# Grape Solar Photovoltaic Modules

# Safety and Installation Manual

This document applies to Grape Solar photovoltaic modules with model number GS-P-220-Fab5, GS-P-225-Fab5, GS-P-230-Fab5, GS-P-235-Fab5, GS-S-250-Fab5, GS-S-240-Fab8, GS-S-245-Fab8, and GS-S-250-Fab8. Carefully read through this manual in its entirety before installing, operating or servicing the photovoltaic (PV) system. Failure to comply with the instructions described in this manual may cause bodily injury or damage to property, and invalidate Grape Solar's limited warranty for photovoltaic modules!

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## I. GENERAL INFORMATION

1. Grape Solar photovoltaic (PV) modules are designed to produce DC electrical energy from sunlight.

2. This manual contains important safety and installation information of Grape Solar PV modules. All safety and installation instructions described in this manual should be thoroughly understood before installing, operating and maintaining the PV system.

3. Working on a PV system requires specialized knowledge, and must be performed by appropriately qualified and authorized personnel only.

4. Grape Solar PV modules are subject to operate at ambient temperatures within the range -40°C to +85°C (-40°F to +185°F).

5. PV modules are intended for outdoor, land-based applications only.

6. Rated power output specification of Grape Solar PV modules are made at the Standard Test Condition (STC), which is 1000W/$m^2$ irradiance, 1.5 Air Mass (AM), and 25°C (77ºF) cell temperature. However PV modules can produce voltage at as little as 5% of full sunlight, either connected or not connected to an electrical circuit or load.

7. Electrical current and power generated by PV module increases with light intensity and higher power output than the rated specifications can be achieved at colder temperatures.

8. Reflection from snow, water or other surfaces can increase light intensity, and therefore increase the current and power generated by the module.

9. Do not artificially concentrate light on the module. Concentrating light on the module may result in damage to the module and malfunction of the whole PV system.

10. Follow all safety precautions of other equipments and components used in the PV system.

11. Retain this manual for future reference.

12. Grape Solar recommends that the customer makes a note of the serial numbers of modules in order to keep a record of the system.

## II. SAFETY PRECAUTIONS

### 1. General Safety

1.1 Ensure that the modules are used for the intended purpose only.

1.2 When installing, operating and maintaining the PV system, observe all local, regional, national and international statutory regulations, guidelines, norms and code requirements.

1.3 The safety information for other system components must also be followed.

1.4 Keep children away from the module and PV system.

### 2. Handling Safety

2.1 The utmost care is required when unpacking, transporting, and storing the modules. Leave modules in packaging until they are to be installed.

2.2 Always store the modules in a dry, ventilated in-door space if possible. If the un-connected modules have to be stored outside for any length of time, always have the glass surface facing down and cover modules with water-proof material to prevent water collecting inside the panel and causing damage to exposed connectors.

2.3 Carry modules with both hands. Do not use the junction box as a handle to hold or transport the module.

2.4 Do not stand or step on the module.

2.5 Do not drop module or allow objects to fall on module.

2.6 Do not mark or scratch the front or rear surface of the module with sharp objects.

2.7 Do not disassemble, modify or adapt the module such as drilling holes in the frame or glass. Do not apply paint or adhesive to the module rear surface.

2.8 Do not remove any part or labeling installed by Grape Solar from the module. Doing so will void the module warranty.

2.9 Keep all electrical contacts of module clean and dry. Do not handle modules when they are wet unless wearing the appropriate protective equipment.

2.10 Do not leave a module unsupported or unsecured.

2.11 There are no user serviceable parts within the module. Do not attempt to repair any part of the

module. Broken or damaged modules must not be used and must be handled carefully and disposed properly since the broken glass can be sharp and cause bodily injury if not handled with the appropriate protective equipment, and contact with any surface or the frame of the broken module can result in electrical shock.

## 3. Installation Safety

3.1 All installations must be performed in compliance with the National Electrical Code (NEC) and any applicable local codes by authorized personnel. If the module is installed in Canada, installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

3.2 Keep children away from module and the system when installing.

3.3 Do not wear metallic jewelry while performing mechanical or electrical installation of modules to avoid accidental exposure to live circuits.

3.4 When working with modules exposed to light, follow all applicable regulations regarding working with live electrical equipment.

3.5 Do not install or handle the modules when they are wet or during periods of high wind.

3.6 Do not install modules where contact with salt water is likely or where modules are likely to become partially or wholly submerged in fresh or salt water, examples of which include boats, docks and buoys.

3.7 Always use insulated tools and rubber gloves that are approved for working on electrical installations to reduce the risk of electric shock.

3.8 Always use equipment, connectors, wiring and support frames suitable for working with PV electric systems.

3.9 When installing modules on elevated locations, such as a rooftop, use caution to avoid falling or other safety hazards by following appropriate safety practices and using required safety equipment.

3.10 PV modules do not have a power ON/OFF switch. The only way to make modules inoperative is removing them from light, or fully covering their front surface with an opaque material, or placing modules face down on a smooth, flat surface.

3.11 Avoid setting the module down with any type of force on any surface, particularly when placing it at a corner.

3.12 To prevent untrained personnel from disconnecting the modules after installed, locking connectors and safety clips must be used in the installation.

3.13 Do not touch electrical terminals or the ends of any wire while installing the module. Do not open electrical connections or unplug connectors while the PV system circuit is under load. Contact with electrically active parts of the modules, such as terminals, can result in burns, sparks and lethal shock whether the module is connected or disconnected.

3.14 Cover all modules in the PV array with an opaque cloth or material before making or breaking electrical connections.

3.15 Broken junction boxes or broken connectors are electrical and laceration hazardous and cannot be repaired. Please contact the installers to remove the broken module from the array and contact the supplier for disposal instructions.

## 4. Fire Safety

4.1 Grape Solar's PV modules are non-explosion-protected equipment and fire rated Class C.

4.2 Building fire safety may be affected by installing a PV system. Improper installation may lead to hazards in the event of fire. Refer to local authority for guidelines and requirements for building or structural fire safety.

4.3 For roof installation, PV modules should be mounted over a fire resistant covering which is rated for the application.

4.4 Do not install modules near equipment or locations where flammable gases can be generated or collected.

4.5 Grape Solar recommends using components such as earth ground fault circuit breakers, fuses and circuit breakers in the PV system for fire prevention.

# III. MODULE INSTALLATION

## 1. Installation Site Selection

1.1 The site for PV module installation shall have an environment temperature within Grape Solar's PV module operating temperature range -40°C to +85°C (-40°F to +185°F).

1.2 The site shall allow all modules to be exposed to sunlight without obstruction all year round (shadows generated by trees or buildings, even partial shading, on the module array will result in reduction of PV system yield).

1.3 The site shall have adequate ventilation of the module backside to avoid heat build-up, which can cause module performance degradation and system yield reduction. For roof mounted systems, at least a 4 inch clearance is required between the module back surface and roof for rear ventilation and module cooling.

1.4 The modules have been evaluated by following UL-1703 standard that can sustain a positive or negative mechanical loading of 30 lbs/ft$^2$ (1600 Pascal). To avoid exceeding the 30 lbs/ft$^2$ mechanical loading limit, site specific loads such as wind and snow should be taken into account.

1.5 The site should not have exposure to extremely corrosive chemicals (e.g. emissions from manufacturing facilities).

## 2. Module Orientation & Tilt Angle

2.1 To obtain maximum yield from the PV system, the direction and tilt angle for the modules shall be set to receive the incident sunlight perpendicularly to the module surface. To avoid performance degradation in serial connected module strings, all modules shall have the same orientation and tilt angle.

2.2 To avoid dirt build-up on the glass against the frame edge, low module tilt angle is not recommended. Dirt build-up on the module surface can cause partial shading and degrade module and system electrical performance.

## 3. Electrical Connection

3.1 All installations must be performed in compliance with the National Electrical Code (NEC) and any applicable local codes by authorized personnel. If the module is installed in Canada, installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

3.2 Modules may be connected in series and/or in parallel to achieve the desired electrical output.

When serial connected, all modules must have the same amperage, but the maximum open circuit voltage of the system must not exceed the specified maximum system voltage of the modules. When parallel connected, all modules must have the same voltage.

3.3 Do not use modules with different electrical performance or physical property in the same system.

3.4 To prevent untrained personnel from disconnecting the modules when under load, which may cause serious bodily injury or death, all Grape Solar PV modules are equipped with factory-installed PV wires and MC-4 connectors with locking safety clips. Once connected, the connector requires the use of a special tool to disconnect module-to-module connections.

3.5 When making module-to-module connections, the polarities of cables and terminals must be matched. Failure to do so may result in damage to the module and void the module warranty.

3.6 Use cables and wires with adequate cross-sectional areas (min. of 12AWG) and suitable MC-4 connectors which are approved for use at the maximum short-circuit current of the module.

3.7 Over-current device (e.g. fuse or circuit breaker) whose rating is not greater than the value of the protective fuse marked on the back of the module must be serial connected with each module or string of modules when reverse current is anticipated to exceed the value of the module protective fuse.

3.8 The junction box contains factory installed bypass diodes and is not designed to be field accessible or maintainable, and should not be opened under any circumstances. Opening the junction box will void the warranty.

## 4. Grounding

4.1 To reduce the possibility of electrical shock and protect the PV system from lightning, all module frames and mounting racks must be properly earth grounded by using grounding hardware that has been UL certified and in accordance with the National Electrical Code before wiring the circuit.

4.2 If the building at which the PV system is installed is already equipped with exterior lightning protection system, the PV system installation must be integrated in the lightning protection system.

4.3 Each PV module has 2 holes on back frame with grounding sign. Grape Solar recommends the following three methods of grounding the module frame:

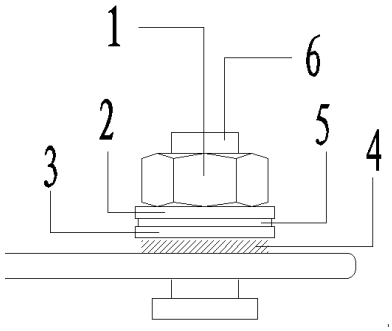
4.3.1 Facing the back of the module, attach an ILSCO GBL-4DBT ground lug to either

grounding hole at the back of the module. Place the ground lug on the module frame's outer surface and in-line lengthwise. Insert a #8-32 x 0.5" stainless steel screw through the ground lug and frame, and secure from behind with a #10 stainless steel star washer and nut. Torque the screw to 25 inch lbs (2.8Nm).

4.3.2 Use the UL listed grounding and bonding equipment (KDER), e.g. SOLKlip type 1954381-1, by Tyco Electronics Corp (E69905), to provide a reliable grounding connection to the module frame.

4.3.3 Use a set of stainless steel grounding and bonding equipment including bolt/nut/cupped washer/flat washer/serrated washer to provide a reliable grounding connection to the module frame (refer to Figure-1). A flat washer is required between serrated washer and Φ2.5mm grounding wire. A cupped washer is required between grounding wire and the nut (with torque less than 4N•m). Grounding wire should be directly connected with the screw.

4.4 The rack must also be grounded unless they are mechanically connected by nuts and bolts to the grounded PV modules. The array frame shall be grounded in accordance with NEC Article 250.




1 Stainless steel M5 nut
2 Stainless steel cupped M5 washer
3 Stainless steel flat M5 washer
4 Stainless steel M5 serrated washer
5 Grounding lead
6 Stainless steel M5 bolt

**Figure-1 Grounding panel frame with stainless steel grounding & bonding equipment**

## 5. Mounting

5.1 The modules have been evaluated by UL that can sustain a positive or negative design loading of 30 lbs/ft$^2$ (1600 Pascal). The maximum mechanical load on the module must not exceed 45 lbs/ft$^2$ (2150 Pascal) under any circumstance.

5.2 Each module must be securely fastened at a minimum of 4 points using support frames or mounting kits specialized for PV applications.

5.3 Panels may be mounted at any angle from vertical to horizontal orientation. However, to obtain maximum yield from the PV system, the direction and tilt angle for the modules shall be set to

receive the incident sunlight perpendicularly to the module surface.

5.4 For roof mounted systems, at least a 4 inch clearance is required between the module back surface and roof for rear ventilation and module cooling.

5.5 Clearance of 1/24 inch (1mm) or more between modules is required to allow for thermal expansion of the frames.

5.6 Keep the back surface of the module free from any foreign objects or structural elements which could come into contact with the module, especially when the module is under mechanical load.

5.7 To prevent water from entering the junction box, which could result in a safety hazard, modules should ***not*** be mounted with the front/top glass facing downward.

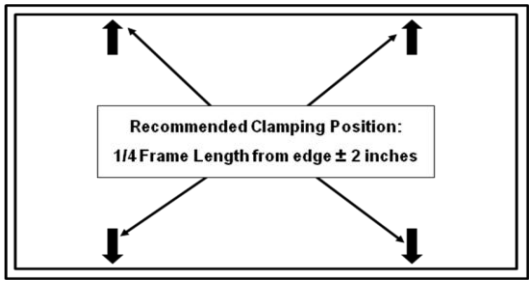
5.8 At least a 4 inch clearance between the module frames and structure, or wall, or ground is required to prevent wiring damage and allows air to circulate behind the module.

5.9 PV modules can be mounted to the structure by the following methods:

5.9.1 Mounting Holes: Secure the module to the structure using the mounting holes. There are 8 mounting holes on module frame which have been evaluated by UL for mounting. Attach ¼ -20 x 0.75" stainless steel screw via each mounting hole with ¼" stainless steel flat washer, and secure from behind with another stainless steel flat washer, local washer and nut. Torque the bolts to 6.3ft lbs (8.5Nm).

5.9.2 Pressure Clamps or Clips: Mount the module with the clamps or clips on the module frame. Installers should ensure the clamps are of sufficient strength to allow for the maximum design pressure of the module.

5.10 It is recommended that modules be securely fastened on the long side of the frames, but mounting the module only on the short side is allowed. The maximum mechanical load applied on the module ***must not*** exceed 30 lbs/ft$^2$ (1600 Pascal).






## IV. MAINTANIENCE

1. No routine maintenance is required.
2. Grape Solar recommends that periodic inspection of the PV system for tight electrical and mechanical connection and free of corrosion should be performed.
3. Periodic cleaning of modules is not required, but is recommended, as periodic cleaning can result in better performance of the PV system, especially in regions with low levels of annual precipitation.
4. Do not remove the dirt by scraping or rubbing away from the module front surface when dry as this may cause micro-scratches on the glass and lead to module performance degrading.
5. Water can be used for regular washing or rinsing of the module front glass to remove dust, dirt or other deposits.
6. To remove ingrained dirt, first rinse off area and let soak for a short period of time (5-minutes). Re-wet and use a soft sponge or seamless cloth to wipe glass surface in a circular motion. Mild detergent or glass cleaner may be used to clean the ingrained dirt, but harsh cleaning materials such as scouring powder, steel wool, scrapers, blades, or other sharp instruments must not be used to clean the module. Use of such materials will void the product warranty.
7. Always wear rubber gloves for electrical insulation while maintaining, washing or cleaning panels.

## V. DISCLAIMER OF LIABILITY

Since the use of this safety and installation manual and the conditions and methods of installation, operation, use and maintenance of the modules are not checked or monitored by Grape Solar Inc., Grape Solar assumes no liability for loss, damage, injury or expense arising through improper use or incorrect installation, operation or maintenance.

Furthermore, Grape Solar assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the module. No license is granted by implication or otherwise under any patent or patent rights.

The information in this Manual is based on Grape Solar's knowledge and experience and is believed to be reliable; but such information including product specifications (without limitations) and suggestions do not constitute a warranty, expressed or implied. Grape Solar reserves the rights to make changes to the product, specifications or this Manual without prior notice.

# Appendix

**Figure-2 Dimension of Module, and Position of Mounting Holes, GS-*X*-*nnn*-Fab5, "*X*" is "S" or "P", "*nnn*" is from 220 to 250**

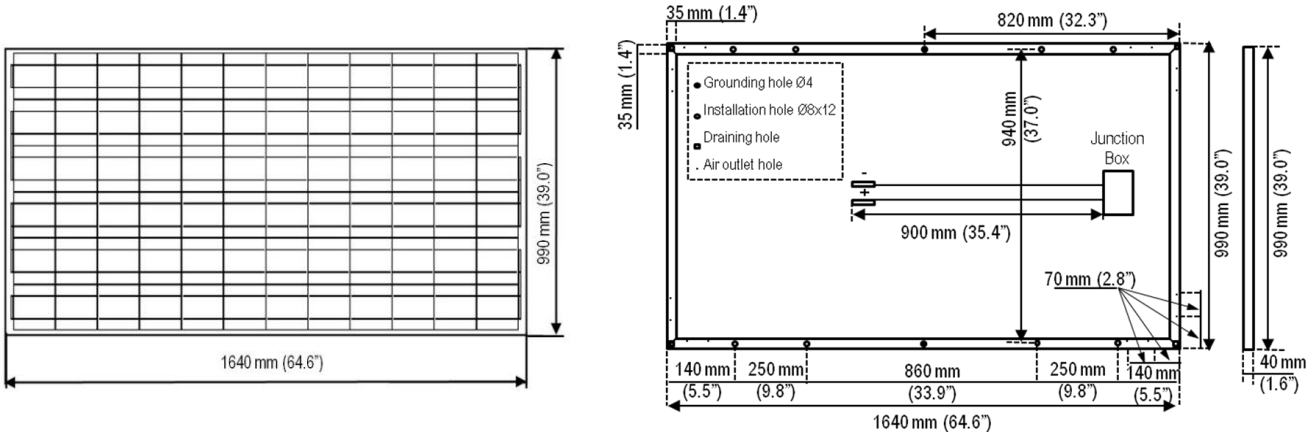
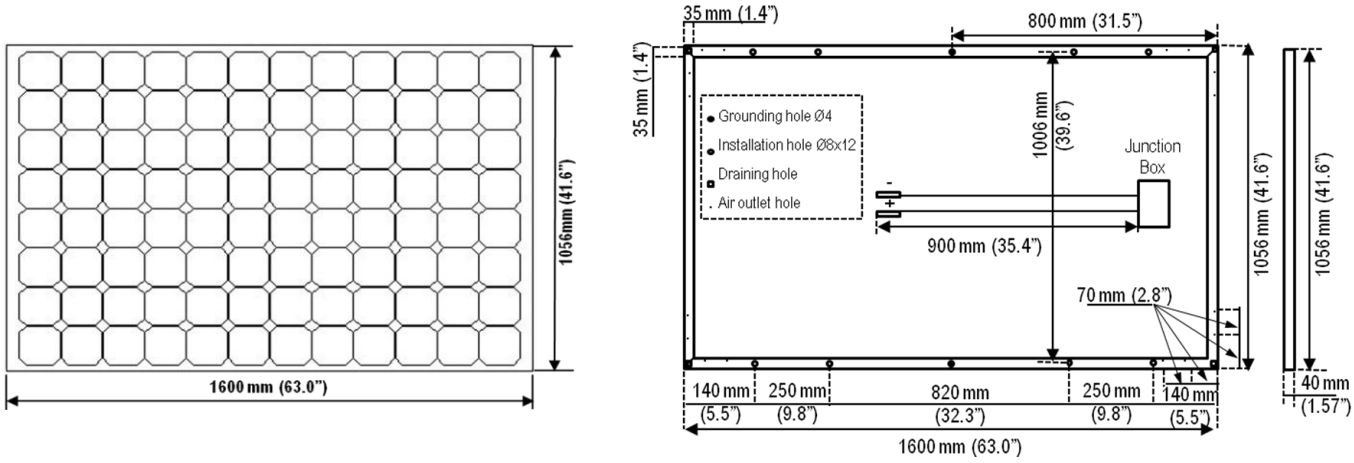



**Figure-3 Dimension of Module, and Position of Mounting Holes, GS-S-*nnn*-Fab8, "*nnn*" is from 240 to 250**



## Table-1. PV Module Electrical Specification

| Module | Crystalline | Cell Size (mmxmm) | Cell# | Max Power Pmax (W) | Max Power Voltage Vmp (V) | Max Power Current Imp (A) | Open Circuit Voltage Voc (V) | Short Circuit Current Isc (A) | Weight (kg/lb) | Max System DC Voltage (V) | NOCT (℃) | Current coeff. (%/K) | Voltage coeff. (%/K) | Power coeff. (%/K) | Max Series Fuse Rating |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GS-P-220-Fab5 | Poly | 156 x 156 | 60 (6x10) | 220 | 30.1 | 7.31 | 36.3 | 7.81 | 18.6/41.0 | 600 | 47 ± 2 | 0.04 | -0.38 | -0.47 | 15A |
| GS-P-225-Fab5 | | | | 225 | 30.2 | 7.46 | 36.3 | 7.97 | | | 47 ± 2 | 0.04 | -0.38 | -0.47 | |
| GS-P-230-Fab5 | | | | 230 | 30.4 | 7.58 | 36.4 | 8.11 | | | 47 ± 2 | 0.04 | -0.38 | -0.47 | |
| GS-P-235-Fab5 | | | | 235 | 30.6 | 7.68 | 36.5 | 8.22 | | | 47 ± 2 | 0.04 | -0.38 | -0.47 | |
| GS-S-250-Fab5 | Mono | | | 250 | 30.7 | 8.15 | 37.7 | 8.72 | | | 45 ± 2 | 0.04 | -0.34 | -0.48 | |
| GS-S-240-Fab8 | Mono | 125 x 125 | 96 (8x12) | 240 | 50.3 | 4.77 | 59.6 | 5.10 | 19.5/42.9 | | 47 ± 2 | 0.04 | -0.38 | -0.47 | 10A |
| GS-S-245-Fab8 | | | | 245 | 50.6 | 4.84 | 59.8 | 5.18 | | | 47 ± 2 | 0.04 | -0.38 | -0.47 | |
| GS-S-250-Fab8 | | | | 250 | 50.8 | 4.92 | 59.9 | 5.26 | | | 47 ± 2 | 0.04 | -0.38 | -0.47 | |

**NOTES**: The electrical characteristics are within ±10 percent of indicated values of Isc, Voc, and Pmax under standard test conditions (irradiance of 1kW/m$^2$, AM1.5 spectrum, and cell temperature of 25℃). Photovoltaic modules may produce more current and /or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on the module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and sizes of regulators which are connected to the PV output. Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.




