

PIP 1648MSX 2KVA 48V 110/120V Output SOLAR INVERTER CHARGER

User Manual

***with built-in 60A MPPT**

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ABOUT THIS MANUAL

Purpose

This manual describes the assembly, installation, operation and troubleshooting of this inverter/charger. 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.

IMPORTANT SAFETY INSTRUCTIONS



SAVE THESE INSTRUCTIONS— This manual contains important instructions that shall be followed during installation and maintenance of the power conversion system (Inverter/Charger).

1. Before using the inverter/charger, read all instructions and warnings marked on the inverter/charger, the batteries and all appropriate sections of this manual.
2. **CAUTION** --To reduce risk of injury, charge it with only Li-ion type rechargeable batteries. It might cause burst or result in physical injury and damage if you charge it with other types of the batteries.
3. Do not disassemble the inverter/charger at will. For servicing or repairs, it's advised to take it to an authorized service center. Incorrect re-assembly may result in a risk of electric shock or fire.
4. To reduce the risk of electric shock, unplug all wirings from the wall outlet before any maintenance or cleaning. Turning off the inverter/charger 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 the batteries. A potential risk exists when you drop tools on or around the batteries. Spark, short circuited batteries or other electrical parts might cause an explosion.
9. Please strictly follow installation procedure when you want to disconnect AC or DC terminals. Please refer to the INSTALLATION section of this manual for the details.
10. Fuses are provided for over-current protection of 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/charger.
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 staffs are able to operate this device. If errors still persist after following the troubleshooting table, please send this inverter/charger back to the local dealer or service center for maintenance.
14. The DC and AC circuits are isolated from the enclosure and that system grounding. If it's required to be compliance with Section 250 of the National Electrical Code, ANSI/NFPA 70, it's is the responsibility of the installer.
15. The Photovoltaic System Grounding shall be installed per the requirements of Section 690.41 through 690.47 of the National Electrical Code, ANSI/NFPA 70 and is the responsibility of the installer.

INTRODUCTION

This is a multi-functional inverter/charger, combining the functions of inverter, MPPT solar charger and battery charger to offer uninterruptible power support with portability. Its comprehensive LCD display offers user-configurable and easy-accessible button operation such as battery charging current, priority setting for AC/solar charger, and acceptable input voltage setting to suit 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 to suit different applications via LCD setting
- Configurable priority of AC/Solar Charger via LCD setting
- Compatible to mains voltage or generator power
- Automatic restart while AC is recovering
- Overload/ Over temperature/ short circuit protection
- Smart battery charger design to optimize battery performance
- Cold start function

Basic System Architecture

The following illustration shows basic application of this inverter/charger. It also includes the following devices to complete the whole running system:

