# User Manual

OPTI-Solar

## Solar Hybrid Inverter

## SP Brilliant Series

Version: 1.2

# Table Of Contents

# ABOUT THIS MANUAL

## Purpose

This manual describes the assembly, installation, operation and troubleshooting of this unit. Please read this manual carefully before installations and operations. Keep this manual for future reference.

## Scope

This manual provides safety and installation guidelines as well as information on tools and wiring.

# SAFETY INSTRUCTIONS

**WARNING: This chapter contains important safety and operating instructions. Read and keep this manual for future reference.**

1. Before using the unit, read all instructions and cautionary markings on the unit, the batteries and all appropriate sections of this manual.
2. **CAUTION** --To reduce risk of injury, charge only deep-cycle lead acid type rechargeable batteries. Other types of batteries may burst, causing personal injury and damage.
3. Do not disassemble the unit. Take it to a qualified service center when service or repair is required. Incorrect re-assembly may result in a risk of electric shock or fire.
4. To reduce risk of electric shock, disconnect all wirings before attempting any maintenance or cleaning. Turning off the unit will not reduce this risk.
5. **CAUTION** – Only qualified personnel can install this device with battery.
6. **NEVER** charge a frozen battery.
7. For optimum operation of this inverter/charger, please follow required spec to select appropriate cable size. It's very important to correctly operate this inverter/charger.
8. Be very cautious when working with metal tools on or around batteries. A potential risk exists to drop a tool to spark or short circuit batteries or other electrical parts and could cause an explosion.
9. Please strictly follow installation procedure when you want to disconnect AC or DC terminals. Please refer to INSTALLATION section of this manual for the details.
10. Fuses (4 pieces of 40A, 32VDC for 2KVA and 6 pieces for 3KVA, 1 piece of 200A, 58VDC for 5KVA) are provided as over-current protection for the battery supply.
11. GROUNDING INSTRUCTIONS -This inverter/charger should be connected to a permanent grounded wiring system. Be sure to comply with local requirements and regulation to install this inverter.
12. NEVER cause AC output and DC input short circuited. Do NOT connect to the mains when DC input short circuits.
13. **Warning!!** Only qualified service persons are able to service this device. If errors still persist after following troubleshooting table, please send this inverter/charger back to local dealer or service center for maintenance.

# INTRODUCTION

This is a multi-function inverter/charger, combining functions of inverter, MPPT solar charger and battery charger to offer uninterruptible power support with portable size. Its comprehensive LCD display offers user-configurable and easy-accessible button operation such as battery charging current, AC/solar charger priority, and acceptable input voltage based on different applications.

## Features

- Pure sine wave inverter
- Built-in MPPT solar charge controller
- Configurable input voltage range for home appliances and personal computers via LCD setting
- Configurable battery charging current based on applications via LCD setting
- Configurable AC/Solar Charger priority via LCD setting
- Compatible to mains voltage or generator power
- Auto restart while AC is recovering
- Overload/ Over temperature/ short circuit protection
- Smart battery charger design for optimized battery performance
- Cold start function

## Basic System Architecture

The following illustration shows basic application for this inverter/charger. It also includes following devices to have a complete running system:

- Generator or Utility.
- PV modules (option)

Consult with your system integrator for other possible system architectures depending on your requirements.

This inverter can power all kinds of appliances in home or office environment, including motor-type appliances such as tube light, fan, refrigerator and air conditioner.

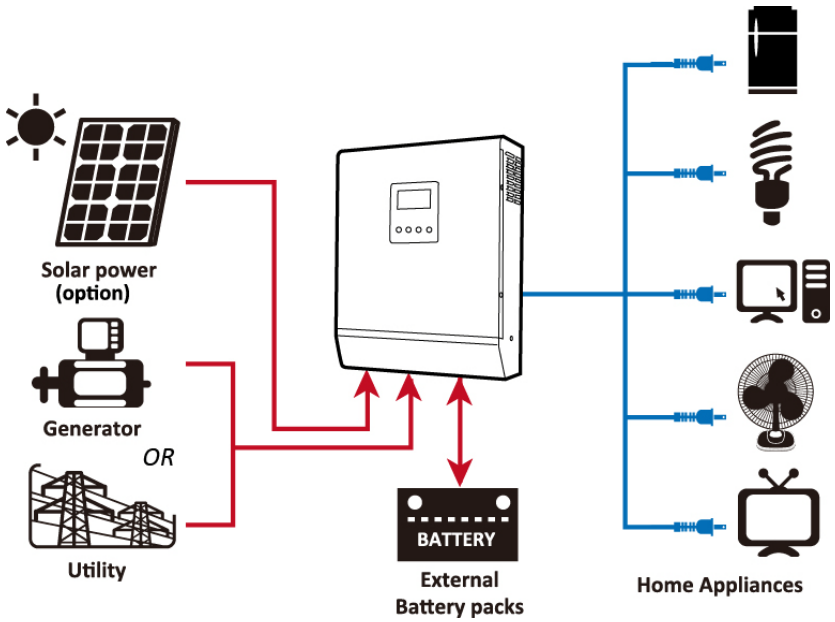
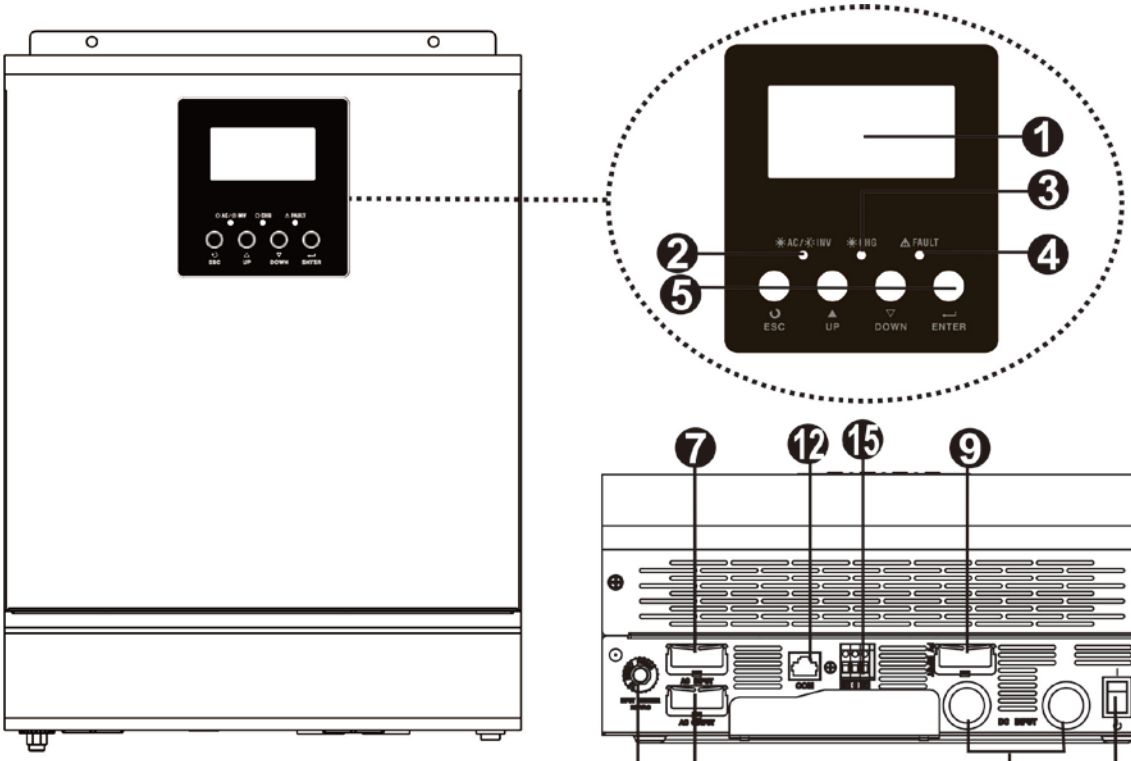
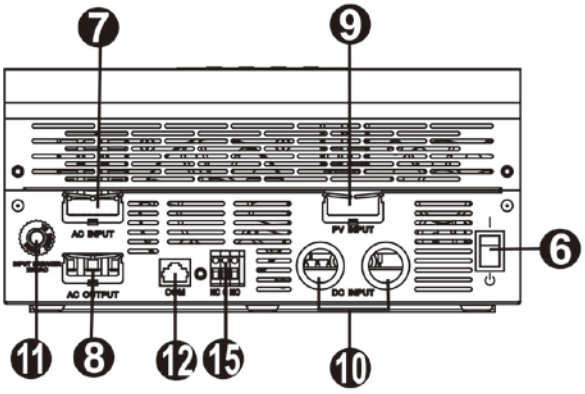



