UTICA GRID PV-INVERTER

Utica Energy PV6

Installation and Operation Manual

Version 1.0E

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1. Before you start

Thank you for choosing our product. The Utica Energy PV6 inverter is a highly reliable product line thanks to its innovative design and stringent quality control. Such a device is intended for use in high-demand grid-linked PV systems.

This manual contains information regarding the 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, always refer to this manual before contacting your local dealer or representative. The instructions provided in this manual will help you solve most installation and operational difficulties.

Please check Section 4, Scope of delivery, before starting the installation process.

Thank you again for choosing our product. Please keep this manual at hand for future reference.

2. Safety instructions

- Risk of electric shock

(1) Do not remove the covers. The Grid PV Inverter contains no user-serviceable parts. Refer any servicing to qualified service personnel.

Both AC and DC voltages are present in this equipment.
All circuits must be disconnected prior to servicing.

(2) When a photovoltaic module is exposed to light, it generates a DC voltage. When connected to this equipment, a photovoltaic array will charge the DC link capacitors.

(3) Energy stored in this equipment's DC link capacitors poses a risk of electric shock. Even after the unit has been disconnected from the grid and photovoltaic array, high voltages may still be present within the unit. Always allow at least 30 minutes following the disconnection of all power sources before removing any covers or panels.

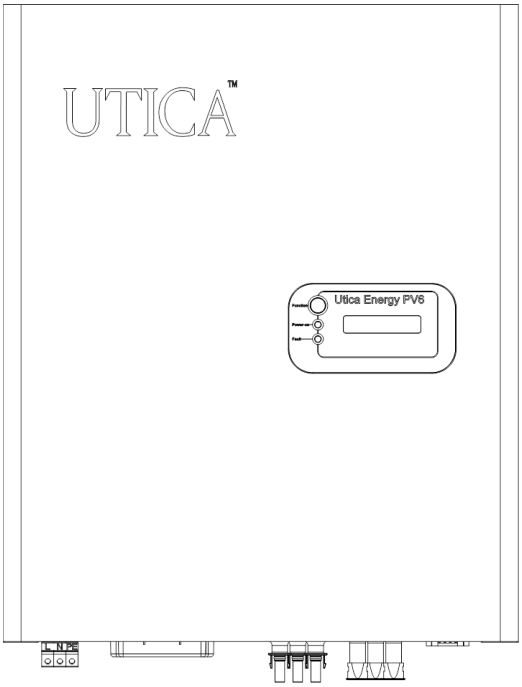
(4) This unit is designed to supply power to the grid (utility) only. Do not connect this unit to an AC source or generator. Connection of the PV Inverter to this type of equipment will cause damage.

(5) Carefully remove the unit from its packaging. Inspect for external damage. If you find any damage, please contact your local dealer.

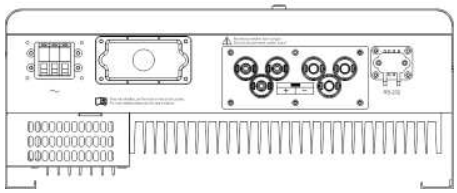
- Hot surface

Although designed to meet all safety requirements, certain parts and surfaces of the PV Inverter will become hot during operation. To reduce the risk of injury, do not touch the heat sink behind the unit or any surface near the heat sink whilst the Grid PV Inverter is operating. Keep a distance of at least 5 cm between AC and DC wiring and the heat sink.

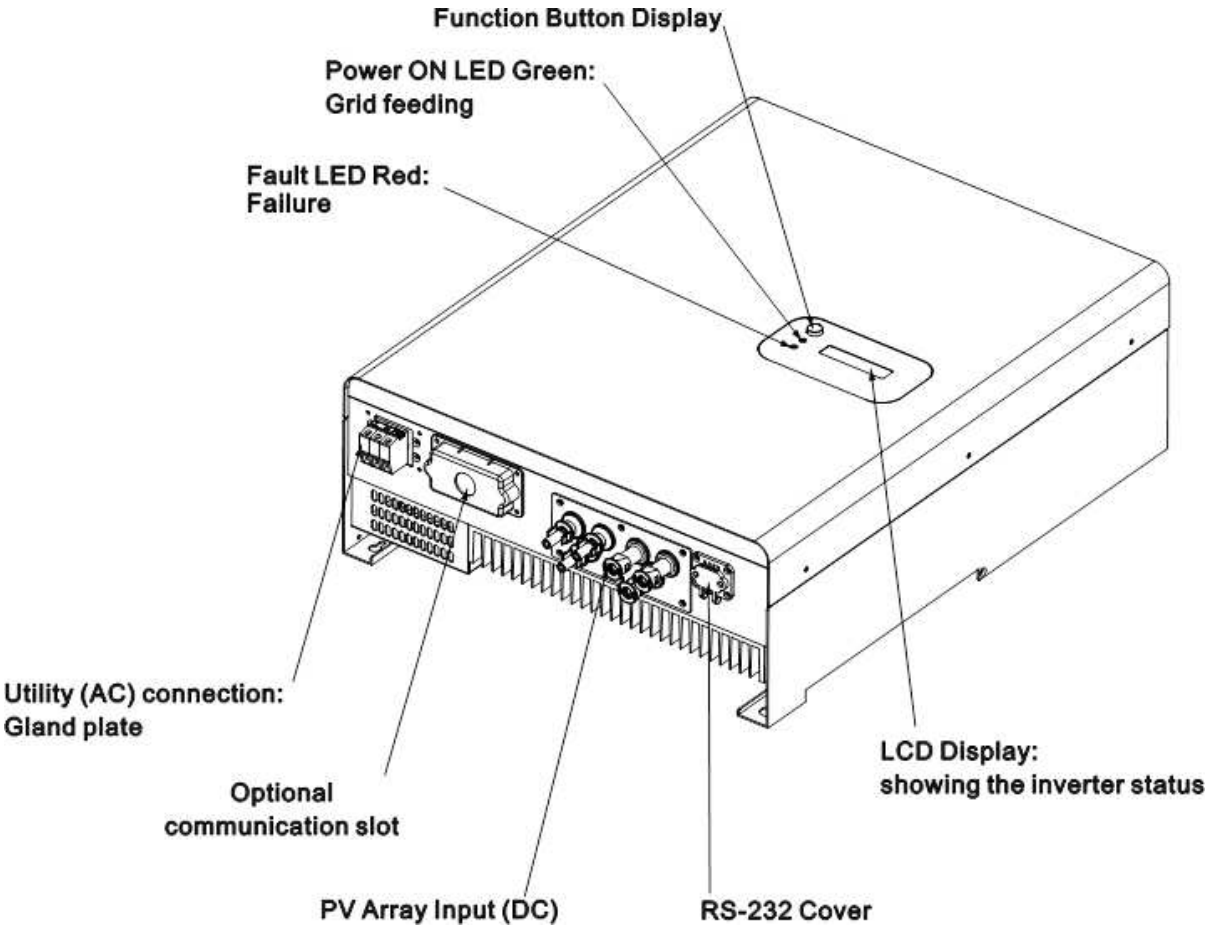
2.1 Overview the Utica Energy PV6 Inverter



