

# CMS2.0 kW Grid PV-Inverter

## Installation and Operation Manual

Version 2.5 E 2008.07





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## Before you start...

Congratulations on choosing CMS2.0 kW Grid PV-Inverter, a product from CMS. 2.0 kW Grid PV-Inverter is a highly reliable product due to its innovative design and perfect quality control. Such an inverter is used in high demand, grid-linked PV systems.



This manual contains important information regarding installation and safe operation of this unit. Be sure to read this manual carefully before using.

If you encounter any problems during installation or operation of this unit, first check this manual before contacting your local dealer or representative. Instructions inside this manual will help you solve most installation and operation difficulties.

Thank you again for choosing our product. Please keep this manual handy for quick reference. Start enjoying Inverter and your life!

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## Safety instructions

- Risk of Electric Shock

1. Do not remove the casing. Inverter contains no user serviceable parts.  
Refer servicing to qualified service personnel.



Both AC and DC voltage sources are terminated inside the PV-Inverter.  
Please disconnect these circuits before servicing.

2. When a photovoltaic panel is exposed to light, it generates a DC voltage.  
When connected to this equipment, a photovoltaic panel will charge the DC link capacitors.
3. Energy stored in this equipment's DC link capacitors presents a risk of electric shock. Even after the unit is disconnected from the grid and photovoltaic panels, high voltages may still exist inside the PV-Inverter.  
Do not remove the casing until at least 30 minutes after disconnecting all power sources.
4. This unit is designed to feed power to the public power grid (utility) only.  
Do not connect this unit to an AC source or generator. Connecting Inverter to external devices could result in serious damage to your equipment.
5. Carefully remove the unit from its packaging and inspect for external damage. If you find any imperfections, please contact your local dealer.

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- Hot surfaces



Although designed to meet all safety requirements, some parts and surfaces of Inverter are still hot during operation. To reduce the risk of injury, do not touch the heat sink at the back of the PV-Inverter or nearby surfaces while Inverter is operating.

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## Limited Warranty

Inverter comes with a limited warranty. This warranty includes all defects of design, components and manufacturing. Excluded from warranty are damages due to:

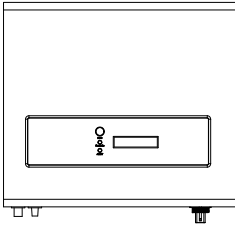
- Breaking the product seal (opening the casing)
- Improper transportation and delivery
- Unqualified persons opening the unit
- Improper installation
- Unauthorized modification, testing or repairing
- Use and application beyond the definition in this manual
- Application beyond the scope of safety standards (AS4777&AS3100 etc.)
- Acts of nature such as lightning, fire, storm etc.

The right to repair and/or replace the unit is at the manufacturers' discretion. Any damages discovered during installation should be submitted via a written damage report within 5 working days of receiving the PV-Inverter. Otherwise not responsible for damages beyond the scope of this warranty.

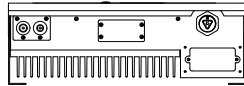
# 1. Overview

## CMS2.0 kW Design Overview

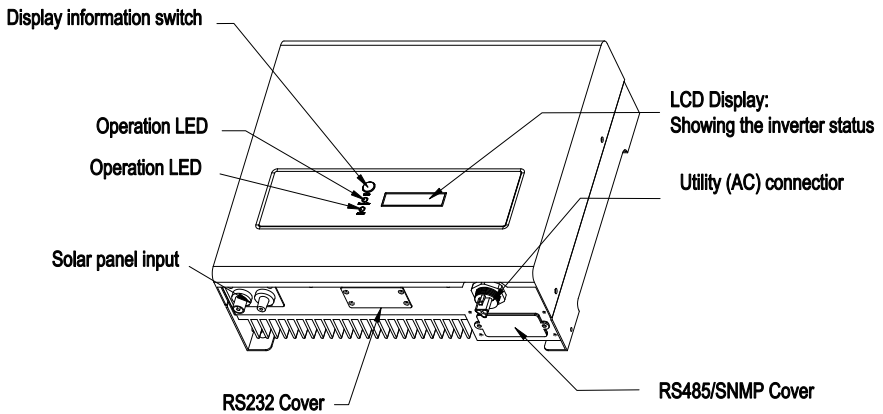
### Front View



### Bottom View



## Parts Description



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## 2. Features

- Very high conversion efficiency (>96%)
- MPPT (Maximum Power Point Tracking)
- Higher power capacity than similar products of the same size.
- Embedded LCD display showing complete status information
- Natural convection cooling. Quiet, fan-less design
- Stylish, modern casing
- Compact, small profile
- High reliability, and Easy to install
- Maintenance free
- Standard RS-232, optional RS-485 and others
- Embedded ENS meets AS3100&AS4777
- No external GFCI breaker is required