Figure 1 Hybrid Power System

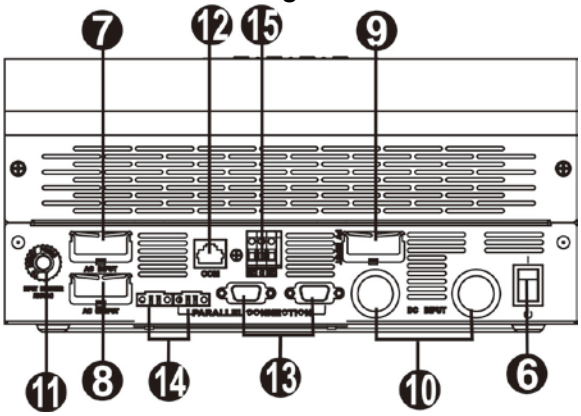
## Product Overview




5KVA single model




2/3KVA model




5KVA parallel model

**NOTE:** For parallel model installation and operation, please check separate parallel installation guide for the details.

1. LCD display
2. Status indicator
3. Charging indicator
4. Fault indicator
5. Function buttons
6. Power on/off switch
7. AC input
8. AC output
9. PV input
10. Battery input
11. Circuit breaker
12. RS232 communication port
13. Parallel communication cable (only for parallel model)
14. Current sharing cable (only for parallel model)
15. Dry contact

# INSTALLATION

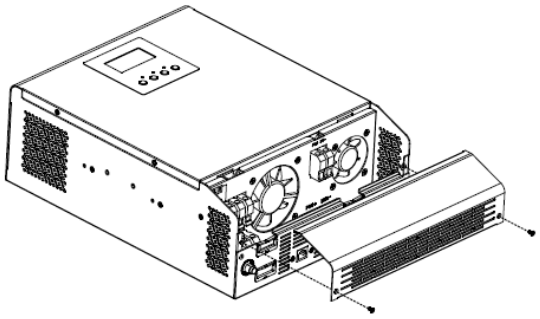
## Unpacking and Inspection

Before installation, please inspect the unit. Be sure that nothing inside the package is damaged. You should have received the following items inside of package:

- The unit x 1
- User manual x 1
- Communication cable x 1
- Software CD x 1

## Preparation

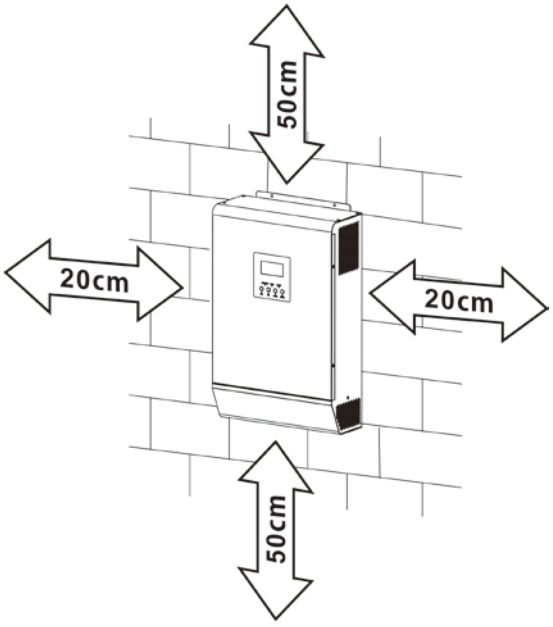
Before connecting all wirings, please take off bottom cover by removing two screws as shown below.



## Mounting the Unit

Consider the following points before selecting where to install:

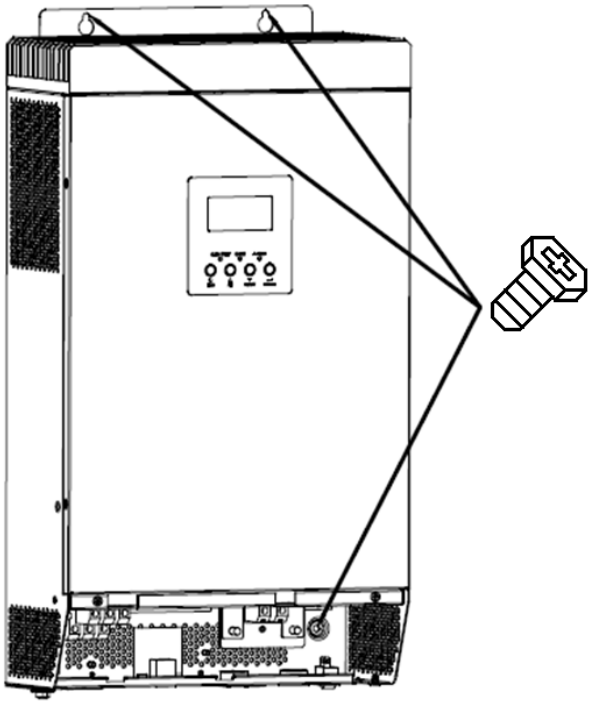
- Do not mount the inverter on flammable construction materials.
- Mount on a solid surface
- Install this inverter at eye level in order to allow the LCD display to be read at all times.
- The ambient temperature should be between 0°C and 55°C to ensure optimal operation.
- The recommended installation position is to be adhered to the wall vertically.
- Be sure to keep other objects and surfaces as shown in the right diagram to guarantee sufficient heat dissipation and to have enough space for removing wires.




**SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY.**

Install the unit by screwing three screws.

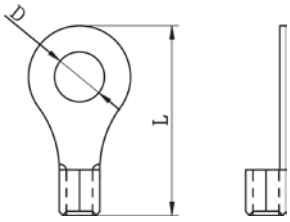
**2KVA/3KVA/5KVA Model**



## Battery Connection

**CAUTION:** For safety operation and regulation compliance, it's requested to install a separate DC over-current protector or disconnect device between battery and inverter. It may not be requested to have a disconnect device in some applications, however, it's still requested to have over-current protection installed. Please refer to typical amperage in below table as required fuse or breaker size.

**Ring terminal:**




**WARNING!** All wiring must be performed by a qualified personnel.

**WARNING!** It's very important for system safety and efficient operation to use appropriate cable for battery connection. To reduce risk of injury, please use the proper recommended cable and terminal size as below.

**Recommended battery cable and terminal size:**

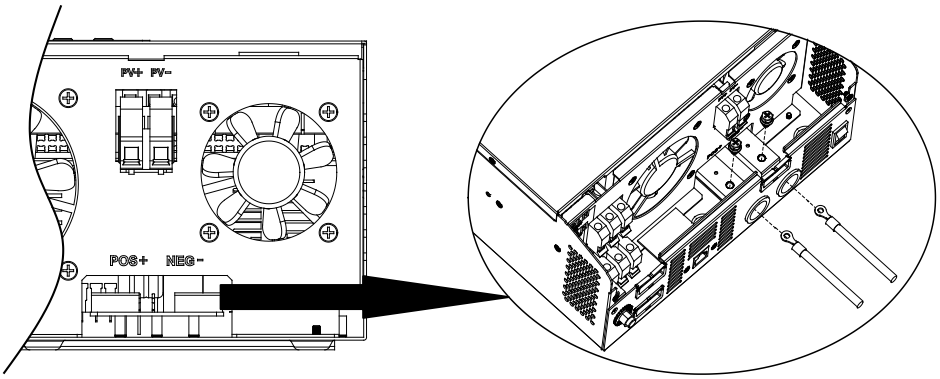
| Model | Typical Amperage | Battery Capacity | Wire Size | Ring Terminal | | | Torque Value |
|---|---|---|---|---|---|---|---|
| | | | | Cable $mm^2$ | Dimensions | | |
| | | | | | D (mm) | L (mm) | |
| 2KVA | 33A | 100AH | 1*10AWG | 5 | 6.4 | 22.5 | 2~ 3 Nm |
| 3KVA | 50A | 100AH | 1*8AWG | 8 | 6.4 | 23.8 | 2~ 3 Nm |
| 5KVA | 87A | 200AH | 1*4AWG | 22 | 6.4 | 33.2 | 2~ 3 Nm |
| | | | 2*8AWG | 14 | 6.4 | 29.2 | |

Please follow below steps to implement battery connection:

1. Assemble battery ring terminal based on recommended battery cable and terminal size.
2. Connect all battery packs as units requires. It's suggested to connect at least 100Ah capacity battery for 1-3KVA model and at least 200Ah capacity battery for 4KVA/5KVA model.

