SUNGROW

# User Manual



## SH3K6 / SH4K6 /

## SH5K-30

## Grid-Connected Hybrid Inverter

SH3.6_4.6_5K-30-UEN-Ver11-201908 Version：1.1

# About This Manual

### Applicability

This manual is applicable to the following inverter type:

- SH3K6-30
- SH4K6-30
- SH5K-30

They will be referred to as “inverter” hereinafter unless otherwise specified.

### Target Group

This manual is intended for:

- qualified personnel who are responsible for the installation and commissioning of the inverter; and
- inverter owners who will have the ability to interact with the inverter via the LCD operation.

### How to Use The Manual

Read the manual and other related documents before any work on the inverter is carried out. Documents must be stored carefully and be available at all times.

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Content may be periodically updated or revised due to product development. The information in this manual is subject to change without notice. The latest manual can be acquired at www.sungrowpower.com.

### Symbols

Safety instructions will be highlighted with the following symbols.

| Symbol | Explanation |
|---|---|
| DANGER | Indicates a hazard with a high level of risk that, if not avoided, will result in death or serious injury. |

| Symbol | Explanation |
| --- | --- |
|   | Indicates a hazard with a medium level of risk that, if not avoided, could result in death or serious injury. |
|   | Indicates a hazard with a low level of risk that, if not avoided, could result in minor or moderate injury. |
| NOTICE | Indicates a situation that, if not avoided, could result in equipment or property damage. |
|  | Indicates additional information, emphasized contents or tips that may be helpful, e.g. to help you solve problems or save time. |

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# 1 Safety

### General Safety

The inverter has been designed and tested strictly according to international safety regulations. Read all safety instructions carefully prior to any work and observe them at all times when working on or with the inverter.

Incorrect operation or work may cause:

- injury or death to the operator or a third party; or
- damage to the inverter and property safety of the operator or a third party.

**DANGER**

**Lethal voltage!**

- **PV strings will produce electrical power when exposed to sunlight and can cause a lethal voltage and an electric shock.**
- **Only qualified personnel can perform the wiring of the PV panels.**

NOTICE

**All electrical connections must be in accordance with local and national standards.**

**Only with the permission of the utility grid, the inverter can be connected to the utility grid.**

### Inverter

A warning label and a nameplate are pasted on the side of the inverter.

**Tab. 1-1** Symbols on the Inverter

| Symbol | Explanation |
|---|---|
|  | Disconnect the inverter from all the external power sources before service! |
|   | Do not touch live parts until 10 minutes after disconnection from the power sources. |

| Symbol | Explanation |
|---|---|
|  | There is a danger from a hot surface that may exceed 60°C. |
|  | Danger to life due to high voltages!<br>Only qualified personnel can open and service the inverter. |
|  | Check the user manual before service! |
|  | Regulatory compliance mark. |
|  | Do not dispose of the inverter together with household wastes. |
|  | The inverter does not have a transformer. |
|  | TUV mark of conformity. |
|  | CE mark of conformity. |

## DANGER

**Danger to life from electric shock due to live voltage**

- Do not open the enclosure when the inverter is working. Unauthorized opening will void guarantee and warranty claims and in most cases terminate the operating license.
- When the enclosure lid is removed, live components can be touched which can result in death or serious injury due to electric shock.

**Danger to life from electric shock due to damaged inverter**

- Only operate the inverter when it is technically faultless and in a safe state.
- Operating a damaged inverter can lead to hazardous situations that can result in death or serious injuries due to electric shock.

**WARNING**

**Risk of inverter damage or personal injury**

**Do not pull out PV connectors, AC connector or battery connectors while the inverter is running. De-energize from all power sources. Wait 10 minutes for the internal capacitors to discharge. Verify that there is no voltage or current before pulling any connector.**

**All the warning labels and nameplate on the inverter body:**

- must be clearly visible; and
- must not be removed, covered or pasted.

**CAUTION**

**Risk of burns due to hot components**

**Do not touch any hot parts (such as heat sinks) during operation. Only the LCD panel and the DC switch can safely be touched at any time.**

NOTICE

**Only qualified personnel can change the country setting.**

**Unauthorized alteration of the country setting may cause a breach of the type-certificate marking.**

**Risk of inverter damage due to electrostatic discharge (ESD).**

**By touching the electronic components, you may damage the inverter. For inverter handling, be sure to:**

- **avoid any unnecessary touching; and**
- **wear a grounding wristband before touching any connectors.**

**Batteries**

**DANGER**

**Batteries deliver electric power, resulting in burns or a fire hazard when they are short circuited, or wrongly installed.**

**Lethal voltages are present in the battery terminals and cables in the inverter. Severe injuries or death may occur if the cables and terminals in the inverter are touched.**

**WARNING**

**Provide sufficient ventilation for the battery system to prevent flames and sparks from the explosive hydrogen gas that the batteries release.**

**Due to the dangers of hydrogen gas and battery electrolyte:**

- **locate batteries in a designated area, complying with the local regulations;**
- **protect the enclosure against destruction;**
- **do not open or deform the battery;**
- **whenever working on the battery, wear suitable personal protective equipment (PPE) such as rubber gloves, rubber boots and goggles;**
- **rinse acid splashes thoroughly with clear water for a long time and consider consulting a doctor.**

NOTICE

**Improper settings or maintenance can permanently damage the battery.**

Incorrect inverter parameters will lead to the premature aging of battery.

### Skills of Qualified Personnel

Qualified personnel must have the following skills:

- training in the installation and commissioning of the electrical system, as well as the dealing with hazards;
- knowledge of the manual and other related documents; and
- knowledge of the local regulations and directives.

# 2 System Solution

**WARNING**

**The inverter must only be operated with PV strings of protection class II in accordance with IEC 61730, application class A. It is not permitted for the positive pole or the negative pole of the PV strings to be grounded. This can cause the inverter to be destroyed.**

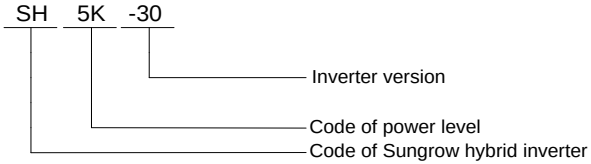
**Damages to the product due to a faulty or damaged PV installation are not covered by warranty.**

**Any use other than that described in this chapter is not permitted.**

The single-phase hybrid inverters are applicable to both on-grid and off-grid PV systems. With the Energy Management System (EMS) integrated, it can control and optimize the energy flow so as to increase the self-consumption of the system.

### Inverter

The type description is as follows:




**Tab. 2-1** Power Level Description

| Type | Nominal Output Power | Nominal Grid Voltage |
|---|---|---|
| SH3K6-30 | 3680 W | 220 Vac / 230 Vac / 240 Vac (single phase) |
| SH4K6-30 | 4600 W | |
| SH5K-30 | 4990 W (AS4777)<br>5000 W (not AS4777) | |

The following figure shows the inverter appearance, which is for reference only. The actual product that you receive may differ.

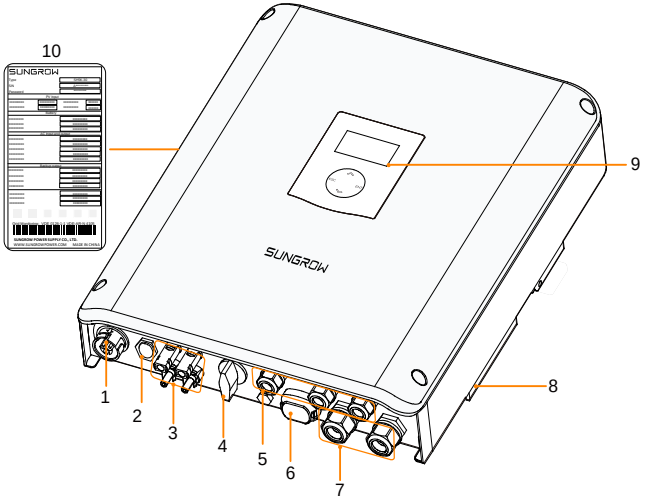



**Fig. 2-1** Inverter Appearance

| No. | Name | Description |
|---|---|---|
| 1 | Grid terminal | To feed power into the utility grid<br>The emergency loads also can be supplied from the grid. |
| 2 | Backup terminal | To connect emergency loads |
| 3 | PV terminals | Positive and negative PV input connectors (two pairs). |
| 4 | DC switch | To disconnect the DC current safely |
| 5 | Communication terminals | RS485, Ethernet, CAN, DO, DRM and SPI |
| 6 | Wi-Fi terminal | To connect the Wi-Fi module |
| 7 | Battery connection | BAT+ and BAT- |
| 8 | Second PE terminal | For reliable grounding |
| 9 | LCD panel | The display and four buttons can be used to access current operating data or change inverter settings. |
| 10 | Nameplate | Clearly identify the product, including the SN, password, technical data, certifications, etc. |

The following figure shows the dimensions of the inverter.

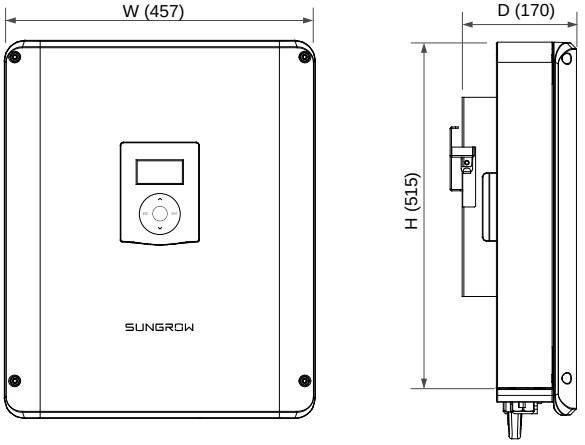



**Fig. 2-2** Dimensions (unit: mm)

The LCD panel with an indicator and four buttons is on the front of the inverter.

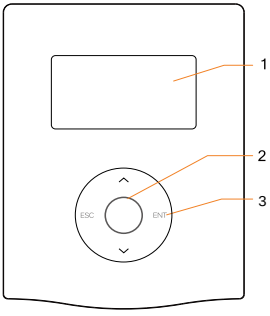



**Fig. 2-3** LCD Display Panel

| No. | Name | Description |
|---|---|---|
| 1 | Screen | To display the information. |
| 2 | Indicator | Green and red can be indicated via the indicator, from which user can know the current status. For detailed definition, see **Tab. 7-5**. |
| 3 | Buttons | User can operate the LCD menu via the four buttons. For detailed functions, see **Tab. 7-1**. |

### Energy Meter

The SUNGROW Energy Meter is installed next to the main switch to detect the electrical measured values at the grid-connected point. It communicates with the inverter via an RS485 connection. The dimensions are shown below.

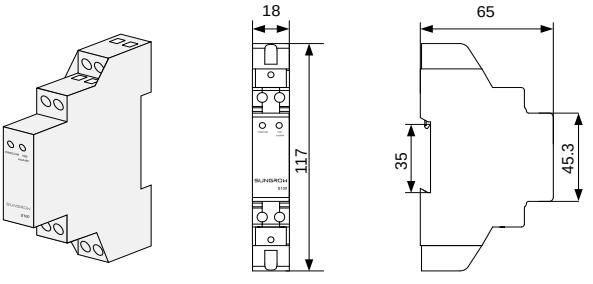



**Fig. 2-4** single-phase Meter Dimensions (unit: mm)

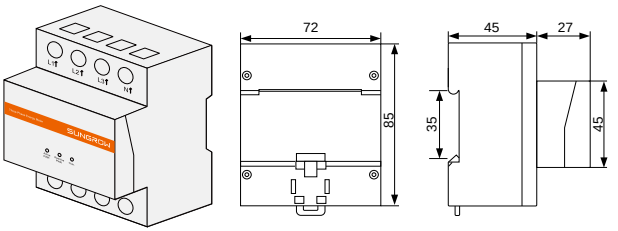



**Fig. 2-5** Three-phase Meter Dimensions (unit: mm)

- The single-phase Energy Meter and the three-phase Energy Meter are alternative in the delivery. The meter figures in this document have been created for the single-phase Energy Meter unless otherwise specified.
- More detailed information on the Smart Energy Meter can be found in the respective Quick Installation Guide.

## 2.1 PV Energy Storage System (PV ESS)

With a battery module for the immediate storage of energy, the conventional PV system can be upgraded to be an Energy Storage System (ESS).

The system is capable of operating as an off-grid system to ensure an emergency power supply for emergency loads in the event of a grid interruption

or blackout. The grid interruption or blackout may be caused by:

- Islanding;
- under-voltage;
- under-frequency; or
- over-frequency.

The error codes will be displayed on the LCD screen.

**NOTICE**

**For the TT utility grid, the N line voltage to ground must be 30 V or less.**

**The utility grid must be a TN system for the off-grid application.**

**The system is not suitable for supplying life-sustaining medical devices. A power outage must not lead to personal injury.**

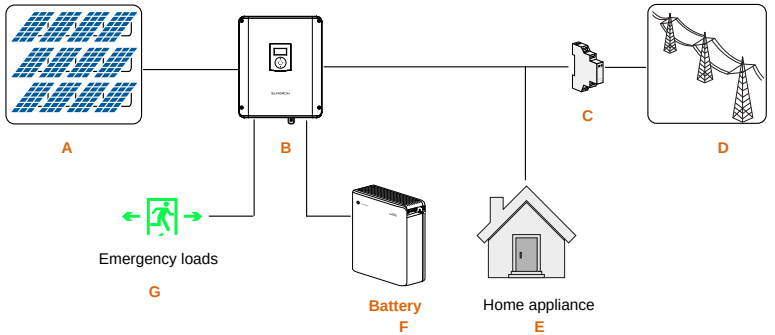



**Fig. 2-6** Inverter Application in PV Energy Storage System (PV ESS)

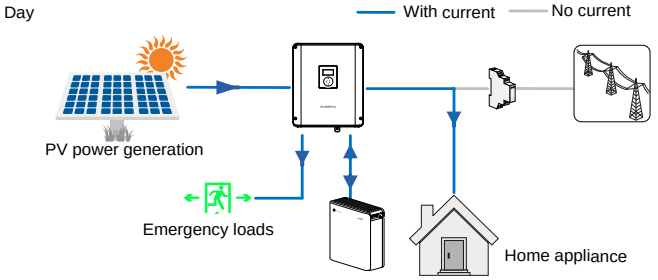
**Tab. 2-2** System Compositions

| Item | Description | Remark |
|---|---|---|
| A | PV strings | Monocrystalline silicon, polycrystalline silicon, and thin-film without grounding |
| B | Inverter | SH3K6-30 / SH4K6-30 / SH5K-30 |
| C | Sungrow Energy Meter (single-phase for example) | Measures the feed-in power and communicates with the inverter via the RS485 port. |
| D | Utility grid | Grid grounding system types: TT, TN |
| E | Household load | Devices that consume energy |
| F | Battery (optional) | A Li-ion battery or a lead-acid battery |
| G | Emergency loads | - |

### Energy Management during Daytime

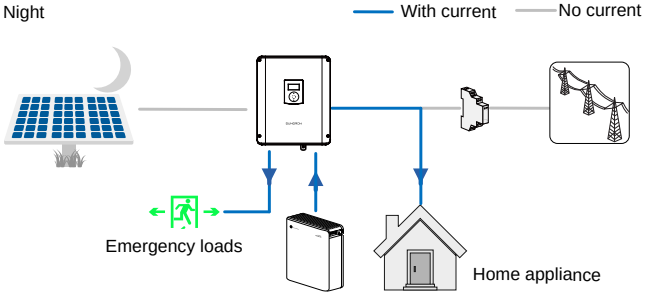
The energy management system (EMS) works in self-consumption mode by default. The PV power will go to emergency loads and house loads first, then the battery. Then if the battery is fully charged the excess will go to the grid, the feed-in power should be not more than the limit value in zero-export setting in initial commissioning.

If the PV power is less than the load power, the battery will discharge and provide the energy shortfall. The inverter will draw power from the mains if the power from the PV and battery is less than the load power.