# Instruction Manual

- Operator
- Authorized Installer

blueplanet 1502xi
blueplanet 2502xi
blueplanet 3502xi
blueplanet 5002xi

KACO new energy.

**For the operator**

# Operating Instructions

**For authorized electricians**

# Installation Instructions

**Instructions begin on page 15**

**blueplanet 1502xi / 2502xi / 3502xi / 5002xi**


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# General Notes

By purchasing an inverter from KACO new energy GmbH, you have opted for a reliable, high-performance technology and will profit from KACO new energy's many years of experience in the field of current inverter technology and power electronics. The blueplanet 1502xi, 2502xi 3502xi and 5002xi 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**

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

### Other applicable documents

Operators, please read any additional operation instructions which may have been included with the inverter. Installers, please refer to the installation manual and any instruction which may have been included with the inverter for information regarding installation of the inverter.

## 1.1 Retention of documents

Please pass these operating and installation instructions on to the installation operator. These documents must be stored near the installation 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**

**DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

**WARNING**

**WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

**CAUTION**

**CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**

**NOTICE**

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

**NOTE**

Useful information and notes.

**ACTION**

This symbol indicates that a certain action is required.

**IMPORTANT**

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

**Electrical voltage!**

**Risk of burns!**

**Read the manual!**

## 1.3 Name plate

The name plate showing the exact designation of the unit is located on the left side of the housing.

# 2 Safety Instructions and Regulations

**DANGER**

- **Danger due to lethal voltages.**
- **Lethal voltages are present within the unit and on the power supply lines. Therefore, only authorized 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 authorized 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 authorized electrician for modifications to the installation 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 installation.**

### Transportation

The inverter is subjected to extensive testing and inspections in our test field. This is how 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 of receipt of the goods.

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

**NOTE**

FCC Compliance
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

# 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 utility grid.
blueplanet inverters are built according to all required 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 authorized electrician undertakes the registration with your power supply company and obtains approval for your photovoltaic installation from the supply grid operator on your behalf. Some of the documents that you require in order to register your photovoltaic installation and have it approved are included in the installation instructions.

## 3.2 Factory warranty and liability

KACO new energy GmbH issues a warranty of ten years or 120 months on the blueplanet inverter starting from the date of installation, but at most 130 months after shipment by KACO new energy GmbH.

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 specialty 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
- Unauthorized 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. The unit must, where possible, 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 and the completed warranty card. 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 power conversion device manufacturing support our 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. Contact our service department directly by telephone at + 1 866 522 6765.

**⚠ CAUTION**

**Incorrect use is prohibited.**

# 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

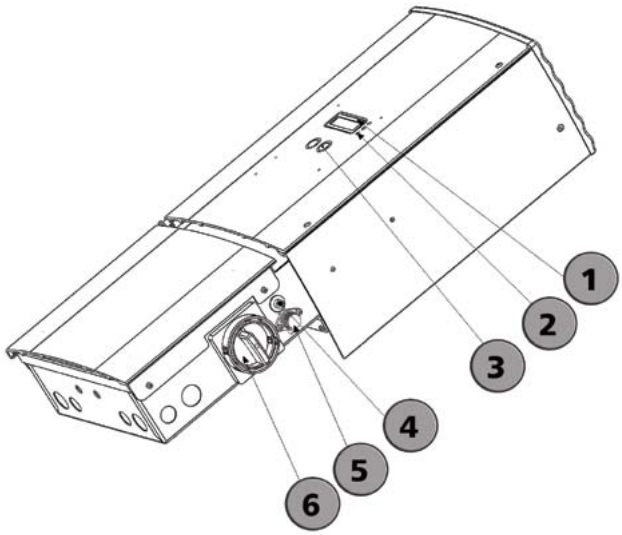



Figure 4.1: **Overview blueplanet**

**Legend**

**1 Display**
See measured values and configuration parameters

**2 LED displays**
Display of the operating state

**3 Control keys**
Switch between displays and configuration of parameters

**4 Night time start switch**
For activating the display after nightfall

**5 GFDI fuse**
Ground Fault Detector Interruptor Fuse.

**6 AC/DC switch**
Disconnects AC and DC power from the inverter

## 4.2 LED displays

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




Figure 4.2: **LED displays**

**LED (1) (green):**

The LED begins to light up when the minimum voltage from a photovoltaic array is present and goes out again if the array voltage is lower than the minimum operating voltage. The LED signals that the inverter is in stand-by mode. If it is illuminated the inverter is ready for operation or is currently operating.

**LED (2) (green):**

The LED is lit 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 approx. 10 mins. to see if the fault is temporary. If this is not the case, notify your authorized electrician.

**IMPORTANT**

If there is a 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 public utility grid is available again.

Check whether the fault in question relates to a general power failure or whether the circuit breaker between the utility service and the inverter has tripped. If the circuit breaker has tripped, notify your authorized technician. If there was a power failure, simply wait until the fault has been cleared. The system automatically re-starts.

## 4.3 Keys "1" and "2"

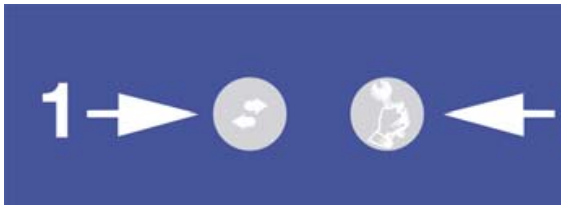



Figure 4.3: **blueplanet control keys**

Key "1" is used to switch between the various displays for measured values and data. You use key "2" 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 used to navigate through the individual displays and settings.

**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 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 blueplanet inverter starts up. Measured values and all of the counters are displayed here. Key "1" is used to navigate through the individual menu items.

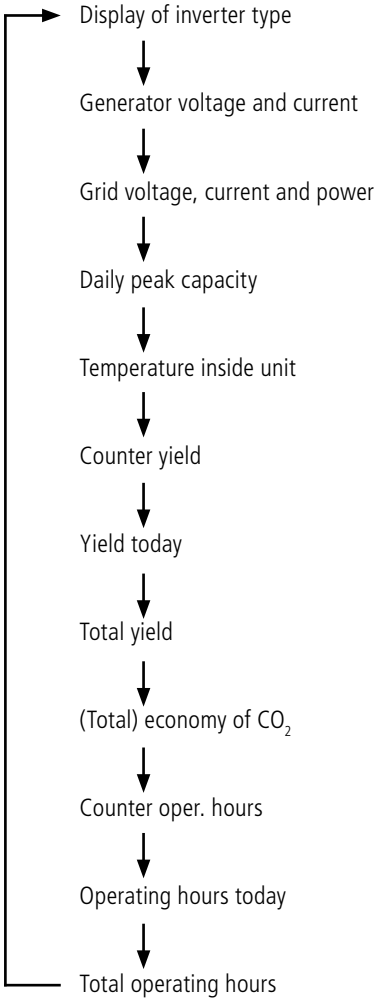



Figure 4.4: **Display mode menu**

### Explanation of the individual menu items:

**Display of inverter type**

Inverter type - blueplanet 1502xi/2502xi/3502xi/5002xi display

**Generator voltage and current**

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

**Grid voltage, current and power**

The current line voltage, line current, and the power that is currently being fed into the power 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. If the unit becomes too hot, the unit will reduct power output or switch off.

**Counter yield**

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

**Yield today**

The power that has been fed into the grid during the current day. This value resets to zero each morning.

**Total yield**

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

**(Total) economy of $CO_2$**

Shows the $CO_2$ savings of this PV installation compared to the German electricity mix. The $CO_2$ savings are calculated from the total yield counter and can also be cleared with this counter.

**Counter oper. hours**

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

**Operating hours today**

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

**Total operating hours**

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

## 4.5 Level 2 menu – Configuration mode

**ACTION**

To access configuration mode, press both keys at the same time. The software version display appears. Pressing key "1" now switches to the next menu item and 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 choice.

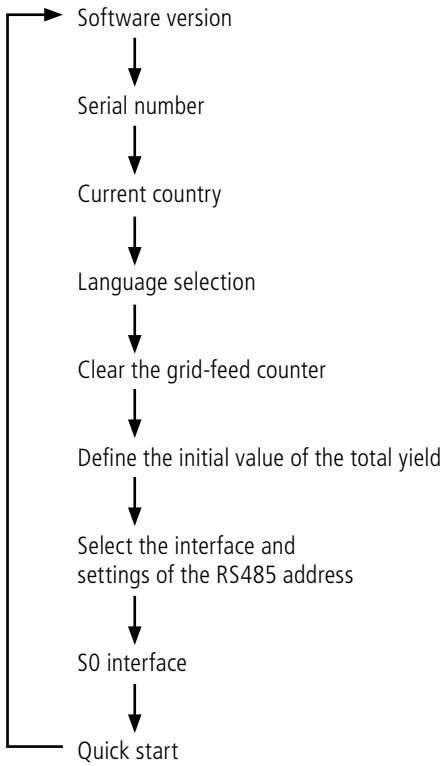



Figure 4.5: **Configuration mode menu**

## 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 display interface can be selected here.

### Clear the grid-feed counter

When you clear the grid-feed counter, 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". By means of an additional confirmation with key "1", all counter are cleared. The display "Grid-feed counter cleared!" confirms 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.

### Define the initial value of the total yield

Use this menu setting to define or reset the intial value of the total yield of the inverter.

### Select the Interface and settings of the RS485 address

With the menu item "Select interface", 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 KACO **pro*LOG***, **watch*DOG*** or other monitor. If several inverters are connected to a KACO **pro*LOG***, **watch*DOG*** or other monitor each address may only be used once. It is possible to monitor 32 blueplanet inverters with one KACO **pro*LOG***. 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 meter to a tariff metering device".
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**

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 blueplanet inverter.

### 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/AC switch

The inverters include a connection box with an internal DC/AC disconnect switch, which allows for the inverter to be disconnected from the photovoltaic generator and the AC power grid and removed for service.
To disconnect the inverter from the photovoltaic generator, turn the internal DC/AC disconnect switch on the right side of the connection box from the ON (1) position to the OFF (0) position (see Fig. 4.1). The ON (1) position is pointing up and the OFF (0) position is pointing toward the front.

## 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 be activated during the night by pressing the start switch on the right side of the connection box.

**ACTION**

To do this, press the "5" switch (see Figure 4.1 – (5)) on the right side of the connection box for approx. 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 totaled. This data remains in memory 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 RS485 interface

Blueplanet inverters are also equipped with an RS485 interface in order to enable remote monitoring of your photovoltaic installation. Several inverters can be monitored over this interface at the same time. Using the KACO **pro***LOG*, **watch***DOG* or other monitoring device you can receive yield and operating data as well as error messages by SMS (text message) or e-mail. These monitoring options are especially recommended for situations where you are unable to check the functionality of the installation on-site at regular intervals, e.g. if you live far away from the installation site. Contact your installer if you wish to integrate remote monitoring into your system.

## 4.9 Display

Inverters in the blueplanet series are equipped with a back-lit LCD (see figure 4.1 – (1) which displays measured values and data.
In normal mode, the backlighting is switched off. As soon as you press one of the keys, the backlighting is activated. If approx. 1 minute elapses without a key being pressed, it switches off once again.

**NOTE**

Calculating efficiency by measuring the current and voltage values leads to unusable results due to the tolerances of the measuring devices. The sole purpose of these values is to monitor the basic operation of the system.

**IMPORTANT**

Due to measuring tolerances, the measured values may not always correspond to the actual values. The inverter's measuring elements 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%. At low power operation the sensors within the unit are not as accurate as when at higher power therefore long term operation may cause this high deviation. Under normal operating conditions this deviation is minimal.

### Operating States

| 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 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. |
| 9 | Test mode | For internal operation only. |
| 11 | Power limitation | If the generator is producing too much power, the inverter limits to the max. 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 amount of time before it switches on (Installation Instructions, section 4, Technical Data). |
| 60 | PV voltage is too high for feeding into the grid | Protective function of the inverter. The inverter can only begin feeding into the grid once the PV voltage falls below a specified value. The PV voltage is below the maximum permissible no-load voltage, this status is not an error. |
| 62 | Standalone mode | The inverter was switched to standalone mode by the blueplanet Grid-Save. function. The inverter is disconnected from the public utility grid. The power indicator percentage refers to the maximum AC power. |
| 64 | Output current limit | The AC current is limited once the specified maximum value has been reached. |

Table 4.1: **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 has switched. This error correction takes a country-specific length of time (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. Once the fault is gone, the blueplanet inverter feeds in again.

Many of these fault signals point to a fault in the grid, and are, therefore, not an operational fault on the part of the blueplanet inverter. The minimum triggering levels are determined by applicable standards (e.g. VDE0126-1-1 or UL 1741), and the inverter must switch off if the permitted values are exceeded.

| Status | Display | Explanation |
|---|---|---|
| 10 | Temperature too high inside | The temperature in the unit has become too high (> 176°F). When the internal reaches 158°F, the inverter limits the power. An internal temperature of 176°F is only reached if convection cooling is impeded by external factors, e.g. by covering the cooling fins. |
| 29 | Error GFDI - Check Fuse! | A ground fault was detected on the DC side. Notify your authorized electrician so that the solar generator can be checked. |
| 30 | Error Measurement | The current and voltage measurements in the inverter are not plausible. This can be caused by very dynamic weather conditions if there are quick changes between low grid-feed power (e.g. 200 W) and high grid-feed power (e.g. the maximum grid-feed power). |
| 32 | Error Selftest | The internal grid separation relay test has failed. If this internal error occurs several times, notify your authorized electrician. |
| 33 | Error DC-gridfeeding | The DC feed into the grid has exceeded the permitted limit value. This grid-feed can be impressed from the grid on the blueplanet inverter so that no inverter fault exists. If this error occurs several times, notify your authorized electrician. |
| 34 | Error Communication | A communication error has occurred in the internal data transmission. If this error occurs several times, notify the service department. |
| 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 | Failure PV-Overvoltage | The voltage of the PV generator is too high. The solar generator is wrongly dimensioned. Notify your authorized electrician. |
| 41 | Line failure Undervoltage | The voltage of the grid-feed phase is too low. The grid cannot be fed into. This error can be grid-related. |
| 42 | Line failure Overvoltage | The voltage of the grid-feed phase is too high. The grid cannot be fed into. This error can be grid-related. |
| 48 | Line failure Underfrequency | The line frequency is too low. This error can be grid-related. |
| 49 | Line failure Overfrequency | The line frequency is too high. This error can be grid-related. |
| 50 | Line failure average value voltage | The average value of the EN50160 voltage measurement is above the set shut down value. |
| 51 | Line failure overvoltage L1 | Phase voltage L1 is above the set maximum phase voltage. |
| 52 | Line failure undervoltage L1 | Phase voltage L1 is below the set maximum phase voltage. |
| 53 | Line failure overvoltage L2 | Phase voltage L2 is above the set maximum phase voltage. |
| 54 | Line failure undervoltage L2 | Phase voltage L2 is below the set maximum phase voltage. |
| 55 | Error DC link | The voltage at the DC link is too high, or the DC link cannot be charged (IGBT damage). |
| 57 | Waiting for reactivation | Waiting for reactivation after an error. |
| 58 | Overtemperature controlling unit | The temperature is too high. To avoid damage, the grid-feed was stopped. Provide for sufficient ventilation. |
| 59 | Error self test | An error occurred during the buffer inspection. |
|  | Internal error EPROM | An error occurred in the EPROM. |
|  | No parameters | Error, no parameters. |

Table 4.2: **Fault signals**

# 5 Accessories

KACO 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.

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



Figure 5.1: **KACO pro*LOG***

KACO-**watch*DOG***
The KACO-**watch*DOG*** card is the integrated communication option from KACO for monitoring your PV installation. Up to three inverters can be monitored with one affordable card.

The KACO-**watch*DOG*** can be installed inside the blueplanet inverter in a few easy steps. For more about the functions and installation of the KACO-**watch*DOG*** and KACO-**pro*LOG*** please visit www.kacosolar.com where you may download the installation manuals for all KACO products.

You can access your PV data at:
www.kaco-newenergy.com/blueplanetweblogin.php



Figure 5.2: **KACO watch*DOG***

Information about additional accessories can be found in our general catalogue, price list and website.

# 6 Troubleshooting

In line with our continuously expanding quality assurance system, we endeavor 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 behavior 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 monitor the inverter closely and, where applicable, make a note of the displays and LEDs. The next step is to contact your installer and explain the problem encountered.

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 using the DC/AC switch in the connection box. |
| 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 sensors of the inverter have been selected to ensure maximum solar yields.<br>Due to these tolerances,<br>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%, especially if operating at very low power for extended periods of time. (see section 4.9) |
| The display is blank and the LEDs are not lighting up. | – The unit is in night shutdown mode.<br>– There is no AC line voltage.<br>– The solar generator voltage is too low.<br>– DC/AC switch is OFF (0). | 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 start-up key.<br>A grid failure will also cause the display to go blank and the grid-feed to stop. Wait until the public utility grid is available again. Also check to see if the DC/AC switch is OFF (0) and if so, switch it to ON (1).<br>If the display does not light up during normal daytime hours, please contact your solar installer. |
| The inverter is active but does not feed into the grid. | – Insufficient generator voltage available.<br>– The line voltage or the solar generator voltage is not stable. | After sunrise, at sunset and when there is not enough solar insolation due to bad weather conditions or due to the solar modules being covered with snow, the generator voltage or the generator power that comes from the roof may be too low to be able to feed in.<br>Before the grid-feed process begins, the inverter has to check the line parameters for a certain period of time. The length of the switch-on time differs by country according to applicable standards and regulations and can take several minutes. |
| The inverter is active but does not feed into the grid. The insolation is sufficient. | The inverter has interrupted the grid-feed due to a fault. | After an interruption of the grid-feed due to a fault (line failure, overtemperature, overload, etc.), the inverter checks the line parameters for 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.<br>With faulty grids, interruptions can occur during the day. Notify your solar installer if the inverter shuts down regularly over a period of several weeks (more than 10 times per day).<br>For an explanation of the individual display error texts, please see the fault signals. |

| 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. | The line fuse capacity is too low.<br>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.<br>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. | When there are certain ambient conditions, the units may emit audible noises. The following causes may be determining factors in this regard:<br>– 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.<br>– In cases of dynamic weather conditions (frequent switching between sunny and cloudy conditions) or strong solar insolation, a light hum may be audible due to the high output.<br>– 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.<br>– People with very sensitive hearing (particularly children) may be able to hear the high-frequency hum caused by the inverter's operating frequency of approx. 17 kHz.<br>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. |
| In spite of high insolation, the inverter does not feed in the maximum power into low-voltage grid. | Unit is too hot and the power is reduced. | The temperature inside the unit became too high. The inverter reduced the power to prevent damage to the unit. Above an internal temperature of 158°F, the inverter limits the power and levels off at a temperature between 158°C and 176°C. An internal temperature of 185°C is only reached if convection cooling is impeded by external factors, e.g. by covering the cooling fins. Provide for sufficient cooling of the unit. |

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's 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 materials. KACO does it's best to ensure our vendors follow a low carbon manufacturing process as we do ourselves. It is not always possible but if you have questions about our products or the components in our products don't hesitate to call +1 (866) 522-6765 and ask.

