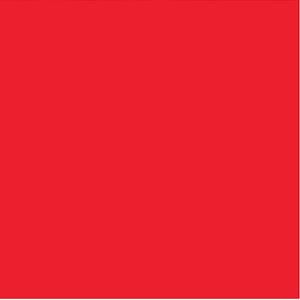
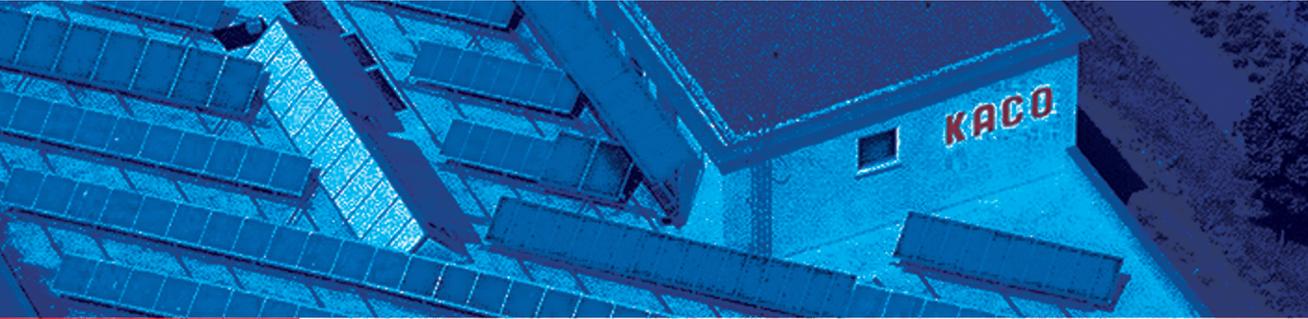


# Installer's Manual.

for skilled and authorized electricians



blueplanet...  
green power



For skilled and authorized electricians

## Installation Instructions

### Blue Planet 1501xi / 2901xi / 3601xi

---

|   |          |   |           |
|---|----------|---|-----------|
| <b>1. About this document</b>                           | <b>2</b> |   |           |
| 1.1 Attachment and Maintenance of documents             | 2        |   |           |
| 1.2 Symbols used in this document                       | 2        |   |           |
| 1.3 UL Certification/Labeling                           | 2        |   |           |
| 1.4 Type label  | 2        |   |           |
| <b>2. Important Safety information and instructions</b> | <b>2</b> |   |           |
| <b>Save these Instructions</b>                          | <b>2</b> |   |           |
| <b>3. Notes concerning installation and operation</b>   | <b>3</b> |   |           |
| 3.1 Factory warranty and liability                      | 3        |   |           |
| 3.2 Service   | 4        |   |           |
| 3.3 Intended (normal) use                               | 4        |   |           |
| <b>4. Device description</b>                            | <b>4</b> |   |           |
| 4.1 Dimensioning of the PV generator                    | 4        |   |           |
| 4.2 Protective concepts                                 | 5        |   |           |
| 4.3 Mechanical dimensions                               | 5        |   |           |
| <b>5. Installation and startup</b>                      | <b>6</b> |   |           |
| 5.1 Selecting the appropriate place of installation     | 6        |   |           |
| 5.2 Installing the inverter                             | 6        |   |           |
| 5.3 Electrical connections                              | 8        |   |           |
|   |          | 5.4 Connecting the fault-signal relay                           | 10        |
|   |          | 5.5 Connection of the S <sub>0</sub> output                     | 10        |
|   |          | 5.6 Connection of the RS485 interface                           | 10        |
|   |          | 5.7 Startup of the inverter                                     | 11        |
|   |          | 5.8 Ground fault indication                                     | 11        |
|   |          | 5.9 Jumper Position   | 11        |
|   |          | <b>6. Applications/Acceptance by Your Utility</b>               |           |
|   |          | <b>Company</b>  | <b>12</b> |
|   |          | <b>7. Switching off the inverter</b>                            | <b>12</b> |
|   |          | <b>8. Troubleshooting</b>                                       | <b>12</b> |
|   |          | <b>9. Technical Data</b>  | <b>15</b> |
|   |          | 9.1 Peak efficiency curves of blueplanet inverter series        | 16        |
|   |          | <b>10. Certificates of Compliance</b>                           |           |
|   |          | 10.1 UL Certificates of Compliance for all blueplanet inverters | 18        |
|   |          | 10.2 Supplement to Certificates of Compliance                   | 24        |

### About this document

The following information will guide you through the entire documentation. Further documents will be valid in conjunction with these operating and installation instructions.

We shall not be liable for any damage caused by non-adherence to the instructions given in this manual.

### Pertaining documents

During the inverter installation please observe all assembly and installation instructions for components and other parts of the system. These instructions are shipped together with the respective installation components or supplementary equipment.

#### 1.1 Attachment and Maintenance of documents

Please keep these operating and installation instructions in a safe place to ensure that they are available if needed.

#### 1.2 Symbols used in this document

Please observe the safety information provided in this manual when operating your inverter!



**Warning!**  
**Lethal Hazard!**



**Danger!**  
**Lethal Hazard by Electric Shock!**



**Caution!**  
**Potential hazard for the product and environment!**



**Note!**  
**Useful information and remarks**



**Important!**  
**Non-adherence to these instructions may adversely affect the operating convenience or functionality of the device.**



This symbol indicates that to connect the inverter the AC and DC side must be disconnected from all voltages.



**Caution!**  
To reduce the risk of fire, connect only to a circuit provided with branch circuit over-current protection in accordance with the

### 1.3 UL Certification/Labeling

UL labeling is used to document that the blue planet inverter indicated on the type label meets the fundamental requirements according to the following IEC directives:

- Directive concerning Electromagnetic Compatibility with Class B (Council Directive 89/336/EEG)

- Low Voltage Directive (Council Directive 73/23/EEG)

For more information on UL certification please see section 10.

### 1.4 Type label

The type label indicating the exact device description is located on the support panel at the underside of the enclosure.

## 2. Important Safety information and instructions

### Save these Instructions



**Danger!**

Danger due to lethal voltages!

Hazardous live voltages are present inside the device/instrument and power lines. Therefore, the device/instrument must only be installed and opened by a skilled electrician.

Even when the device/instrument is switched off, dangerous live voltages may still be present inside the instrument.

### Standards and Regulations

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

- UL 1741 – Standard for Inverters, Converters, and Controllers for Use in Independent Power Systems
- CSA C22.2 No. 107.1-01 General Use Power Supplies
- IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- NEC Sections 690 (ANSI/NFPA 70)

The blue planet inverter has complete on-board over-current, over-temperature and anti-islanding protection.

### Technical rules

The assembly must be in compliance with the local regulations and technical rules.

### Regulations concerning the prevention of accidents

The inverter must be installed by an approved skilled electrician who is responsible for the adherence to existing standards and regulations.

The proper and safe operation of the device/instrument requires proper transportation, storage, erection and assembly, as well as careful operation and maintenance.

Only personnel who have read and fully understood all safety information contained in these operating and installation instructions, as well as the assembly, operating and maintenance instructions, shall be authorized to operate the inverter.

During the operation of this device, certain parts of the device inevitably carry hazardous live voltages, which may lead to severe personal injury or even death. The following precautions should be followed to minimize the risk of lethal hazards or personal injuries.

The installation of the device must be in compliance with the relevant safety regulations (e.g. NEC 690) or other applicable national or local provisions. Proper grounding, conductor dimensioning and an appropriate short-circuit protection must be provided to ensure operational safety.

All instrument covers must remain closed during operation.

Prior to performing any visual checks and maintenance work the device must be disconnected from all power sources and protected against accidental activation. If measurements must be conducted while the device is connected to power, NEVER touch live terminals. Remove all jewelry from your wrists and fingers. Ensure that the equipment is in proper condition.

