2-year warranty*

forza POWER TECHNOLOGIES

User Manual

Off-grid hybrid solar inverter and charger

FIO-P21K12 / FIO-P22K24 / FIO-P23K24 / FIO-P25K48

1KW, 2KVA, 3KVA and 5KVA

Table of contents

IMPORTANT SAFETY INSTRUCTIONS

1. Introduction

2. Product overview

3. Preliminary steps

4. HARDWARE CONNECTIONS
4.1. AC connections
4.2. PV
4.3. Other communications

5. Operation
5.1. Power on/off
5.2. Display panel

6. Advanced operation
6.1. Main LCD configuration screen
6.2. Display information
6.3. Battery charging
6.3.1. Battery equalization

7. Fault codes and warning indicators

8. Troubleshooting

9. Approximate runtime chart

10. Technical specifications

IMPORTANT SAFETY INSTRUCTIONS

This manual contains important information regarding the operation and warranty of the Forza Inverter Series. As with any electrical equipment, certain precautions must be observed when installing the unit. To reduce the risk of personal injury and to ensure safe installation and operation, carefully read and follow all instructions, cautions and warnings included in this manual. Keep it in a safe place for future reference.

1. Before using the product, read all instructions and cautionary markings on the unit, the batteries and all appropriate sections of this manual.
2. **CAUTION** --Charge only deep-cycle lead acid rechargeable batteries. Other types of batteries may burst, causing personal injury and damage.
3. Do not disassemble this product. If service or repair are required, consult a qualified service center.
4. Incorrect re-assembly may cause electric shock or fire.
5. To reduce the risk of electric shock, disconnect all wiring before attempting any maintenance or cleaning. Turning off the unit will not reduce this risk.
6. **CAUTION** – Installation of the batteries should be performed only by qualified personnel.
7. **NEVER** charge a frozen battery.
8. For optimum performance of this inverter/charger, follow all wire and cable sizing specifications included in the manual.
9. Avoid dropping tools onto batteries or other electrical parts.
10. Always use insulated tools.
11. This product must be connected to a permanent grounded wiring system.
12. All wiring and installation methods must comply with local codes and regulations.
13. Do not reverse the polarity of the battery cables. This will destroy the product.
14. Ensure that neither the AC nor the DC circuit is allowed to be short-circuited. Do not connect the system to any AC source if a short circuit occurs.

1. Introduction

Thank you for purchasing the **PULSAR Off-grid solar inverter** from Forza.
Our **PULSAR** line is made up of inverters designed for off-grid, single-phase photovoltaic applications. Equipped with an MPPT charger, the PULSAR optimizes energy harvesting while reducing maintenance and operational costs. As the inverter has been conceived to easily integrate with the Forza battery and the embedded application, it provides seamless status monitoring along with remote management, all in real-time.

Available in the 230-volt version, and with capacities of 1000W, 2000W, 3000W and 5000W, the **PULSAR** is characterized for its sturdy construction, outstanding performance and industry-grade design life.

Features
- Highly-efficient MPPT (Maximum Power Point Tracking) charge controller
- Features restart functionality, including the “cold start” option from battery
- Wide DC input range
- USB On-the Go functionality for easy data transfer to and from the unit
- Selectable input voltage range for home appliances and personal computers
- Configurable AC/Solar input priority via LCD
- Marine/offshore and generator applications
- Rugged design with overload, overtemperature, and short-circuit protection
- Smart battery charger design for optimized battery performance

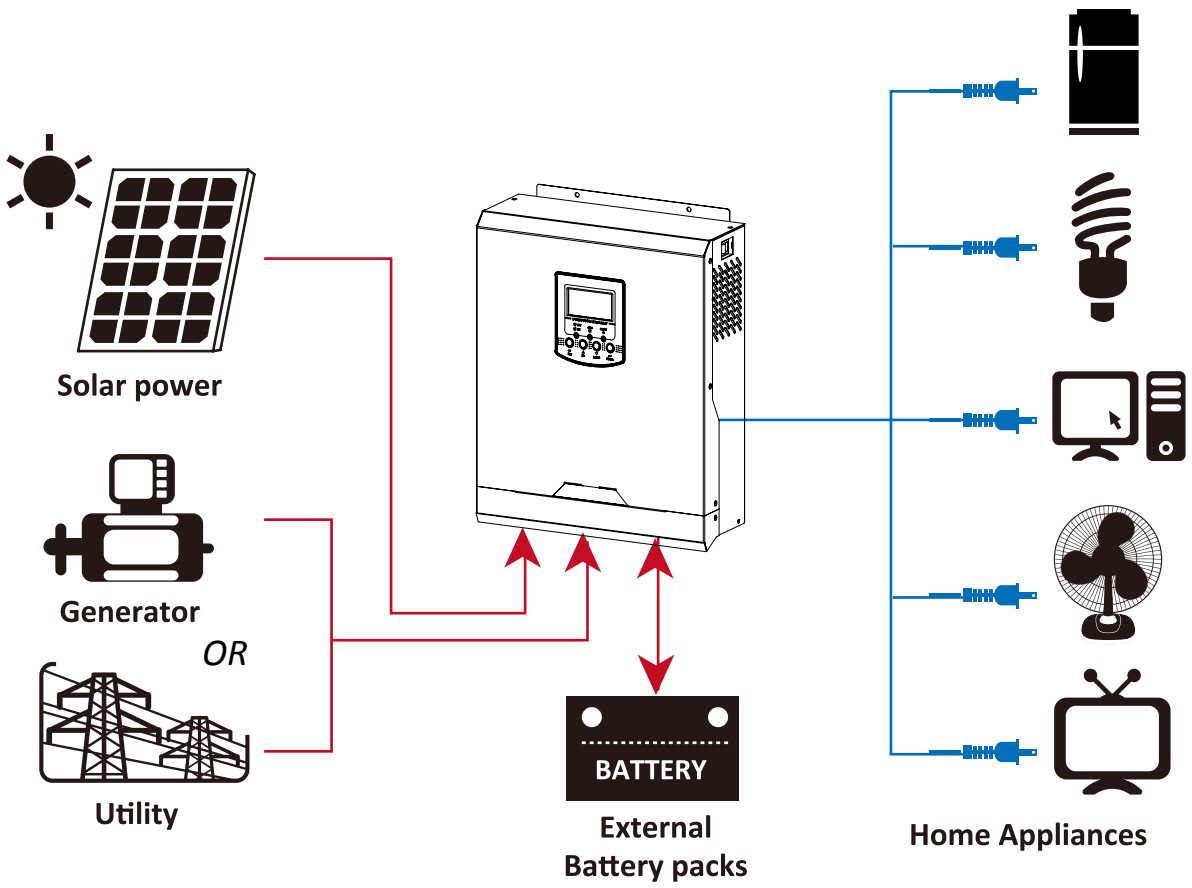
Basic system architecture

The following diagram illustrates a basic application for this inverter/charger. A complete running system should include the following power sources:

- Generator or utility
- PV modules

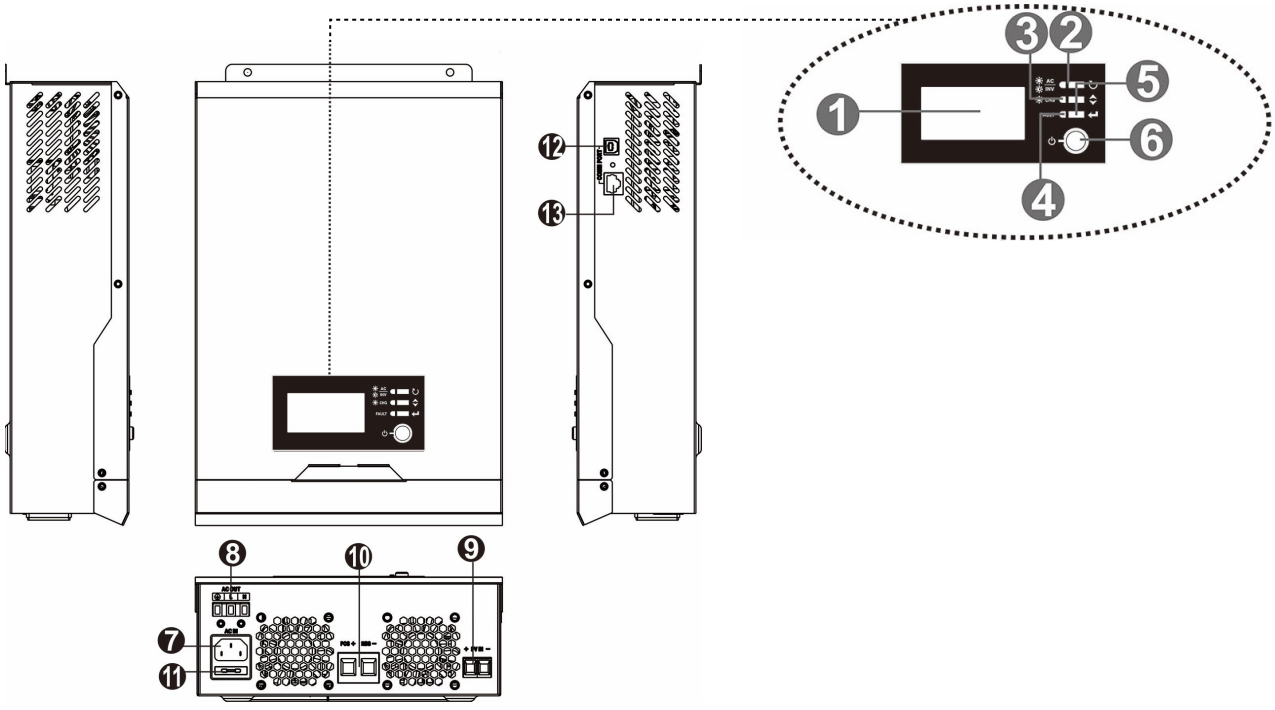
Consult with your system integrator for other possible system architectures depending on your requirements.