### Device

Do not dispose of faulty inverters or accessories together with household waste. Ensure that the old unit and, where applicable, any accessories are disposed of in a proper manner. Most areas have public electronic waste disposal and/or recycling plants. Feel free to contact KACO at +1 (866) 522-6765 to request information about e-waste recycling in your area.

### Packaging

Ensure that the transport packaging is recycled.

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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.

**NOTICE**

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

**Other applicable documents**

When installing the inverters, be sure to observe all assembly and installation instructions for components and other parts of the installation. These instructions are delivered together with the respective components and additional parts of the installation. Please refer to the installation manual and any instructions which may have been included with the inverter for information regarding installation of the inverter.

## 1.1 Retention of documents

Please pass these operating and installation instructions on to the installation operator. The installation 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**

**DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

**WARNING**

**WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

**CAUTION**

**CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.**

**NOTICE**

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

**NOTE**

Useful information and notes.

**ACTION**

This symbol indicates that a certain action is required.

**IMPORTANT**

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



**Electrical voltage!**



**Risk of fire or explosion!**



**Risk of burns!**



**Read the manual!**



**Switch off the power!**

## 1.3 Name plate

The name plate showing the exact designation of the unit is located on the left side of the housing.

# 2 Safety Instructions and Regulations

**DANGER**

– **Danger due to lethal voltages.**
– **Lethal voltages are present within the unit and on the power supply lines. Therefore, only authorized electricians may install and open the unit.**
– **Even when the unit is disconnected, high contact voltages may still be present within the unit.**

**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 operating instructions unless you are qualified to do so.**

### Standards and regulations

Electrical conformity according to U.S., Canadian and international safety operating standards and code requirements:
– UL 1741-1:1999 Rev. May 2007
– CSA 22.2 No. 107-1:2001 Rev 2006
– IEEE Std. 1547-2003
– IEEE Std. 1547.1-2005
– FCC Part 15 Class B
– NEC Sections 690 (ANSI/NFPA 70)
– Directive concerning Electromagnetic Compatibility with Class B (Council Directive 2004/108/EC)
– Low Voltage Directive (Council Directive 2006/95/EC)

The blueplanet inverter has complete on-board overcurrent, over-temperature and anti-islanding protection.

### Technical rules

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

### This symbol designates the Equipment Grounding Conductor



### Accident prevention regulations

The inverter must be installed by a licensed and authorized-electrician. 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 authorized 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 grounding, conductor dimensioning and appropriate protection against short circuiting must be provided.
– Keep all covers on the unit closed during operation.
– Prior to performing any visual inspections or maintenance, ensure that the power supply has been switched off and is prevented from being inadvertently switched back on.
– Never touch the electrical connections when you have to take measurements while the power supply is switched on.
– Remove all jewellery from your wrists and fingers.
– Make sure that the testing equipment is in good and safe operating condition.
– When working on the unit while it is switched on, stand on an insulated surface, ensuring that there is no grounding connection.
– Follow the instructions contained in these operating and installation instructions and observe all danger, warning and safety information.
– This list does not constitute a complete listing of all measures required for the safe operation of the unit. Contact your specialty 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 installation of the inverter are only permitted if they comply with local and national standards.

**CAUTION**

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

**Information regarding 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 | 1502xi | 2502xi | 3502xi | 5002xi |
|---|---|---|---|---|
| DC rated power | 1600 W | 2650 W | 3700 W | 5300 W |
| Max. recommended PV generator power | 2000 W | 3000 W | 4000 W | 6000 W |
| MPP range | 125-400 V | 200-450 V | 200-510 V | 200-510 V |
| No-load voltage | 550 V | 550 V | 600 V / 550V* | 600 V / 550 V* |
| Monitoring input voltage | Stand-by from $V_{in}$ < 125 V | Stand-by from $V_{in}$ < 200 V | Stand-by from $V_{in}$ < 200 V | Stand-by from $V_{in}$ < 200 V |
| Max. DC input current (Isc) | 21.45 A | 21.45 A | 28 A | 40 A |
| Polarity safeguard | Short-circuit diode | | | |

* Feed-In only, if PV-Voltage is smaller 550 V

**Output – Electrical data**

| Model | 1502xi | 2502xi | 3502xi | 5002xi |
|---|---|---|---|---|
| Rated power | 1500 W | 2500 W | 3500 W | 5000 W |
| Maximum power | 1650 W | 2500 W | 3500 W | 5000 W |
| Line voltage | 212 V-264 V @ 240 $V_{AC}$<br>184 V-228 V @ 208 $V_{AC}$ | | | |
| Rated current | 6.5 A @ 240 $V_{AC}$<br>7.2 A @ 208 $V_{AC}$ | 10.4 A @ 240 $V_{AC}$<br>12.0 A @ 208 $V_{AC}$ | 14.6 A @ 240 $V_{AC}$<br>16.8 A @ 208 $V_{AC}$ | 20.8 A @ 240 $V_{AC}$<br>24.0 A @ 208 $V_{AC}$ |
| Max. current | 8.0 A @ 240 $V_{AC}$<br>8.0 A @ 208 $V_{AC}$ | 12.0 A @ 240 $V_{AC}$<br>12.5 A @ 208 $V_{AC}$ | 16.0 A @ 240 $V_{AC}$<br>17.0 A @ 208 $V_{AC}$ | 24.0 A @ 240 $V_{AC}$<br>24.0 A @ 208 $V_{AC}$ |
| Power factor | 0.99 | | | |
| Rated frequency | 60.0 Hz | | | |
| Frequency range | 59.3 Hz-60.5 Hz | | | |
| Distortion factor according to VDE0838 part 2 (EN 61000-3-2) | < 3% at rated power<br>< 5% over the entire range | | | |
| Fault signal relay | Potential-free NO contact (make contact), max. 30 V / 3 A | | | |
| S0 output | Open collector-output max. 30 V / 50 mA | | | |
| Overvoltage protection | Varistors and spark gaps | | | |

**Inverter – Electrical data**

| Model | 1502xi | 2502xi | 3502xi | 5002xi |
|---|---|---|---|---|
| Max. degree of efficiency | 95.9% @ 240 $V_{AC}$<br>95.5% @ 208 $V_{AC}$ | 96.0% @ 240 $V_{AC}$<br>95.6% @ 208 $V_{AC}$ | 96.2% @ 240 $V_{AC}$<br>95.9% @ 208 $V_{AC}$ | 96.3% @ 240 $V_{AC}$<br>96.0% @ 208 $V_{AC}$ |
| CEC degree of efficiency | 95.5% @ 240 $V_{AC}$<br>95.0% @ 208 $V_{AC}$ | 95.5% @ 240 $V_{AC}$<br>95.0% @ 208 $V_{AC}$ | 95.5% @ 240 $V_{AC}$<br>95.5% @ 208 $V_{AC}$ | 95.5% @ 240 $V_{AC}$<br>95.0% @ 208 $V_{AC}$ |
| Internal consumption | Night shutdown: 0.4 W @ 240 $V_{AC}$ / 0.3 W @ 208 $V_{AC}$<br>Operation: < 5 W | | | |
| Minimum grid-feed power | 10 W | 15 W | 25 W | 25 W |
| Maximum Output Fault Current (AC) and Duration | 30A / 100µs | 50A / 100µs | 70A / 100µs | 96A/100 µs |
| Maximum Input Short Circuit Current | 21.45 A | 21.45 A | 28.0 A | 40.0A |
| Maximum Input Source Backfeed Current to Input Source | 0A | | | |
| Synchronization In-Rush Current | 0A | | | |
| Voltage and Frequency Trip Time | < 160ms | | | |
| Voltage Trip Limit Accuracy | 1.5% of nominal value | | | |
| Frequency Trip Limit Accuracy | ± 0.06Hz | | | |
| Trip Time Accuracy | ± 0.1% | | | |
| Circuit design | Galvanically isolating high frequency DC/DC converter with downstream self-commutated inverter | | | |
| Clock frequency | 17kHz | | | |
| Grid monitoring | complies with IEEE 1547 | | | |

**Inverter – Mechanical and technical data**

| Model | 1502xi | 2502xi | 3502xi | 5002xi |
|---|---|---|---|---|
| Visual displays | LEDs: PV generator (green)<br>Grid-feed (green)<br>Fault (red)<br>LCD (2 x 16 characters) | | | |
| Controls | 2 keys for display operation and configuration of parameters | | | |
| AC/DC cut-off point | Pre-installed and separable AC/DC rotary disconnect switch | | | |
| Connections | Screw compression terminals in the connection box<br>Cable connection via conduit fittings using 3/4" or 1/2" knockouts on connection box<br>Terminals accept AWG 4 to AWG 12, 75'C, copper wire. Torque to 20lb-in (2.2N-m). | | | |
| Interfaces | RS485, S0, error transmitting relay | | | |
| Ambient temperature | –4°F ... +140°F (> 104°F power derating) | | –13°F ... +140°F (> 104°F power derating) | |
| Internal Temperature monitoring | > 158°F temperature-dependent power limiting<br>> 176°F disconnection from the grid | | | |
| Max. humidity | 95% (not-condensing) | | | |
| Cooling | Free convection (no fan)<br>5002xi: Free convection (fan assist) | | | |
| Protection class | NEMA-3R | | | |
| Noise emission | < 35 dB (noiseless)<br>5002xi: <45dB (fan operation) | | | |
| Housing | Aluminium wall-mounted housing | | | |
| Dimensions W x D x H | 30 x 14 x 8 1/4 in. | 32 x 14 x. 8 1/4 in. | 35 7/8 x 14 x 9 1/2 in. | 35 7/8 x 14 x 9 1/2 in. |
| Weight | 42 lbs | 52 lbs | 69 lbs | 70 lbs |

# 4 Unit Description

**CAUTION**

**Incorrect use is prohibited.**

The galvanically isolated blueplanet units are available with different power ratings. The appropriate inverter type is selected according to the maximum output of the photovoltaic modules that have been installed. The maximum output values can be found in the data sheet (see Technical Data, section 3).

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

## 4.1 Included in box

– blueplanet inverter with pre-installed connection box
– Wall bracket
– Documentation

## 4.2 Designing the PV array

The selection of the PV array is of great importance when designing a PV installation. When doing so, you must ensure that the solar array is compatible with the inverter.
Observe the data provided in the data sheet (see section 3, Technical Data) when designing your solar array.

**NOTE**

KACO Calc PRO, a dimensioning program for the easy selection of PV modules, can be downloaded at no cost at the following address:
http://www.kaco-newenergy.com

**Designing the PV array:**

– 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. Depending on the way in which the modules are installed and the geographic location, a suitable temperature 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:

– $U_0$ (voltage open circuit) < max. input voltage of the inverter. Even at very low outside temperatures, the open circuit voltage of the connected string must lie within the permitted input voltage range. The open circuit voltage of the entire string must be less than the max. input voltage under all conditions.

– $U_{Mpp}$ (voltage maximum power point) > min. input voltage. Even at very high outside temperatures, the MPP voltage of the connected string should lie within the permitted input voltage range. The MPP voltage of the entire string must always be greater than the lowest MPP voltage of the inverter.

If the MPP voltage moves outside of the permitted input range, the installation may still appear to function properly. In this situation, the maximum possible amount of power is not fed into the grid; instead, a smaller amount is back fed to the utility grid. The amount of energy fed into the grid will depend on what point the inverter is operating on the PV generator Voltage/Current curve.

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 a solar installation. For this reason, it is extremely important to obtain maximum energy yields from the solar generator. To achieve this, solar generators in the northern hemisphere should be oriented to the south at an angle of inclination best suited for the location. The PV generator should never be shaded.

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, the solar generator power can be increased.

For roofs with an east-west orientation, we recommend a multi-string PV installation. To achieve an optimum yield from the installation, half of the strings must be installed on the east side of the roof; the second half on the west side.

For exposed locations in mountains or in southern regions with higher than normal solar radiation, we recommend that the power generator be reduced appropriately. Please consult with us or your specialty dealer about this matter.

## 4.3 Protection concepts

The following monitoring and protective functions are integrated into blueplanet inverters:
– Overvoltage conductors/varistors to protect the power semiconductors from high-energy transients on the grid side.
– Temperature monitoring of the heat sink.
– EMC filters to protect the inverter from high-frequency line interference.
– PV generator grounded varistors to protect the inverter against bursts and surge pulses.
– Islanding detection according to IEEE 1547.
– Ground Fault Detector Interrupter (GFDI) according to NEC 690.5.

## 4.4 Dimensions and weights

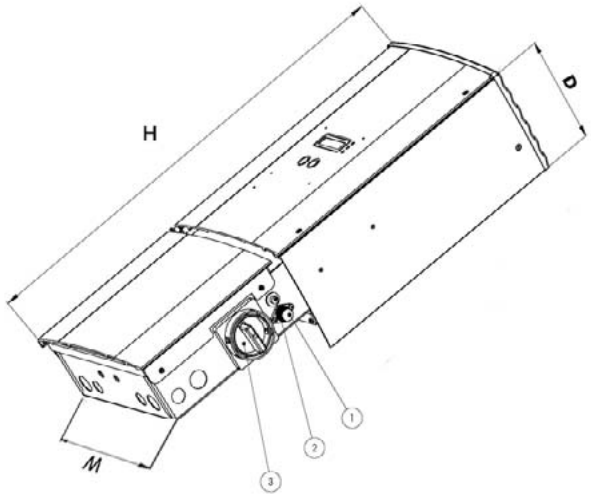



Figure 4.1: **blueplanet dimensions refer to table below for dimensions**

**Legend**

**1 GFDI fuse**
**2 Night time start switch**
**3 DC/AC disconnect switch**

| Model | Height (H) | Width (W) | Depth (D) | Weight |
|---|---|---|---|---|
| 1502xi | 30 in. | 14 in. | 8 1/4 in. | 42 lbs |
| 2502xi | 32 in. | 14 in. | 8 1/4 in. | 52 lbs |
| 3502xi | 35 7/8 in. | 14 in. | 9 1/2 in. | 69 lbs |
| 5002xi | 35 7/8 in. | 14 in. | 9 1/2 in. | 70 lbs |

## 4.5 Inverter knockout dimensioning

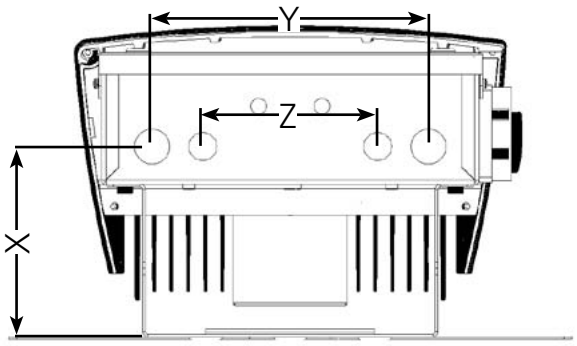



Figure 5.1 (A): Inverter bottom knockout dimensions

| Model | X | Y | Z |
|---|---|---|---|
| 1502xi | 4 13/32" | 8 19/32" | 5 13/32" |
| 2502xi | 4 13/32" | 8 19/32" | 5 13/32" |
| 3502xi | 6" | 8 19/32" | 5 13/32" |
| 5002xi | 6" | 8 19/32" | 5 13/32" |

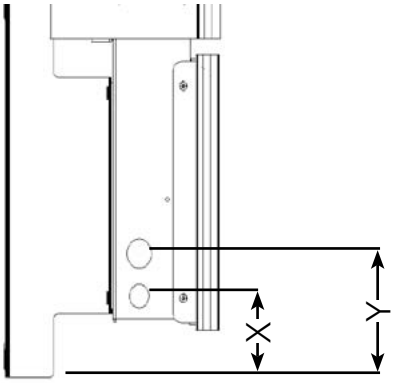



Figure 5.1 (B): Inverter left view knockout dimensions

| Model | X | Y | Z |
|---|---|---|---|
| 1502xi | 3" | 4 19/32" | N/A |
| 2502xi | 3" | 4 19/32" | N/A |
| 3502xi | 3" | 4 19/32" | N/A |
| 5002xi | 3" | 4 19/32" | N/A |

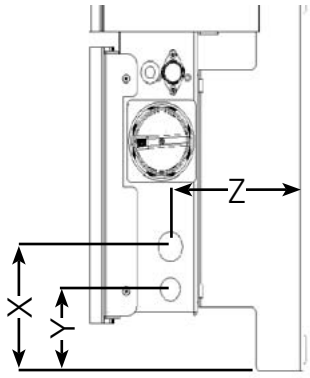



Figure 5.1 (C): Inverter right view dimensions

| Model | X | Y | Z |
|---|---|---|---|
| 1502xi | 4 19/32" | 3" | 4 13/32" |
| 2502xi | 4 19/32" | 3" | 4 13/32" |
| 3502xi | 4 19/32" | 3" | 6" |
| 5002xi | 4 19/32" | 3" | 6" |

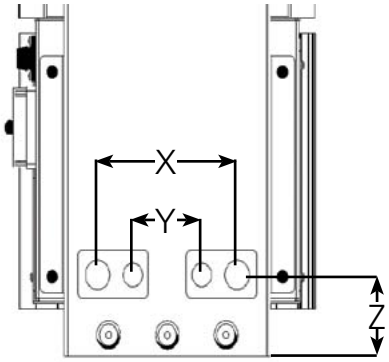



Figure 5.1 (D): Inverter back plate access dimensions

| Model | X | Y | Z |
|---|---|---|---|
| 1502xi | 6 3/16" | 3 3/32" | 3" |
| 2502xi | 6 3/16" | 3 3/32" | 3" |
| 3502xi | 6 3/16" | 3 3/32" | 3" |
| 5002xi | 6 3/16" | 3 3/32" | 3" |

# 5 Installation and Start-Up

**WARNING**

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

**CAUTION**

**Risk of burns from hot housing components.**
**Install the blueplanet so that unintentional contact with heat sink is not possible.**

## 5.1 Selecting an appropriate place for installation

**NOTE**

blueplanet inverters meet the requirements of protection class NEMA 3R if all cable feedthroughs are used or appropriately sealed.

The units should be installed in areas that are as dry as possible in order to extend their service life. It is recommended 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:**

  **7 7/8" side clearance to other units,**

  **27 1/2" clearance to other stacked units,**

  **19 5/8" clearance to cabinets, ceilings and above unit,**

  **36" from bottom of connection box to ground when mounted outdoors.**

- 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 194°F 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, however it is important to note that the minimum distance to ground is 3 feet when mounted outdoors.
- Installation at eye level makes it easier to read the display.
- Mount the inverter in a location where the ambient temperature is ideally in the range of-4° to +104°F.