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### 3. Installation instructions

#### Opening the package

After opening the package, please check the contents of the box. It should contain the following:

1. One CMS2000 Inverter
2. Instruction manual
3. One mounting frame
4. 4 mounting screws
5. 2 safety-lock screws
6. One cable gland for AC cable
7. One AC socket assembly in CMS Inverter2000
8. One service card

#### Before installation

Before starting installation please consider the following items:

This unit is designed for indoor usage. Do not expose the unit to wet, or moist conditions.



Do not expose the PV-Inverter to direct sunlight. Direct sunlight increases the internal temperature that may reduce conversion efficiency.



- ✓ Check the ambient temperature of installation is within specified range -20 ~ +55°C.
- ✓ The AC grid voltage is between 200 and 270VAC, 50/60Hz.
- ✓ Electric utility company has approved the grid connection.
- ✓ Qualified personnel are performing the installation.
- ✓ Adequate convection space surrounds the inverter.

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- ✓ Inverter is being installed away from explosive vapors.
  - ✓ No flammable items are near the inverter.

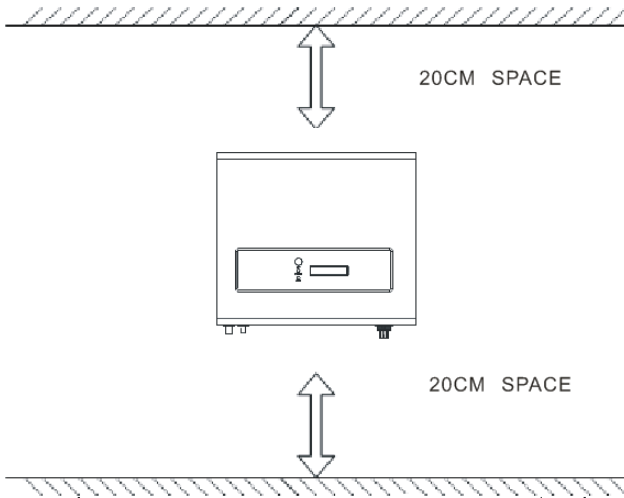


Inverter can be installed and operated at locations where the ambient temperature is up to 55°C. However, for optimal operation, it is recommended that Inverter is installed where the ambient temperature is between 0~40°C.

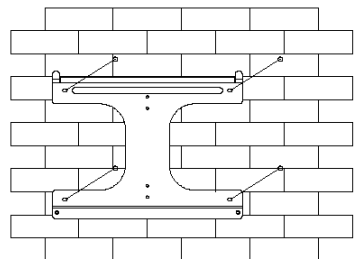
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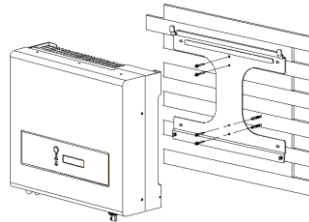
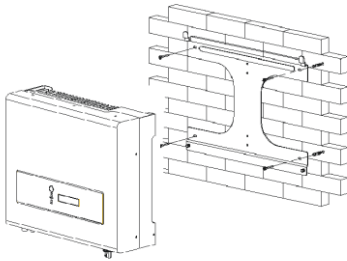
## Mounting Inverter to the wall

1. Select a wall or solid vertical surface that can support the PV-Inverter.
2. Inverter requires adequate cooling space. Allow at least 20cm space above and below the inverter.