This inverter can power a wide assortment of appliances in home or office environments, including motor-type appliances such as fans, refrigerators, air conditioners and even tube lights.

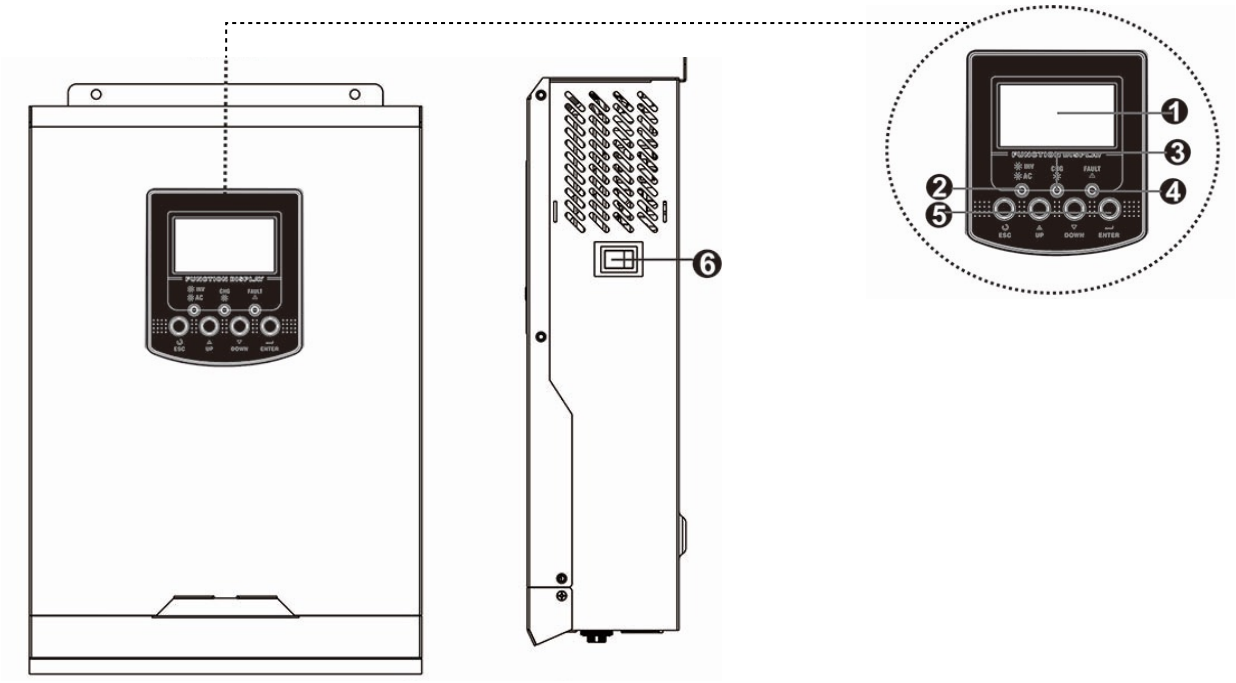


Off-Grid Hybrid Power System

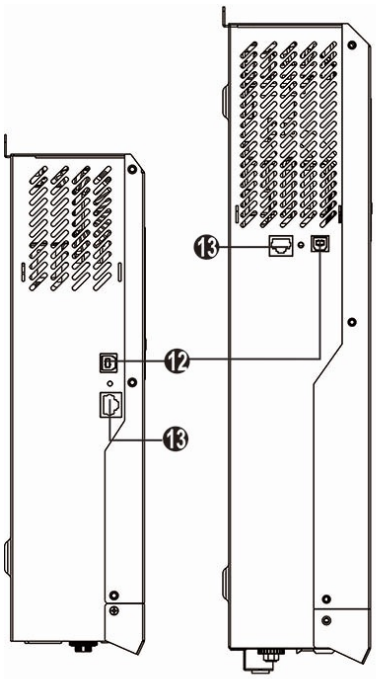
2. Product overview



1KVA/2KVA with MPPT model

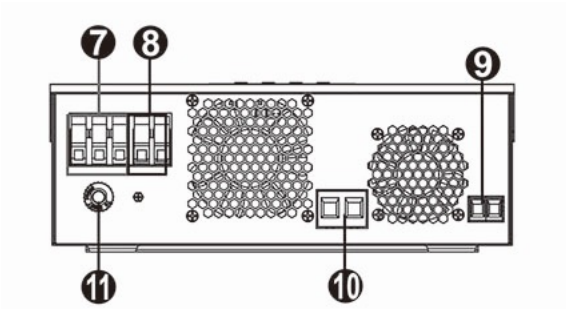


3KVA/5KVA with MPPT model

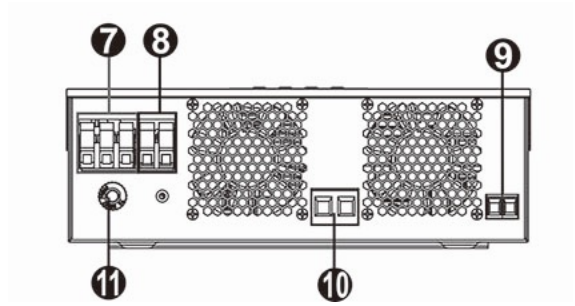


3KVA side view

5KVA side view



3KVA model



5KVA model

1. LCD display panel
2. Status LED indicator
3. Charging LED indicator
4. Fault LED indicator
5. Configuration buttons
6. Power on/off switch
7. Grid connection (input)
8. AC output (load connection)
9. PV connector
10. Battery input
11. Fuse (1KVA/2KVA) / Circuit breaker (3KVA/5KVA)
12. USB communication port
13. RS-232 communication port

3. Preliminary steps

Unpacking and inspection

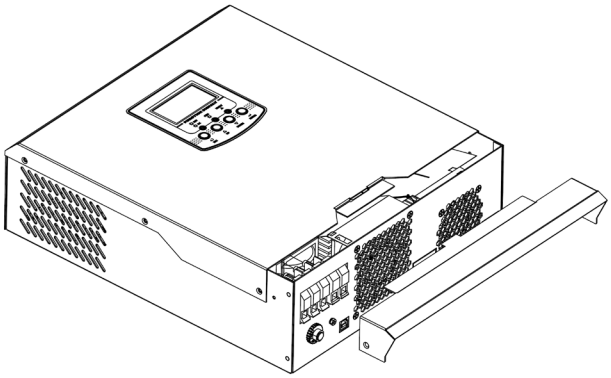
Upon opening the box, make sure the following items are included:

- Inverter unit (1)
- USB communication cable (1)
- Software CD (1)
- Spare DC fuse (1)
  (only for the 3/5KVA models)
- Grounding ring terminal (1)
  (only for the 3/5KVA models)
- Strain relief plate (2)
  (only for the 3/5KVA models)
- Mounting screw kit (1)
- User manual (1)

Carefully inspect the unit before installation. Make sure that nothing inside the package is damaged or loose. Keep the original package in a safe place for future use.

Preparation

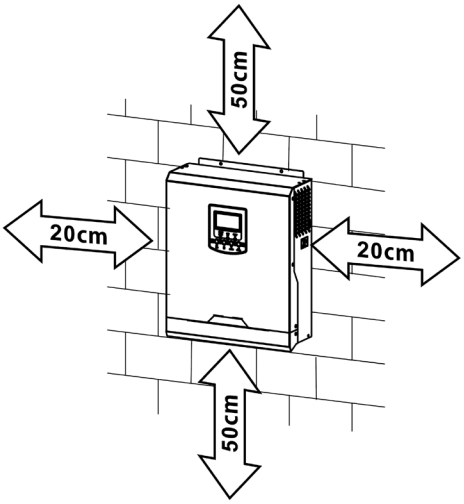
1. On the underside of the unit, unfasten the screws holding the cover in place.



2. Remove the bottom cover to expose the wired connections and ports.
   Leave the screws in a safe place for replacing the cover once the hardware connections are completed.

Mounting the unit

Important
- Mount the unit on concrete or another non-combustible surface only.
- Install the unit at eye level for easy reading of the display panel.
- This product will function most effectively if installed upright.
- For optimal operation, ambient temperature should be between -10°C and 55°C.

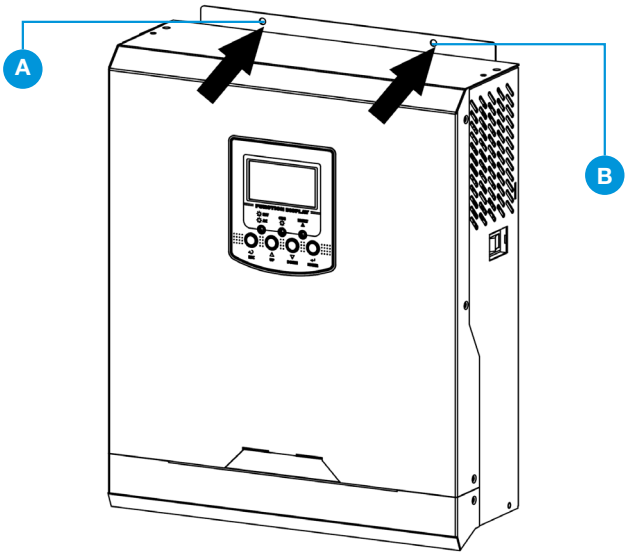


Mounting and clearances

- Observe all marked clearance requirements when a single or multiple units are installed.

For proper ventilation and heat dissipation, allow clearances of approximately 20cm (8in) to either side and 50 cm (20in) above and below the unit.

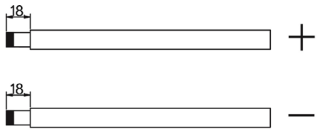
• To secure the unit(s) in place, insert the supplied M5x12mm hex screws at points **A** and **B**. M4 screws can be used as well.



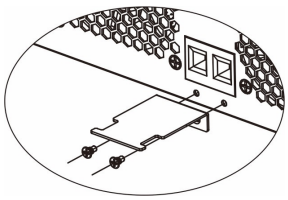
4. HARDWARE CONNECTIONS

WARNING: Shock hazard
All wiring must be performed by qualified personnel. High voltages can be harmful to human life.

