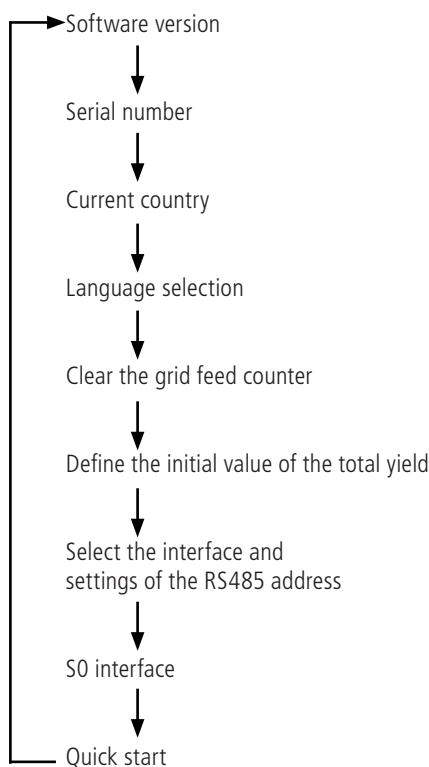


Figure 4.5: Configuration mode menu

Explanation of the individual menu items:

Software version

The current software version is displayed here.

Serial number

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.

Clear the grid feed counter

When the grid feed counter 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. "Grid feed counter 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.

Choice of interface and address setting

Using the "Select interface" menu item, you can use key "2" to switch between the RS232 and RS485 interfaces.

If the RS485 interface is activated, you can reach the address setting by pressing key "1". 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. Because of this, it is 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 43864 - Current interface for transmitting pulses from a pulsing counter to a tariff metering unit".

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.

	ACTION
<p>Settings are saved only upon exiting configuration mode. If 2 minutes elapse without a key being pressed, the configuration mode is automatically exited. The configuration mode can also be immediately exited by pressing both keys. As a confirmation, "Settings saved" appears on the display. The settings are now permanently saved in the Powador inverter.</p>	

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 solar generator power, the inverter stops feeding into the grid after a short period of time.

4.6 DC switch


The inverters include an internal DC isolator, which allows for the inverter to be disconnected from the photovoltaic generator in case of repair or fault.

To disconnect the inverter from the photovoltaic generator, turn the internal DC isolator on the underside of the inverter from the ON (1) position to the OFF (0) position (see figure 4.1).

When delivered, the inverter’s internal DC isolator is in the OFF (0) position.

4.7 Night time start switch

The unit switches off in the evening as nightfall approaches. The display is no longer shown. In order to retrieve the values from the current day (daily yield, daily hours of operation and max. grid feed power) after the display switches off, the unit can also be activated during the night by pressing the start switch on the underside of the inverter.



ACTION

To do this, press the “5” 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 grid feed power are available until the following morning and are cleared when PV generator voltage is present again.

4.8 The serial RS232 interface

Operating data can be transmitted to a computer (e.g. notebook) over a galvanically isolated serial interface (see figure 4.1 - (6)) from where it can then be individually processed further using standard spreadsheet software.

A standard serial 1:1 interface cable is all that is required for connecting the inverter to the computer. The cable length should not exceed 20 metres.

The data from the inverter is sent unidirectionally as pure ASCII text over the serial interface. The data is not checked for errors.

The RS232 interface has the following parameters:

Baud rate	Data bits	Parity	Stop bits	Protocol
9600 baud	8	none	1	none

Figure 4.6 shows, as an example, a few of lines of transmission via the RS232 interface.

Spalte 1	2	3	4	5	6	7	8	9	10
00.00.0000	00:05:30	5	363.8	0.37	134	226.1	0.53	103	23
00.00.0000	00:05:40	5	366.0	0.39	142	226.1	0.53	112	23
00.00.0000	00:05:50	5	359.5	0.41	147	226.1	0.53	116	23
00.00.0000	00:06:00	5	369.8	0.42	155	226.1	0.58	118	23
00.00.0000	00:06:10	5	377.0	0.43	162	226.1	0.63	131	23
00.00.0000	00:06:20	5	373.6	0.45	168	226.1	0.63	133	23
00.00.0000	00:06:30	5	364.0	0.48	174	226.1	0.68	146	23
00.00.0000	00:06:40	5	364.3	0.49	178	226.1	0.68	146	23

Figure 4.6: Excerpt from the RS232 interface transmission log

Column	Meaning	Column	Meaning
1	Placeholder	6	Generator power in W_{DC}
2	Daily running time	7	Line voltage in V_{AC}
3	Operating state (table 4.2)	8	Line current, grid feed current in A_{AC}
4	Generator voltage in V_{DC}	9	Power fed into the grid in W_{AC}
5	Generator current in A_{DC}	10	Temperature of the unit in °C

Table 4.1: Explanation of the individual columns of the log

The interface of the connected PC or laptop must comply with the standard for RS232 interfaces. Some computer manufacturers do not fully adhere to the standard. In such cases, problems may occur during data transmission.

Data can be received with any terminal emulator, which comes with every operating system, or with the KACO-viso visualisation tool.



NOTE

The KACO-viso visualisation software can be downloaded from <http://www.kaco-newenergy.de>

Together with the Powador inverter, KACO-viso takes over the role of a data logger. It saves the data from the inverter and displays it in various diagram types as a daily or monthly representation.

The PC, however, must also run continuously. Because of the amount of energy used, this type of monitoring only makes sense over limited periods, such as during a fault analysis. For permanent monitoring, we recommend the optional accessories (see page 14).



NOTE

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.

4.9 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 integrate remote monitoring into your system.

4.10 Display

Inverters in the Powador xi 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 keys, the backlight is activated. If approximately 1 minute elapses without a key being pressed, 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 grid feed counter by up to 15 %.

Operating states

Please consult the logged data in the RS485/RS232 for the status.

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 voltage regulator	The inverter continues to operate with minimum MPP voltage when the grid feed power is low.
5	Grid feed 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 grid feed mode.
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.
57	Waiting time after a fault	After a fault, the inverter waits a defined country-specific time period before it switches back on (Installation Instructions, section 3, Technical Data).

Table 4.2: **Explanation of the operating states**

Fault signals

When these error messages are displayed, the grid feed is interrupted, the red LED (3) lights up and the fault signal relay is switched. This error correction takes a country-specific time period (see Installation Instructions, section 3, Technical Data). 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. If the fault is no longer present, the Powador inverter begins feeding into the grid once again after a country-specific time period (see Installation Instructions, section 3, Technical Data).

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.