- Generator or Utility.
- PV modules

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

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

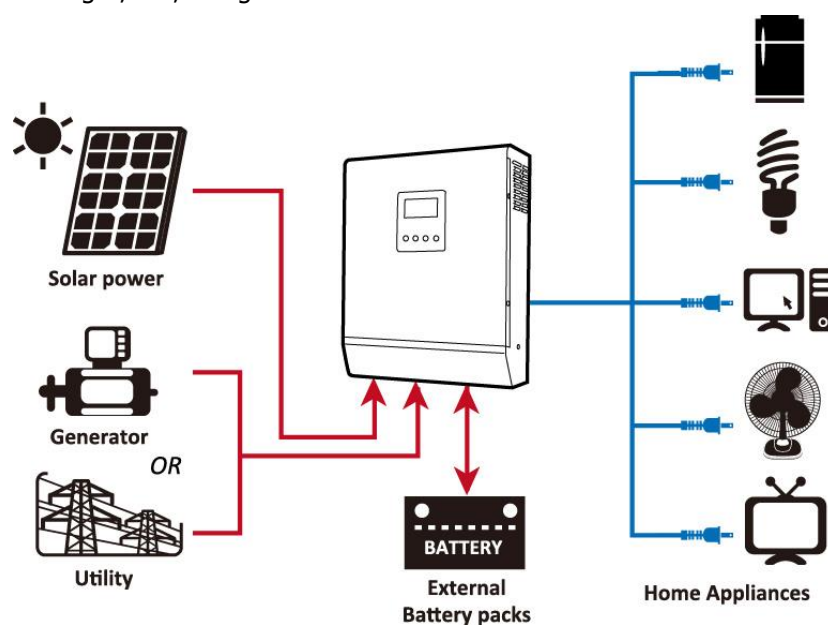
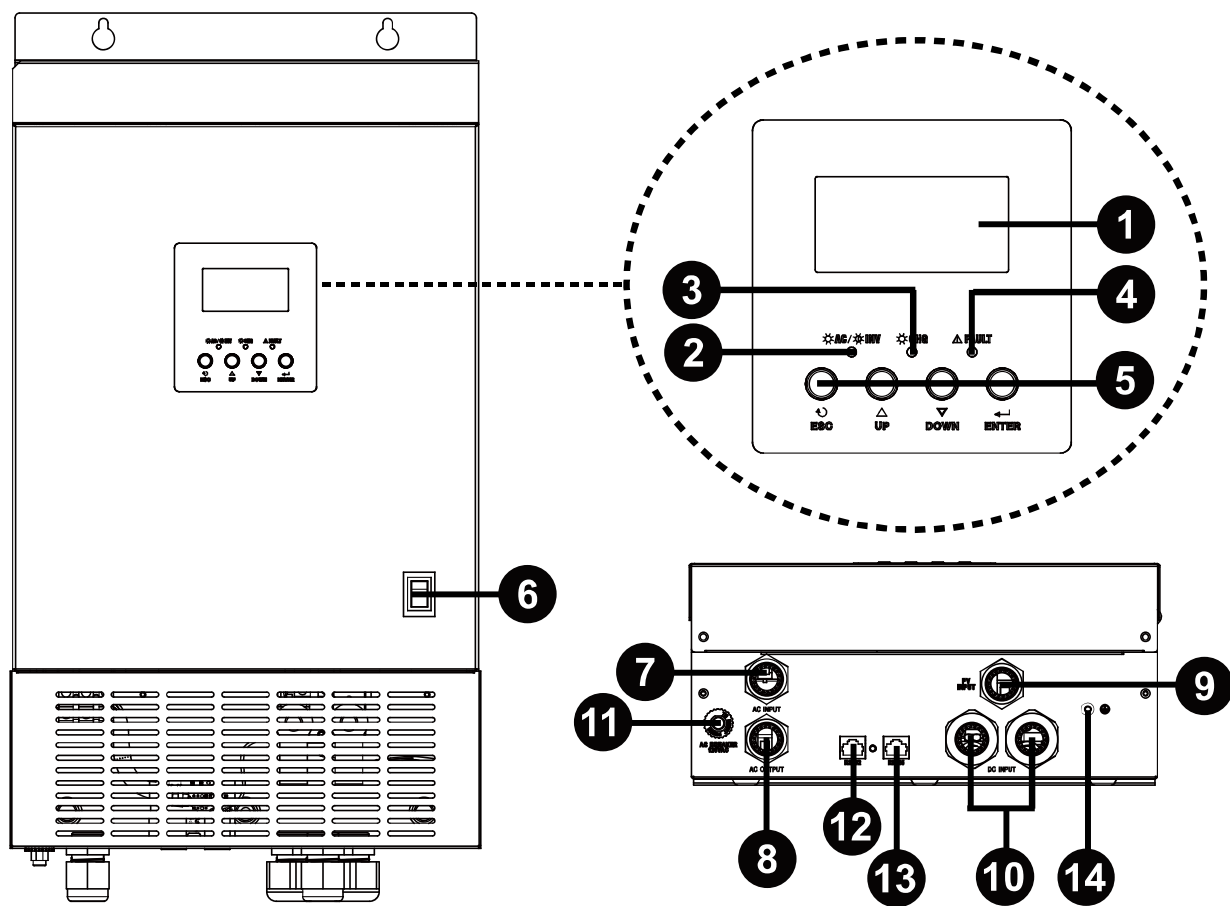


Figure 1 Hybrid Power System

Product Overview



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. RS-485 communication port (Reserved)
14. Grounding

INSTALLATION

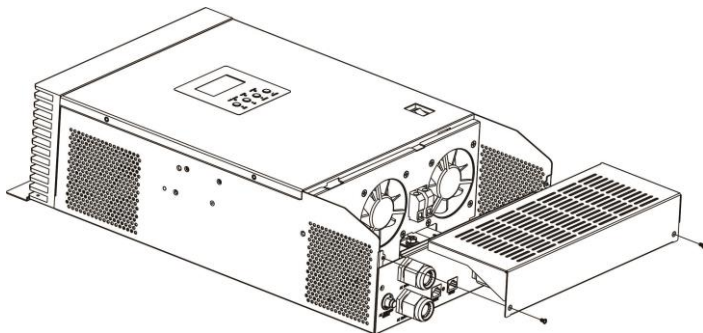
Unpacking and Inspection

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

- The inverter/charger x 1
- User manual x 1
- Communication cable x 2 (RS232 cable and RS485 cable)
- Software CD x 1

Preparation

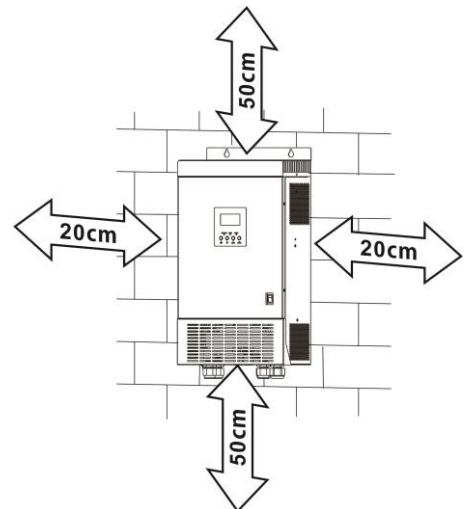
Before connecting all wirings, please take off the cover of the bottom by removing the two screws as shown below.