When working on an energized inverter, use appropriate tools and do not come into contact with grounded surfaces including the earth.

Exactly follow the instructions given in these operating and installation instructions and especially observe all information concerning possible hazards, warnings and precautions.

Should any specific problems occur, which are specifically in this or the operators manual, please contact your specialist dealer.

#### Modifications/Changes

Performing any modifications or changes on the inverter is generally prohibited. Performing any changes or modifications in the environment of the inverter is only permitted if they comply with national standards.

#### Transportation



**Caution!**  
**Hazard of damage due to unauthorized modifications/manipulation! By no means manipulate the inverter or modify or change the inverter or any other part of the installation!**

The blue planet inverter is subjected to extensive testing and inspection in our test field, so as to ensure the superb quality of our products. Our inverters leave our factory in proper electrical and mechanical condition. Special packaging ensures that nothing can happen during the transport to our customers. Nevertheless, transport damage may not be ruled out completely. In this case, the forwarding agent/carrier will be responsible.

Please check the inverter carefully on arrival. Should you discover any visible signs of damage on the packaging, which may imply that the inverter may be damaged, or should you find any visible signs of damage on the inverter please notify your responsible forwarding agent/carrier immediately?

If necessary, your solar installation provider or KACO solar service specialist will assist you. However, written damage

reports must be received by the forwarding agent within six days after receipt of the goods. Use exclusively the original packaging for returning the inverter – only this material will ensure safe transportation.

### 3. Notes concerning installation and operation

#### 3.1 Factory warranty and liability

##### Terms and conditions

Customers shall contact KACO Solar, Inc. to obtain a Return Merchandise Authorization (RMA) number before returning products. KACO Solar, Inc. accepts no responsibility or liability for products returned without prior authorization. KACO Solar, Inc., at its sole determination, will repair or replace inverters returned by customers. Inverters must be returned with a copy of the original dealer invoice or written proof of installation if the inverter has not been already registered by fax or mail. Inverters must include a legible data label showing the serial number and the type of inverter. The warranty belongs to the unique serial number of the inverter and not any particular person; therefore, KACO inverters are sold with a 10 year transferable warranty.

The inverter must be returned to KACO Solar, Inc. in the original packaging materials or packaging providing equal protection during shipment. KACO Solar, Inc. is not responsible for damage occurring during shipment.

To satisfy the claims of our easy swap warranty; KACO Solar, Inc. will ship any replacement inverter within 24 hours after a claim has been issued and approved. If the inverter fails out of the box or within a 6 month period of operation a new inverter shall be issued. After 6 months of installation, a factory reconditioned unit of newer or similar age shall be issued.

##### Exclusion of Liability

KACO Solar, Inc. disclaims any liability for direct or indirect damages due to:

1. improper installation or commissioning,
2. modifications, alterations or repair attempts,
3. inappropriate use or operation,
4. insufficient ventilation of the device,
5. non-compliance with relevant safety standards or regulations,
6. flood, lightning, overvoltage, storm, fire (acts of nature).

We do not guarantee that the software is completely free of faults. In most cases technical alerts will be posted on the KACO Solar website describing how to avoid the effects of the fault. If the concern is greater, written explanation will be mailed to registered installers. The solar system installer is responsible for the correct selection, proper use, supervision and consequences of the use of software.

We reserve the right to make alterations that will improve the functioning of the device.

KACO Solar, Inc. will not be liable for any direct, indirect or consequential damages, losses, costs or expenses however arising in contract or tort, including without restriction any economic losses of any kind, any loss or damage to property, any personal injury, any damage or injury arising from or as a result of misuse or abuse, or the incorrect installation, integration or operation of the product.

### 3.2 Service

From the initial stages of product development, high quality and longevity for our inverters is of central importance to us. This philosophy is the result of our experience of over 60 years in the field of power conditioning and current inverters.

Despite these quality-assuring measures, in some rare cases errors may occur. KACO Solar, Inc. will offer a maximum of assistance if one of these cases should arise. KACO Solar, Inc. will take every effort to remedy any defects fast and without unnecessary bureaucracy. Please contact our service department directly for fast and efficient support.

#### Service Reimbursement

KACO Solar will pay \$100.00 for each inverter replacement and \$25 per additional inverter at the site when there is a true inverter failure within the first one year of commissioning. Thereafter, KACO customers will still enjoy the protection of the standard 10 years replacement guarantee and compensation for service performed to repair an inverter will be awarded on a case by case basis.

Technical support is available by telephone at 1-866-522-6765 Monday through Friday 8 AM – 5PM PST.

### 3.3 Intended (normal) use

Blue planet inverters are built according to state-of-the-art and approved safety requirements. However, improper use may cause lethal hazards for operators or third parties and/or damage of instruments/devices or other property. The device is intended to convert the direct voltage generated in the photovoltaic (PV) modules into alternating voltage (AC) and feed this voltage into the grid.

The inverter is intended to convert direct current (dc) energy generated by the photovoltaic (PV) modules into alternating current (ac) energy that is then fed into the utility grid.

Any use other than the specified intended use is not deemed intended or normal use, and the manufacturer/supplier shall not be liable for any damage caused by such unintended use. Damage caused by unintended use is at the sole risk of the operator.

The term "intended use" shall also include the adherence to the operating and installation instructions. Some of the documents which are needed for these applications and acceptance are attached to these installation instructions.

## 4. Device description

The electrically isolated blue planet xi-series devices are currently available for two different power classes. The appropriate inverter type should be selected in accordance with the power rating of the selected photovoltaic module array. The max. power values are indicated in the data sheet (Section 9).

The inverter designation is shown on the front side above the display and on the type label.

#### 4.1 Dimensioning of the PV generator

The selection of the PV generator is of crucial importance when dimensioning a PV installation. It must be observed by all means that the solar generator is the right match for the

inverter. Please observe the data given in the Technical Data Sheet (Section 9) for dimensioning the solar generator.



The design and dimensioning KACOCalc pro is available for easy selection of PV modules – please obtain your free download at <http://www.kacosolar.com>

#### Dimensioning of 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 is maintained within the admissible input voltage range of the inverter – even in the event of extreme external temperatures. The U.S. module temperatures can significantly vary and you should be sure to consult your solar installation specialist about the effect on final voltage calculation. It is important that the temperature coefficient of the solar modules is observed. The following criteria must be met for calculating the voltage of the PV generator.

#### $U_0 (-13^{\circ}\text{F}) < \text{max. input voltage (400 VDC)}$

Even at very low external temperatures ( $-13^{\circ}\text{F}$ ), the no-load voltage of the connected string must remain within the admissible input voltage range. For example, if the temperature falls from  $77^{\circ}\text{F}$  to  $-13^{\circ}\text{F}$ , the no-load voltage of 12-V modules will increase by approx. 2.8 V per module (5.6V for 24V modules). The no-load voltage of the entire string must be less than 400 volts.

#### $U_{MPP} (+140^{\circ}\text{F}) > \text{min. input voltage (125VDC)}$



**Caution!**  
Using the device for any purpose other than intended/normal use is prohibited!

Even at very high external temperatures ( $+140^{\circ}\text{F}$ ) the MPP voltage of the connected string should remain within the admissible input voltage range. If the temperature rises from  $77^{\circ}\text{F}$  to  $140^{\circ}\text{F}$ , the MPP voltage of 12V modules will decrease by approx. 3.6 V per module (7.2 V for 24V modules). The MPP voltage of the entire string should be  $> 125 \text{ V}$ .

Even if the MPP voltage is beyond the admissible input range, the installation nevertheless will continue to work properly. However, the delivered power is slightly less than the maximum yield.