Status	Display	Explanation
10	Temperature too high in unit	The temperature in the unit has become too high (> 80 °C). At internal temperatures of 70 °C and higher, the inverter limits the power and levels off at a temperature between 70 °C and 80 °C. An internal temperature of 80 °C is only reached if convection cooling is impeded by external factors, e.g. by covering the cooling fins.
29	Earth fault Check the fuse!	An earth fault was detected on the DC side. Check the solar generator and notify your authorised electrician.
30	Fault in voltage transformer	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 grid feed power (e.g. 200 W) and high grid feed power (e.g. the maximum grid feed power) occur.
32	Error Self test	The internal grid separation relay test has failed. If this internal error occurs several times, notify your authorised electrician.
33	Error DC grid feed	The DC grid feed has exceeded the permitted limit value. This DC grid feed 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	Error Communication	A communication error has occurred in the internal data transmission. Notify your authorised electrician to check the data cable.
35	Protection shutdown	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	Error PV overvoltage	The voltage of the PV generator is too high. The solar generator is wrongly dimensioned. Notify your authorised electrician.
41	Line failure Undervoltage L1	The voltage of a grid phase is too low, the grid cannot be fed into. The phase in which the fault occurs (undervoltage) is displayed in each case. This error can be grid-related.
42	Line failure Overvoltage L1	The voltage of a grid phase is too high, the grid cannot be fed into. The phase in which the fault occurs (overvoltage) is displayed in each case. This error can be grid-related.
48	Line failure / undervoltage	The line frequency is too low. This error can be grid-related.
49	Line failure / overvoltage	The line frequency is too high. This error can be grid-related.
50	Line failure Average voltage	The average line voltage measurement over a 10 minute period according to EN 50160 has exceeded the maximum permitted limit value. This error can be grid-related.
55	Error in DC link	An error occurred during charging of the DC link. Notify your authorised electrician.
56	Algorithm error	An internal error occurred during the calculation algorithm. Try to restart or notify your authorised electrician.
58	Control card overtemperature	The temperature was too high. To avoid damage, the grid feed was stopped. Provide sufficient ventilation.

Table 4.3: **Fault signals**

5 Accessories

KACO new energy GmbH offers its customers a comprehensive range of helpful accessories. The array of products includes monitoring, display, visualisation and data transmission equipment of the highest quality.

Powador-proLOG

Are you looking for professional system monitoring and data logging equipment? Powador-proLOG is the high-end solution for your PV system. Error messages by SMS (text message), fax or e-mail, remote access to the system, the representation of the PV system on the Internet and much more are no problem whatsoever for the Powador-proLOG. Up to 32 inverters can be connected to the Powador-proLOG via the RS485 interface.



Figure 5.1: Powador-proLOG

Powador-go

If you simply wish to know whether your system is working properly, the Powador-go is exactly what you need. If your PV system or modules are no longer producing power, the Powador-go set reports this after 24 hours by means of an audible warning signal. The whole process works independent of the inverter. You can simply sit back and relax in the knowledge that your system will let you know if there is a problem.



Figure 5.2: Powador-go

Additional accessories can be found in our general catalogue.

6 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 solar generator 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.

Error	Cause of error	Troubleshooting / explanation
Inverter displays an impossible daily peak value.	Faults in the line 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 grid feed counter.	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 grid feed counter by up to 15 %.
The display is blank and the LEDs are not lighting up.	<ul style="list-style-type: none"> – The unit is in night shutdown mode. – There is no line voltage. – The solar generator voltage is too low. 	<p>The inverter switches to night shutdown mode as soon as the solar generator voltage is below the minimum grid feed 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 time start switch.</p> <p>A grid failure will also cause the display to go blank and the grid feed to stop. Wait until the public low-voltage grid is available again.</p> <p>If the display does not light up during normal daytime hours, please contact your solar installer.</p>
The inverter is active but does not feed into the grid.	<ul style="list-style-type: none"> – Insufficient generator voltage available. – The line voltage or the solar generator voltage is not stable. 	<p>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.</p> <p>Before the grid feed 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.</p>
The inverter is active but does not feed into the grid. The insolation is sufficient.	The inverter has interrupted the grid feed due to a fault.	<p>After an interruption of the grid feed 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.</p> <p>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.</p>

Error	Cause of error	Troubleshooting / 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 grid feed 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.	<ul style="list-style-type: none"> – The line fuse capacity is too low. – Damage to the inverter’s hardware. 	In cases of high insolation, the inverter can - depending on the solar generator - 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 grid feed current. If the line fuse immediately trips when the inverter switches to grid feed 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.	<p>When there are certain ambient conditions, the units may emit audible noises. The following causes may be determining factors in this regard:</p> <ul style="list-style-type: none"> – 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. <p>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.</p>
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.	<p>The temperature inside the unit became too high. The inverter reduced the power to prevent damage to the unit. At internal temperatures of 75 °C and higher, the inverter limits the power and levels off at a temperature 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.</p> <p>Provide for sufficient cooling of the unit.</p>

Table 6.1: **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 imperative:

Details pertaining to the inverter

- The 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 of day

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

7 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 in a proper manner.

For authorised electricians

Installation Instructions

Powador 2002/3002

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1 About This Documentation

The following notes guide you through all of the 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 additional parts of the system.

	NOTICE
<p>Read the manual! We assume no liability for any damage caused by failure to observe these instructions.</p>	

1.1 Retention of documents

Please pass these operating and installation instructions on to the installation 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
<p>Failure to observe a warning indicated in this manner will directly lead to serious bodily injury or death.</p>	

	WARNING
<p>Failure to observe a warning indicated in this manner may lead directly to serious bodily injury or death.</p>	

	CAUTION
<p>Failure to observe a warning indicated in this manner may directly lead to minor or moderate bodily injury.</p>	

NOTICE
<p>Failure to observe a warning indicated in this manner may lead to damage to property.</p>

	NOTE
<p>Useful information and notes.</p>	

	ACTION
<p>This symbol indicates that a certain action is required.</p>	

	IMPORTANT
<p>Failure to observe this information may result in reduced convenience or impaired functionality.</p>	



Electrical 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 concerning 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
<ul style="list-style-type: none"> – 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, certain parts of the unit unavoidably 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 earthing, conduct 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 earthing 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 make changes to the inverter. Changes to the surroundings of the inverter are only permitted if they comply with national standards.

	CAUTION
<p>Risk of damage due to improper modifications. Never modify or manipulate the inverter or other components of the system.</p>	

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

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

3 Technical Data

Input - Electrical data

Model	2002	3002
DC rated power	1750 W	2650 W
Max. PV generator power	2000 W	3000 W
MPP range	125–510 V _{DC}	200–510 V _{DC}
No-load voltage*	Up to 600 V _{DC}	Up to 600 V _{DC}
Monitoring - input voltage	Stand-by from U _e < 125 V _{DC}	Stand-by from U _e < 200 V _{DC} Night shutdown from U _e < 100 V _{DC}
Max. DC input current	14.3 A _{DC}	13.5 A _{DC}
Polarity safeguard	Short-circuit diode	

* To protect the electronic system, the grid feed is made at < 550 V.