Battery:
1. First assemble the batteries in series or parallel as needed for the system nominal voltage.
2. Remove 10mm of the insulation sleeve from the positive and negative conductors.
3. We recommend inserting bootlace ferrules at the end of the positive and negative wires with a proper crimping tool.



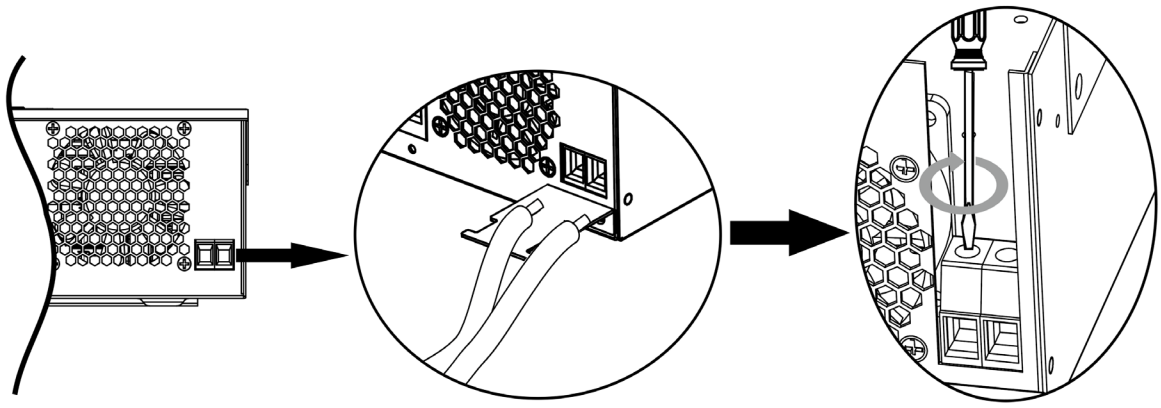
4. With the supplied screws, attach the strain relief plate *to the inverter, as shown in the illustration below.



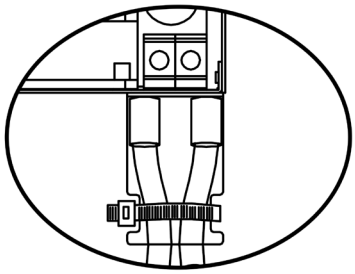
NOTES:
* On applicable models only.
• Cables should be sized according to the table below.
• For safety and compliance purposes, install a DC overcurrent protection between this unit and the battery. This is required for both safety reasons and regulatory compliance. A manual disconnect device may also be required. These devices should be sized according to the cable size (see table).
• The minimum recommended battery capacity for this model is 100Ah.

5. Insert the battery wires flatly into the battery connectors on the inverter, making sure to apply a torque of 2Nm clockwise to properly tighten the bolts.

6. Make sure to use the correct polarity at both ends of the battery and inverter/charge terminals.



7. Finish by firmly securing all conductors. Install a cable cable tie to relieve the strain of all wires in your installation.



Battery conductors

Model	Maximum amperage	Battery capacity	Wire size	Terminal torque
1KW / 2KW	109A	100Ah	1x4AWG	2~ 3Nm
3KVA	164A	100Ah 200Ah	1x2AWG	
5KVA	137A	200Ah	1x2AWG	

CAUTION: Hazard to equipment

- Do not reverse the polarity of the positive (+) and negative (–) battery cables. Otherwise, the product will be damaged. Check the polarity of all connections before applying battery power.
- Do not place any other object or hardware between the inverter terminal surface and the ring terminal. Overheating may result.
- Apply antioxidant compound to protect the terminals.

4.1 AC connections

Before any connections are made, open all disconnect devices on both AC and DC sources.

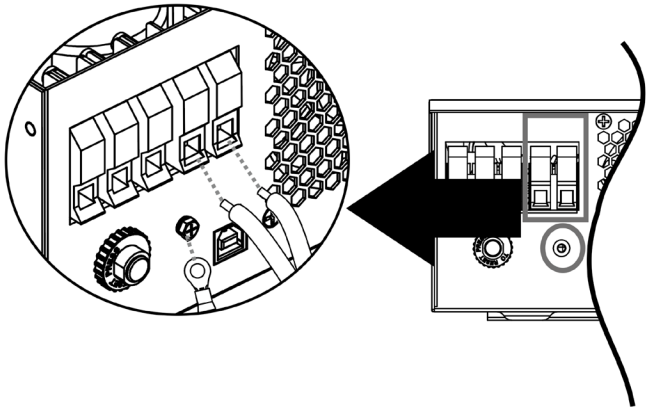
CAUTION!! Before connecting to AC input power, install a separate circuit breaker between the inverter and AC source. It is needed for AC input overcurrent protection and also as a manual disconnect device during maintenance. The recommended specification for the AC breaker is 10A for 1KVA.
CAUTION!! Two terminal blocks with IN and OUT markings are provided. Be careful not to reverse the connections to the input and output terminals. Check all connections before applying power.

WARNING: Shock hazard
All wiring must be performed only by a qualified electrician. High voltages can be harmful to human life.
WARNING! For system safety and efficient operation, use the appropriate cable to make AC input connections. To reduce the risk of injury, the recommended wire size shown in the table below should be followed.

To install AC input and output connections for the inverter:

1. Remove 10mm (0.4in) of the insulation sleeve from each of the six conductor wires. Trim an additional 3mm (0.11in) of conductor wire from phase L (line) and N (neutral).
2. Insert AC input wires observing the polarity marked on the terminal block, then proceed to tighten the screws. The protective earth (PE) conductor (⏚) must be connected first.

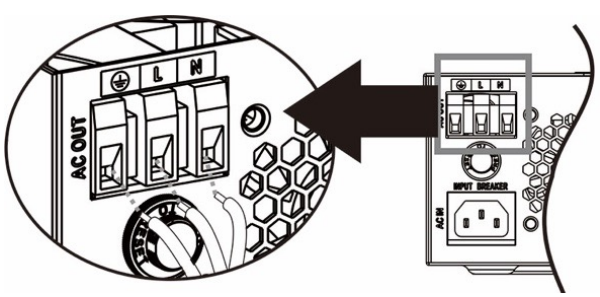
⏚ → **Ground (yellow-green)**
L → **LINE (brown or black)**
N → **Neutral (blue)**



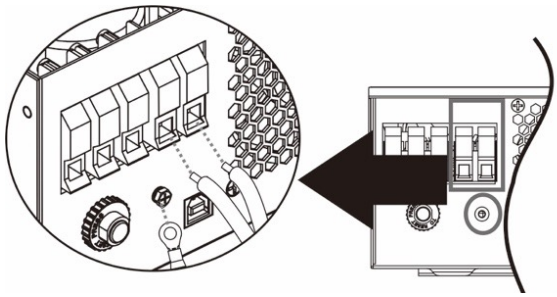
WARNING:
Be sure that AC power source is disconnected before attempting to hardwire it to the unit.

3. After inserting the AC output wires observing the polarity marked on the terminal block, proceed to tighten the screws. The protective earth (PE) conductor (⏚) must be connected first.

⏚ ⟶ Ground (yellow-green)
L ⟶ LINE (brown or black)
N ⟶ Neutral (blue)



1KVA/2KVA



3KVA/5KVA

4. Verify that that all wire connections are properly secured.

Recommended AC conductor size

Model	Gauge	Terminal torque
1KVA	16 AWG	0.6 Nm
2KVA	14 AWG	1.0 Nm
3KVA	12 AWG	1.2 Nm
5KVA	10 AWG	1.2 Nm

CAUTION:
Follow the correct polarity when connecting AC wires. If **L** and **N** wires are reversed, it may cause a utility short-circuit when the inverters are in parallel operation.

NOTE: Appliances such as air conditioners often require at least 3 minutes to restart after a short-term power outage (time is required to balance the refrigerant gas in inside circuits). In order to protect your air conditioner, consult the manufacturer whether they have already provided a time delay function before the installation. Otherwise, the inverter will trigger an overload fault and shut off its output to protect your appliance. Even so there is some risk of damage to the air conditioner.

4.2 PV

Selection of the modules

CAUTION: Hazard to equipment
Never exceed the maximum V_{oc} under any circumstances. This can cause permanent damage to the unit.

When selecting PV modules, observe the following parameters:

- Never exceed the maximum permitted open-circuit voltage (V_{OC}), specified for the PV array.
- The open-circuit voltage (V_{OC}) of PV modules should be higher than minimum specified for the battery.

Table– Module voltages

Solar charging mode					
INVERTER MODEL	1KVA	2KVA	3KVA	5KVA	
Max. PV array open circuit voltage	102VDC			145VDC	
PV array MPPT voltage range	15~80VDC	30~80VDC		30~115VDC	60~115VDC

Connection of the modules

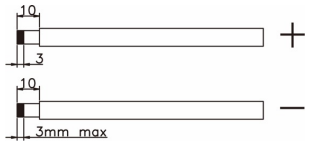
NOTES:

- PV wires should be sized according to the table below.
- A separate DC circuit breaker should be installed for overcurrent protection. It must be placed between the inverter and the PV modules.

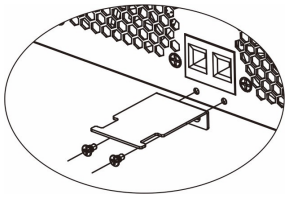
Model	Gauge	Cable mm2	Torque
1KVA/2KVA/3KVA /5KVA	1 x 8AWG	10	1.6 Nm

To connect the PV modules to the unit:

1. Remove approximately 10mm (0.4in) of the insulation from the PV wires. We recommend using bootlace ferrules at the end of the positive and negative wires with a proper crimping tool.