Provided that the input voltage is within the admissible input voltage range, the inverter will not be damaged if a connected PV generator should supply current above the max. usable input current.

If the PV generator should supply more than the max. PV generator power of the inverter for a short time, particularly due to clouds and relatively low module temperatures, it is possible that the inverter switches off for safety reasons and automatically switches on again after approx. 10 seconds. The overload status is shown on the display in plain text. Under normal circumstances, however, the dynamic control of the inverter ensures that this condition is recognized and the inverter operation is continued without any interruption.

The solar generator still represents the most substantial cost factor of a solar installation. Therefore, it is very

important to obtain maximum energy yields. To achieve this goal, solar generators located in the US should be orientated towards the South at an angle of inclination of 30°, and shading of whatever kind should be prevented under all circumstances.

In many cases, the recommended angle of inclination cannot be implemented for technical reasons. To achieve the highest energy yield of a solar generator with optimal orientation (South, inclination angle of 30°), the efficiency of the solar generator can be increased.

For roofs that are orientated towards the East/West we recommend two-string PV installations. To ensure optimum yield of the installation, the first string should be installed on the East side of the roof, whereas the second string should be installed on the West side of the roof.

Please consult your specialist dealer or notify us if you should require any further assistance.

#### 4.2 Protective concepts

The following monitoring and protective functions are integrated in blue planet inverters:

- BiSI grid monitoring to protect against personal injuries and avoid islanding effects according to UL 1741
- Overvoltage varistors to protect the power semiconductors against high-energy transients on the grid side
- Temperature monitoring of the heat sink
- EMC filters to protect the inverter against high-frequency grid interference
- Grid-side varistors to earth/ground, to protect the inverter against burst and surge pulses.
- Ground Fault Detector Interrupter (GFDI) according to NEC 690.5

#### 4.3 Mechanical dimensions

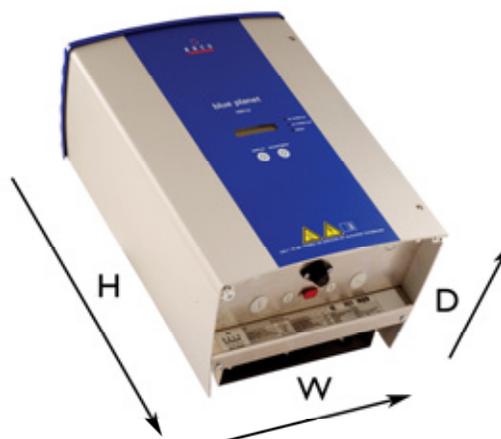


Figure 4.1: Dimensions of Blue Planet

| Type   | Height  | Width   | Depth  |
|--------|---------|---------|--------|
| 1501xi | 17 3/4" | 13 3/8" | 7 7/8" |
| 2901xi | 19 5/8" | 13 3/8" | 8 3/8" |
| 3601xi | 25 5/8" | 13 3/8" | 8 3/8" |

## 5. Installation and startup

### 5.1 Selecting the appropriate place of installation



Blue planet inverter housings meet the requirements of NEMA-3R.

The inverter is outdoor rated. In addition, the installation environment should be well ventilated so as to protect against overheating and ensure long inverter life.

The following rules should be observed when selecting the place of installation of your inverter:

- Ensure good access for assembly or service work.
- Maintain a minimum clearance of 19 11/16 in. around the device and between the device and other objects, such as cabinets, ceiling, or similar
- The device has been designed for vertical wall installation.
- Please ensure free air circulation around the device and through the heat sink at the rear side.
- If the inverter is installed in a switch cabinet or similar, please provide forced ventilation to ensure that heat is dissipated adequately.
- Ensure that the wall has an adequate load-bearing capacity and only use the appropriate installation material.
- In areas with a special risk of flooding, always make sure to install the inverter in a sufficiently elevated place.
- Installation at eye level makes it easier to read the display.
- Temperature: Ensure that the GT Inverter is mounted in a location where the ambient temperature range is  $-4^{\circ}$  to  $+104^{\circ}$  F.



**Important!**  
Due to the high system voltage, less current may flow on the DC voltage side than on the AC voltage side. Given the same cable cross-sections, losses are therefore higher on the AC voltage side than on the DC voltage side. The inverter will ideally be located in close proximity to the local utility's electric meter.

### 5.2 Installing the inverter

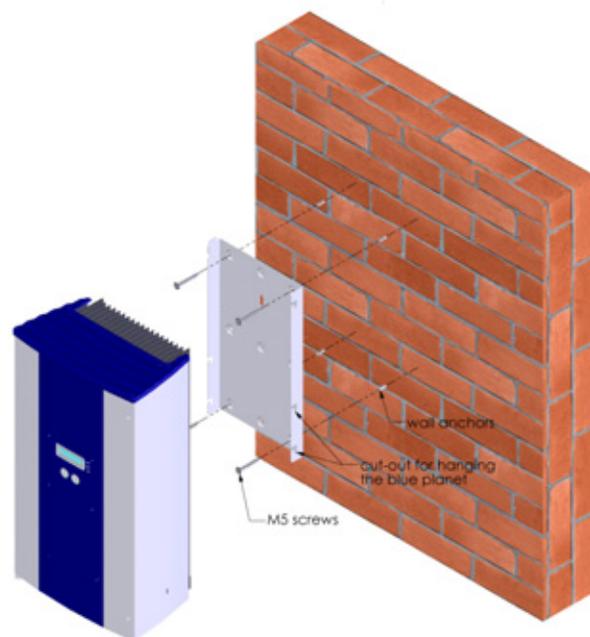


Figure 5.1a: Wall installation of blue planet

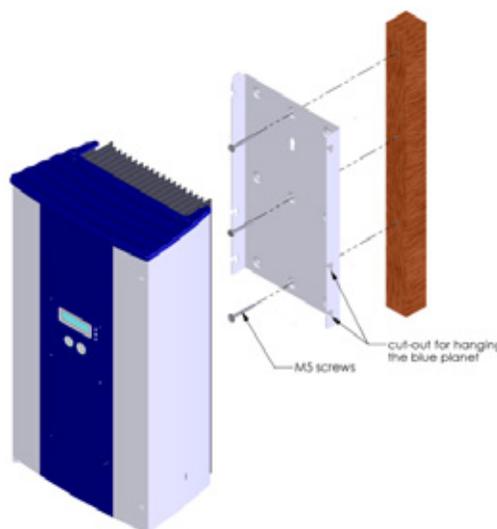


Figure 5.1b: Wall installation of blue planet

The inverter is shipped together with an installation kit consisting of four dowel pins and four 2 ¾ in. screws. Prior to installation the condition of the mounting wall has to be checked. If necessary, use a kit other than the one shipped with your inverter.



- Drill the holes for the dowel pins according to the positions indicated on the mounting plate.
- Place the dowel pins into the holes.
- Do not just hang the dowel pins on holes in drywall (wall board). Ensure that the screws and preferably the dowel pins are fastened to a solid wood support such as a wall stud (2x4 lumber)
- Using the screws, fasten the mounting plate to the wall. Make sure that the arrow shown on the mounting plate is directed upwards.
- Suspend the inverter in the suspension fixture. Ensure that the bars rest on the appropriate lugs/noses in the heat sink. Lock the safety catch. To do, this, slide the upper end of the catch towards the wall until the groove is parallel to the wall (see )



Figure 5.2a: Safety catch is open (left) and closed (right)



Figure 5.2b: Mounting plate dimensions

### 5.3 Electrical connections

#### General Information

The electrical connections can be established after the inverter has been installed in its fixed location.



**Caution!**  
The electrical installation of the blue planet must only be performed by a qualified electrician.



**Caution!**  
To connect the inverter the AC and DC side must be disconnected from all voltage sources and protected against inadvertent switching-on.