Output - Electrical data

Model	2002	3002
Rated power	1650 W	2500 W
Maximum power	1650 W	2500 W
Line voltage	See section 4 - Technical Data - Country-specific parameters - page 8	
Rated current	7.2 A	10.9 A
Max. current	8.0 A	12.5 A
Power factor	≈ 1	
Frequency	See section 4 - Technical Data - Country-specific parameters - page 8	
Distortion factor according to VDE0838 part 2 (EN 61000-3-2)	< 3 % at rated power < 5 % over the entire range	
Fault signal relay	Potential-free NO contact, max. 30 V / 1 A	
S0 output	Open collector – output max. 30 V / 50 mA	
Overvoltage protection	Varistors and spark gaps	

Inverter - Electrical data

Model	2002	3002
Max. degree of efficiency	95.7 %	95.8 %
European deg. of efficiency	95.0 %	95.1 %
Internal consumption	Night shutdown: 0.4 W Operation: < 5 W	
Minimum grid feed power	10 W	15 W
Circuit design	Galvanically isolating high-frequency DC/DC converter with downstream self-commutated inverter	
Clock frequency	17 kHz	
Grid monitoring	Automatic disconnection device in accordance with DIN VDE 0126-1-1:2006-02	

Inverter - Mechanical and technical data

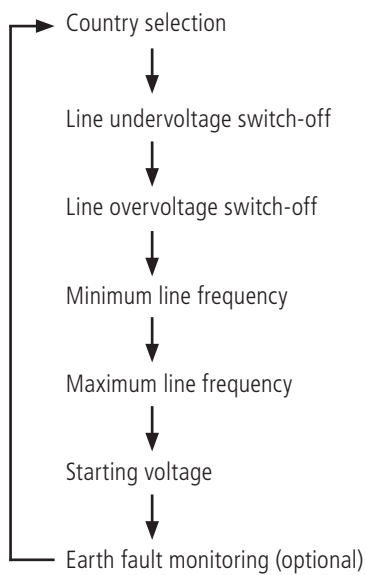
Model	2002	3002
Visual display :	LEDs: PV generator (green) Grid feed (green) Fault (red) LCD: (2 x 16 characters)	
Controls	2 keys for operating display	
DC disconnecter	Integrated DC disconnecter with rotary switch	
Connections	PCB terminals inside the unit Cable connection via cable fittings	
Ambient temperature	-20 to +60 °C (> 40 °C power derating at high ambient temperature)	
Temperature monitoring	> 70 °C temperature-dependent impedance matching > 80 °C disconnection from the grid	
Max. humidity	95 % (non-condensing)	
Cooling	Free convection (no fan)	
Protection class	IP54 according to EN 60529	
Noise emission	< 35 dB (noiseless)	
Housing	Aluminium wall-mounted housing	
Dimensions W x D x H	340 x 200 x 450 mm	340 x 200 x 500 mm
Weight	12 kg	20 kg

Country-specific setting of parameters

Parameter → Country	Rated Voltage (in V)	Grid voltage range (in V)	Grid voltage in accordance with EN 50160 (in V)	Rated frequency (in Hz)	Frequency range (in Hz)	Switch-on value (in seconds) after insufficient grid feed power	Operation resumption time (in seconds) after a fault
South Korea	220 V	194....242		60 Hz	59.3 - 60.5	> 360	> 360
Australia	230 V	200....264		50 Hz	47.5 - 52	> 60	> 60
Great Britain	230 V	207....264		50 Hz	47 - 50.5	> 180	> 180

The switch-on times after a restart, fault or after insufficient grid feed power are approximate values.

Parameter menu



4 Unit Description



The galvanically isolated Powador units are currently available in three 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).

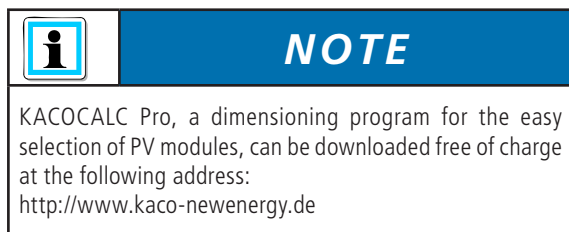
Your inverter's designation is located on the front side above the display as well as on the name plate.

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 solar generator is also compatible with the inverter. Observe the data provided in the data sheet (see section 3, Technical Data) when dimensioning the solar generator.



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:

- U_0 (-10 °C) < max. input voltage. Even at very low outside temperatures (-10 °C), the no-load voltage of the connected string must lie within the permitted input voltage range. If the temperature falls from 25 °C to -10 °C, the no-load voltage in 12V modules increases by approx. $2.8 V_{DC}$ per module ($5.6 V_{DC}$ for a 24 V module). The no-load voltage of the entire string must be less than the max. input voltage.
- U_{MPP} (+60 °C) > min. input voltage. Even at very high outside 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. $3.6 V_{DC}$ per module ($7.2 V_{DC}$ 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; instead, a small amount less is fed.

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 max. usable input current.

The solar generator still represents the largest factor in the cost of 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 solar generator (south, 30° angle of inclination), the solar generator power can be increased.

For roofs with an east-west orientation, we recommend a two-string PV system. To achieve an optimum yield from the system, the first string must be installed on the east side of the roof and the second string on the west side.

For exposed locations in mountains or in southern regions, we recommend that the power generator is reduced appropriately. Contact us or your specialist dealer if you require more information.