3. Using the mounting frame as a template, drill 4 holes as illustrated in the following figures.
4. Fix the mounting frame as the figure shows. Do not drive-in the screws flush to the wall. Instead, leave 2 to 4mm exposed.
5. Hang the inverter on the mounting frame



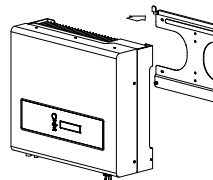
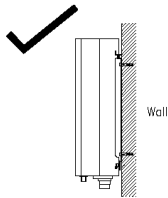
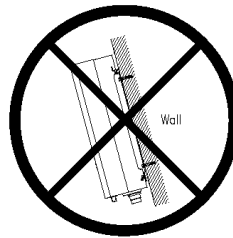


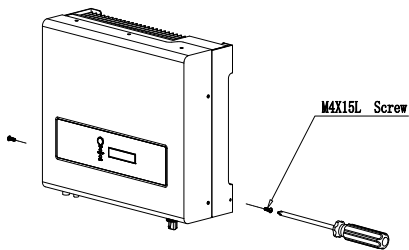
6. Check the installation conditions

a) Do not install the PV-Inverter on a slanted surface

b) Check the upper straps of PV-Inverter and ensure it fits on to the bracket

c) Insert safety-lock screws to the bottom leg to secure the inverter.






Check the secure mounting of the PV-Inverter by trying to raise it from the bottom. The PV-Inverter should remain firmly attached.

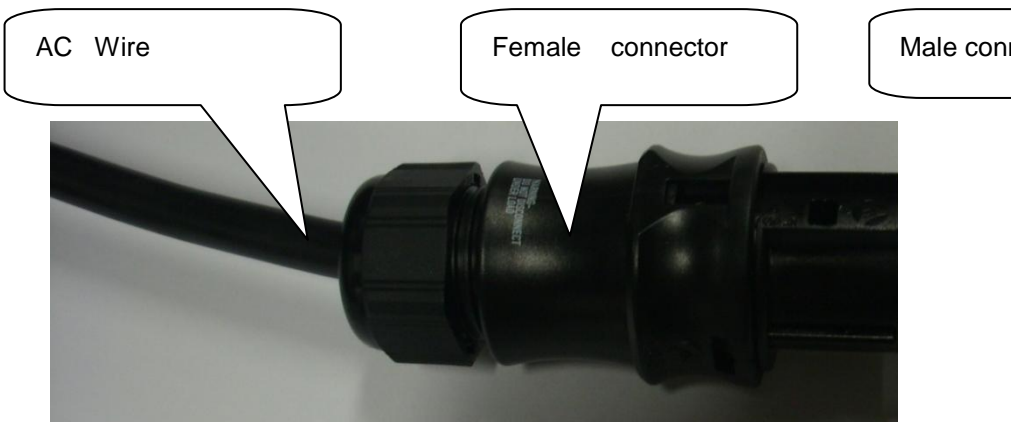


Select the installation location so that the status display can be easily viewed.  
Choose a strong mounting wall to prevent vibrations while inverter is operating.

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## Connecting to the grid (AC utility)

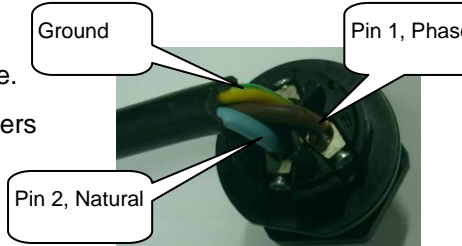
1. Measure grid (utility) voltage and frequency. It should be 230VAC (or 220VAC), 50/60Hz, and single phase.
2. Open the breaker or fuse between PV-Inverter and utility.
3. For Inverter, connect AC wires as follows:
  - Insert utility wires through cable gland. Connect wires according to polarities indicated on terminal block. L → LINE (brown or black), N → Neutral (blue) and → system ground (yellow-green).
  - Fasten the gland plate with attached screws.
  - Twist the gland so that the cable is firmly fixed.
  - Refer to left figure. 
4. For Inverter 2000 connect AC wires as follows:
  - Disassemble female socket.
  - Connect AC wires to connection socket as indicated.



- Insert Line wire to Pin 1, Neutral wire to Pin 2 and Ground wire to Pin



- Assemble the socket again and replace.
- Twist the coupling ring to the PV-Inverters receptacle. Make sure it is correctly matched.



To prevent risk of electric shock, ensure the ground wire is properly earthed before operating the PV-Inverter.