**NOTE:** Please only use sealed lead acid battery or sealed GEL/AGM lead-acid battery.

3. Insert the ring terminal of battery cable flatly into battery connector of inverter and make sure the bolts are tightened with torque of 2-3 Nm. Make sure polarity at both the battery and the inverter/charge is correctly connected and ring terminals are tightly screwed to the battery terminals.




| | |
|---|---|
| ⚠ | **WARNING: Shock Hazard**<br>Installation must be performed with care due to high battery voltage in series. |

| | |
|---|---|
| ⚠ | **CAUTION!!** Do not place anything between the flat part of the inverter terminal and the ring terminal. Otherwise, overheating may occur.<br>**CAUTION!!** Do not apply anti-oxidant substance on the terminals before terminals are connected tightly.<br>**CAUTION!!** Before making the final DC connection or closing DC breaker/disconnector, be sure positive (+) must be connected to positive (+) and negative (-) must be connected to negative (-). |

## AC Input/Output Connection

**CAUTION!!** Before connecting to AC input power source, please install a **separate** AC breaker between inverter and AC input power source. This will ensure the inverter can be securely disconnected during maintenance and fully protected from over current of AC input. The recommended spec of AC breaker is 20A for 2KVA, 32A for 3KVA and 50A for 5KVA.

**CAUTION!!** There are two terminal blocks with "IN" and "OUT" markings. Please do NOT mis-connect input and output connectors.

**WARNING!** All wiring must be performed by a qualified personnel.

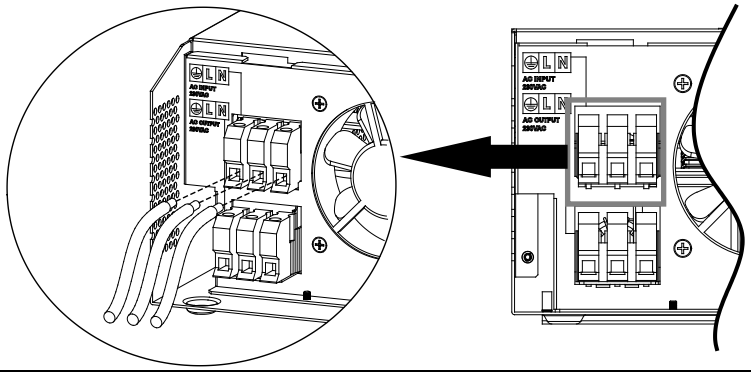
**WARNING!** It's very important for system safety and efficient operation to use appropriate cable for AC input connection. To reduce risk of injury, please use the proper recommended cable size as below.

**Suggested cable requirement for AC wires**

| Model | Gauge | Torque Value |
|---|---|---|
| 2KVA<br>3KVA | 12 AWG | 1.2~ 1.6 Nm |
| 5KVA | 8 AWG | 1.4~ 1.6Nm |

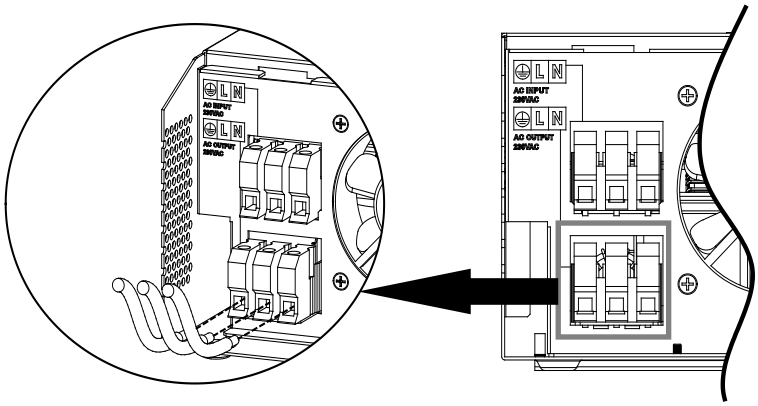
Please follow below steps to implement AC input/output connection:

1. Before making AC input/output connection, be sure to open DC protector or disconnector first.
2. Remove insulation sleeve 10mm for six conductors. And shorten phase L and neutral conductor N 3 mm.
3. Insert AC input wires according to polarities indicated on terminal block and tighten the terminal screws. Be sure to connect PE protective conductor (⏚) first.
   ⏚**→Ground (yellow-green)**
   **L→LINE (brown or black)**
   **N→Neutral (blue)**



| | |
|---|---|
| ⚠ | **WARNING:**<br>Be sure that AC power source is disconnected before attempting to hardwire it to the unit. |

4. Then, insert AC output wires according to polarities indicated on terminal block and tighten terminal screws. Be sure to connect PE protective conductor (⏚) first.
   ⏚**→Ground (yellow-green)**
   **L→LINE (brown or black)**
   **N→Neutral (blue)**



5. Make sure the wires are securely connected.

**CAUTION: Important**

Be sure to connect AC wires with correct polarity. If L and N wires are connected reversely, it may cause utility short-circuited when these inverters are worked in parallel operation.

**CAUTION:** Appliances such as air conditioner are required at least 2~3 minutes to restart because it's required to have enough time to balance refrigerant gas inside of circuits. If a power shortage occurs and recovers in a short time, it will cause damage to your connected appliances. To prevent this kind of damage, please check manufacturer of air conditioner if it's equipped with time-delay function before installation. Otherwise, this inverter/charger will trig overload fault and cut off output to protect your appliance but sometimes it still causes internal damage to the air conditioner.

## PV Connection

**CAUTION:** Before connecting to PV modules, please install **separately** a DC circuit breaker between inverter and PV modules.

**WARNING!** All wiring must be performed by a qualified personnel.
**WARNING!** It's very important for system safety and efficient operation to use appropriate cable for PV module connection. To reduce risk of injury, please use the proper recommended cable size as below.

| Model | Typical Amperage | Cable Size | Torque |
|---|---|---|---|
| 2KVA<br>3KVA<br>5KVA | 60A | 8 AWG | 1.4~1.6 Nm |

**PV Module Selection:**

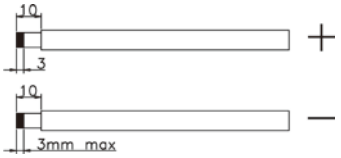
When selecting proper PV modules, please be sure to consider below parameters:

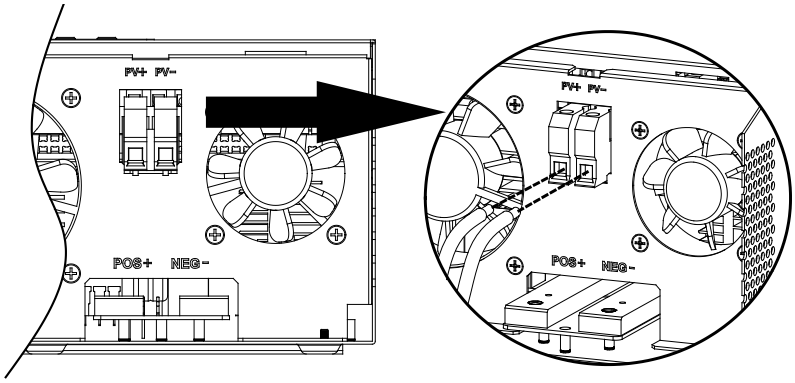
1. Open circuit Voltage (Voc) of PV modules not exceeds max. PV array open circuit voltage of inverter.
2. Open circuit Voltage (Voc) of PV modules should be higher than min. battery voltage.

| **Solar Charging Mode** | |
|---|---|
| **INVERTER MODEL** | **2KVA /3KVA / 5KVA** |
| **Max. PV Array Open Circuit Voltage** | 145Vdc |
| **PV Array MPPT Voltage Range** | 60~115Vdc |
| **Min. battery voltage for PV charge** | 34Vdc |

Please follow below steps to implement PV module connection:

1. Remove insulation sleeve 10 mm for positive and negative conductors.
2. Check correct polarity of connection cable from PV modules and PV input connectors. Then, connect positive pole (+) of connection cable to positive pole (+) of PV input connector. Connect negative pole (-) of connection cable to negative pole (-) of PV input connector.