## 5.2 Installing the inverter

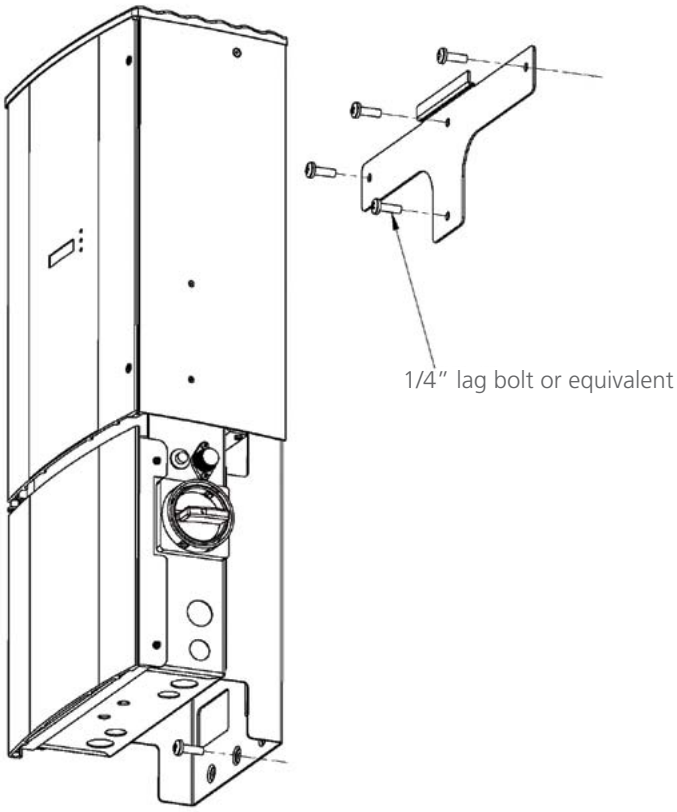



Figure 5.1: **installing the wall bracket**

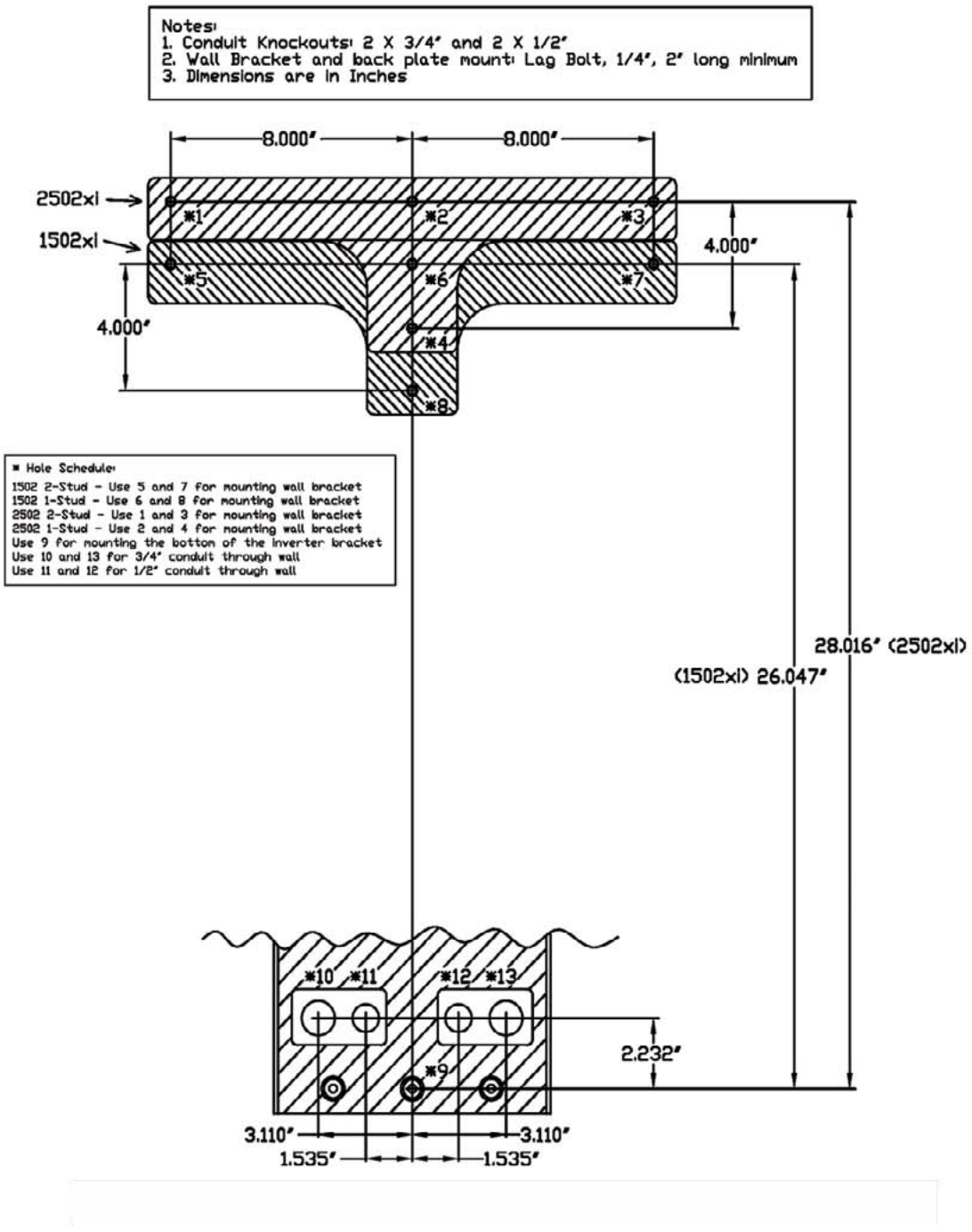



Figure 5.2: **blueplanet 1502xi and 2502xi wall bracket dimensions**

Check the composition and condition of the wall before installation. If necessary, use an alternate means of installing the inverter to the wall.

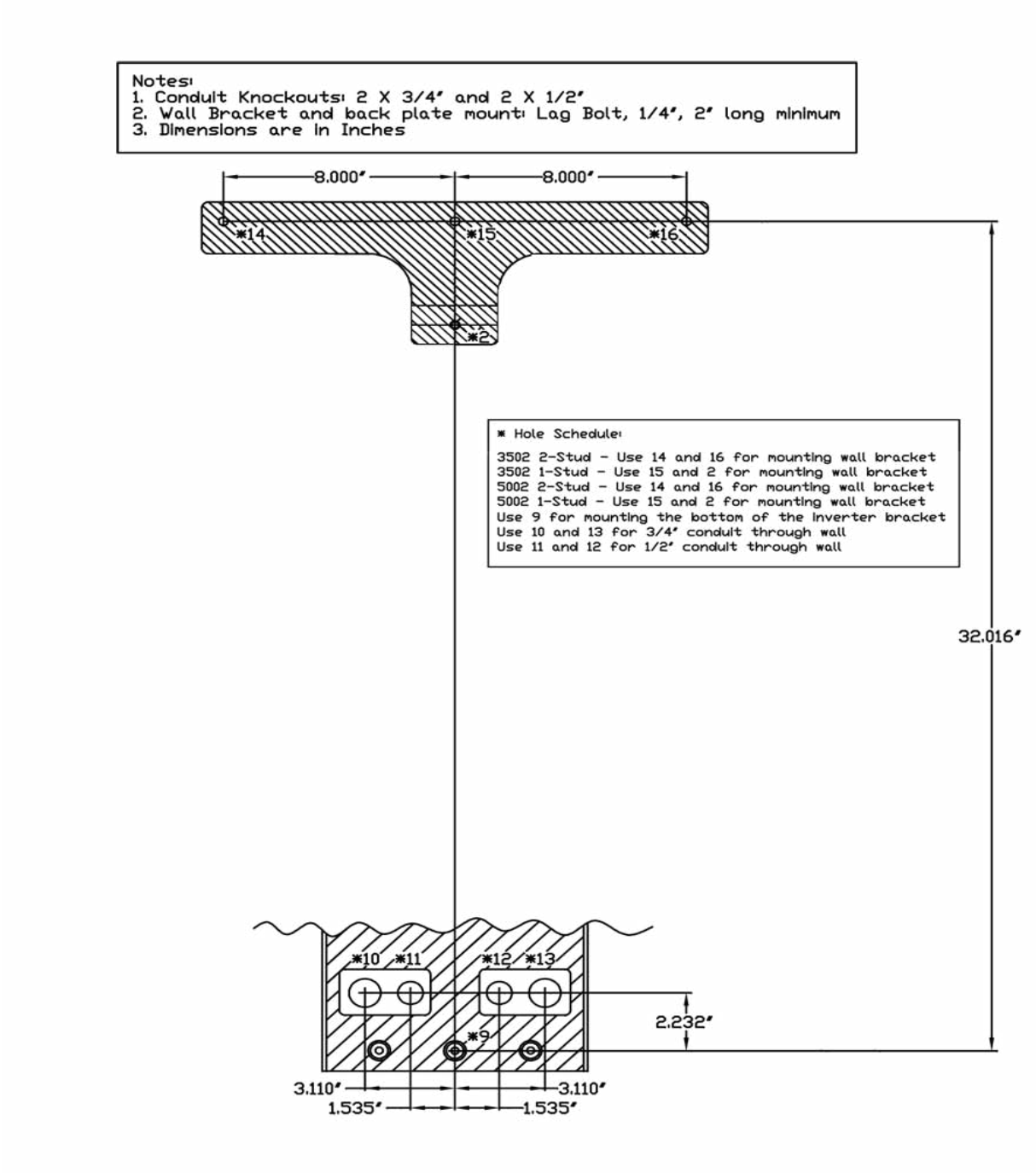



Figure 5.3: **blueplanet 3502xi and 5002xi wall bracket dimensions**

**ACTION**

– Mount the inverter so that the wall bracket fits into the notch on the rear of the inverter assembly mounting plate.
– Then secure the inverter assembly mounting plate with the help of the lower screw.

## 5.3 Connection box with AC/DC disconnect

### Intended use

The blueplanet connection box is intended to be installed with the inverter as one unit during the initial installation. If an inverter must be removed for service, the connection box must remain installed to protect persons from contact with the live DC and AC conductors inside. The connection box contains an integrated AC/DC disconnect switch to comply with the NEC article 690 disconnecting means. The switch disconnects only the AC Line-1, AC Line-2 and DC Hot conductors. The switch has a hole used for locking into the OFF position during inverter replacement. When the switch is in the off position the AC and DC wiring inside the inverter is disconnected and should be safe for removal. The connection box has a shield which is secured by Torx type screws which protect service personnel from electric shock as the circuits inside are energized by the photovotaic array. For servcing the connections inside the shielded area, the photovoltaic array must be de-energized by applying an opaque cover over the array or other means and the AC circuit must be de-energized by switching off the breaker or other means.

**DANGER**

**When replacing the inverter section, the installer must turn off the switch in the connection box, lock it and measure the AC and DC wiring to be sure it is not energized.**

**DANGER**

**If there is a ground fault in the PV array, the grounded conductor may be live. This is a problem with the requirements of the National Electric Code requiring that only the ungrounded conductor be switched. If a ground fault is present and the GFDI fuse blows, the grounded conductor is no longer grounded and is live with respect to the position of the ground fault.**

### Description of components

The DC/AC switch is located on the right side of the connection box. When pointed to the front of the unit it is in the OFF position. When pointed in the UP position the unit is in the ON position. Clearly visible labels can be provided upon request.

I Designates the ON or energized position.
O Designates the OFF or non-energized position.

### Safety of components

The Authority Having Jurisdiction (AHJ) has a difficult charge and maintains ultimate authority of the solar electric system's final inspection. The AHJ must be well versed with the requirements of the NEC, understand the local utilities' ruling on the use of a utility external disconnect switch (UEDS), and applicable use of a UL 1741 approved product.

The following NEC 2008 subsections provide an overview of the solar electric system disconnect requirements: 690.13; 690:14, 690.15, 690.17; 690.64, 230.82.6. Subsections are summarized below. For the complete text refer to the applicable NEC version approved for use in your jurisdiction.

690.13: The means to disconnect all current carrying conductors of a solar electric system from all other conductors in a building.

690.14, sections A through D: Section A, the disconnection means are not required to be suitable for service equipment and should be rated in accordance with 690.17. Section B, equipment specific to the photovoltaic source circuits such as over current devices, circuit isolation switches, and blocking diodes are permitted on the solar electric side of the disconnection means. Section C, the disconnection means should be located in a readily accessible location, preferably near the points of building entrance, be marked as a solar electric system disconnect, suitable for use for the prevailing conditions, and limits the grouping of disconnects to six per enclosure. Section D, permits utility interactive, or grid tied inverters to be located in areas that are not readily accessible, and details the switch requirements. The AC and DC disconnect should be line of sight with the inverter and be readily accessible.

690.15: The means for disconnecting all aspects of a solar electric system must be provided, and if the equipment is energized from more than one source, the disconnecting means should be grouped and identified. Allowances for several AC circuits to be disconnected is allowed as long as the disconnect complies with 690.17

690.17: The means for disconnect all ungrounded conductors should be readily accessible, externally operable with exposing the operator to live circuits, and plainly indicate the open and closed positions. The disconnect shall have an interrupting rating sufficient for the nominal circuit voltage and current that is available at the line terminals of the equipment.

690.64: The supply side of the inverter shall be permitted to be connected to the supply side of the service disconnecting means as permitted in 230.82.6. The load side is permitted as long as each interconnection

is made with a dedicated circuit breaker rated for the appropriate current back feed rating.

230.82.6: The type of equipment connected to the supply is listed, with subsection six identifying solar electric systems as permissible.

All components within a UL 1741 compliant inverter must pass evaluation spacing, voltages and currents that the inverter is rated for. The UL 508 standard, industrial control equipment, auxiliary devices has provisions for testing manually operated switches. The integrated switch passed the UL508 standard under the file E304888 for use within a UL 1741 approved grid tied inverter. The switch was tested 6000 operating cycles at the nominal AC and DC voltages and currents as noted in table one below. Additional operating cycles of 4000 resulted in a total of 10000 successful operating cycles. The switch was de constructed and evaluated under a pass fail criteria.

As referenced in the NEC, subsection 690.17, the switch must meet applicable voltage and current ratings. The AC and DC switch ratings are detailed in this table:

| AC / DC Disconnect | | Inverter Models | | | |
|---|---|---|---|---|---|
| | | 1502 | 2502 | 3502 | 5002 |
| DC Nominal Voltage: VDC | 600 | 550 | 550 | 550 | 550 |
| DC Nominal Current IDC | 40 | 21.45 | 21.45 | 40 | 40 |
| AC Nominal Voltage VAC | 300 | 240/ 208 | 240/ 208 | 240/ 208 | 240/ 208 |
| AC Nominal Current: IAC | 36 | 8 | 12.5 | 17 | 24 |

The disconnect solution offered by KACO new energy complies with all applicable NEC, and UL1741 requirements. The use of an integrated disconnect with the inverter is potentially safer due to less electro mechanical connections. The only requirement which would necessitate an individual disconnect would be the specific ruling of the utility requiring a UEDS.

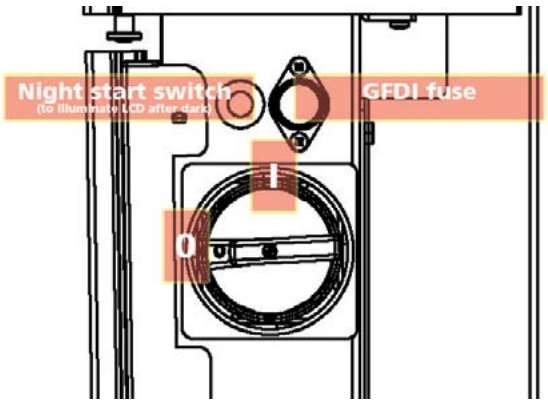



Figure 5.4: **DC/AC and night switch, GFDI fuse**

The GFDI fuse is located on the right side of the connection box. When a ground fault occurs this fuse will open causing the inverter to shut down and indicate a fault. Replace only with the same type and rating fuse. The fuse is a fast-acting 600 $V_{DC}$/1 A KLKD1(manufacturer: littlefuse) rated device.

The night time start switch is located on the right side of the connection box. Press and hold the start switch for up to 5 seconds to wake the inverter when there is no DC input voltage. This allows the user to display the power that was produced during that day.

## 5.4 Grounding the inverter

Grounding must be done according to the NEC (National Electric Code) and any applicable local electric codes! The inverter has two sides of grounding we need to consider.

System ground (grounding): connecting the circuit to ground (i.e. negative of a PV generator, neutral of a split single phase or bi-polar dc system).

Equipment ground (bonding): Connecting all non-current carrying metal parts to ground (array structure, metal enclosure, module frame)

The AC Grounding Electrode Conductor (GEC) shall be sized as required by NEC 250.66 and the GEC does not have to be larger than #6 copper or #4 aluminum if connected to Rod, Pipe or Plate Electrodes!

The DC Equipment Grounding Conductor (EGC) shall be sized in accordance with NEC 250.122, if ground fault protection is used. Otherwise, it should be the same size as the current carrying conductor!

### (A) Grounding single inverters:

For the AC side (system ground) use a continuous irreversibly appropriately sized conductor bare or insulated conductor (GEC) to ground the Inverter to the AC GE (Grounding Electrode - ground rod or in some cases the main water line). If the ground rod is unavailable, splice irreversibly to the AC GEC.

The DC side (equipment ground) should start at the PV array. All non-current carrying exposed metal parts of equipment, raceways, and other enclosures of the PV system shall be grounded according to NEC 690.43 (e.g. each PV module, combiner and junction box, metal roofing, mounting structure, DC disconnect, and Inverter). The grounding equipment must be listed and labeled.

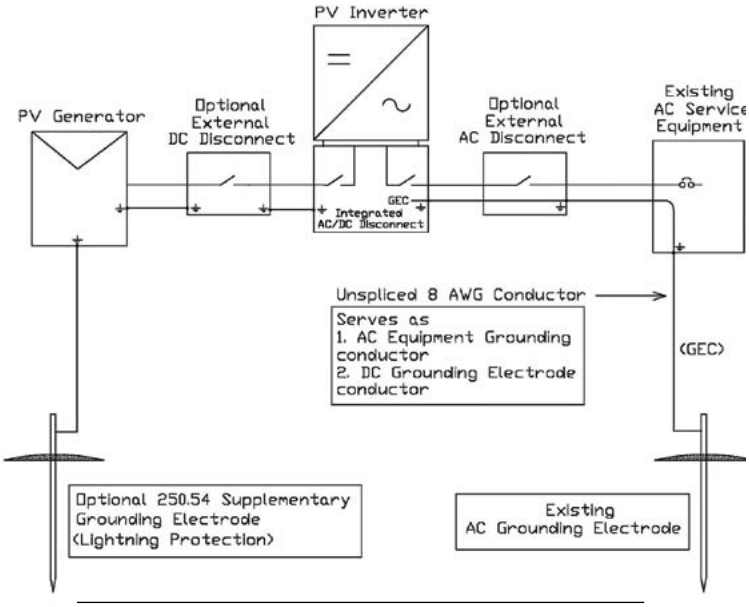



Figure 5.5: **System grounding**

### (B) Grounding multiple inverters:

Use a DC GE (Grounding Electrode – ground rod) and run an appropriately sized conductor from the DC GE to the AC GE. This will become a GEC for the inverters. Then use a short appropriately sized conductor jumper to each inverter that is irreversibly spliced to the GEC.

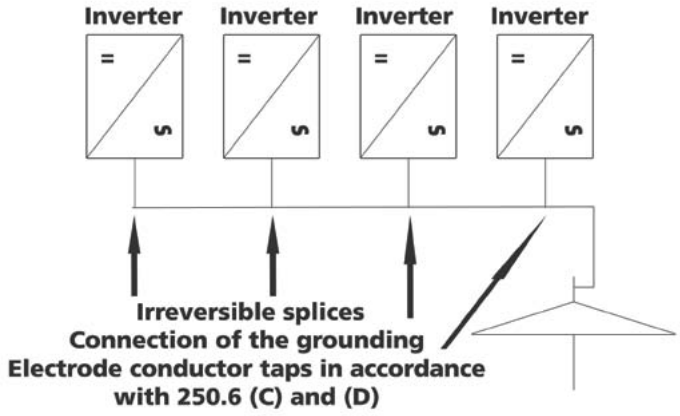



Figure 5.6: **System grounding-multiple inverters**

**DANGER**

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

**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 positive or negative connection of the PV generator must be grounded. To find out which way is correct, ask the module manufacturer. If there is no preferred grounded connection by the module manufacturer we recommend grounding the Negative as this is the most common method.