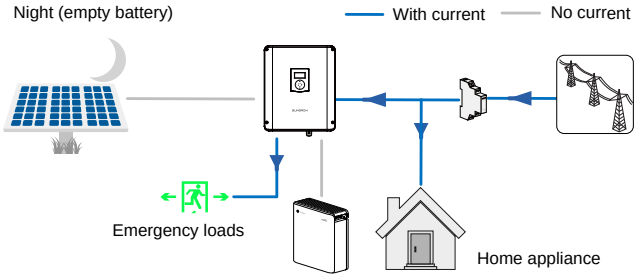



### Energy Management during Night

The battery discharges to provide energy to loads. If the battery is empty or there is not enough power from the battery system, the unmet power will be supplied by the grid first to emergency loads and house loads.




When the grid is present, the bypass function of the hybrid inverter works and the emergency loads will be directly connected to the grid via the bypass relay integrated in the inverter. The emergency loads are preferentially supplied with PV or battery energy, and is supplemented by the grid when the PV and battery energy are insufficient.




If the meter is abnormal or not equipped, the inverter can run normally, the battery can be charged but not allowed to discharge, the feed-in power setting on the LCD display will be ineffective, and the DO function of optimized mode will be disabled.

## 2.2 Retrofitting System

The hybrid inverter is compatible with any single-phase PV grid-connected inverters. An existing PV system can be retrofitted to be a PV ESS with the addition of the hybrid inverter.

The power generation from the existing PV inverter will be firstly provided to the loads and then charge the battery. With the energy management function of the hybrid inverter, the self-consumption of the new system will be greatly improved.

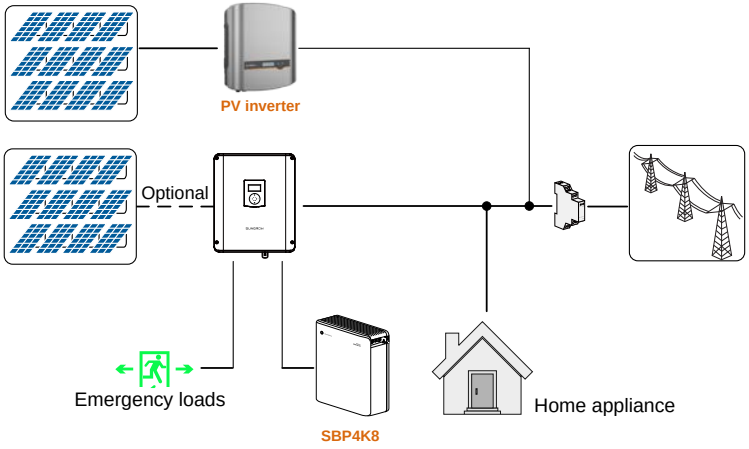
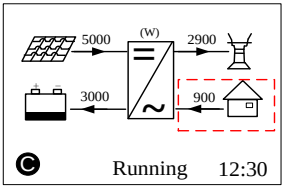



**Fig. 2-7** Retrofitting the Existing PV System

Note:

1. In zero-export scenario, the hybrid inverter can only promise no power exported to grid itself but not promise the PV inverter zero-export. Please contact the PV inverter manufacture for its zero-export solution.
2. PV modules for hybrid inverter are optional.

The existing PV inverter provides power to the PV ESS, as the power flow shown on the main screen.




Refer to "**7.4.2 Adding the Existing Inverter**" to set the rated power of the existing PV inverter. The output power of the existing PV inverter should be taken into consideration for feed-in power setting.

# 3 Function Description

## 3.1 Safety Function

### 3.1.1 Protection

The protective functions are integrated in the inverter, including short circuit protection, grounding insulation resistance surveillance, residual current protection, anti-islanding protection, DC overvoltage / over-current protection, etc.

### 3.1.2 Earth Fault Alarm

The inverter has integrated a multiple-function dry-contact (DO relay), which can be used for the external alarm for an earth fault. The external alarm needs to be powered by the grid.

The additional equipment required is a light indicator and/or a buzzer. The recommended cross-section of the DO cable is 1 $mm^2$.

If an earth fault occurs,

- the DO dry-contact will switch on automatically to signal the external alarm;
- the buzzer inside the inverter will also beep; and
- the Ethernet communication port can be used for the remote alarm.

### 3.1.3 SPI and Auto Test ("IT")

The auto test system will check the maximum/minimum frequency and voltage provided in the interface protection system (SPI). For each frequency and voltage protection function, the tripping threshold varies linearly upward or downward with a slope of ≤ 0.05 Hz/s or ≤ 0.05 V/s respectively for the frequency and voltage protection. For details, see "**10.8 Self-test (Italy)**".

The integrated SPI is capable to receive the signals aimed at changing the frequency protection thresholds or the command of remote shutdown. For details, see "**6.10.2 SPI Connection ("IT")**".

## 3.2 Energy Conversion and Management

The inverter converts the DC power from the PV strings or the battery to the AC power, which conforms to the grid requirements. It also transmits the DC power from the PV panel to the battery.

With the bidirectional converter integrated inside, the inverter can charge or discharge the battery.

Two string MPP trackers can be utilized to maximize the power from PV strings with different orientations, tilts, or module structures.

### 3.2.1 Power Derating

Power derating is a way to protect the inverter from overload or potential faults. In addition, the derating function can also be activated by the requirements of the utility grid. Situations requiring inverter power derating are:

- grid dispatching;
- over-temperature (including ambient temperature and module temperature);
- grid under-voltage;
- feed-in power limit setting; and
- power factor.

#### Grid Dispatching Derating

Adjust the output power according to the remote scheduling instructions and the inverter operates with the power derating.

#### Over-temperature Derating

A high ambient temperature or poor ventilation will lead to a power derating of the inverter.

When the internal temperature or module temperature exceeds the upper limit, the inverter will reduce the power output until the temperature drops within the permissible range.

#### Grid Under-voltage Derating

When the grid voltage is too low, the inverter will reduce the output power to make sure that the output current is within the permissible range, as calculated by the following equation.

When Vmin < V < 230 V, $P = Pn \times (V_{grid} / 230\ V)$

Refer to “12 Appendix **III:** Active Power Response” for over-voltage curve. The following figure shows the under-voltage derating curve.

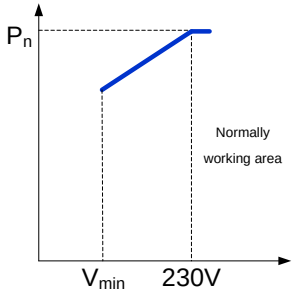



**Fig. 3-1** Grid Under-voltage Derating

### Feed-in Power Limit Derating

When the meter detects that the feed-in power is greater than the limit value on the LCD, the inverter will reduce the output power within the specified range.

### Power Factor Derating

When the power factor PF<1.0, the inverter will reduce the output power within a specified range. The following figure shows the power factor derating curve.

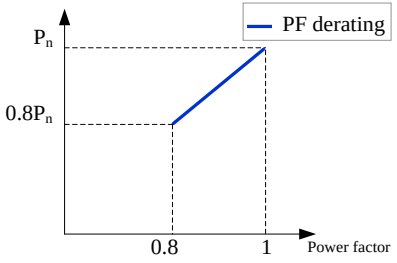



**Fig. 3-2** Power Factor Derating

## 3.2.2 DRM (“AU”/“NZ”)

The inverter provides a terminal block for connecting to a demand response enabling device (DRED). The DRED asserts demand response modes (DRMs). The inverter detects and initiates a response to all supported demand response commands within 2s. For the connections, see “**6.10.1 DRM Connection (“AU”/“NZ”)**”.

The following table lists the DRMs supported by the inverter.

**Tab. 3-1** Demand Response Modes (DRMs)

| Mode | Explanation |
|---|---|
| DRM0 | The inverter is in the state of “Turn off”. |
| DRM1 | The import power from the grid is 0. |
| DRM2 | The import power from the grid is no more than 50 % of the rated power. |
| DRM3 | The import power from the grid is no more than 75 % of the rated power. |
| DRM4 | The import power from the grid is 100 % of the rated power, but subject to the constraints from other active DRMs. |
| DRM5 | The feed-in power to the grid is 0. |
| DRM6 | The feed-in power to the grid is no more than 50 % of the rated power. |
| DRM7 | The feed-in power to the grid is no more than 75 % of the rated power. |
| DRM8 | The feed-in power to the grid is 100 % of the rated power, but subject to the constraints from other active DRMs. |

The DRED may assert more than one DRM at a time. The following shows the priority order in response to multiple DRMs.

| Multiple Modes | Priority Order |
|---|---|
| DRM1…DRM4 | DRM1 > DRM2 > DRM3 > DRM4 |
| DRM5…DRM8 | DRM5 > DRM6 > DRM7 > DRM8 |

### 3.2.3 Regular Operational Voltage Range

#### European Countries (DE, BE, LUX, NL, IT)

The inverters can operate within the allowable voltage range for at least the specified observation time. The setting of the conditions depends on whether the connection is due to a normal operational start-up or an automatic reconnection after tripping of the interface protection.

When the voltage level is out of the operational levels, the inverter will disconnect from the grid in the protection time. If a disturbance lasts less than the required protection time, the inverter can reconnect to the grid if the voltage level goes back to normal levels after the disturbance.

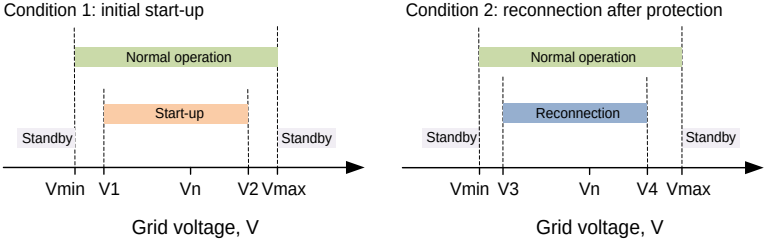



**Fig. 3-3** Inverter Action related to Grid Voltage (“DE” for example)

**Tab. 3-2** Operational Voltage Parameter Description

| Parameter | Explanation |
|---|---|
| **Grid-connection** | |
| V1 | The lower voltage limit for initial start-up. |
| V2 | The upper voltage limit for initial start-up. |
| V3 | The lower voltage limit for reconnection. |
| V4 | The upper voltage limit for reconnection. |
| $t_v$ | Minimum observation time. |
| $k_v$ | Connection or recovery gradient. |
| **Protection** | |
| $V_{min}$ | Under-voltage protection value. |
| $V_{max}$ | Over-voltage protection value. |
| $T_{min}$ | Under-voltage protection time. |
| $T_{max}$ | Over-voltage protection time. |

**Tab. 3-3** Default Values of Operational Voltage Parameter

| Parameter | DE | BE | LUX | NL | IT |
|---|---|---|---|---|---|
| V1 (V) | 195.5 | 195.5 | 195.5 | 195.5 | 197.5 |
| V2 (V) | 251.0 | 253.0 | 253.0 | 253.0 | 253.0 |
| V3 (V) | 195.5 | 195.5 | 195.5 | 195.5 | 197.5 |
| V4 (V) | 251.0 | 253.0 | 253.0 | 253.0 | 253.0 |
| $t_v$ (s) | 60 | 60 | 60 | 60 | 30 or 300 (2) |
| $k_v$ | Not applicable or 10 % Pn/min (1) | | | | 20 % Pn/min |
| 1-$V_{min}$ (V) | 184.0 | 184.0 | 184.0 | 184.0 | 195.5 |
| 2-$V_{min}$ (V) | 103.5 | 184.0 | 184.0 | 184.0 | 92.0 |
| 1-$V_{max}$ (V) | 287.5 | 264.5 | 264.5 | 253.0 | 264.5 |
| 2-$V_{max}$ (V) | 287.5 | 264.5 | 264.5 | 253.0 | 264.5 |
| 1-$T_{min}$ | 3.1 | 0.2 | 1.35 | 2.0 | 0.4 |
| 2-$T_{min}$ | 0.4 | 0.2 | 1.35 | 2.0 | 0.2 |
| 1-$T_{max}$ | 0.1 | 0.2 | 0.15 | 2.0 | 0.2 |
| 2-$T_{max}$ | 0.1 | 0.2 | 0.15 | 2.0 | 0.2 |

(1) Not applicable for initial connection and 10 % Pn/min for reconnection.

(2) 30 s for initial connection and 300 s for reconnection.

### Brazil

Nominal voltage of Brazilian grid is 220 V.

The inverters can operate within the voltage limits defined in the following table.

**Tab. 3-4** Disconnection related to Voltage

| Voltage Level at Grid-connected Point (% related to Local Nominal Voltage) | Maximum Time to Disconnect * |
|---|---|
| V < 80 % | 0.4 s |
| 80 % <= V <= 110 % | Normal operation |
| V > 110 % | 0.2 s |

When the voltage level is out of the operational levels shown in the table, the inverter will disconnect from the grid.

If a disturbance lasts less than the required disconnection time, the inverter can reconnect to the grid if the voltage level goes back to normal levels after the disturbance.

* The maximum time to disconnect refers to the interval between the abnormal voltage level and the action of inverter (disconnect from the grid).

### 3.2.4 Regular Operational Frequency Range

#### European Countries (DE, BE, LUX, NL, IT)

The inverter can operate within the frequency allowable range for at least the specified observation time. The setting of conditions depends on whether the connection is due to a normal operational start-up or an automatic reconnection after tripping of the interface protection.

When the frequency level is out of the operational levels, the inverter will disconnect from the grid. If a disturbance lasts less than the required protection time, the inverter can reconnect to the grid if the frequency level goes back to normal levels after the disturbance.

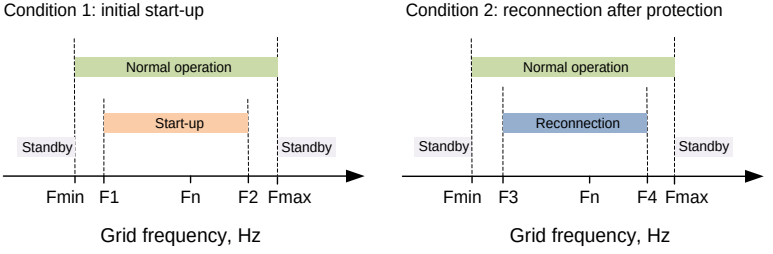



**Fig. 3-4** Inverter Action related to Grid Frequency (“DE” for example)

**Tab. 3-5** Operational Frequency Parameter Description

| Parameter | Description |
|---|---|
| **Grid-connection** | |
| F1 | The lower frequency limit for initial start-up. |
| F2 | The upper frequency limit for initial start-up. |
| F3 | The lower frequency limit for reconnection. |
| F4 | The upper frequency limit for reconnection. |
| $t_f$ | Minimum observation time. |
| $k_f$ | Connection gradient. |
| **Protection** | |
| $F_{min}$ | Under-frequency protection value. |
| $F_{max}$ | Over-frequency protection value. |

| Parameter | Description |
|---|---|
| $T_{min}$ | Under-frequency protection time. |
| $T_{max}$ | Over-frequency protection time. |

**Tab. 3-6** Default Values of Operational Frequency Parameter

| Parameter | DE | BE | LUX | NL | IT |
|---|---|---|---|---|---|
| F1 (Hz) | 47.52 | 47.50 | 47.50 | 48.00 | 49.90 |
| F2 (Hz) | 50.10 | 50.10 | 50.10 | 50.10 | 50.10 |
| F3 (Hz) | 47.52 | 47.50 | 47.50 | 48.00 | 49.90 |
| F4 (Hz) | 50.10 | 50.10 | 50.10 | 50.10 | 50.10 |
| $t_f$ (s) | 60 | 60 | 60 | 60 | 30 or 300 (2) |
| $k_f$ | Not applicable or 10 % Pn/min (1) | | | | 20 % Pn/min |
| 1-$F_{min}$ (Hz) | 47.50 | 47.50 | 47.50 | 48.00 | See Tab. 6-2 (3) |
| 2-$F_{min}$ (Hz) | 47.50 | 47.50 | 47.50 | 48.00 | |
| 1-$F_{max}$ (Hz) | 51.50 | 51.50 | 52.00 | 51.00 | |
| 2-$F_{max}$ (Hz) | 51.50 | 51.50 | 52.00 | 51.00 | |
| 1-$T_{min}$ (s) | 0.1 | 0.2 | 0.4 | 2.0 | |
| 2-$T_{min}$ (s) | 0.1 | 0.2 | 0.4 | 2.0 | |
| 1-$T_{max}$ (s) | 0.1 | 0.2 | 0.4 | 2.0 | |
| 2-$T_{max}$ (s) | 0.1 | 0.2 | 0.4 | 2.0 | |

(1) Not applicable for initial connection and 10 % Pn/min for reconnection.