Mounting the Inverter/charger

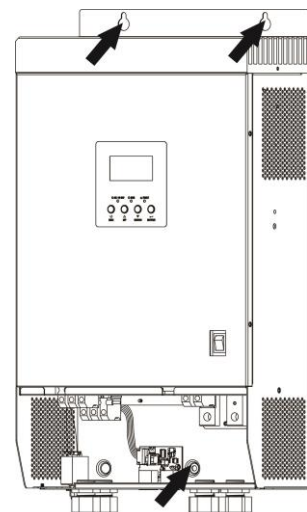
Consider the following points before selecting where to install:

- Do not mount the inverter/charger on any flammable construction materials.
- Mount this inverter/charger on a solid surface, like board (thickness $\geq 15\text{mm}$), metal frame, or cement wall.
- Install this inverter/charger at eye level in order to read the LCD display at all times.
- The ambient temperature should be between 0°C and 55°C to ensure optimal operation.
- The inverter/charger should be adhered to the wall vertically.
- Be sure to keep other objects away and leave the space in a minimum as shown in the right diagram to guarantee sufficient heat dissipation and enough space for replacing wires.



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

Install the inverter/charger by screwing three screws as shown in the diagram. It's recommended to use M4 or M5 screws.



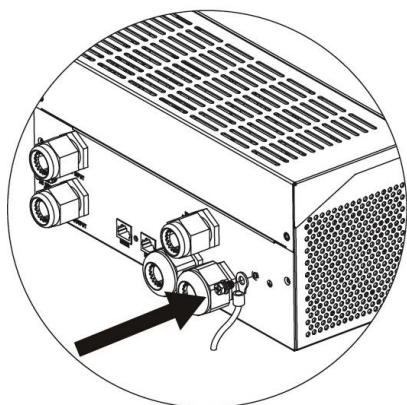
Grounding

CAUTION: For safety, it's requested to connect the device to the ground first. Proper grounding can not only remove the unwanted "electrical noise" but can even make surge protection device work better. Please refer to the typical requirement in the table below as required grounding cables.

Suggested cable requirement for grounding

Gauge	Torque Value	Color
8 AWG	2.52 Nm	Green

Please refer to the diagram below to complete the grounding:



Battery Connection

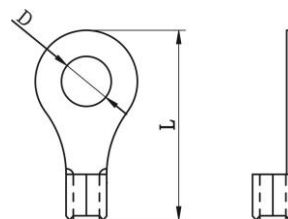
CAUTION: For safety operation and regulation compliance, it's requested to install a separate DC over-current protector or disconnect the device between battery and inverter/charger. It may not be necessary to disconnect the device for some applications, however, it's requested to have over-current protection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

CAUTION: To reduce the risk of fire, connect only to a Battery circuit provided with 50 amperes maximum branch-circuit overcurrent protection in accordance with the NEC, ANSI/NFPA 70.

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 proper cables and suitable size of terminal recommended below.

Ring terminal:

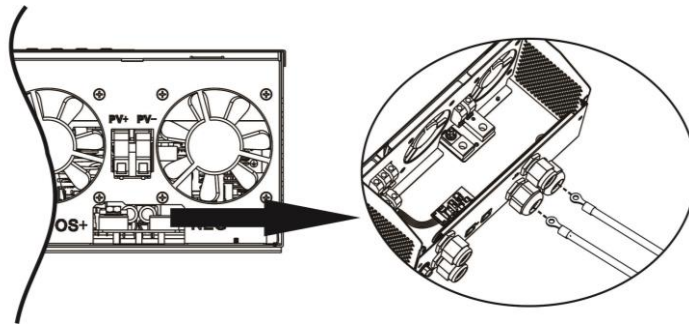


Recommended battery cables and size of terminal:

Model	Typical Amperage	Battery Capacity	Wire Size	Ring Terminal			Torque Value
				Cable mm ²	Dimensions		
					D (mm)	L (mm)	
2KVA 48V	33A	100AH	1*10AWG	5	6.4	22.5	2.07~ 2.3 Nm

Please follow the steps below to implement the battery connection:

1. Assemble battery ring terminal according to the recommended battery cable and terminal size.
2. Connect all battery packs according to the requirement of the inverter/charger. It's suggested to connect at least 100Ah capacity battery.
3. Insert the ring terminal of battery cable flatly into battery connector of inverter/charger and make sure the bolts are tightened with torque of 2-3 Nm. Make sure polarities at both the battery and the inverter/charger is correctly connected and ring terminals are tightly screwed to the battery terminals.



WARNING: Shock Hazard
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/charger terminal and the ring terminal. Otherwise, overheating may occur.
CAUTION!! Do not apply any anti-oxidant substance on the terminals before the terminals are connected tightly.
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!! To reduce the risk of fire, connect only to an AC line circuit provided with 30 amperes maximum branch-circuit overcurrent protection in accordance with the National Electric Code, ANSI/NFPA 70 by the installer.

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 the 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 recommended cable size as below.

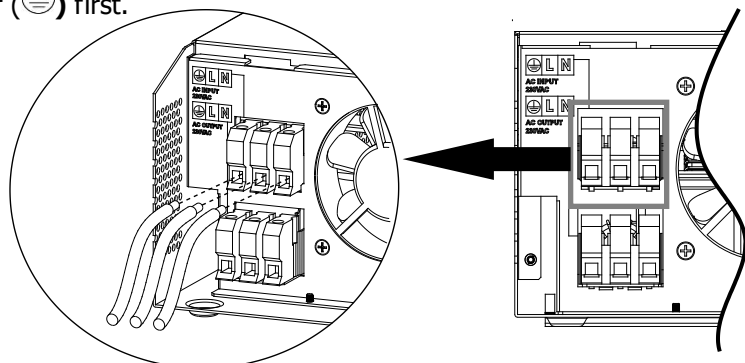
Suggested cable requirement for AC wires

Gauge	Torque Value
12 AWG	2.07~ 2.3 Nm

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

- Before making AC input/output connection, be sure to open DC protector or disconnector first.
- Remove insulation sleeve 10mm from the six conductors. And short-circuit phase L and neutral conductor N 3 mm.
- 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:**

Be sure that AC power source is disconnected before attempting to hardwire it to the inverter/charger.