*Negative Grounded System (Factory Default)*

– Connect the positive PV generator connection to Hot in the connection box.
– Connect the negative PV generator connection to Return in the connection box.

See diagram in 5.8

No modifications should be made to the inverter. In this configuration the Negative of the PV generator is grounded through the GFDI fuse.

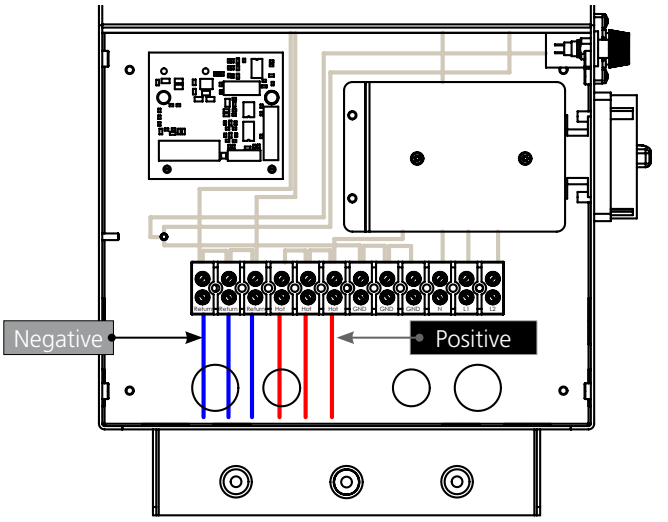



Figure 5.7: **DC connection of the connection box – Negative Grounding System**

**NOTE**

In this configuration the Negative of the PV generator is connected to the 'Ret' (Return) terminal and is grounded through the GFDI fuse. The positive is connected to the "Hot Terminal".

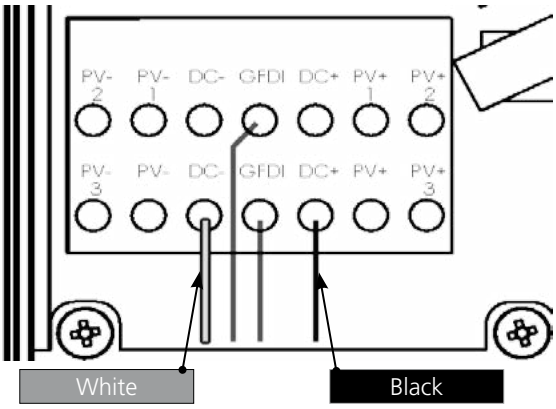



Figure 5.8: **DC connection 02xi series -Negative Grounding System**

*Positive Grounded System*

– Connect the negative generator connection to Hot in the connection box.
– Connect the positive generator connection to Return in the connection box.
– Connect Return (white cable) to DC+ in the inverter.
– Connect Hot (black cable) to DC- in the inverter.

See diagram in figure 5.10

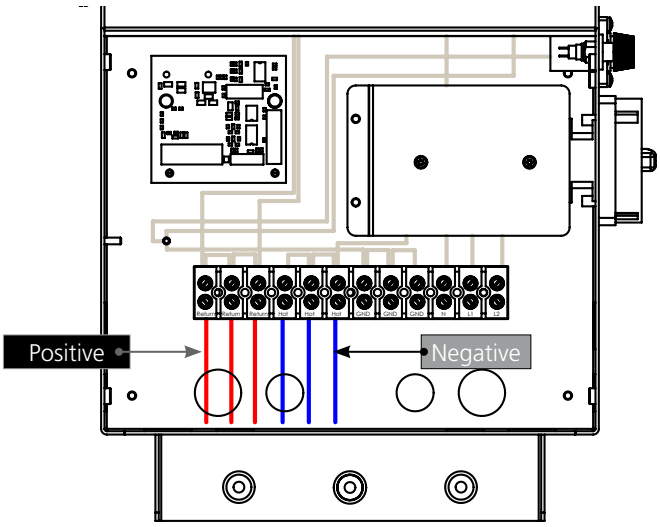



Figure 5.9: **DC connection of the connection box – Positive Grounding System**

**NOTE**

In this configuration the Positive of the PV generator is connected to the 'Ret' (Return) terminal and is grounded through the GFDI fuse. The negative is connected to the 'Hot' Terminal.

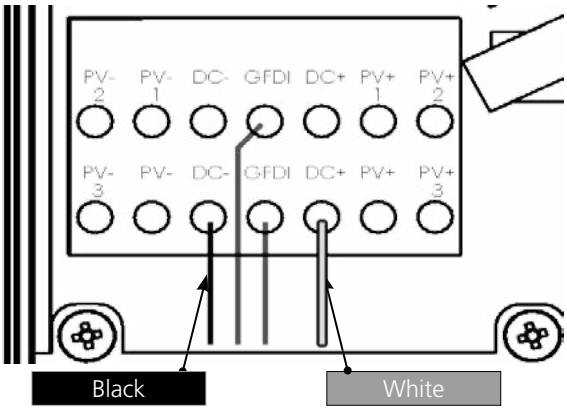



Figure 5.10: **DC connection 02xi series -Positive Grounding System**

**NOTE**

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 a bit. Put 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. Lightly pull on the wire to be sure it is secure.

**CAUTION**

**Be sure the inverter is configured for the proper DC grounding configuration of the system.**

**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 max. generator voltage because this would destroy the unit.**

**ACTION**

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

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

Once the wiring in the connection box is installed the protective cover over the terminals must be secured using the included screws and must not be opened unless the switch is in the off position, the AC breaker is in the off position, and the PV array is powered down with an opaque cover or other equivalent method to assure there is no DC voltage present in the box. The connection box should be considered the same as any other external DC disconnect switch which has live conductors inside.

**ACTION**

The ground for the DC input is provided by the integral GFDI circuit. DC input should not be grounded external to the unit.

### Circuit board fuse

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 250VAC/0.4A
Manufacturer: SIBA

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

**WARNING**

**For continued protection against risk of fire, replace only with same type and ratings of fuse.**

## 5.5 Connecting to the Public Grid

The inverter can be installed on the following grid-types:

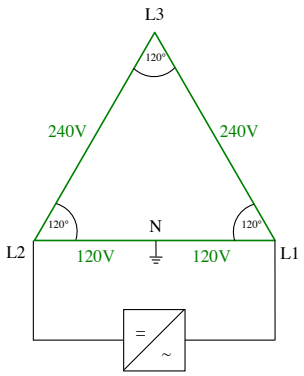



Figure 5.11: **240 V Delta: 120 V Stinger**

Country setting on the display: USA 240 V

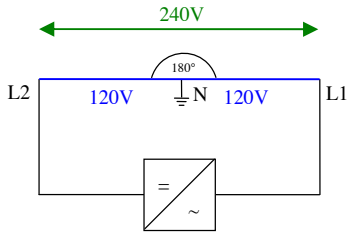



Figure 5.12: **240/120 V Split Phase**

Country setting on the display: USA 240 V

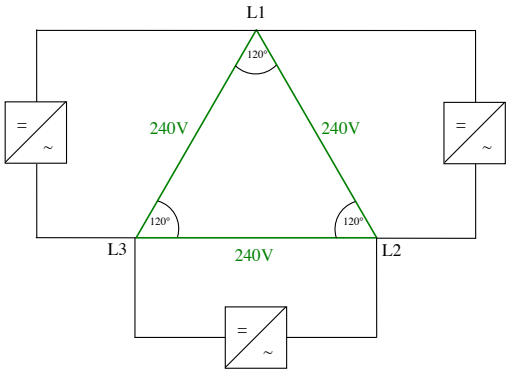



Figure 5.13: **240 V Delta**

Country setting on the display: USA 240 V no neut

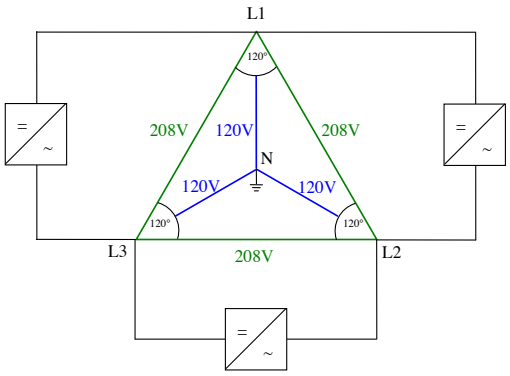



Figure 5.14: **208V/120V WYE**

Country setting on the display: USA 208V

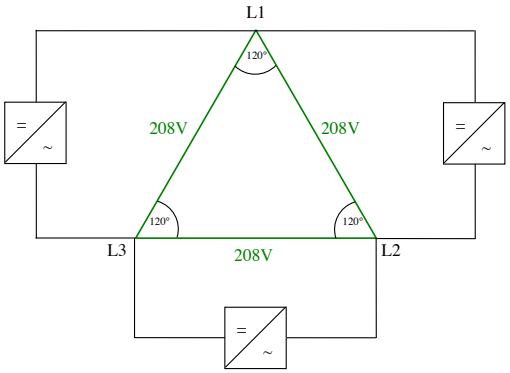



Figure 5.15: **208V Delta**

Country setting on the display: USA 208V no neut

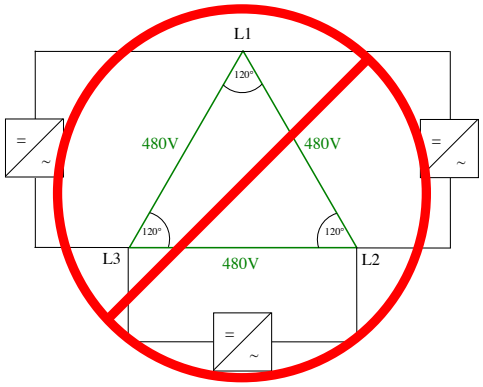



Figure 5.16: **480V Delta or 480/277V WYE**

**WARNING**

**Do not connect the inverter to the 480 V Delta or 480V/277V WYE power grids.**

## 5.6 Electrical connection

### General information

The electrical connections can be established after the inverter is installed in its fixed location. Knockouts are provided on the sides, bottom, and rear of the connection box to easily run conduit to the desired locations.

**NOTE**

Only conduit pipes according to UL 514 B can be used.

**WARNING**

**Inputs and output circuits of this unit are isolated from the enclosure. System grounding must be done in accordance with the National Electrical Code (NEC), ANSI/NFPA 70 and is the responsibility of the installer.**

**ACTION**

Guide the wiring through the conduit pipe.
Connect the wiring to the appropriate terminal labeled in the connection box.
Torque Field Wiring Terminals to 20 in. lbs.

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.

**WARNING**

**To connect the inverter, the AC and DC sides must be disconnected from all power sources and secured against being inadvertently energized.**

## (A) Grid Connection

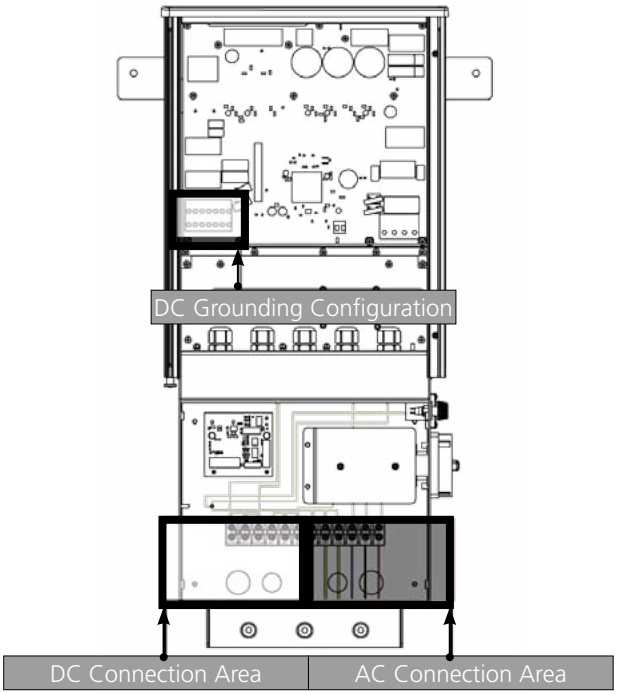



Figure 5.17: **Connection of the connection box blueplanet 1502xi und 2502xi**

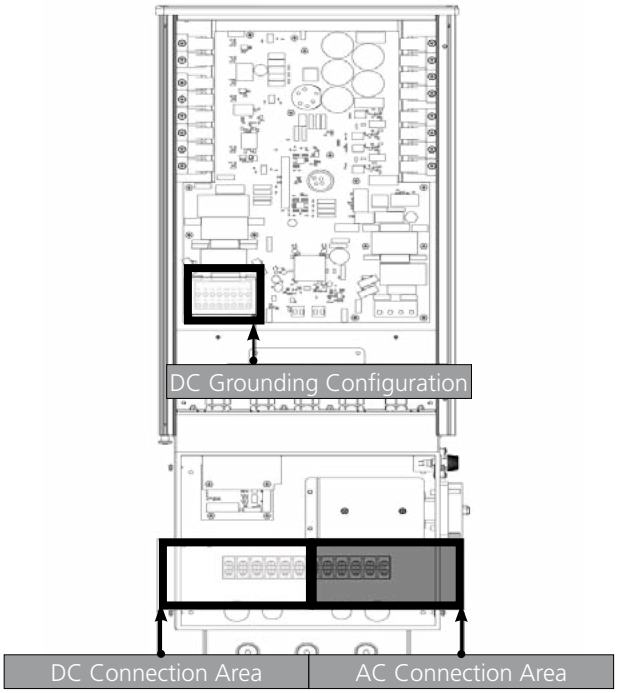



Figure 5.18: **Connection of the connection box blueplanet 3502xi und 5002xi**

AC Connections are a 3 or 4 wire connection. In 4 wire systems incorporating a Neutral there will be the following connections; Line-1, Line-2, Neutral, and Ground. In 3 wire systems not incorporating a Neutral there will be the following connections; Line-1, Line-2, and Ground.

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

– blueplanet 1502xi: AWG 12 up to AWG 4 75°C Copper Wire
– blueplanet 2502xi: AWG 12 up to AWG 4 75°C Copper Wire
– blueplanet 3502xi: AWG 12 up to AWG 4 75°C Copper Wire
– blueplanet 5002xi: AWG 8 up to AWG 4 75°C Copper Wire

Larger cross-sections should be used for longer leads.

**NOTE**

Use Copper Conductors only.

The following AC over-current protection must be used for the installation of the inverter.

– blueplanet 1502xi → 15 A Breaker
– blueplanet 2502xi → 20 A Breaker
– blueplanet 3502xi → 25 A Breaker
– blueplanet 5002xi → 30 A Breaker

**DANGER**

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

**WARNING**

**To reduce the risk of fire, connect only to a circuit provided with the required branch-circuit overcurrent device sized in accordance with the National Electrical Code, ANSI/NFPA 70. The maximum size overcurrent device shall not be more than 15 A for the 1502xi, 20 A for the 2502xi, 25 A for the 3502xi and 30 A for the 5002xi.**

**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 blueplanet 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.

**CAUTION**

**Check that the leads are properly connected.**

**ACTION**

Once again, ensure that all connected leads are firmly connected.

**PV generator connection**

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

## 5.7 Interfaces

All interfaces are connected on the communication circuit board. The circuit board is in the connection box.

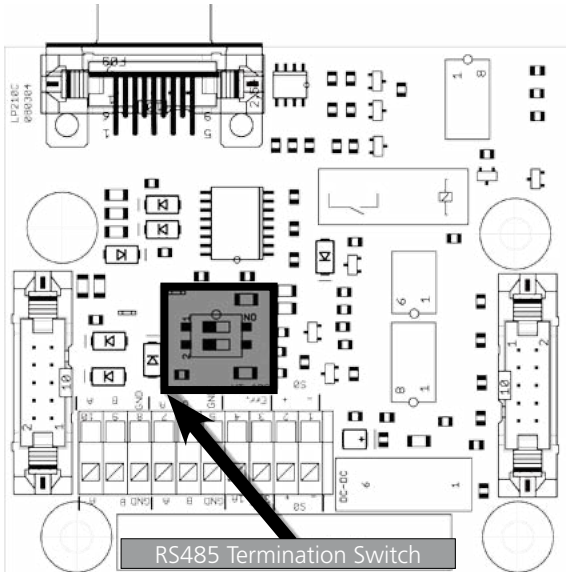



Figure 5.19: **Communication circuit board with highlighted RS485 termination switch**

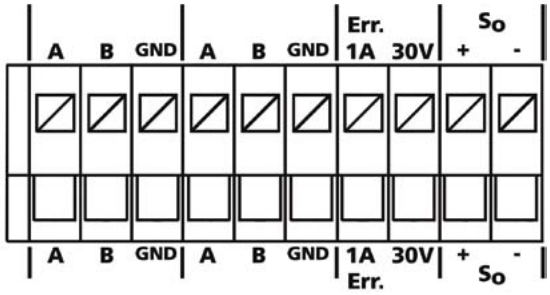



Figure 5.20: **Interface terminals**

## (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.

## (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 5.9, "Parameter programming").

## (C) The RS485 interface connection

The connection terminal (Figure 5.20) is on the blueplanet communication circuit board. To connect several blueplanet inverters, terminal A of one blueplanet is connected to terminal A of the other blueplanet. Terminal B is connected in the same manner. A twisted, shielded data cable is required for this. The connection to the KACO proLOG is established similarly to the interconnection of inverters. A connection diagram is displayed in figure 5.21. The total length of the RS485 wiring should not exceed 4,000 feet. Proper polarity must be maintained or devices will not be able to communicate.

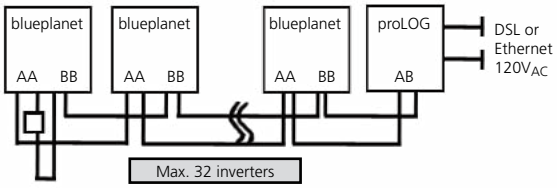



Figure 5.21: **Connection diagram for the RS485 interface using the KACO pro*LOG***

In figure 5.21, a terminating resistor ($R_a$) is connected to the last inverter in the chain. For proper signal transmission, the last unit in a chain must have a terminating resistor.

The terminating resistors in the other inverters of the chain must be deactivated (set to "OFF"). In the last unit of the chain, switch "1" is set to "ON" and switch "2" is set to "OFF". The switch is on the communication circuit board above the terminal block (Figure 5.19).

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 any other device. The exception is the monitoring device which is the master. This unit does not need an address. 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.

## 5.8 Starting up the inverter

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

**NOTE**

The inverter can be put into operation only 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 night start key if there is AC voltage present (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.

**ACTION**

Switch on the line voltage and the solar generator with the aid of the AC/DC disconnect switch (**O** → **I**).

During the initial start-up, the corresponding country and language must be selected. Select the appropriate language using the '2' (right) key, press the '1' (left) key to advance to the country selection. Press the '2' key to advance through the various grid types. Once the proper grid type is selected press the '1' key then press both the '1' and '2' keys at the same time to save the settings. If the improper grid settings were selected, hold down the '2' key to start the process again.

**NOTE**

If the power is cycled or 10 minutes elapse the settings for the grid type are locked and a password will need to be obtained from tech support.

The top green LED "OK" lights when DC voltage is available and indicates that it is ready to be put into operation. The display now indicates the current PV generator voltage "Start from xx V, meas.: xxx V". If the measured voltage is greater than the starting voltage, the unit will start grid-feeding after a country-specific waiting time. This start-up waiting period is required in order to ensure that the generator voltage is continuously above the power delivery limit of 125 V (1502xi) and 200 V (2502xi, 3502xi and 5002xi).