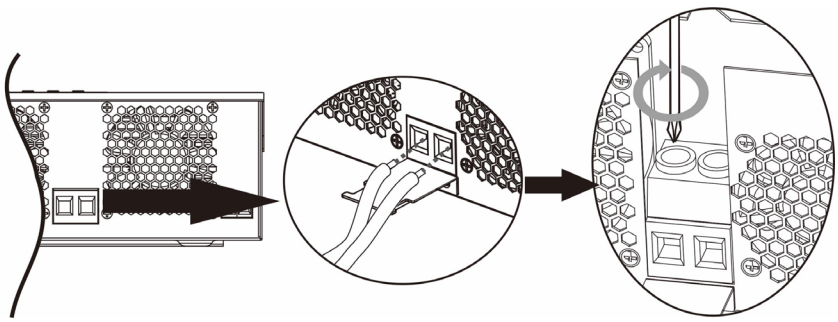
2. Identify the cable coming from the PV modules and the PV input connectors located on the inverter. Use the supplied screws to attach the strain relief plate* to the inverter, as shown in the illustration below.



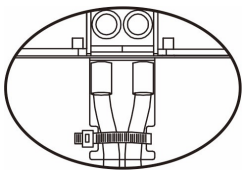
NOTE:

* On applicable models only.

3. Following the correct polarity, insert the positive (+) wire into the positive terminal of the PV input, and the negative (–) wire into the negative terminal of the PV input. Refer to the image below.

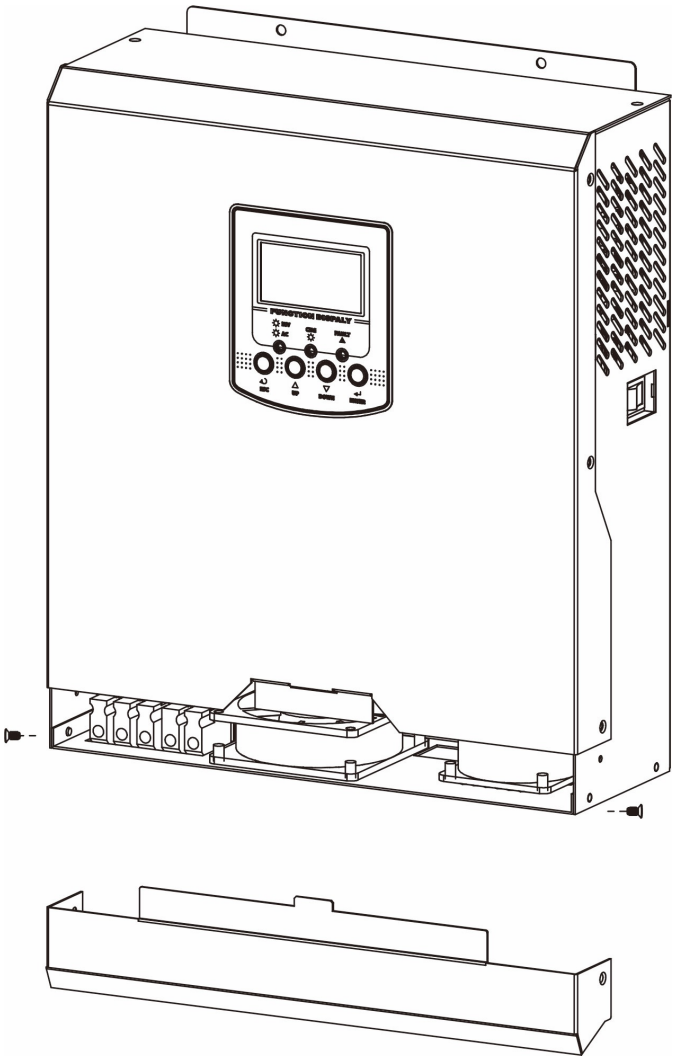


4. Tighten all connections to the torque values, as shown on the table above in this section. Finish by installing a cable cable tie to relieve the strain of all wires in your installation.



Final assembly

1. Place the bottom cover near the inverter housing.
2. Install the supplied communication cables in the corresponding ports.
3. Set the bottom cover in place. Then, secure it using the same screws that were removed in the previous steps.



4.3 Other communications

The inverter provides two interface connections to a PC:

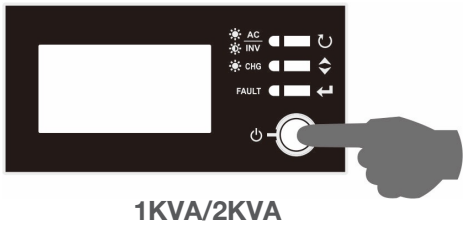
USB and RS-232 ports

Insert the supplied CD into the computer and follow the on-screen instructions to install the monitoring software. For detailed software operation, refer to the digital user manual from the download section of the product website.

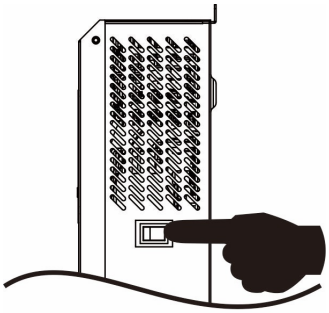
5. OPERATION

5.1. Power on/off

Once the inverter/charger has been properly installed and the batteries set as its power source, simply press the power switch to turn on the unit.



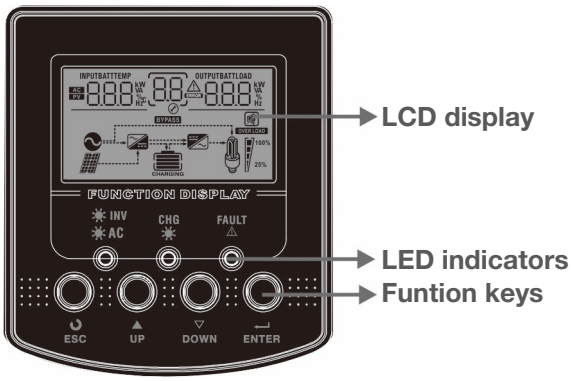
1KVA/2KVA



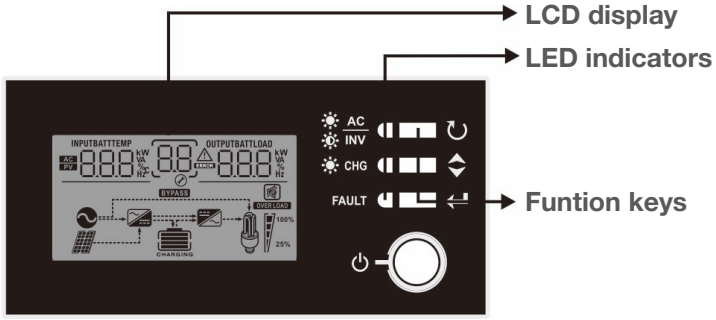
3KVA/5KVA

5.2. Display panel

Located on the front of the unit, this panel features a LCD screen, LED indicators and configuration buttons.



3KVA/5KVA



1KVA/2KVA

LED indicators
The display panel features three LED indicators.

Description			Status
AC / INV	Green	Solid	Loads are powered by an AC source in Line mode
		Intermittent	Loads are powered by battery or in PV mode
CHG	Green	Solid	Battery is fully charged
		Intermittent	Battery is charging
⚠ FAULT	Red	Solid	Inverter error (fault)
		Intermittent	Inverter warning

Configuration buttons
The display panel features four buttons for setting up the inverter parameters.

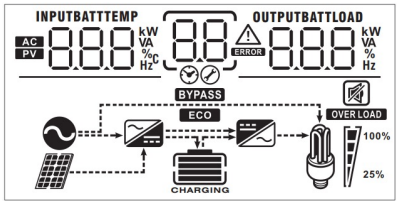
1KVA/2KVA models

Description	Command
ESC	To exit the current setting
SCROLL	To move up or down to the next selection
ENTER	To confirm or select a parameter. It is also used to access the configuration mode

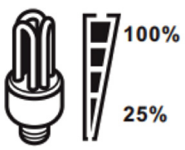
3KVA/5KVA models

Description	Command
ESC	To exit the current setting
UP	To move up to the previous selection
DOWN	To move down to next selection
ENTER	To confirm or select a parameter. It is also used to access the configuration mode

LCD display icons
The display contains a variety of icons showing the status and operation mode of the inverter.



Icon	Function description
Input source information	
AC	Indicates that an AC input is connected
PV	Indicates that PV input is connected
INPUTBATT 888 kW VA %C Hz	Indicates AC input voltage and frequency, PV voltage, charging current and battery voltage
Settings, warning and fault indications	
88	Displays the **setting** screen mode
88 ERROR	Shows any warning or fault codes. A warning code appears intermittently, followed by an ⚠. A fault code lights up showing the detected event or condition
Output data	
OUTPUTBATTLOAD 888 kW VA % Hz	Indicates AC output voltage and frequency, load percentage, discharge current, and load in volt-amps and watts

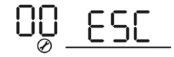
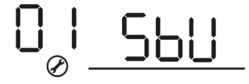
Battery data			
	Battery level indicator at 0-24%, 25-49%, 50-74%, and 75-100% of its capacity In battery mode, the number of bars shows the remaining charge In line mode, the number of bars indicates how much charge it will need to reach its full capacity		
In AC mode, the battery state of charge is displayed			
	Status	**Battery voltage**	**LCD Display**
	Constant Current mode / Constant Voltage mode	<2V/cell	4 bars will flash alternatively
		2 ~ 2.083V/cell	Bottom bar will be on and the other three bars will flash alternatively
		2.083 ~ 2.167V/cell	Bottom two bars will be on and the other two bars will flash alternatively
		> 2.167 V/cell	Bottom three bars will be on and the top bar will flash
	Float stage: maintains batteries in a fully charged state		4 bars will be on
In battery mode, the remaining capacity is displayed			
	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	Displays the inverter shutdown due to an overload		
	Indicates the load level compared to the inverter's maximum load capacity in increments of 0-24%, 25-49%, 50-74% and 75-100%		
	0%~24%	25%~49%	50%~74%	75%~100%
				