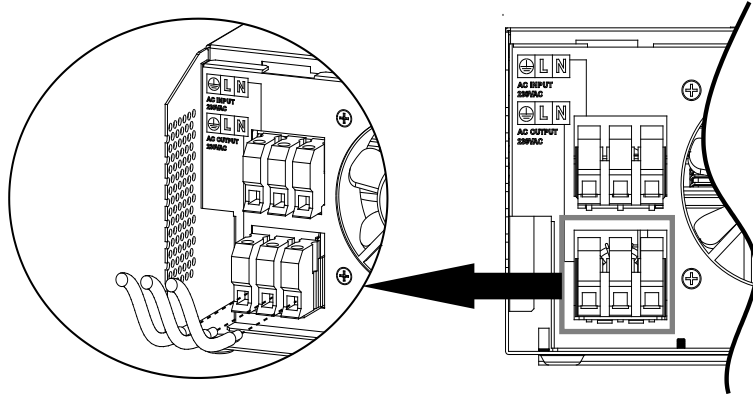
4. Then, insert AC output wires according to polarities indicated on terminal block and fasten the terminal screws. Be sure to connect PE protective conductor (⊕) first.



→ **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.

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 with the manufacturer of the air conditioner if it's equipped with time-delay function before installation. Otherwise, this inverter/charger will cause overload fault and cut off the output to protect your appliance but sometimes it still causes internal damage to the air conditioner.

CAUTION: Important

Be sure that the AC output / neutral is not bonded to ground inside of the inverter.

PV Connection

CAUTION: Before connecting to PV modules, please install **separately** a DC circuit breaker between the inverter/charger 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 recommended cable size as below.

Typical Amperage	Cable Size	Torque
45 A	6 AWG	3.6 Nm

PV Module Selection:

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

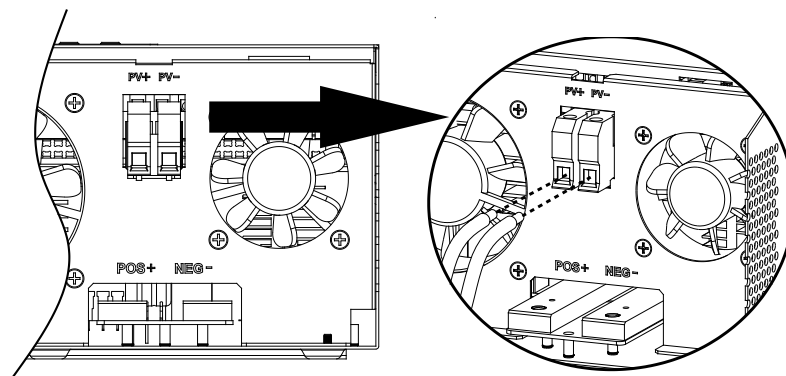
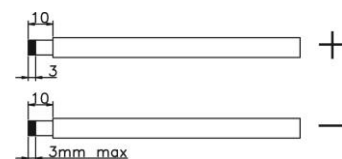
1. Open circuit Voltage (Voc) of PV modules can't exceed the maximum voltage of the PV array open circuit of the inverter/charger.

- Open circuit Voltage (Voc) of PV modules should be higher than the minimum voltage of the battery.

Solar Charging Mode	
Max. PV Array Open Circuit Voltage	145Vdc
PV Array MPPT Voltage Range	60~115Vdc
Min. battery voltage for PV charge	34Vdc

Please follow the steps below to implement PV module connection:

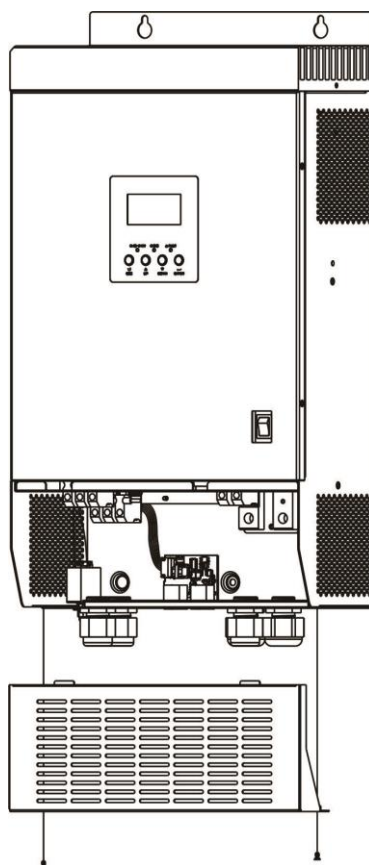
- Remove insulation sleeve 10 mm from positive and negative conductors.
- Check the correct polarity of connected cable from PV modules and PV input connectors. Then, connect positive pole (+) of connection cable to positive pole (+) of PV input connector. Connect negative pole (-) of connection cable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



- Make sure the wires are securely connected.