Bottom View



2.2 Introducing the Utica Energy PV6 Inverter



3. Features

- Easy to install
- Easy to operate
- Embedded LCD display, complete status information
- Stylish, modern design
- Compact, small profile
- High reliability
- Maintenance-free
- Natural convection cooling. Quiet, no-fan design
- Very high conversion efficiency
- MPPT (Maximum Power Point Tracking)
- Higher power capacity than similar products of the same size.
- Standard RS232 and RS485

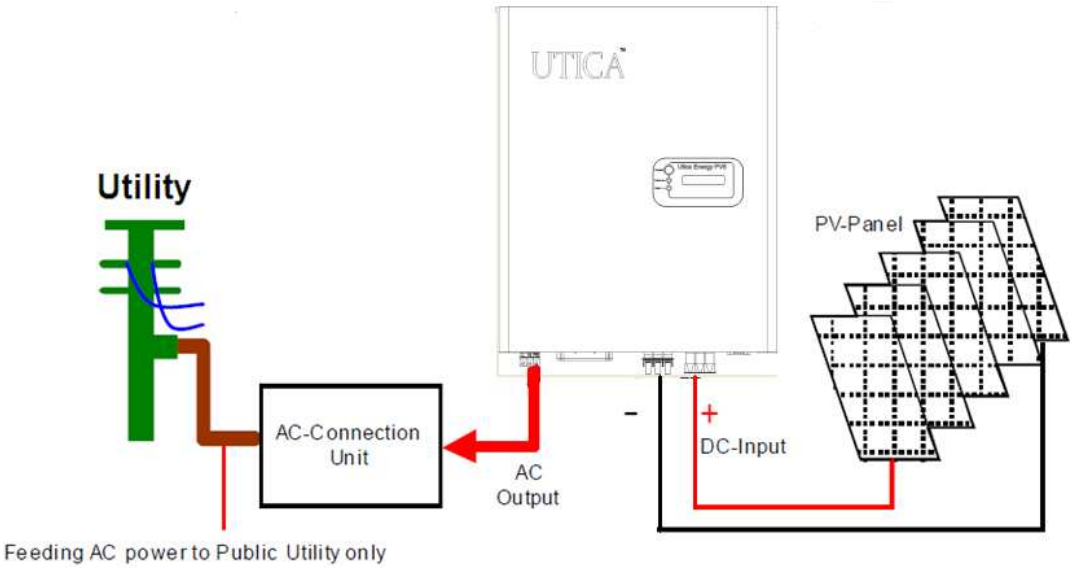
4. Scope of delivery

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

- 1 x Grid PV Inverter
- 1 x User manual
- 1 x Mounting frame
- 6 x Mounting screws
- 2 x Safety-lock screws
- 1 x Output cover
- 1 x Cable gland (M32)

5. System Diagrams

A typical connection for an entire PV system is shown in the drawing below:



(1) **PV array**: provides DC power to the Inverter

(2) **DC dis-connector**: for de-energizing the DC side of the PV array

(3) **PV Inverter**: converts the DC (Direct Current) power from the PV array into AC (Alternating Current) power. As this unit is a grid-connected Inverter, it controls the optimum output current amplitude according to the power provided from the PV array.

(4) **DC SPD**: this surge protective device protects the system from transient surges caused by the effects of lightning strikes.

(5) **Connection System**: the "interface" between the grid and the Inverter. This will consist of a circuit breaker, fuse and terminals for the connection, for example. To comply with local safety standards and codes, this part must be designed by a qualified technician.

(6) **Utility**: this is also referred to as the "grid" within this manual. It is the method used by your electricity company to provide power to your site. Please note that the Inverter can only be connected to low-voltage systems (namely, 220, 230 VAC, 50Hz).

6. Installation instructions

6.1 Prior to installation

Before starting the installation process, please consider the following:

- **IP65 proof for outdoor use**

This unit is designed for outdoor use; however we do not recommend that it is exposed to moist or wet environments.

Do not expose this unit to direct sunlight. Direct sunlight will increase internal temperatures, thus reducing efficiency.

Check that:

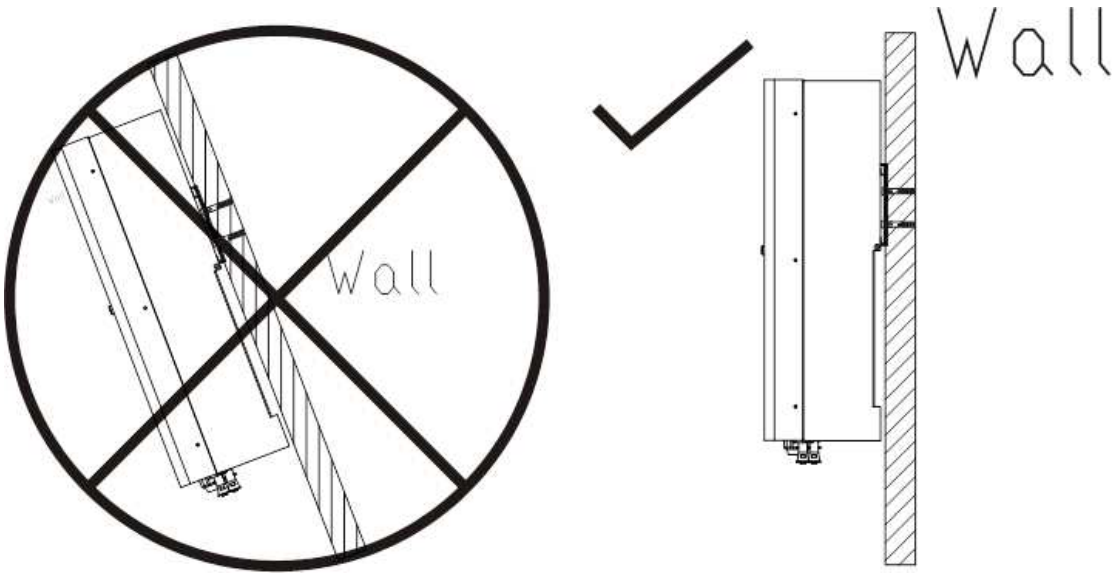
- The ambient temperature of the PV Inverter is within the specified range (-20 to +55°C).

