GESOLAR

Build and Beyond

Operating Manual

On Grid PV Inverters
Without Transformer

GES-15KTL/20KTL

Safety

SAVE THESE INSTRUCTIONS– This manual contains important instructions for Models GES-15KTL and GES-20KTL that shall be followed during installation and maintenance of the GESOLAR inverter.

Safety Precautions/Safety Notes

Only the trained qualified electrical personnel are allowed to perform the electrical installation, wiring, opening and repair of the inverters. Even when no external voltage is present, the inverters can still contain high voltages and the risk of electrical shock.

The temperature of the heat sinks outside of the device can reach over 70°C (158°F) in normal operation (Ambient temperature rating: 45°C / 113°F). There is the risk of burn injury when these parts are touched.

The following general safety precautions must be observed during all phases of operation, service, installation and repair of this device. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the device. The manufacturer assumes no liability for the customer's failure to comply with these requirements.

Safety Symbols

To reduce the risk of injury and to ensure the continued safe operation of this product, the following safety instructions and warnings are marked in this manual.



Warning, risk of electric shock

Presents safety information to prevent injury or death to users and/or installers.



Earth ground symbol



Caution

Presents information to prevent damage to this product.

Intended Use

GESOLAR inverters shall be installed according to the specific codes and regulations of your local building and safety department to meet the following qualifications:

- Electrical installation must be carried out correctly to meet the applicable regulations and standards;
- The inverters shall be mounted in a well ventilated environment for protection against rain, condensation, moisture and dust;
- The inverters shall be installed in a permanent location according to the instructions stated in this manual;
- The inverters shall operate according to the technical specifications as stated in this manual.

General Safety Precautions

- Personnel must remove all conductive jewelry or personal equipment prior to installation or service of the device, parts, connectors, and/or wiring.
- Trained qualified personnel are required to mount, reconfigure or repair this device.
- Licensed electricians are required to install permanently wired equipment.
- Stand on an insulated surface when working on the operating device (i.e., ensure that there is no grounding).
- Instructions in this manual must be precisely followed and all information on cautions or warnings must be adhered to.
- Use proper lifting techniques whenever handling enclosure, equipment or parts.
- The inverter must be provided with an equipment-grounding conductor connected according to local codes and regulations.
- The AC Neutral connection is only for voltage sensing and shall be neither used to carry currents nor bonded to ground inside the inverter.
- The list does not contain all measures pertinent to the safe operation of the device. If special problems arise which are not described in sufficient detail for the purposes of the buyer, contact your specialized dealer or technician.

Safe Installation and Operation

- Installation of the device must be in accordance with the relevant national or local regulations. Correct grounding and short circuit protection must be provided to ensure operational safety.
- Read all instructions and cautionary remarks in the manual before installation.
- Switch off the circuit breakers before installation and wirings. Avoid standing water when working on the inverter.
- PV arrays will be energized when exposed to light. Cover the arrays with opaque (dark) material during installation and wiring.
- Check both of the AC and DC connections with a digital volt meter prior to any installation or removal procedures.
- Close the cover properly before switching on the circuit breakers.
- Not to install the inverter exposed to sunlight directly.
- When no external voltage is present; the inverter can still contain high voltages and the risk of electrical shock.
- Allow at least 5 minutes for the inverter to discharge completely after disconnecting the AC and DC sources from the inverter.
- External heat sinks can reach high enough temperature in normal operation and cause skin burn injury when touched. Pay attention to high temperature.
- To prevent the risk of fire hazard, do not cover or obstruct the heat sink.
- Changes in your electrical system are carried out only by qualified electricians.

Wiring the inverter



WARNING!

All electrical installation and the wiring methods shall be done in accordance with the relevant national or local electrical regulations and should follow the important safety instructions in this manual.



WARNING!

Make sure that you use suitable connecting cables for both the AC and DC wirings. The cables must be adequately dimensioned and suitably inert to temperature fluctuation, UV radiation and other possible hazards.



WARNING!

Reconfirm that all connections have been performed properly and all screws are properly tightened.

Connection of the DC cable

For DC Input Terminals, use wire size 10 to 16 mm^2 (#8 to #6 AWG),

90°C (194°F) Copper Wire.



CAUTION!

Identify the different polarity of DC voltage on each PV string and connect respectively to the input terminals. Make sure the DC voltage that PV arrays generate is equal or less than 850 VDC in any case.



WARNING!

Route the DC connection cables to the inverters away from any possible hazards that could damage the cables.



WARNING!

Hazardous voltage is still present on the device after disconnection of all PV DC inputs. Allow 5 minutes for the inverter to discharge the energy completely.



WARNING!

PV arrays will be energized when exposed to light. Cover the arrays with opaque materials during installation and wiring.

Connection of the AC cable

For AC Output Terminals, use wire size 6 to 10 mm^2 (#10 to #8 AWG), 90°C (194°F) Copper Wire.



WARNING!

Reconfirm that the circuit breaker to the mains utility is switched OFF before connecting the power cables from the breaker to the AC connector.

Interaction with a Utility



CAUTION!

The default interface protection has been verified according to the valid low-voltage grid connection standards. Only the authorized installers can change the tripping-limit settings under the approval of the distribution network operator (DNO).



CAUTION!

Confirm the grid connection standard is selected correctly before tied with the grid (Std. DK5940 (ENEL 2010) for Italy, VDE0126-1-1 for Germany or RD1663 for Spain). Please refer to the Section 3.3.5 Setting Operation for the selection of the grid connection standards.



CAUTION!

The default interface protection is saved permanently in the EEPROM and won't be erased even if the inverter shuts down.

Repair and Maintenance

The inverter contains no user serviceable parts inside, except for the fans. Only GESOLAR trained staff is authorized to repair the unit. Please return the equipment for further examination if the faults are not caused by fans.



WARNING!

Not to make alterations or use tampering assembly in the inverter without manufacturer's authorization unless specified elsewhere in this Manual. They may result in injury, electric shock, or fire and void the warranty.

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1. Introduction

1.1 General

The GESOLAR product family is a series of grid-connected photovoltaic inverters which are designed to convert DC power generated by photovoltaic arrays to AC power that is delivered to the home loads and then fed into the utility grid with any excess power. The GES-15KTL and GES-20KTL are the members of the family with three (3) phases AC outputs for the European market. The overview of the grid-connected solar energy system is shown in Fig 1.1.1. The inverters utilize the state-of-the-art technology to achieve the purpose of high reliability and ease of use. In addition, GES-15KTL and GES-20KTL comply with the requirements of VDE0126-1-1, RD1663/RD661, DK5940/Enel Connections Guide (2010), Section F Standards. Also the 3-phase inverters are certified to comply with the Standard EN50178 and EN55022 EMC Regulations with Class A device.

The GESOLAR inverter is designed to operate automatically once it is installed and commissioned correctly according to the technical specifications. When the DC input voltage generated by the photovoltaic arrays raises above the minimum MPPT voltage setting, the embedded controller starts and goes into the system initialization mode. If the DC input voltage goes above the PV Start voltage point, the inverter will go into Checking mode (Riso check) and monitor all parameters needed for grid connection. During this time, the inverter is not generating AC power yet. Once all conditions necessary for grid connection are satisfied, the inverter goes into the Grid/MPP mode and begins feeding the AC power into the grid. When the input DC voltage falls below the pre-set threshold

voltage setting, the inverter will then shut off the output AC power. And the inverter will shut down itself when the DC input voltage is under the minimum MPPT voltage setting. The inverter will be awakened again automatically when the input DC voltage rises above the minimum MPPT voltage point.

We appreciated your choice of GESOLAR inverters for your power conversion devices in your solar power system. This document contains the information you need for the installation and settings of the inverters. Therefore, it is strongly recommended to read this manual carefully before the inverter installation and settings.

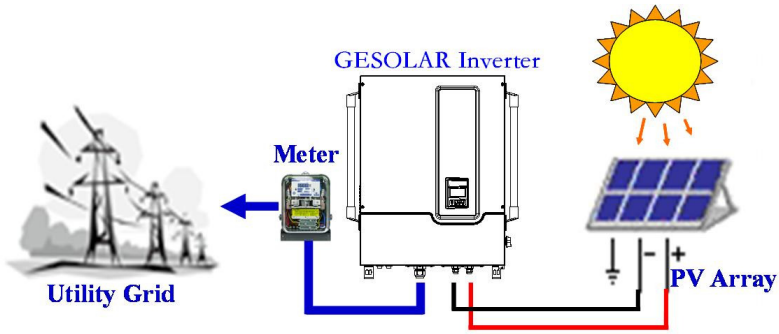


Fig1.1.1 Grid Connected Solar System Overview

1.2 Specifications

Specifications for GES-15KTL and GES-20KTL

Name-Part number	**GES-15KTL**	**GES-20KTL**
Grid output (AC)		
Grid voltage, nominal	400VAC 3PH/N/PE	
Grid voltage, operating range	320 ~ 460VAC	
Grid frequency, nominal	50 Hz	
Grid frequency, operating range	48~52.5 Hz (adjustable)*	
Nominal Output Power	15,000 W	20,000 W (19,990W**)
Maximum output power	16,500 W	22,000 W
Nominal Output Current	21.8 A	29.0 A
Maximum Output Current	23.9 A	31.9 A (31.88A**)
Waveform	True sine	
Power factor	> 0.99 @ nominal power	
Total Harmonic Distortion	< 5 %	
DC Component	< 0.5 %	
Phase	Three Phase balanced output	
Solar input (DC)		
Maximum DC Power	17,300 W	23,100 W
Maximum input voltage	850 VDC	
Input voltage range	200 ~ 850 VDC	
MPP voltage range	250 ~ 850 VDC	
PV start voltage	300~800 VDC (adjustable)	
Nominal voltage	630 VDC	
Nominal input current	2x13.8A (27.6 A)	2x18.4A (36.8A)

Maximum input current	2x21.7A (43.4A)	2x29.0A (58.0 A)
General		
Name-Part number	**GES 15KTL**	**GESOLAR 20KTL**
Maximum efficiency	96.5 %	97.0 %
European efficiency	95.5 %	96.0 %
Night consumption	< 1W	
Environmental		
Operating temperature range	-25° ~ +60°C (-13° ~ +140°F)	
Storage temperature range	-25° ~ +70°C (-13° ~ +158°F)	
Maximum full power operating ambient	50°C (122°F)	45°C (113°F)
Relative humidity	Max. 95 %	
Mechanical		
Outdoor enclosure	IP55, ref. IEC 60529(2001)	
Cooling	Intelligent control fan	
Input & Output terminals	DC input - Accept wire size of 10 to 16 mm^2 (#8 to #6 AWG) AC output - Accept wire size of 6 to 10 mm^2 (#10 to #8 AWG)	
Weight/Shipping weight	71.5 kg / 85kg (165.3 lb / 187.3 lb)	
Dimensions (HxWxD)	890.5x751x245.5 mm (35.1x29.6x9.7 inches)	
Shipping dimensions (HxWxD)	1130x900x700 mm (44.6x35.5x27.6 inches)	
Interface		
Communication	RS232 and RS485	
Display	128 * 64 graphic display	
Certifications		
Electromagnet Compatibility	Directive 2004/108/EC EN 55022(1998) : IEC/CISPR22 EN 61000-6-2(2005) EN 61000-6-4(2007) EN 61000-3-11(2000)	

	EN 61000-3-12(2004)
Low-Voltage Regulation	Directive 2006/95/EC EN 50178(1997), covered by IEC 62103(2003)
Network Monitoring	VDE 0126-1-1(2006), RD 1663(2000) / RD 661 (2007), DK 5940(2007) / Enel Connections Guide (2010), Section F, AS3100, AS4777.2 & AS4777.3, PPC
RoHS	Directive 2002/95/EC

* Some factory settings can be re-configured with the approval of the local utility provider. This inverter is provided with adjustable trip limits and may be aggregated over 200kW on a single Point of Common Coupling.

** The output power capacity 19.99 kW is for DK5940 (ENEL 2010) only.

Adjustable voltage, Frequency and Reconnection Settings (1)

Setting	DK5940 (ENEL 2010)		VDE0126-1-1	
	Range	Default	Range	Default
Over-frequency (Hz)	50.05~50.95	50.25	50.05~50.15	50.15
Over-frequency disconnection time (cycle)	1~3	3	1~8	8
Under-frequency (Hz)	49.05~49.95	49.75	47.55~49.95	47.55
Under-frequency disconnection time (cycle)	1~4	4	1~8	8
Over-voltage (Vac)	235~270	270	235~260	260
Over-voltage disconnection time (cycle)	1~4	4	1~8	8
Under-voltage (Vac)	188~225	188	188~225	188
Under-voltage disconnection time (cycle)	1~8	8	1~8	8
Dc injection tripping current (A)	0.10~0.60	0.60	0.10~0.80	0.80
Dc injection disconnection time (cycle)	1~4	4	1~8	8
Insulation resistance trip setting (MOhm)	0.5~10	1.0	0.5~10	1.0
PV start voltage (Vdc)	400~800	400	400~800	400
Reconnect delay* (s)	20~300	20	30~300	30

***** Once a grid failure occurred, the inverter waits 20~600 seconds before the next connection to the grid. The default setting is 20 seconds for DK (Italy), 30 seconds for VDE (Germany) and 180 seconds for RD1663 (Spain).

Adjustable voltage, Frequency and Reconnection Settings (2)

Setting	RD1663		User	
	Range	Default	Range	Default
Over-frequency (Hz)	50.05~50.95	50.95	50.05~54.50	50.95
Over-frequency disconnection time (cycle)	1~8	8	1~250	4
Under-frequency (Hz)	48.05~49.95	48.05	45.50~49.95	49.05
Under-frequency disconnection time (cycle)	1~8	8	1~250	4
Over-voltage (Vac)	235~249	249	235~276	264
Over-voltage disconnection time (cycle)	1~8	8	1~150	4
Under-voltage (Vac)	199~225	199	160~225	196
Under-voltage disconnection time (cycle)	1~8	8	1~150	4
Dc injection tripping current (A)	0.10~0.80	0.80	0.10~0.80	0.80
Dc injection disconnection time (cycle)	1~150	8	1~150	8
Insulation resistance trip setting (MOhm)	0.5~10	1.0	0.5~10	1.0
PV start voltage (Vdc)	400~800	400	400~800	400
Reconnect delay* (s)	180~300	180	20~600	20

***** Once a grid failure occurred, the inverter waits 20~600 seconds before the next connection to the grid. The default setting is 20 seconds for DK (Italy), 30 seconds for VDE (Germany) and 180 seconds for RD1663 (Spain).