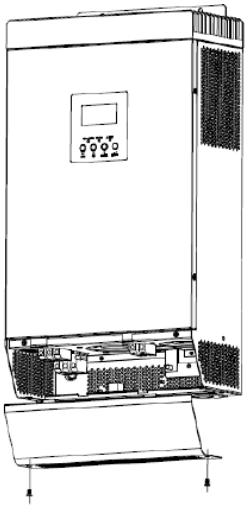



3. Make sure the wires are securely connected.

## Final Assembly

After connecting all wirings, please put bottom cover back by screwing two screws as shown below.



2KVA /3KVA /5KVA

## Communication Connection

Please use supplied communication cable to connect to inverter and PC. Insert bundled CD into a computer and follow on-screen instruction to install the monitoring software. For the detailed software operation, please check user manual of software inside of CD.

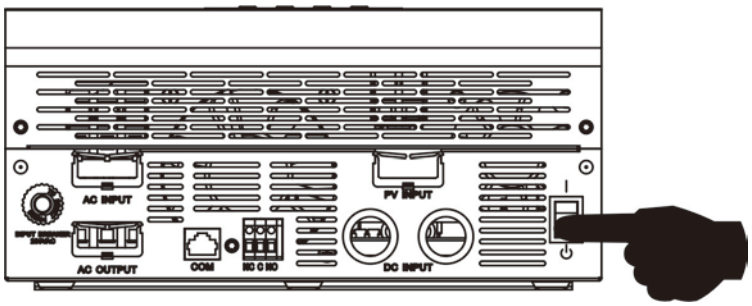
## Dry Contact Signal

There is one dry contact (3A/250VAC) available on the rear panel. It could be used to deliver signal to external device when battery voltage reaches warning level.

| Unit Status | Condition | | | Dry contact port:   | |
|---|---|---|---|---|---|
| | | | | NC & C | NO & C |
| Power Off | Unit is off and no output is powered. | | | Close | Open |
| Power On | Output is powered from Utility. | | | Close | Open |
| | Output is powered from Battery or Solar. | Program 01 set as Utility | Battery voltage < Low DC warning voltage | Open | Close |
| | | | Battery voltage > Setting value in Program 13 or battery charging reaches floating stage | Close | Open |
| | | Program 01 is set as SBU or Solar first | Battery voltage < Setting value in Program 12 | Open | Close |
| | | | Battery voltage > Setting value in Program 13 or battery charging reaches floating stage | Close | Open |

# OPERATION

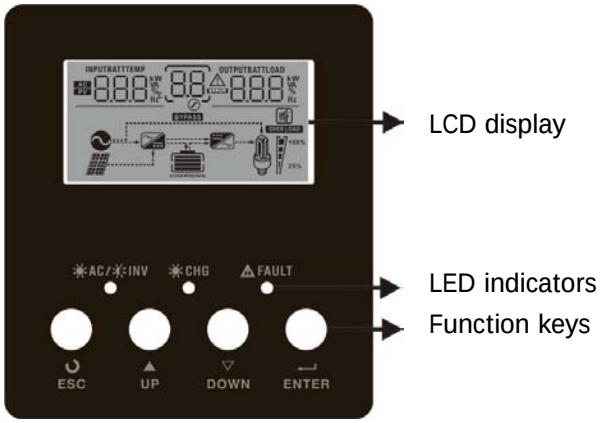
## Power ON/OFF




Once the unit has been properly installed and the batteries are connected well, simply press On/Off switch (located on the button of the case) to turn on the unit.

## Operation and Display Panel

The operation and display panel, shown in below chart, is on the front panel of the inverter. It includes three indicators, four function keys and a LCD display, indicating the operating status and input/output power information.



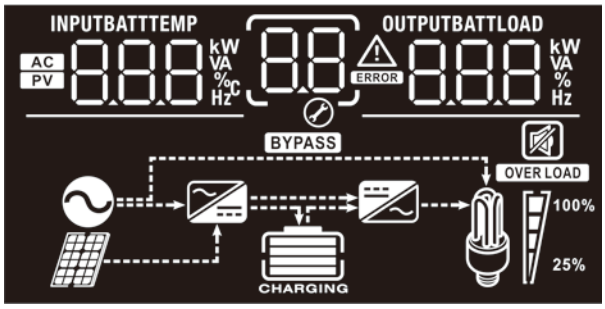

**LED Indicator**

| LED Indicator | | | Messages |
|---|---|---|---|
| AC / INV | Green | Solid On | Output is powered by utility in Line mode. |
| | | Flashing | Output is powered by battery or PV in battery mode. |
| CHG | Green | Solid On | Battery is fully charged. |
| | | Flashing | Battery is charging. |
| ⚠ FAULT | Red | Solid On | Fault occurs in the inverter. |
| | | Flashing | Warning condition occurs in the inverter. |

**Function Keys**

| Function Key | Description |
|---|---|
| ESC | To exit setting mode |
| UP | To go to previous selection |
| DOWN | To go to next selection |
| ENTER | To confirm the selection in setting mode or enter setting mode |

## LCD Display Icons



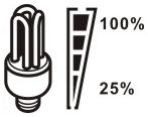

| Icon | Function description |
|---|---|
| **Input Source Information** | |
| AC | Indicates the AC input. |
| PV | Indicates the PV input |
| INPUTBATT 888 kW VA %°C Hz | Indicate input voltage, input frequency, PV voltage, battery voltage and charger current. |
| **Configuration Program and Fault Information** | |
| 88 | Indicates the setting programs. |
| 88 ERROR | Indicates the warning and fault codes.<br>Warning: 88 flashing with warning code.<br>Fault: 88 ERROR lighting with fault code |
| **Output Information** | |
| OUTPUTBATTLOAD 888 kW VA % Hz | Indicate output voltage, output frequency, load percent, load in VA, load in Watt and discharging current. |
| **Battery Information** | |
| CHARGING | Indicates battery level by 0-24%, 25-49%, 50-74% and 75-100% in battery mode and charging status in line mode. |

In AC mode, it will present battery charging status.

| Status | Battery voltage | LCD Display |
|---|---|---|
| Constant Current mode / Constant Voltage mode | <2V/cell | 4 bars will flash in turns. |
| | 2 ~ 2.083V/cell | Bottom bar will be on and the other three bars will flash in turns. |
| | 2.083 ~ 2.167V/cell | Bottom two bars will be on and the other two bars will flash in turns. |
| | > 2.167 V/cell | Bottom three bars will be on and the top bar will flash. |
| Floating mode. Batteries are fully charged. | | 4 bars will be on. |

In battery mode, it will present battery capacity.

| Load Percentage | Battery Voltage | LCD Display |
|---|---|---|
| Load >50% | < 1.717V/cell |  |
| | 1.717V/cell ~ 1.8V/cell |  |
| | 1.8 ~ 1.883V/cell |  |
| | > 1.883 V/cell |  |
| 50%> Load > 20% | < 1.817V/cell |  |
| | 1.817V/cell ~ 1.9V/cell |  |
| | 1.9 ~ 1.983V/cell |  |
| | > 1.983 |  |
| Load < 20% | < 1.867V/cell |  |
| | 1.867V/cell ~ 1.95V/cell |  |
| | 1.95 ~ 2.033V/cell |  |
| | > 2.033 |  |

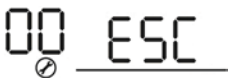
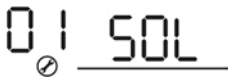
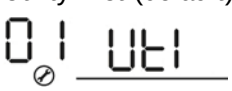
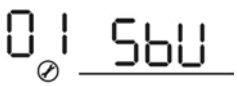
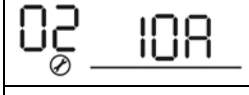
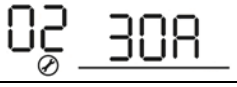
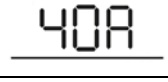
| **Load Information** | | | | |
|---|---|---|---|---|
| OVER LOAD | Indicates overload. | | | |
|   | Indicates the load level by 0-24%, 25-50%, 50-74% and 75-100%. | | | |
| | 0%~25% | 25%~50% | 50%~75% | 75%~100% |
| |  |  |  |  |