For optimum operation we recommend an ambient temperature within the range of 0 to +40°C.

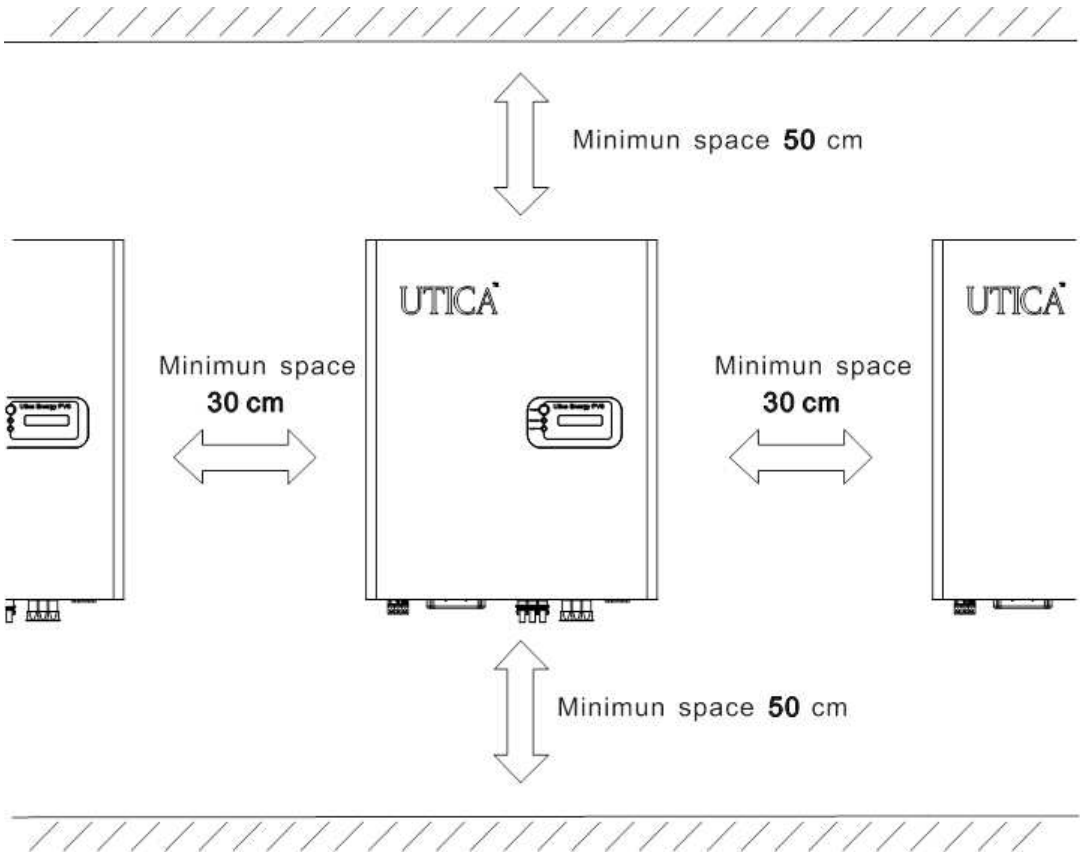
- The AC grid voltage is between 212 and 256 VAC, 50Hz.
- The electricity utility company has approved connection to the grid.
- Qualified personnel are performing for the installation process.
- Adequate ventilation space is provided around the Inverter.
- The Inverter is installed in a room free from explosive vapors.
- No flammable items are near the Inverter.

6.2 Wall mounting

(1) Select a wall or solid vertical surface which can adequately support the weight of the Inverter. Do not install the Inverter at an angle.



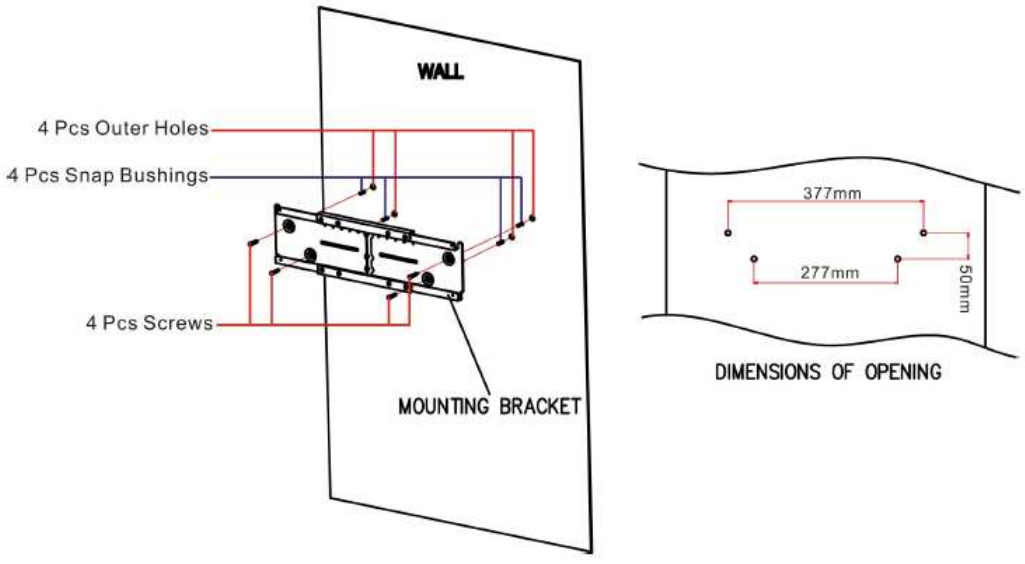
(2) The Grid PV Inverter requires adequate cooling space. Allow at least 50cm space above and below the Inverter.



(3) Use the mounting frame as a template; drill 3 or 4 holes according to the installation requirements (as shown in the figures).

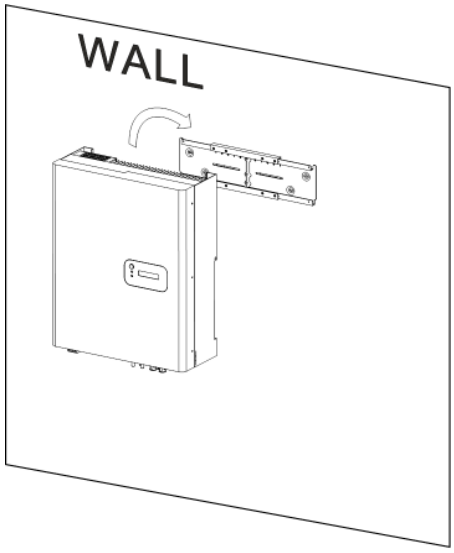
(4) Fix the mounting frame as shown.