Measurement precision

	Range	Resolution		Accuracy
		Display	Measurement	
Input voltage (VDC)	0~900V	0.1V	0.3V	±2V
Input Current (IDC)	0~50000mA	100mA	15mA	±500mA
Grid voltage (VAC)	0~300V	0.1V	0.3V	±1V
Grid current (IAC)	0~60000mA	100mA	30mA	±500mA
Grid frequency (Hz)	45~65Hz	0.01Hz	0.001Hz	±0.02Hz
Output power (W)	0~22000W	1W	1W	±50W
Energy yield (kWh)	$0\sim65535\times10^{3}$kWh	0.1kWh	2.2×10^{-6}kWh	1%

1.3 Features

☼ High conversion efficiency

☼ Dual-MPP trackers (Can be connected in parallel)

☼ IP55 enclosure (Outdoor)

☼ Graphical display (Internal mini-datalogger)

☼ Three-phase balanced outputs

☼ Easy installation

☼ Smart self-diagnostics

☼ High power / small size ratio

☼ High reliability @ competitive price

☼ Conformity to VDE 0126-1-1 (ENS), RD1663/RD661,

DK5940/Enel Connections Guide (2010), Section F

AS3100, AS4777.2 & AS4777.3, PPC

1.4 Accessories

- Operation Manual (incl. warranty page) 1 pcs
- Mounting Bracket 1 pcs
- Fixing screws (bet. the inverter and bracket) 2 pcs
- Cross jumper (for input terminal) 1 pcs
- Auto Test Software CD-ROM 1 pcs
- Mounting screws 10 pcs

2. Installation

2.1 Placement

- GESOLAR inverters that must be vertically mounted can be located indoors or outdoors according to protection degree of enclosure IP55.
- Leave at least 50 cm (19.7 inches) of free space above and 100 cm (39.4 inches) below the inverter when installed outdoors. Allow 20 cm (7.9 inches) between inverters when installing multiple inverters for better ventilation (see Fig 2.1.1).
- Mount the inverter on a wall that is strong enough to sustain the inverter with 75 kg weight.
- Avoid mounting the inverter on a location directly exposed to sunlight to maintain the ambient temperature of the inverter within -25° and 60 °C (-13° and 140°F). Humidity shall be within 0% and 95%.



WARNING!

Some parts of the cooling surface can reach temperatures over 70°C (158°F) when the inverter is in operation. Not to operate the inverter where it exposes to flammable, explosive environment or around combustibles like trash or unknown materials that may result in danger.



WARNING!

Do not expose the inverter to the corrosive liquids and/or gases.

- Keep DC wirings as short as possible to minimize power loss.
- The mounting bracket should be fastened on a concrete or a masonry wall with the recommended anchors.

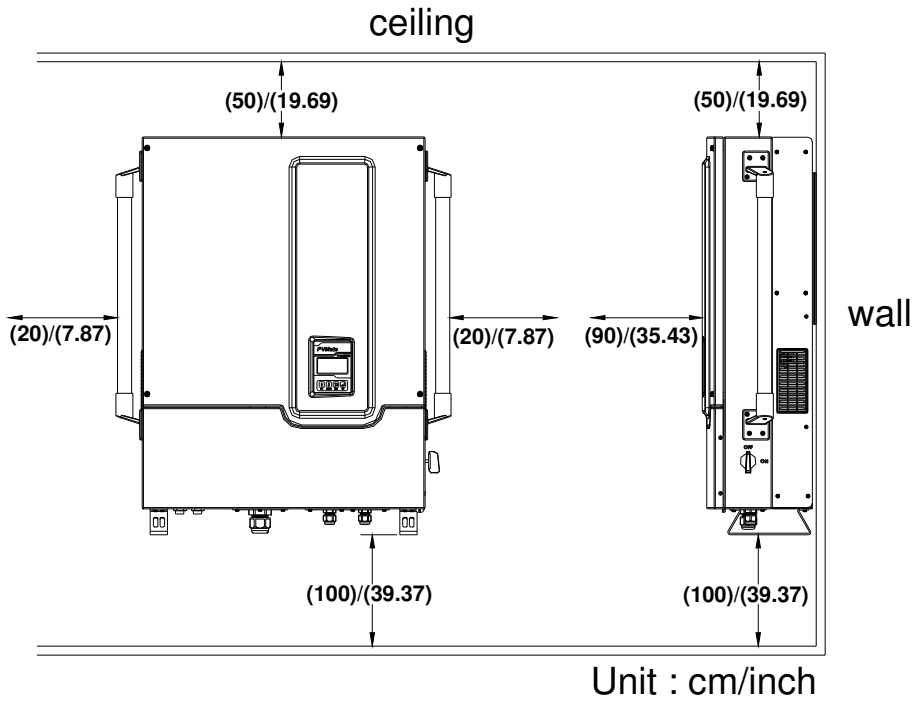


Fig 2.1.1 Clearances required for inverter installation

2.2 Mounting

The steps listed below describe how to mount the inverter on the wall:

1. After taking out the inverter from the carton, the attached mounting bracket

shall first be removed from the inverter by follow the steps shown in Fig 2.2.1 below.

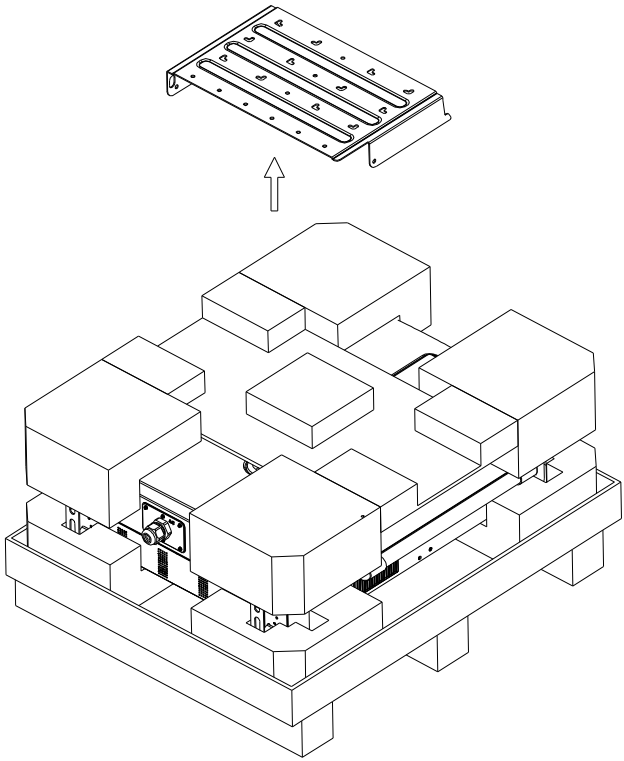


Fig 2.2.1 To remove the mounting bracket from the inverter t

2. Use the mount bracket (Fig 2.2.2) as a template to mark the location of the holes to be drilled in the wall. After drilling the holes, the mounting bracket is then held against the wall and fastened to the wall with anchors as shown in Fig 2.2.3.1 and Fig 2.2.3.2.

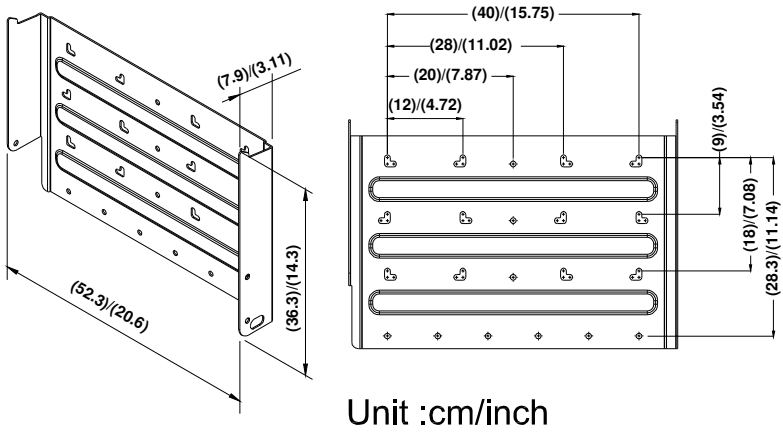


Fig 2.2.2 Inverter mounting bracket

3. For mounting on wooden wall as shown in Fig 2.2.3.1, the suggested diameter of screw is at least 6.35mm and the length is 25.4mm. The nut size needs to be at least 12.7mm. A minimum of 10 screws are required to mount the bracket on wooden wall.
4. For mounting on steal plate as shown in Fig 2.2.3.2, the suggested screw size is M8x16. A minimum of 8 screws are required to mount the bracket on steel plate.
5. For mounting on cement wall as shown in Fig 2.2.3.2, the suggested anchor screw with outer diameter of 8mmx38.1mm is recommended. The nut size needs to be at least 12.7 mm. A minimum of 8 screws are required to mount the bracket on cement wall.

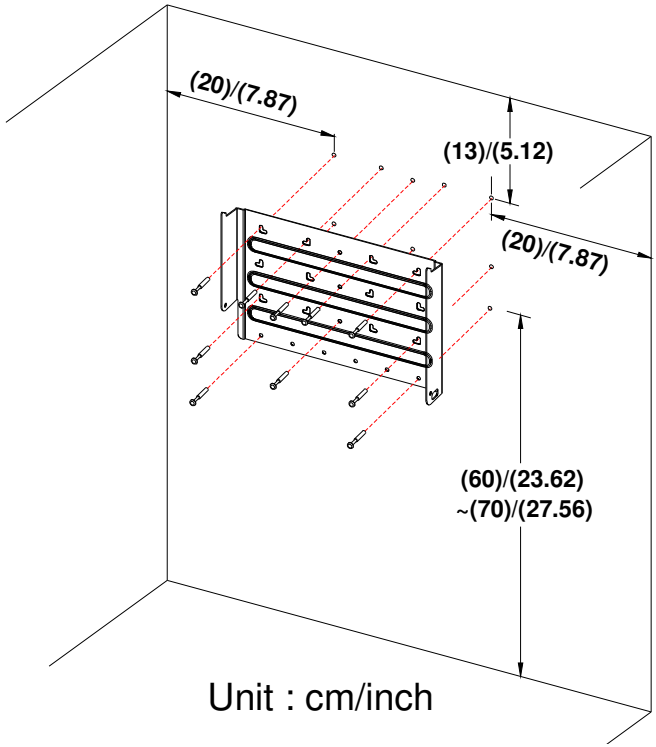


Fig 2.2.3.1 Fasten the mounting bracket on wooden wall

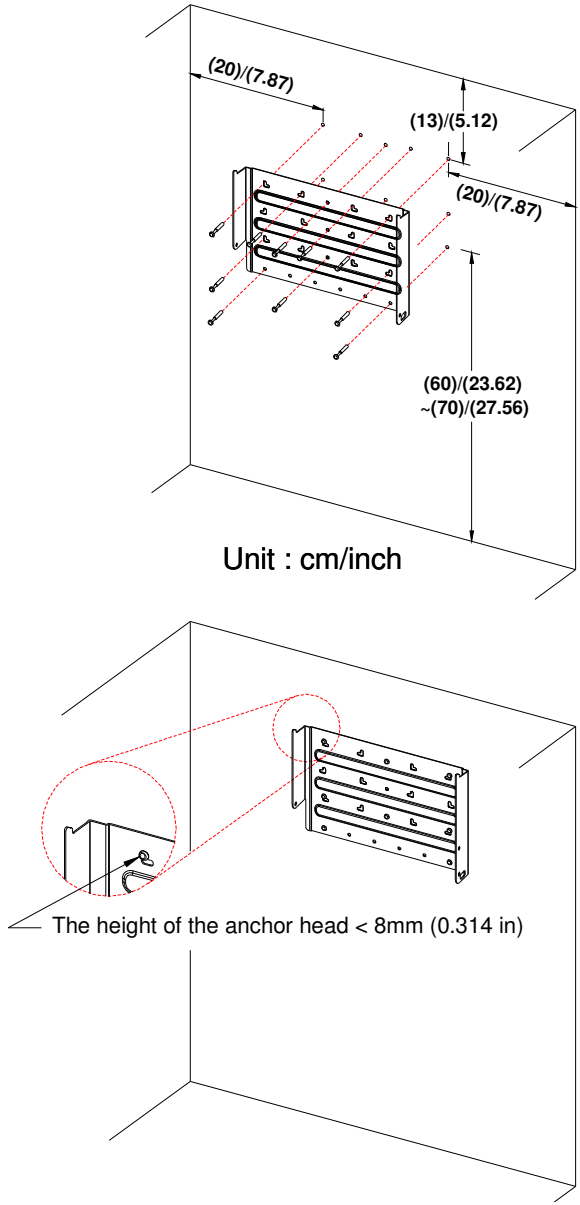
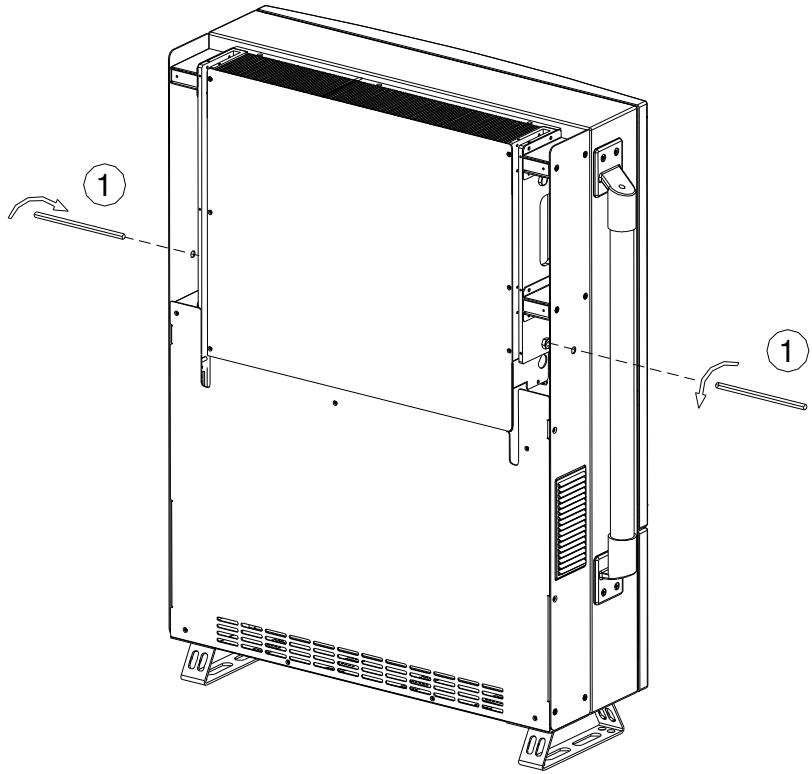
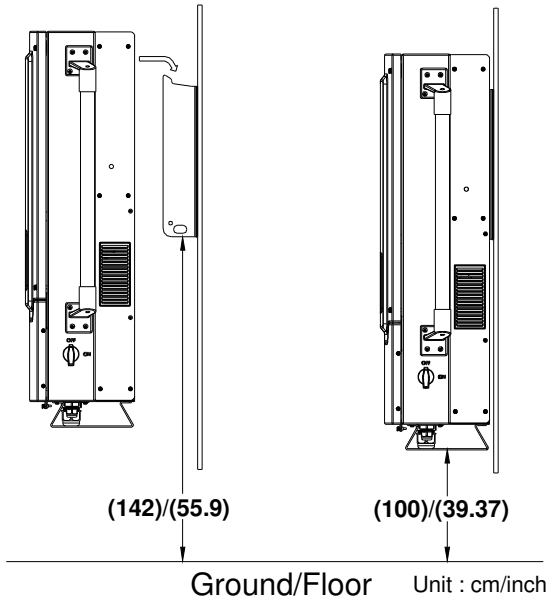
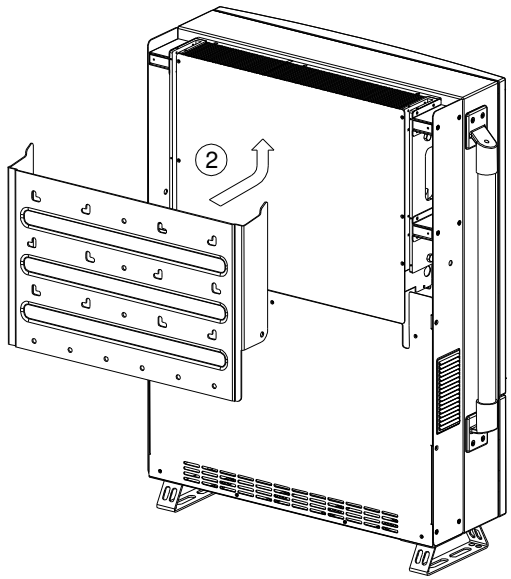


Fig 2.2.3.2 Fasten the mounting bracket on steel plate and cement wall

6. Once the mounting bracket is fastened to the wall, the inverter can be mounted and fastened on the bracket. Hook the inverter on the mounting bracket flanges and slip down carefully to lock it in place. And then fasten the inverter to the mounting bracket as shown in Fig 2.2.4.