(2) 30 s for initial connection and 300 s for reconnection.

(3) For Italy, the over- / under- frequency protection value and time can be controlled by the SPI function or a remote command via RS485 communication. Please refer to "**6.10.2 SPI Connection ("IT")**" for details.

### Brazil

Nominal frequency of Brazilian grid is 60 Hz.

The inverters can operate within the frequency limits defined in the following table.

**Tab. 3-7** Disconnection related to Frequency

| Grid Frequency Level | Maximum Time to Disconnect (1) |
|---|---|
| f < 57.5 Hz | 0.2 s |
| 57.5 Hz <= f <= 62 Hz | Normal operation (2) |
| f > 62 Hz | 0.2 s (3) |

When the frequency level is out of the operational levels shown in the table, the inverter will disconnect from the grid.

Remarks:

(1) The maximum time to disconnect refers to the interval between the abnormal frequency level and the action of inverter (disconnect from the grid).

(2) After the low frequency, the inverter will only reconnect to the grid again when the frequency returns to 59.9 Hz, respecting the reconnection waiting time of 300 seconds. When the grid frequency is more than *60.5 Hz* and less than 62 Hz, the inverter will reduce the active feed-in power. Define the response curve with a start grid frequency and an end grid frequency. The inverter power output will vary in response to the increase in grid frequency. The values can be set via LCD menu. Refer to "**12.2 Frq-Watt Response**".

(3) After the high frequency, the inverter will only reconnect to the grid again when the grid frequency returns to 60.1 Hz, respecting the reconnection waiting time of 300 seconds. The feed-in power will grow in a rate up to 20 % per minute of $P_{max}$ per minute.

### 3.2.5 Reactive Power Regulation

The inverter is capable of operating in reactive power regulation modes for the purpose of providing support to the grid. The Q(U) mode can only be set via the iSolarCloud App or the iSolarCloud server. The other modes can be set via the LCD menu. For details, see "**11 Appendix II: Reactive Power Regulation**".

- ***PF***: Fixed power factor mode. The PF mode controls the active power factor of the inverter's output according to a set-point set via the LCD. The PF ranges from 0.8 leading (+) to 0.8 lagging (-), with the default value of +1.0.
- ***Qt***: Fixed reactive power mode.
- ***Q(P)***: Power related control mode. The displacement power factor of the inverter output varies in response to the output power of the inverter.
- ***Q(U)***: Voltage related control mode. The reactive power output of the inverter varies in response to the grid voltage.

### 3.2.6 Active Power Response

The inverter supports two power quality response modes, which can be set via the LCD menu. For details, see "**12 Appendix III: Active Power Response**".

- Volt-watt:

  Define the response curve with four grid reference voltages. The inverter power output or input will vary in response to the grid voltages. Only countries Australia, New Zealand, and Italy support this response.

- Volt-watt (Charging):

  When the power from the grid is required to charge the energy storage system, the import power from the grid varies in response to the grid voltages. The response curve is defined by the voltage reference values and

the corresponding power consumption from the grid for charging energy storage. Only countries Australia and New Zealand support this response.

- Frq-watt:

  Define the response curve with a start grid frequency and an end grid frequency. The inverter power output or input will vary in response to the increase or decrease in grid frequency.

  Countries Australia, New Zealand, and Italy support over- and under-frequency response. Other countries only support over-frequency response.

### 3.2.7 Load Control

The inverter has integrated a multiple-function dry-contact (DO relay), which can be used for load control via a contactor. Refer to "**6.9 DO Connection"** for the cable connection.

User may set the control mode according to individual demand. Refer to "**10.4.11 DO Function Setting**" for LCD settings.

***Timer***: Set the starting time and end time. The DO function will be enabled during the interval.

***ON/OFF***: The DO function will be enabled if ***ON*** or disabled if ***OFF***.

***Optimized:*** Set the starting time, end time, and the optimized power. During the interval, when the feed-in power reaches to the optimized power, the DO function will be enabled.

## 3.3 Battery Management

The following kinds of batteries are compatible with the PV ESS.

- Li-ion battery from SUNGROW, LG Chem, GCL, Pylon, BYD and TAWAKI.
- Lead-acid batteries which require manual configuration.

To maximize the battery life, the inverter will perform battery charge, discharge, and maintenance management basing on the battery state.

#### State Definition

In order to avoid overcharging or deep discharging of the battery, distinguish four battery states according to different voltage ranges, as shown in the following table.

**Tab. 3-8** Battery State Definition

| Type | Port Voltage/SOC | | | |
|---|---|---|---|---|
| | Damaged | Empty | Normal | Full |
| SUNGROW (new system) | < 28 V | SOC < 5 % | 5 %–100 % | SOC = 100 % |
| SUNGROW (retrofitting system or with the forced charge function enabled) | < 28 V | SOC < 10 % | 10 %–100 % | SOC = 100 % |
| LG | < 30 V | SOC < 5 % | 5 %–100 % (by default) | SOC = 100 % |
| GCL | < 30 V | SOC < 15 % | 15 %–95 % (by default) | SOC > 95 % |
| Pylon (US2000B), TAWAKI | < 30 V | SOC < 20 % | 20 %–100 % (by default) | SOC = 100 % |
| BYD | < 30 V | SOC < 10 % | 10 %–100 % (by default) | SOC = 100 % |
| Other lead-acid | < 30 V | Configured by the customer | | |

* The SOC limits of Li-ion batteries except SUNGROW batteries can be modified via iSolarCloud App or the iSolarCloud server by qualified personnel.

### 3.3.1 Charge Management

A hybrid inverter should provide a means for temperature compensation of the battery charge voltages. This is particularly important for use with lead acid batteries in warm climates, to avoid damage to batteries by overcharging in hot weather, and related hazards due to release of hydrogen gas and cell rupture. The SH5K-30 does not include a connection terminal for a remote battery temperature sensor. If installing SH5K-30 with lead acid batteries in Australia, please check with Sungrow for advice regarding charge settings.

#### Emergency Charge Management

The emergency charge management function is to protect the battery from the damage caused by long time excessive discharge. The inverter cannot respond to discharge command during emergency charge. The following tables describe the emergency charge conditions for different types of batteries.

**Tab. 3-9** Emergency Charge Management for Li-ion Battery

| Status | Conditions |
|---|---|
| Trigger | Either of the following conditions is met:<br>• SOC ≤ (Min. SOC) – 3% (valid only when the Min. SOC is ≥ 3 %).<br>• A battery under-voltage warning is triggered.<br>• An emergency charge command is reported to the inverter. (only for SUNGROW and BYD batteries) |
| Finish | All the following conditions are met:<br>• SOC ≥ (Min. SOC) – 1% (valid only when the Min. SOC is ≥ 3 %).<br>• No battery under-voltage warning is triggered.<br>• No emergency charge command is reported to the inverter. (only for SUNGROW and BYD batteries) |

**Tab. 3-10** Default SOC Conditions for Li-ion Battery Emergency Charge

| Type | Trigger SOC | Finishing SOC |
|---|---|---|
| SUNGROW (new system) | Triggered by BMS | Triggered by BMS |
| SUNGROW (retrofitting system) | SOC ≤ 2 % | SOC ≥ 4 % |
| LG | SOC ≤ 2 % | SOC ≥ 4 % |
| GCL | SOC ≤ 12% | SOC ≥ 14 % |
| Pylon (US2000B) | SOC ≤ 17 % | SOC ≥ 19 % |
| TAWAKI | SOC ≤ 15 % | SOC ≥ 17 % |
| BYD | SOC ≤ 7 % | SOC ≥ 9 % |

**Tab. 3-11** Emergency Charge Management for Lead-acid Battery

| Status | Conditions |
|---|---|
| Trigger | The battery voltage is under the lower limit (42 V by default). |
| Finish | The battery voltage rises to the final discharge voltage. |

### Normal Charge Management

When the battery voltage is within the normal range, the inverter could charge the battery if the PV power is higher than the load power and could ensure that the battery is never over-charged.

The maximum allowable charge current is limited to the smaller one of:

- the maximum charge current of the inverter 65 A; and
- the maximum / recommended charge current from the battery manufacturer.

The charge power is also limited to the smaller current of the above and may not reach the nominal power.

- If the PV voltage is higher than the upper limit value of MPP voltage 560 V, the battery cannot charge.
- The hybrid system will start to charge the battery when the feed-in power value exceeds a threshold value of 70 W.

### 3.3.2 Discharge Management

Discharge management can effectively protect the battery from deep discharging.

The maximum allowable discharge current is limited to the smaller one of:

- the maximum discharge current of the inverter 65 A; and
- the maximum / recommended discharge current from the battery manufacturer.

The discharge power is also limited to the smaller current of the above and may not reach the nominal power.

- If the PV voltage is higher than the upper limit value of MPP voltage 560 V, the battery cannot discharge.
- The hybrid system will start to discharge the battery when the import power value exceeds a threshold value of 70 W.

### 3.3.3 Maintenance Management

To maximize the lead-acid battery life, the inverter will maintain the lead-acid battery every six months, no matter whether the PV power is sufficient or not. Generally, the maintenance management is only suitable for a lead-acid battery.

The maintenance process is as follows.

1. Charge the battery with a constant current of 0.165 C, in which C is the nominal capacity specified by the manufacturer and is indicated in Ah.
2. Charge the battery with a trickle current when the battery voltage is stabilized at the average charge voltage.
3. When the trickle current decreases to 3 A, end the maintenance.

## 3.4 Communication and Configuration

The inverter provides various ports for device and system monitoring, including RS485, Ethernet, Wi-Fi, and CAN; provides various parameter configurations for optimal operation; records running information and displays error information on the LCD screen.

# 4 Unpacking and Storing

## 4.1 Unpacking and Inspecting

The inverter is thoroughly tested and strictly inspected before delivery. Damage may still occur during shipping. Therefore, the first thing you should do after receiving the device is to conduct a thorough inspection.

1. Check the packaging for any visible damage.
2. Check the delivery contents for completeness according to the packaging list.
3. Check the inner contents for any visible damage.

Contact SUNGROW or the distributor in case of any damaged or missing components.

It is the best choice to store the inverter in the original packaging. So, do not dispose of it.

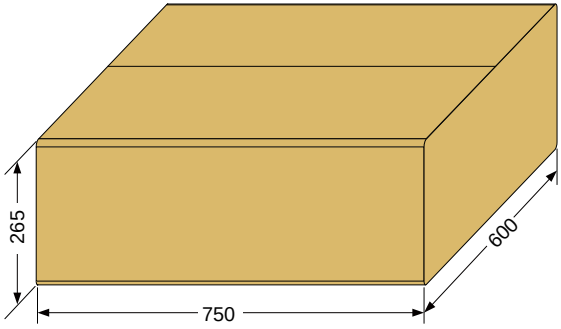



**Fig. 4-1** Single Inverter in Original Packaging Carton (unit: mm)

## 4.2 Delivery Contents

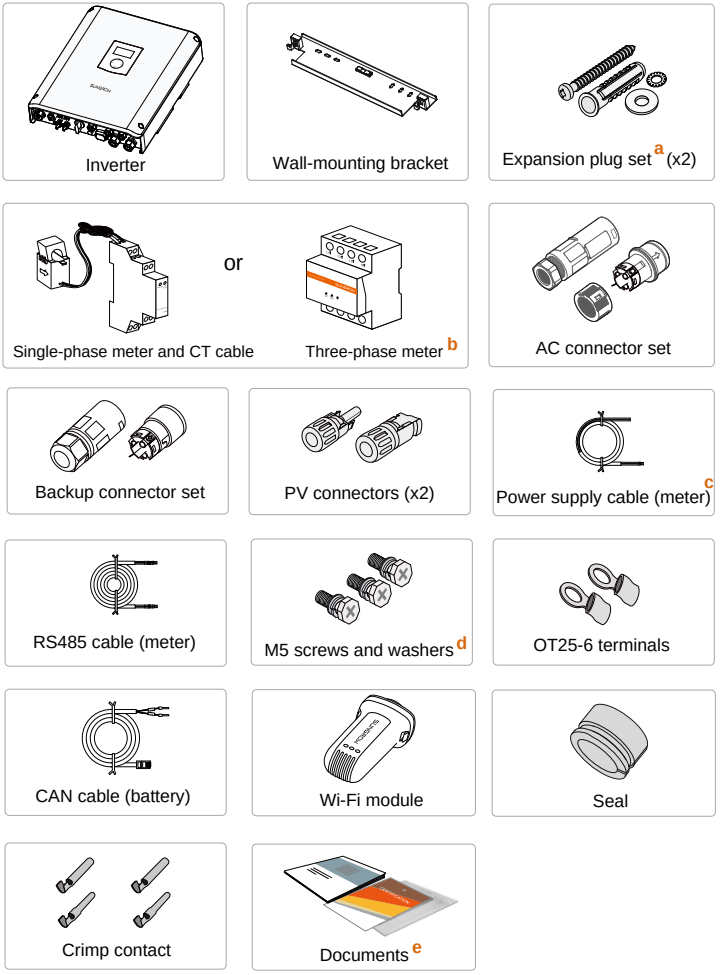



**Fig. 4-2** Delivery Contents

a) Each set includes a self-tapping screw, a spring washer, a fender washer, and an expansion tube.

b) If user purchases the three-phase Energy Meter, it will be delivered separately.

c) The power supply cable is only delivered for the single-phase Energy Meter.

d) One is for external grounding and the other two are for securing the inverter.

e) The documents include the Quick Installation Guide, quality certificates, packaging list and product test reports.

## 4.3 Storing the Inverter

If you do not install the inverter immediately, choose an appropriate location to store it. Instructions for storage are:

- The device must be stored in the original packaging.
- The storage temperature should be always between -30°C and +70°C, and the storage relative humidity should be always between 0 and 100 %, non-condensing.

The following figure shows the storage of the inverter.

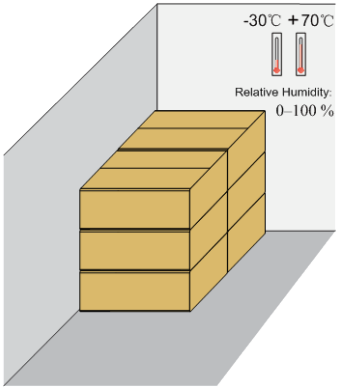



**Fig. 4-3** Example of Inverter Storage

NOTICE

**The packaging should be upright.**

**When storing inverters, do not stack more than 5 inverter packages on top of each other.**

# 5 Mechanical Mounting

**DANGER**

**In order to avoid electric shock or other injury, be sure there is no electricity or plumbing installations before drilling holes.**

**CAUTION**

**Risk of injury due to improper handling**

- **The weight can cause injuries, serious wounds, or bruise.**
- **Always follow the instructions when moving and positioning the inverter.**

**System performance loss due to bad ventilation**

- **The inverter requires good ventilation during operation. Keep it upright and nothing covering the heat sink.**

NOTICE

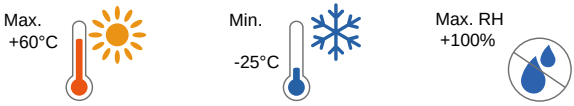
**Wear gloves to avoid scratches when mounting the inverter.**

## 5.1 Location Requirements

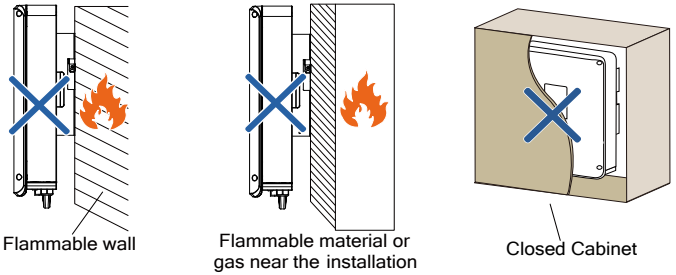
The inverter with IP65 can be installed indoors or outdoors.