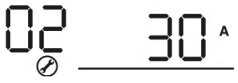
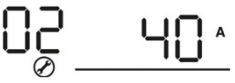
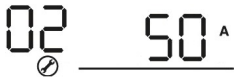
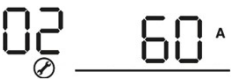
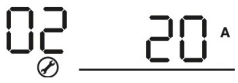
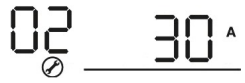
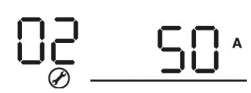
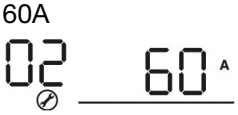
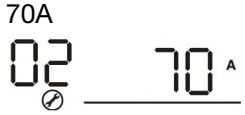
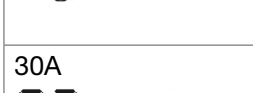
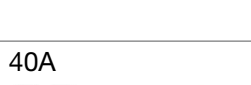
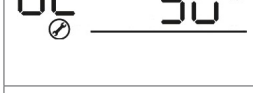
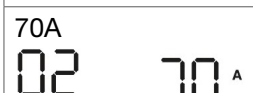
Mode of operation	
	Indicates that the unit is connected to an AC source
	Indicates that the unit is connected to a PV panel
	Indicates that the inverter is operating in bypass mode
	Indicates that the AC source is charging the battery
	Indicates that the DC-AC conversion is enabled
Mute control	
	Indicates that the audible alarm is disabled

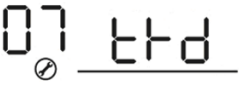
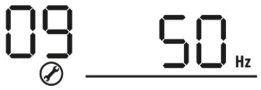
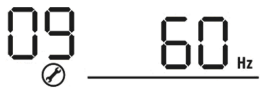
6. Advanced operation

6.1. Main LCD configuration screen

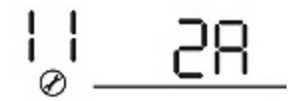
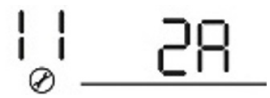
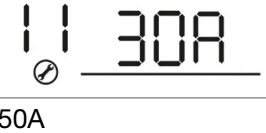
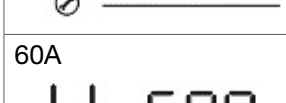
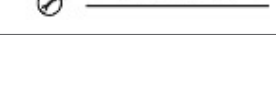
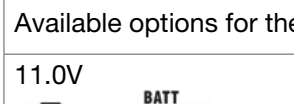
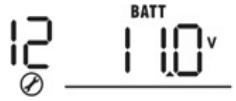
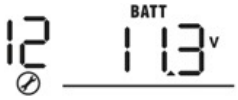
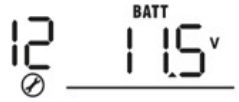
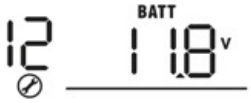
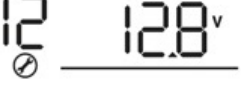
To enable the configuration screen mode, press and hold the **ENTER** button for 3 seconds. Use the **UP** or **DOWN** buttons to go through the available parameters within each menu item. Pressing the **ENTER** button again allows the selected item to be set. To exit, simply press the **ESC** button.

Item	Description	Selectable parameters	
00	Exit the setting screen mode	Escape 	
01	**Output source priority setting:** If multiple power sources are available, this controls which source is used first to power the loads	USB: Utility first (default) 	Utility will provide power to the loads as first priority Solar and battery energy will provide power to the loads only when the AC source is not available
		SOL: Solar first 	Solar energy provides power to the loads as first priority If solar energy is not enough to power all the connected loads, the AC source will assist PV Batteries will be used if neither PV nor AC is available or insufficient
		SBU priority 	Solar energy provides power to the loads as first priority If solar energy is not enough to power all the connected loads, battery power will assist PV AC source is only used if the battery drops to the low battery warning level or when it reaches the AC transfer voltage setting in item 12

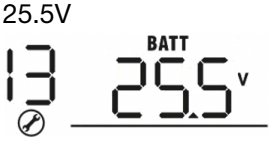
02	The total input generated by solar and AC sources combined **(Max. charging current** = utility charging current + solar charging current	Available options for the 1KVA/2KVA model:	
		10A 	20A 
		30A 	40A (default for MPPT model) 
		50A 	60A 
		Available options for the 3KVA model:	
		20A 	30A 
		40A (default for MPPT model) 	50A 
		60A 	70A 
		Available options for the 3KVA/5KVA model:	
		10A 	20A 
		30A 	40A 
		50A 	60A (default for MPPT model) 
		70A 	80A 
		90A 	100A 
		110A 	120A 

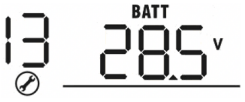
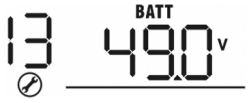
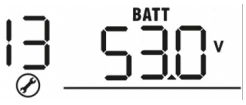
03	AC input voltage range	Appliances (default) 	When selected, the acceptable AC input voltage will range from 90VAC to 280VAC
		UPS 	When selected, the acceptable AC input voltage will range from 170VAC to 280VAC
05	Battery type	AGM (default) 	Flooded 
		User-defined 	If **user defined** is selected, then battery charging and low DC cutoff voltages can be programmed in items 26, 27 and 29
06	Auto-restart when an overload shutdown occurs	Restart disable (default) 	Restart enable 
07	Auto-restart when an over-temperature shutdown occurs	Restart disable (default) 	Restart enable 
09	Output frequency	50Hz (default) 	60Hz 

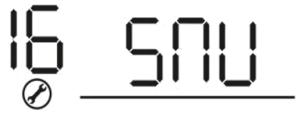
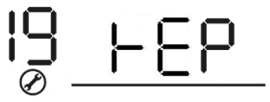
<table>
<tr><td rowspan="10">11</td><td rowspan="10">Maximum charging current (from an AC source)

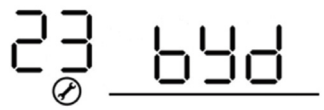
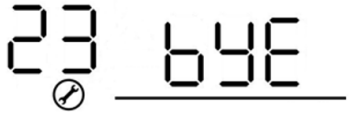
Note: If the value set in item 02 is lower than the one programmed in item 11, then the charging current the inverter is to apply will be the one specified in item 02 for utility charger.</td><td colspan="2">Available options for the 1KVA/2KVA model:</td></tr>
<tr><td>10A
  </td><td>20A (default)
  </td></tr>
<tr><td colspan="2">Available options for the 3KVA model:</td></tr>
<tr><td>15A
  </td><td>25A (default)
  </td></tr>
<tr><td colspan="2">Available options for the 5KVA model:</td></tr>
<tr><td>2A
  </td><td>10A
  </td></tr>
<tr><td>20A
  </td><td>30A (default)
  </td></tr>
<tr><td>40A
  </td><td>50A
  </td></tr>
<tr><td>60A
  </td><td></td></tr>
<tr><td rowspan="10">12</td><td rowspan="10">Defines the AC transfer voltage when the priority source in item 01 is set to SBU or SUB</td><td colspan="2">Available options for the 1KVA model:</td></tr>
<tr><td>11.0V
  </td><td>11.3V
  </td></tr>
<tr><td colspan="2">11.5V (default)
 
11.8V
  </td></tr>
<tr><td colspan="2">12.0V
 
12.3V
  </td></tr>
<tr><td colspan="2">12.5V
 
12.8V
  </td></tr>
</table>

12		Available options for the 2KVA/3KVA model:	
		22.0V 	22.5V 
		23.0V (default) 	23.5V 
		24.0V 	24.5V 
		25.0V 	25.5V 
		Available options for the 5KVA model:	
		44V 	45V 
		46V (default) 	47V 
		48V 	49V 
		50V 	51V 

<table>
<tr><td rowspan="12">13</td><td rowspan="12">Defines the battery transfer voltage when the priority source has been set to SBU or SOL in item 01</td><td colspan="2">Available options for the 1KVA model:</td></tr>
<tr><td>Fully-charged battery
  </td><td>12.0V
  </td></tr>
<tr><td>12.3V
  </td><td>12.5V
  </td></tr>
<tr><td>12.8V
  </td><td>13.0V
  </td></tr>
<tr><td>13.3V
  </td><td>13.5V (default)
  </td></tr>
<tr><td>13.8V
  </td><td>14.0V
  </td></tr>
<tr><td>14.3V 14.3V
  </td><td>14.5V
  </td></tr>
<tr><td colspan="2">Available options for the 2KVA/3KVA model:</td></tr>
<tr><td>Battery fully charged
  </td><td>24V
  </td></tr>
<tr><td>24.5V
  </td><td>25V
  </td></tr>
<tr><td>25.5V
  </td><td>26V
  </td></tr>
</table>

13	Defines the battery transfer voltage when the priority source has been set to **SBU** or **SOL** in item 01	26.5V 	27V (default) 
		27.5V– 	28V 
		28.5V 	29V 
		Available options for the 5KVA model:	
		Battery fully charged 	48V 
		49V 	50V 
		51V 	52V 
		53V 	54V 
		55V 	56V 
		57V 	58V 

16	**Charger source priority:** This item controls which source is used first to charge the batteries and power the loads	When the inverter/charger operates in standby, line or fault mode, the charger source can be programmed as shown below	
		Solar first 	Solar energy will be used to charge the battery as first priority AC power will be used to charge the battery when solar energy is not available
		Utility first (default) 	Utility will provide power to the loads first. Solar energy will be used to charge the battery when utility power is not available
		Solar and utility 	Solar and utility power will be used to charge the battery at the same time
		Only solar 	Solar energy will be the only charger source regardless of whether the AC is available or not
		When the inverter/charger operates in battery mode, only solar energy will be able to charge the battery as long as this source is available and sufficient to feed them	
18	Alarm control	Alarm on (default) 	Alarm off 
19	Auto-return to default display screen	Auto-return screen (default) 	Sets the screen to return to the default display (Input voltage /output voltage) after 1 minute if no button is pressed
		Stay on current screen 	If selected, the display will remain unchanged
20	Backlight control	Backlight on (default) 	Backlight off 
22	Beeps when the primary source is interrupted	Alarm on (default) 	Alarm off 