(5) Hang the Inverter on the mounting frame.

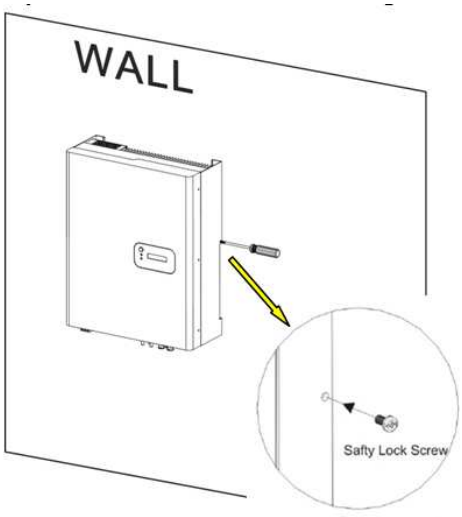


(6) Check the installation conditions

a) Check the upper straps of the Inverter, making sure they fit perfectly into the bracket.



b) Insert the safety-lock screws on the bottom leg to secure the Inverter.



Check the Inverter is secure by trying to lift the Inverter vertically from the bracket.

Select the installation location such that the Inverter display can be viewed easily. Choose a strong mounting wall to prevent vibration whilst the PV Inverter is operating.

6.3 Installation

Comply with all necessary national and international installation standards, especially series IEC 60364 Part 7-712.

Requirements' for special installations - Solar photovoltaic (PV) power supply systems.

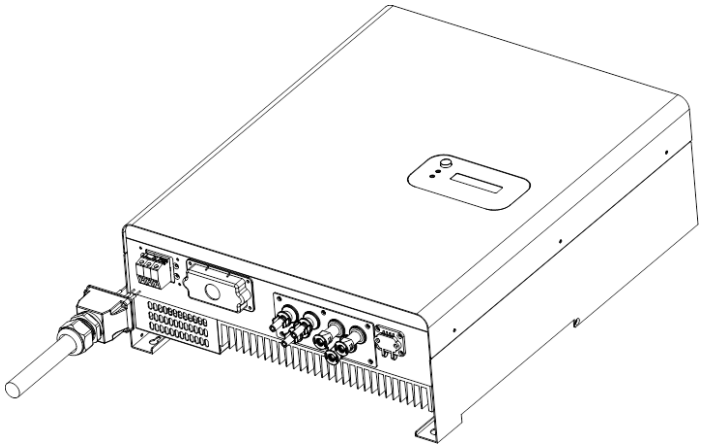
6.3.1 Connection to the grid (AC side)

(1) Measure the grid (utility) voltage and frequency. It should be 230VAC (or 220VAC), 50Hz single phase.

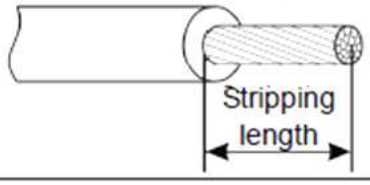
(2) Open the breaker or fuse located between the Inverter and the grid.

(3) Use the correct cross-section for wiring (according to IEC 60364-4-43 and your national installation standards).

Suggested minimum cross-sections:



Model	AC Power	Cross section		Stripping length
		Stranded wire	Solid wire	
	[W]	[mm²]		mm
Utica Energy PV6	6000	6~8	6~8	10



- Refer to the diagram on the right.
- Insert the utility cable through the cable gland. Connect the wires according to the polarity indicated on the terminal block.

  L → Line (brown, black,

White, blue, grey are usually used for N (according to NEC).

N → Neutral (blue)

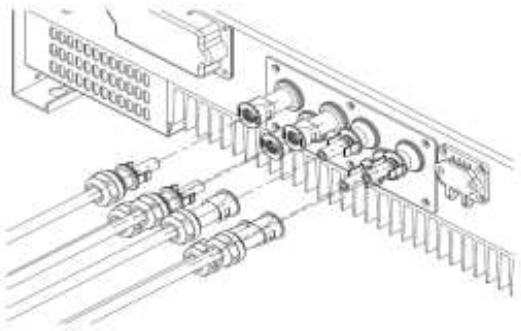
PE → System ground (green-yellow)

- Secure the gland plate with the supplied screws.
- Rotate the gland until the cable is firmly secured.
- We recommend a 30mA or 100 mA Type A RCD for additional protection as per IEC 60364-4-41 Clause 412.5

6.3.2 Connection to PV panel (DC input)

(1) Make sure that the maximum open circuit voltage (VOC) of each PV string Is less than listed in the table below:

Model	Voc	Max. Current
	[VDC]	[ADC]
Utica Energy PV6	≤ 550	27.5



(2) Use MC4 or compatibly MC4 (Multi-contact®) connectors for the DC wiring. (ex: Wieland PST40il)

(3) Connect the positive wire from the PV array to the (+) terminal and the negative wire to the (-) terminals. Each DC terminal is rated to a maximum of 27.5ADC.

Cover the unused MC4 plugs on the PV Inverter with protection covers.

Before energizing the PV Inverter, please ensure that the polarity is correct. Incorrect polarity connection could cause permanent damage to the PV Inverter.

Check the short-circuit current, ISC, of the connected PV array.

ISC should be less than the PV Inverter's maximum DC input current.

High voltages arise when the PV array is exposed to the sun. This can cause an electric shock in conjunction with exposed live components. Always be very careful when handling the PV modules / array and any connections. Ensure touch protection for individuals.

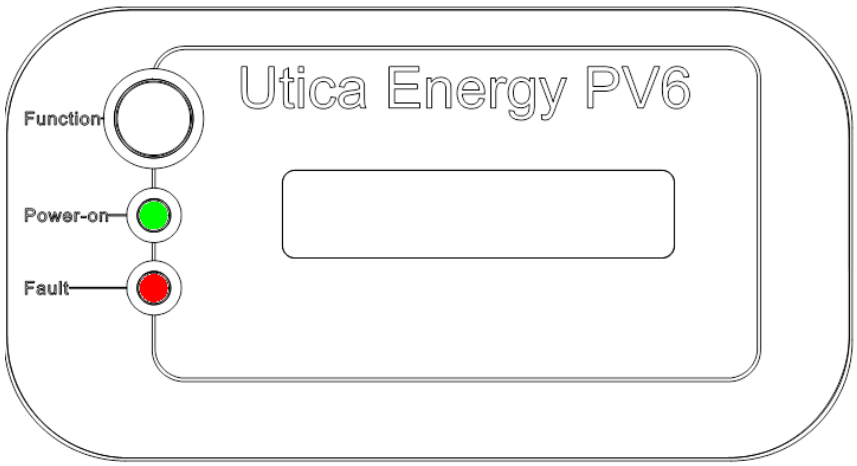
6.4 Checking and start-up after installation