(142)/(55.9)
(100)/(39.37)
Ground/Floor
Unit : cm/inch


2

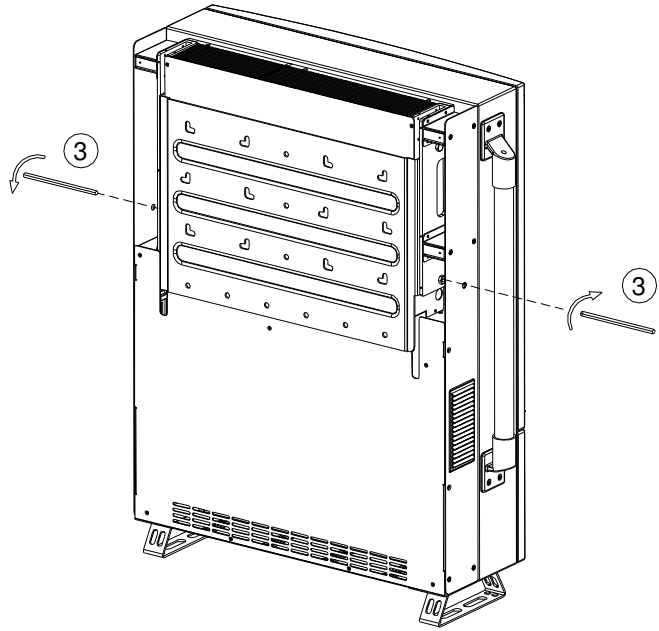


Fig 2.2.4 Hook the Inverter on the mounting bracket and then fasten the screw

After the inverter is hooked correctly on the bracket and fastened to the mounting bracket, it then may be able to do the wiring for the inverter.

2.3 Wiring the inverter

It is necessary to open the front lid of the wiring box before wiring the inverter. First, the DC disconnect switch must be turned OFF as shown in Fig 2.3.1. And then remove the two screws on the right hand side; open the front lid of the wiring box as shown in the Fig 2.3.2 and Fig 2.3.3 below.

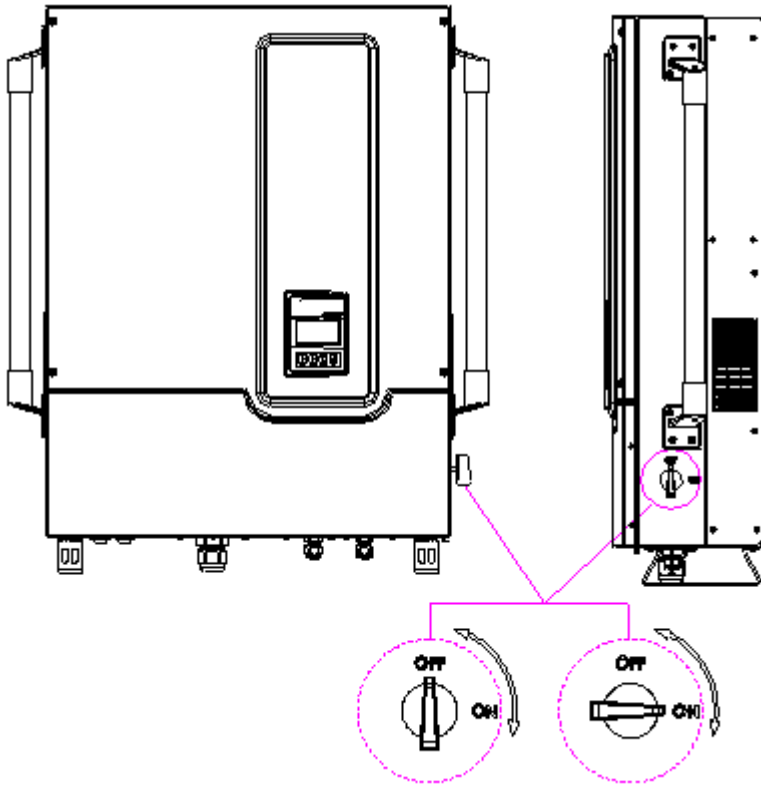


Fig 2.3.1 Turn the DC disconnect switch OFF

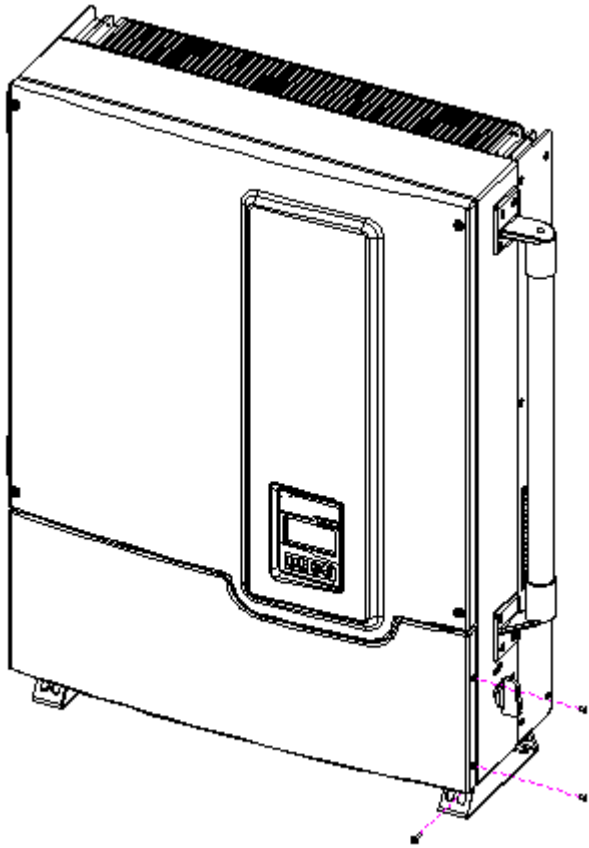


Fig 2.3.2 Loosen the screws

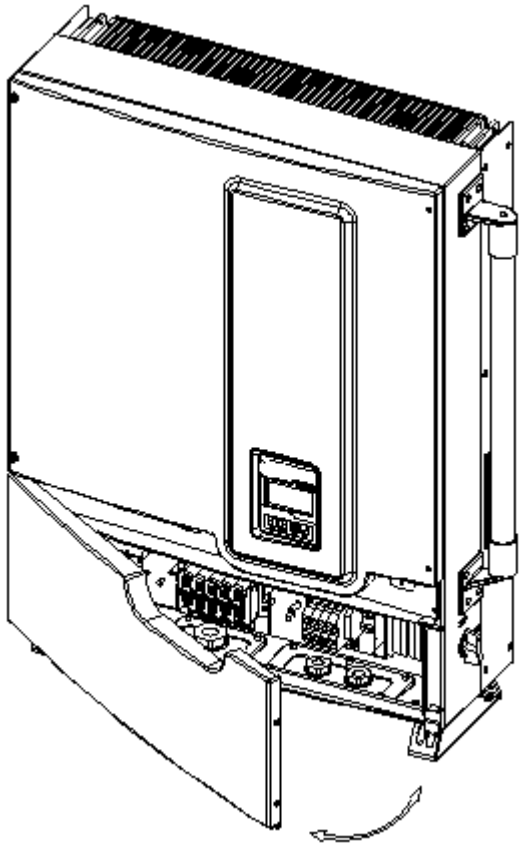


Fig 2.3.3 Open the front lid of the wiring box

After the door is opened, it is then possible to remove the covers of the Threaded Conduit holes as shown in the Fig 2.3.4 for the DC and AC cables to be put through the threaded conduit holes when wiring the inverter.

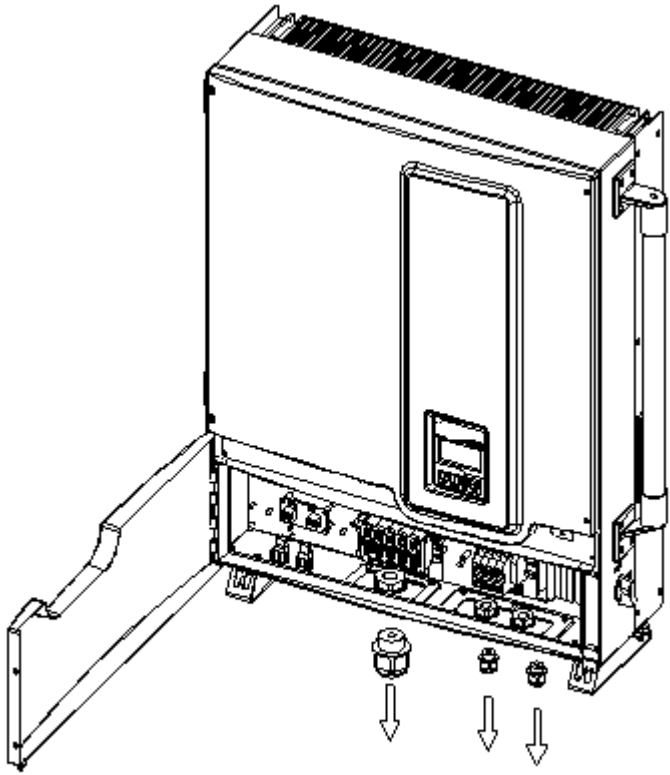


Fig 2.3.4 Removal of the covers for the cable through holes

The following three sections describe the wiring for the AC, DC, and communication ports. The wiring shall be done in the wiring box for the GES-15KTL and GES-20KTL. There is a DC terminal block, two (2) RJ-45 connectors, and one (1) AC terminal block in the wiring box as shown in Figure 2.3.5. The DC terminal block is used to connect up to two (2) PV strings in parallel in the wiring box. The RJ-45 connectors are used for external communication to a remote computer or terminal. The AC terminal block is used

to connect to the utility grid through a circuit breaker and distribution panel according to national and local requirements.

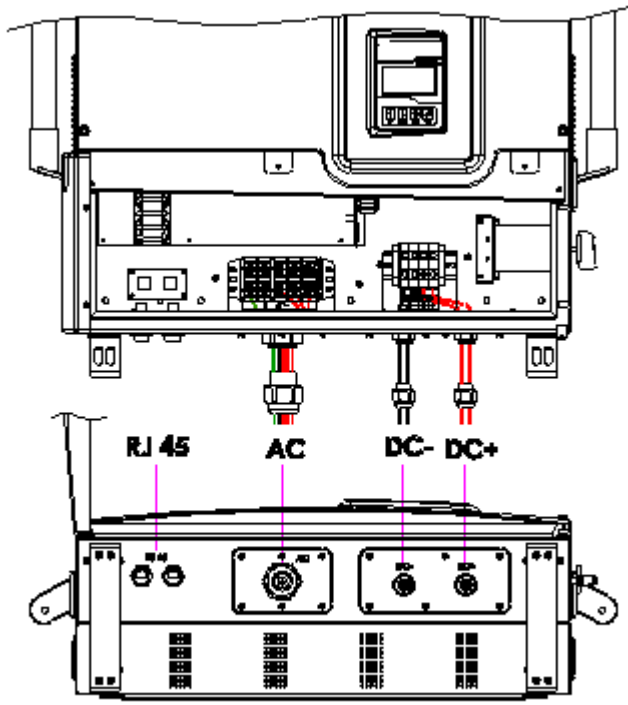


Fig 2.3.5 Wiring box front view

WARNING!

All electrical work shall be done in accordance with the local and national electrical codes and should follow the important safety instructions in this manual.

WARNING!

Make sure that suitable connecting cables are used for both the AC and DC wirings. The cable must be adequately dimensioned

and suitably inert to temperature fluctuation, UV radiation and other possible hazards. For DC wiring connection to the GESOLAR inverter, use 10 to 16 mm^2 (#8 to #6 AWG), 90°C (194°F) copper wire; For AC wiring connection, use 6 to 10 mm^2 (#10 to #8 AWG), 90°C (194°F) copper wire.

WARNING!

PV arrays will be energized when exposed to light. Cover the arrays with opaque (dark) material during installation and wiring.

Before wiring the inverter, it is necessary to determine the utility configuration that the inverter will be connected to. The GES-15KTL and GES-20KTL inverters shall be used in three-phase utility interconnection with neutral as well as the ground as shown in Fig 2.3.6.

Note: When connecting the inverter to the utility, the grid voltage **must** be compatible.

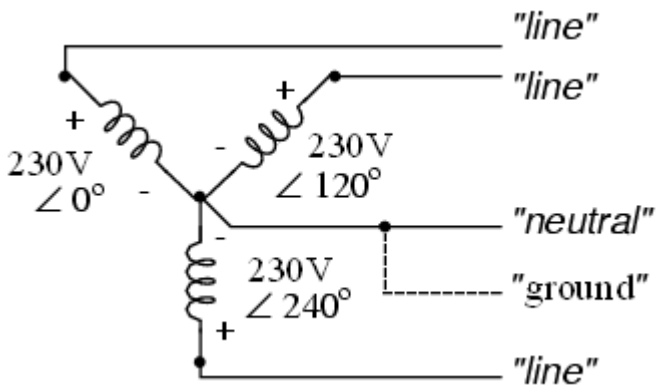


Fig 2.3.6 Utility Configurations

2.3.1 Connection of the AC cable

Use the following procedures to wire the AC cables.

1. Open the Distribution panel and switch off the circuit breaker used to connect the inverter to the grid.
2. Use **6 to 10 mm^2 (#10 to #8 AWG)**, 90°C (194°F) copper wire for all AC wiring connections to the GESOLAR inverter.
3. Connect the cable GND to the ground terminal labeled ⏚ or **"PE"**.
4. Connect the cable N to the terminal labeled N of the AC terminal block.

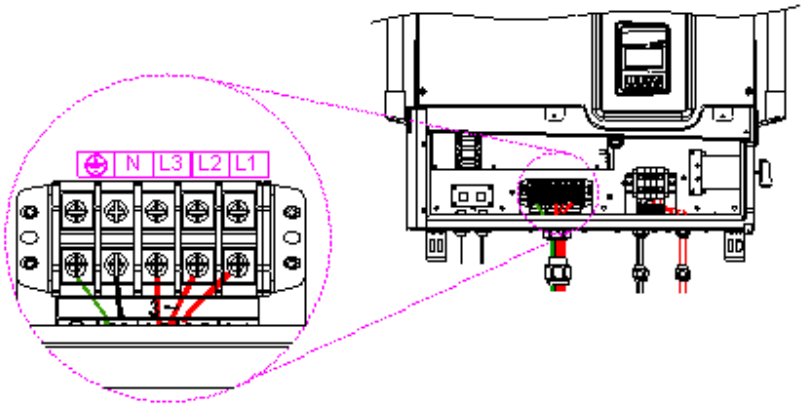


Fig 2.3.1.1 AC Terminal Block for AC cable connections

5. Connect the cables L1, L2 and L3 to the terminal labeled **"L1"**, **"L2"** and **"L3"** of the AC terminal block correctly.