Final Assembly

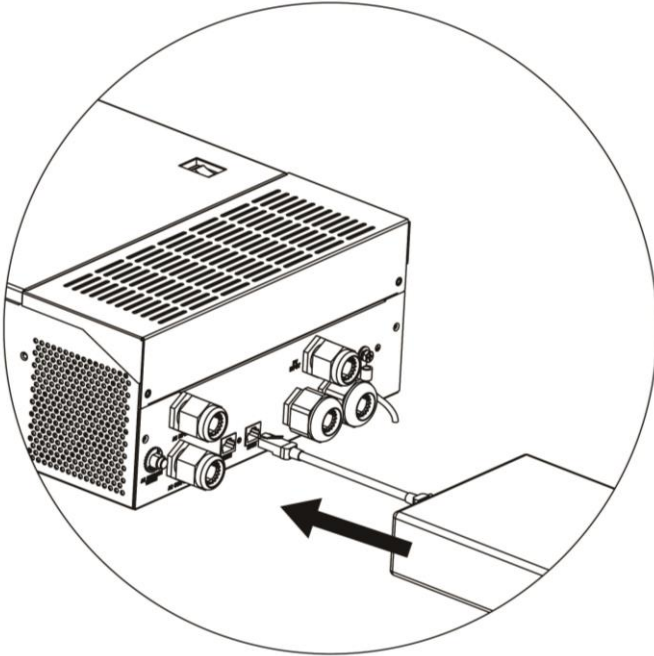
After connecting all wirings, please put the bottom cover back by fixing two screws as shown below.



Communication Connection

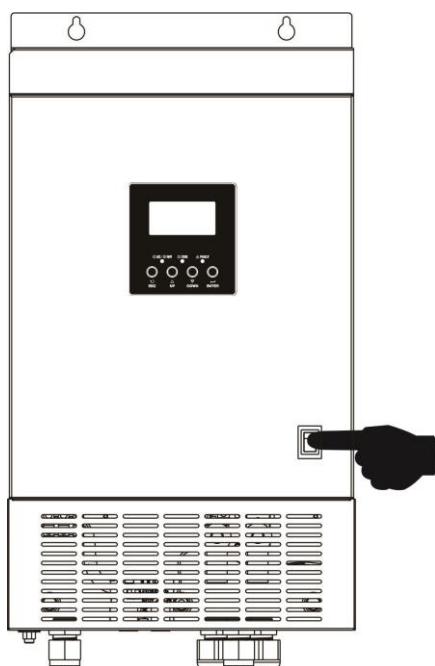
Please use supplied RS232 cable to connect to the inverter/charger and PC. Insert bundled CD into a computer and follow the on-screen instructions to install the monitoring software. For the detailed software operations, please check user manual of software inside the CD.

There is one RS485 port reserved for communication with external battery management system.



OPERATION

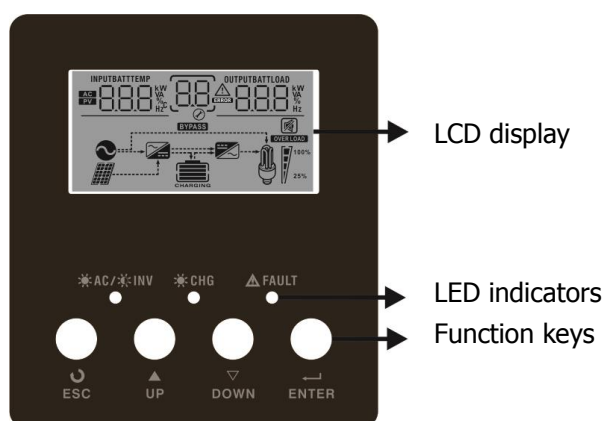
Power ON/OFF



Once the inverter/charger has been properly installed and the batteries are connected well, simply press On/Off switch (located on the right corner of the top panel) to turn on the inverter/charger.

Operation and Display Panel

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



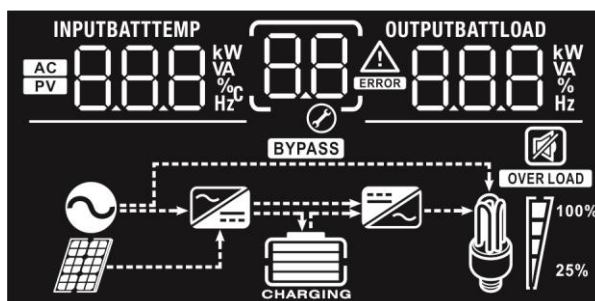
LED Indicator










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/charger.
		Flashing	Warning occurs in the inverter/charger.






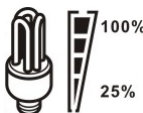










Function Keys

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		
	Indicates the AC input.	
	Indicates the PV input	
	Indicates input voltage, input frequency, PV voltage, battery voltage and charger current.	
Configuration Program and Fault Information		
	Indicates the setting programs.	
	Indicates the warning and fault codes.	
	Warning:	 flashing with warning code.
	Fault:	 lighting with fault code
Output Information		
	Indicate output voltage, output frequency, load percent, load in VA, load in Watt and discharging current.	
Battery Information		
	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 /	Battery level < 25%	4 bars will flash in turns.
	25% ≤ battery level < 50%	Bottom bar will be on and the other three bars will flash in turns.