(1) Follow the messages on the display

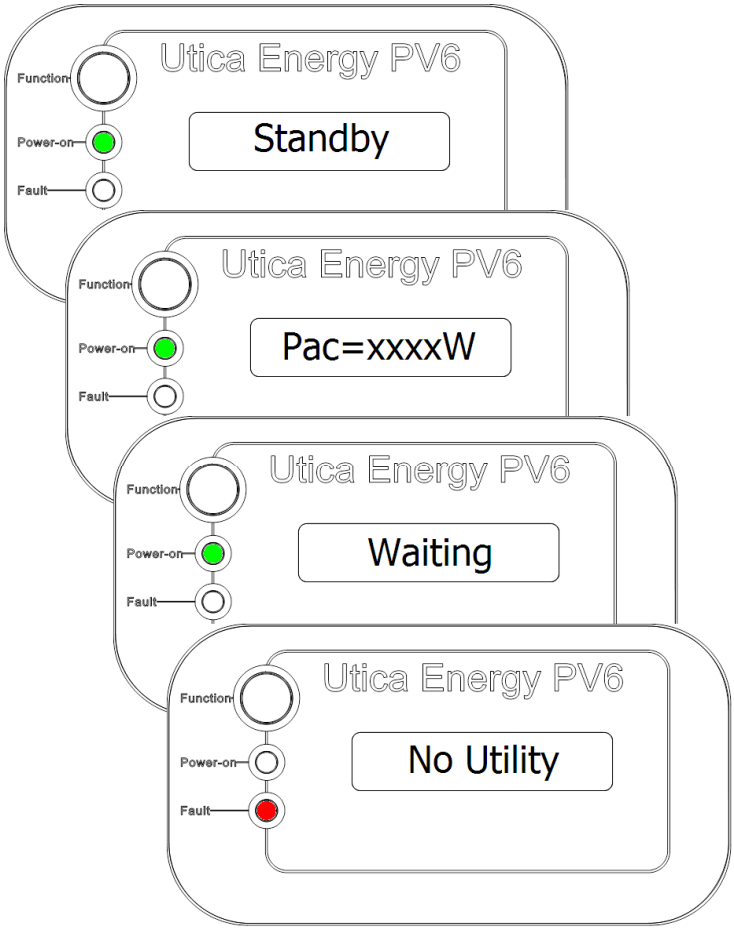
These are: Power ON LED (Green)

Fault LED (Red)

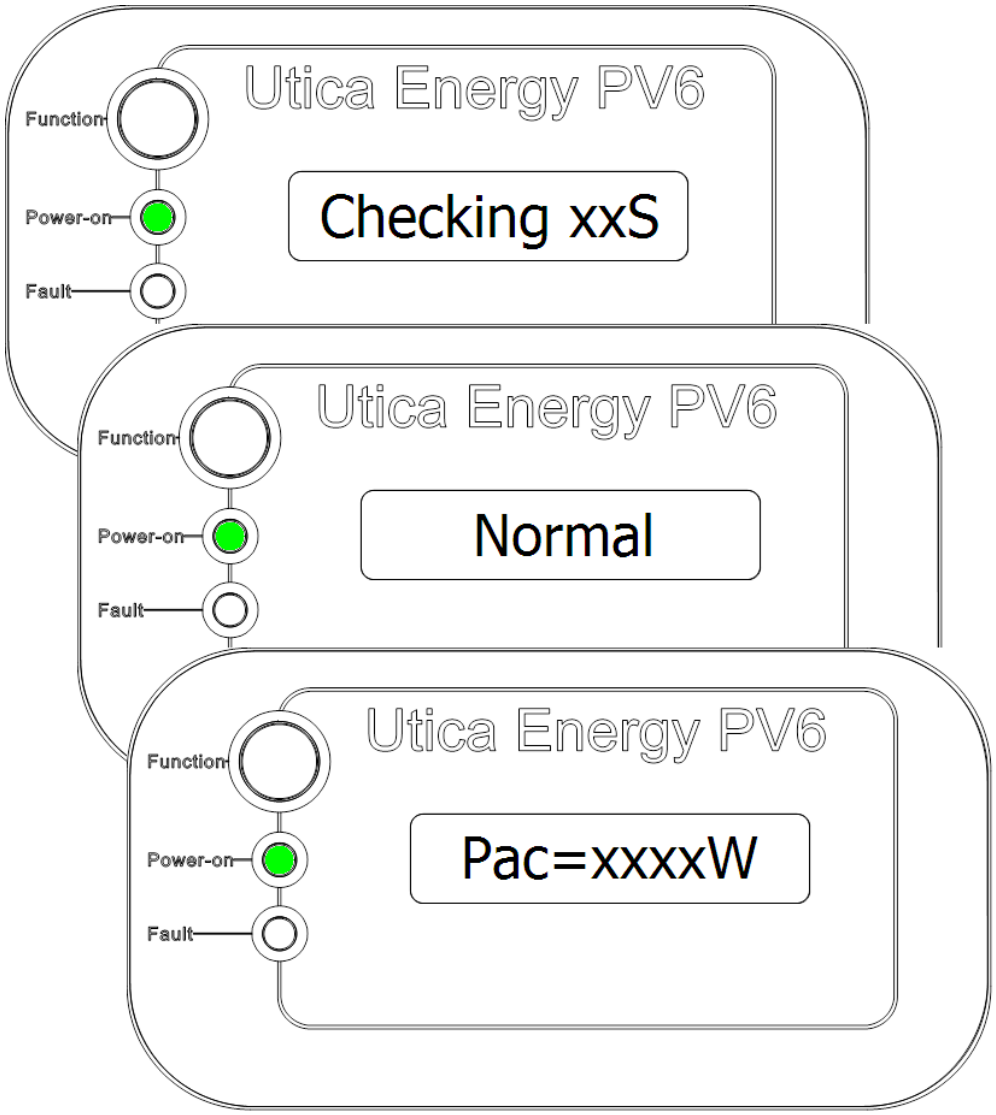
LCD Display



When the PV array is connected and the input voltage is higher than 180VDC, if the AC grid is not connected the LCD will display the following message "Standby" -> “XXXX W" -> "Waiting" -> "No Utility". In this status the "No Utility" message will remain and the RED Fault LED is illuminated.