Selecting an optimal location for the inverter is critical for its operating safety as well as the expected efficiency and service life. Considerations for the location include:

1. The structure should be capable of withstanding a force of four times the weight of the inverter and be suitable for the dimensions of the inverter.
2. Install the inverter where it is convenient for installation, cable connection and service.
3. The location should be not accessible to children.
4. The max. power output will reduce when the ambient temperature exceeds 45°C. The following figure shows the ambient temperature and relative humidity limits.

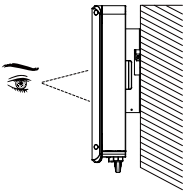



5. Only mount the inverter on a non-flammable surface or a wooden structure. Keep away from flammable materials or gas. Do not enclose the inverter into a tight confinement.

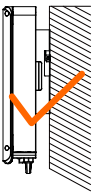



6. Prevent the inverter from direct exposure to sun, rain and snow.

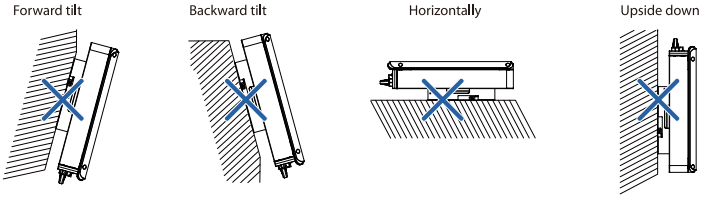
7. Install at eye level for easy inspection.



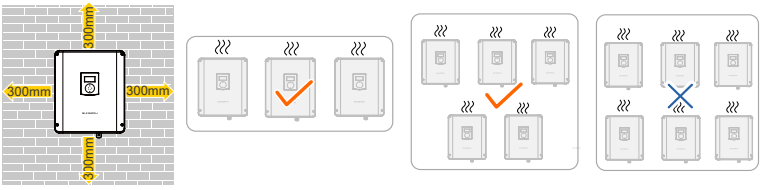
8. Install vertically for good heat dissipation.



9. Never install the inverter horizontally, or with a forward tilt or with a backward tilt or even with upside down. The horizontal installation could result in damage to the inverter.

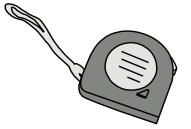
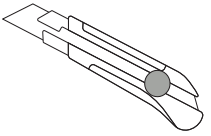
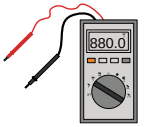
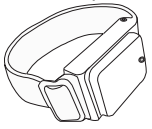
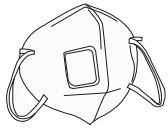


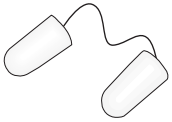
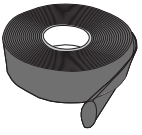
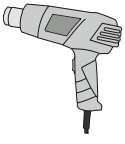
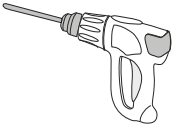
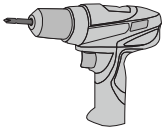
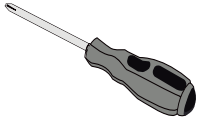
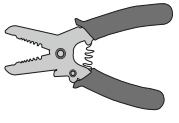
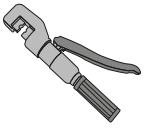
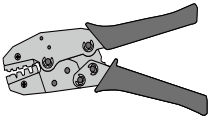
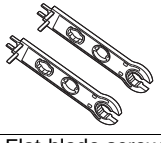
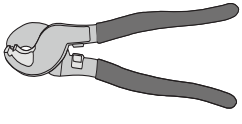
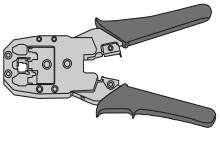
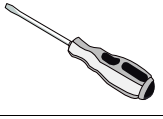

10. Clearance requirement and multiple installation:




## 5.2 Tools

Installation tools include but are not limited to the following recommended ones. If necessary, use other auxiliary tools on site.

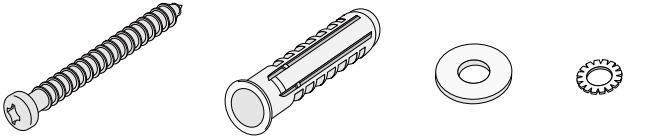
| **General tools (recommended)** | | |
|---|---|---|
| Packaging tape  | Marker  | Measuring tape  |
| Utility knife  | Multimeter<br>Measurement range: ≥ 600Vdc   | Protective clothing  |
| Wrist strap  | Protective gloves  | Dust mask  |

| | | |
|---|---|---|
| Earplugs  | Goggles  | Insulated shoes  |
| Vacuum cleaner  | Heat shrink tubing  | - |
| **Installation tools (recommended)** | | |
| Heat gun  | Hammer drill<br>Drill bit: φ10  | Rubber mallet  |
| Electric screwdriver<br>Tool bit: M5  | Phillips screwdriver<br>Specification: M5  | Wire stripper  |
| Hydraulic plier  | Crimping tool<br>Crimping range: 2.5-6mm²  | Wrench for MC4 terminal  |
| Wire clipper  | RJ45 crimping tool  | Flat-blade screwdriver<br>M2  |

## 5.3 Installing the Inverter

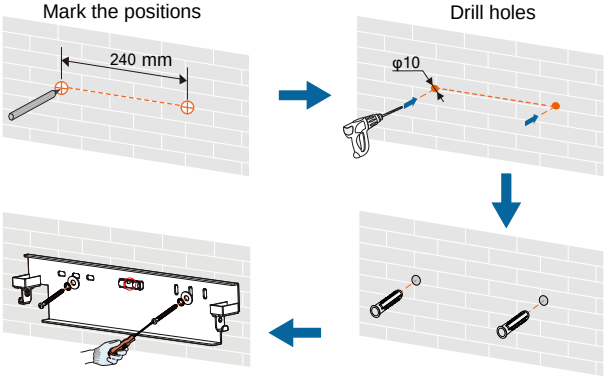
Inverter is installed on the wall by means of wall-mounting bracket and the expansion plug sets.

The expansion plug set shown below is recommended for the installation.



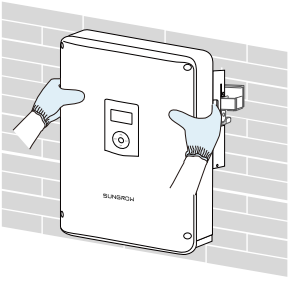
Self-tapping screw M6 Expansion tube Fender washer Spring washer

1. Install the wall-mounting bracket.

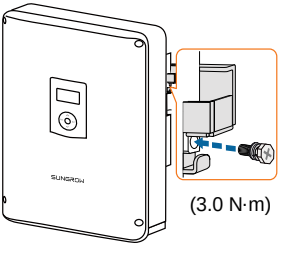



Note that the depth of the holes should be about 70 mm. Be sure to adhere to the screw assembly sequence: self-tapping screw, spring washer, fender washer and bracket. The air bubble in the bracket must be between the two lines in the red circles to ensure the horizontal level.

2. Mount the inverter to the bracket.

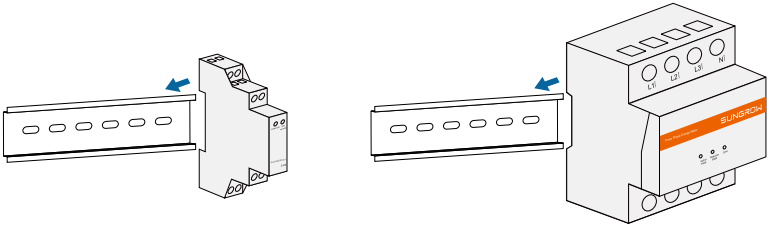


3. Secure the inverter with two M5 screws and washers. (3.0 N·m)




## 5.4 Installing the Energy Meter

The SUNGROW Energy Meter should be installed between the grid and the load. It supports a 35 mm DIN-rail installation, as shown in the following figure.




Single-phase Energy Meter

Three-phase Energy Meter

**Fig. 5-1** Installing the Energy Meter to the Rail

# 6 Electrical Connection

This chapter mainly describes the cable connections on the inverter side.

**DANGER**

**Danger to life due to a high voltage inside the inverter**

- **Make sure that the cables are not live before electrical connection.**
- **Do not turn on the AC circuit breaker until all the electrical connections are completed.**

**WARNING**

**All cables must be firmly attached, undamaged, properly insulated and adequately dimensioned.**

NOTICE

**All electrical connections must be in accordance with local and national standards.**

**Before fastening the lid, be sure that:**

- **Seal the unused terminals with waterproof plugs.**
- **The rubber strip is fully filled with air.**

## 6.1 Terminal Description

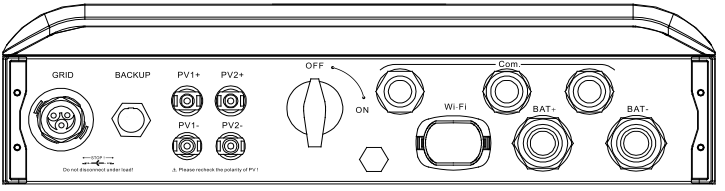



**Fig. 6-1** Terminals at the Bottom of the Inverter

| Label | Description |
|---|---|
| GRID | To feed power into the utility grid<br>The emergency loads also can be supplied from the grid. |
| BACKUP | To connect emergency loads |
| PV1+, PV1-, PV2+, PV2- | Terminals for the DC cables |
| ON, OFF | DC switch |
| Com. | Cable glands for Ethernet, RS485, CAN, DO, DRM and SPI |
| Wi-Fi | Terminal for the Wi-Fi module |
| BAT+ , BAT- | Cable glands for the battery power cables |

Connection terminals on the inner configuration circuit board are shown below:

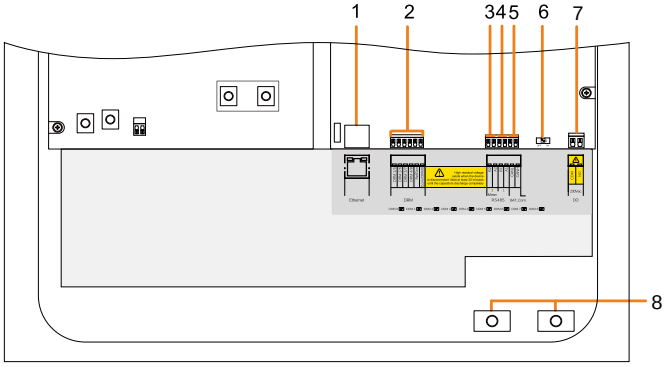


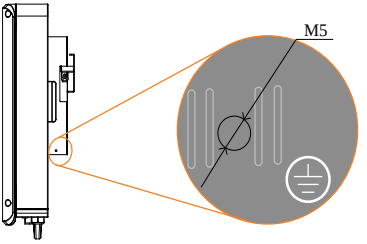

**Fig. 6-2** Configuration Circuit Board Inside the Inverter

| No. | Label | Connection |
|---|---|---|
| 1 | Ethernet | Communication |
| 2 | DRM | • "AU"/"NZ": Demand response enabling device (DRED)<br>• "IT": interface protection system (SPI) |
| 3 | RS485 (A2, B2) | Meter communication |
| 4 | RS485 (A1, B1) | Connect to an external device to receive the command to shut down the inverter remotely (Italy only) or enable the communication between inverters in parallel. |
| 5 | CANH, CANL | Battery communication. |
| 6 | 120 Ohm | RS485. |
| 7 | DO | Connect to an external light indicator and/or buzzer to signal an alarm or connect to home load for power management. |

| No. | Label | Connection |
|---|---|---|
| 8 | BAT+, BAT- | Battery |

## 6.2 Grounding the Inverter

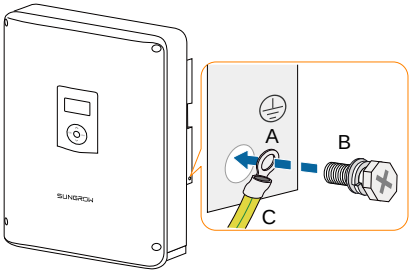
A second protective earth (PE) terminal is equipped at the side of the inverter. Be sure to connect this PE terminal to the PE bar for reliable grounding and ensure that the grounding resistance should be less than 10 Ohm.




**WARNING**

**Correct grounding connection of the second PE terminal and the AC terminal is mandatory. Not properly connecting both PE will void any or all product warranty.**

Proceed as follows for second PE connection.



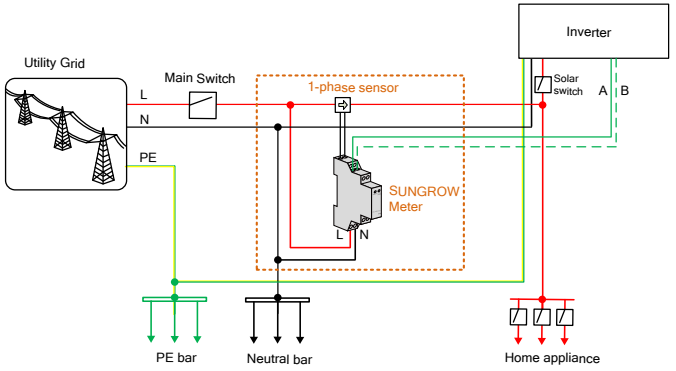

| Item | Description | Specification |
|---|---|---|
| A | Cable socket | Not included in the delivery scope. |
| B | Screw | M5×12 mm (3.0 N·m) |
| C | Grounding cable | The second PE conductor should be of the same cross-sectional area as the original PE conductor in the AC connector. The cable is not included in the delivery scope. |

# 6.3 Energy Meter Connection

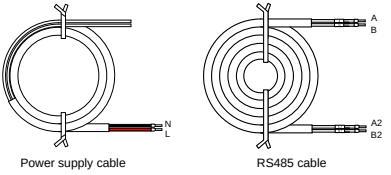
## 6.3.1 On the Meter Side

### For Single-phase Energy Meter

For the single-phase meter, with the signal from the 1-phase sensor, the inverter determines the energy exchange with the utility grid on one phase. The CT clamp of 1-phase sensor can be placed before or after the main switch.




1. Take out the Energy Meter (with 1-phase sensor) and the cables from the packaging.

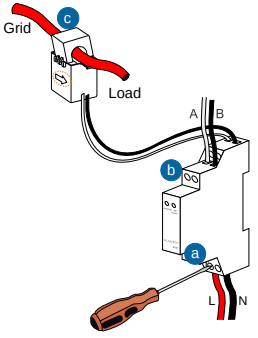



2. Connect the cables to the Energy Meter.

   (a) Tighten the power supply wires to terminal **3 (L)** and terminal **6 (N)**.

   (b) Tighten the RS485 wires to terminal **2** and terminal **5**.

   (c) Place the CT clamp of 1-phase sensor before or after the main switch.