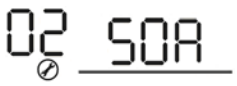
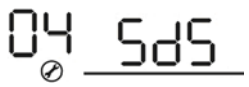
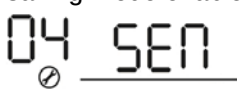
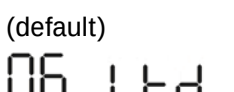
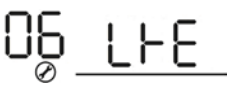
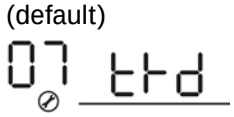
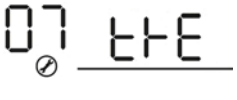
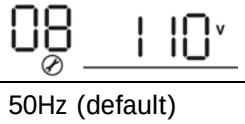
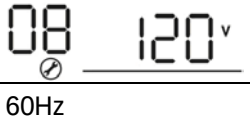
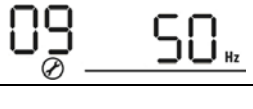
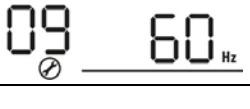
| **Mode Operation Information** | |
|---|---|
|  | Indicates unit connects to the mains. |
|  | Indicates unit connects to the PV panel. |
| BYPASS | Indicates load is supplied by utility power. |
|  | Indicates the utility charger circuit is working. |
|  | Indicates the DC/AC inverter circuit is working. |
| **Mute Operation** | |
|  | Indicates unit alarm is disabled. |

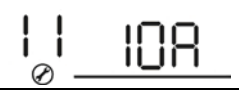
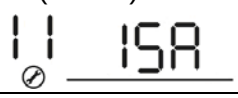
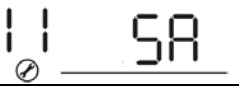
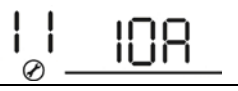
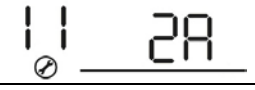
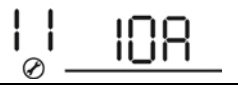
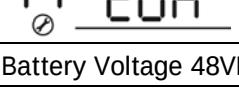
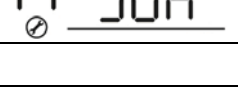
## LCD Setting

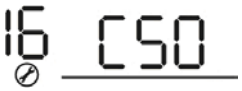
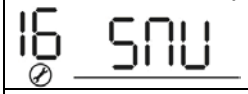
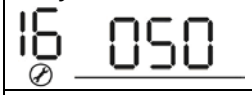
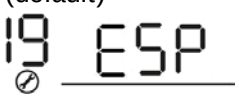
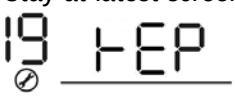
After pressing and holding ENTER button for 3 seconds, the unit will enter setting mode. Press “UP” or “DOWN” button to select setting programs. And then, press “ENTER” button to confirm the selection or ESC button to exit.

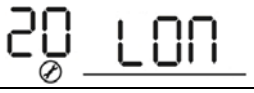
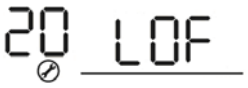
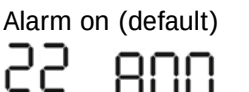
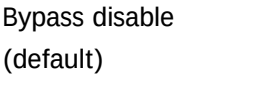
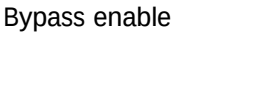
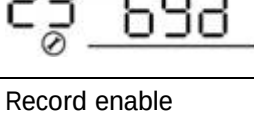
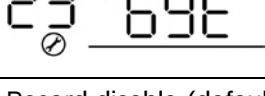
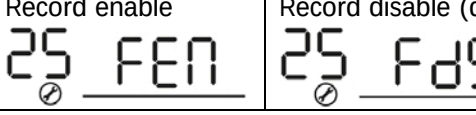
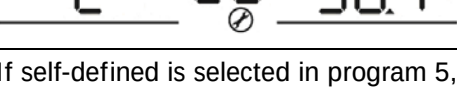
**Setting Programs:**

<table>
<tr><th>Program</th><th>Description</th><th colspan="2">Selectable option</th></tr>
<tr><td>00</td><td>Exit setting mode</td><td colspan="2">Escape<br>  </td></tr>
<tr><td rowspan="4">01</td><td rowspan="4">Output source priority:<br>To configure load power source priority</td><td>Solar first<br>  </td><td>Solar energy provides power to the loads as first priority.<br>If solar energy is not sufficient to power all connected loads, battery energy will supply power the loads at the same time.<br>Utility provides power to the loads only when any one condition happens:<br>- Solar energy is not available<br>- Battery voltage drops to either low-level warning voltage or the setting point in program 12.</td></tr>
<tr><td>Utility first (default)<br>  </td><td>Utility will provide power to the loads as first priority.<br>Solar and battery energy will provide power to the loads only when utility power is not available.</td></tr>
<tr><td>SBU priority<br>  </td><td>Solar energy provides power to the loads as first priority.<br>If solar energy is not sufficient to power all connected loads, battery energy will supply power to the loads at the same time.<br>Utility provides power to the loads only when battery voltage drops to either low-level warning voltage or the setting point in program 12.</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="3">02</td><td rowspan="3">Maximum charging current:<br>To configure total charging current for solar and utility chargers.<br>(Max. charging current = utility charging current + solar charging current)</td><td colspan="2">Available options in 2KVA, 3KVA and 5KVA models:</td></tr>
<tr><td>10A<br>  </td><td>20A<br>  </td></tr>
<tr><td>30A<br>  </td><td>40A<br>  </td></tr>
</table>

| | | | |
|---|---|---|---|
| | | 50A<br>  | 60A (default)<br>  |
| 03 | AC input voltage range | Appliances (default)<br>  | If selected, acceptable AC input voltage range will be within 95-140VAC(120V) or 90-280VAC(230V). |
| | | UPS<br>  | If selected, acceptable AC input voltage range will be within 65-140 VAC(120V) or 170-280VAC(230V). |
| 04 | Power saving mode enable/disable | Saving mode disable (default)<br>  | If disabled, no matter connected load is low or high, the on/off status of inverter output will not be effected. |
| | | Saving mode enable<br>  | If enabled, the output of inverter will be off when connected load is pretty low or not detected. |
| 05 | Battery type | AGM (default)<br>  | Flooded<br>  |
| | | User-Defined<br>  | If “User-Defined” is selected, battery charge voltage and low DC cut-off voltage can be set up in program 26, 27 and 29. |
| 06 | Auto restart when overload occurs | Restart disable (default)<br>  | Restart enable<br>  |
| 07 | Auto restart when over temperature occurs | Restart disable (default)<br>  | Restart enable<br>  |
| 08 | Output voltage (only available for 2KVA 120Vac models) | 110V<br>  | 120V<br>  |
| 09 | Output frequency | 50Hz (default)<br>  | 60Hz<br>  |