<table>
<tr><td>23</td><td>Bypass function:
When enabled, the unit will transfer to line mode if an overload occurs in battery mode.</td><td>Bypass disable (default)
  </td><td>Bypass enable
  </td></tr>
<tr><td>25</td><td>Record fault code</td><td>Record enable
  </td><td>Record disable (default)
  </td></tr>
<tr><td rowspan="4">26</td><td rowspan="4">Bulk charging voltage
(Constant voltage CV)</td><td colspan="2">1KVA default setting: 14.1V
  </td></tr>
<tr><td colspan="2">2KVA/3KVA default setting: 28.2V
  </td></tr>
<tr><td colspan="2">5KVA default setting: 56.4V
  </td></tr>
<tr><td colspan="2">This is selectable when item 05 is set to USER-DEFINED.
Available settings are:
12.5V to 15.0V for the 1K model
25.0V to 30.0V for the 2KVA model
25.0V to 31.5V for the 3KVA model
48.0V to 61.0V for the 5KVA model.
Increments of 0.1V per click.</td></tr>
<tr><td rowspan="2">27</td><td rowspan="2">Float charging voltage</td><td colspan="2">1KVA default setting: 13.5V
  </td></tr>
<tr><td colspan="2">2KVA/3KVA default setting: 27.0V
  </td></tr>
</table>

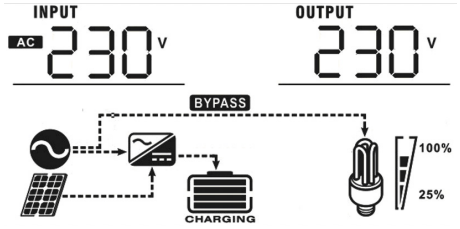
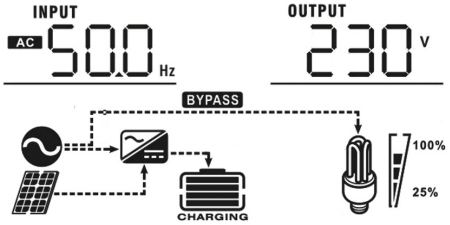
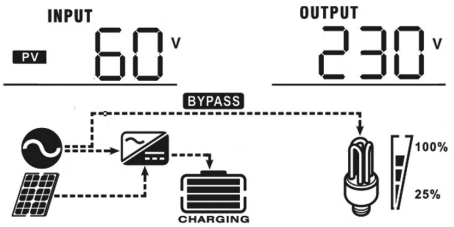
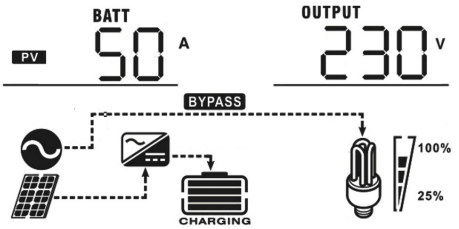
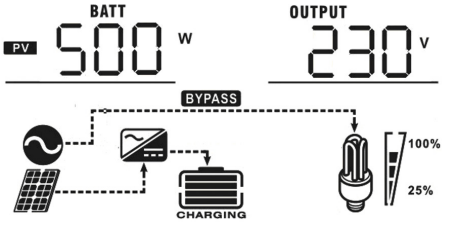
<table>
<tr><td></td><td></td><td>5KVA default setting: 54.0V
  </td></tr>
<tr><td></td><td></td><td>This is selectable when item 05 is set to USER-DEFINED
Available settings are:
12.5V to 15.0V for the 1K model
25.0V to 30.0V for the 2KVA model
25.0V to 31.5V for the 3KVA model
48.0V to 61.0V for the 5KVA model.
Increments of 0.1V per click.</td></tr>
<tr><td rowspan="4">29</td><td rowspan="4">Low DC cutoff voltage</td><td>1KVA default setting: 10.5V
  </td></tr>
<tr><td>2KVA/3KVA default setting: 21.0V
  </td></tr>
<tr><td>5KVA default setting: 42.0V
  </td></tr>
<tr><td>This is selectable when item 05 is set to USER-DEFINED
Available settings are:
10.5V to 12.0V for the 1K model
21.0V to 24.0V for the 2KVA/3KVA model
42.0V to 48.0V for the 5KVA model.
Increments of 0.1V per click.
Low DC cutoff voltage is determined regardless of the load percentage connected.</td></tr>
<tr><td rowspan="3">30</td><td rowspan="3">Equalization mode enable / disable</td><td>Battery equalization enabled
  </td><td>Battery equalization disabled (default)
  </td></tr>
<tr><td colspan="2">This item is selectable when item 05 is set to either FLOOD or USER DEFINED.</td></tr>
</table>

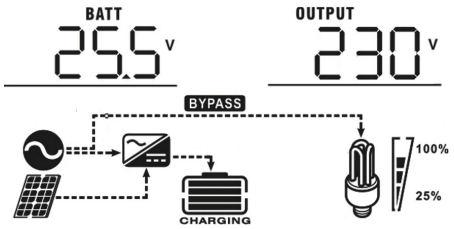
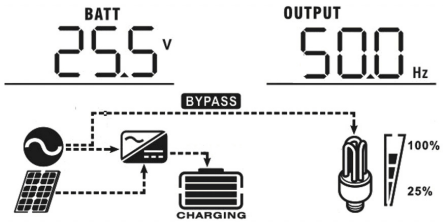
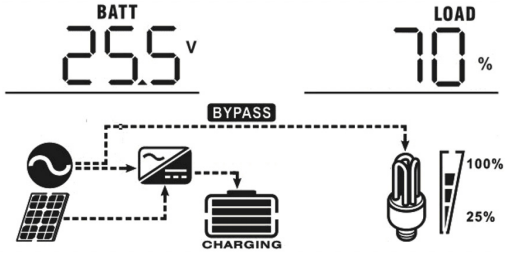
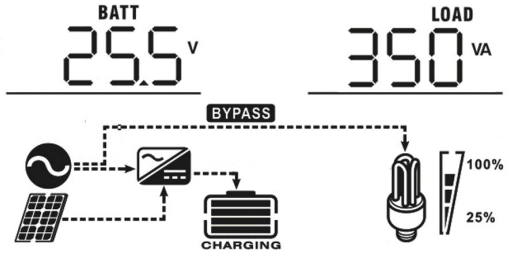
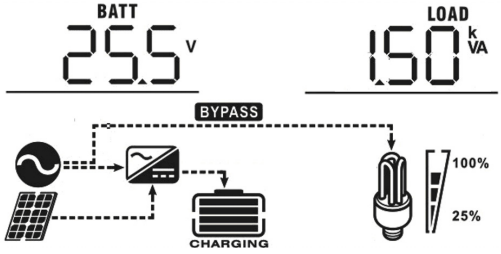
31	Battery equalization voltage	1KVA default setting: 14.6V 	
		2KVA/3KVA default setting: 29.2V 	
		5KVA default setting: 58.4V 	
		Available settings are: 12.5V to 15.0V for the 1K model 25.0V to 30.0V for the 2KVA 25.0V to 31.5V for the 3KVA model 48.0V to 61.0V for the 5KVA model Increments of 0.1V per click	
33	Equalization time	60min (default) 	The time allowed for the equalization to take place. The duration ranges from 5min to 900min. Increments are set to 5min per click
34	Equalization timeout	120min (default) 	The maximum time permitted for equalization. The duration ranges from 5 min to 900 min. Increment of 5 min per click
35	Equalization interval	30 days (default) 	The days between automatic equalization cycles. The duration ranges from 0 min to a maximum of 90 days. Increments of 1 day per click
36	Immediate equalization	Enabled 	Disabled (default) 
		This item can be selected when item 30 is set to enable. In this case "E9" will appear on the main display, causing the immediate activation of the battery equalization cycle When **Disable** is selected, equalization will be cancelled until the next automatic cycle starts, as per configuration of item 35	

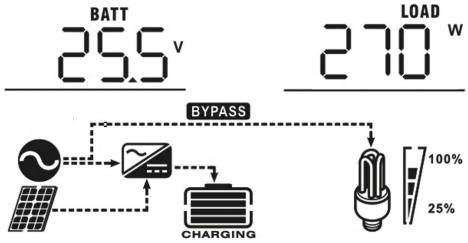
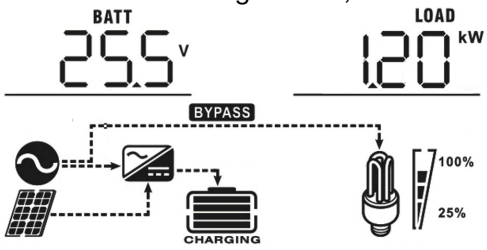
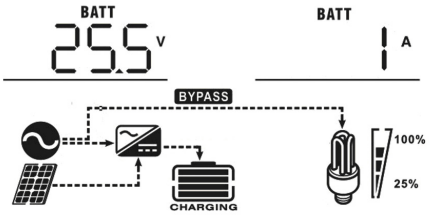
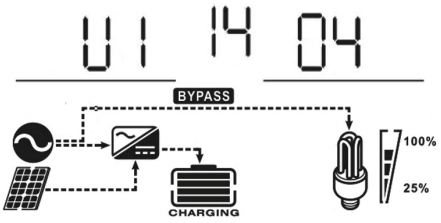
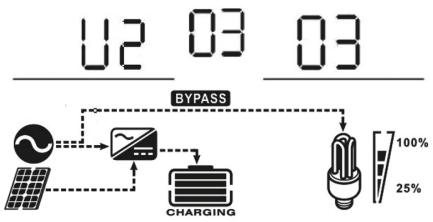
Display information

The LCD display has three sections with system information and readings. These readings can be switched to display the different parameters.