4.3 Protection concepts

The following monitoring and protective functions are integrated into Powador inverters:

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

4.4 Dimensions and weights

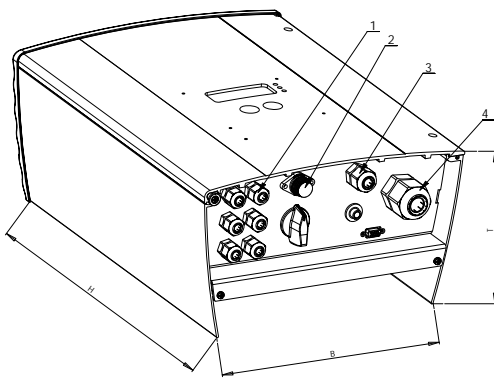


Figure 4.1: Powador dimensions

Key

- 1 Cable fitting for DC connection
- 2 Fuse for generator earthing kit (optional)
- 3 Cable fitting for interface cable
- 4 Cable fitting for AC connection

Model	Height	Width	Depth	Weight
2002	450 mm	340 mm	200 mm	12 kg
3002	500 mm	340 mm	200 mm	20 kg

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

NOTE


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

Nevertheless, the units should be installed in areas that are as dry as possible in order to extend their service life. In addition, ensure that the units are installed in climate-controlled areas in order to protect them from overheating. 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 side clearance to other units
 - 700 mm clearance to other stacked units
 - 500 mm to cabinets, ceilings etc.
- The unit is designed for vertical wall installation.
- 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

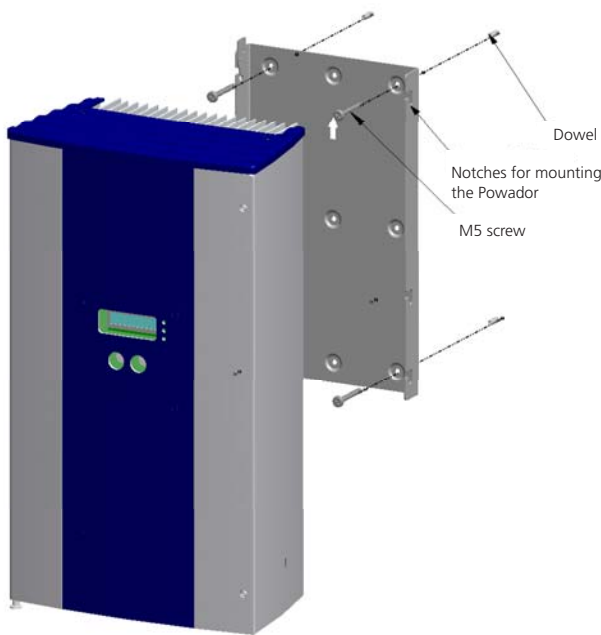



Figure 5.1: **Powador wall bracket**

An installation kit consisting of four dowels 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 fixture 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).

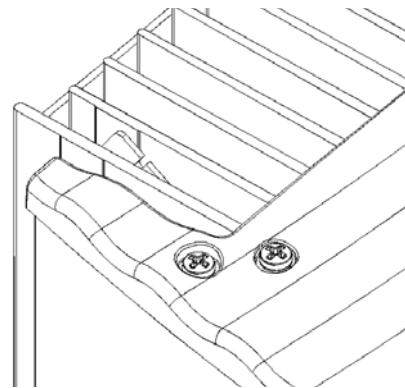


Figure 5.2: **Safety catch (open)**

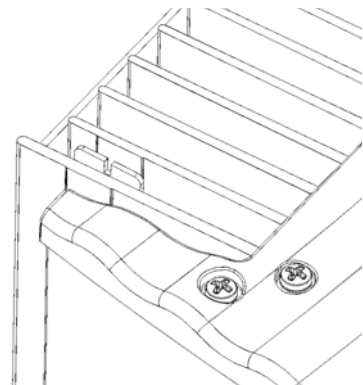


Figure 5.3: **Safety catch (closed)**

5.3 Electrical connection

General information

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

DANGER

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

You must adhere to all mandatory safety regulations, the currently required technical connection specifications of the responsible power supply company, as well as to other generally applicable regulations.

When connecting the inverter, the AC and DC sides must be disconnected from all power sources and secured 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.

NOTE

At the AC and DC connection terminals, the maximum conductor cross-section that can be connected is 6 mm² (AC) or 10 mm² (DC). When wire sleeves are used, the cross-section is reduced to 4 mm² (AC) or 6 mm² (DC). The strip-off length is 12mm (AC) or 15 mm (DC). A screwdriver (slotted, 3.5 mm) is to be used for the terminals in the inverter. Put the screwdriver into the intended cut-out. 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.

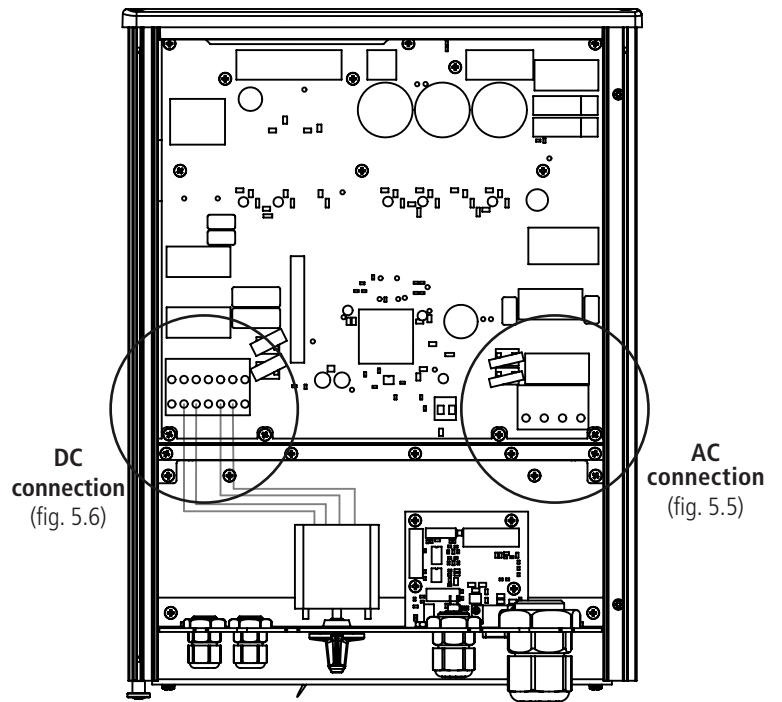


Figure 5.4: **Overview of the Powador 2002 and 3002**

Grid connection

The grid connection is made using 3 conductors (L1, N, PE). 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 metres:

- Powador 2002 1.5 mm²
- Powador 3002 2.5 mm²

Larger cross-sections should be used for longer leads.

In accordance with VDE 0100 part 430, "Protection of cables and lines against overcurrent", NYM leads with fixed wiring should be secured 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.

- 1.5 mm² → 16 A
- 2.5 mm² → 20 A
- 4.0 mm² → 25 A
- 6.0 mm² → 35 A

NEOZED gL safety fuses should be used.

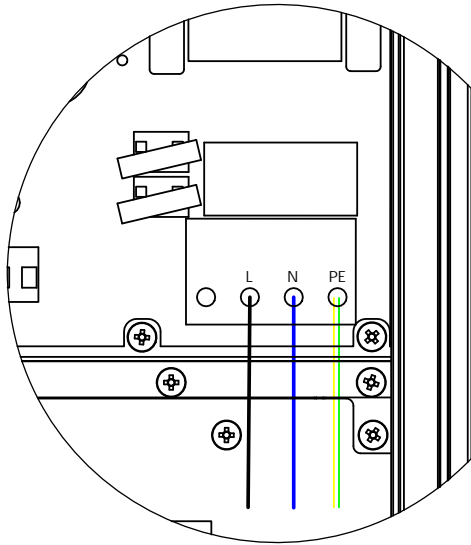


Figure 5.5: AC connection of the Powador 2002 and 3002



NOTE

Be sure to use cables with a sufficiently large cross-section 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 line terminals of the inverter will increase as power is being fed 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.