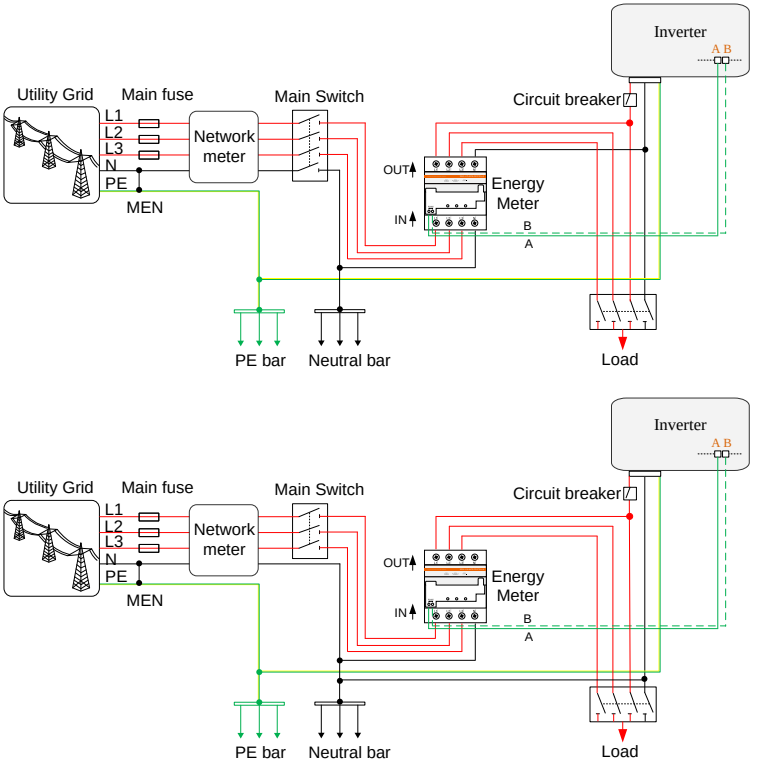


NOTICE

**Make sure that the 1-phase sensor is installed in the right direction: the arrow on the sensor must point away from the grid towards the load.**

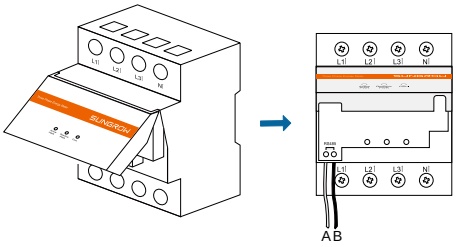
### For Three-phase Energy Meter

The following figures show two connection examples for the three-phase energy meter in the PV system.

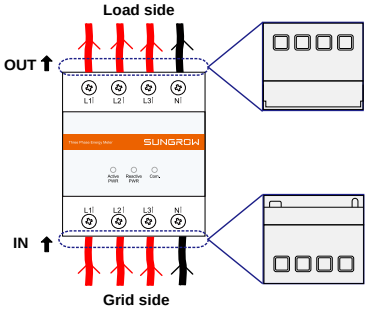



* The MEN connection only applies to Australia and New Zealand.

1. Take out the RS485 cable from the packaging and connect the ends to terminals A and B on the Energy Meter, as shown below.




2. Strip the insulation from the power wires by 10 mm. Then connect the wires to the terminals on the Energy Meter, as shown below. (Cross-section: 10 $mm^2$ to 25 $mm^2$)

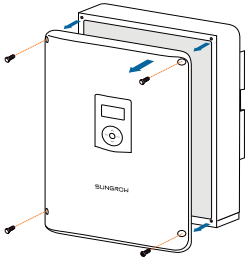



- The line conductor L1 supplies power to the Energy Meter. At least the line conductor L1 and the neutral conductor must be connected to the Energy Meter.
- Just connect the line conductor L1 and the neutral conductor, then the three-phase Energy Meter can be used as a single-phase Energy Meter.

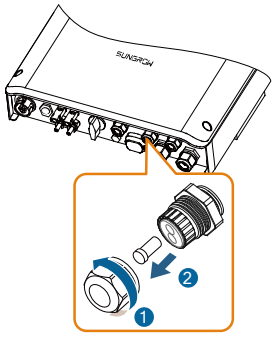
### 6.3.2 On the Inverter Side

Proceed as follows to connect the RS485 wires to the inverter.

1. Unscrew four screws and remove the enclosure lid. Retain the screws for later use.



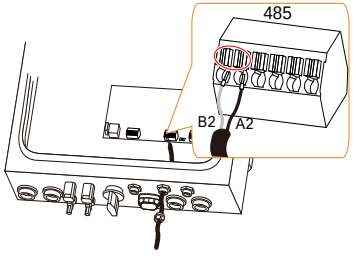
2. Unscrew the swivel nut from any **Com.** Port.



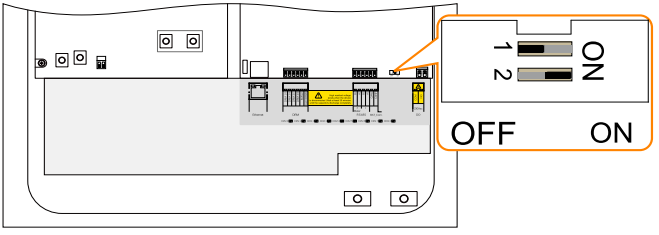
3. Lead the cable through the cable gland.
4. Plug the wires into terminals **A2** and **B2** on the inverter without tool tightening.

   Note:

   For reconnection, press the part as shown in the red circle so as to pull out the cable.




5. When the length of RS485 cable is longer than 100 m, push the 120 Ohm **(2)** switch to "**ON**" to ensure stable communication, as shown below.




## 6.4 Grid Connection

### Residual Current Device

With an integrated universal current-sensitive residual current monitoring unit inside, the inverter will disconnect immediately from the mains power as soon as a fault current with a value exceeding the limit has been detected.

However if an external residual current device (RCD) is mandatory, the switch must be triggered at a residual current of 300 mA or higher.

**Cable Requirements**

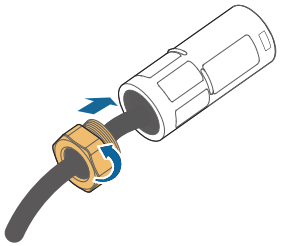
Cross-section: 3 * 6 mm², cable diameter: 11 mm - 15 mm.

All the AC cables should be equipped with correctly colored cables for distinguishing. Please refer to related standards about the wiring color.

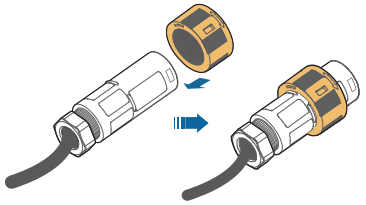
### 6.4.2 Assembling the AC Connector

Take out the AC connector parts from the packaging.

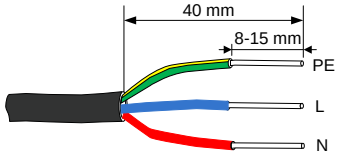
1. Lead the AC cable through the cable gland and the housing.



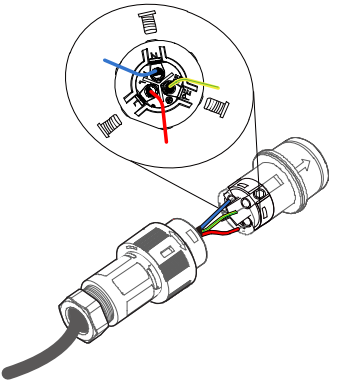
2. Put the locking ring into the housing.



3. Remove the cable jacket by 40 mm, and strip the wire insulation by 8-15 mm.



4. Fully insert the conductors to the corresponding terminal and tighten the screws with the torque 0.8 N·m. Pull cables outward to check whether they are firmly installed.

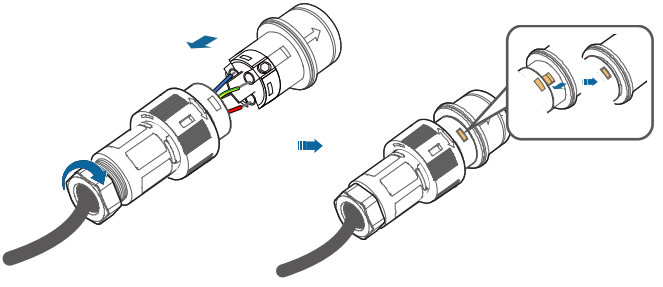


NOTICE

**Observe the terminal layout of terminal block.**

**Do not connect the phase lines to "PE" terminal, otherwise the inverter will not function properly and the loss of any or all the warranty rights may follow.**

5. Assemble the housing, the terminal block and cable gland. Make sure that the rib of the terminal block and the groove on the housing engage perfectly until a "Click" is heard or felt.



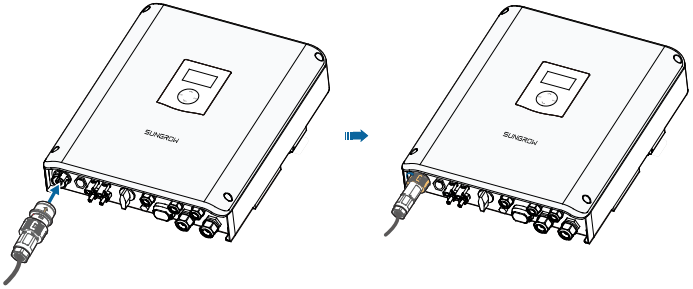
### 6.4.3 Installing the AC Connector

Procedure:

1. Install an AC circuit breaker at the AC output of the inverter. In the systems with multiple inverters, protect each inverter with a separate circuit breaker.

| Type | Specification |
|---|---|
| SH3K6-30 | 40 A |
| SH4K6-30 | 45 A |
| SH5K-30 | 45 A |

2. Disconnect the AC circuit breaker and secure it against reconnection.
3. Align the AC connector and the AC terminal and mate them together by hand until a “Click” is heard or felt.



4. Connect the other ends. Connect “PE” conductor to the grounding electrode. Connect “L” and “N” conductors to the AC circuit breaker.
5. Pull all the lines outward to check whether they are firmly installed.

## 6.5 PV Connection

**WARNING**

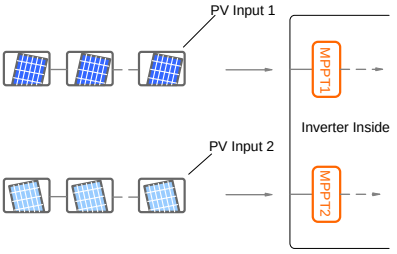
**Before connecting the PV strings to the inverter, ensure that the impedances between the positive terminals of the PV string and Earth, and between the negative terminals of the PV string and Earth are larger than 200 kOhm.**

### 6.5.1 PV Input Configuration

#### Independent Mode

The two PV inputs work independently, each with its own MPPT. The two PV inputs can be different from each other in PV module types, numbers of PV panels in PV strings, tilt angles and orientation angles of PV modules. The following figure details the need for a homogenous PV string structure for

maximum power.

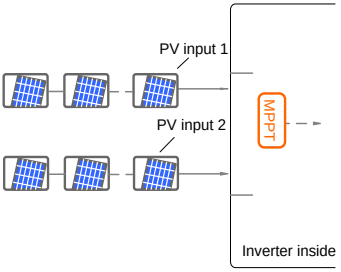



Prior to connecting the inverter to PV inputs, the specifications in the following table should be met:

| Area | DC Power Limit for Each Input | Total DC Power Limit | Open-circuit Voltage Limit for Each Input | Short circuit Current Limit for Each Input |
|---|---|---|---|---|
| DC1<br>DC2 | 5600 W | 6600 W | 560 V | 12 A |

### Parallel Mode

Both PV strings should have the same type, the same number of PV panels, identical tilt and identical orientation. Two trackers are configured in parallel to handle power and/or current levels higher than those a single tracker can handle.




Prior to connecting the inverter to PV inputs, the specifications in the following table should be met:

| Total DC Power Limit for Inverter | Open-circuit Voltage Limit for Each Input | Short circuit Current Limit for Total Input |
|---|---|---|
| 6600 W | 560 V | 24 A |

To avoid the power unbalance of two inputs or input load-restriction, ensure the two PV input cables are of the same type.

### 6.5.2 Connecting the Inverter to the PV Strings

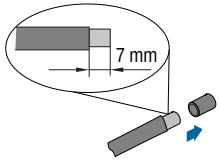
All DC cables are equipped with water-proof direct plug-in connectors, which match the DC terminals at the bottom of the inverter.

#### Cable Requirements

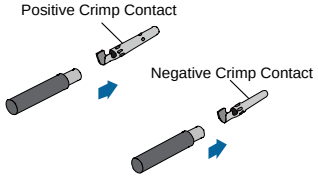
| Cross-Section | Cable Diameter | Max. Withstand Voltage | Max. Withstand Current |
|---|---|---|---|
| 4 $mm^2$–6 $mm^2$ AWG12–AWG10 | 6 mm–9 mm | 600 V | Same as short circuit current. |

#### Assembling the PV Connector

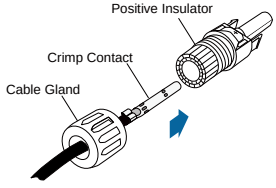
1. Strip the insulation from the cables by 7 mm–8 mm.

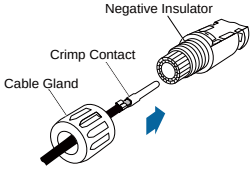



2. Assemble the cable ends by crimping pliers.




3. Lead the cable through the cable gland to insert into the insulator until it snaps into place. Then tighten the cable gland (torque 2.5 N·m–3 N·m).




4. Make sure that the cable polarities of the PV string are correct.

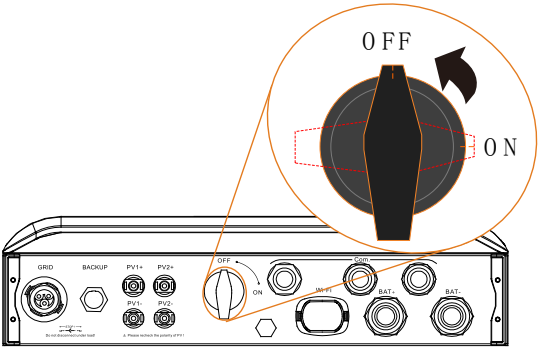
**NOTICE**

**The inverter will not function properly if the PV polarities are reversed.**

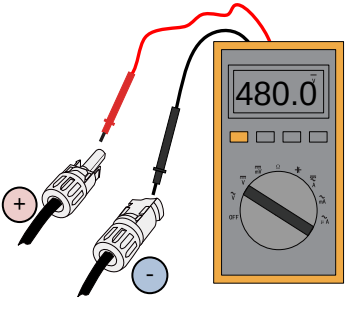
**If the PV connectors are not assembled into place, it may cause an arc or overheat. The loss caused by this issue will void the warranty.**

### Installing the PV Connector

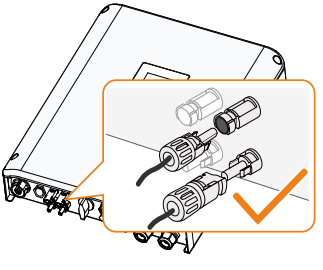
1. Rotate the optional DC switch at the bottom to the “OFF” position.




2. Check the connection cable of the PV string for the correct polarity and that the open-circuit voltage does not exceed the inverter input limit of 600 V, even under the lowest operating temperature. Refer to the module specification supplied by the module manufacturer for detailed information.




3. Plug the connectors into corresponding terminals.
4. Seal unused DC terminals with the terminal caps.



## 6.6 Communication Connection

There are three ports and a Wi-Fi terminal on the bottom of the inverter, as shown in the following figure.

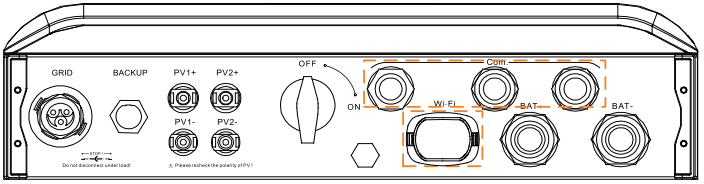



**Fig. 6-3** Communication Ports and Terminal

Ethernet function:

- Through the Modbus TCP/IP protocol, the EMS or the Control Box from the third party can fully control the on/off, derating, charging and discharging of the inverter.
- The inverter operation information can be transferred via **Ethernet** port. Visit the Webserver and you can view the information.
- The inverter operation information can be transferred to the iSolarCloud server via the router.