**Caution!**  
To reduce the risk of fire, connect only to a circuit provided with branch circuit over-current protection in accordance with the National Electrical Code, ANSI/NFPA70.

All applicable safety instructions and technical connections stipulated by local utility and the relevant NEC codes along with any other local or regional stipulations must be followed.

The connection of the PV-Generator and the grid are established via terminal blocks on the printed circuit board (See Figure 5.3).

Openings for conduit fittings are located on the bottom plate of the unit.



Open the door of the housing / enclosure. The door is secured against opening by means of two recessed head screws on the right upper side.



The max. connecting wire cross-section for the AC and DC connection terminals is 13.3 mm<sup>2</sup> (AWG 6) for flexible lines and 16 mm<sup>2</sup> for rigid (non-flexible) lines. The stripping length is 10 mm. The terminal is to be tightened with a torque of 1.2 to 1.5 Nm.



Figure 5.3: Connection box of blue planet

#### Grid connections

3-lead connections are used (L1, GRD, L2). To insert the wires use watertight conduits at the underside of the housing.

We recommend the following wire cross sections for cable lengths up to 60 feet:

Blue Planet 1501xi: AWG 12 15A Breaker

Blue Planet 2901xi: AWG 12 20A Breaker

Blue Planet 3601xi: AWG 10 30A Breaker

Larger cross sections should be used for longer cable lengths.



Please make sure to use wires with sufficient cross section width to avoid excessive line impedance (internal resistance of the electrical grid) between the domestic distribution and the respective blue planet inverter. NEC, ANSI/NFPA 70 wiring methods must be used.

At a high line impedance, i.e. long AC-side leads, the voltage at the grid terminals will increase during power delivery. This voltage is measured by the inverter. If the voltage across the grid terminals exceeds a defined limit, the inverter will switch off due to grid overvoltage. This condition must be taken into consideration when sizing the AC lead.



**Danger!**  
Hazard due to electric shock from contact with terminals carrying high voltages! The external AC and DC disconnects should be opened before any connections are made.



Route the wire through the conduit fitting. Connect the wire according to the mark shown on the sticker on the right side of the PCB.



Caution

**Caution!**  
Please check all leads for proper connection.



Once again check if all connected leads are securely fastened. Fasten the wire connection of the cable fitting.



A disconnect switch shall be provided by others for the dc input and ac output circuit.

### 5.3.1 PV array connections

The PV array connections are established on the right side of the connection box.



Caution

**Caution!**  
Do not connect the ground to the DC negative at any point. This is already done within the inverter!



Caution

**Caution!**  
Risk of damage!  
Ensure correct polarity.



Danger

**Danger!**  
To ensure maximum protection against hazardous live voltages during the assembly of the photovoltaic installation, both the plus and minus leads must be strictly isolated from earth potential (GRD).



Determine the DC voltage between protective earth (PE) and the positive lead or, respectively, between ground and the negative lead of the PV generator. If stabilized voltages can be measured, this indicates a ground fault in the PV generator or generator wiring. The ratio between the measured voltages indicates the location of this fault. Make sure to remedy this fault prior to performing any further actions!

Determine the electrical resistance between the ground and the negative (minus) lead of the PV generator.

A low resistance value ( $< 2 \text{ M}\Omega$ ) indicates a high-resistance ground fault of the PV generator, which must be remedied prior to further installation!



Caution

**Caution!**  
Prior to connecting the DC leads to the inverter terminals the voltage of the solar generator must be measured.  
The DC voltage must not exceed max. 400 VDC. Connecting to higher voltages will result in the destruction of the device.

Connect the DC leads as described in the following:

- Insert the DC leads through a watertight conduit at the underside of the housing.
- Connect the positive lead (+) on the DC+ terminal, and the negative lead (-) on the DC- terminal.
- Connect the ground wire to one of the marked ground terminals.
- Ensure all connections are correctly wired and properly torqued with 17 in-lb (1,2Nm).



Caution

- The input and output circuits are isolated from the enclosure.
- System grounding is the responsibility of the installer as required by sections 690.41 and 690.49 of the NEC, ANSI/NFPA 70

#### 5.4 Connecting the fault-signal relay

The inverter is equipped with a potential-isolated relay contact to signal faults. If a fault occurs, this contact will be closed.

Max. contact load: 30V / 1A.



#### Important!

In the event of a power failure in the public grid the relay will not trigger. In this case, all LEDs and the display will be extinguished and the inverter will be shut down completely. A fault signal will not be possible in this case!

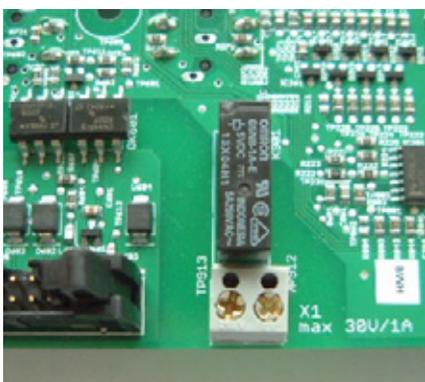


Figure 5.3 Fault-signal relay

#### 5.5 Connection of the S<sub>0</sub> output

The inverter is equipped with an S<sub>0</sub> pulse output for connection of, e.g. a large display. The pulse rate is adjustable (see page 11, Section 5.8)



Figure 5.4 S<sub>0</sub>-Connection

#### 5.6 Connection of the RS485 interface

On the control board (at the rear side of the door of the blue planet inverter), there are four terminals marked RS485 A and B (see Figure 5.6). To connect several blue planet inverters, terminal A of the first blue planet must be connected to terminal A of the second blue planet; terminals B are connected in the same way.

You need a twisted and shielded data cable for connection, such as an ISDN cable. The connection to proLOG is established analogously. The wiring plan is shown in Figure

5.7. The total length of the RS485 wiring should not exceed 250 m.



Figure 5.5: Connection terminals for RS485-Interface

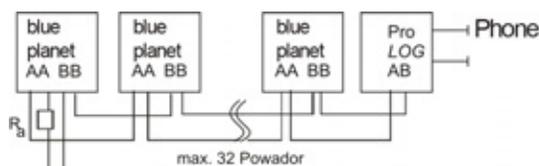


Figure 5.6: Wiring plan for RS485 Interface

Figure 5.7 shows a terminator which is connected to the left inverter (R<sub>a</sub>, 330Ω). This terminator resistor is needed on the last device in the chain to ensure correct signal transfer. The terminator is supplied together with the blue planet inverters.

Within a bus system, such as the RS485, each device taking part in this system must have a unique address (regardless of whether this is an inverter or current sensor). For inverters, the address range can be selected between 0 and 31. The address of each inverter can be determined via the Set menu, (see Operator's Manual).



#### Important!

Please ensure correct connection of the A and B wires. If these wires are improperly connected, no correct communication will be possible!

### 5.7 Startup of the inverter

After completing the mechanical and electrical installation you may now put the inverter into operation as follows:



**NOTE!**

The inverter can only be put into operation under daylight conditions (i.e. at a solar generator voltage of > 100 V).

If no daylight or solar generator voltage is present, the inverter can be activated by pressing the Start key (see Section 4.4 of the Operating Instructions), but normal operation will not be possible in this condition. (Only the values can be read off the display).



- Switch on the grid voltage (via the external automatic safety breakers).
- Switch on the solar generator via the DC circuit breaker (or DC plug-type connector).

The green LED "PV generator" will now be illuminated (if the generator voltage is greater than 125V). The display now shows the current generator voltage: "Start from 125V; measurement xxx V. " If the measured voltage is greater than 125V, the device will start power delivery after approx. 5 minutes. This starting-up period of 5 minutes is necessary to ensure that the generator voltage is permanently above the power delivery limit of 125V.