Constant Voltage mode	50% ≤ battery level < 75%	Bottom two bars will be on and the other two bars will flash in turns.			
	Battery level ≥ 75%	Bottom three bars will be on and the top bar will flash.			
In floating mode, batteries are fully charged.		4 bars will be on.			
In battery mode, it will present battery capacity.					
Battery Voltage		LCD Display			
battery level < 25%					
25%≤ battery level < 50%					
50%≤ battery level < 75%					
battery level ≥ 75%					
Load Information					
		Indicates overload.			
		Indicates the load level by 0-24%, 25-49%, 50-74% and 75-100%.			
		0%~24%	25%~49%	50%~74%	75%~100%
					
Mode Operation Information					
		Indicates inverter/charger connects to the mains.			
		Indicates inverter/charger connects to the PV panel.			
		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 the alarm is disabled.			

LCD Setting




After pressing and holding the ENTER button for 3 seconds, the inverter/charger 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:

Program	Description	Selectable option	
00	Exit setting mode	Escape 	
01	Output source priority: To configure load power source priority	Solar first 	Solar energy provides power to the loads as first priority. If solar energy is not sufficient to power all connected loads, battery energy will supply power the loads at the same time. Utility provides power to the loads only when any one condition happens: - Solar energy is not available - Battery voltage drops to low-level warning voltage.
		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 utility power is not available.
		SBU priority 	Solar energy provides power to the loads as first priority. If solar energy is not sufficient to power all connected loads, battery energy will supply power to the loads at the same time. Utility provides power to the loads only when battery voltage drops to low-level warning voltage.
02	Maximum charging current: To configure total charging current for solar and utility chargers. (Max. charging current = utility charging current + solar charging current)	10A 	20A 
		30A 	40A 
		50A 	60A (default) 
03	AC input voltage range	Appliances (default) 	If selected, acceptable AC input voltage range will be within 65-140 VAC.

		UPS 03 <u>UPS</u>	If selected, acceptable AC input voltage range will be within 95-140VAC.
04	Power saving mode enable/disable	Saving mode disable (default) 04 <u>SdS</u>	If disabled, no matter connected load is low or high, the on/off status of inverter output will not be effected.
		Saving mode enable 04 <u>SEn</u>	If enabled, the output of inverter will be off when connected load is pretty low or not detected.
05	Battery type	AGM (default) 05 <u>AGn</u>	Flooded 05 <u>FLd</u>
		User-Defined 05 <u>USE</u>	If "User-Defined" is selected, battery charge voltage and low DC cut-off voltage can be set up in program 26, 27 and 29.
07	Auto restart when over temperature occurs	Restart disable (default) 07 <u>tTd</u>	Restart enable 07 <u>tTE</u>
08	Output voltage	110V 08 <u>110</u> v	120V (default) 08 <u>120</u> v
09	Output frequency	50Hz 09 <u>50</u> Hz	60Hz (default) 09 <u>60</u> Hz
11	Maximum utility charging current	5A 11 <u>5A</u>	10A(default) 11 <u>10A</u>
12	Setting voltage point back to utility source when selecting "SBU priority" or "Solar first" in program 01.	44V 12 <u>BATT 44</u> v	45V 12 <u>BATT 45</u> v
		46V (default) 12 <u>BATT 46</u> v	47V 12 <u>BATT 47</u> v
		48V 12 <u>BATT 48</u> v	49V 12 <u>BATT 49</u> v
		50V 12 <u>BATT 50</u> v	51V 12 <u>BATT 51</u> v

13	Setting voltage level back to battery mode when selecting "SBU priority" or "Solar first" in program 01.	Battery fully charged 13 ^{BATT} FUL	48V 13 ^{BATT} 480 ^v
		49V 13 ^{BATT} 490 ^v	50V 13 ^{BATT} 500 ^v
		51V 13 ^{BATT} 510 ^v	52V 13 ^{BATT} 520 ^v
		53V 13 ^{BATT} 530 ^v	54V (default) 13 ^{BATT} 540 ^v
		55V 13 ^{BATT} 550 ^v	56V 13 ^{BATT} 560 ^v
		57V 13 ^{BATT} 570 ^v	58V 13 ^{BATT} 580 ^v
16	Charger source priority: 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 16 C50	Solar energy will charge battery as first priority. Utility will charge battery only when solar energy is not available.
		Utility first (Default) 16 CUT	Utility will charge battery as first priority. Solar energy will charge battery only when utility power is not available.
		Only Solar 16 050	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) 18 60n	Alarm off 18 60F