5. Suggested cable width for AC wire

Model	Diameter $\phi$ (mm)	Area (mm <sup>2</sup> )	AWG no.
CMS2000	$\geq 1.02$	$\geq 1.0$	$\leq 18$

**Connect to PV Panel (DC input)**

1. Make sure the maximum open circuit voltage ( $V_{oc}$ ) of each PV string is less than  $500V_{DC}$  UNDER ANY CONDITION. We recommend  $V_{oc}$  less than  $360V_{DC}$  with ambient temperature of  $25^{\circ}C$ .
2. Use MC (Multi-contact<sup>®</sup>) connectors for PV array terminals.
3. Connect the positive and negative terminals from the PV panel to positive (+) terminals and negative (-) terminals on the PV-Inverter. Each DC terminal on Inverter can withstand  $20A_{DC}$



Before connecting PV panels to DC terminals, please make sure the polarity is correct. Incorrect polarity connection could permanently damage the unit.

Check short-circuit current of the PV string. The total short-circuit current of

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the PV string should be less than the inverter's maximum DC current.



High voltages exist when the PV panel is exposed to the sun. To reduce risk of electric shock, avoid touching live components and treat connection terminals carefully.

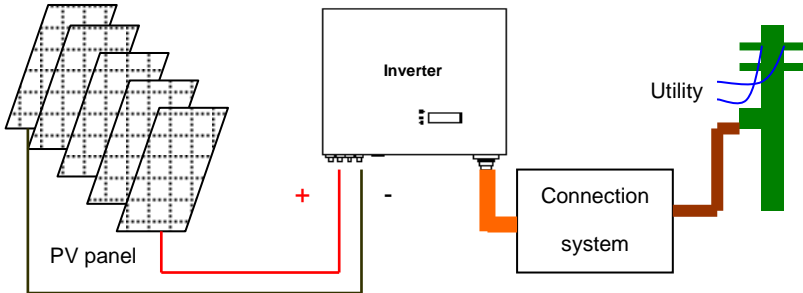
### Checking

1. When the PV panels are connected and their output voltage is greater than  $100 V_{DC}$  but the AC grid is not yet connected, the message on the LCD display produce the following messages in order: "MODEL= XkW" -> "Waiting" -> "No Utility". The display repeats "No Utility" and the RED "fault LED" turns on.
2. Close the AC breaker or fuse between PV-Inverter and grid. The normal operating sequence begins.
3. Under normal operating conditions the LCD displays "Watt=xxxx.xW". That is the power fed to the grid. The green LED turns lights-up.
4. This completes the check.

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## 4. System Diagram

The typical connection diagram for the entire PV system is shown in the following figure.



1. **PV Panel:** Provide DC power to inverter
2. **2.0kW PV-Inverter:** Converts DC (Direct Current) power from PV panel(s) to AC (Alternating Current) power. Because Inverter is grid-connected it controls the current amplitude according to the PV Panel power supply. Inverter always tries to convert the maximum power from your PV panel(s).
3. **Connection system:** This “interface” between Utility and PV-Inverter may consist of electrical breaker, fuse and connecting terminals. To comply with local safety standards and codes, the connection system should be designed and implemented by a qualified technician.
4. **Utility:** Referred to as “grid” in this manual, is the way your electric power company provides power to your place. Please note that Inverter can only connect to low-voltage systems (namely, 220, 230VAC, 50/60Hz).

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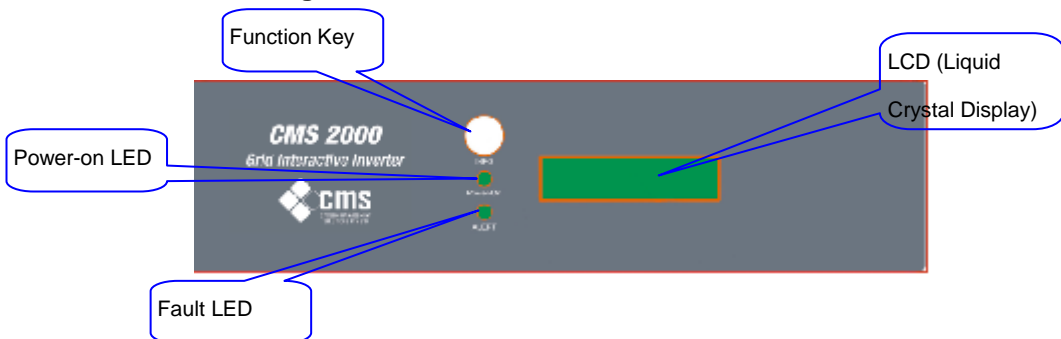
## 5. Operating Your PV-Inverter

### Modes of operation

There are 3 different modes of operation.