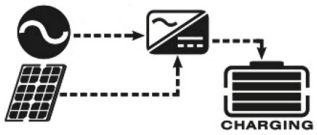
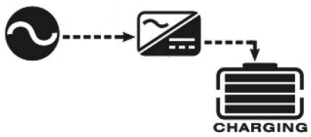
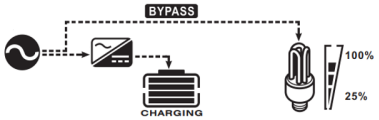
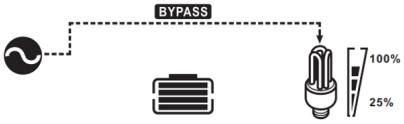
The order illustrated in the table is the order of the screens when the **UP** and **DOWN** selection keys are pressed: input voltage, input frequency, PV voltage, MPPT charging current, MPPT charging power, battery voltage, output voltage, output frequency, load percentage, load in VA, load in Watt, DC discharging current, main CPU Version and second CPU Version.

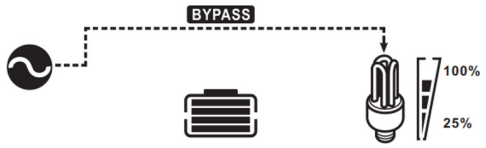
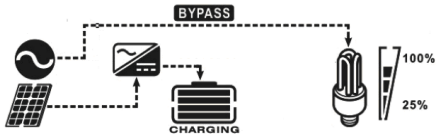
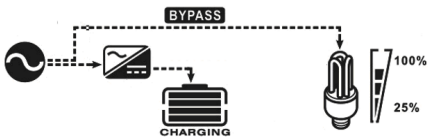
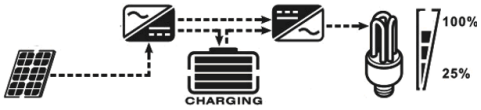
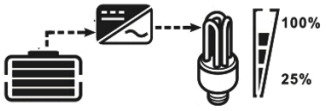
Selection parameter	LCD display
Input voltage/ Output voltage The **AC** marker appears on the left. The **INPUT** and **OUTPUT** markers appear in upper field. (This is the default screen)	Input voltage=230V / Output voltage=230V 
Input AC frequency (with decimal) The **Hz** marker appears on the left, next to the frequency reading	Input frequency=50Hz 
PV voltage The **PV** marker appears on the left, in front of the photovoltaic input	PV voltage=60V 
Charging current from PV The upper field displays the **BATT** marker instead of the **INPUT**	Charging current=50A 
Charging power from PV The **W** marker appears on the left, next to the power reading	MPPT charging power=500W 

Battery voltage (with decimal) / DC discharge current The upper left field displays the **BATT** marker The **A** marker is shown on the right field of the display	Battery voltage=25.5V, output voltage=230V 
Output frequency (with decimal) This is displayed on the upper right field, which also displays a **Hz** marker The upper left field continues to display battery voltage	Output frequency=50Hz 
Load percentage of inverter capacity The upper right field displays a **%** marker The upper left field continues to display the battery voltage	Load percent=70% 
Load in volt-amperes The upper right field displays a **VA** marker The upper left field continues to display battery voltage	When the load size is less than 1kVA, the right field will display the **VA** marker, as shown below.  When the load size exceeds 1kVA (≥1KVA), the right field and marker will change to **kVA**, as shown below. 

Load in watts These parameters are displayed on the upper fields of the screen	When the load size is less than 1kW, the left field will display the **W** marker, as shown below.  When the load size exceeds 1kW (≥1KW), the right field and marker will change to **kW**, as shown below. 
Battery voltage/DC discharging current	Battery voltage=25.5V, discharging current=1A 
Firmware version, main CPU	Main CPU version 00014.04 
Firmware version, secondary CPU	Secondary CPU version 00003.03 

6.3 Battery charging

Mode	Description	LCD display
Standby mode The charger can operate even if the inverter is not turned on	In this state, the unit does not supply output to the loads, but it can still provide power to charge the batteries from PV or AC sources	Charging from utility and PV power 
		Charging from an AC source 
		Charging from PV power 
		No charging 
Fault mode Errors or failures can be caused by internal issues or other external factors	PV and utility power can charge the batteries	AC and PV charging 
		Charging from utility 
		Charging from PV power 
		No charging 
		Charging from an AC source 
		No charging 

Fault mode Errors or failures can be caused by internal issues or other external factors	Utility power is transferred to bypass	No charging / AC bypass 
		No charging 
Line mode	In this mode, the inverter can provide output power from the mains, while charging the batteries at the same time	Charging from PV power 
		Charging from an AC source 
Battery mode	The unit will provide output power from battery and PV sources	Power from battery and PV sources 
		Power from battery only 

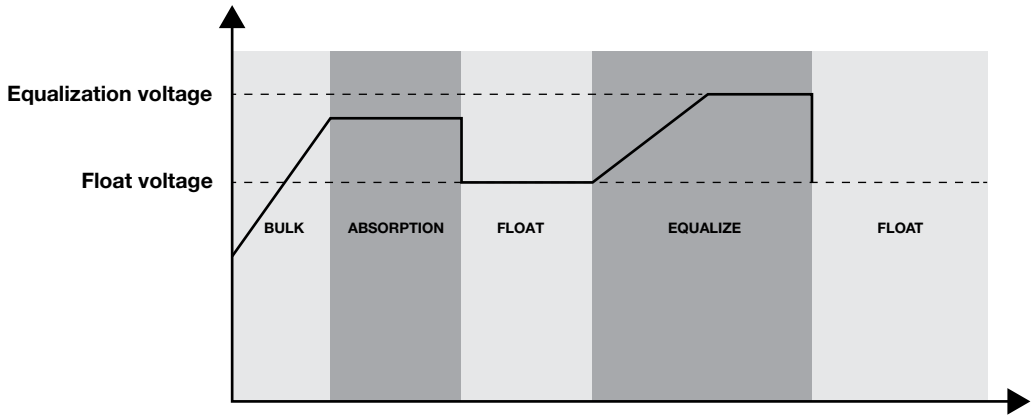
BATTERY EQUALIZATION

Equalization mode is used for Flood and User-defined batteries.
Equalization is an advanced charging process of the inverter, designed to improve the performance and to extend the life of a multi-battery string. By carrying out a controlled overcharge, it brings the batteries to a much higher voltage than usual and maintains them there for a time. This removes inert lead sulfate compounds from the battery plates. It also reduces stratification by circulating the electrolyte. If left unchecked, such conditions will degrade the capacity of the batteries. Therefore, we recommend carrying out maintenance equalization cycles periodically.

• How to set up the equalization function
Battery equalization mode must be first enabled in item 30 of the LCD configuration screen.
Then, equalization can be either started manually or on an automatic “interval” basis. The available options are:
1. To program automatic equalization setpoints, access parameters in item 35.
2. To carry out immediate equalization, manually activate the cycle in item 36.

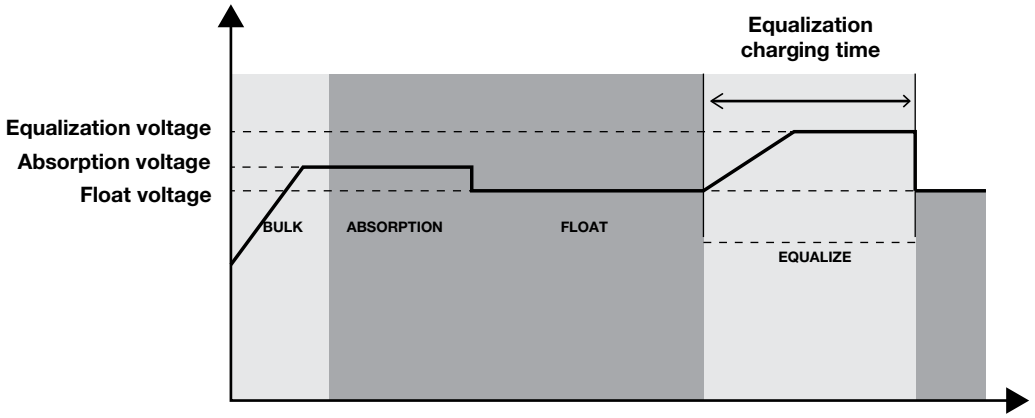
• When to equalize

Once the interval setpoint (battery equalization cycle) is reached, or the equalization cycle is activated immediately in float stage, the controller will initiate the equalization process.

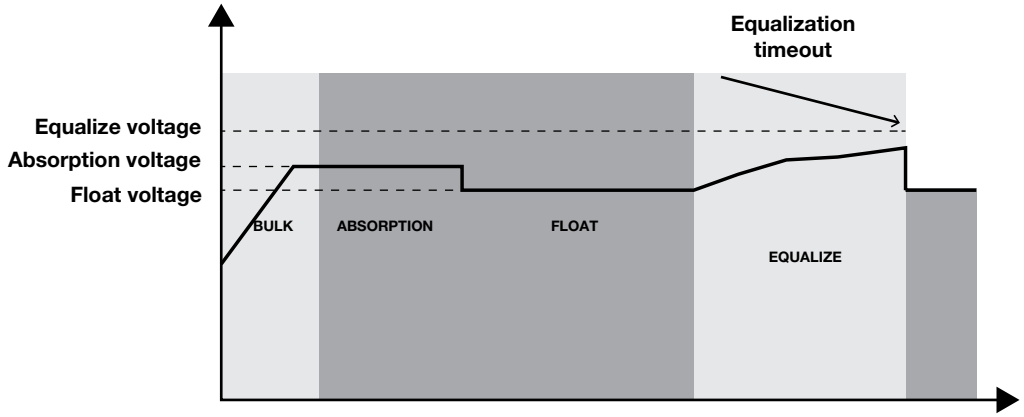


• Equalization charging time and timeout

During this process, the controller will supply power to charge battery and hold it there until the voltage reaches the set equalization point. Then, the timer will enter a constant voltage stage which requires the battery to be held at the equalization level until the cycle time expires.