6. Tighten the screws with a torque of 3.0 Nm (27.6 lb-in).
7. Reconfirm that all connections have been performed properly as described above and all screws are properly tightened.



WARNING!

Reconfirm that the circuit breaker to the main utility is switched OFF before connect the power cable from the breaker to the AC terminal block.



WARNING!

Each connection to a inverter must be installed with a dedicated circuit breaker in the main utility service panel. The breaker must be sized to handle the rated maximum output voltage and current of a inverter. No other appliances may be connected to the circuit breaker.

2.3.2 Connection of the DC cable

The wiring box of the inverter is designed to support up to two (2) independent PV strings to be connected in parallel or individual in the wiring box and then feed into the inverter.

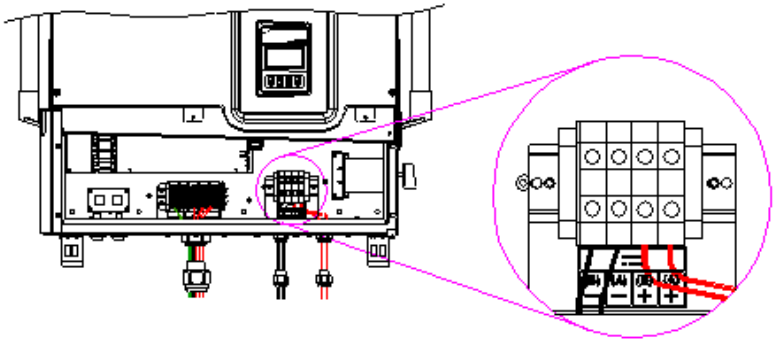


Fig 2.3.2.1 GESOLAR Inverter supports two (2) independent PV strings

CAUTION!

Overcurrent protection may be required depending on the type and ratings of the PV module configured in your system. The maximum DC input current is 43.3A for GES-15KTL and 57.8A for GES-20KTL. The maximum DC current allowed per string is 21.6A for GES-15KTL and 28.9A for GES-20KTL.

CAUTION!

The +PV and –PV cables of a PV sting shall be connected to the DC terminals labeled "+" and "-" respectively. The capacity of the cables should be taken into account by system installers to

determine the proper rating of the PV string fuse or a fire hazard may occur if there is short-circuit in a PV string.

There are two (2) terminals per PV string located inside the wiring box used for the DC cable connections. Up to two (2) independent PV strings are supported by the inverter. Therefore, there are four (4) terminals, two (2) of them are labeled with "**+**" and other two (2) are labeled with "**-**", in the wiring box for DC cable connections as shown in Fig 2.3.2.2 and Fig 2.3.2.3. All the screws for the cable connections shall be tightened with a torque of 3.5 Nm (35.5 lb-in).

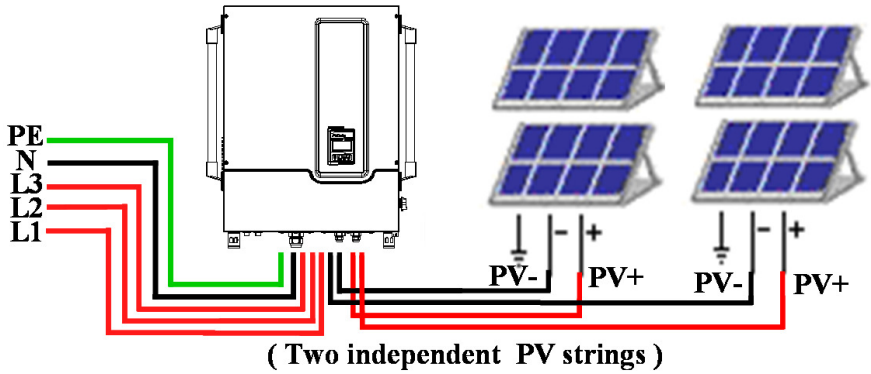


Fig 2.3.2.2 PV Inverter Connections

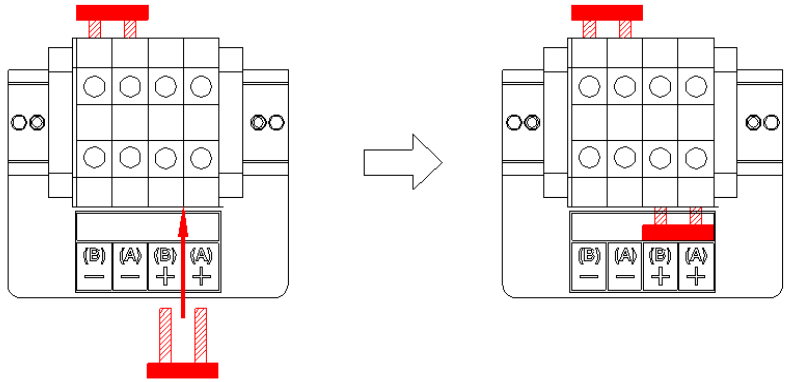


Fig 2.3.2.3 PV Strings in Parallel

NOTE: The inverter with Dual-MPP trackers is designed applicable to a variety of surroundings. In most case it is recommended to link the two PV strings into a single whole to attain the highest efficiency. Please consult with your installation servicer and see how to connect, as show in Fig 2.3.2.3.



CAUTION!

PV arrays are energized when ex-posed to light. Use safe working practices when working on PV arrays.



WARNING!

Route the DC cables to be connected to the inverters away from any possible hazards that could damage the cables.



WARNING!

Hazardous voltage is still present on the inverter after disconnection of all PV DC inputs. Allow 5 minutes for the device to discharge the energy completely.



CAUTION!

Make sure that the DC input voltage generated by the PV arrays must be equal to or less than 850 VDC in any condition or it will cause damage to the inverter.

2.3.3 Connection of the Communication cable

The GESOLAR inverter supports two common data interface standards, RS-232 and RS-485 that will be used to communicate to a remote computer or terminal with RS-232/RS-485 equipped. Only one of the communication interfaces can work at a time. As shown in Figure 2.3.3.1, there are two RJ-45 connectors, RJ45-R and RJ45-L, which are located on the bottom of the enclosure. The pin numbers of the RJ-45 connectors and the corresponding signals are described in Figure 2.3.3.2 below. If the RS485 is used as the external communication interface and the inverter is the last device within the RS485 chain connections, then the termination switch shall be put to ON position (shown in Figure 2.3.3.4). Users shall open the front lid of the wiring box to switch the termination switch to ON position. The termination switch is default set to OFF position.

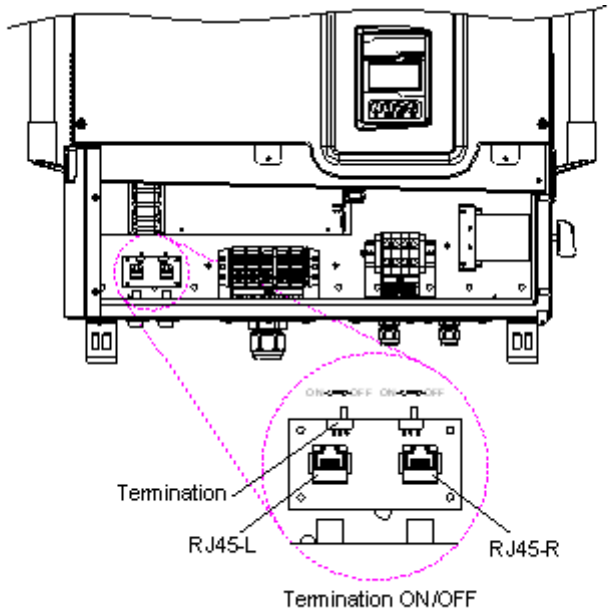


Fig 2.3.3.1 Positions of the communication ports and termination switch

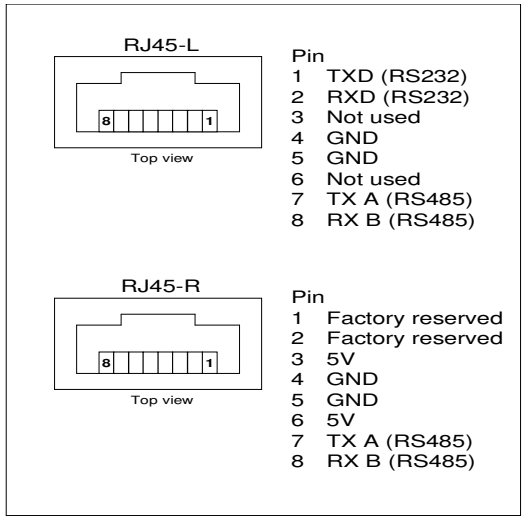


Fig 2.3.3.2 RJ-45 Pins and Signals

As shown in Fig 2.3.3.2, the RS-232 signal pins, TXD and RXD, are only on the RJ45-L. Therefore, only the RJ45-L can be used to connect to the remote PC or terminal when the RS-232 interface is selected. The cable with the part number of WABG-0918S, which is 180 cm (70.9 inches) in length, is dedicated for the communications between a GESOLAR inverter and a computer when RS-232 interface is used. This cable has a RJ45 connector on one end and a RS-232 (DB9) connector on the other end as shown in Fig 2.3.3.3. If RS-485 interface is selected, then both RJ-45 connectors on the GESOLAR inverter can be used for the cascaded RS-485 connections shown in Fig 2.3.3.4.

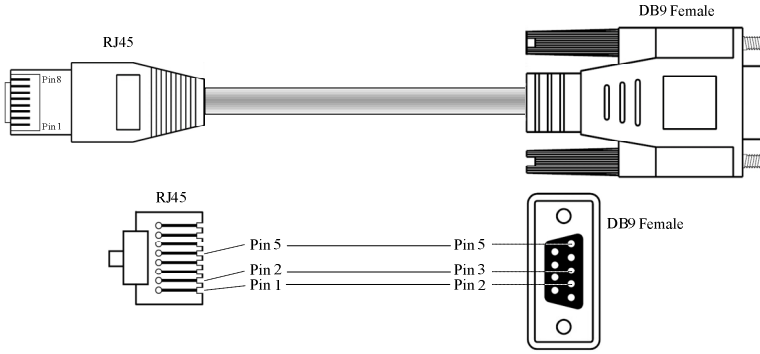


Fig 2.3.3.3 RS-232 connection

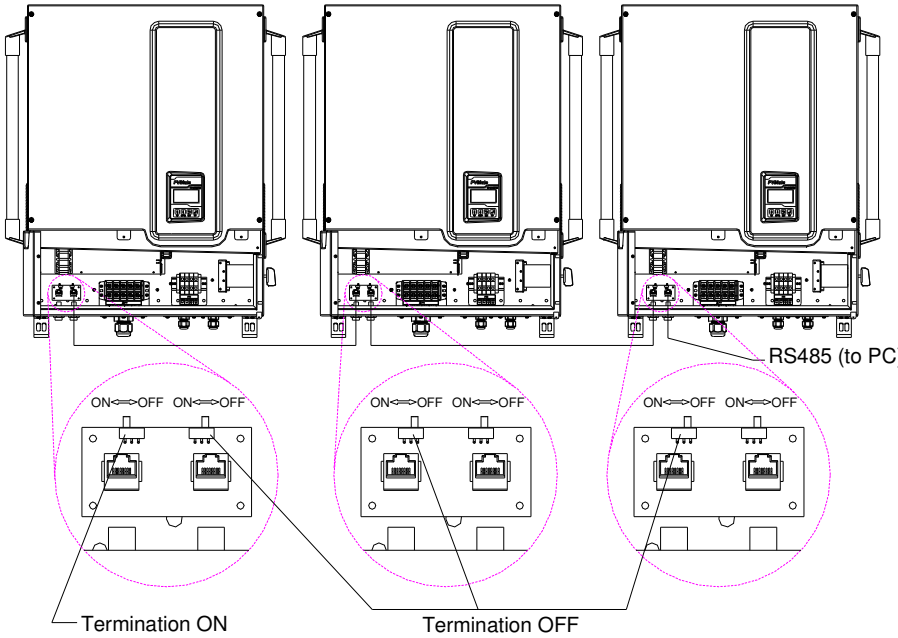


Fig 2.3.3.4 RS-485 connection

2.4 Wiring inverter in parallel

GESOLAR inverters can be connected in parallel when more power is required. In the parallel configuration, each inverter shall connect to its own PV array. It is not recommended to connect one PV array to more than one inverter. This may cause the inverter to work abnormally. The Fig 2.4.1 below shows the connections between inverters and PV arrays in parallel configuration.

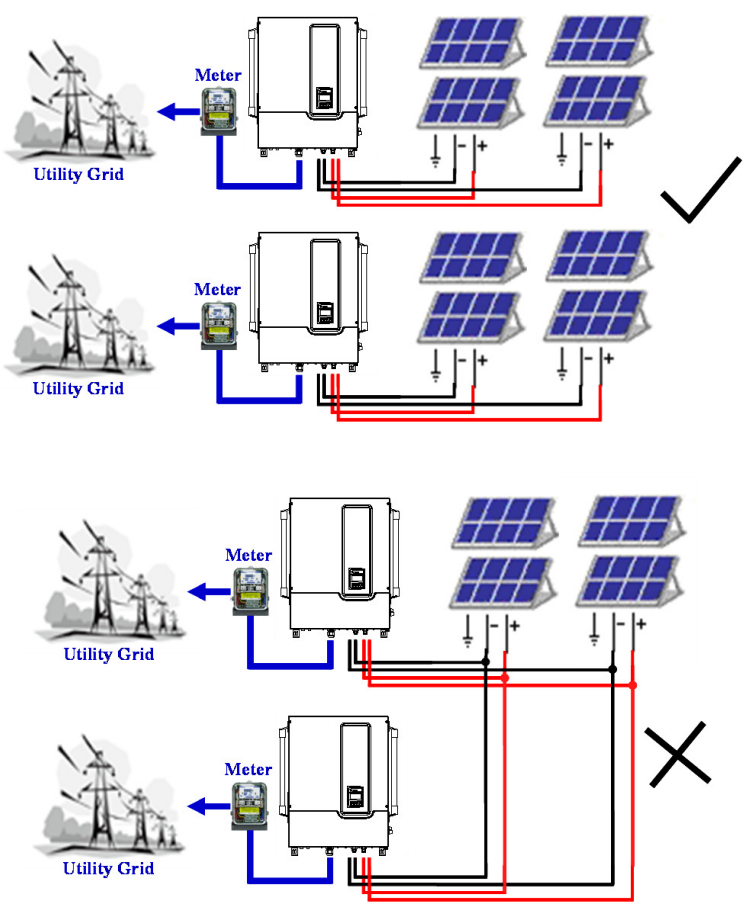


Fig 2.4.1 Parallel configuration of inverter

2.5 Optional Theft Protection

You can protect the inverter from theft by locking it to the rear panel with a padlock. The padlock should meet the following criteria.