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

Only 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 two internal circuit board fuses. These are labelled F801 or F861 on the circuit board.

F801:
Model: 179120 5x20 time-lag 250 VAC/0.4 A
Manufacturer: SIBA

F861:
Model: TR5-Fuse series 372, 250 VAC/125 VDC/1 A time-lag
Manufacturer: Littlefuse/Wickmann

PV generator connection

The PV generator leads are connected on the left side of the connection box.

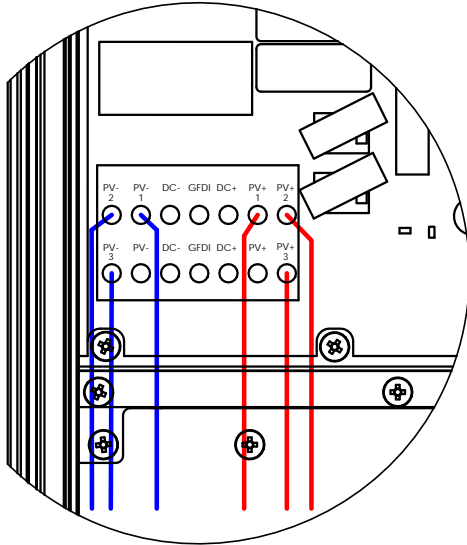




Figure 5.6: DC connection of the Powador 2002 and 3002



ACTION



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

- 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 earth 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 earth fault of the PV generator, which must be fixed prior to continuing with the installation.




CAUTION

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

DANGER

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



CAUTION


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


The PV generator can be connected in the following ways:

- 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

	NOTICE
To achieve protection class IP54, unused cable fittings must be closed off using the included 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.

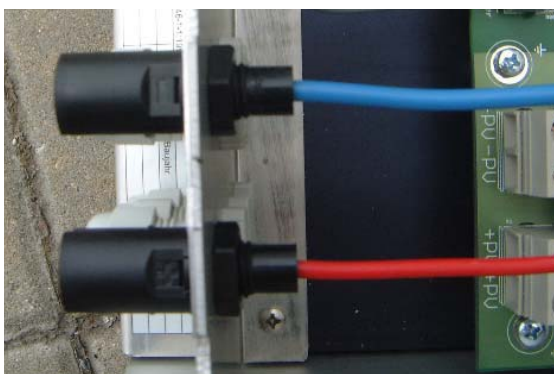





Figure 5.7: **Installation of Tyco sockets**

		WARNING
Always disconnect the inverter from the PV generator by operating the integrated DC disconnecter before pulling apart 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 5.8 and figure 5.9 respectively.



Figure 5.8: **Assembly of the MC plug connectors**



Figure 5.9: **Assembly of the Tyco plug connectors**

5.4 Generator earthing kit (optional)

Some module manufacturers stipulate that the solar modules must be earthed at the generator (especially when applied to thin-film modules). An optional earthing kit for use on galvanically isolated Powador inverters is available for this purpose.



WARNING

Disconnect the inverter from all power sources before beginning installation.

Installation of the earthing kit:

1. Using a TORX 20 screwdriver, remove the blank fitting for the fuse holder on the front of the inverter.
2. Attach the fuse holder using the screws provided.
3. Connect the black cable to the DC terminal labelled "GFDI" (underneath).
4. Attach the PE cable (green/yellow) to the corresponding PCB fitting using the cable shoe.

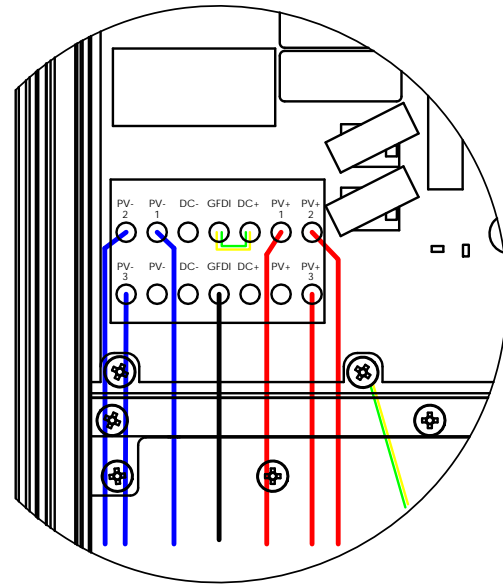


Figure 5.11: Positive earthing

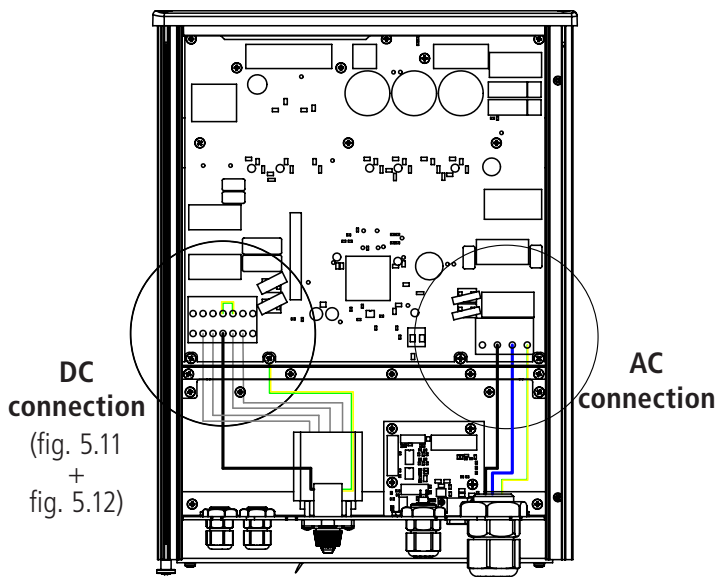


Figure 5.10: **Powador 2002 and 3002 with generator earthing kit**

5. Clamp the enclosed cable bridge in the upper GFDI terminal and the DC+ (figure 5.11) or DC- connection (figure 5.12). Consult the module manufacturer for information on which generator pole should be earthed.
6. Activate earthing monitoring using the display. See section 5.7 for more information on this procedure.