A quick-start routine is provided for test purposes – this routine circumvents the start-up period. This quick-start is menu-controlled and obtained from the set-up mode (see Operator's Manual).

During the normal startup procedure the line power relay is switched on after approx. 5 minutes (audible acoustic noise), and power delivery is started. This is also signaled by the green "Grid-feeding" LED. The display now shows the delivered power. The "Display" key can be used to indicate the various measurement values (see Operator's Manual).

It may be necessary to reset the date and hour (please refer to the Operator's Manual).

### 5.8 Ground fault indication

The Inverter is equipped with a ground-fault detection and interruption (GFDI) as required by UL 1741. If a ground fault occurs on the DC side the inverter disconnects from the grid and a message is displayed. In this case the inverter blocked until the following actions are done:

- Switch off the AC and DC disconnect.
- Remove the ground fault on the DC side
- Replace the GFDI fuse with a "Littlefuse KLKD 1 AMP 600V" fuse.
- Switch on the AC and DC disconnect.

### 5.9 Jumper position

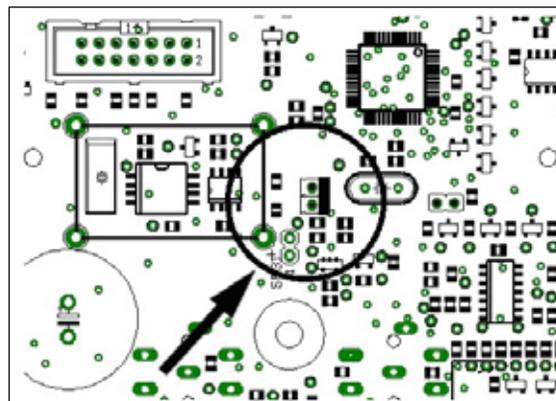


Figure 5.7: Jumper Position in normal feed-in operation (power delivery) – (shipping status)



**FACTORY USE ONLY! DO NOT ATTEMPT TO ALTER SETTINGS! DOING SO WILL VOID WARRANTY AND COULD POTENTIALLY BE HARMFUL TO USER!**

## 6. Applications/Acceptance by Your Utility Company

Your PV installation must meet all applicable utility, NEC and local electrical codes regarding PV installation requirements. The documents you will need to apply for acceptance of your PV system can be provided by your solar system installer. If you are licensed electrical contractor you may be eligible to install the PV system yourself. In this case you may then request all necessary documents directly from your local utility.

## 7. Switching off the inverter

The inverter must be switched off for adjusting, maintenance and repair work. Please proceed as follows:



To shutdown the inverter follow the directions exactly or arcing might occur when disconnecting the DC connector under load. This will destroy the connectors.



- Disconnect the grid voltage (deactivate the external safety breakers).
- Disconnect the photovoltaic module via the DC disconnect.
- Check that the grid terminals of the inverter are disconnected from all voltage sources.



**Danger!**  
**Lethal hazard by electric shock!**  
**Hazardous live voltages can be present in the inverter even if the electrical connections have been switched off or disconnected.**  
**Please wait for five minutes before accessing the inverter. If you have to work on the solar generator you must additionally disconnect all connections of the DC main switch on the generator connection box (or DC connector). It is not sufficient to switch off the grid voltage.**

## 8. Troubleshooting

Within the scope of our continuously expanding Quality Assurance System, our goal is to rule out and eliminate any faults and defects. You have purchased a product that has left our factory in proper operating condition. Each individual device has successfully passed extensive inspection tests for proper operation and functioning of protective devices, as well as a long-duration test at our factory.

Should your PV installation not work properly despite all these measures, we recommend the following procedure for remediation:

Check the solar generator and grid connections leading to the PVI, observing all the safety instructions given in this manual. Please observe the inverter carefully and take note of the display messages and LED displays. Below is a summary of possible error and recommended remedies:



### Warning!

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the operation instructions.

**Table 8-1 Troubleshooting Guide**

| Error  | Possible Cause  | Remedy/Explanation  |
|--|---|---|
| Daily yield values do not correspond to the values shown on the power meter of the Utility company   | - Tolerances of the inverter's internal measuring elements/sensors  | Measuring errors are caused by tolerances of the measuring elements/sensors. The tolerances of the individual measuring values are given in the Operator's Instructions. The daily yield value may deviate from the value shown on the power meter by up to 15%.  |
| Inverter shows an unrealistic daily peak value   | - Grid voltage failure  | Even if an incorrect daily peak value is displayed the inverter continues to work properly and without any yield losses. Values are reset overnight. If you wish to reset the display immediately, disconnect the inverter and the DC grid voltage supply and switch on the inverter again.   |
| Grid fuse triggers   | - Insufficient grid fuse rating<br>- Inverter hardware is damaged   | At times of high solar irradiation the inverter may exceed its rated current for a short time, depending on the type of solar generator. Therefore, the grid fuse should have a higher rating than the max. grid feeding current.<br>The grid fuse acts immediately if the inverter changes over to grid feeding (i.e. on termination of the start-up period). In this case, the inverter hardware is damaged and the device has to be returned to KACO for repair.   |
| No display shown   | - Device is in the night shut-down mode<br>- No grid voltage is present<br>- Solar generator voltage is less than 100V      | The inverter shuts down over night.<br>If the display should not be illuminated during a normal time of the day you should check on the power meter whether or not the device delivers power. If power is delivered the display module is defective, and the inverter has to be returned to KACO for repair.<br>If no power is delivered you should check that grid voltage is present and that the solar generator voltage is higher than 125 V. If this is the case but the inverter still fails to deliver power the device will have to be returned to KACO for repair. |
| Inverter does not start  | - Device is in the night shut-down mode<br>- No grid voltage is present<br>- The solar generator voltage is less than 100 V | The inverter shuts down over night.<br>If the display should not be illuminated during a normal time of the day you should check on the power meter whether or not the device delivers power. If power is delivered the display module is defective and the inverter has to be returned to KACO for repair.<br>If no power is delivered you should check that grid voltage is present and that the solar generator voltage is higher than 125 V. If this is the case but the inverter still fails to deliver power the device has to be returned to KACO for repair.        |
| Inverter is active but does not deliver power – the display reads: Start from 125 V<br>Measurement: xxx V  | - Insufficient generator voltage. Voltage measured < 125V   | After sunrise, at sunset, and during times of low solar irradiation due to bad weather conditions the generator voltage or, respectively, generator power fed from the roof may be insufficient for grid feeding  |
| Inverter is active but does not deliver power – the display reads: Start from 125 V<br>Measurement: xxx V (measured voltage is higher than 125V) | - The inverter has interrupted grid feeding due to a malfunction/disturbance  | After an interruption of the grid feeding process due to a disturbance (grid power failure, overtemperature, overload, etc.) the inverter always waits for approx. 5 minutes before resuming its grid feeding operation. Grid failures may cause interruptions during the day. If more than 10 interruptions per day should occur over several weeks you should contact your solar installation provider.   |
| The inverter terminates grid feeding shortly after starting-up although there is enough solar irradiation  | - Defective grid isolation relay in the inverter  | Although there is enough solar irradiation, the inverter delivers power for a few seconds only and switches off again. During this short time a grid feeding value between 0 – 5 W is displayed. If insufficient generator power can be ruled out in this case the grid isolation relay is presumably defective and prevents the inverter from being activated.   |

| Error                 | Possible causes                    | Remedy / Explanation   |
|-----------------------|------------------------------------|--|
| Inverter causes noise | - Special environmental conditions | <p>Under special environmental conditions the devices may cause audible noise. This may be due to the following causes:</p> <ul style="list-style-type: none"> <li>- Grid effects and/or grid disturbances caused by special consumers (motors, machines, etc.), which are connected to the same grid point or which may be installed in the vicinity of the inverter.</li> <li>- Dynamic weather conditions (frequent changes between sun and clouds) may cause slight line hum due to high energy.</li> <li>- Certain grid conditions may result in grid resonance between the input filter of the device and the grid, which may continue to be audible even after the inverter is switched off.</li> <li>- Persons with very sensitive ears (children, in particular) may perceive high-frequency hum of the inverter, caused by the operating frequency of 18 kHz.</li> </ul> <p>This noise does not affect the operation of the inverter or inverter performance and will not result in any failure, damage or shorter useful life of the devices.</p> |

If the defects found should not be able to be remedied through utilization of the measures described above, please contact your solar installation provider or our Service Department.