	Dimension
A	20 ~ 30 mm
B	8 ~ 13 mm
C	12 ~ 15 mm
D	12 ~ 18 mm
E	∅3 ~∅5 mm

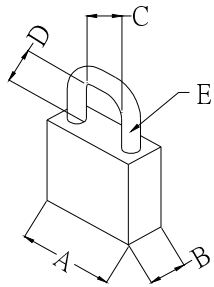


Fig 2.5.1 Padlock requirement

Place the shackle of the padlock through the hole on the mounting bracket and heat sink, and close the lock. Keep the key in a safe location for future possible service purposes, and now the inverter is protected against theft.

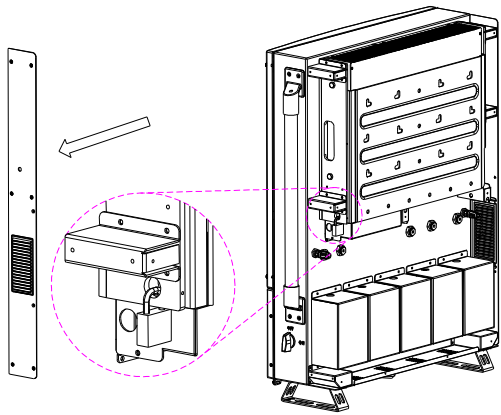


Fig 2.5.2 Lock the inverter

3. Operation

3.1 Overview

The control electronics will be active as soon as the DC (PV) voltage reaches "minimum MPPT" voltage point which is around 200VDC. The GESOLAR inverter is then powered up and will show "Illumination" on the LCD, complete the system initialization and wait for the DC voltage to reach the "PV start" voltage point which is 400VDC. When the DC voltage reaches the "PV start" voltage point, the inverter will enter "Checking" mode and then go on-line with the mains grid ("Grid/MPP" mode) if all necessary conditions for grid connection are checked and fulfilled. The inverter will then load the PV array, bring the DC voltage down from 400VDC to no less than the "pre-set threshold" point which is 300VDC. Once the DC input voltage falls below the "pre-set threshold" point, the inverter will shut off its output AC power and go back to "Illumination Low" mode if the DC voltage remains above the minimum MPPT voltage point. Once the DC voltage goes under the "minimum MPPT" voltage point, the inverter will shut down itself. There are five main operating modes described in detail below.

Illumination: When the DC input voltage goes above the "minimum MPPT" voltage point, the inverter is powered up, and enters the system initialization procedure with "Illumination" displayed on the LCD. In this operation mode, the inverter sets the initial values, runs diagnostics, and detects all parameters that will be stored for future use. This stage takes only a few seconds and then the inverter will wait until the DC input voltage reaches the "PV start" voltage point to enter the "Checking" mode.

Checking: In this operation mode, the inverter checks all parameters on both AC and DC sides to ensure that connecting to the mains is safe. All conditions must be fulfilled and last for a certain period of time, then the system will enter the Grid/MPP mode. If any parameter except the DC voltage that is under the "PV start" voltage, does not meet the criteria the inverter goes to "System Fault" mode.

Grid/MPP: The inverter will turn on the AC relays and start feeding the AC power to the grid. In this operating mode, the inverter continues to convert the DC power generated by the PV array to the AC power that is then fed into the grid. The inverter may stop feeding the power and go back to checking mode once any condition for grid feeding mode is found not satisfied.

System Fault: When fault(s) occurs and been detected in the operating mode described above, the inverter will display "System Fault" on the LCD and terminate the present state, stop feeding power to the grid, and then jump into the fault mode that executes a

preset sequence. When the faults have been cleared and stay clean for certain period of time, the inverter will leave system fault mode and enter checking mode. Some faults, like component failure, will cause the inverter go into the idle mode that will need service staff to clean the errors.

System Idle: Once the inverter has detected a malfunction, it will go into the system idle mode and stop feeding the power to the grid for safety reason. Normally this is a failure that cannot be removed in field. It needs service personnel coming to remove the problems and put the inverter back to operation.

3.2 LCD Display

The GESOLAR inverter has a 128 x 64 graphic LCD with three (3) colors backlight, as shown in Figure 3.2.1 below, to display various information of the inverter such as the operating status/settings, input/output data, cumulated power, and error messages. Also, there are four keypads for users to select the information to be displayed on the LCD from one of the categories of "System Status", "Energy Production", and "Error Message". Users can change, with password protected; some of the settings by select the "Edit Settings" followed by the password input. As long as the DC input voltage is above the minimum MPPT voltage, the LCD continues to display the information following the process flow described below in this section.

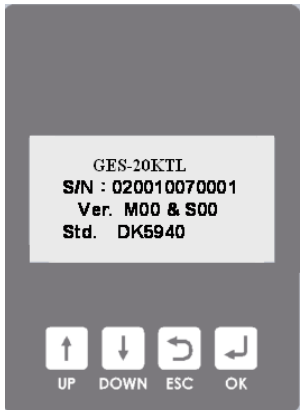


Fig 3.2.1 Front panel of the inverter

3.2.1 LCD Backlight Indication

There are three (3) colors, white, green, and red, visible for the backlight of the LCD. The color will be changed according to the inverter operation status as

shown in Figure3.3.1.1. The explanations of the status and the corresponding color of the backlight are described in the following table.

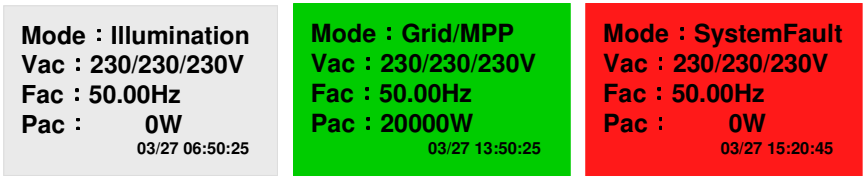


Fig 3.2.1.1 3 colors backlight of the LCD

LCD Backlight Indication Table

LCD backlight		Operating status	Description
White		Initialization	The inverter sets the initial values and detects all parameters.
		Illumination	The low insolation can not start the inverter.
		Checking	The inverter monitors all the system parameters.
Green		Grid/MPP	The Inverter feeds the AC power to the grid.
		Derating	Reduce the AC power feeding.
		Warning	The system has encountered a minor warning, but it can continue to feed the AC power to the grid.
Red		SystemFault	The inverter has detected a recoverable failure and re-starts its own.
		SystemIdle	An unrecoverable failure occurred; it needs technical staff coming to remove the problems.
		Programming	The program is being updated.

3.2.2 Operational Status

The process flow could be the regular procedure, fault procedure or idle procedure. The regular procedure is when the system goes from power-on (illumination low), system check, and then Grid/MPPT mode without any fault condition detected. The inverter should work following the regular procedure and eventually feeds the power to the grid. During the system check, if a fault condition that could be cleared automatically is detected, then the system will go into the fault procedure. The system will return to regular procedure once the fault condition goes away. One obvious example is that an "island" condition is detected due to the grid going off and then back on later, the fault condition is cleared when the power returns. If a fault cannot clear on its own, then the system will enter the idle procedure and will need a service staff to clear the fault and reset the system. The following paragraphs explain how the display works for the operating modes.

Illumination:

When the DC input voltage rises above the "minimum MPPT" voltage point but under the "PV start" voltage point, the GESOLAR inverter is powered up and will show the model name (e.g. GES-20KTL), serial number, firmware versions, and the standards been complied, on the LCD. After around five (5) seconds, the Main Menu with four (4) selections, System Display, Graphic Method, Error message, and Setting, that user can select through the up/down keypads will be displayed on the LCD. Three seconds later, if there is no selection is made, the "System Display" will automatically be selected to display the "Illumination" on the LCD and stop there until the system goes into the "Checking" mode. Accompany with the "Illumination", the LCD also displays the three-phase AC

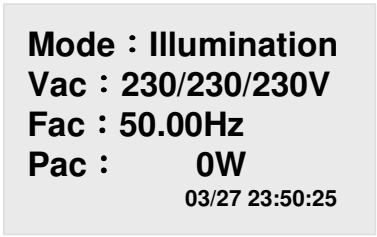
voltages, Frequency, and AC output power on the AC side.



5 seconds ↓



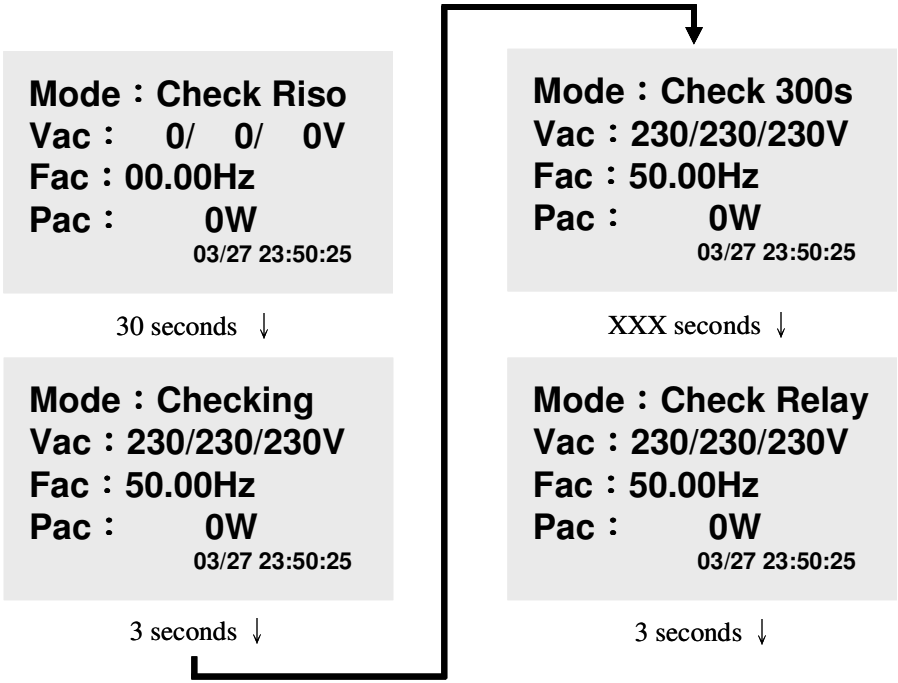
3 seconds ↓



Checking:

When the DC input voltage reaches the "PV start" voltage point, the inverter goes into the Checking mode. In this operation mode, the inverter will check Riso, all parameters on both AC and DC sides, and then the AC relay to ensure that connecting to the mains is safe. After all conditions are satisfied for a certain period of time which can be set from 20 to 600 seconds, then the system

will enter the Grid/MPP mode and feed AC power to the grid. During the Checking mode, the following information tells users that the system is on-going and will go into the Grid/MPP mode in certain seconds with the measured data of the existing voltage and frequency on the grid side.



Grid/MPP:

After the system going into the Grid/MPP (grid feeding) mode, the inverter will feed the AC power to the mains grid and display the operating mode, the existing AC voltage, frequency, and power on the LCD with the backlight in green color. Also, the messages such as the cumulated energy, the DC input power of each PV string, and the AC output power of each phase, can be displayed on the LCD by press the “DOWN” keypad as shown in the figure

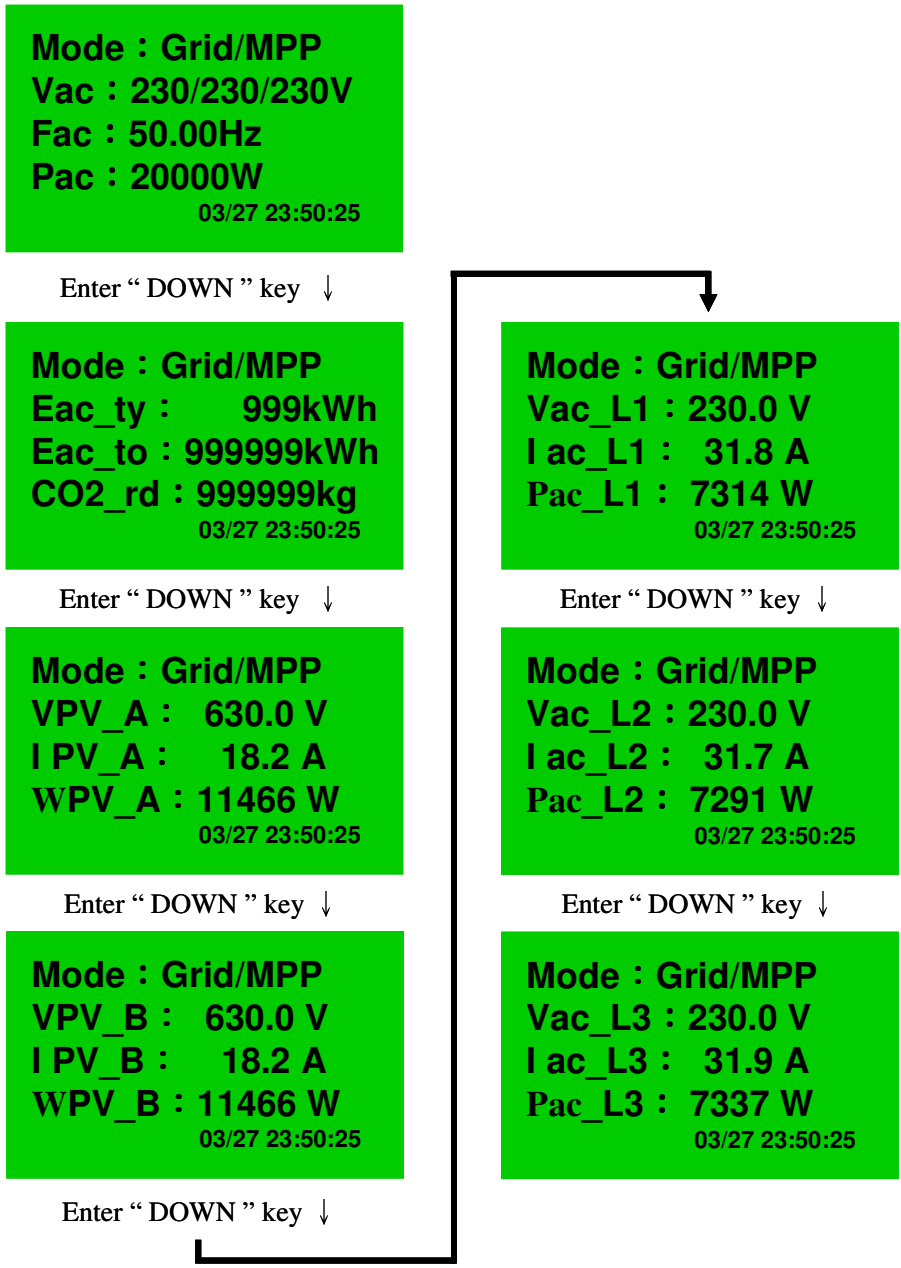
below.

By using the “UP”, “DOWN”, “ESC”, and “OK” buttons, users may be able to view the selected messages they want.

(a) Press “UP” or “DOWN” key to select the monitoring parameter.