A quick start routine is provided for startup and test purposes. This routine circumvents the start-up delay 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 waiting time and the feeding of the grid starts. This is indicated by the middle green LED with the house and power line symbol next to it. The display now shows the power being fed into the grid. Key '1' (left) can now be used to display the various measured values (see Operating Instructions section 4.4).

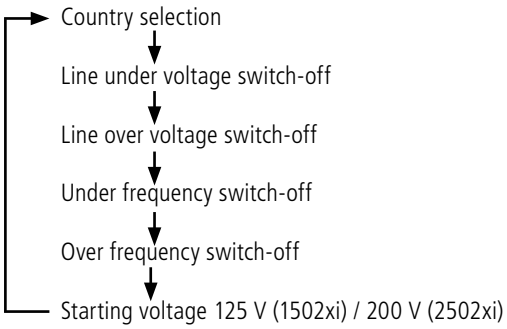
## 5.9 Parameter programming

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

**WARNING**

**Wrong parameter settings can lead to loss of functionality as well as render your system unsafe.**
**Modifications may be made only in exceptional cases and only after having consulted with the manufacturer and the utility company.**

### Parameter menu




**ACTION**

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

**NOTE**

After the country and grid type have been set, and either the inverter is powered down or 10 minutes have elapsed, and a change to the country or grid type is needed, a pass code must be obtained from KACO support. Please have the inverter serial number available when calling to obtain the pass code.

### Explanation of the individual parameters:

**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 service.

**Line undervoltage switch-off:**

The inverter is equipped with 1-phase monitoring. If the line voltage drops below the value set for "Minimum line voltage", the inverter switches off. The minimum cut-off threshold can be set in 1 V increments.

**Line overvoltage switch-off:**

If the line voltage exceeds the value set for "Maximum line voltage", the inverter switches off. The cut-off threshold can be set in 1 V increments.

**Under and overfrequency switch-off:**

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

**Starting voltage for grid-feeding:**

After sunrise, the inverter will begin to feed into the grid once the voltage has reached 125 V / 200 V (display: "Start from 125 V / 200 V"). This setting enables safe operation in any solar generator configuration. In rare cases, it may be necessary to adjust this starting voltage threshold. At a low generator voltage (few modules connected in series), the starting voltage may be reduced to ensure a safe start-up, even during unfavorable weather conditions. 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 150 V or 200 V to 225 V in 5 V increments.

**ACTION**

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

**ACTION**

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

# 6 Two-Stage Shutdown in Accordance with IEEE (standard values for < 30 kW)

The shutdown times and the shutdown values for the line voltage and frequency can be narrowed to within a specified range for the blueplanet 02xi series inverters. The allowed values can be taken from the following tables.

The specifications of the grid operator and the applicable standard must be observed. It is particularly important that systems < 30 kW comply with the applicable shutdown values for the line frequency.

The clearing time, is the time between the start of the abnormal condition and the inverter stops to feed in.

**Voltage – USA 208 V**

| | Voltage range | Clearing time |
|---|---|---|
| Undervoltage range 2 | 104 V * < V < 184 V | 0.16 sec (fixed) |
| Undervoltage range 1 | 184 V * < V < 208 V | 0.16 sec * - 2 sec. |
| Overvoltage range 1 | 208 V < V < 228 V * | 0.16 sec * - 1 sec. |
| Overvoltage range 2 | 228 V < V < 249 V | 0.16 sec (fixed) |

**Voltage – USA 240 V**

| | Voltage range | Clearing time |
|---|---|---|
| Undervoltage range 2 | 120 V * < V < 212 V | 0.16 sec (fixed) |
| Undervoltage range 1 | 212 V * < V < 240 V | 0.16 sec * - 2 sec. |
| Overvoltage range 1 | 240 V < V < 264 V * | 0.16 sec * - 1 sec. |
| Overvoltage range 2 | 264 V < V < 288 V * | 0.16 sec (fixed) |

**Voltage – Mexico 220 V**

| | Voltage range | Clearing time |
|---|---|---|
| Undervoltage | 198 V *< V < 220 V | 0.16 sec (fixed) |
| Overvoltage | 220 V < V < 242 V * | 0.16 sec (fixed) |

**Frequency**

| | Anlage Grösse | Frequency range | Clearing time |
|---|---|---|---|
| Overfrequency range 1 | ≤ 30 kW | 60.0 Hz < f < 60.5 Hz * | 0,16 sec (fixed) |
| Underfrequency range 1 | | 59.3 Hz * < f < 60.0 Hz | 0,16 sec (fixed) |
| Overfrequency range 1 | > 30 kW | 60.0 Hz < f < 60.5 Hz | 0,16 sec (fixed) |
| Underfrequency range 1 | | 57.0 Hz < f < 59.8 Hz | 0,16 sec * - 300 sec. |
| Underfrequency range 2 | | f < 57.0 Hz | 0,16 sec (fixed) |

*** = default**

# 7 Maintenance

**DANGER**

- **Risk of fatal injury by electric shock at live connections. Lethal voltages are still present in the inverter and the connection box even after the electrical connections have been disconnected.**
- **Wait five minutes before reaching into the inverter and the connection box.**
- **When working on the photovoltaic modules, the current must be switched off on the inverter and the solar installation with the aid of the AC/DC disconnect switch on the connection box.**

**ACTION**

Switch off the line voltage and the solar generator with the aid of the AC/DC disconnector (**I** = on or energized / **O =** off or deenergized).

## 7.1 Cleaning the fan

If the fan is only covered with loose dust, it can be cleaned with the help of a vacuum cleaner or a soft brush.

If the fan is very dirty, or if it s defective, it can be removed.

## 7.2 Removing the fan

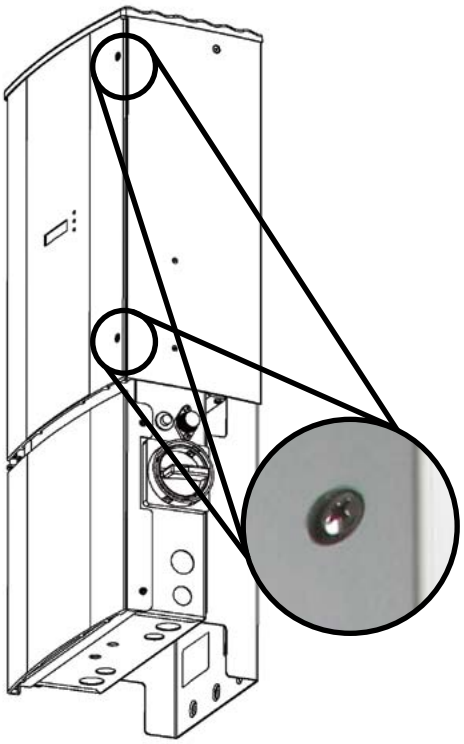
If the fan is very dirty or defective, proceed as follows:

**DANGER**

**Danger due to lethal voltages.**

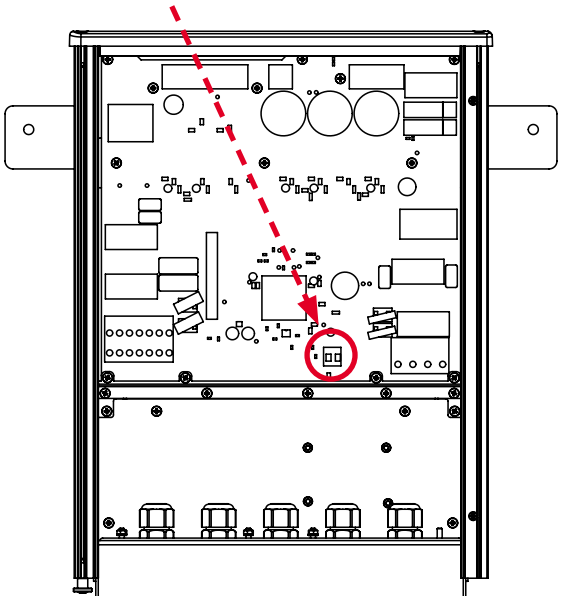
1. Switch the DC/AC disconnect to the OFF (0) position to de-energize the inverter and lock out to prevent inadvertent energizing of the inverter during service.

2. Wait 5 minutes for the internal components of the inverter to discharge.

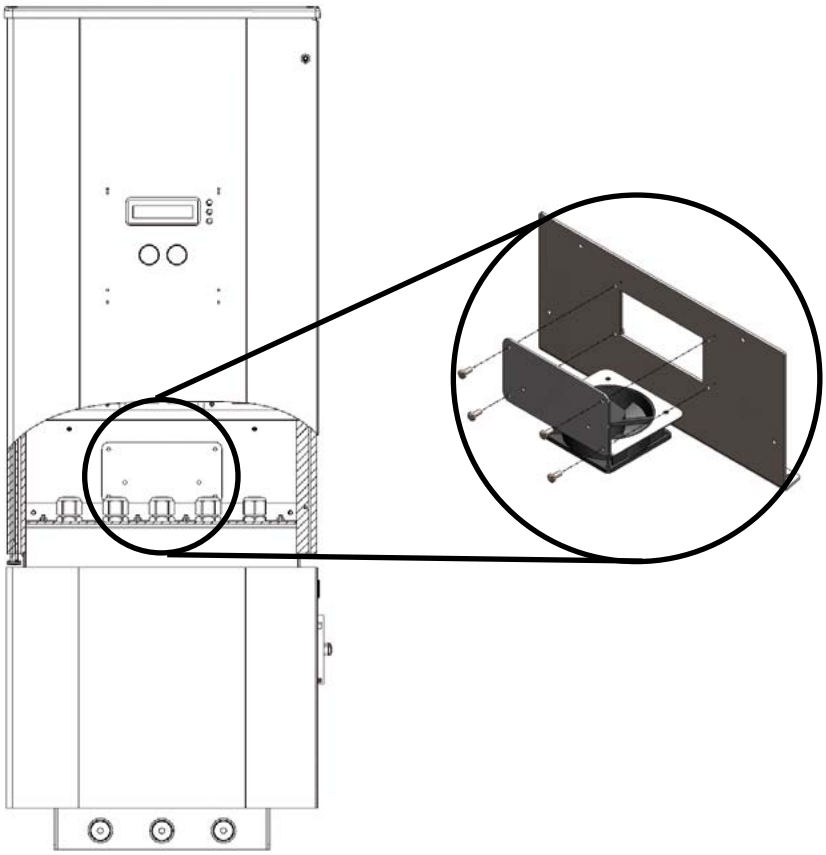


3. Remove the two inverter hinged door screws and open door.

4. Disconnect the fan connections



5. Remove the fours screws from the mounting bracket.



6. The fan can be removed along with the mounting bracket.

7. After cleaning or replacing the fan, perform this sequence in reverse to reinstall the fan.

# 8 blueplanet as Part of a PV Installation

## 8.1 Design of installation

A sample design of a grid-connected PV installation using a blueplanet is shown below in the overview circuit diagram.

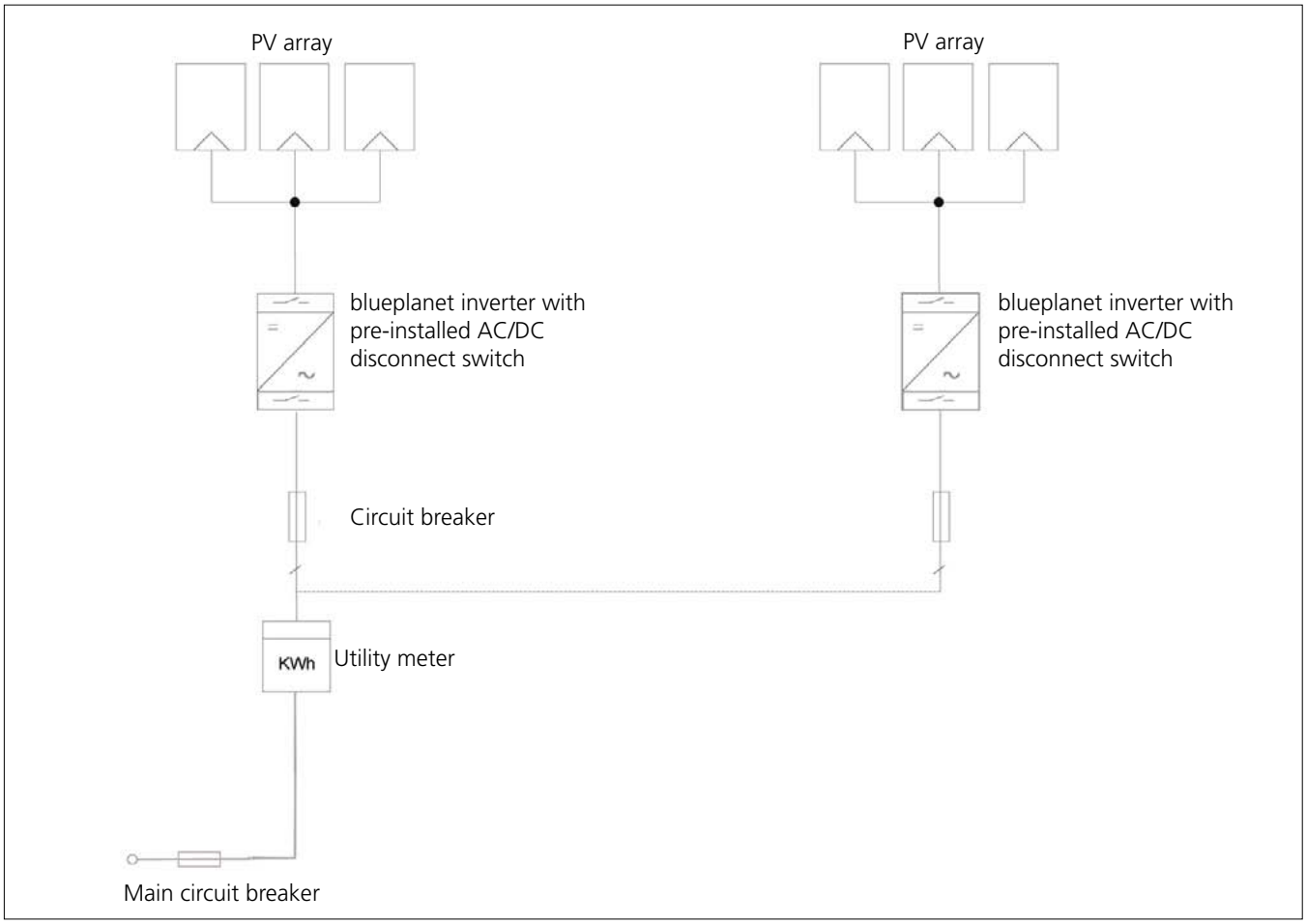



Figure 8.1 **Single-line overview circuit diagram for an installation with two inverters**

**A summary of the components:**

**DC terminal point:**

Two PV strings can be 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. External fusing may be required, refer local and national electric codes.

**DC/AC disconnect:**

In order to be able to disconnect the inverter on the PV generator side from sources of voltage, the inverter comes equipped with an pre-installed AC/DC disconnect switch. As a result, the installation of an external AC or DC disconnect switch is not required. NOTE: Be sure to check with local electrical codes and utility requirements as some inspectors will require a separate visible blade disconnect.

**Line overcurrent protection:**

In order to protect the wiring, the inverter's supply leads should be secured with circuit breakers or fuses as appropriate. The circuit breakers or fuses that are used should be appropriate to the length and cross-section of the wiring and fulfill applicable standards and directives (5.3: Electrical connection – grid connection).

**Utility power meter:**

The required utility power meter is specified and installed by the responsible power company.

**Main circuit breaker:**

Contact your utility and check with local and national electrical codes if you have questions concerning the required main circuit breaker.

## 8.2 Installation with multiple inverters on a three phase system

Observe the following regarding installations with multiple inverters on a three phase system:

Asymmetric grid-feed:
The power should be distributed as equally as possible over the three phases. In the US, typically the asymmetry between the phases may be a maximum of 6 kW (This number can vary depending on utility transformer size and codes).

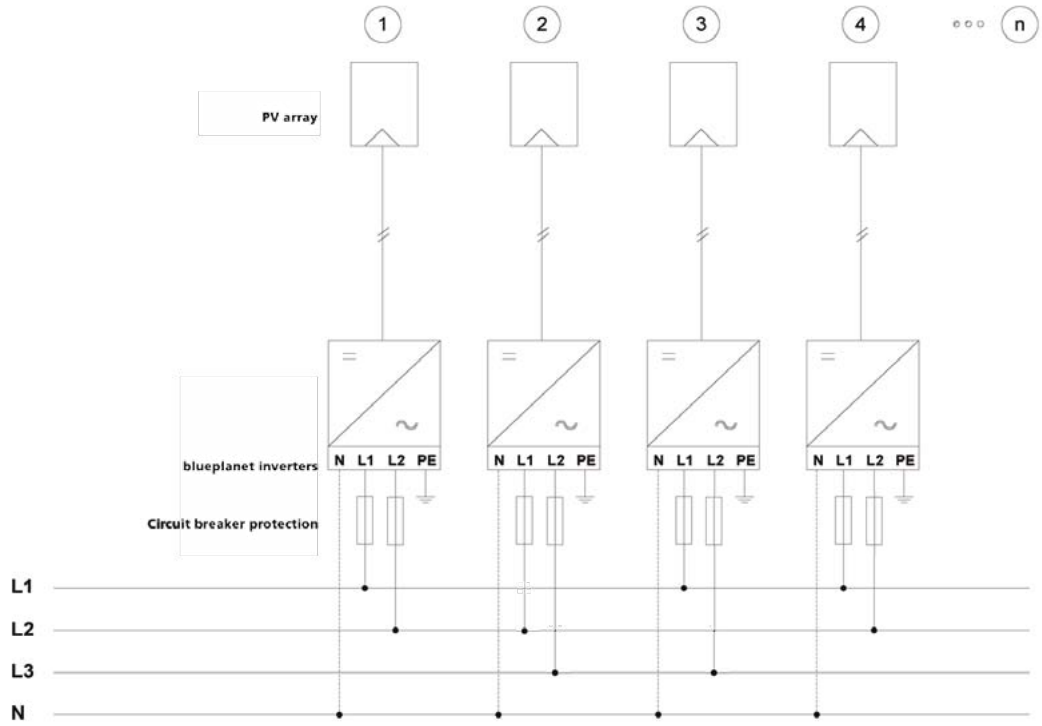



Figure 8.2: **Three phase grid connection for installations with multiple inverters**

**Electrical connection:**

The blueplanet feeds only on two phases. In order to avoid asymmetries on a 3 phase grid, installations with multiple inverters should be designed so that the inverters feed into the grid in differing phases. The inverter feeds into the connections labelled L1 and L2. If you have multiple inverters, connect the actual phases L1 and L2 to terminals L1 and L2 on the first unit. On the second unit, connect phases L2and L3 to terminals L1 and L2. On the third unit, connect phases L3 and L1 to terminals L1 and L2. Continue as above. This distributes the power optimally.

# 9 Troubleshooting

In line with our continuously expanding quality assurance system, we endeavor to eliminate all errors and faults. You have purchased a product which left our factory in proper working condition. Each individual unit has successfully passed an endurance test as well as extensive tests for the purpose of assessing the operating behavior 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 blueplanet. 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 are not lighting up. | – There is no line voltage.<br>– The solar generator voltage is too low. | 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 changes to stand-by status once 80% of the minimum grid-feed voltage is reached.<br>Check the AC voltage as well. The permissible voltage ranges for grid-feed can be found in the technical data.<br>If despite these measures the display stays blank, please contact KACO new energy service. |
| The inverter stops supplying power to the grid shortly after being switched on, even though there is sufficient sunlight. | Faulty grid separation relay in the inverter. | Although there is sufficient sunlight, the inverter feeds into the grid only for a few seconds before switching off again. During the short 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.<br>Please contact KACO new energy service. |
| 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. | 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".<br>If the line failure exists for a long time, please contact the grid operator. |
| The line overcurrent protection trips. | The line overcurrent protection capacity is too low. | 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 overcurrent protection should be somewhat higher than the maximum grid-feed current. You can find a dimensioning of the line overcurrent protection in the section "Installation and Start-Up". |
| The line overcurrent protection trips. | Damage to the inverter's hardware. | If the line overcurrent protection immediately trips when the inverter switches to grid-feed mode (after the start-up period is complete), the inverter's hardware is possibly damaged.<br>Please contact KACO new energy service. |

If the measures described in this guide do not assist in clearing the fault, please notify KACO technical support at +1 (866) 522-6765.