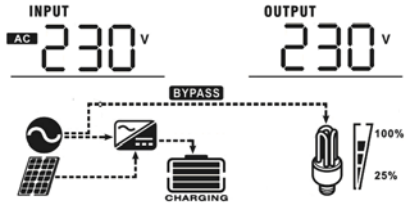
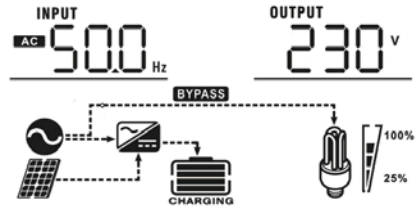
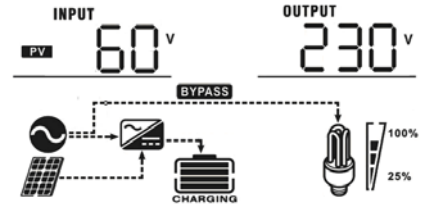
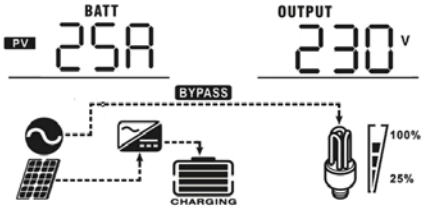
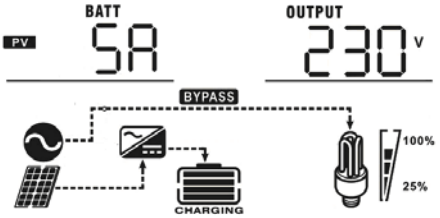
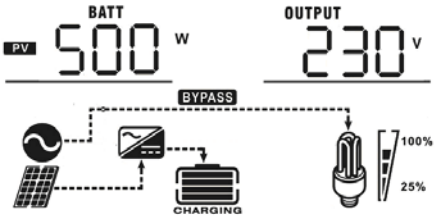
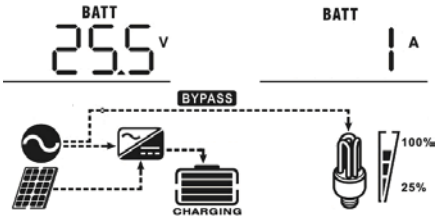
| | | | |
|---|---|---|---|
| 11 | Maximum utility charging current | Available options in 3KVA models: | |
| | | 10A  | 15A(default):  |
| | | Available options in 2KVA 120Vac model: | |
| | | 5A  | 10A(default)  |
| | | Available options in 5KVA models: | |
| | | 2A  | 10A  |
| | | 20A  | 30A (default)  |
| 12 | Setting voltage point back to utility source when selecting “SBU priority” or “Solar first” in program 01. | Battery Voltage 48VDC: | |
| | | 44V  | 45V  |
| | | 46V (default)  | 47V  |
| | | 48V  | 49V  |
| | | 50V  | 51V  |
| 13 | Setting voltage point back to battery mode when selecting “SBU priority” or “Solar first” in program 01. | Battery Voltage 48V: | |
| | | Battery fully charged  | 48V  |
| | | 49V  | 50V  |
| | | 51V  | 52V  |

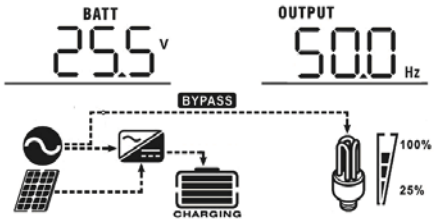
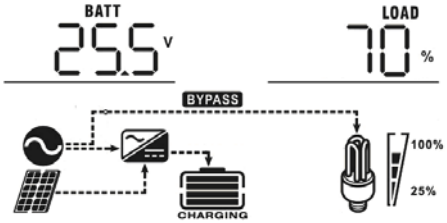
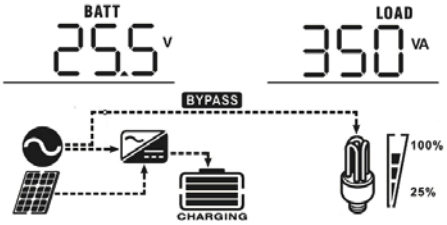
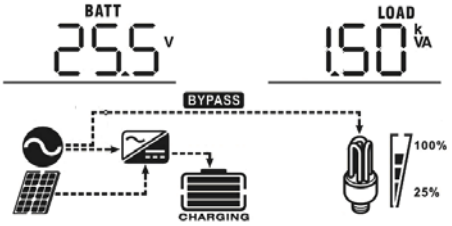
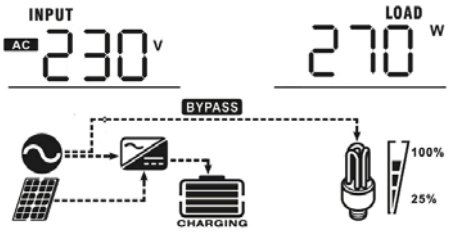
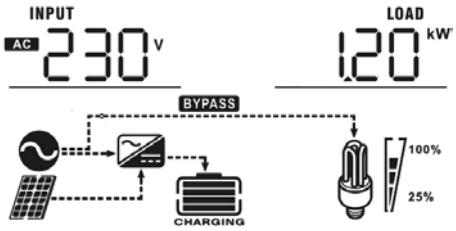
| | | | |
|---|---|---|---|
| | | 53V<br>  | 54V (default)<br>  |
| | | 55V<br>  | 56V<br>  |
| | | 57V<br>  | 58V<br>  |
| 16 | Charger source priority:<br>To configure charger source priority | If this inverter/charger is working in Line, Standby or Fault mode, charger source can be programmed as below: | |
| | | Solar first<br>  | Solar energy will charge battery as first priority.<br>Utility will charge battery only when solar energy is not available. |
| | | Utility first<br>  | Utility will charge battery as first priority.<br>Solar energy will charge battery only when utility power is not available. |
| | | Solar and Utility<br>(Only available for 4KVA/5KVA model)<br>  | Solar energy and utility will charge battery at the same time. |
| | | Only Solar<br>  | Solar energy will be the only charger source no matter utility is available or not. |
| | | If this inverter/charger is working in Battery mode or Power saving mode, only solar energy can charge battery. Solar energy will charge battery if it's available and sufficient. | |
| 18 | Alarm control | Alarm on (default)<br>  | Alarm off<br>  |
| 19 | Auto return to default display screen | Return to default display screen (default)<br>  | If selected, no matter how users switch display screen, it will automatically return to default display screen (Input voltage /output voltage) after no button is pressed for 1 minute. |
| | | Stay at latest screen<br>  | If selected, the display screen will stay at latest screen user finally switches. |

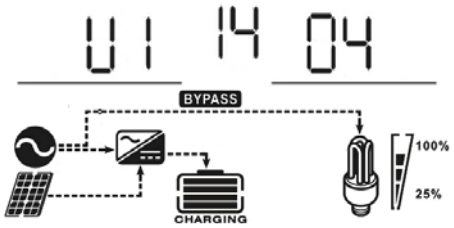
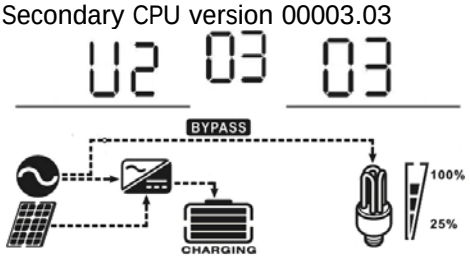
| | | | |
|---|---|---|---|
| 20 | Backlight control | Backlight on (default)<br>  | Backlight off<br>  |
| 22 | Beeps while primary source is interrupted | Alarm on (default)<br>  | Alarm off<br>  |
| 23 | Overload bypass:<br>When enabled, the unit will transfer to line mode if overload occurs in battery mode. | Bypass disable (default)<br>  | Bypass enable<br>  |
| 25 | Record Fault code | Record enable<br>  | Record disable (default)<br>  |
| 26 | Bulk charging voltage (C.V voltage) | 48V model default setting: 56.4V<br>  | |
| | | If self-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 58.4V for 48V model. Increment of each click is 0.1V. | |
| 27 | Floating charging voltage | 48V model default setting: 54.0V<br>  | |
| | | If self-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 58.4V for 48V model. Increment of each click is 0.1V. | |
| 29 | Low DC cut-off voltage | 48V model default setting: 42.0V<br>  | |
| | | If self-defined is selected in program 5, this program can be set up. Setting range is from 40.0V to 48.0V for 48V model. Increment of each click is 0.1V. Low DC cut-off voltage will be fixed to setting value no matter what percentage of load is connected. Then, low DC warning voltage is 2V higher than cut-off voltage, low DC warning return voltage is 4V higher than cut-off voltage and Cold Start Voltage is 4V higher than cut-off voltage. | |

## Display Setting

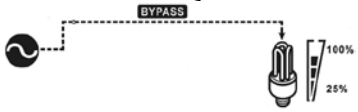
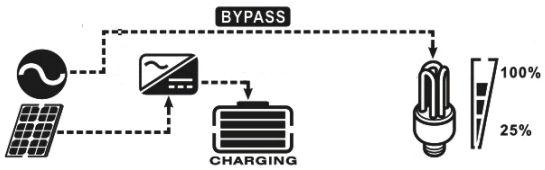
The LCD display information will be switched in turns by pressing “UP” or “DOWN” key. The selectable information is switched as below order: input voltage, input frequency, PV voltage, MPPT charging current, MPPT charging power, battery voltage, output voltage, output frequency, load percentage, load in VA, load in Watt, DC discharging current, main CPU Version and second CPU Version.