1. **Normal mode:** In this mode, Inverter works normally. Whenever the supplied power from PV panel is sufficient (voltage $>$ 150VDC), Inverter converts power to the grid as generated by the PV panel. If the power is insufficient, (voltage $<$ 120VDC) Inverter enters a “waiting” state. Whilst “waiting” Inverter uses just enough power from the PV panel monitor internal system status. In normal mode the green LED is on.
2. **Fault mode:** The internal intelligent controller can continuously monitor and adjust the system status. If Inverter finds any unexpected conditions such as grid problems or internal failure, it will display the information on its LCD and light up the red “Fault” LED.
3. **Shutdown mode:** During periods of little or no sunlight, Inverter automatically stops running. In this mode, Inverter does not take any power from the grid. The display and LED’s on the front panel do not work.

### Front Panel arrangement



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## Front Panel

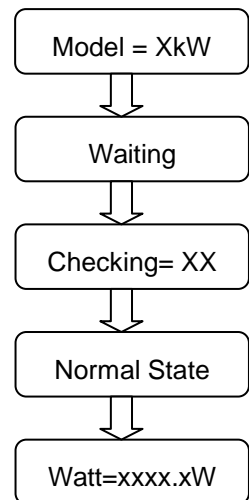
Operating Inverter is quite easy. During normal operation, Inverter runs automatically. However, to achieve maximum conversion efficiency of Inverter please read the following information:

1. Automatic ON-OFF: Inverter starts up automatically when DC-power from the PV panel is sufficient. Once the PV-Inverter starts it enters one of the following 3 states:
  - **Standby:** The PV string can only provide just enough voltage to minimum requirements of the controller.
  - **Waiting:** When the PV string DC voltage is greater than 100V, Inverter enters a “waiting” state and attempts to connect to the grid.
  - **Normal operation:** When PV string DC voltage is greater than 150V, Inverter operates in the normal state.

In this state, it feeds power to the grid.

Inverter automatically stops when the PV power is not enough.

2. Starting-up display sequence: Once the PV power is sufficient, Inverter displays information as shown in the flow chart to the right
3. Change display information: During normal operation, Inverter can show details about the PV-Inverter. The display is setup to automatically indicate the supplying power to the grid. Press the “Function” button on the front panel and release it immediately to see additional



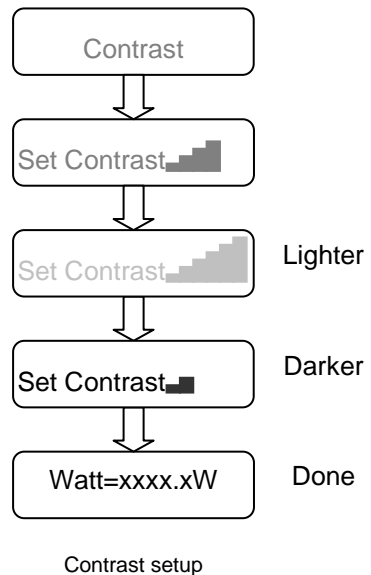
Information during start-up

information. Each subsequent press changes the display. The display sequence is shown in panel LCD display sequence figure on next page.