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's serial number
– Model
– A short description of the error and error code if applicable
– Is the error reproducible? If yes, how?
– Does the error occur sporadically?
– Describe the prevailing insolation conditions when the error occurred?
– Time of day

# 10 Efficiency curves

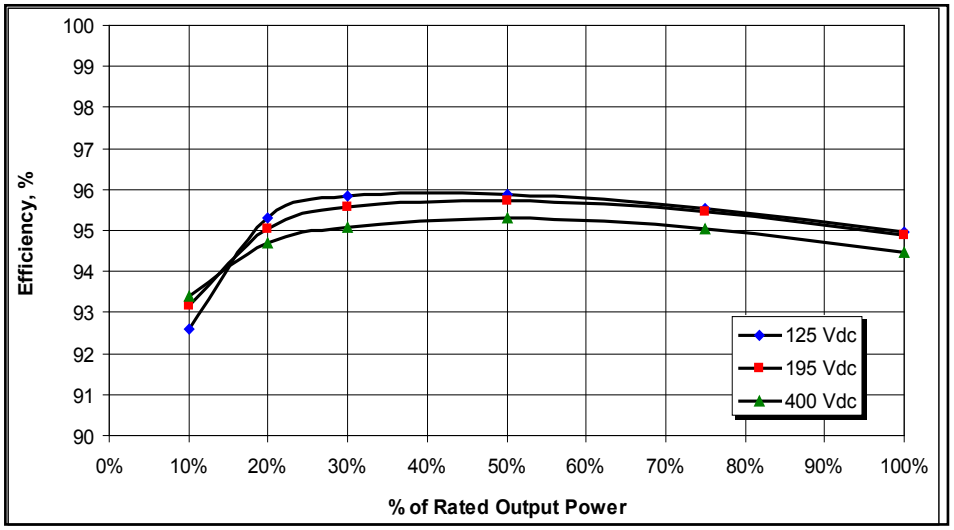



Figure 10.1: **Efficiency curve 1502xi / 240 V**

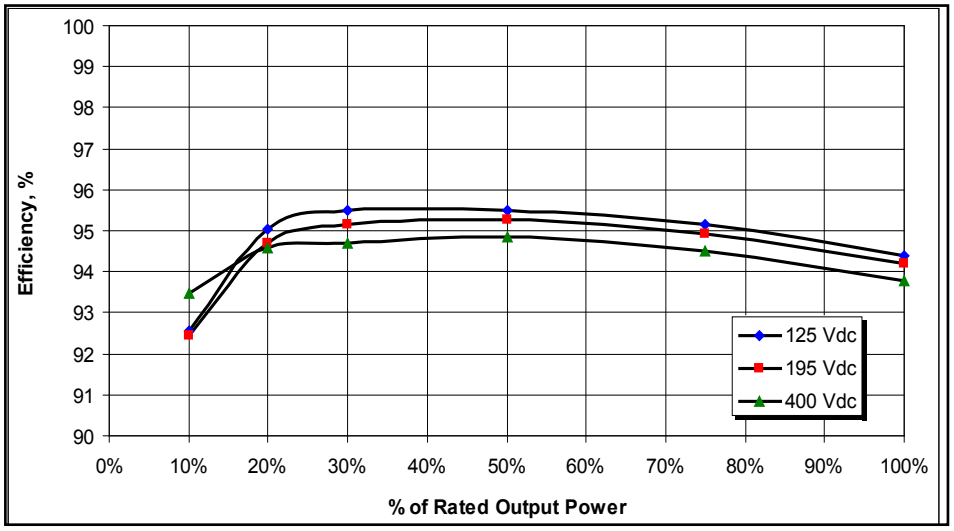



Figure 10.2: **Efficiency curve 1502xi / 208 V**

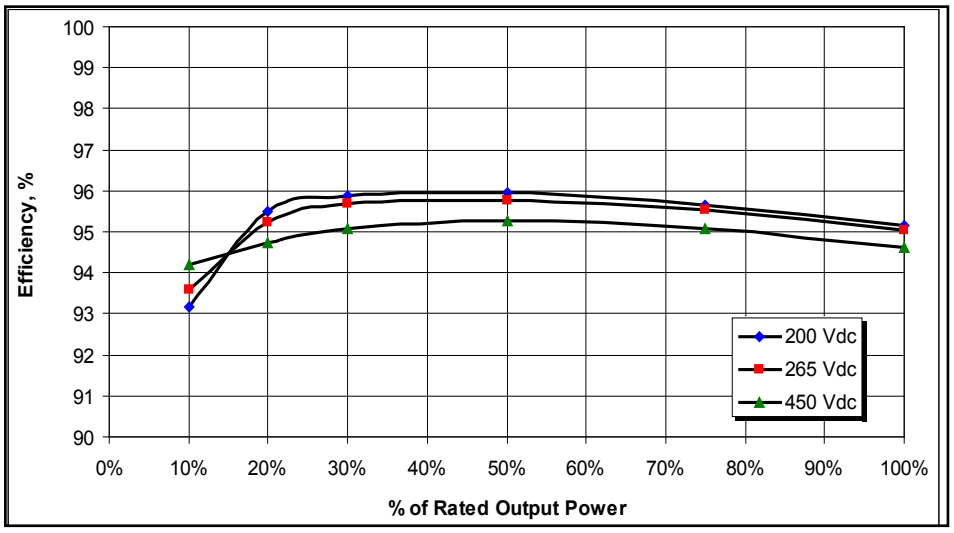



Figure 10.3: **Efficiency curve 2502xi / 240 V**

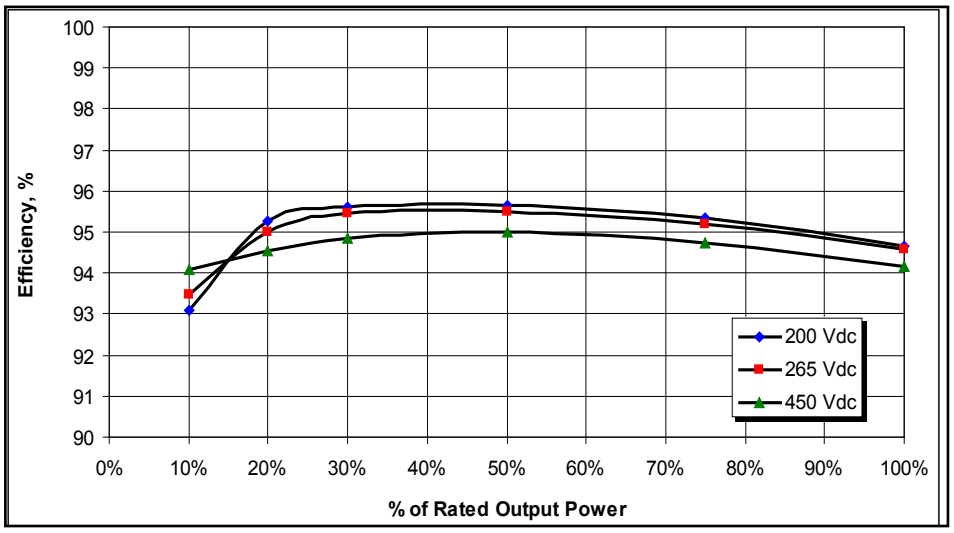



Figure 10.4: E**fficiency curve 2502xi / 208 V**

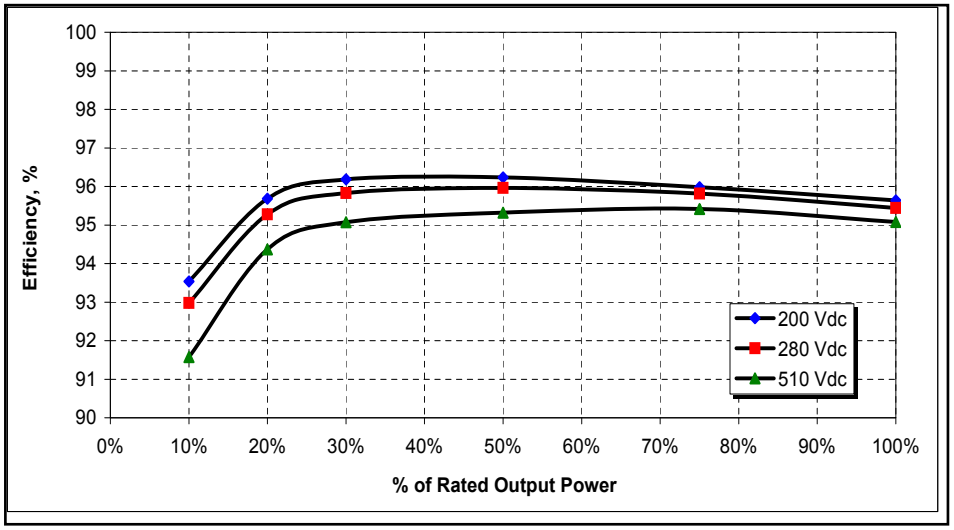



Figure 10.5: **Efficiency curve 3502xi / 240 V**

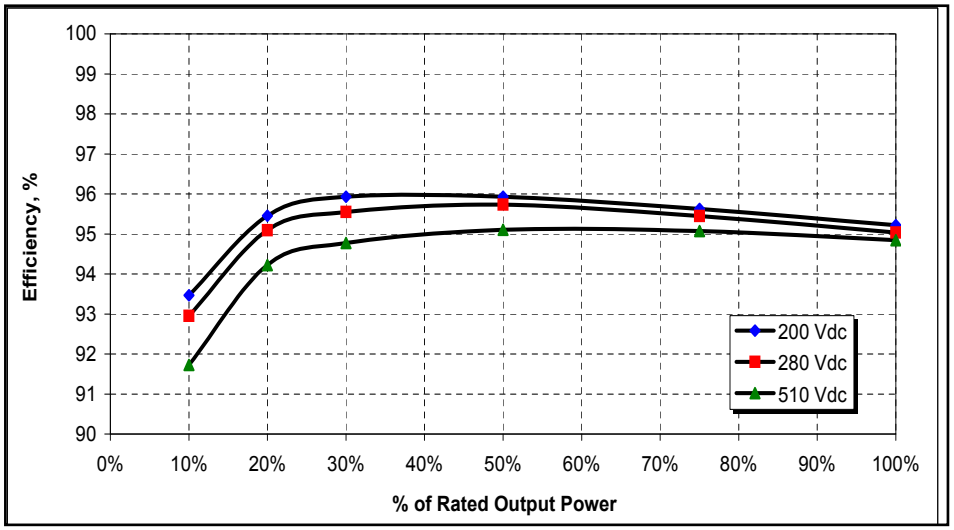



Figure 10.6: **Efficiency curve 3502xi / 208 V**

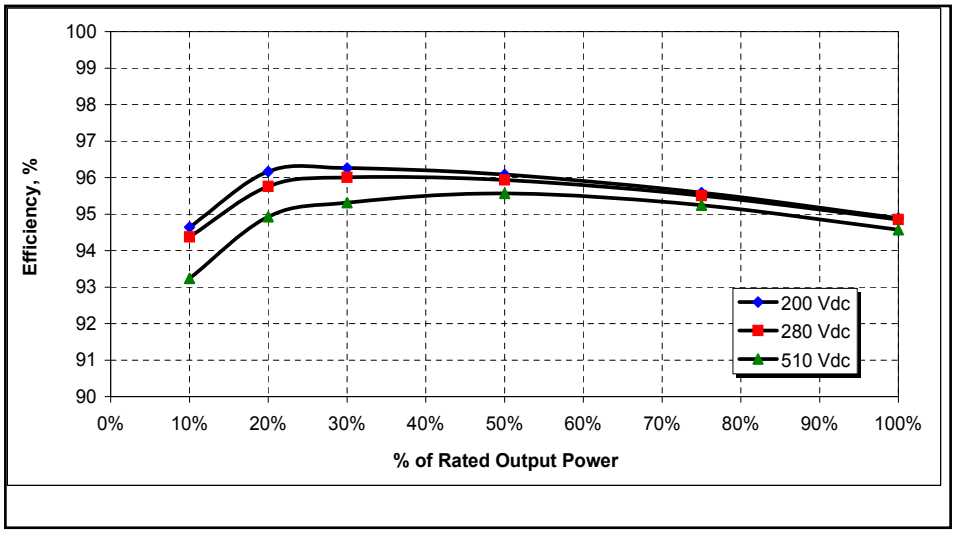



Figure 10.8: **Efficiency curve 5002xi / 240 V**

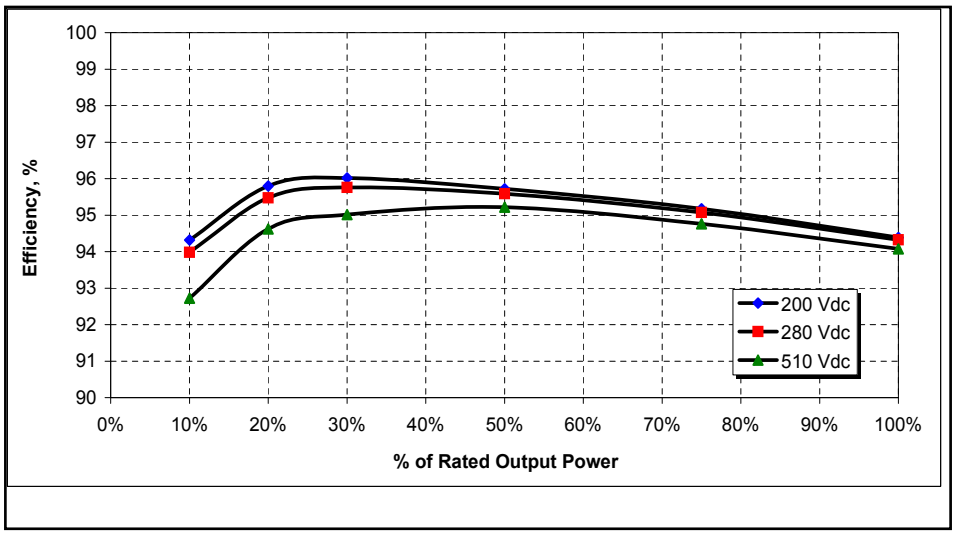



Figure 10.7: **Efficiency curve 5002xi / 208 V**

# 11 Compliance Certificates



# Certificate

TÜVRheinland®

Certificate no. CU 72091301 01

**License Holder:**
Kaco new energy GmbH
Gottfried-Leibniz-Str. 1

74172 Neckarsulm
Germany

**Manufacturing Plant:**
Kaco new energy GmbH
Gottfried-Leibniz-Str. 1

74172 Neckarsulm
Germany

**Test report no.:** USA-DS 30981733 001 **Client Reference:** Matthias Haag

**Tested to:** UL 1741:1999 R11.05
CSA C22.2.107.1-01 (R2006)

**Certified Product:** Solar Inverter with Galvanic Separation **License Fee - Units**

Model Designation: 1) blueplanet 1502xi 7
2) blueplanet 2502xi

Rated Voltage: 1) DC 550V max.
(MPP Voltage Range: DC 125-400V)
2) DC 550V max.
(MPP Voltage Range: DC 200-450V)

Rated Current: 1) 14.3A
2) 13.5A

contd.

7

Appendix: 1, 1-16

**Licensed Test mark:** TUV Rheinland of North America, Inc. C US

**Signature**

Dipl.-Ing. M. Glagla
QA Certification Officer

**Date of Issue (day/mo/yr)**
02/07/2009

TUV Rheinland of North America, Inc., 12 Commerce Road, Newtown, CT 06470, Tel (203) 426-0888 Fax (203) 426-4009

# Certificate

TÜVRheinland®

Certificate no. CU 72091301 02

**License Holder:**
Kaco new energy GmbH
Gottfried-Leibniz-Str. 1

74172 Neckarsulm
Germany

**Manufacturing Plant:**
Kaco new energy GmbH
Gottfried-Leibniz-Str. 1

74172 Neckarsulm
Germany

**Test report no.:** USA-DS 30981733 001 **Client Reference:** Matthias Haag

**Tested to:** UL 1741:1999 R11.05
CSA C22.2.107.1-01 (R2006)

**Certified Product:** Solar Inverter with Galvanic Separation **License Fee - Units**

contd.

| | | |
|---|---|---|
| Output Ratings: | AC 208/240V, 60Hz | |
| Continuous Output Current: | 1) AC 8.0A max. | 2) AC 12.5A max. |
| Continuous Output Power: | 1) 1500W max. | 2) 2500W max. |
| Peak Output Power: | 1) 1650W | 2) 2500W |
| Protection Class: | I | |
| Ingress Protection: | IP54 / NEMA 3R | |

Special Remarks: Also complies with IEEE 1547 & IEEE 1547.1.

**Licensed Test mark:** TUV Rheinland of North America, Inc. C US

**Signature**

Martin Glagla

Dipl.-Ing. M. Glagla
QA Certification Officer

**Date of Issue (day/mo/yr)**
02/07/2009

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# Certificate

TÜVRheinland

Certificate no. CU 72092077 01

**License Holder:**
Kaco new energy GmbH
Carl-Zeiss-Str. 1

74172 Neckarsulm
Germany

**Manufacturing Plant:**
Kaco new energy GmbH
Friedrich-Gauss-Str. 1

74172 Neckarsulm
Germany

**Test report no.:** USA-DS 30982753 001 **Client Reference:** Matthias Haag

**Tested to:** UL 1741:1999 R11.05
CSA C22.2.107.1-01 (R2006)

**Certified Product:** Inverter with Galvanic Separation **License Fee - Units**

Model Designation: 1) blueplanet 3502xi
2) blueplanet 5002xi — 7

Rated Voltage: DC 200-510V
(DC 600V/550V max.)
Rated Current: 1) 18.5A max.
2) 26.5A max.
Protection Class: I
Ingress Protection: IP54 / NEMA 3R

contd.

7

Appendix: 1, 1-41

**Licensed Test mark:**

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# Certificate

TÜVRheinland

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Kaco new energy GmbH
Carl-Zeiss-Str. 1

74172 Neckarsulm
Germany

**Manufacturing Plant:**
Kaco new energy GmbH
Friedrich-Gauss-Str. 1

74172 Neckarsulm
Germany

**Test report no.:** USA-DS 30982753 001 **Client Reference:** Matthias Haag

**Tested to:** UL 1741:1999 R11.05
CSA C22.2.107.1-01 (R2006)

**Certified Product:** Inverter with Galvanic Separation **License Fee - Units**

contd.

Output Ratings:
1a) AC 208V, 60Hz; 16.8A; 17.0A max.; 3500W nom.; 3500W max.
b) AC 240V, 60Hz; 14.6A; 16.0A max.; 3500W nom.; 3500W max.
2a) AC 208V, 60Hz; 24.0A; 24.0A max.; 5000W nom.; 5000W max.
b) AC 240V, 60Hz; 20.8A; 24.0A max.; 5000W nom.; 5000W max.

Special Remarks: Also complies with IEEE 1547 & IEEE 1547.1.

**Licensed Test mark:**

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**Signature**

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QA Certification Officer

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25/09/2009

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31000770-02-112609

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

KACO new energy

KACO new energy (866) 522 6765 kacoinfo@kaco-newenergy.com www.kaco-newenergy.com

14000 Burn Rd
Arlington, WA 98223
USA
Ph (425)374-9060
www.midnitesolar.com

# MNPV Installation Instructions






The MNPV6 combiner is rated for outdoor use. Designed for combing PV strings up to 150VDC and 120 amps total using breakers, or high voltage strings using 10mm x 38mm fuses up to 80 amps total. The use of touch safe din rail mount fuse holders and fuses allow operation up to 600 Volts. The MNPV6 combiner comes with two copper bus bars. One for circuit breakers and one for fuses. The MNPV3 busbar is designed for circuit breakers or fuses. The MNPV3 busbar is rated for 60 amps total.