(2) Close the AC breaker or fuse between the PV Inverter and the grid. The PV Inverter status should change to normal operation after a countdown "Checking xxS" if the PV array is energizing with a DC voltage higher than 180VDC.



7. Operating PV-Inverter

7.1 Modes of operation

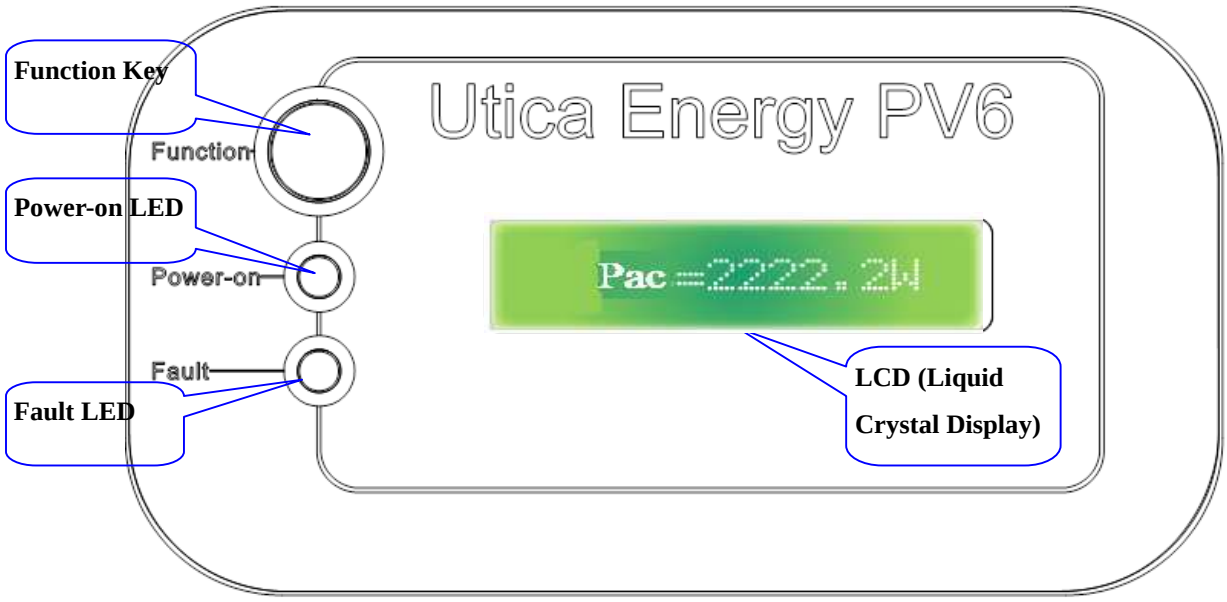
There are 3 different modes of operation.

(1) **Normal mode**: In this mode, Utica Energy PV6 inverter works normally. Whenever the supplied power from PV panel is sufficient (voltage>180VDC), Utica Energy PV6 inverter converts power to the grid as generated by the PV panel. If the power is insufficient, (voltage<130VDC) Utica Energy PV6 inverter enters a "waiting" state. While "waiting" Utica Energy PV6 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 Utica Energy PV6 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, Utica Energy PV6 inverter automatically stops running. In this mode, Utica Energy PV6 inverter does not take any power from the grid. The display and LED's on the front panel do not work.

7.2 Front Panel arrangement



7.3 Front Panel

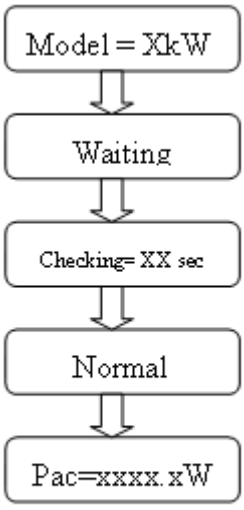
Operating Utica Energy PV6 inverter is quite easy. During normal operation, Utica Energy PV6 inverter runs automatically. However, to achieve maximum conversion efficiency of Utica Energy PV6 inverter please read the following information:

(1) Automatic ON-OFF: Utica Energy PV6 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 130V, Utica Energy PV6 inverter enters a “waiting” state and attempts to connect to the grid.
- **Normal operation**: When PV string DC voltage is greater than 180V, Utica operates in the normal state. In this state, it feeds power to the grid.

  Utica Energy PV6 inverter automatically stops when the PV power is not enough.

(2) Starting-up display sequence: Once the PV power is sufficient, Utica Energy PV6 inverter displays information as shown in the flow chart to the right.



Information during start-up

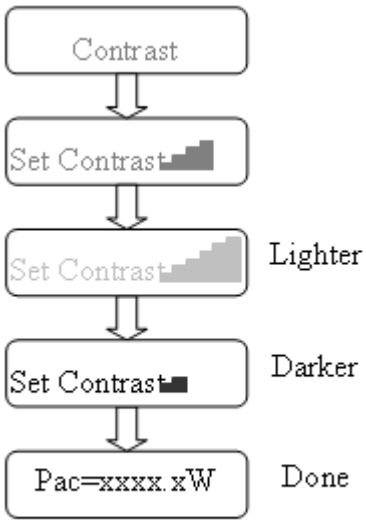
(3) Change display information: During normal operation, Utica Energy PV6 inverter can show details about the PV-Inverter. The display is setup to automatically indicate the supplying power to the grid. Press the “Function” button on the front panel and release it immediately to see additional information. 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.

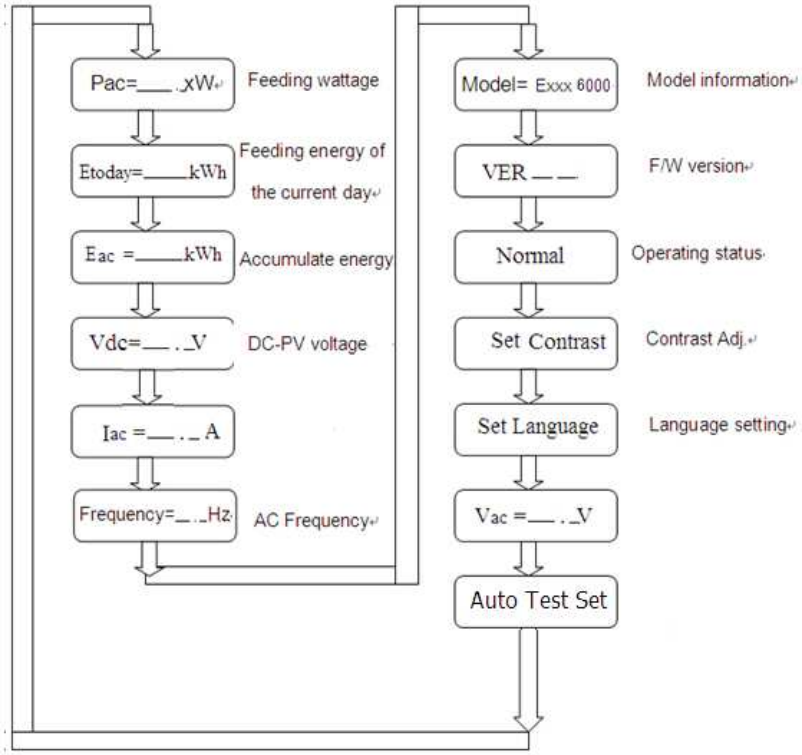
(5) LCD backlight control: To save power, the LCD display’s backlight automatically turns off after 30 seconds. To enable it, press the “Function” key again.