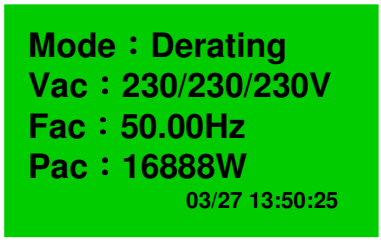
(b) Press “ESC” key return to previous state.

(c) Press “OK” key to confirm.


Mode : Grid/MPP
Vac : 230/230/230V
Fac : 50.00Hz
Pac : 20000W
03/27 23:50:25
Enter " DOWN " key
Mode : Grid/MPP
Eac_ty : 999kWh
Eac_to : 999999kWh
CO2_rd : 999999kg
03/27 23:50:25
Enter " DOWN " key
Mode : Grid/MPP
VPV_A : 630.0 V
I PV_A : 18.2 A
WPV_A : 11466 W
03/27 23:50:25
Enter " DOWN " key
Mode : Grid/MPP
VPV_B : 630.0 V
I PV_B : 18.2 A
WPV_B : 11466 W
03/27 23:50:25
Enter " DOWN " key
Mode : Grid/MPP
Vac_L1 : 230.0 V
I ac_L1 : 31.8 A
Pac_L1 : 7314 W
03/27 23:50:25
Enter " DOWN " key
Mode : Grid/MPP
Vac_L2 : 230.0 V
I ac_L2 : 31.7 A
Pac_L2 : 7291 W
03/27 23:50:25
Enter " DOWN " key
Mode : Grid/MPP
Vac_L3 : 230.0 V
I ac_L3 : 31.9 A
Pac_L3 : 7337 W
03/27 23:50:25

Derating:

When the power de-rating is detected, the “Derating” message will be displayed on the LCD as shown in the picture below. There are five possible occasions may cause output power de-rating. Only one occasion that causes de-rating could be detected at a time. Therefore, users shall also view other information through the RS485 interface to identify the reason that causes de-rating when the “Derating” message is displayed. Please refer to **Section 4.3 De-rating Operation** for the occasions that will cause power de-rating. The GES 15KTL /20KTL inverter is capable of feeding a maximum AC output power to the grid up to 110% of its nominal power rating temporarily. When this happens the inverter will output 110% of its nominal power for 10 minutes and then lower the output power (output power de-rating) back to its nominal power rating (100%) and displays the “Derating” message on the LCD for 20 minutes. If the condition remains, the inverter will again raise the output power to 110% for 10 minutes and then back to 100% for 20 minutes until the condition dismissed.

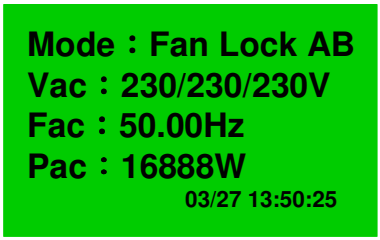


Warning:

There are three possible warning messages that will be displayed on the LCD when situations occur in Grid/MPP mode. When the system has encountered a failure access to the internal EEPROM memory device, the “EEPROM” warning message will be displayed. The GESOLAR inverter has communication

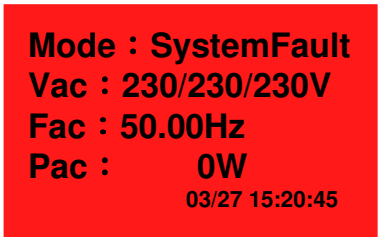
port available for communicating to an external computer. If it encountered a communication error with the external terminal, the “COMM” warning message will be displayed on the LCD. There are two (2) fans, fan A and fan B, attached on the back of the inverter. If one and/or two fans stop running, the warning message, Fan Lock A, Fan Lock B or Fan Lock AB, will be displayed on the LCD. If all warnings occurred simultaneously, the warning messages will be displayed in the following order with three (3) seconds interval:

COMM => EEPROM => Fan Lock A (or B or AB)



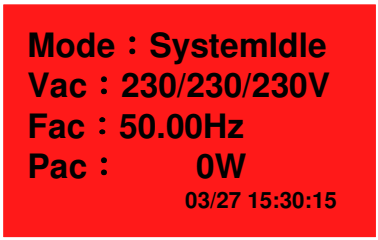
System Fault:

When the system goes into the fault mode, it will shut off the output AC power, disconnect from the mains grid, and have the “System Fault” message displayed on the LCD with the backlight in red color as shown in the figure below. The fault(s) that cause the system going into the fault mode will be recorded. Users can press the “ESC” button to go into the main menu and then select the “Error message” to view the error message(s) of the fault(s). Users may refer to the Error Message Table on Section 3.6 for the explanations of the error messages. If the fault has been cleared, the inverter will automatically try to go from the Checking mode and then the Grid/MPP mode to feed AC power to the grid.



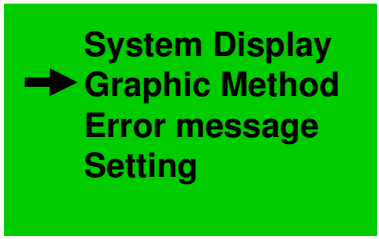
System Idle:

If the GESOLAR inverter goes into the idle mode, it will need a service staff to clear the fault(s) and reset the inverter. When in the idle mode, the inverter will shut off the output AC power, disconnect from the mains grid, and have the "System Idle" message displayed on the LCD with the backlight in red color as shown in the figure below. The fault(s) that cause the system going into the idle mode will be recorded. Users can press the "ESC" button to go into the main menu and then select the "Error message" to view the error message(s) of the fault(s). Users may refer to the Error Message Table on Section 3.5 for the explanations of the error messages.

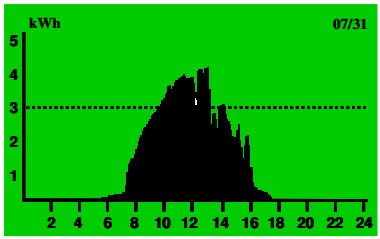


3.2.3 Cumulative Power Graphic

Press the “ESC” button to return to the main menu and then press the “Down” keypad to select “Graphic Method”. Then press the “OK” button to confirm the selection and then daily chart will be displayed on LCD as shown in the figure below. The chart shows the output AC power trend for a specified date which is indicated on the upper right corner. If daily chart is needed then press the “OK” button first and then press the “DOWN” or “UP” button to select the date wanted. The GESOLAR inverter has the memory enough to record the daily chart for up to 31 days.



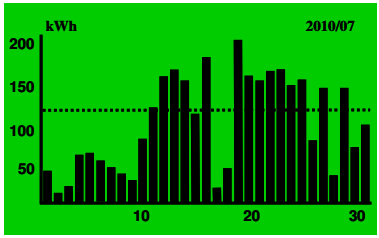
Press “OK” key ↓



Press “DOWN” key ↓

If the monthly chart is needed then it shall return to the daily chart first by press the “ESC” button and then press the "DOWN" key to change to the monthly

chart as shown below. On the upper right corner, it shows the present month, press “OK” first and then press “DOWN” or “UP” button to switch to the month wanted. The inverter may record the monthly chart for up to 12 months.



3.2.4 Error Message

To review the recorded error messages, users shall select the "Error Message" by press the “Down” or “Up” key from the main menu and then press the "OK" key to confirm. The LCD will then display an error message recorded on the LCD with the date and time that the fault occurred. To see another recorded error message, press “DOWN” or “UP” key to switch to next page. The GESOLAR may record up to 99 error messages in the memory.

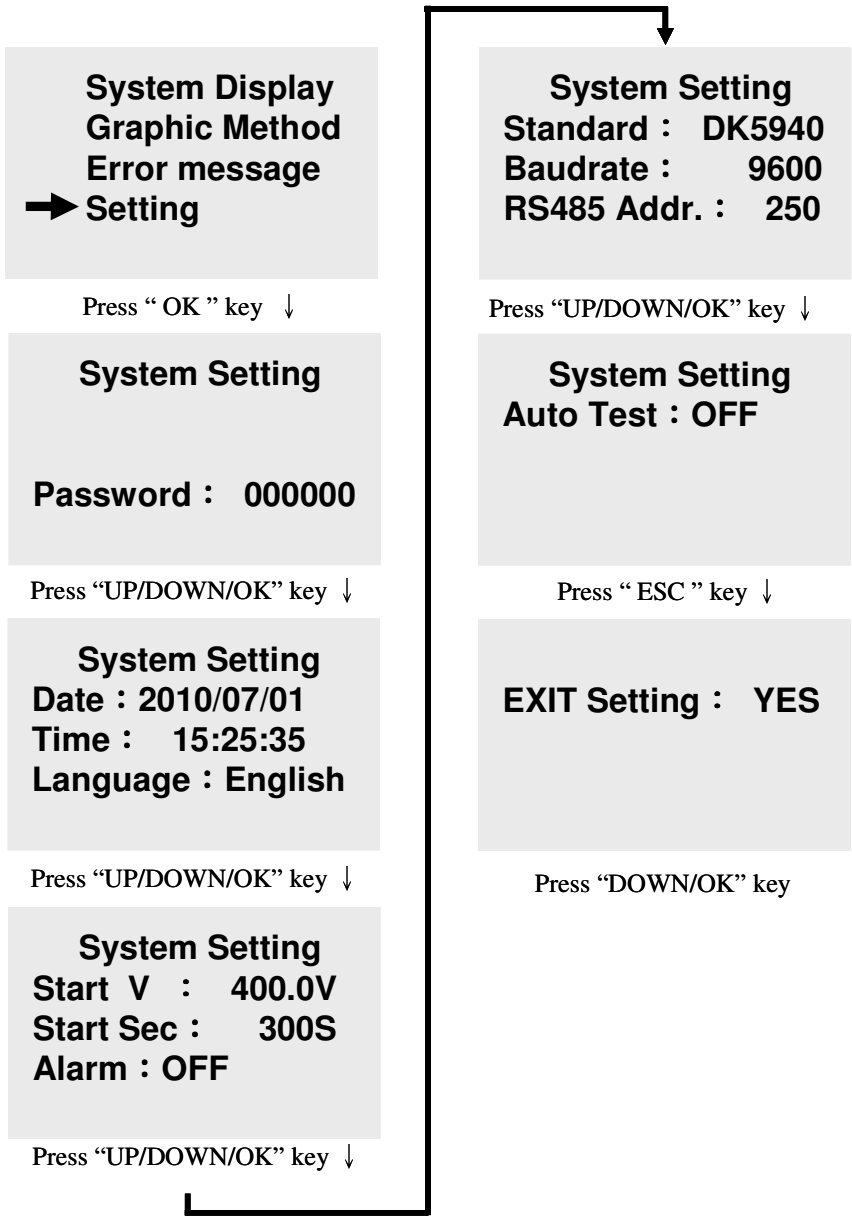


3.2.5 Setting Operation

There are some parameters can be re-configured from the panel. Users may select the "Setting" from the main menu and press the "OK" key to enter System Setting as shown below. Only the standard selection is password protected. For other settings such as the date, time, language, minimum start voltage, start-up time, buzzer ON/OFF, communication baud rate, and RS485 address, users may or may not need to enter a password. If it needs to change the standard, DK5940 (ENEL 2010), VDE 0126, or RD1663, that must be done by a professional service staff then a specific password shall be entered. When the setting is completed, the inverter must be restarted to have the new settings effectively executed.

The parameters can be re-configured from the panel are described as follows:

- ☼ Date: The date setting.
- ☼ Time: Current time setting.
- ☼ Language: Change the display language.
- ☼ Start V: Adjust the minimum startup voltage.
- ☼ Start Sec: Adjust the start-up time.
- ☼ Alarm: Turn "ON" or "OFF" the buzzer.
- ☼ Standard: The standard setting according to local requirements.
- ☼ Baudrate: Change the communication baud rate.
- ☼ RS485 Addr: Change the RS485 address.
- ☼ Auto Test: To perform auto-test function. (For Italian market only)


System Display
Graphic Method
Error message
Setting
Press " OK " key ↓
System Setting
Password： 000000
Press "UP/DOWN/OK" key ↓
System Setting
Date：2010/07/01
Time： 15:25:35
Language：English
Press "UP/DOWN/OK" key ↓
System Setting
Start V ： 400.0V
Start Sec： 300S
Alarm：OFF
Press "UP/DOWN/OK" key ↓
System Setting
Standard： DK5940
Baudrate： 9600
RS485 Addr.： 250
Press "UP/DOWN/OK" key ↓
System Setting
Auto Test：OFF
Press " ESC " key ↓
EXIT Setting： YES
Press "DOWN/OK" key

3.3 Auto Test (for Italian market only)

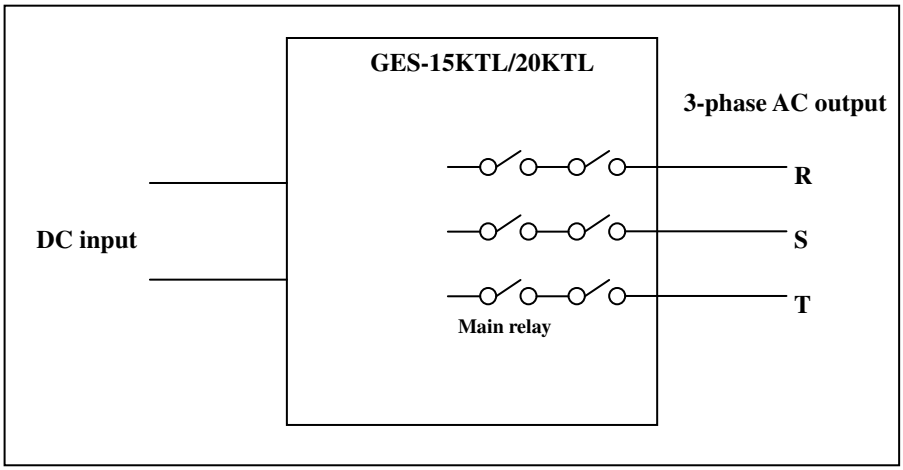
This Auto Test function is required according to the Italian Standard DK5940 (ENEL 2010). With the Auto Test function, users may be able to verify the AC voltage and frequency (grid side) monitoring function. When the Auto Test function is running, the inverter will not output power to the mains grid. The Auto Test routine shall be in the order as:

Maximum AC voltage threshold test for each phase

Minimum AC voltage threshold test for each phase

Maximum AC frequency threshold test for each phase

Minimum AC frequency threshold test for each phase



There are two relays cascade connected for each phase of the AC output as shown above. The Main relay will be closed (activated) when running each threshold test for each phase. After the threshold test is complete the Main relay will be released (de-activated). The Auto Test functionality and procedure is described in the following sections.

3.3.1 Use PC Software

The Auto Test software as an accessory provided with the inverter should be installed in a computer which is connected to the inverter through the **"RJ45-L port"** (the RJ45 port on the left-hand side). Once the software is installed successfully, there is an execution file **"GES 15KTL-20KTL Auto Test 1.0 Setup"** created in the sub-directory **"Start\Programs menu"**. Users may start the Auto Test function by double click the execution file "**GES-15KTL-20KTL Auto Test**". The program starts with a search for all inverters connected to the computer that will pop out a window "Search for inverters" as shown in Figure 3.3.1.1. If there is no inverter found, the "Search again" warning message will be displayed on the screen. It needs to re-confirm that the connections are correct within the RS485 communication loop and then click on the "Search for inverters" button to search again. If at least one inverter is found, the serial number and the status of the inverter will be shown on the screen as shown in Figure 3.3.1.2.