Wi-Fi function:

With the Wi-Fi module installed, visit the iSolarCloud App to view the inverter information.

### 6.6.1 Ethernet Connection

The following figure shows how the Ethernet connection may work with a router.

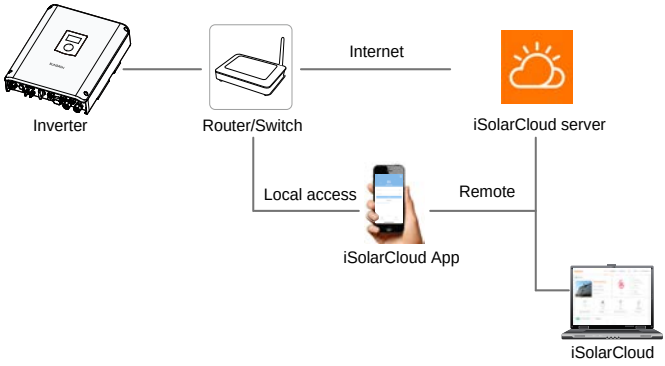



**Fig. 6-4** Ethernet Connection with a Router

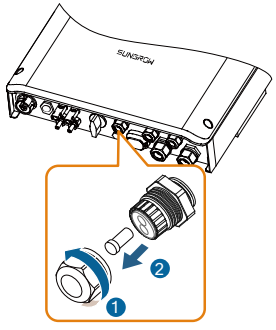
### Cable Requirements

Use a TIA/EIA 568B standard network cable with a diameter of 3 mm–5.3 mm.

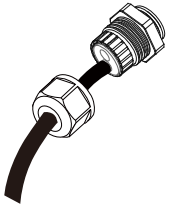
Refer to the switch/router's manual for the definition of the communication port.

### Cable without RJ45 plug

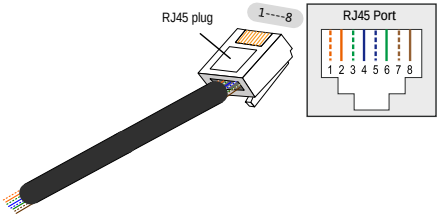
1. Unscrew the swivel nut from any **Com.** port.




2. Lead the cable through the cable gland and remove the cable jacket by 8 mm–15 mm.



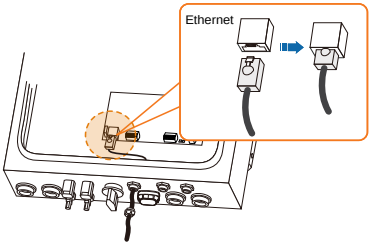
3. Use the Ethernet crimper to crimp the cable and connect the cable to RJ45 plug according to TIA/EIA 568B, as shown below.




**Corresponding Relationship Between Cables and Pins:**

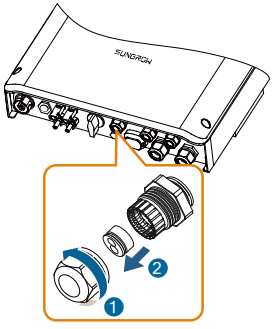
| | |
|---|---|
| Pin 1: White-orange; | Pin 2: Orange; |
| Pin 3: White-green; | Pin 4: Blue; |
| Pin 5: White-blue; | Pin 6: Green; |
| Pin 7: White-brown; | Pin 8: Brown. |

4. Install the RJ45 plug to the **Ethernet** port.
5. Fasten the swivel nut and connect the other end to the socket of the switch or the router.

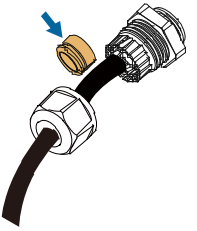



## Cable with RJ45 plug

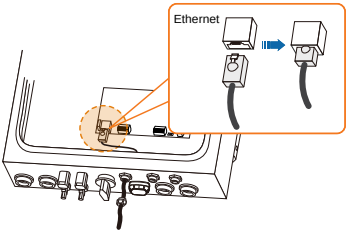
1. Unscrew the swivel nut from any **Com.** port and remove the seal.



2. Lead the cable through the cable gland.

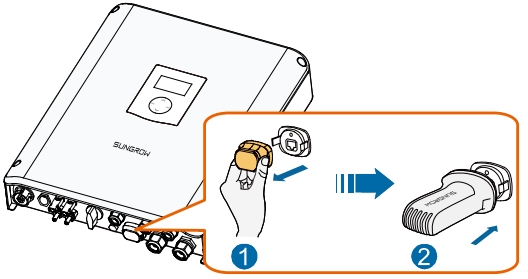


3. Install the RJ45 plug to the **Ethernet** port.
4. Fasten the swivel nut and connect the other end to the socket of the switch or the router.




### 6.6.2 Wi-Fi Connection

1. Unscrew the waterproof lid from the Wi-Fi terminal.
2. Install the Wi-Fi module. Slightly shake it by hand to determine whether it is installed firmly, as shown below.




3. Refer to the **Quick User Manual** delivered with the Wi-Fi module to configure the Wi-Fi.

### 6.6.3 RS485 Connection

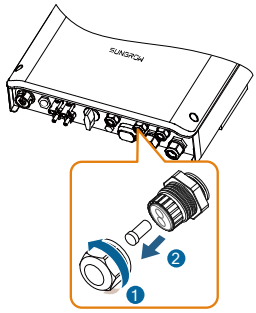
The RS485_1 can be connected to an external device for the communication. In Italy, the RS485_1 connection can be used to receive the command to shut down the inverter remotely. The RS485_2 can be connected to meter for the feed-in power function.

### Cable Requirements

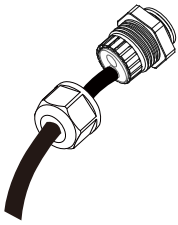
Cross-section: 2*0.5 mm², cable diameter: 3 mm–5.3 mm

### Procedure

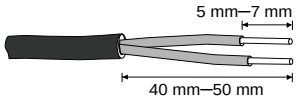
1. Unscrew the swivel nut from any **Com.** port.




2. Lead the cable through the cable gland.



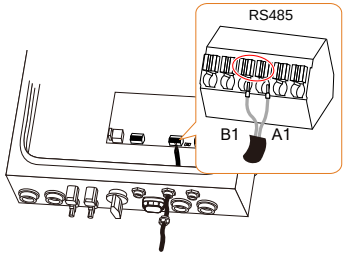
3. Remove the cable jacket and strip the wire insulation.




4. Plug the wires into the corresponding terminals according the marks without tool tightening.

   Note:

   For reconnection, press the part as shown in the red circle so as to pull out the cable.




5. Fasten the swivel nut and connect the other end to the external device or to the RS485_1 terminal in slave inverter.

## 6.7 Battery Connection

This section mainly describes the cable connections on the inverter side. Refer to the instructions supplied by the battery manufacturer for the connections on the battery side.

**WARNING**

**Only use properly insulated tools to prevent accidental electric shock or short circuits. If insulated tools are not available, use electrical tape to cover the entire exposed metal surfaces of the available tools except their tips.**

### 6.7.1 Connecting the Power Cable

A fuse with the specification of 150 V/125 A (type: Bussmann BS88 125LET) is integrated to the **BAT-** terminal.

NOTICE

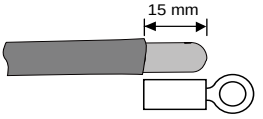
**A two-pole DC circuit breaker with over-current protection (voltage rating not less than 100 V and current rating not less than 100 A) should be installed between the inverter and the battery.**

#### Cable Requirements

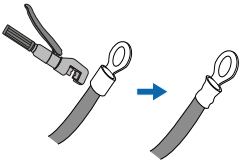
Cross-section: 16 $mm^2$–25 $mm^2$, OT25-6, cable diameter: 13 mm–16 mm.

#### Procedure

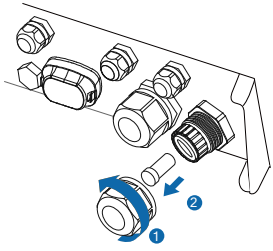
1. Remove the battery cable jacket.



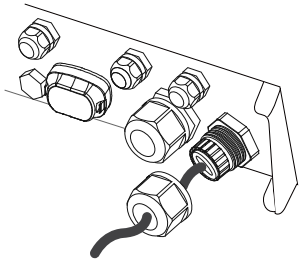

2. Crimp the OT terminal and install the heat shrinkable casing.



3. Unscrew the swivel nut from the **BAT+** and **BAT-** ports.

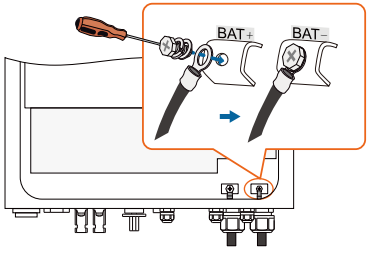


4. Lead the cable through the cable gland.



5. Loosen and remove the screw sets on the **BAT+** and **BAT-** terminal blocks.
6. Fasten the cables to the corresponding terminals (torque 2.5 N·m).

   Be sure to adhere to the following screw assembly sequence: screw head, spring washer, fender washer, OT terminal.

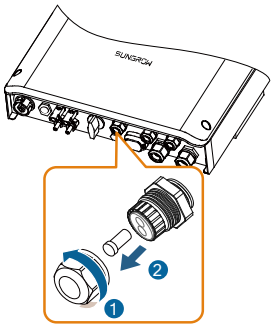



## 6.7.2 Connecting the CAN Cable

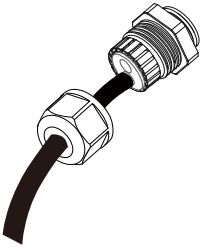
The CAN cable enables the communication between the inverter and the Li-ion battery from LG, Sungrow, GCL, Pylon (US2000B), BYD or TAWAKI.

### Procedure

1. Take out the CAN cable (terminal marks **CANH** and **CANL**) from the packaging.
2. Unscrew the swivel nut from any **Com.** port.




3. Lead the cable through the cable gland.



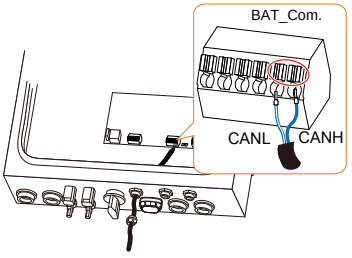
4. Plug the wires into the corresponding terminals according the marks without tool tightening.

   **CANH:** blue (pin 4)

   **CANL:** white-blue (pin 5)

   Note:

   For reconnection, press the part as shown in the red circle so as to pull out the cable.



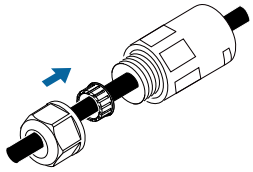

5. Fasten the swivel nut and connect the other end to the battery.

## 6.8 Emergency Load Connection (Backup)

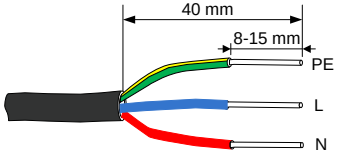
Cable cross-section: 3 * 4.0 mm² – 3 * 6.0 mm², cable diameter: 10.5 mm - 15 mm.

All the AC cables should be equipped with correctly colored cables for distinguishing. Please refer to related standards about the wiring color.

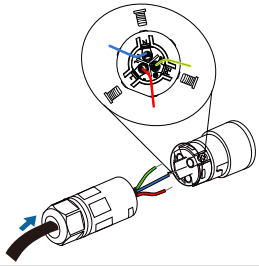
1. Lead the AC cable through the cable gland and the housing.



2. Remove the cable jacket by 40 mm, and strip the wire insulation by 8-15 mm.



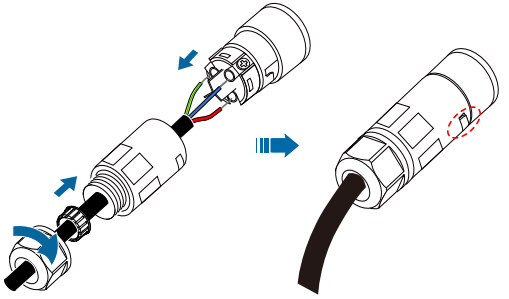

3. Fully insert the conductors to the corresponding terminal and tighten the screws with the torque 0.8 N·m. Pull cables outward to check whether they are firmly installed.



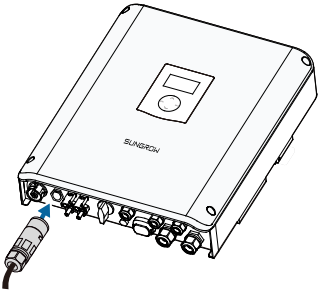
NOTICE

**Observe the terminal layout of AC connector. Do not connect the phase lines to "PE" terminal, otherwise the inverter will not function properly and the loss of any or all the warranty rights may follow.**

4. Assemble the housing, the terminal block and cable gland. Make sure that the rib of the terminal block and the groove on the housing engage perfectly until a "Click" is heard or felt.



5. Align the AC connector and the AC terminal and mate them together by hand until a “Click” is heard or felt.



6. Connect the other ends to the emergency loads. Pull all the lines outward to check whether they are firmly installed.

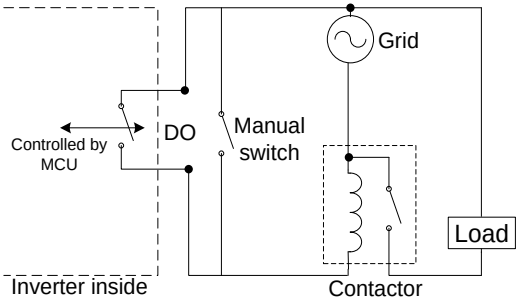
## 6.9 DO Connection

The inverter has one DO relay with multiple functions as follows:

- Consumer load control. Please choose the appropriate contactor according to the load power, e.g. the contactor types of the 3TF30 series from SIEMENS (3TF30 01-0X).
- Earth fault alarm. The additional equipment required is a light indicator and/or a buzzer.

| Relay | Trigger condition | Description |
|---|---|---|
| Consumer load control | The load control mode has been set via the LCD menu. | The relay is activated once the conditions of the control mode are satisfied. |

| Relay | Trigger condition | Description |
|---|---|---|
| Earth fault alarm | The earth fault occurs. | Once the inverter receives the earth fault signal, the relay closes the contact. The relay remains triggered until the fault is removed. |




NOTICE

**An AC contactor must be installed between the inverter and appliances. It is prohibited to connect the load directly to the DO port.**

**The current of the DO dry contact should not be larger than 3 A.**

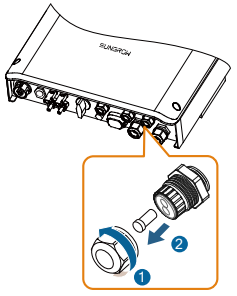
**The DO node is not controlled once the inverter is powered off. Connect the AC contactor by the manual switch, so as to control the loads.**

### Cable Requirements

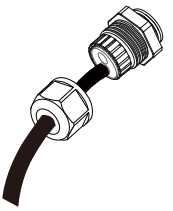
Cross-section: 1.0 mm², cable diameter: 3 mm–5.3 mm

### Procedure

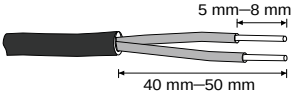
1. Unscrew the swivel nut from any **Com.** port.



2. Lead the cable through the cable gland.



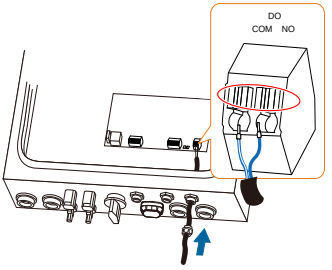
3. Remove the cable jacket and strip the wire insulation.




4. Plug the wires into **DO** terminals without tool tightening.

   Note:

   For reconnection, press the part as shown in the red circle so as to pull out the cable.