(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 “Pac=xxxx.xW”.
e. Setting completed



Contrast setup



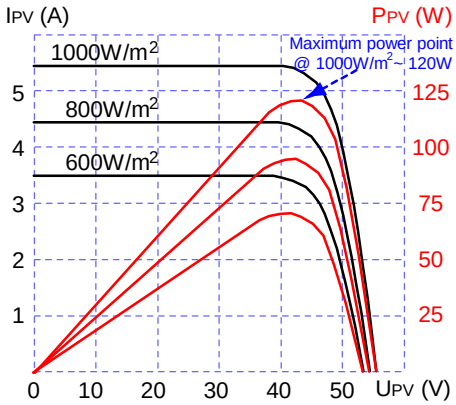
LCD Display

7.4 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 ±2%. In all ranges of operation, the accuracy is up to ±5%.

8. 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, Utica Energy PV6 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, Utica Energy PV6 inverter is converting the maximum power from panels. When the LCD power reading is significantly changes, Utica Energy PV6 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.

9. Communication

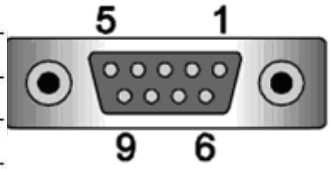
The Inverter is equipped with a powerful communication interface and options. The user can use software to monitor the status of the Inverter. Qualified personnel can also upgrade the firmware via the RS232 port.

Optional communication slot: the Inverter can accept various special cards designed for this slot only these provide powerful interfacing.

RS232: to use the RS232 port, remove the RS232 cover from the underside of the inverter. This is a DB9 socket and the pin-out is as follows:

DB9 connector pin definition

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.



TxD : *Data transmission.*
RxD : *Data reception.*
N.C. : *Not Connected.*

ATTENTION: If you are already using an optional communication card slot device, the RS232 port cannot be used!

10. Display message table

The PV Inverter requires very little attention in most situations. However, if the inverter is not working correctly, please refer to the following instructions before calling your local dealer. Users will usually be able to solve most problems.

- Whenever the Red Fault LED is illuminated, the LCD will display information about the problem. Please read this information and refer to the table below:

Operating conditions	In English	Description
Normal Working Status		
Power off	No display	PV inverter is totally shutdown, V_{PV} <100V.
Standby	Standby	100V< Input voltage <130V.
Initialization & waiting	Waiting	Input voltage range 130~180V during start-up. After PV voltage is higher than 150V, inverter is waiting for feeding to grid.
Check grid	Checking xxxs	When PV voltage> 180V, inverter is checking feeding conditions.
Feeding grid, MPPT	Normal	Inverter is feeding power. After 10 seconds of this display, LCD will show wattage.
FLASH	FLASH	Flash firmware
Monitoring Parameters		
Instantaneous Output power	Pac=xxxx.xW	The real time output power in xxxx W.
Accumulated energy information	Energy=xxxxxxkWh	Total energy to has been fed to grid since inverter was installed.
Grid voltage	Vac=xxx.xV	Grid voltage in xxx.x VAC.
Grid frequency	Frequency=xx.xHz	Grid frequency in xx.x Hz.
Feeding current	AC-Current=xx.xA	Feeding current amount in xx.x A.
PV array voltage	Vdc= xxx.x V	Input voltage from the PV array, xxx.x VDC.
Daily Energy	Etoday=xxx.xxkWh	The accumulated kWh of that day.
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

Operating conditions	In English	Description
Input voltage too high	PV over voltage	Input voltage higher than the maximum input voltage
Inverter Fault		
Consistent failure	Consistent Fault	The readings of 2 microprocessors are not consistent. It could be caused by CPU and/or other circuit do not function well.
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 failure between microprocessors	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 prolem	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.
System Information		
Model display	Utica Energy PV6	Inverter model
LCD contrast	Contrast	The top menu of LCD contrast setting
LCD contrast setting	Set Contrast	Setting the contrast of LCD
LCD display lock	Lock	Hold the present display message.
Waiting for reconnect to grid	Reconnect xxxs	The time for reconnect to grid.
Firmware version	Ver xx.xx	F/W version information.

Operating conditions	In English	Description
Setting Language	Set Language	Set up of the display language.

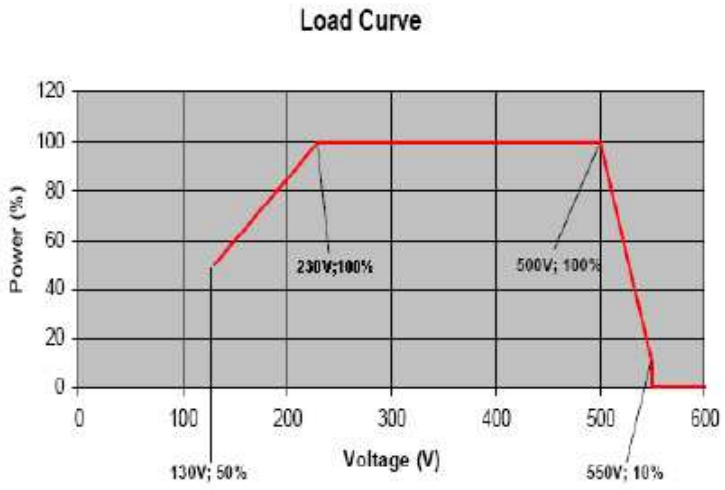
11. Electrical specification

Model	Utica Energy PV6
Grid interface regulation	G83/1-1
Input (DC)	
Nominal DC voltage	380V
Max. PV open voltage	550V
System start-up voltage	Typical 150 V
Initial feeding voltage	180 V
Shutdown voltage	100V
Working voltage range[1]	130 ~ 550 V
MPPT voltage range	150 ~ 500 V
MPPT efficiency	> 99%
Number of MPP tracker(s)	1
Max. DC current per tracker	27.5A
DC voltage ripple	< 10%
DC insulation resistance[2]	>5MΩ
Output (AC)	
Nominal AC power	6000W
Max. AC power (in 10 minutes)	6000W
Nominal voltage	230V
Operational voltage range[3] (FW Setting)	212~256 V
Nominal frequency	50Hz
Operational frequency range[4] (FW Setting)	47.05~50.45Hz
AC wiring system	Single phase
Nominal AC current	26 A
Max. AC current	28.6 A
O/P current distortion (THD i)	< 3%
Power Factor	> 0.99
Efficiency	