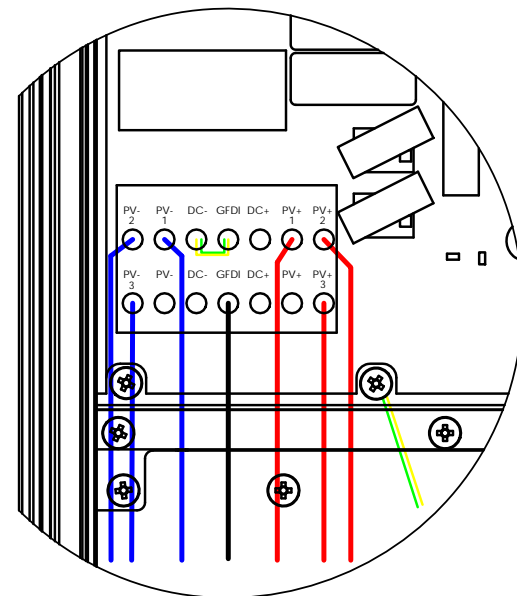



Figure 5.12: Negative earthing


IMPORTANT

The fuse is triggered in the event of an earth fault in the PV system. The inverter interrupts the grid feed until the fuse has been replaced. Only use identical fuses of the same type (Littlefuse KLKD1, 600 V, 1 A, fast-acting).

5.5 Interfaces

All interfaces are connected on the communication circuit board. The circuit board is found directly underneath the terminal block of the cable connection.

(A) Connecting the fault signal relay

The inverter is equipped with a potential-free relay contact to signal faults. This contact closes if a fault occurs. 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 / 1.5 A

IMPORTANT

In the event of failure of the grid feed 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.

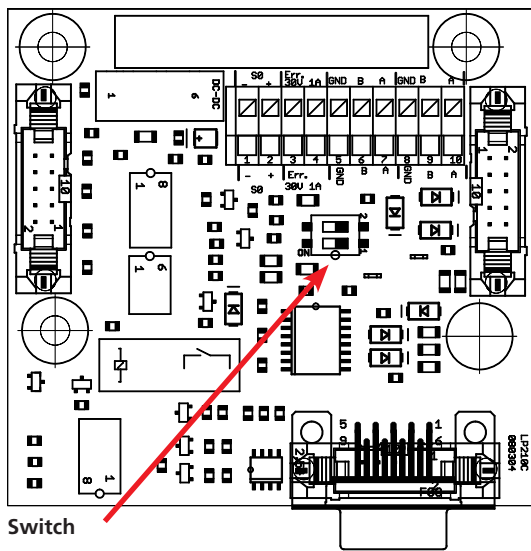


Figure 5.13: Communication circuit board

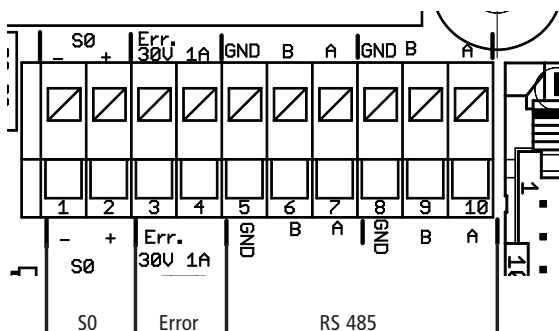


Figure 5.14: Interface terminals

(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 5.7, "Parameter programming").

(C) The RS485 interface connection

The connection terminal (figure 5.13) is found on the Powador communication circuit board. To connect several Powadors, terminal A of one Powador is connected to terminal A of the other Powador. Terminal B is connected in the same manner. A twisted, shielded data cable, such as an ISDN cable, is required for this. The connection to the Powador-proLOG is established similarly to the interconnection of inverters. A connection diagram is displayed in figure 5.15. The total length of the RS485 wiring should not exceed 250 m.

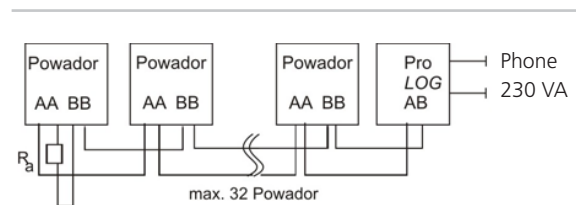


Figure 5.15: Connection diagram for the RS485 interface

In figure 5.15, a terminating resistor (R_a) with 330Ω is connected to the left inverter. For proper signal transmission, the last unit in a chain must have a terminating resistor.

The terminating resistors in the other inverters in the chain must be deactivated (set to "OFF"). In the last unit in the chain, switch "1" is set to "ON" and switch "2" is set to "OFF". The switch is found on the communication circuit board underneath the terminal block (figure 5.13).


With a bus system such as the 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.

5.6 Starting up the inverter

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

	NOTE
<p>The inverter can only be put into operation under daylight conditions (i.e. when the solar generator voltage is present). If no daylight or solar generator voltage is present, the inverter can be activated by pressing the night time start switch (see section 4.4 in the Operating Instructions). However, normal operation is not possible in this condition. Only the values can be read off the display.</p>	

	ACTION
<ul style="list-style-type: none"> – Switch on the line voltage (via the external circuit breakers). – Switch on the solar generator via the DC disconnector (0 → 1). 	

During the initial start-up, the corresponding country and language must be selected.


The green “PV-Generator” LED lights up when in non-grid feed mode and indicates that it is ready to be put into operation. The display now indicates the current generator voltages “Start from xx V, meas.: xxx V”. If the measured voltage is greater than the starting voltage, the unit will start the grid feed after a country-specific waiting time. This start-up period is required in order to ensure that the generator voltage is continuously above the grid feed limit of 125 V (2002) / 200 V (3002). A quick start routine is provided for start-up 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 grid feed 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).

5.7 Parameter programming

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

	WARNING
<p>Wrong parameter settings can lead to loss of functionality as well as render your safety certificate invalid.</p> <p>Modifications may only be made in exceptional cases and after prior consultation with the manufacturer and power supply company.</p>	

	ACTION
<p>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.</p>	

	ACTION
<p>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.</p>	

Parameter menus are located in section 4 - Technical Data - page 8.

Explanation of the individual parameters:

Parameter menu :

Country selection

During the initial start-up, the country can be selected and changed again without entering a code. If no entry is made for 10 minutes or the unit is switched off, the country selection is stored. For further changes, a code is needed that can be obtained from the service department.

Line undervoltage/overvoltage switch-off:

The line voltage is monitored. If the voltage drops below the value set in "MINIMAL LINE VOLTAGE" or exceeds the value set in "MAXIMUM LINE VOLTAGE", the inverter switches off. Both limit values can be set in 2 V increments (see section 4 - Technical Data - Country-specific parameters).