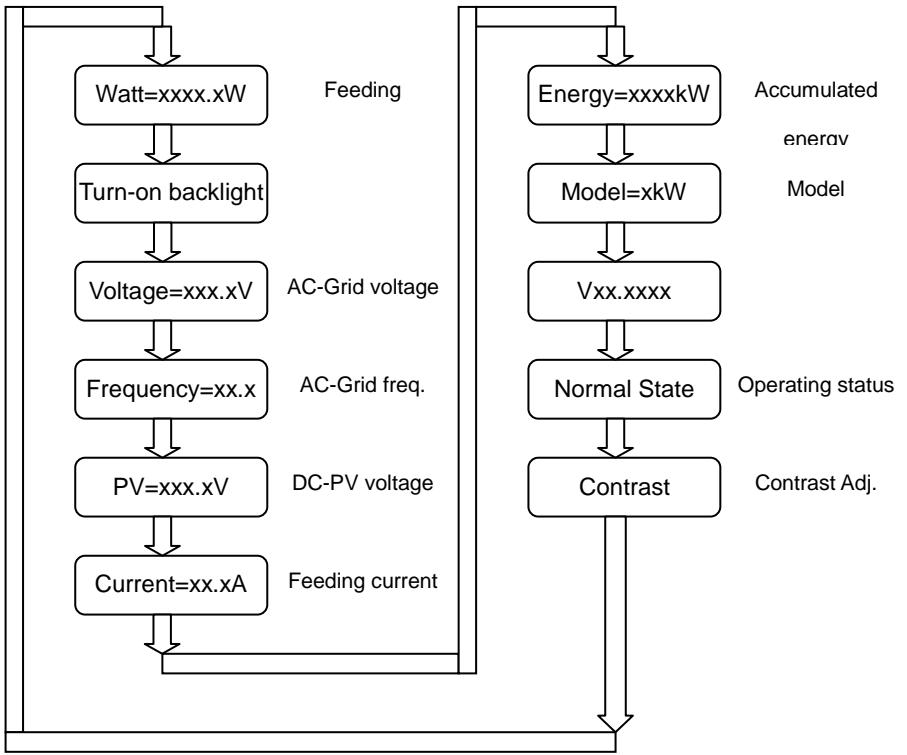
4. Hold display: If you want to hold a specific display. Repeatedly press the function key until the desired display is reached. Release the key and press again for more than 1 second until you see “Lock”, release the key; the information remains on the display. To change the display again, please press the key as indicated in 3
5. LCD backlight control: To save power, the LCD display’s backlight automatically turns off after 30 seconds. To enable it, press the “Function” key again.

6. Contrast control: A natural phenomenon of LCD displays is the background color is darker at higher temperatures. At higher temperatures, the characters may not be easily identified. In this case, the adjust the contrast as follows:

- a. Press the “Function” key repeatedly until “Contrast” shows in the display.
- b. Hold the “Function” key down for more than 2 seconds, until display shows “Set contrast” and a bar graph on the right.
- c. Press the “Function” key repeatedly until the display’s contrast is acceptable.
- d. Release the key for more than 10 seconds, the display will show “Watt=xxxx.xW”.
- e. Setting completed



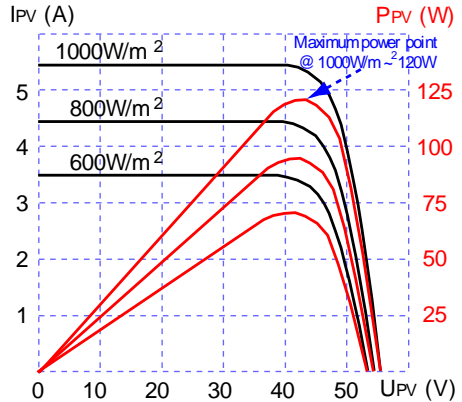




LCD display sequence

## Maximum Power Point Tracking (MPPT)

A good PV inverter must be able to convert the maximum power from any PV panel. Due to its advanced design, Inverter PV-Inverter can track the maximum power from your PV panel in any condition. When the displayed power on the LCD output does not change dramatically, inverter is converting the maximum power from panels. When the LCD power reading is significantly changes, Inverter is tracking the power according to the varied sunlight.



When the PV panel's output is low, the feeding DC-power may drift slowly as does the AC power. It is because PV-Inverter is tracking maximum DC-power continuously.



## Accuracy of the reading

The reading on the LCD is just for reference. We do not recommend using the data for checking or testing of the system. Normally, its accuracy is around  $\pm 2\%$ . In all ranges of operation, the accuracy is up to  $\pm 5\%$ .

## 6. Inverter Status

Inverter is designed to be user-friendly; therefore, the status of the Inverter can be easily understood by reading the information shown on the front panel display. All possible messages are shown in the following table.