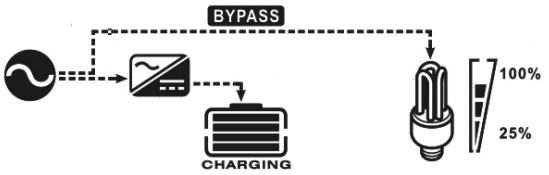
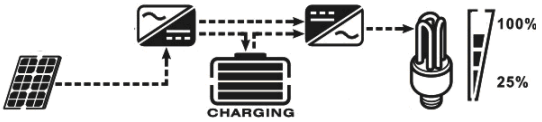
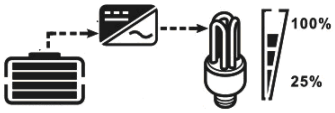
| Selectable information | LCD display |
|---|---|
| Input voltage/Output voltage<br>(Default Display Screen) | Input Voltage=230V, output voltage=230V<br>  |
| Input frequency | Input frequency=50Hz<br>  |
| PV voltage | PV voltage=60V<br>  |
| MPPT Charging current | Current ≧10A<br>  <br>Current < 10A<br>  |
| MPPT Charging power | MPPT charging power=500W<br>  |
| Battery voltage/ DC discharging current | Battery voltage=25.5V, discharging current=1A<br>  |

| | |
|---|---|
| Output frequency | Output frequency=50Hz<br>  |
| Load percentage | Load percent=70%<br>  |
| Load in VA | When connected load is lower than 1kVA, load in VA will present xxxVA like below chart.<br>  <br>When load is larger than 1kVA (≧1KVA), load in VA will present x.xkVA like below chart.<br>  |
| Load in Watt | When load is lower than 1kW, load in W will present xxxW like below chart.<br>  <br>When load is larger than 1kW (≧1KW), load in W will present x.xkW like below chart.<br>  |

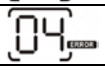
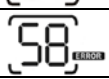
| | |
|---|---|
| Main CPU version checking | Main CPU version 00014.04<br>  |
| Secondary CPU version checking | Secondary CPU version 00003.03<br>  |

## Operating Mode Description

| Operation mode | Description | LCD display |
|---|---|---|
| Standby mode / Power saving mode<br>**Note:**<br>*Standby mode: The inverter is not turned on yet but at this time, the inverter can charge battery without AC output.<br>*Power saving mode: If enabled, the output of inverter will be off when connected load is pretty low or not detected. | No output is supplied by the unit but it still can charge batteries. | Charging by utility.<br>  |
| | | Charging by PV energy.<br>  |
| | | No charging.<br>  |
| Fault mode<br>Note:<br>*Fault mode: Errors are caused by inside circuit error or external reasons such as over temperature, output short circuited and so on. | PV energy and utility can charge batteries. | Charging by utility. (Only available in 2K/3K model)<br>  |
| | | Charging by PV energy.<br>  |
| | | No charging.<br>  |
| Fault mode<br>Note:<br>*Fault mode: Errors are caused by inside circuit error or external reasons such as over temperature, output short circuited and so on. | Utility can power loads when the unit starts up without battery. (Only available in 4K/5K model with single operation) | Power from utility<br>  |
| Line Mode | The unit will provide output power from the mains. It will also charge the battery at line mode. | Charging by PV energy<br>  |
| | | Charging by utility. |

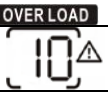
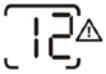
| | | |
|---|---|---|
| | |  |
| Battery Mode | The unit will provide output power from battery and PV power. | Power from battery and PV energy.<br>  |
| | | Power from battery only.<br>  |

## Fault Reference Code

| Fault Code | Fault Event | Icon on |
|---|---|---|
| 01 | Fan is locked when inverter is off. |  |
| 02 | Over temperature |  |
| 03 | Battery voltage is too high |  |
| 04 | Battery voltage is too low |  |
| 05 | Output short circuited or over temperature is detected by internal converter components. |  |
| 06 | Output voltage is abnormal. (For 2K/3K model)<br>Output voltage is too high. (For 5K model) |  |
| 07 | Overload time out |  |
| 08 | Bus voltage is too high |  |
| 09 | Bus soft start failed |  |
| 11 | Main relay failed |  |
| 51 | Over current or surge |  |
| 52 | Bus voltage is too low |  |
| 53 | Inverter soft start failed |  |
| 55 | Over DC voltage in AC output |  |
| 56 | Battery connection is open |  |
| 57 | Current sensor failed |  |
| 58 | Output voltage is too low |  |

**NOTE: Fault codes 51, 52, 53, 55, 56, 57 and 58 are only available in 5K model.**

## Warning Indicator

| Warning Code | Warning Event | Audible Alarm | Icon flashing |
|---|---|---|---|
| 01 | Fan is locked when inverter is on. | Beep three times every second |  |
| 03 | Battery is over-charged | Beep once every second |  |
| 04 | Low battery | Beep once every second |  |
| 07 | Overload | Beep once every 0.5 second |   |
| 10 | Output power derating | Beep twice every 3 seconds |  |
| 12 | Solar charger stops due to low battery. | |  |
| 13 | Solar charger stops due to high PV voltage. | |  |
| 14 | Solar charger stops due to overload. | |  |

# SPECIFICATIONS

Table 1 Line Mode Specifications

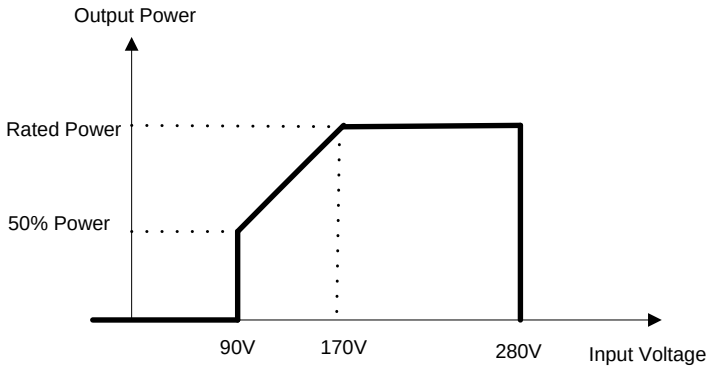
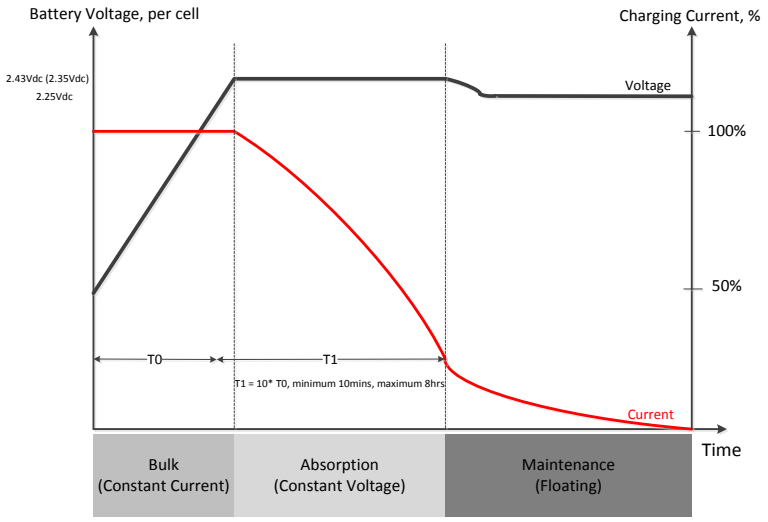
| INVERTER MODEL | 2KVA | 3KVA | 5KVA |
|---|---|---|---|
| **Input Voltage Waveform** | Sinusoidal (utility or generator) | | |
| **Nominal Input Voltage** | 120Vac | 230Vac | |
| **Low Loss Voltage** | 95Vac±7V(UPS);<br>65Vac±7V(Appliances) | 170Vac±7V (UPS);<br>90Vac±7V (Appliances) | |
| **Low Loss Return Voltage** | 100Vac±7V(UPS);<br>70Vac±7V(Appliances) | 180Vac±7V (UPS);<br>100Vac±7V (Appliances) | |
| **High Loss Voltage** | 140Vac±7V | 280Vac±7V | |
| **High Loss Return Voltage** | 135Vac±7V | 270Vac±7V | |
| **Max AC Input Voltage** | 150Vac | 300Vac | |
| **Nominal Input Frequency** | 50Hz / 60Hz (Auto detection) | | |
| **Low Loss Frequency** | 40±1Hz | | |
| **Low Loss Return Frequency** | 42±1Hz | | |
| **High Loss Frequency** | 65±1Hz | | |
| **High Loss Return Frequency** | 63±1Hz | | |
| **Output Short Circuit Protection** | Line mode: Circuit Breaker<br>Battery mode: Electronic Circuits | | |
| **Efficiency (Line Mode)** | >95% ( Rated R load, battery full charged ) | | |
| **Transfer Time** | 10ms typical (UPS);<br>20ms typical (Appliances) | | |
| **Output power derating:**<br>When AC input voltage drops to 170V, the output power will be derated. |  | | |