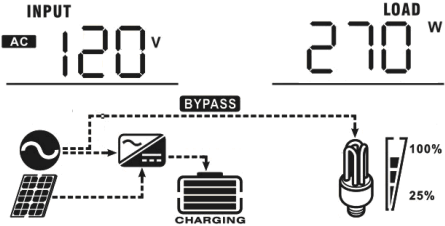
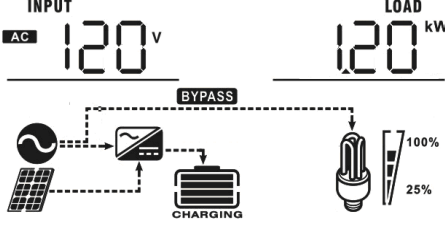
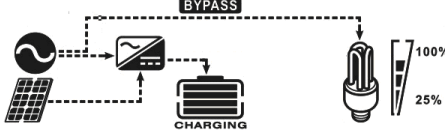
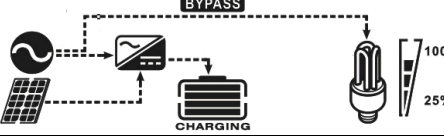
19	Auto return to default display screen	Return to default display screen (default) 19 ESP	If selected, no matter how users switch display screen, it will automatically return to default display screen (Input voltage /output voltage) after no button is pressed for 1 minute.
		Stay at latest screen 19 LEP	If selected, the display screen will stay at latest screen user finally switches.
20	Backlight control	Backlight on (default) 20 LON	Backlight off 20 LOF
22	Beeps while primary source is interrupted	Alarm on (default) 22 AON	Alarm off 22 AOF
23	Overload bypass: When enabled, the inverter/charger will transfer to line mode if overload occurs in battery mode.	Bypass disable (default) 23 bYd	Bypass enable 23 bYE
25	Record Fault code	Record enable 25 FEN	Record disable (default) 25 FdS
26	Bulk charging voltage (C.V voltage)	Default setting: 56.4V  If self-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 58.4V. Increment of each click is 0.1V.	
27	Floating charging voltage	Default setting: 54.0V  If self-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 58.4V. Increment of each click is 0.1V.	
29	Low DC cut-off voltage	Default setting: 42.0V  If self-defined is selected in program 5, this program can be set up. Setting range is from 40.0V to 48.0V. 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.	

Display Setting







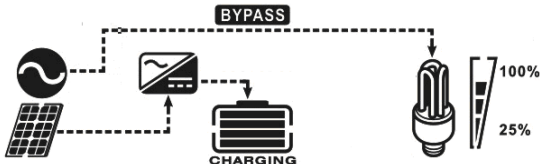
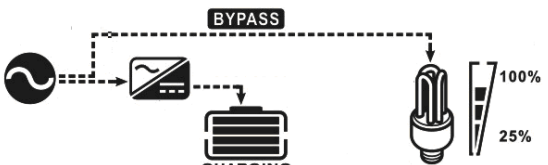
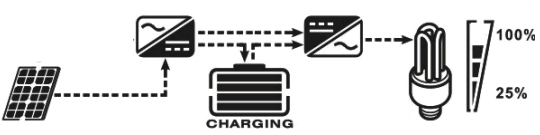
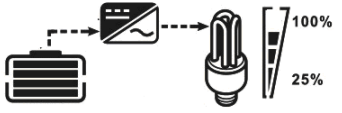
The LCD display information will be switched in turns by pressing "UP" or "DOWN" key. The selectable information is switched as below order: input voltage, input frequency, PV voltage, MPPT charging current, MPPT charging power, battery voltage, output voltage, output frequency, load percentage, load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

Selectable information	LCD display
Input voltage/Output voltage (Default Display Screen)	<p>Input Voltage=120V, output voltage=120V</p>
Input frequency	<p>Input frequency=60Hz</p>
PV voltage	<p>PV voltage=60V</p>
MPPT Charging current	<p>Current $\geq 10A$</p> <p>Current < 10A</p>
MPPT Charging power	<p>MPPT charging power=500W</p>

Battery voltage/ DC discharging current	<p>Battery voltage=50.5V, discharging current=1A</p>
Output frequency	<p>Output frequency=60Hz</p>
Load percentage	<p>Load percent=70%</p>
Load in VA	<p>When connected load is lower than 1kVA, load in VA will present xxxVA like below chart.</p> <p>When load is larger than 1kVA ($\geq 1\text{kVA}$), load in VA will present x.xkVA like below chart.</p>

<p>Load in Watt</p>	<p>When load is lower than 1kW, load in W will present xxxW like below chart.</p>  <p>When load is larger than 1kW ($\geq 1\text{kW}$), load in W will present x.xkW like below chart.</p> 
<p>Main CPU version checking</p>	<p>Main CPU version 00014.04</p> 
<p>Secondary CPU version checking</p>	<p>Secondary CPU version 00003.03</p> 

Operating Mode Description

Operation mode	Description	LCD display
Standby mode / Power saving mode Note: *Standby mode: The inverter/charger is not turned on yet but at this time, the inverter/charger can charge battery without AC output. *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 inverter/charger but it still can charge batteries.	Charging by utility. 
		Charging by PV energy. 
		No charging. 
Fault mode Note: *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. 
		Charging by PV energy. 
		No charging. 
Line Mode	The inverter/charger will provide output power from the mains. It will also charge the battery at line mode.	Charging by PV energy 
		Charging by utility. 
Battery Mode	The inverter/charger will provide output power from battery and PV power.	Power from battery and PV energy. 
		Power from battery only. 