## Applications:

PV combiner up to six strings using MNPV breakers rated for 150VDC. 120 amps total output
PV combining up to four strings using 600VDC fuses and MNTS touch safe fuse holders rated for 600VDC
DC load center using MNPV breakers

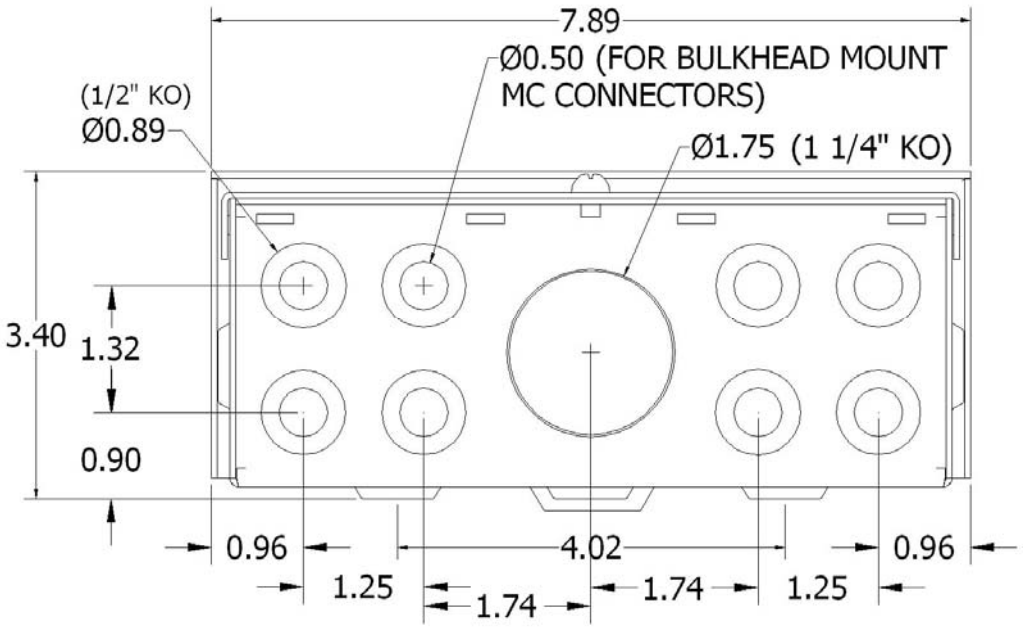
## Features:

All aluminum powder coated housing that won't rust
Flip up cover that can stay in the open position during installation
PV Negative bus bar with 14 useable openings (10 #14-6 and 4#1/0-14)
Chassis ground bus bar with 14 useable openings (10 #14-6 and 4#1/0-14)
Standard din rail to mount up to 6 breakers or 4 fuse holders
Tin plated copper bus bar to combine breaker outputs (MNPV6 busbar may be split in two)
Dead front cover snaps into place after wiring is complete for safety
Knock outs for PV in and PV out on bottom and sides
Top surface is available to bring conduit in from directly above the enclosure
**Note: The plastic dead front fits very tight. You must first remove the lid in order to remove the dead front.**

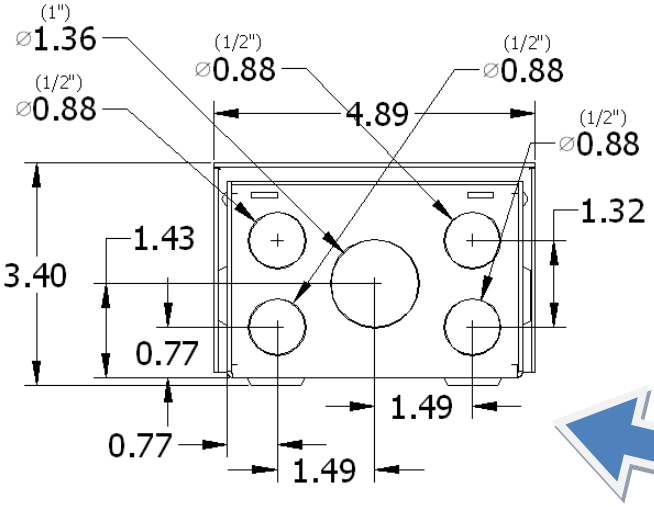
# MNPV Installation Instructions (continued)

The installation of a PV combiner is fairly straight forward. Select the location to install your combiner first. Some systems have the PV modules located close to the inverters and or battery system. If this is the case, you can elect to mount the MNPV inside and run each PV string down to the MNPV inside the house. This is convenient for trouble shooting and upgrading. For longer runs the combiner will be mounted outdoors on the pole for pole mounted PV arrays or similar mounting for rack mounted arrays. The combiner can be mounted in the vertical position or slanted backwards to accommodate up to a 3/12 roof pitch. All unused holes should be blocked using RTV sealant or some similar goop in order to keep rain and insects out of the enclosure. Care must be taken to insure that no water will get on terminal busbars when mounted less than vertical.

The following dimensioned drawings show the location and size of knockouts available on the MNPV3&6. Note that on the MNPV6 the center bottom knock out is sized for a 1 1/4" conduit adapter. The left and right side each have a ½" knock out for either wire entry or for lightning arrestors. Follow directions above when using side knockouts. Lightning arrestors may require a locknut on the outside in order to clear the lid.

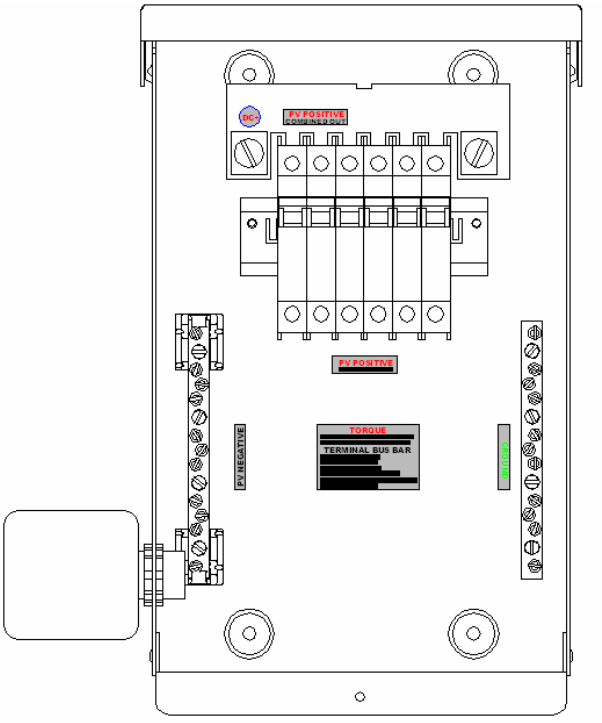



**MNPV6 & MNPV6-250 Bottom conduit locations and sizes**

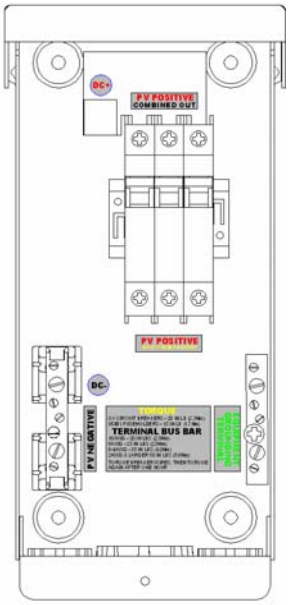





MNPV3 bottom conduit locations

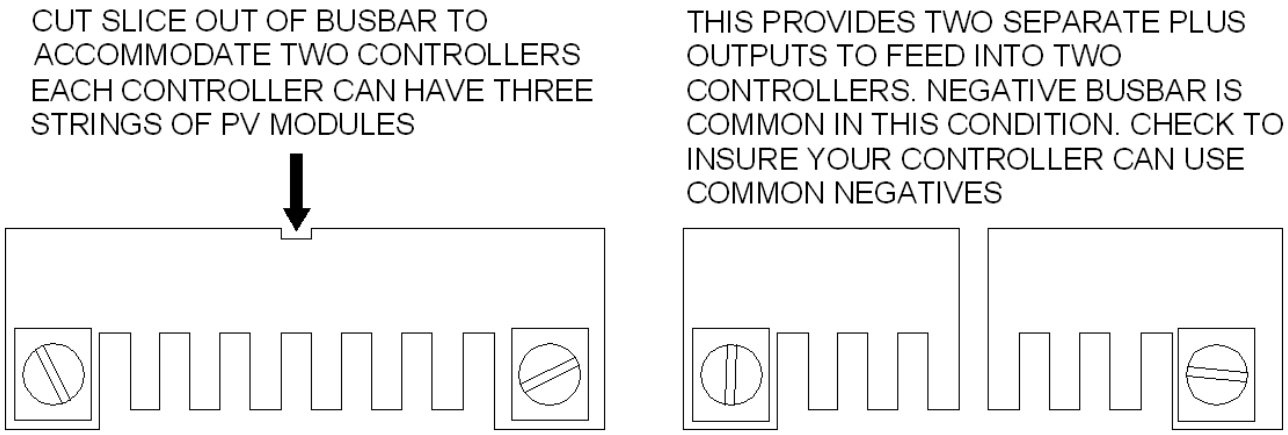



MNPV6 shown with breakers & lightning arrestor




MNPV3 with 3 brkrs

The MNPV6 enclosure can be split into two sections. This is sometimes done in 12 and 24V systems where more controllers are required for additional power. For instance in a 24 volt system using the MX60 charge controller, you are limited to about 1600 watts of PV per controller. If using Kyocera KC130 modules, you can make three strings of 4 modules in series. This adds up to 1560 watts per controller. That is a good match of PV vs. controller capability. The MNPV3 can accommodate this arrangement directly, but the MNPV6 can accommodate two of these systems, thus saving wiring, space and money. See the following figure on splitting the busbar into two systems.




When selecting breakers for use with the MidNite combiners, first check with the PV manufacturer to determine the proper “series fuse”. The term fuse is used even though you are probably using breakers. This is a carry over from UL terminology.

MidNite Solar offers PV combiner breakers rated at **150VDC and 300VDC**. The 150V breakers come in these amp ratings. 1,2,3,4,5,6,7,8,9,10,12, 15, 20, 30,40,50 and 63. Other sizes are available on special order.
Part numbers for breakers are as follows:
MNEPV10, MNEPV15, MNEPV20 etc.

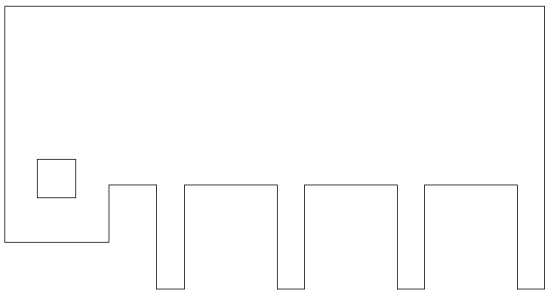
The 300VDC breakers are twice as wide as the 150 volt versions. The wire input and output are located on the top side. These breakers come in 7,10,12,15,20,30 and 50 amps. Part numbers are MNEPV15-300 etc.

Polarity of the din rail DC breakers **IMPORTANT!** The DC breakers supplied by MidNite Solar are custom manufactured in Lesotho Africa by CBI. These breakers are polarity sensitive. This means that they need to be installed correctly in order to insure that they will be able to trip if called upon to do so. In a PV combiner the + sign marked on the breaker connects to the PV positive output. The same breaker when hooked up to the battery circuit (not in a PV combiner) hooks up a little different. The + sign hooks up to the battery plus. This hook up is not obvious. The + sign designates the highest potential should be connected there. This is an easy one to determine in a PV combiner. Follow the current path through the combiner, into the PV input of a charge controller and out of the controller to an output breaker and then into the battery plus. You would think that the end of the output breaker connected to the controller would be at a higher potential than the battery plus. In normal operation this is true. The main job of this output breaker is to trip when and if there is a catastrophic failure. (Any manufacture of power electronics will tell you that power electronics can fail). If the output breaker fails to trip, you are at risk of fire from the output wires burning up. When a charge controller fails, they always short from positive output to negative output. Since these two terminals inside the charge controller are normally connected up to a very large battery bank, you have a direct short across the battery bank if the controller fails. During this condition, the controller is acting like a piece of wire. The battery positive terminal is the highest potential! Make sure that the plus (line) of the breaker is connected to the battery plus terminal. If the breaker is connected backwards, it can fuse in the closed position as it attempts to open. That could ruin your entire day!

The MidNite MNPV6 can also utilize touch safe fuse holders and fuses rated for up to 600 volts DC for high voltage strings. The MNPV6 comes with a special busbar that has four legs to accommodate four of these USM1 type fuse holders made by Ferraz Shawmut. Fuses are available from 1 to, 30 amps. (80 amps total) These devices are not polarity sensitive, but do not open them under load. You **WILL** have a fire on your hands!




USM1 Fuse touch safe fuse holder

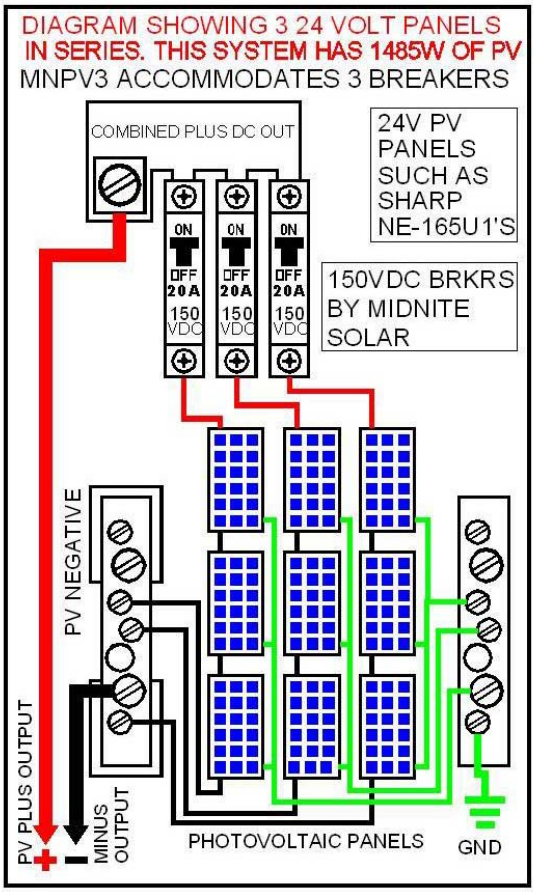


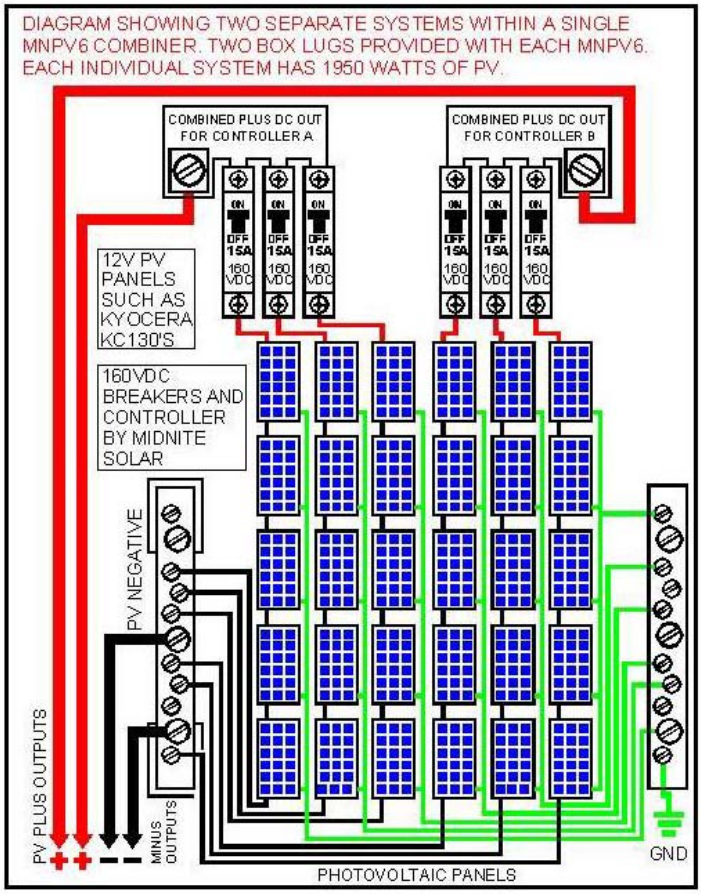
3-079-1 Busbar, Fuse Holder

The following wiring diagrams are intended to help you decide which type of combiner installation to do. There are numerous ways to hook up a PV array. There are no “best” or “correct” ways to accomplish this. They all have merit. For instance if the battery bank is 24 volts and you have six 24 volt PV modules, what

would be the best way to wire them? For this installation we will assume an MX60 or similar charge controller that allows the freedom to change PV array voltages.

1. This array could have all 6 panels hooked in parallel using the MNPV6 combiner and 6 MNEPV15 breakers. This array would be ok if situated close to the battery bank. It requires larger wires than higher voltage arrays, but has the advantage of temporarily directly connection to the battery bank in case the controller fails. You can also substitute a PWM controller for the MPPT in the event it becomes necessary.
2. The array could be wired in three strings of two panels in series for a 48 volt nominal array. This is a very common installation and could be made in the MNPV3 with 3 breakers. This hook up is safe from a cold VOC standpoint, but you cannot directly connect it to the battery bank. You cannot easily hook up a PWM controller either. If the PV array is between 30 and 100 feet from the battery bank, this hook up may offer the best power production.
3. The array could also be hooked up in two strings of three modules in series. The MNPV3 and two breakers will accommodate this array. You have room to grow this system without adding another combiner if only three more modules are added later. Combiners can also be combined for additional power, so if six modules or more get added later, you can simply add an additional MNPV3. When putting three 24 V modules in series you must pay attention to VOC during cold spells so that you do not over voltage the controller. MidNite Solar breakers are all rated for 150 volts DC which is higher than any present MPPT controller (2006). This configuration works very well especially when the array is far away from the battery bank. You can sometimes save enough money on reduced wire size to pay for an MPPT charge controller.



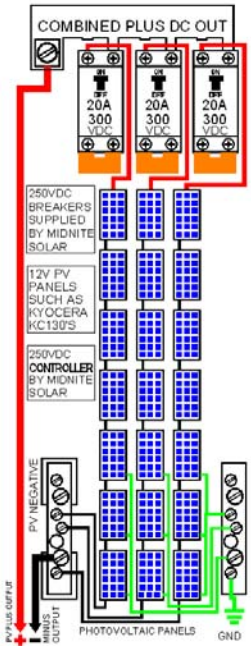



To remove the dead front: Pry off the lid as shown using something like a screwdriver as a lever. The dead front will then come out easily.

# MNPV Installation Instructions (continued)

The picture on the right is from Lance Barker.
It shows an MNPV6 with a MidNite Solar DC-GFP installed inside along with two combiner breakers.
This is a novel use of the DC-GFP in the combiner enclosure. The use of din rail mount breakers makes
for real flexibility. 18” trenching is reduced to 12” when a DC-GFP is on the PV end of the trench. 2008 NEC article 300-wiring methods 300.5 page 70-129 , table 300.5 minimum cover requirements, 0 to 600 volts, burial in millimeters (inches) column 4: residential branch circuits rated 120 volts or less with GFCI protection and maximum over-current protection of 20 amps or less. Lance’s inspector used the working voltage rather than max voltage in his determination. Lance was digging in a rocky area, so this trick made the job possible. You would not be allowed to reduce the trench depth if using a 200 or 250 volt controller and PV array.






This is a special configuration that is possible with the MidNite Solar Classic charge controller. Note that in order to use 300VDC breakers you will need the MNPV6-250 or the MNPV12-250 combiner. 300VDC breakers take up two spaces. The MNPV6-250 holds three breakers. The MNPV12-250 holds six breakers.



MNPV3 and MNPV6




3 Fuse holders in deadfront shown with the fuse adapter installed



Fuse holders in enclosure