Please have the following information ready to enable the KACO Solar, Inc. Service Department to respond quickly and properly:

**Inverter Data**

- Serial number of the device
- Inverter type
- Short description of errors the fault or error reproducible? (If so, please provide a short description)
- Does the fault or error occur sporadically?
- Describe the solar irradiation conditions when the error occurred
- Hour of the day when the hour occurred

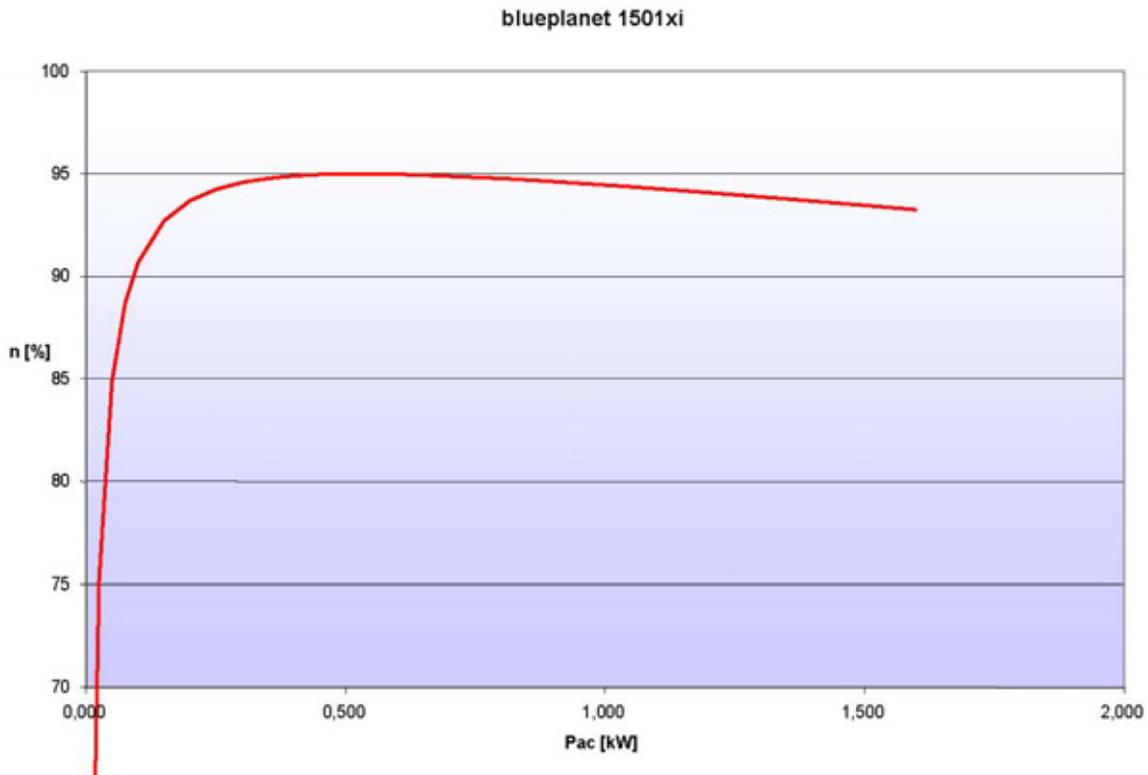
**Photovoltaic module data:**

- Module type, manufacturer (if available, send data sheet)
- Number of modules connected in series
- Number of strings
- Generator power

## 9. Technical Data

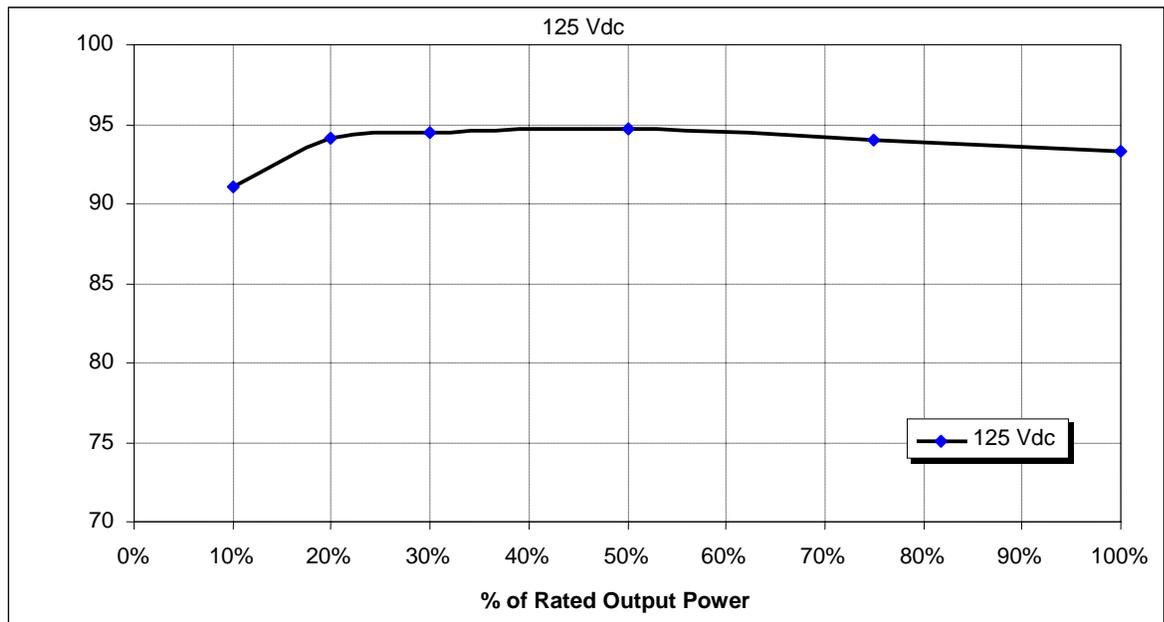
| Input – Electrical data                  |  |   |   |
|--|--|---|---|
| Model                                    | 1501xi   | 2901xi  | 3601xi  |
| Max. PV generator power                  | 1800 W   | 3800 W  | 4800 W  |
| MPP range                                | 125 – 300 V <sub>DC</sub>  |   |   |
| No-load voltage                          | Up to 400 V <sub>DC</sub>  |   |   |
| Monitoring - input voltage               | Stand-by from U <sub>e</sub> >125V <sub>DC</sub><br>Night shutdown from U <sub>e</sub> <100V <sub>DC</sub> |   |   |
| Max. operating current (DC)              | 14 A <sub>DC</sub>   | 30 A <sub>DC</sub>  | 43 A <sub>DC</sub>  |
| Max. array short circuit current (DC)    | 15 A <sub>DC</sub>   | 33 A <sub>DC</sub>  | 48 A <sub>DC</sub>  |
| Polarity safeguard                       | Short-circuit diode  |   |   |
| Overvoltage protection                   | Varistors  |   |   |
| Output – Electrical data                 |  |   |   |
| Rated output @ 25°C (AC)                 | 1500 W   | 3100 W  | 3900 W  |
| Rated output @ 40°C (AC)                 | 1500 W   | 2900 W  | 3600 W  |
| Nominal voltage (AC)                     | 240 V  |   |   |
| Grid voltage (AC)                        | 211 – 264 V  |   |   |
| Max. utility backfeed current (AC)       | 0 A <sub>AC</sub>  | 0 A <sub>AC</sub>   | 0 A <sub>AC</sub>   |
| Max. continuous current (AC)             | 7.8 A <sub>AC</sub>  | 15.0 A <sub>AC</sub>  | 24.0 A <sub>AC</sub>  |
| Overcurrent protection                   | 15 A <sub>AC</sub>   | 20 A <sub>AC</sub>  | 30 A <sub>AC</sub>  |
| Frequency                                | 59.3 – 60.5 Hz   |   |   |
| Distortion factor                        | <3% at rated power<br><5% over the entire range  |   |   |
| Fault-signal relay                       | Potential-free NO contact (make contact), max. 30V / 1A  |   |   |
| S <sub>0</sub> -output                   | Open-Collector – output max. 30V / 50mA  |   |   |
| Inverter – Electrical data               |  |   |   |
| Max. degree of efficiency                | 95.0 %   | 95.0 %  | 95.0 %  |
| CEC efficiency                           | 94.0 %   | 94.0 %  | 93.5 %  |
| Internal consumption                     | Night shutdown: 0W<br>Operation: < 5 W   |   |   |
| Min. grid-feeding power                  | 10W  |   |   |
| Circuit design                           | Grid-tied, electrically isolated, RF transformer   |   |   |
| Clock frequency                          | 18 kHz   |   |   |
| Principle                                | 1.) Potential-free DC/DC converter<br>2.) IGBT full bridge as part of the inverter                         |   |   |
| Grid monitoring                          | UL 1741  |   |   |
| Inverter – Mechanical and technical data |  |   |   |
| Optical displays                         | DC Power In (green)<br>AC Power Out (green)<br>Error (red)<br>LC display (2 x 16 characters)               |   |   |
| Operating elements                       | 2 keys for display operation   |   |   |
| Connections                              | PCB terminals inside the device - Cable routing via PG fittings  |   |   |
| Ambient temperature                      | -5 ... +149°F  |   |   |
| Temperature monitoring                   | >158°F temperature-dependent power adjustment<br>>176°F disconnection from the grid                        | >167°F temperature-dependent power adjustment<br>>185°F disconnection from the grid | >167°F temperature-dependent power adjustment<br>>185°F disconnection from the grid |
| Cooling                                  | True convection (no fan or blower)   |   |   |
| Protection Class                         | NEMA 3R (IP54) according to EN 60529   |   |   |
| Noise emission                           | < 35dB (soundless)   |   |   |
| Housing/enclosure                        | Aluminum wall-mounted enclosure  |   |   |
| Dimensions W x D x H                     | 13 3/8 x 7 7/8 x 17 3/4 in   | 13 1/4 x 23 3/4 x 8 3/4 in  | 13 1/4 x 25 3/4 x 8 3/4 in  |
| Weight                                   | 30.8 lbs   | 52.7 lbs  | 65.7 lbs  |