Fault Reference Code

Fault Code	Fault Event	Icon on
01	Fan is locked when inverter/charger 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.	
07	Overload time out	
08	Bus voltage is too high	
09	Bus soft start failed	
11	Main relay failed	

Warning Indicator

Warning Code	Warning Event	Audible Alarm	Icon flashing
01	Fan is locked when inverter/charger 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

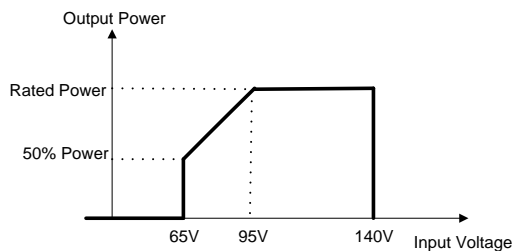
INVERTER MODEL	2KVA 48V Plus
Input Voltage Waveform	Sinusoidal (utility or generator)
Nominal Input Voltage	110/120Vac
Low Loss Voltage	95Vac \pm 7V (UPS) 65Vac \pm 7V(Appliances)
Low Loss Return Voltage	100Vac \pm 7V(UPS); 70Vac \pm 7V(Appliances)
High Loss Voltage	140Vac \pm 7V
High Loss Return Voltage	135Vac \pm 7V
Max AC Input Voltage	150Vac
Nominal Input Frequency	50Hz / 60Hz (Auto detection)
Low Loss Frequency	40 \pm 1Hz
Low Loss Return Frequency	42 \pm 1Hz
High Loss Frequency	65 \pm 1Hz
High Loss Return Frequency	63 \pm 1Hz
Output Short Circuit Protection	Line mode: Circuit Breaker Battery mode: Electronic Circuits
Efficiency (Line Mode)	>95% (Rated R load, battery full charged)
Transfer Time	10ms typical (UPS); 20ms typical (Appliances)
Output power derating: When AC input voltage drops to 65V or 95V depending on models, the output power will be derated.	110/120Vac model:  <p>The graph illustrates the output power derating characteristics for the 110/120Vac model. The vertical axis represents Output Power, and the horizontal axis represents Input Voltage. The power remains constant at a level below 50% of the rated power until the input voltage reaches 65V. Between 65V and 95V, the output power increases linearly, reaching the full Rated Power at 95V. From 95V to 140V, the output power remains constant at the Rated Power level. The graph also indicates a 50% Power level on the vertical axis.</p>

Table 2: Inverter Mode Specifications

INVERTER MODEL	2KVA 48V Plus
Rated Output Power	2KVA/1.6KW
Output Voltage Waveform	Pure Sine Wave
Output Voltage Regulation	110/120VAC±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 @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	44.0Vdc 42.8Vdc 40.4Vdc
Low DC Warning Return Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	46.0Vdc 44.8Vdc 42.4Vdc
Low DC Cut-off Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	42.0Vdc 40.8Vdc 38.4Vdc
High DC Recovery Voltage	58Vdc
High DC Cut-off Voltage	62Vdc
No Load Power Consumption	<25W
Saving Mode Power Consumption	<10W

Table 3: Charging Mode Specifications

Utility Charging Mode		
INVERTER MODEL		2KVA 48V Plus
Charging Current (UPS) @ Nominal Input Voltage		5/10A
Bulk Charging Voltage	Flooded Battery	58.4
	AGM / Gel Battery	56.4
Floating Charging Voltage		54Vdc
Overcharge Protection		60Vdc
Charging Algorithm		3-Step
Charging Curve		<p>The graph illustrates the 3-step charging algorithm. The left y-axis represents Battery Voltage per cell, with markers at 2.25Vdc and 2.43Vdc (2.35Vdc). The right y-axis represents Charging Current in percentage, with markers at 50% and 100%. The x-axis represents Time. The first stage, Bulk (Constant Current), shows a linear increase in voltage from 2.25Vdc to 2.43Vdc while current remains at 100%. The duration is T0. The second stage, Absorption (Constant Voltage), shows the voltage held constant at 2.43Vdc while the current decreases exponentially to 0%. The duration is T1, where T1 = 10 * T0, with a minimum of 10 minutes and a maximum of 8 hours. The third stage, Maintenance (Floating), shows the voltage slightly reduced and current remaining at 0%.</p>

Solar Charging Mode	
INVERTER MODEL	2KVA 48V Plus
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
Max Charging Current	60Amp
Default Charging Current	60 Amp

Table 4 General Specifications

INVERTER MODEL	2KVA 48V Plus
Safety Certification	UL1741
Operating Temperature Range	0°C to 55°C
Storage temperature	-15°C~ 60°C
Dimension (D*W*H), mm	500 x 295 x 140
Net Weight, kg	12

TROUBLESHOOTING

Problem	LCD/LED/Buzzer	Explanation / Possible cause	What to do
Inverter/charger 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. 2. Replace battery.
No response after power on.	No indication.	1. The battery voltage is far too low. (<1.4V/Cell) 2. Battery polarity is connected reversed.	1. Check if batteries and the wiring are connected well. 2. Re-charge battery. 3. Replace battery.
Mains exist but the inverter/charger 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. 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 inverter/charger 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/charger 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.	Check whether the air flow of the inverter/charger is blocked or whether the ambient temperature is too high.
	Fault code 02	Internal temperature of inverter/charger 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	Output abnormal (Inverter voltage is lower than 90Vac or is higher than 140Vac)	1. Reduce the connected load. 2. Return to repair center
	Fault code 08/09	Internal components failed.	Return to repair center.