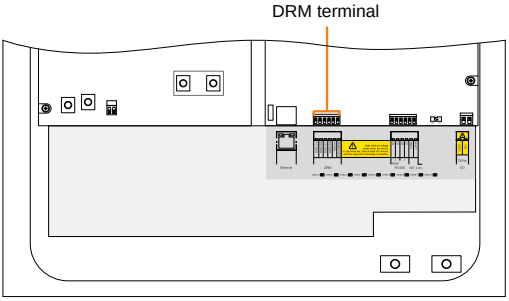



5. Fasten the swivel nut and connect the other end of the cable to the original edge of the AC contactor.

## 6.10 DRM / SPI Connection

### 6.10.1 DRM Connection (“AU”/“NZ”)

The inverter supports the demand response modes as specified in the standard AS/NZS 4777. The inverter has integrated a terminal block for connecting to a DRED. After the connection, the DRED assert DRMs by shorting together terminals as specified in **Tab. 6-1**.




The modes from DRM0 to DRM8 are supported by the inverter and the information is marked on the label located near the DRM terminals.

**Tab. 6-1** Method of Asserting DRMs

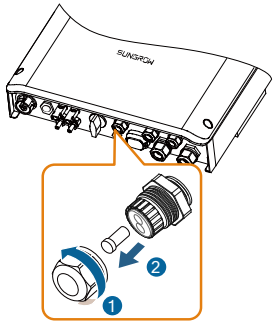
| Mode | Asserted by Shorting Terminals |
|---|---|
| DRM0 | RefGen or Com/DRM0 |
| DRM1 | 1/5 |
| DRM5 | 1/5 or RefGen |
| DRM2 / DRM6 | 2/6 |
| DRM3 / DRM7 | 3/7 |
| DRM4 / DRM8 | 4/8 |

The cable for connecting to the DRED is not included in the delivery.

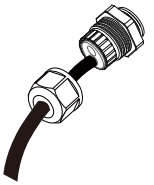
Use a TIA/EIA 568B standard network cable with a diameter of 3 mm–5.3 mm.

### Procedure

1. Unscrew the swivel nut from any **Com.** port.



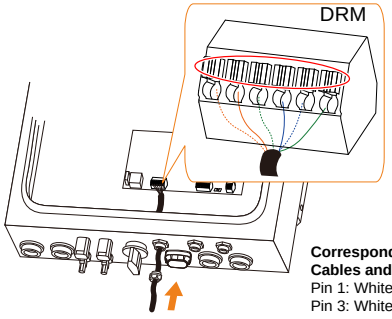
2. Lead the cable through the cable gland.



3. Remove the cable jacket by 40 mm to 50 mm and strip the wire insulation by 5 mm–7 mm.
4. Plug the wires into the corresponding terminals without tool tightening, as shown below.

   Note:

   For reconnection, press the part as shown in the red circle so as to pull out the cable.




**Corresponding Relationship Between Cables and Pins:**

Pin 1: White-orange; Pin 2: Orange;
Pin 3: White-green; Pin 4: Blue;
Pin 5: White-blue; Pin 6: Green;

5. Fasten the swivel nut and connect the other end to the DRED.
6. When the inverter is running with the demand respond commands, the DRM which is being performed by the inverter will be display on LCD screen.

   In “Run Info” menu, **Press** ▲/▼ to turn to the page showing DRM information.

| Menu | 1/2 |
|---|---|
| ► Run Info | |
| ON / OFF | |
| Settings | |

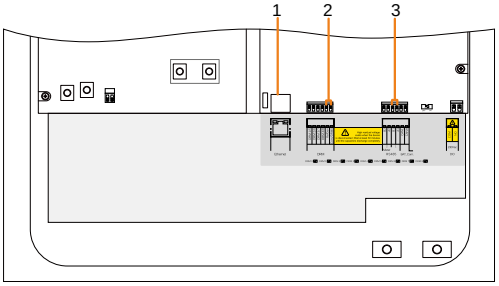
| DRM State | DRM1 |
|---|---|
| Import Limit | 100.0% |
| Export Limit | 100.0% |
| | |

## 6.10.2 SPI Connection (“IT”)

The inverter has integrated the interface protection system (SPI) to provide the

following functions:

- Maximum/minimum frequency protection;
- Ability to receive signals aimed at changing the frequency protection thresholds and to receive the command of remote shutdown.




| NO. | Interface | SPI Function |
|---|---|---|
| 1 | Ethernet | Receive external signal/command to change the frequency protection parameters or shutdown the inverter. See "**6.6.1 Ethernet Connection**" for the cable connection. |
| 2 | RefGen, Com/DRM0 | Shortly connecting the two terminals will change the frequency protection parameters. See **Fig. 6-6**. |
| 3 | A1, B1 | Receive external command to shutdown the inverter remotely. See **Fig. 6-7**. |

The following figure shows the cable connection to external device.

Cross-section: 2*0.5 mm², cable diameter: 3 mm...5.3 mm.

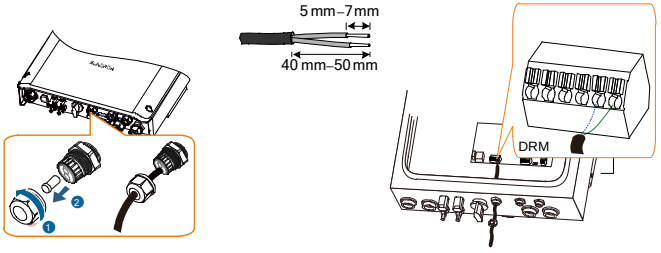



**Fig. 6-5** RefGen and Com. / DRM0 Connection

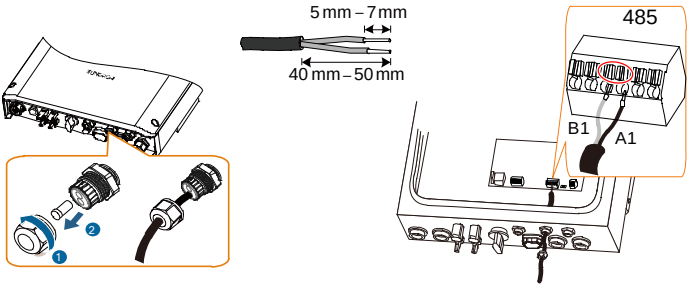



**Fig. 6-6** RS485 Connection to External Device

Note: For reconnection, press the part as shown in the red circle so as to pull out the cable.

### Local Control

In this mode, the inverter is in the absence of a communication “always on” prepared by the distributor. Through the local control via *RefGen* and *Com/DRM0* terminals:

- Low (state value 0): two terminals are not connected and you can get permanent operation at permissive thresholds;
- High (state value 1): two terminals are connected and you can get permanent operation at restrictive thresholds;

### External Control

In this mode, the inverter is connected with the external device via an Ethernet cable. Through the external signal:

- Low (state value 0) in case of really operating communication
- High (state value 1) in case of external commands sent by the external device

**Note**: The local control must be set permanently in the high state (value 1).

**Tab. 6-2** Frequency Protection Parameters in Conditions of SPI

| Explanation | Local Control | | External Control | |
|---|---|---|---|---|
| | 0 | 1 | 0 | 1 |
| Minimum frequency 1 (F<) (Hz) | 47.50 | 49.50 | 47.50 | 49.50 |
| Minimum frequency 1 (F<) tripping time (s) | 0.1 | 0.1 | 4 | 0.1 |
| Minimum frequency 2 (F<<) (Hz) | 47.50 | 47.50 | 47.50 | 47.50 |
| Minimum frequency 2 (F<<) tripping time (s) | 0.1 | 0.1 | 4 | 4 |

| Explanation | Local Control | | External Control | |
|---|---|---|---|---|
| | 0 | 1 | 0 | 1 |
| Maximum frequency 1 (F>) (Hz) | 51.50 | 50.50 | 51.50 | 50.50 |
| Maximum frequency 1 (F>) tripping time (s) | 0.10 | 0.1 | 1 | 0.1 |
| Maximum frequency 2 (F>>) (Hz) | 51.50 | 51.50 | 51.50 | 51.50 |
| Maximum frequency 2 (F>>) tripping time (s) | 0.10 | 0.1 | 1 | 1 |

- The default mode of SPI is local control with low state value 0 (no connection between *RefGen* and *Com/DRM0* terminals).
- When the local control and external control modes exist at the same time, the external control takes priority over the local control.

# 7 Commissioning

Proper commissioning is essential for the system to protect it against fires, injury and electric shock.

## 7.1 Inspection before Commissioning

Check the following items before starting the system:

1. All the installation sites are convenient for operation, maintenance and service.
2. Check and confirm that all devices are firmly installed.
3. Space for ventilation is sufficient for one inverter or multiple inverters.
4. Nothing is left on the top of the inverter or battery.
5. The inverter and accessories are correctly connected.
6. Cables are routed in a safe place or protected against mechanical damage.
7. The selection of the AC circuit breaker is in accordance to this manual and all applicable local standards.
8. All unused terminals at the bottom of the inverter are properly sealed.
9. Warning signs and labels are suitably affixed and durable.

## 7.2 Button Introduction

The inverter offers four buttons for operation. Please refer to the following table before any operation of the inverter.

**Tab. 7-1** Button Functions

| Button | Description |
|---|---|
| ▲ | For navigating up or increasing the setting value. |
| ▼ | For navigating down or decreasing the setting value. |
| ESC | For navigating to left, quitting the menu or canceling the settings. |
| ENT | For navigating to right or confirming a selection or settings. |

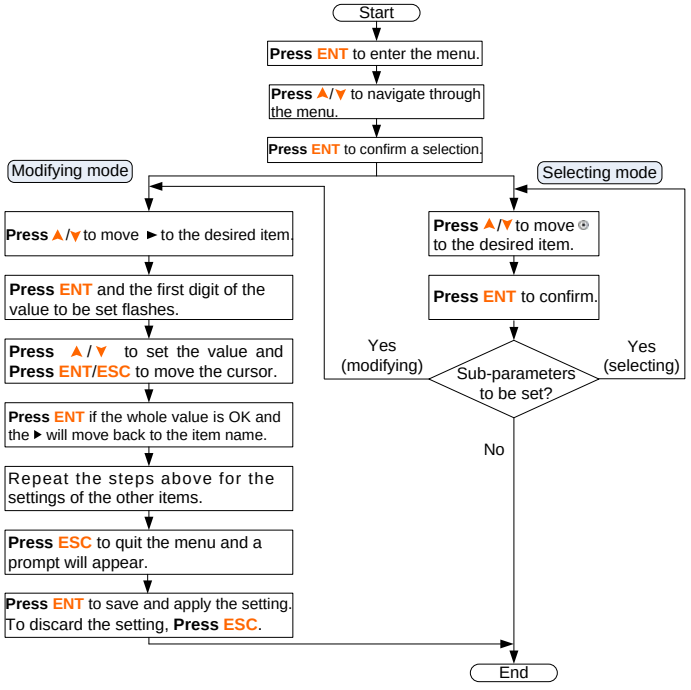
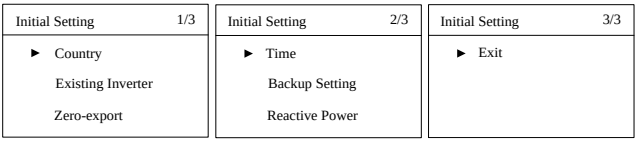



**Fig. 7-1** Button Operations

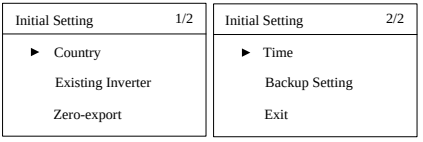
## 7.3 Powering on the System

If all the items mentioned in section **7.1** are OK, proceed as follows to start the inverter for the first time.

1. Connect the AC circuit breaker.
2. Connect the DC circuit breaker between the inverter and the battery pack.
3. **(Optional)** Power on the battery pack manually if applicable.
4. Rotate the optional DC switch to “ON”. The DC switch may be integrated in the inverter or installed by the customer.
5. The LCD screen will be activated 5s later and enter the initial settings.
   − Country Germany (“DE”)




− Countries except Germany (“DE”)

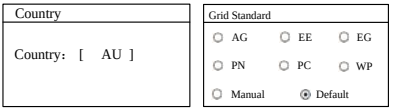



# 7.4 LCD Initial Settings

## 7.4.1 Setting the Country Code

### Countries Australia (“AU”) and New Zealand (“NZ”)

**Press** ▲/▼ to select the grid standard and **Press ENT** to confirm. Set the protective parameters if you choose “Manual”.




**Tab. 7-2** Grid Standard Description

| Grid Standard | Company |
|---|---|
| AG | AusGrid, NSW |
| EE | Ergon Energy, QLD |
| EG | Energex, QLD |
| PN | SA Power Networks,SA |
| PC | Powercor,VIC |
| WP | Western Power,WA |
| Default | Company not mentioned above |

The values listed in the following table are for your reference only. Please follow local grid requirements.

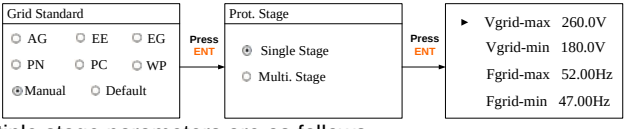
**Tab. 7-3** Parameters of Grid Standards in Australia

| Parameter | Default | AG | EE | EG | PN | PC | WP |
|---|---|---|---|---|---|---|---|
| **Over-voltage** | | | | | | | |
| 1-$V_{max}$ (V) | 260.0 | 260.0 | 260.0 | 260.0 | 260.0 | 260.0 | 260.0 |
| 1-Time (s) | 2.0 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 |
| 2-$V_{max}$ (V) | 265.0 | 265.0 | 265.0 | 265.0 | 265.0 | 265.0 | 265.0 |
| 2-Time (s) | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |

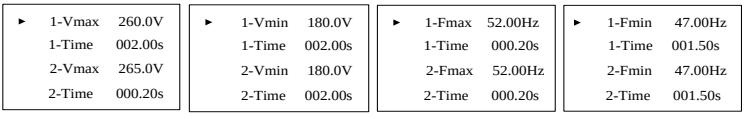
| Parameter | Default | AG | EE | EG | PN | PC | WP |
|---|---|---|---|---|---|---|---|
| **Under-voltage** | | | | | | | |
| 1-$V_{min}$ (V) | 180.0 | 200.0 | 180.0 | 180.0 | 180.0 | 180.0 | 180.0 |
| 1-Time (s) | 2.0 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 |
| 2-$V_{min}$ (V) | 180.0 | 200.0 | 180.0 | 180.0 | 180.0 | 180.0 | 180.0 |
| 2-Time (s) | 2.0 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 | 1.80 |
| **Over-frequency** | | | | | | | |
| 1-$F_{max}$ (Hz) | 52.00 | 52.00 | 52.00 | 52.00 | 52.00 | 52.00 | 51.50 |
| 1-Time (s) | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| 2-$F_{max}$(Hz) | 52.00 | 52.00 | 52.00 | 52.00 | 52.00 | 52.00 | 51.50 |
| 2-Time (s) | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| **Under-frequency *** | | | | | | | |
| 1-$F_{min}$ (Hz) | 47.00 | 48.00 | 47.00 | 47.00 | 47.00 | 47.00 | 47.00 |
| 1-Time (s) | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| 2-$F_{min}$(Hz) | 47.00 | 48.00 | 47.00 | 47.00 | 47.00 | 47.00 | 47.00 |
| 2-Time (s) | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| 10-min voltage | 255.0 | 255.0 | 255.0 | 257.0 | 255.0 | 255.0 | 258.0 |

* In New Zealand, the default value for under-frequency protection is 45.00 Hz, the others are the same as in Australia. Refer to **Tab. 10-7** for the parameter explanations.

The single stage parameters are as follows.

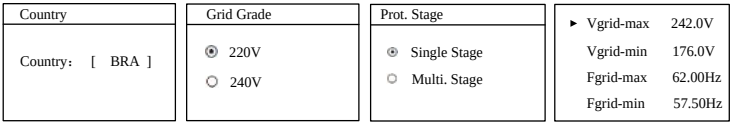



The multiple stage parameters are as follows.