Table 2 Inverter Mode Specifications

| **INVERTER MODEL** | **2KVA** | **3KVA** | **5KVA** |
|---|---|---|---|
| **Rated Output Power** | 2KVA/1.6KW | 3KVA/2.4KW | 5KVA/4KW |
| **Output Voltage Waveform** | Pure Sine Wave | | |
| **Output Voltage Regulation** | 110/120VAC±5% | 230Vac±5% | |
| **Output Frequency** | 60Hz or 50Hz | | |
| **Peak Efficiency** | 90% | | |
| **Overload Protection** | 5s@≥150% load; 10s@110%~150% load | | |
| **Surge Capacity** | 2* rated power for 5 seconds | | |
| **Nominal DC Input Voltage** | 48Vdc | | |
| **Cold Start Voltage** | 46.0Vdc | | |
| **Low DC Warning Voltage**<br>@ load < 20%<br>@ 20% ≤ load < 50%<br>@ load ≥ 50% | <br>44.0Vdc<br>42.8Vdc<br>40.4Vdc | | |
| **Low DC Warning Return Voltage**<br>@ load < 20%<br>@ 20% ≤ load < 50%<br>@ load ≥ 50% | <br>46.0Vdc<br>44.8Vdc<br>42.4Vdc | | |
| **Low DC Cut-off Voltage**<br>@ load < 20%<br>@ 20% ≤ load < 50%<br>@ load ≥ 50% | <br>42.0Vdc<br>40.8Vdc<br>38.4Vdc | | |
| **High DC Recovery Voltage** | 58Vdc | | |
| **High DC Cut-off Voltage** | 62Vdc | | |
| **No Load Power Consumption** | <25W | | <50W |
| **Saving Mode Power Consumption** | <10W | | <15W |

Table 3 Charge Mode Specifications

| **Utility Charging Mode** | | | | |
|---|---|---|---|---|
| **INVERTER MODEL** | | **2KVA** | **3KVA** | **5KVA** |
| **Charging Current (UPS)** @$V_{I/P}$=230Vac | | 5/10A | 10/15A | 20/30A |
| **Bulk Charging Voltage** | **Flooded Battery** | 58.4Vdc | | |
| | **AGM / Gel Battery** | 56.4Vdc | | |
| **Floating Charging Voltage** | | 54Vdc | | |
| **Charging Algorithm** | | 3-Step | | |
| **Charging Curve** | |  | | |



| **Solar Charging Mode** | |
|---|---|
| **INVERTER MODEL** | **2KVA/3KVA/5KVA** |
| **Rated Power** | 3000W |
| **Efficiency** | 98.0% max. |
| **Max. PV Array Open Circuit Voltage** | 145Vdc |
| **PV Array MPPT Voltage Range** | 60~115Vdc |
| **Min battery voltage for PV charge** | 34Vdc |
| **Standby Power Consumption** | 2W |
| **Battery Voltage Accuracy** | +/-0.3% |
| **PV Voltage Accuracy** | +/-2V |
| **Charging Algorithm** | 3-Step |

Table 4 General Specifications

| INVERTER MODEL | 2KVA / 3KVA | 5KVA |
|---|---|---|
| **Operating Temperature Range** | 0°C to 55°C | |
| **Storage temperature** | -15°C~ 60°C | |
| **Dimension (D*W*H), mm** | 140 x 295 x 479 | 140 x295 x540 |
| **Net Weight, kg** | 11.5 | 13.5 |

# TROUBLE SHOOTING

| Problem | LCD/LED/Buzzer | Explanation / Possible cause | What to do |
|---|---|---|---|
| Unit shuts down automatically during startup process. | LCD/LEDs and buzzer will be active for 3 seconds and then complete off. | The battery voltage is too low (<1.91V/Cell) | 1. Re-charge battery.<br>2. Replace battery. |
| No response after power on. | No indication. | 1. The battery voltage is far too low. (<1.4V/Cell)<br>2. Battery polarity is connected reversed. | 1. Check if batteries and the wiring are connected well.<br>2. Re-charge battery.<br>3. Replace battery. |
| Mains exist but the unit works in battery mode. | Input voltage is displayed as 0 on the LCD and green LED is flashing. | Input protector is tripped | Check if AC breaker is tripped and AC wiring is connected well. |
| | Green LED is flashing. | Insufficient quality of AC power. (Shore or Generator) | 1. Check if AC wires are too thin and/or too long.<br>2. Check if generator (if applied) is working well or if input voltage range setting is correct. (UPS→Appliance) |
| | Green LED is flashing. | Set “Solar First” as the priority of output source. | Change output source priority to Utility first. |
| When the unit is turned on, internal relay is switched on and off repeatedly. | LCD display and LEDs are flashing | Battery is disconnected. | Check if battery wires are connected well. |
| Buzzer beeps continuously and red LED is on. | Fault code 07 | Overload error. The inverter is overload 110% and time is up. | Reduce the connected load by switching off some equipment. |
| | Fault code 05 | Output short circuited. | Check if wiring is connected well and remove abnormal load. |
| | | Temperature of internal converter component is over 120°C. (Only available for 2/3KVA models.) | Check whether the air flow of the unit is blocked or whether the ambient temperature is too high. |
| | Fault code 02 | Internal temperature of inverter component is over 100°C. | |
| | Fault code 03 | Battery is over-charged. | Return to repair center. |
| | | The battery voltage is too high. | Check if spec and quantity of batteries are meet requirements. |
| | Fault code 01 | Fan fault | Replace the fan. |
| | Fault code 06/58 | Output abnormal (Inverter voltage below than 190Vac or is higher than 260Vac) | 1. Reduce the connected load.<br>2. Return to repair center |
| | Fault code 08/09/53/57 | Internal components failed. | Return to repair center. |
| | Fault code 51 | Over current or surge. | Restart the unit, if the error happens again, please return to repair center. |
| | Fault code 52 | Bus voltage is too low. | |
| | Fault code 55 | Output voltage is unbalanced. | |
| | Fault code 56 | Battery is not connected well or fuse is burnt. | If the battery is connected well, please return to repair center. |

# Appendix: Approximate Back-up Time Table

| Model | Load (VA) | Backup Time @ 48Vdc 100Ah (min) | Backup Time @ 48Vdc 200Ah (min) |
|---|---|---|---|
| 2KVA | 200 | 1581 | 3161 |
| | 400 | 751 | 1581 |
| | 600 | 491 | 1054 |
| | 800 | 331 | 760 |
| | 1000 | 268 | 615 |
| | 1200 | 221 | 508 |
| | 1400 | 172 | 387 |
| | 1600 | 136 | 335 |
| | 1800 | 120 | 295 |
| | 2000 | 106 | 257 |
| 3KVA | 300 | 1054 | 2107 |
| | 600 | 491 | 1054 |
| | 900 | 291 | 668 |
| | 1200 | 196 | 497 |
| | 1500 | 159 | 402 |
| | 1800 | 123 | 301 |
| | 2100 | 105 | 253 |
| | 2400 | 91 | 219 |
| | 2700 | 71 | 174 |
| | 3000 | 63 | 155 |
| 5KVA | 500 | 613 | 1288 |
| | 1000 | 268 | 613 |
| | 1500 | 158 | 402 |
| | 2000 | 111 | 271 |
| | 2500 | 90 | 215 |
| | 3000 | 76 | 182 |
| | 3500 | 65 | 141 |
| | 4000 | 50 | 112 |
| | 4500 | 44 | 100 |
| | 5000 | 40 | 90 |

**Note:** Backup time depends on the quality of the battery, age of battery and type of battery. Specifications of batteries may vary depending on different manufacturers.