### Display information

Operating conditions	Message in English	Description
<b>Normal working status</b>		
Power off	No display	PV inverter is totally shutdown, $V_{PV} \leq 70V$
Standby	Standby	$70V < \text{Input voltage} \leq 100V$
Initialization & waiting	Waiting	Input voltage range 100~150V during start-up. After PV voltage is higher than 100V, inverter is waiting for feeding to grid
Check grid	Checking	When PV voltage > 150V, inverter is checking feeding conditions
Feeding grid, MPPT	Normal State	Inverter is feeding power. After 10 seconds of this display, LED will show wattage.
FLASH	FLASH	FLASH firmware
<b>Monitoring parameters</b>		
Instantaneous Output power	$P_{ac} = \text{xxxx}W$	The real time output power in xxxx W
Accumulated energy information	$\text{Energy} = \text{xxxxxx}kWh$	Total energy to has been fed to grid since inverter was installed
Grid voltage	$V_{ac} = \text{xxx}.xV$	Grid voltage in xxx.x VAC
Grid frequency	$\text{Frequency} = \text{xx}.xHz$	Grid frequency in xx.x Hz
Feeding current	$\text{AC Current} = \text{xx}.xA$	Feeding current amount in xx.x A
PV array voltage	$V_{dc} = \text{xxx}.xV$	Input voltage from PV array, xxx.x VDC
<b>System fault</b>		
Isolation failure	Isolation fault	Earth fault of the PV-panels or failure of surge voltage protection
GFCI active	Ground I fault	Leakage current on ground

		conductor is too high
Grid failure	Grid fault	Grid measured data is beyond the specification (voltage & frequency)
No utility	No Utility	Utility is not available
Input voltage too high	PV over voltage	Input voltage higher than the max input voltage
<b>Inverter fault</b>		
Consistent failure	Consistent fault	The readings of 2 microprocessors are not consistent. CPU and/or other circuit do not function well could cause it.
Temperature too high	Over temperature	The internal temperature is higher than normal value
Output relay failure	Relay Failure	The relay between inverter and grid is not functional
Output DC injection too high	DC INJ High	Output DC injection too high
EEPROM problem	EEPROM Failure	EEPROM inside has data access problem
Communication between microprocessors problem	SCI Failure	The communication between MCU inside is abnormal
DC bus voltage is too high	High DC Bus	The DC BUS inside is higher than expected
DC bus voltage is too low	Low DC Bus	The DC BUS inside is lower than expected
2.5V reference voltage inside problem	Ref 2.5V Fault	The 2.5V reference inside are abnormal
Output DC sensor abnormal	DC Sensor Fault	The DC output sensor is abnormal
GFCI detection problem	GFCI Failure	The GFCI detection circuit is abnormal
<b>Inverter information</b>		
Model display	Model = xkW	Inverter model, xkW inverter
LCD contrast setting	Set Contrast	Setting the contrast of inverter

LCD display lock	Lock	Hold the present display message
Waiting for reconnect to grid	Reconnect in xxx sec	The time for reconnect to grid
Firmware version	Ver xx.xx	F/W version information
Setting Language	Set Language	Set up of the display language

## LED

There are 2 LED's on Inverter, one is **green** and the other is **red**.

Normally, only the green LED switches on during operation. Their indicated status is explained as follows:

1. Power on (green LED): It lights to indicate that Inverter is running.
2. Fault (red LED): Illuminates during a "fault" or "failure". Details of possible faults and their solutions can be found in the previous table.

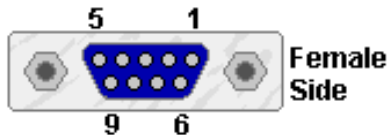
## 7. Communications

Inverter is equipped with a powerful communications interface and options. Use Inverter's EZ control to monitor the status of your PV-Inverter. Also, qualified personnel can upgrade the firmware using the RS232 port.

1. RS232: To use the RS232 port, remove the RS232 cover on the bottom side of Inverter. It is a DB9 socket. The pin definition is

Pin	Functional Description
1	N.C.
2	TxD
3	RxD
4	N.C.
5	Common
6	N.C.
7	N.C.
8	N.C.
9	N.C.

N.C. means "No Connection"



2. Optional communications port: This port is a very powerful extension. Inverter can accept a special card designed for the port only. The RS485 card is used to work with Inverter's EZ logger and in multiple monitoring applications. CMS plan to release other communication cards in the near future. For information of card details, please refer to the user manual of each individual card. To get the latest information, please contact with your local dealer or visit our website.
3. Firmware upgrade: To keep the firmware up to-date, use the RS232 port and supplied program to upgrade firmware. To do this, please contact

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your local service



To prevent risk of damage it is recommended that only authorized personnel perform firmware upgrades.