Fig 3.3.1.1 Search for inverters



Fig 3.3.1.2 Communicated successfully

Only one inverter can be selected to run the Auto Test function even more than one inverter is found. Users can choose the inverter by highlight the serial number and then click the **"Start Auto Test"** button to run the Auto Test function which will perform in the order as shown in Figure 3.3.1.3 and described below.

a. Maximum AC voltage (VacH) threshold (phase order: R → S → T)

b. Minimum AC voltage (VacL) threshold (phase order: R → S → T)

c. Maximum AC frequency (FacH) threshold (phase order: R → S → T)

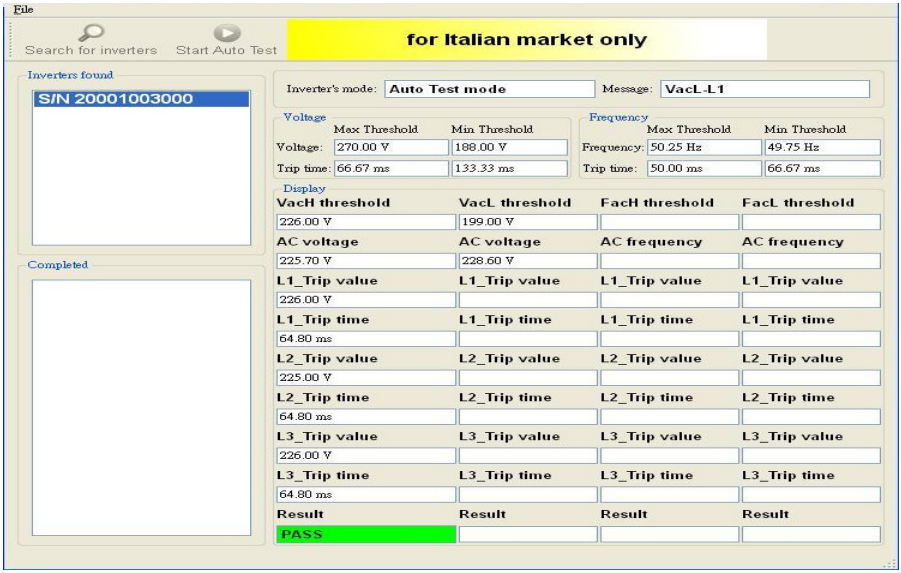
d. Minimum AC frequency (FacL) threshold (phase order: R → S → T)

The standard threshold values and the trip time related to the specified sub test will be displayed on the PC screen before the Auto Test is running. The slew rate of the threshold values, either increase or decrease, are ≤ 0.05 Hz/s for frequency and ≤ 1 V/s for voltage starting from the maximum (or minimum)

threshold value. During the Auto Test the threshold value changes linearly and the measured voltage or frequency of the AC grid will be displayed on the PC screen. The maximum/minimum threshold values and the accepted trip time defined in DK5940 (ENEL 2010) are as follows:

a. **Maximum AC voltage threshold: 270 V; < 80 ms**
b. **Minimum AC voltage threshold: 188 V; < 160 ms**
c. **Maximum AC frequency threshold: 50.25 Hz; ≤ 60 ms**
d. **Minimum AC frequency threshold: 49.25 Hz; ≤ 80 ms**

The threshold value will decrease (or increase) from the maximum (or minimum) threshold value toward the measured value of the AC grid. When the threshold value reaches the measured AC voltage or frequency of the grid the inverter will disconnect the AC line by de-activate the Main relay. The inverter will measure the time duration from the command has been sent to the disconnection is recognized. This time duration must be less than the trip time defined.



(a)Start Auto-test



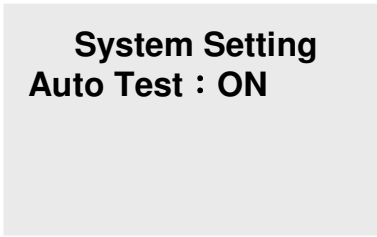
(b) Auto-test completed

Fig 3.3.1.3 Auto-test process

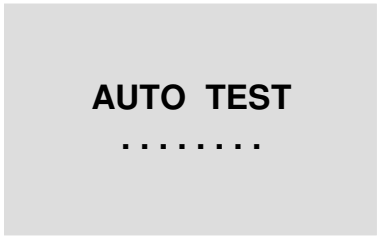
After all sub tests are complete, a window “All tests are finished” will be pop out and users shall click the “OK” button to stop the Auto Test software.

3.3.2 Use Self-testing

It is also possible to run the Auto Test function without a computer connected. Users may select “Setting” from the main menu and then select “Auto Test” and press “OK” to perform the Auto Test function as shown below. (Please refer to Section 3.3.5)



Press “ OK “ key ↓



After the Auto Test function starts running, the “AUTO TEST” will be displayed on the LCD as shown above and stay until the Auto Test function stops with “PASS” or “FAIL”. If the test is fail, it will also show the test item which does not pass the threshold test.



or





CAUTION!

If any one of these sub tests fails, the inverter will go into the "fault mode" and stop the test. It must re-run and pass the Auto Test function or the inverter will stay in "fault mode" and not restart.



CAUTION!

The Auto Test function is used only for the confirmation of the interface protection function of the inverter. It will NOT change any actual threshold and trip settings. When a real abnormal event occurs on utility grid, the inverter will cease and trip based on the default settings but not these test results shown on user's PC.

3.4 Explanations of Error Messages

In the event of a fault, the inverter will stop feeding the AC power to the utility grid and display the error message on the LCD. Qualified service staff shall do the analysis, measurement, and debug if needed according to the error message in order to resume normal conditions. It is recommended to screen out the fault condition(s) by referring to the table below and then remove the fault condition(s) to have the inverter returned to normal condition and continue to feed AC power to the utility. Please contact GESOLAR or your service representative if the same error message is persistent.

Error Message Table

Error Message	Description
GridNA	No AC voltage is detected on the utility grid side.
VacH	The AC voltage of utility grid is over the upper limit.
VacL	The AC voltage of utility grid is under the lower limit.
FacH	The AC frequency of the utility grid is over the upper limit.
FacL	The AC frequency of the utility grid is under the lower limit.
Phase Loss	One or two phases are missing (AC voltage is not present on that phase).
L2, L3 Swap.	L2 and L3 phases are reversed.
Drift Fac	Islanding is detected.
FastEarthCurrent	The drastic change of the leakage current has been detected
SlowEarthCurrent	The leakage current has exceeded a safe operating limit.
DCInjectCurH	The DC current injected into the AC grid is over the upper limit.
Iac_Max.	Over current on the grid side.
IacH	The AC current is over the upper limit.

Error Message	Description
Riso Low	The insulation resistance between PV array and the ground is below the safe operating limit.
VpvH	The DC voltage of PV array is over the upper limit.
IpvH	Over current on the DC side.
PpvH	Over power on the DC side.
VdcbusH	Internal DC bus voltage is over the upper limit.
VdcbusL	Internal DC bus voltage is below the lower limit.
Temp. High	The internal temperature of the inverter exceeded the safe operating limit.
CPUs diff.High	Internal measurements from both CPU's are differ from each other.
System Error	The system is failed.
Relay Open Relay Short Relay Fault	The output relay is fail.
Vdcbus Fault	The DC/DC converter is fail.

Error Message	Description
RCMU Fault	The leakage current measurement device is fail.
I/P HCT Fault O/P HCT Fault HCT Fault	Input/Output current sensor is fail.
Idc-inj. Fault	The DC injection current monitoring function is fail.
SPI Error	Internal communication is fail.
EEPROM Fault	EEPROM test failed. *warning message
FanLock_A FanLock_B	The fan stops running. *warning message
Comm. Error	External communication failed. *warning message
Offset Fault	Internal reference voltage failed, +1.5VA, +1.5VB.
CalDataLoss	Calibration data is lost.
Model Error	The hardware MODEL and the CPU software version are not matched.
Version Error	The firmware version is not correct.

3.5 Troubleshooting

The error message(s) will be displayed on the LCD and recorded in memory when the inverter has encountered an event of fault. Some critical faults will cause the inverter to automatically shut off the output AC power. For safety reason, the inverter will not re-start unless the fault has been cleared. In general, we suggest following the steps described below to identify and solve the problem.

1. To make sure that the inverter is correctly connected to the mains utility and PV arrays following the connection procedures described in this manual.
2. Try to identify and solve the problem based on the troubleshooting table below.
3. If the problem cannot be identified and solved, please contact your GESOLAR distributor for assistance.

Trouble Shooting Table

Error Message	Possible Causes	Disposal Measures
Comm. Error	External communication malfunctions	Restart the inverter again; Inform professional service staff if failed to restore
CPUs diff.High	Calibration parameters are deviated	Inform professional service staff to check the calibration parameters
	Internal circuits malfunction	Restart the inverter again; Inform professional service staff if failed to restore
DCInjectCurH	AC current sensor malfunctions	
	The default settings is inappropriate	Inform professional service staff to check the settings
EEPROM Fault	EEPROM's parameters are unrecognized	Inform professional service staff to update the EEPROM's parameters
FanLock_A **FanLock_B**	Fan malfunctions	Inform professional staff to replace the fan
FastEarthCurrent **SlowEarthCurrent**	DC or AC wires insulation is damaged and it causes a high ground fault current	Check the DC and AC wire insulation

Error Message	Possible Causes	Disposal Measures
GridNA (Loss of Mains)	? AC feed lines are disconnected	Check the AC wirings
	? AC switch/breaker is open	Close the AC switch/ breaker after clearing the faults
	? Grid power is blackout	Wait until the grid is restored
HCT Fault	? DC or AC current sensor malfunctions	Restart the inverter again; Inform professional staff if failed to restore
Iac_Max. IacH	? Mains voltage drops suddenly	Benign neglect if it seldom occurs
	? The inverter malfunctions	Inform professional staff if failed to restore
Idc-inj. Fault Offset Fault	? Internal circuit malfunctions	Restart the inverter again; Inform professional staff if failed to restore
L2, L3 Swap.	? L2 and L3 cables are reverse wired	L2 and L3 wirings shall be reversed
Model Error	? Default setting is wrong	Inform professional staff to replace the inverter

Error Message	Possible Causes	Disposal Measures
Phase Loss	One of the AC wirings is disconnected	Check the AC wirings
RCMU Fault	Residual current protective device malfunctions	Restart the inverter again; Inform professional staff if failed to restore
Relay Open **Relay Short** **Relay Fault**	AC relay malfunctions	
Riso Low	Dew or some object exits between DC lines and earth.	Clean the objects and restart the inverter again
SPI Error	Internal communication malfunctions	Restart the inverter again and Inform professional staff if failed to restore
Temp. High	Air circulation is insufficient	Allow for a clearance of 20cm at least from walls or other devices for air intake and exhaust
	Ambient temperature is too high	Ensure the ambient temperature is under 60°C

Error Message	Possible Causes	Disposal Measures
VacH **VacL** **FacH** **FacL** **(Mains voltage or frequency is beyond the limit)**	AC voltage or frequency exceeds the default settings	Wait until the grid is back to stable.
	Mains voltage or frequency is unstable	Request the utility supplier to improve and then inform professional staff to change the settings.
	The settings are inappropriate	Inform professional staff to check the settings.
VdcbusH **VdcbusL** **Vdcbus Fault**	The inverter malfunctions	Restart the inverter and Inform professional staff if failed to restore
Version Error	Firmware version is incompatible	Reinstall the firmware according to the instruction
VpvH **IpvH** **PpvH**	PV array voltage exceeds the permissible value	Disconnect the DC source and inform the system installer to check the configuration of PV arrays

4. Technical Documentation

4.1 Outline Drawing

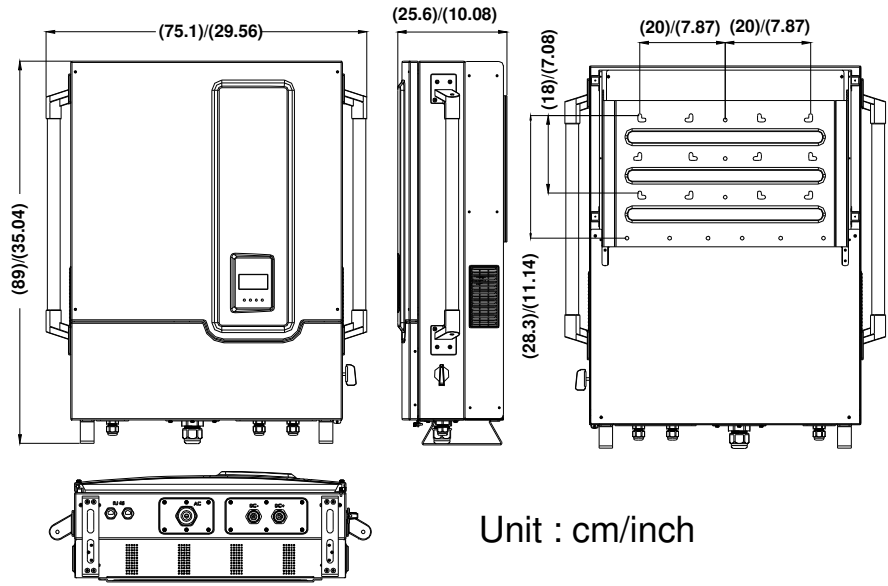


Fig 4.1.1 Outline Drawing of GES-20KTL

4.2 Efficiency

The efficiency of the GES-15KTL/20KTL is shown in Figure 4.2.1 and Figure 4.2.2 below.

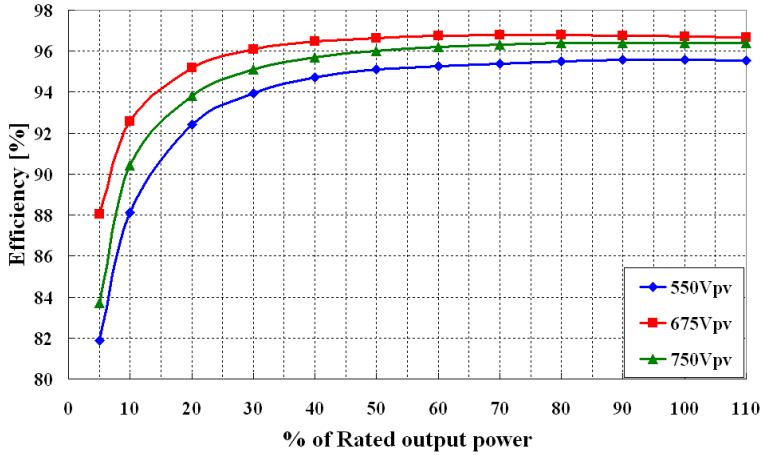


Fig 4.2.1 Efficiency of the GES-20KTL= 96.0%

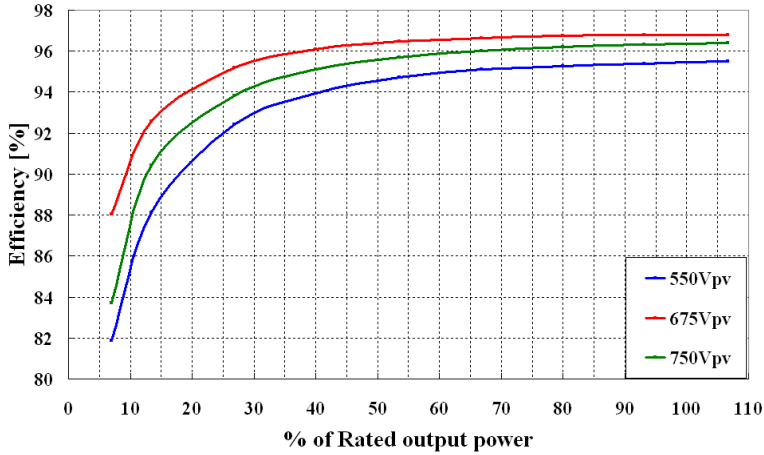


Fig 4.2.2 Efficiency of the GES-15KTL= 95.5%

4.3 De-rating Operation

The occasions that the GESOLAR inverter will take into account and then regulate the output and/or restrict the input power to ensure the system is in a safe operation are described in detail below.