Minimum and maximum line frequency:


The line frequency is monitored. If the frequency drops below the value set in "MINIMAL 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 (see section 4 - Technical Data - Country-specific parameters).

Starting voltage for grid feed:

The inverter begins the grid feed 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 within a range from 125 V to 160 V (2002) or 200 V to 240 V (3002) in 5 V increments.



Earth fault monitoring (optional)


One pole of the PV generator is earthed in the device using a fuse. The earth fault monitor is triggered in the event of an earth fault in the generator. This prevents possible damage to the modules. Monitoring must only be activated when the optional earthing kit has been installed.


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

6 Switching the Inverter Off

The inverter must be switched off to adjust settings and for maintenance and repair work. This is done as follows:

		DANGER
<ul style="list-style-type: none"> – Risk of fatal injury by electric shock at live connections. Lethal voltages are still present in the inverter even after the electrical connections have been disconnected. – Wait five minutes before reaching into the inverter. – When working on photovoltaic modules, in addition to disconnecting from the grid, the DC main switch on the generator terminal box (or the DC plug connectors) must always be disconnected at all poles. – Disconnecting the line voltage is not enough. 		

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

	ACTION
<ul style="list-style-type: none"> – Disconnect the line voltage (deactivate the external circuit breakers). – Disconnect the photovoltaic module using the DC disconnecter. – Ensure that the inverter's grid connection terminals are voltage-free. 	

7 Powador as Part of a PV system

7.1 System layout

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

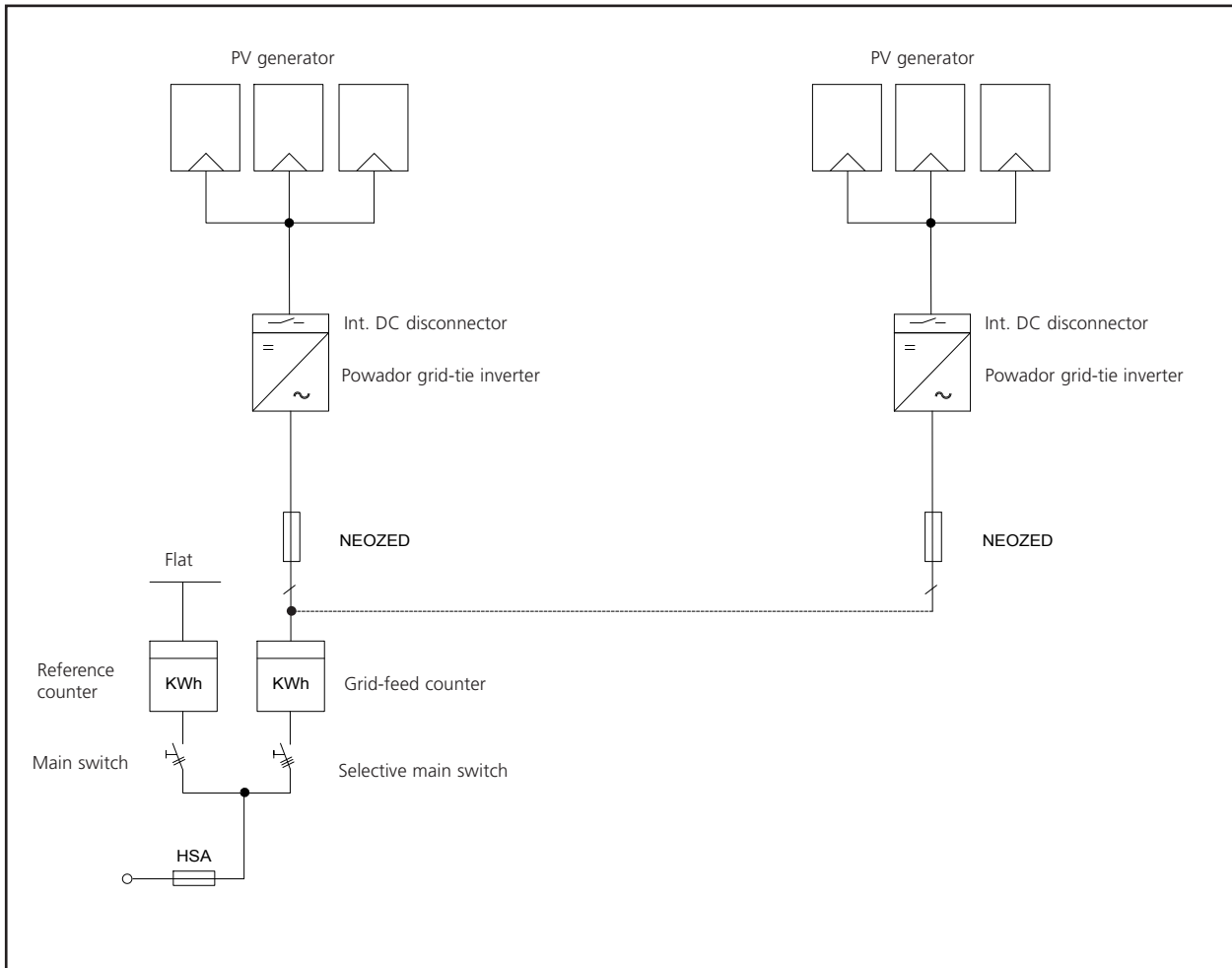


Figure 7.1 **Single-pole overview circuit diagram for a system with two inverters**

A summary of the components:

DC terminal point:

Two generator strings are connected in parallel either at a DC terminal point between the solar generator 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 solar generator and then run just one negative and one positive lead to the inverter.

DC disconnecter:

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 disconnecter. As a result, the installation of an external DC disconnecter is not required.

Line fuses:

In order to protect the leads, the inverter's supply lead should be secured with NEOZED fuses. The fuses that are used should be appropriate to the length and cross-section of the leads and fulfil applicable standards and directives (5.3: Electrical connection - grid connection).

Grid feed counter:

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

Selective main switch:

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

7.2 System with multiple inverters

Observe the following regarding systems with multiple inverters:

Asymmetric grid feed:

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 plants on the low-voltage grid, 4th edition, 2001).