However, when the cycle time expires and the battery voltage fails to reach the equalization point, then the time will be extended to ensure that this occurs. If battery voltage drops below the equalization voltage when the timeout is reached, the charger will then return to Float to prevent battery damage.



7. Fault codes and warning indicators

The inverter has indications for error or warning conditions. An error is defined as a critical fault that shuts the unit down. A warning is a non-critical fault that allows the unit to continue operating. Some warnings may become errors if left unattended.

Fault code	Event	Solid icon
01	Fan is locked when inverter is off	
02	Overtemperature	
03	Battery voltage is too high	
04	Battery voltage is too low	
05	Output is short-circuited or has been overtemperature is detected by internal converter components	
06	Output voltage is too high	
07	Overloaded output (timeout has expired)	
08	Bus voltage is too high	
09	Bus soft start 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 the 5KVA model.

Warning indicators

Warning code	Event	Audible alarm	Flashing icon
01	Fan is locked when inverter is on	Beeps three times every second	
03	Battery is over-charged	Beeps once every second	
04	Low battery	Beeps once every second	
07	Overload	Beeps once every 0.5 second	
10	Output power derating	Beeps twice every 3 seconds	
E9	Battery equalization is occurring	None	

8. Troubleshooting

Problem	LCD/LED/Buzzer	Explanation / Possible cause	What to do
Unit shuts down automatically during the startup process	LCD/LEDs and buzzer turn on for about 3 seconds before completely shutting off	The battery voltage is too low (<1.91V/Cell)	1. Re-charge battery 2. Replace battery
No response after power on	No indication	1. The battery voltage is far too low. (<1.4V/Cell) 2. The internal fuse tripped	1. Contact the service center for replacing the fuse 2. Re-charge battery 3. Replace the battery
Despite AC input is available, the unit continues to operate in battery mode	Input voltage is displayed as 0 on the LCD and the green LED is flashing	Input protector is tripped	Check if the AC breaker is tripped and if the AC wiring is connected well
	Green LED is flashing	The quality of AC power is poor (shore or generator)	1. Check if AC wires are too thin and/or too long 2. Check if generator (if applies) is working well or if the input voltage range setting is correct (UPS→appliance)
	Green LED is flashing	The output source priority is set to **Solar first**	Change the output source priority setting to **Utility first**
When the unit is turned on, the internal relay is switched on and off repeatedly	LCD display and LEDs are flashing	Battery is disconnected	Check if battery wires are properly connected
Buzzer beeps continuously and red LED is on	Fault code 07	Overload error. The inverter is overloaded ≥105% for more than the allowed duration	Reduce the connected loads by switching off less critical equipment
	Fault code 05	The output is short circuited	Check if the wiring is correctly connected and remove abnormal loads
		Temperature of internal converter components is over 120°C. (Only available for 1-3KVA 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 components is over 100°C	
	Fault code 03	Battery is overcharged	Return to service center
		The battery voltage is too high	Check whether the type and quantity of batteries specified are met
	Fault code 01	Fan fault	Replace the fan
	Fault code 06/58	Output abnormal (inverter voltage is either below 190VAC or over 260VAC)	1. Reduce the number of connected loads 2. Return to service center
	Fault code 08/09/53/57	Internal components failed	Return to service center

Buzzer beeps continuously and red LED is on	Fault code 51	Over current or surge	Restart the unit. If the error persists, return to service center.
	Fault code 52	Bus voltage is too low	
	Fault code 55	Output voltage is unbalanced	
	Fault code 56	Battery connection is defective, or the fuse is blown	If the battery is connected properly, return unit to service center.

9. Approximate runtime chart

Model	Load (VA)	Backup time at 12VDC/100Ah (min)	Backup time at 12VDC/200Ah (min)
1KW	100	766	1610
	200	335	766
	300	198	503
	400	139	339
	500	112	269
	600	95	227
	700	81	176

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

10. Technical specifications

Table 1
Line mode specifications

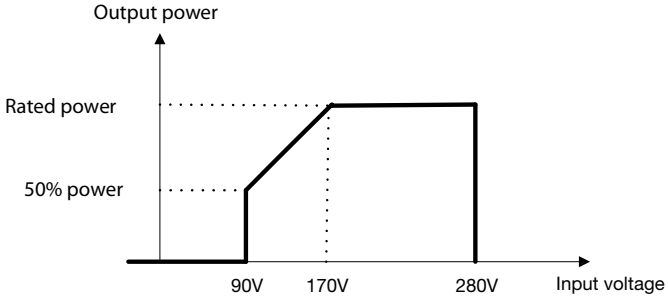
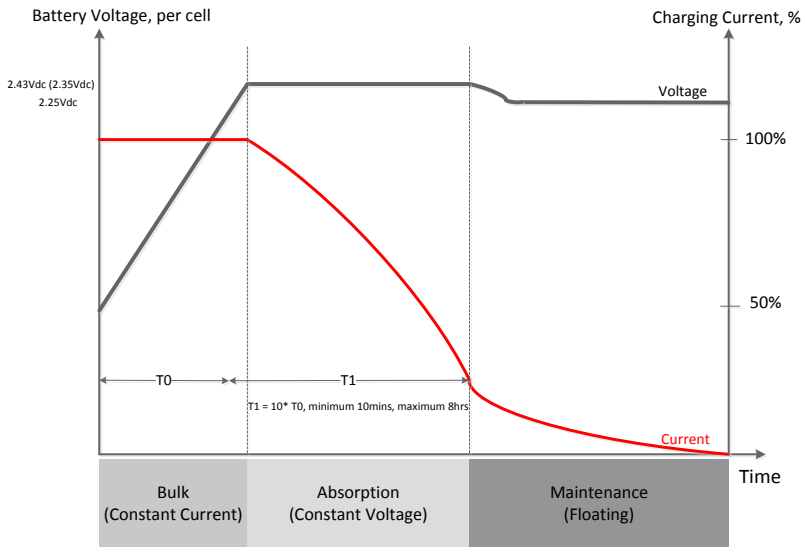
INVERTER MODEL	1KW	2KVA	3KVA	5KVA
Input voltage waveform	Sinusoidal (utility or generator)			
Nominal input voltage	230VAC			
Low-loss voltage	170VAC±7V (UPS); 90VAC±7V (appliances)			
Low-loss return voltage	180VAC±7V (UPS); 100VAC±7V (appliances)			
High -loss voltage	280AC±7V			
High-loss return voltage	270VAC±7V			
Max AC input voltage	300VAC			
Nominal Input Frequency	50Hz / 60Hz (autosensing)			
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 Battery mode: electronic circuits			
Efficiency (line mode)	>95% (rated R load, battery fully charged)			
Transfer time	10ms typical (UPS) 20ms typical (appliances)			
Output power derating: When AC input voltage drops to 170, the output power will be derated				

Table 2
Inverter mode specifications

INVERTER MODEL	1KW	2KVA	3KVA	5KVA
Rated output power	1KVA/1KW	2KVA/2KW	3KVA/3KW	5KVA/5KW
Output voltage waveform	Pure sine wave			
Output voltage regulation	230VAC±5%			
Output frequency	50Hz			
Peak efficiency	93%			
Overload protection	5s with ≥150% load; 10s with 105%~150% load			
Surge capacity	2 times the rated power for 5 seconds			
Nominal dc input voltage	12VDC	24VDC	24VDC	48VDC
Cold start voltage	11.5VDC	23.0VDC	23.0VDC	46.0VDC
Low DC warning voltage For a load < 50% For a load ≥ 50%	 11.5VDC 11.0VDC	 23.0VDC 22.0VDC	 23.0VDC 22.0VDC	 46.0VDC 44.0VDC
Low DC warning return voltage For a load < 50% For a load ≥ 50%	 11.7VDC 11.5VDC	 23.5VDC 23.0VDC	 23.5VDC 23.0VDC	 47.0VDC 46.0VDC
Low DC cutoff voltage For a load < 50% For a load ≥ 50%	 10.7VDC 10.5VDC	 21.5VDC 21.0VDC	 21.5VDC 21.0VDC	 43.0VDC 42.0VDC
High DC recovery voltage	15VDC	30VDC	32VDC	62VDC
High DC cut-off voltage	16VDC	31VDC	33VDC	63VDC
No load power consumption	<25W			<55W

Table 3
Charge mode specifications

Utility charging mode					
INVERTER MODEL		**1KVA**	**2KVA**	**3KVA**	**5KVA**
Charging algorithm		3-step, with equalization			
AC charging current (max)		20A (at $V_{I/P}$=230VAC)		25A (at $V_{I/P}$= 230VAC)	60A (at $V_{I/P}$=230VAC)
Bulk Charging Voltage	**Flooded battery**	14.6	29.2		58.4
	AGM / Gel battery	14.1	28.2		56.4
Floating charging voltage		13.5VDC	27VDC		54VDC
Overcharge protection		16VDC for 1KW 31VDC for 2K 33VDC for 3KW 63VDC for 5KW			

Charging curve	

MPPT solar charging mode				
INVERTER MODEL	**1KVA**	**2KVA**	**3KVA**	**5KVA**
Charging current	40A			60A
PV array MPPT voltage range	15~80VDC	30~80VDC		60~115VDC
Charging current	102VDC			145VDC
Max. charging current (AC charger plus solar charger)	60A			120A

Table 4
General specifications

INVERTER MODEL	1KW	2KVA	3KVA	5KVA
Safety certification	CE			
Operating temperature range	-10°C to 50°C			
Storage temperature	-15°C~ 60°C			
Humidity	5% to 95% relative humidity (non-condensing)			
Dimensions (DxWxH)	88x225x320mm		100x285x334mm	100x300x440mm
Net weight	4.4kg	5kg	6.5kg	9.7kg

NOTES

NOTES


forza
POWER TECHNOLOGIES