9.1 Peak efficiency curve

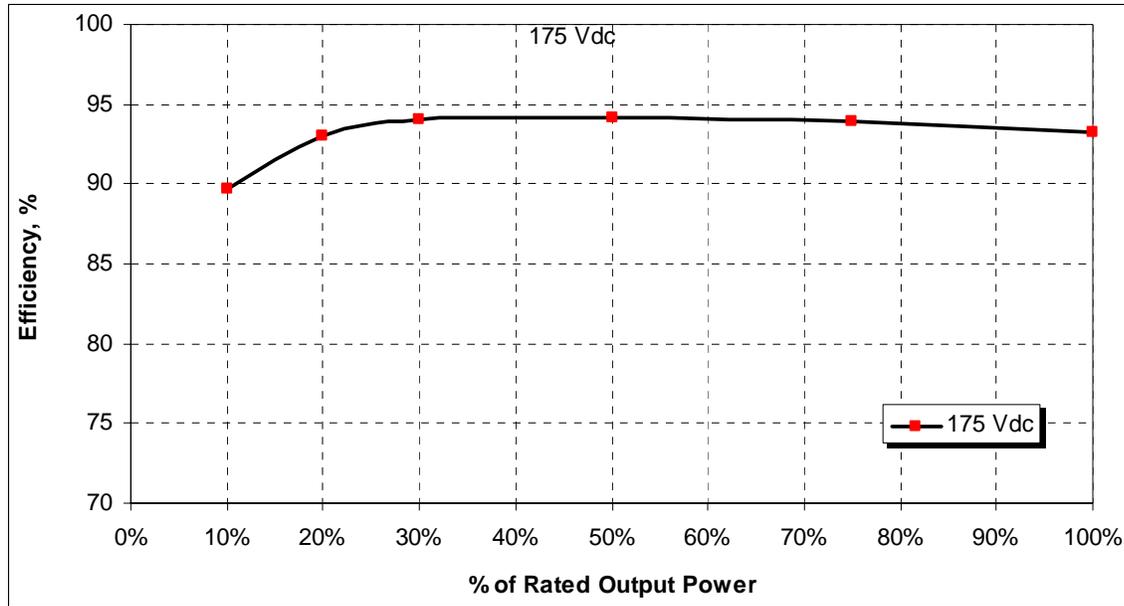


peak efficiency curve Blue Planet 1501xi

**blueplanet 2901xi**



peak efficiency curve Blue Planet 2901xi



peak efficiency curve Blue Planet 3601xi

## 10. UL listing confirmation letter

### 10.1 UL Certificate of Compliance



# Certificate of Compliance

|   |                         |
|---|-------------------------|
| Certificate: 1624128  | Master Contract: 228346 |
| Project: 1790852  | Date Issued: 2006/06/01 |
| Issued to: <b>KACO Geratetechnik GmbH</b><br>Gottfried-Leibniz-Str. 1<br>Neckarsulm, 74172<br>Germany<br>Attention: Mr. Matthias Haag |                         |

*The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US'*



Issued by: Ernesto Lopez, AScT.  
  
 Authorized by: Lindsay Clark, Product Group Manager



**PRODUCTS**

**CLASS 5311 09** - POWER SUPPLIES - Distributed Generation Power Systems Equipment  
**CLASS 5311 89** - POWER SUPPLIES - Distributed Generation - Power Systems Equipment  
 - Certified to U.S. Standards

Utility Interactive Inverter, Model Blue Planet 1501xi, permanently connected, system ratings as follows:

Maximum System Voltage: 400 Vdc  
 Range of Operating DC Voltage: 125-300 Vdc  
 Maximum Operating Current (DC): 14 A

The 'C' and 'US' indicators adjacent to the CSA Mark signify that the product has been evaluated to the applicable CSA and ANSI/UL Standards, for use in Canada and the U.S., respectively. This 'US' indicator includes products eligible to bear the 'NRTL' indicator. NRTL, i.e. National Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.