## 8. Trouble shooting

In most situations, the Inverter requires very little service. However, if Inverter is not able to work perfectly, please refer to the following instructions before calling your local dealer.

- Should any problems arise, the red (Fault) LED on the front panel turns on and the LCD displays the relevant information. Please refer to the following table for a list of potential problems and their solutions.

	Display	Possible actions
System Fault	Isolation Fault	<ol style="list-style-type: none"> <li>1. Check the impedance is between PV (+) &amp; PV (-) and the PV-Inverter is earthed. The impedance must be greater than 8MΩ</li> <li>2. If the problem persists please call service</li> </ol>
	Ground I Fault	<ol style="list-style-type: none"> <li>1. The ground current is too high.</li> <li>2. Unplug the inputs from the PV generator and check the peripheral AC system</li> <li>3. After the cause is cleared, re-plug the PV panel and check PV-Inverter status.</li> <li>4. If the problem persists please call service.</li> </ol>
	Grid Fault	<ol style="list-style-type: none"> <li>1. Wait for 5 minutes, if the grid returns to normal, PV-Inverter automatically restarts.</li> <li>2. Make sure grid voltage and frequency meet the specifications</li> <li>3. If the problem persists please call service</li> </ol>
	No Utility	<ol style="list-style-type: none"> <li>1. Grid is not connected.</li> <li>2. Check grid connection cables.</li> <li>3. Check grid usability.</li> </ol>
Inverter Failure	PV over Voltage	<ol style="list-style-type: none"> <li>1. Check the open PV voltage, see if it is greater than or too close to 500VDC</li> <li>2. If PV voltage is less than 500VDC, and the problem still occurs, please call local service</li> </ol>
	Consistent Fault	<ol style="list-style-type: none"> <li>1. Disconnect PV (+) or PV (-) from the input, restart the PV-Inverter</li> <li>2. If it does not work, call service</li> </ol>

	Over Temperature	<ol style="list-style-type: none"> <li>1. The internal temperature is higher than specified normal value</li> <li>2. Find a way to reduce the ambient temperature.</li> <li>3. Or move the inverter to a cooler environment</li> <li>4. If it is not effective, call local service</li> </ol>
	Relay Failure	<ol style="list-style-type: none"> <li>1. Disconnect <b>ALL</b> PV (+) or PV (-)</li> <li>2. Wait for few seconds</li> <li>3. After the LCD switches off, reconnect and check again</li> <li>4. If the message reappears call your local service</li> </ol>
	DC INJ High	
	EEPROM Failure	
	SCI Failure	
	High DC Bus	
	Low DC Bus	
	Ref 2.5V Fault	
	DC Sensor Fault	
GFCI Failure		

- If there is no display on the panel, please check PV-input connections. If the voltage is higher than 150V, call your local service.
- During periods of little or no sunlight, the PV-Inverter may continuously start up and shut down. This is due to insufficient power generated to operate the control circuits.

## 9. Specifications

### Electrical

Model	2.0 Kw Inverter
Nominal AC power	2000W
Max. AC power	2200W
<b>Input</b>	
Nominal DCV	360V <sub>DC</sub>
Max. open DCV	500V <sub>DC</sub>
MPPT range	250to 450V <sub>DC</sub>
Working range	100 to 500V <sub>DC</sub>
Max. input current	10A <sub>DC</sub>
<b>Output</b>	
Operational voltage	230VAC
Operational frequency	50/60Hz, auto selection (The auto selection is not available for some areas)
Current distortion	<3%
Power factor	>0.99
Maximum $\eta$	>96%
European $\eta$	>94%
<b>Environment</b>	
Protection degree	IP 43
Operating temperature	-20 to 55°C
Humidity	0 to 95%, non-condensing
Heat Dissipation	Convection
Power consumption	~7W
Acoustic noise	<35dBA
<b>Communication &amp; Features</b>	
LCD	1-Line, 16 characters. Information changeable by Function key on the panel
Comm. Interface	RS232 standard, RS485 optional
F/W upgrade	Yes, via RS232
<b>Mechanical</b>	
W×D×H (mm)	350*300*135
Weight (kg)	11.3

\*Product specifications are subject to change without notice