Temperature

The inverter will monitor the temperature on the heat sink. Once the temperature exceeds 70℃ (ambient temperature is around 45℃), the system will reduce the output power until the temperature drops under the critical value. The inverter will shut down the power output to the grid if the temperature reaches 85℃. If this occasion happens often, it needs to check whether the inverter is mounted at an appropriate place with good ventilation and not directly exposure to the sunshine.

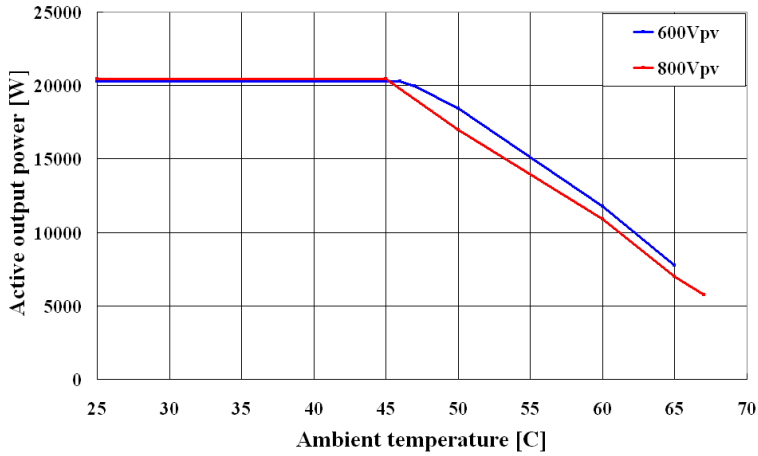


Fig 4.3.1 Temperature de-rating curve of the GES-20KTL

Input DC current

When the input current from the PV strings is about to exceed the maximum limit, the inverter will restrict it to the operating limit in order to prevent damages to the inverter. If this occasion happens frequently, it needs to check whether the PV arrays are configured properly to supply the DC current within the maximum limit to the inverter.

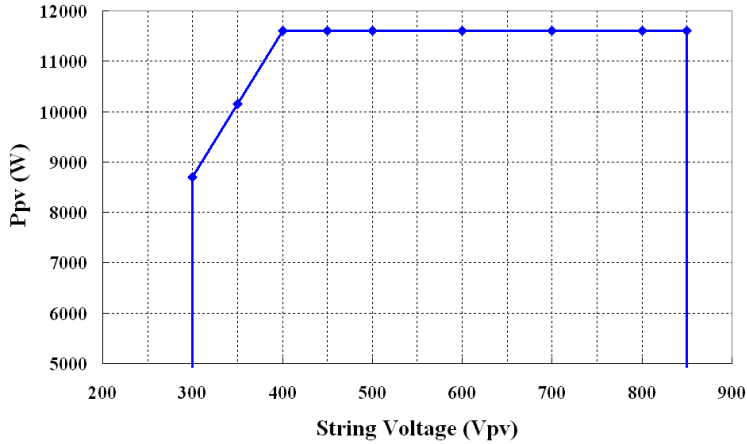


Fig 4.3.2 DC Power curve of the independent PV string of the GES-20KTL

Output AC power

The maximum power that the inverter feeds to the grid is limited according to the specifications listed in Section 1.2. Even the output current does not reach the maximum current limit; the inverter will still automatically restrict the delivery output current to keep the output power within the maximum power limit when the output voltage is too high.

Output AC current

The maximum current that the inverter feeds to the grid is limited according to the specifications listed in Section 1.2. Even the output power does not reach the maximum power limit the inverter will still restrict the delivery output current within the maximum current limit when the output voltage is too low.

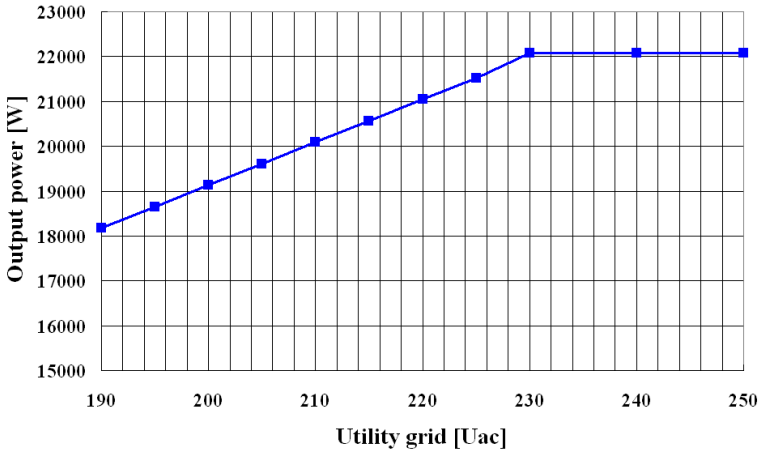


Fig 4.3.3 Output Power v.s. Grid voltage of the GES-20KTL

4.4 MPP Efficiency

The GES-15KTL/20KTL supports up two (2) PV strings that can be either connected in parallel feeding into a single MPP tracker or connected individually to each MPP tracker. The efficiency of the MPP tracker when two (2) PV strings are connected in parallel and independently are shown in Figure 4.4.1 and Figure 4.4.2 respectively.

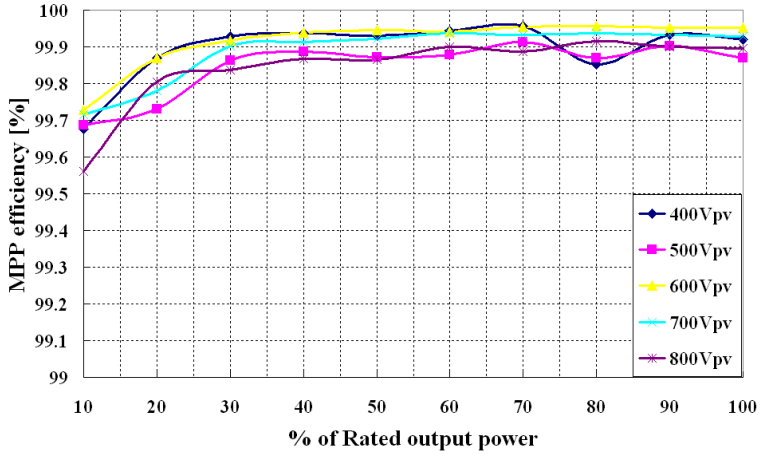


Fig 4.4.1 MPP Efficiency of the two PV strings in parallel

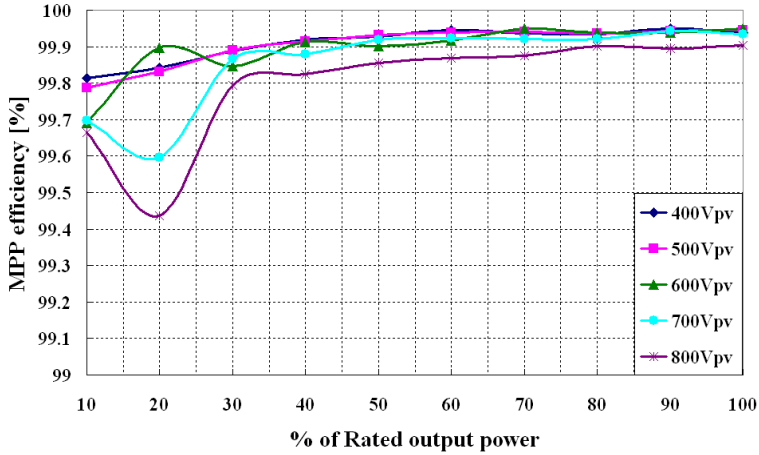


Fig 4.4.2 MPP Efficiency of the two PV strings in individual

4.5 Reactive Power and Power Factor

According to DK5940 (ENEL 2010), the reactive power and the power factor shall be taken into account. The inverter will feed the AC power to the public grid with the reactive power and power factor shown in Figure 4.5.1 and Figure 4.5.2.

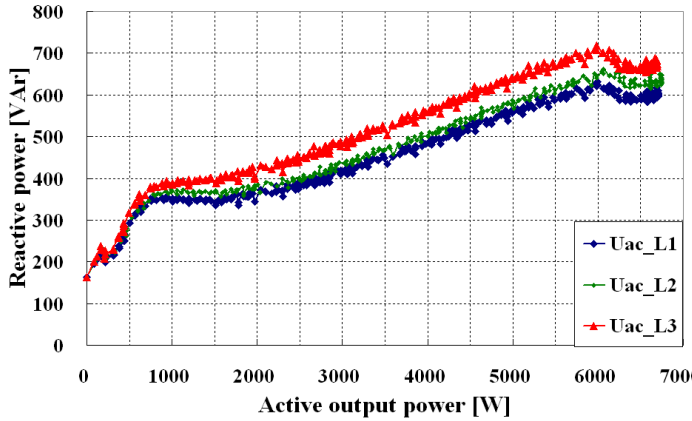


Fig 4.5.1 Active output power v.s. Reactive power of the GES-20KTL

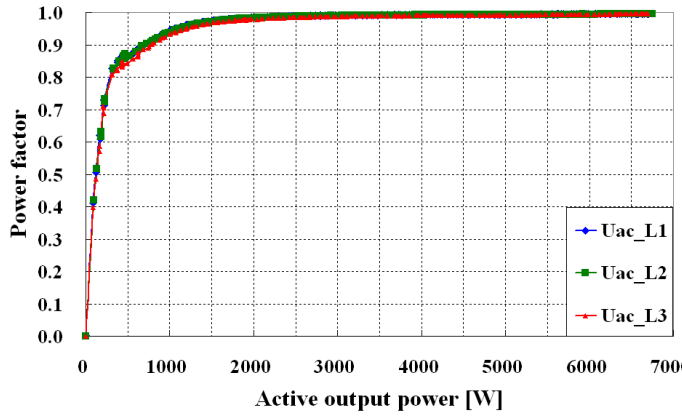


Fig 4.5.2 Active output power v.s. Power factor of the GES-20KTL



WARNING!

PV arrays is always energized when exposed to light therefore hazardous voltage is still present on the terminal blocks and the PV string fuse holders even the DC/AC disconnect switch is switched OFF. Please cover the PV arrays with opaque (dark) materials during the inverter removal and absence until the inverter is hooked back and reconnected.



WARNING!

Hazardous voltage is still present on the device after disconnection of all PV DC inputs. Allow 5 minutes for the inverter to discharge the energy completely.



WARNING!

Must confirm that all DC and AC switches are turned off for at least five (5) minutes before opening the front covers of the inverter and the wiring box and disconnect the DC and AC wires between them. The wires been disconnected must be wrapped with an insulated material to prevent staff from the electrical shock.



WARNING!

After the inverter is removed from the mounting bracket, the through holes of the wires on top of the wiring box must be covered with the cover plate that is attached on top of the wiring box to prevent the box from the water drops causing current leakages.



WARNING!

Not to keep any spare parts inside the wiring box.

5. Warranty information

Warranty Period

A period of 5 years is warranted from the date of your purchase of the GESOLAR series Products.

Warranty Terms

GESOLAR hereby provides this written Limited Warranty covering the Products with the models **GES-15KTL** and **GES-20KTL**, and if the Buyer discovers and notifies GESOLAR in writing of any defect in material or workmanship within the applicable warranty period stated above, then GESOLAR may, at its option: repair or replace the Product; or issue a credit note for the defective Product; or provide the Buyer with replacement parts for the Product.

The Buyer will, at its expense, return the defective Product or parts thereof to GESOLAR in accordance with the return procedure specified below.

GESOLAR will, at its expense, deliver the repaired or replaced Product or parts to the Buyer.

Exclusion of Liability

Any warranty of GESOLAR will not apply if the Buyer is in default under the Purchase Order Agreement or where the Product, any part or its original label thereof is

1. Damaged by misuse, accident, negligence or failure to maintain the same as specified or required by GESOLAR.
2. Damaged by external hazard or force majeure such as lightning strikes,

storm, and/or fire.

3. Damaged by modifications, alterations or attachments thereto which are not authorized by GESOLAR.
4. Transported, installed or operated contrary to the instructions of GESOLAR.
5. Opened, altered, modified or disassembled in any way without GESOLAR's consent.
6. Used in combination with items, articles or materials not authorized by GESOLAR.

GESOLAR reserves the rights to determine whether the problem exists within the Product. The Buyer may not assert any claim that the Products are not in conformity with any warranty until the Buyer has made all payments to GESOLAR provided for in the Purchase Order Agreement.

Product Return Procedure

On-site Inspection & Repair

If a product requires warranty service, contact your merchant or GESOLAR directly. After your application is received, the service will be implemented by our qualified technician in the installation field. Problem isolation processes include,

1. Qualified service technician on site with digital measurement equipments, including but not limited to digital voltmeter and current clamp meter.
2. Isolation of the inverter from the external electrical environment under the guidance of a qualified GESOLAR service representative.
3. Full declaration of the environmental conditions currently in place and historically preceding the failure, including but not limited to the utility

grid connection and PV generator array configuration.

What Comes to Your Notice before Return

In case the Product fails to function and requires a Factory Service after diagnosis, the Product could be sent back using the proper shipping box and the packing materials. A copy of the original purchase invoice is also required to be included in the package. In addition, here are some documents which shall be attached with the return Product. Please provide as much detail as possible.

1. Model number and serial number shown on the label.
2. Fault message on the panel and how it reproduces.
3. Detailed descriptions before & after the fault condition and the utility grid system connected.

How Our Factory Service Goes On

1. Replace the defective Product with a **new** unit if it is purchased **within 90 days**.
2. Replace the defective Product with a **refurbished** unit if it is purchased **after 90 days**.

NOTE: All remaining warranty periods will remain effective for the replacement inverter or parts.

NOTE: Unauthorized returns will not be accepted and will be returned at the shipper's expense.

NOTE: All component replacement and its service labor costs are covered by the warranty in effect. Once the warranty expires, a Product found upon inspection by GESOLAR, to be in specification is subject to an evaluation fee and applicable freight charges, if any.

WARRANTY REGISTRATION FORM

It is very important to you that you register the product. Changes in product technologies as well as new developments in software and features may make it necessary for us to notice you the related information about your inverter. Please register immediately after purchasing.

Company: _____ **Product Type:** _____

City, State Zip: _____ **Serial Number(s):** _____

Phone: _____ **Date Installed:** _____

E-mail: _____

System Description: PV array size/type, Connection…

Your Comment:

GESOLAR

Build and Beyond

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