DQD 507 Rev. 2004-06-30



**Certificate:** 1624128

**Master Contract:** 228346

**Project:** 1790852

**Date Issued:** 2006/06/01

Maximum Array Short Circuit Current: 15 A  
 Maximum Utility Backfeed Current (AC): 0 A  
 Operating Voltage Range (AC): 211-264 Vac, 240 Vac nominal  
 Operating Frequency Range (HZ): 59.3-60.5 Hz  
 Nominal Output Voltage (AC): 240 Vac  
 Normal Output Frequency: 60 Hz  
 Maximum Continuous Output Current @ 40°C (AC): 7.8 A  
 Maximum Continuous Output Power @ 40°C (AC): 1500 W  
 Maximum Output Fault Current: 18 A  
 Maximum Output Overcurrent Protection: 15 A  
 Enclosure Rating Type: 3R

**Notes:**

1. Inverter, Model Blue Planet PVI1501xi has been evaluated for use in utility-interactive applications.
2. Utility interactive evaluation were conducted with firmware version 1.2

**APPLICABLE REQUIREMENTS**

CAN/CSA-C22.2 No. 0-M91 - General Requirements - Canadian Electrical Code - Part II

CAN/CSA-C22.2 No. 0.4-04 - Bonding of Electrical Equipment

CSA-C22.2 No. 107.1-01 - General Use Power Supplies

UL Std No. 1741-First Edition - Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems (Including Revisions through and including January 17, 2001)



# Certificate of Compliance

|                     |   |                         |            |
|---------------------|---|-------------------------|------------|
| <b>Certificate:</b> | 1779571   | <b>Master Contract:</b> | 228346     |
| <b>Project:</b>     | 1779571   | <b>Date Issued:</b>     | 2006/12/21 |
| <b>Issued to:</b>   | <b>KACO Geratetechnik GmbH</b><br>Gottfried-Leibniz-Str. 1<br>Neckarsulm, 74172<br>Germany<br>Attention: Mr. Mattias Haag |                         |            |

*The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US'*



**Issued by:** Ernesto Lopez, AScT.

**Authorized by:** Lindsay Clark, Product Group Manager



**PRODUCTS**

- CLASS 5311 09** - POWER SUPPLIES - Distributed Generation Power Systems Equipment
- CLASS 5311 89** - POWER SUPPLIES - Distributed Generation - Power Systems Equipment
- Certified to U.S. Standards

Utility Interactive Inverter, Models Blue Planet 2901xi and SUNstring 4000, permanently connected, system ratings as follows:

Maximum System Voltage: 400 Vdc

Range of Operating DC Voltage: 125-300 Vdc

The 'C' and 'US' indicators adjacent to the CSA Mark signify that the product has been evaluated to the applicable CSA and ANSI/UL Standards, for use in Canada and the U.S., respectively. This 'US' indicator includes products eligible to bear the 'NRTL' indicator. NRTL, i.e. National Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.



|                             |                                |
|-----------------------------|--------------------------------|
| <b>Certificate:</b> 1779571 | <b>Master Contract:</b> 228346 |
| <b>Project:</b> 1779571     | <b>Date Issued:</b> 2006/12/21 |

---

Maximum Operating Current (DC): 30 A  
 Maximum Array Short Circuit Current: 33 A  
 Maximum Utility Backfeed Current (AC): 0 A  
 Operating Voltage Range (AC): 211-264 Vac, 240 Vac nominal  
 Operating Frequency Range (HZ): 59.3-60.5 Hz  
 Nominal Output Voltage (AC): 240 Vac  
 Normal Output Frequency: 60 Hz  
 Maximum Continuous Output Current (AC): 15 A  
 Maximum Continuous Output Power (AC): 3100 W @ 40°C  
 Maximum Output Fault Current: 20 A  
 Maximum Output Overcurrent Protection: 20 A  
 Enclosure Rating Type: 3R for Model Blue Planet 2901xi, 1 for Model SUNstring 4000

**Notes:**

1. Inverter, Models Blue Planet 2901xi and SUNstring 4000 have been evaluated for use in utility-interactive applications.

**APPLICABLE REQUIREMENTS**

CAN/CSA-C22.2 No. 0-M91 - General Requirements - Canadian Electrical Code - Part II

0.4-04 - Bonding of Electrical Equipment

107.1-01 - General Use Power Supplies

UL Std No. 1741-First Edition - Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems  
(Including Revisions through and including January 17, 2001)



# Certificate of Compliance

|                     |   |                         |            |
|---------------------|---|-------------------------|------------|
| <b>Certificate:</b> | 1807016   | <b>Master Contract:</b> | 228346     |
| <b>Project:</b>     | 1807016   | <b>Date Issued:</b>     | 2006/12/21 |
| <b>Issued to:</b>   | <b>KACO Geratetechnik GmbH</b><br>Gottfried-Leibniz-Str. 1<br>Neckarsulm, 74172<br>Germany<br>Attention: Mr. Mattias Haag |                         |            |

*The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US'*



**Issued by:** Ernesto Lopez, AScT.

**Authorized by:** Lindsay Clark, Product Group Manager



**PRODUCTS**

- CLASS 5311 09** - POWER SUPPLIES - Distributed Generation Power Systems Equipment
- CLASS 5311 89** - POWER SUPPLIES - Distributed Generation - Power Systems Equipment
- Certified to U.S. Standards

Utility Interactive Inverter, Models Blue Planet 3601xi and SUNstring 5000, permanently connected, system ratings as follows:

Maximum System Voltage: 400 Vdc

Range of Operating DC Voltage: 125-300 Vdc

The 'C' and 'US' indicators adjacent to the CSA Mark signify that the product has been evaluated to the applicable CSA and ANSI/UL Standards, for use in Canada and the U.S., respectively. This 'US' indicator includes products eligible to bear the 'NRTL' indicator. NRTL, i.e. National Recognized Testing Laboratory, is a designation granted by the U.S. Occupational Safety and Health Administration (OSHA) to laboratories which have been recognized to perform certification to U.S. Standards.



|                     |         |                         |            |
|---------------------|---------|-------------------------|------------|
| <b>Certificate:</b> | 1807016 | <b>Master Contract:</b> | 228346     |
| <b>Project:</b>     | 1807016 | <b>Date Issued:</b>     | 2006/12/21 |

---

Maximum Operating Current (DC): 43 A  
 Maximum Array Short Circuit Current: 48 A  
 Maximum Utility Backfeed Current (AC): 0 A  
 Operating Voltage Range (AC): 211-264 Vac, 240 Vac nominal  
 Operating Frequency Range (HZ): 59.3-60.5 Hz  
 Nominal Output Voltage (AC): 240 Vac  
 Normal Output Frequency: 60 Hz  
 Maximum Continuous Output Current (AC): 24 A  
 Maximum Continuous Output Power (AC): 4000 W @ 25°C / 3900 W @ 40°C  
 Maximum Output Fault Current: 30 A  
 Maximum Output Overcurrent Protection: 30 A  
 Enclosure Rating Type: 3R for Model Blue Planet 3601xi, 1 for Model SUNstring 5000

**Notes:**

1. Inverter, Models Blue Planet 3601xi and SUNstring 5000 have been evaluated for use in utility-interactive applications.

**APPLICABLE REQUIREMENTS**

CAN/CSA-C22.2 No. 0-M91 - General Requirements - Canadian Electrical Code - Part II

0.4-04 - Bonding of Electrical Equipment

107.1-01 - General Use Power Supplies

UL Std No. 1741-First Edition - Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems  
(Including Revisions through and including January 17, 2001)



*Supplement to Certificate of Compliance*

**Certificate:** 1624128

**Master Contract:** 228346

*The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.*

**Product Certification History**

---

| <b>Project</b> | <b>Date</b> | <b>Description</b>  |
|----------------|-------------|---|
| 1790852        | 2006/06/01  | Update to Report 1624128 to Include Alternative Construction and Firmware Revision. |
| 1672417        | 2005/11/25  | Update to Report 1624128, Inverter, Model Blue Planet 1501xi.                       |
| 1624128        | 2005/02/14  | Original certification.   |



**K A C O**

**S O L A R**

KACO Solar Inc.  
1002 B O'Reilly Ave  
San Francisco, CA 94129  
T: +1 (415) 931 2046  
F: +1 (415) 931 1688  
[info@kacosolar.com](mailto:info@kacosolar.com)  
[www.kacosolar.com](http://www.kacosolar.com)