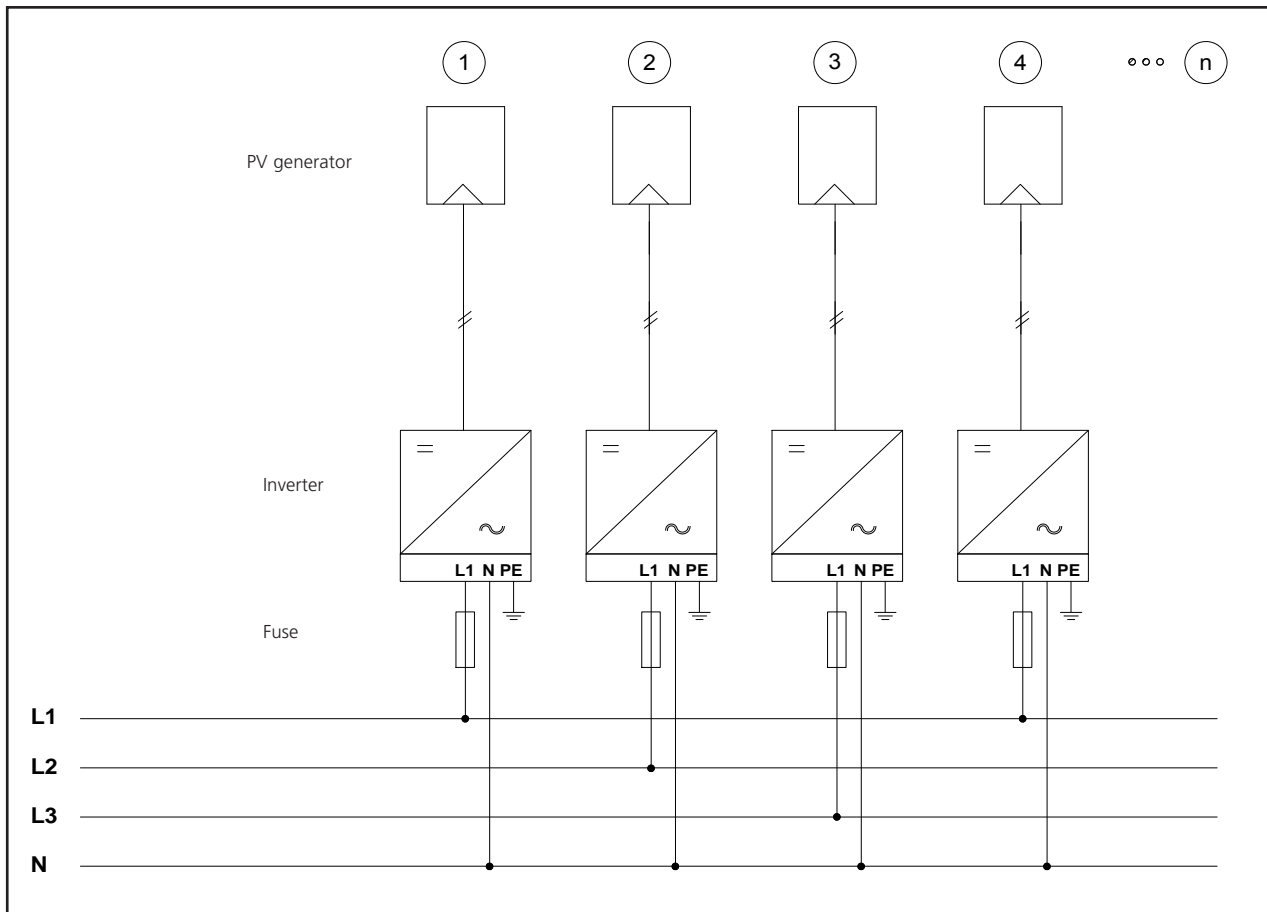


Figure 7.2: **Grid-side connection for systems with multiple inverters**

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 L on the inverter's terminals.

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

8 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 installation does not function properly despite these measures, we suggest the following troubleshooting procedures:

The first step is to check that the solar generator 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.

Error	Cause of error	Troubleshooting / explanation
The display is blank and the LEDs do not light up.	<ul style="list-style-type: none"> – There is no line voltage. – The solar generator voltage is too low. 	<p>The inverter switches to night shutdown mode as soon as the solar generator voltage is below the minimum grid feed voltage for a longer period of time. For this reason, check first to see if the solar generator voltage is sufficiently high. The inverter switches to stand-by mode at approximately 80 % of the minimum grid feed voltage.</p> <p>Also check the AC voltage. The permissible voltage ranges for the grid feed can be found in the technical data.</p> <p>If the display continues to remain blank, please contact KACO new energy GmbH service.</p>
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.	<p>Although there is sufficient sunlight, the inverter feeds into the grid only for a few seconds before switching off again. During the short grid feed 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.</p> <p>Please contact KACO new energy GmbH service.</p>
The inverter is active but does not feed into the grid. The display indicates a line failure.	The inverter has interrupted the grid feed due to a line failure.	<p>Due to a line failure (line impedance too high, over/undervoltage, over/underfrequency), the inverter stopped the grid feed 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".</p> <p>If the line failure exists for a long time, please contact the grid operator.</p>
The line fuse trips.	The line fuse capacity is too low.	<p>In cases of high insolation, the inverter can - depending on the solar generator - 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 grid feed current. You can find a dimensioning of the line fuse in the section "Installation and Start-Up".</p>
The line fuse trips.	Damage to the inverter's hardware.	<p>If the line fuse immediately trips when the inverter switches to grid feed mode (after the start-up period is complete), the inverter's hardware is probably damaged.</p> <p>Please contact KACO new energy GmbH service.</p>

Table 8.1: **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 imperative:

Details pertaining to the inverter

- The 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 of day?

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

9 Documents

9.1 EU Declaration of Conformity

Name and address of the manufacturer:	KACO new energy GmbH Gottfried-Leibniz-Str. 1 74172 Neckarsulm, Germany
Product description:	Photovoltaic grid-tie inverter
Type description:	Powador 2002 - 3002

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 60950-1:2006 EN 50178:1997* <small>* Regarding clearance and creepage distances</small>
2004/108/EC "Directive relating to electromagnetic compatibility"	Interference immunity: EN 61000-6-1:2007 EN 61000-6-2:2005 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 61000-3-3:1995 + A1:2001 + A2:2005** EN 61000-3-11:2000*** <small>** Applicable for models ≤ 16 A *** Applicable for models ≥ 16 A</small>

The types stated above are labelled with the CE marking for this reason.

Any unauthorised modifications to the supplied units and/or any use for other than for the intended purposes shall render this Declaration of Conformity null and void.

Neckarsulm, 02 April 2009
KACO new energy GmbH



Matthias Haag
Head of Grid-Connected Systems Division

9.2 Certificate of compliance



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

Certificate of compliance

Applicant: Kaco new energy GmbH
Gottfried-Leibniz-Str.1
74172 Neckarsulm
Germany

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

Model: Powador 2002, Powador 3002

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 of valid safety specifications for the specified use in accordance with regulations.

Report number: 08TH0280-VDE0126
Certificate nummer: U09-111
Date of issue: 2009-05-27 **Valid until:** 2012-05-25


Andreas Aufmuth