[1] Which is the DC voltage range that inverter can feed power to grid.
[2] The DC resistance requirement for positive or negative terminal to chassis ground
[3] Regulation voltage range is 207~264 VAC according to G83/1-1
[4] Regulation frequency range is 47~50.5Hz according to G83/1-1

Model	Utica Energy PV6
Max. conversion efficiency	97%
European efficiency	95%
General Data	
Topology	Transformer-less
Power consumption: standby / night	< 8W / < 0.1W
Protection degree	IP65
Heat dissipation	Convection
Operating temperature range	-20 ~ +55℃
Humidity	0 to 95%, non-condensing
Altitude	Up to 2000m without power derating
Communication	RS232 standard and RS485
Hazard substance restriction	Lead free, complied with RoHS GP2
RS485 Protocol	Standard protocol, Eaton Phoenixtec MMPL proprietary protocol
Normative references	
Grid interface regulation	G83/1-1
Safety	DIN EN 50178 (4.98) (VDE0160) (IEC62103)
EMC: EMS / EMI	EN 61000-6-2 (2005) / EN 61000-6-3 (2007)
CE	LVD: 2006/95/EC EMC: 2004/108/EC

11.1 Load graphs for Utica Energy PV6



Note: Test equipment tolerances and deviation between products may cause the test results to be slightly different.

12. Mechanical requirements

12.1 Dimension

Model	Utica Energy PV6
Dimension W×D×H (mm)	429.8 x 171.3 x 531.8

12.2 Weight

Model	Utica Energy PV6
Net weight	34.5
Gross weight	39.5

12.3 Installation method

Model	Utica Energy PV6
Wall mounted	Yes
Tower orientation	No

12.4 Connection of wires

Model	Utica Energy PV6
DC side pair(s) (+,-) MC connectors	3
AC side	Terminal block labeled with L, N and PE
Wire diameter range	Multibrainded: 6.0~8.0 mm^2; Solidcore: 6.0~8.0 mm^2

13. Troubleshooting

In most situations, the Utica inverter requires very little service. However, if Utica® 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	1. Check the impedance is between PV (+) & PV (-) and the PV-Inverter is earthed. The impedance must be greater than 5MΩ. 2. If the problem persists please call service
	Ground I Fault	1. The ground current is too high. 2. Unplug the inputs from the PV generator and check the peripheral AC system. 3. After the cause is cleared, re-plug the PV panel and check PV-Inverter status. 4. If the problem persists please call service.
	Grid Fault	1. Wait for 30 seconds, if the grid returns to normal, PV-Inverter automatically restarts. 2. Make sure grid voltage and frequency meet the specifications. 3. If the problem persists please call service.
	PV over Voltage	1. Check open PV voltage, see if it is too close to or over 550VDC. 2. If PV voltage is less than 550Vdc, and the problem still occurs, please call service.
	No Utility	1. Grid is not connected. 2. Check grid connection cables. 3. Check grid usability.
	Consistent Fault	1. Disconnect PV (+) or PV (-) from the input, restart the PV-Inverter 2. If it does not work, call service
	Over Temperature	1. The internal temperature is higher than specified normal value 2. Find a way to reduce the ambient temperature. 3. Or move the inverter to a cooler environment 4. If it is not effective, call local service
	Relay Failure	1. Disconnect ALL PV (+) or PV (-) 2. Wait for few seconds 3. After the LCD switches off, reconnect and check again 4. If the message reappears call your local service
	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 180V, 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.

14. Preventative maintenance

Although PV-Inverter requires very little maintenance, the following inspections at regularly would help to ensure PV Inverter operation with optimal performance.

14.1 Visual Inspection

Check the inverter and cables for any signs of external damage. Contact your installer immediately if you find any defects. **Do not carry out any repairs on your own**.

14.2 Checking and Maintenance

Asking your installer to check for proper inverter operation at regularly is the measure we suggested for preventative maintenance. The following check is the key:

(1) Check If the fan guard is covered with debris or dust, get rid of it if find any.
(2) Check heat sink to ensure no barrier blocking its air flow.
(3) Inspect for corrosion, especially at connecting point.
(4) Verify all connections are firmly tightened periodically.
(5) Clean the exterior of the unit periodically with a damp cloth to prevent accumulation of dust and dirt, Keep warranty label intact anyhow.
(6) To get optimal performance, PV-panel cleaning periodically would also be essential due to it is prone to dust and dirt accumulation.

Before cleaning PV-panel or Inverter, be sure to switch off AC power and double check LCD of Inverter displaying “No Utility”, cleaning shall be restricted to the exterior surface.

To avoid any risk of electric shock, AC and DC power shall be switched off whenever personnel need to contact PV-panel under any circumstances.

15. Regulation & Certificate

Compliance & Standards

EMC:

IEC 61000-6-2: Electromagnetic compatibility (EMC) –Part 6-2: Generic standards – Immunity for industrial environments.

IEC 61000-6-3: Electromagnetic compatibility (EMC) –Part 6-3: Generic standards –Emission standard for residential, commercial and light-industrial environments.

IEC 61000-3-11: Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subjet to conditional connection.

IEC 61000-3-12: Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤ 75 A per phase.

EN 55014-1: Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission.

IEC 61000-4-2: Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test.

IEC 61000-4-3: Electromagnetic compatibility (EMC) - Part 4-3 : Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.

IEC 61000-4-4: Electromagnetic compatibility (EMC) – Part 4-4:Testing and measurement techniques – Electrical fast transient/burst immunity test.

IEC 61000-4-5: Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test.

IEC 61000-4-6: Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.

IEC 61000-4-8: Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test.

IEC 61000-4-11: Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests.

Grid Monitoring:

G83/1-1: Recommendations for the Connection of Small-Scale Embedded Generators in Parallel with Public Low-Voltage Networks.

Safety:

IEC 60529: Degrees of protection provided by enclosures (IP Code)

IEC 62103: Electronic equipment for use in power installations

IEC 61683: Photovoltaic systems –Power conditioners –Procedure for measuring efficiency