### Country Brazil (“BRA”)

Select the grid type and set the protective parameters.



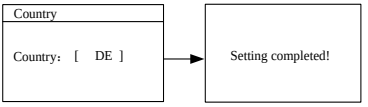

**Tab. 7-4** Default Parameters for Brazil

| Parameter | Explanation | Default / Range | |
|---|---|---|---|
| | | 220 V Grid | 240 V Grid |
| $V_{grid\text{-}max}$ (V) | Grid over-voltage protection value | 242.0 (230.0–299.0) | 264.0 (230.0–299.0) |
| $V_{grid\text{-}min}$ (V) | Grid under-voltage protection value | 176.0 (46.0–230.0) | 192.0 (46.0–230.0) |
| $F_{grid\text{-}max}$ (Hz) | Grid over-frequency protection value | 62.00 (60.00–65.00) | |
| $F_{grid\text{-}min}$ (Hz) | Grid under-frequency protection value | 57.50 (55.00–60.00) | |

* The values listed in the table are for your reference only. Please follow local grid requirements.

**Countries except "AU", "NZ" and "BRA"**

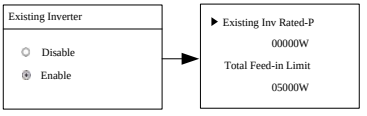
**Press** ▲ / ▼ to select the grid standard and **Press ENT** to confirm. Take Germany "DE" for reference in the figure.




## 7.4.2 Adding the Existing Inverter

**Existing Inv Rated-P:** rated power of the existing inverter.

**Total Feed-in Limit:** feed-in power limit of the new system.



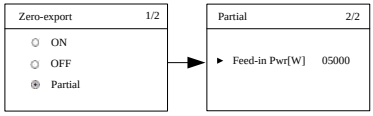

The total feed-in limit ranges from **(**rated power of the existing inverter) to ([rated power of the hybrid inverter] + [rated power of the existing inverter]). For example, retrofit an existing PV system (rated power: 3000 W) with SH5K-30 hybrid inverter (rated power: 5000 W). The total feed-in limit can be set from 3000 W to 8000 W.

The feed-in power limit setting and zero-export setting are from the same source. If one is changed, the other will synchronize the value.

### 7.4.3 Setting Feed-in Power

**ON:** no power could be fed into the grid.

**OFF:** all system output power could be fed into the grid.




**Partial:** partial of the output power could be fed into the grid.

- When the existing system is disabled, the **feed-in power ranges from** 0 to the rated power of the existing system.
- When the existing system is enabled, the **feed-in power ranges from** (rated power of the existing system) to ([rated power of the hybrid inverter] + [rated power of the existing system]).

NOTICE

**According to the local regulations in Germany, please set the feed-in power to 70 % of the installation capacity.**

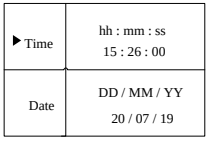
**For example, with a total maximum installation capacity of 4600 W (SH4K6), the feed-in power should be set to 3220 W (i.e. 4600 * 70 %).**

### 7.4.4 Setting System Time

The correct system time is very important. Wrong system time will directly affect the data logging and power generation value. The clock is in 24-hour format.

DD, MM, and YY stand for day, month, and year respectively.

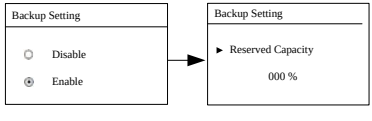
hh, mm, and ss stand for hour, minute, and second respectively.




### 7.4.5 Setting Backup Function

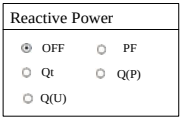
The backup function is disabled by default.

If the backup function is enabled, you should set the reserved capacity for Li-ion batteries.

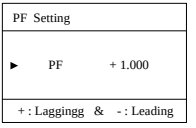


### 7.4.6 Setting Reactive Power Regulation ("DE")

OFF:
The reactive power regulation function is disabled.
The power factor (PF) is limited to +1.000.



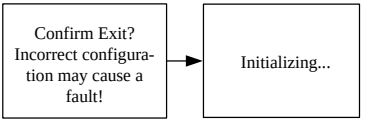

"**PF**" mode:
The inverter is capable of operating with fixed power factor. The PF ranges from 0.8 leading to 0.8 lagging.
**Leading**: the inverter is sourcing reactive power to the grid.
**Lagging**: the inverter is sinking reactive power from the grid.



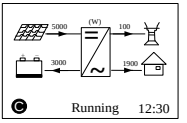

For the explanations of other modes, see "**11 Appendix II: Reactive Power Regulation**".

### 7.4.7 Initializing

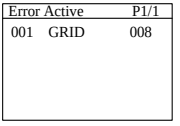
1. If all the items are successfully completed, select "Exit" to quit the initial setting.




2. Check and confirm the communication method. Refer to "**10.4.12 Setting the Communication Parameters**" for the communication configuration. Use the iSolarCloud APP to create a new plant. For details, refer to the User Guidance of iSolarCloud APP.




3. Check the icons on the main screen. Refer to **Tab. 10-1** for the explanations.
4. Check the state of the LED indicator (**Tab. 7-5**).
5. Visit www.iSolarCloud.com or iSolarCloud App to view inverter information. Get the related manuals at www.sungrowpower.com.
6. If the inverter commissioning fails, **Press** ▼ to view the active errors. Remove the existing malfunctions and then repeat starting up the inverter according to the procedure detailed in this section.




**Tab. 7-5** State Descriptions of the LED Indicator

| Color | Status | Description |
|---|---|---|
| Green | On | The inverter is running normally. |
| | Blinking | The inverter is in the process of starting. |
| | Off | Other states except Running and Starting. (Refer to **Tab. 10-1** for state descriptions.) |

| Color | Status | Description |
|---|---|---|
| Red | On | Permanent fault or upgrade failure. |
| | Blinking | Other system faults or main alarms. |
| | Off | No fault occurs. |

NOTICE

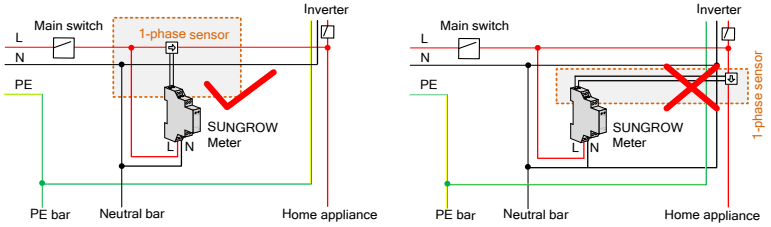
**In the case of commissioning failure, power off the system and wait 1 minute to commission the system again.**

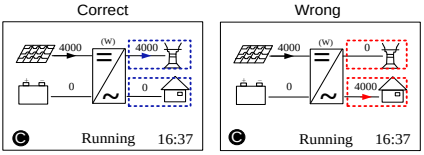
## 7.5 Result Verification

### 7.5.1 Energy Meter Installation and Connection

#### For Incorrect Installation Position

Make sure that the 1-phase sensor of the Sungrow Energy Meter should be placed to the phase line (L) from the main switch. If otherwise, the energy flow indicated on the LCD will be wrong.




| Action | LCD Explanation |
|---|---|
| Turn off all the household loads. All the PV power generation should be fed into the grid, as shown in the “Correct” figure. |  |



#### For Reverse Sensor Connection

Make sure that the arrow on the 1-phase sensor must point away from the grid towards the load. If otherwise, the energy flow indicated on the LCD will be wrong.

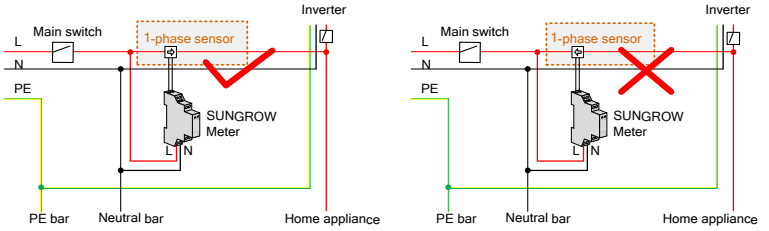



**Fig. 7-2** Correct CT Installation for Single-phase Energy Meter

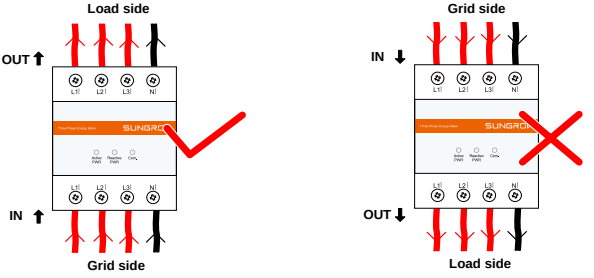
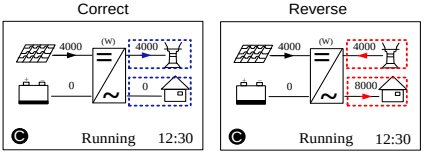
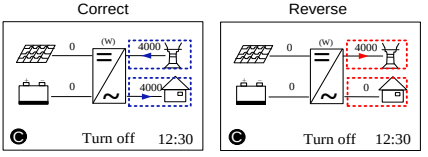



**Fig. 7-3** Correct Power cable connection for Three-phase Meter

| Action | LCD Explanation |
|---|---|
| Method 1:<br>Turn off all the household loads.<br>All the PV power generation should be fed into the grid, as shown in the “Correct” figure. |  |
| Method 2:<br>Stop the inverter via the LCD menu and turn on the household loads.<br>All the load power consumption should be imported from the grid, as shown in the “Correct” figure. |  |

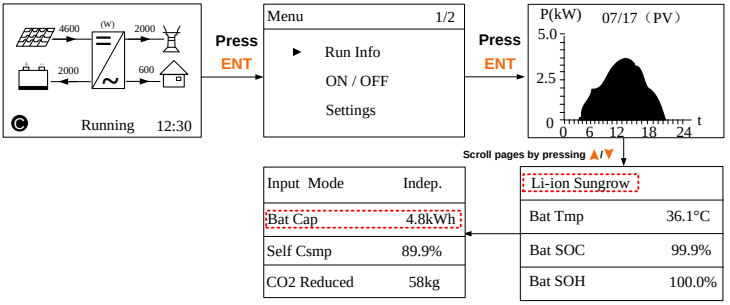
## NOTICE

**The reverse sensor connection will cause the communication fault 084.**

**To clear the fault 084, please turn off the DC sources and then restart the system after reconnecting the sensor in correct direction.**

### 7.5.2 Battery Information

After initial settings, check the detailed battery information on the LCD display.

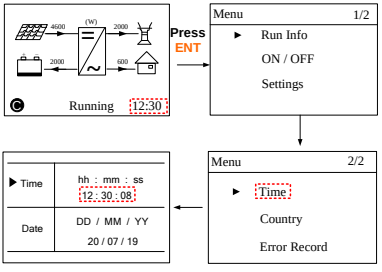



If the battery type or capacity setting is inconsistent with the actual, the charge/discharge current may be less than the actual charge/discharge ability. However, the system can operate normally.

Please stop the inverter via the LCD menu. Reset the battery type and parameters and then start the inverter again.

### 7.5.3 System Time

The correct system time is very important. If there is deviation between the system time and the local time, the inverter will not operate normally. The clock is in 24-hour format. Proceed as follows to set the correct time.



# 8 Troubleshooting and Maintenance

## 8.1 Troubleshooting

### 8.1.1 Troubleshooting of LED Indicators

See "**Tab. 7-5 State Descriptions of the LED Indicator**" for the definition.

| Fault Type | Troubleshooting |
|---|---|
| The LED indicator and LCD screen cannot be lit. | 1. Disconnect the AC circuit breaker.<br>2. Rotate the DC Switch to "OFF".<br>3. Check the polarities of the DC inputs. |
| The LED indicator goes out. | 1. Disconnect the AC circuit breaker.<br>2. Rotate the DC Switch to "OFF".<br>3. Check the electrical connection.<br>4. Check whether the DC input voltage exceeds the start voltage of the inverter.<br>5. If all of the above are OK, please contact SUNGROW. |
| The LED indicator is lit red. | 1. A fault is not resolved.<br>2. Perform troubleshooting according to the fault type on the LCD screen. See "**8.1.2 Troubleshooting of the Errors**".<br>3. If it cannot be resolved, please contact SUNGROW. |

### 8.1.2 Troubleshooting of the Errors

When an error occurs, the "Error" state will be shown on the main screen. **Press** ▼ to view detailed error information.

- For the battery error codes, if all the conditions are OK but the error still occurs, contact the distributor or the battery manufacturer.
- We need the following information to provide you with the best assistance: inverter type (e.g. string, central, grid-connected, hybrid, transformerless, single phase, triple phase, single MPPT, multiple MPPTs), or product name, serial number of the inverter, error code/name, and a brief description of the issue.

### For Inverter Side

| Code | Specification | Troubleshooting |
|---|---|---|
| 002 | Grid over-voltage.<br>The grid voltage exceeds the protective value. (stage I) | 1. Check the grid voltage.<br>2. If the grid voltage exceeds the permissible range, consult the utility grid for a solution. |
| 003 | Transient over-voltage in on-grid mode.<br>The grid transient voltage exceeds inverter allowable upper limit. | This is a short-term fault.<br>Wait a moment for inverter recovery or restart the system. |
| 004 | Grid under-voltage.<br>The grid voltage is below the protective value. (stage I) | 1. Check the grid voltage.<br>2. If the grid voltage exceeds the permissible range, consult the utility grid for a solution. |
| 005 | Grid under-voltage.<br>The grid voltage is below the protective value, which is lower than the protective value of error 004. (stage II) | |
| 007 | Transient AC over-current.<br>The transient AC current has exceeded the allowable upper limit. | Wait a moment for inverter recovery or restart the system. |
| 008 | Grid over-frequency.<br>The grid frequency exceeds the protective value. (stage I) | 1. Check the grid frequency.<br>2. If the grid frequency exceeds the permissible range, consult the utility grid for a solution. |
| 009 | Grid under-frequency.<br>The grid frequency is below the protective value. (stage I) | |
| 010 | Grid failure (Islanding).<br>Abnormal connection between the system and the grid. | 1. Check whether the AC circuit breaker is triggered.<br>2. Check whether all the AC cables are firmly connected.<br>3. Check whether the grid is in service. |
| 011 | DC injection over-current.<br>The DC injection of the AC current exceeds the upper limit. | Wait a moment for inverter recovery or restart the system. |
| 012 | Leakage current over-current.<br>The leakage current exceeds the upper limit. | 1. Check whether there is a grounding fault in the PV strings.<br>2. Wait a moment for inverter recovery or restart the system. |
| 014 | 10-minute grid over-voltage.<br>The average grid voltage in 10 minutes exceeds the upper limit. | 1. Check whether the grid is operating normally.<br>2. Wait a moment for inverter recovery or restart the system. |
| 015 | Grid over-voltage. | 1. Check the grid voltage. |

| Code | Specification | Troubleshooting |
|---|---|---|
| | The grid voltage exceeds the protective value, which is higher than the protective value of error 002. (stage II) | 2. If the grid voltage exceeds the permissible range, consult the utility grid for a solution. |
| 019 | Bus transient over-voltage.<br>The transient bus voltage exceeds the upper limit. | Wait a moment for inverter recovery or restart the system. |
| 021 | PV1 input over-current.<br>The input current of PV1 exceeds the upper limit. | 1. Check the PV input power and configuration.<br>2. Wait a moment for inverter recovery or restart the system. |
| 022 | PV2 input over-current.<br>The input current of PV2 exceeds the upper limit. | |
| 024 | Neutral point voltage imbalance.<br>The deviation of the neutral point voltage exceeds the allowable limit. | 1. The inverter will recover once the deviation falls below the protective limit.<br>2. Wait a moment for inverter recovery or restart the system. |
| 028 | Reverse polarity of the PV1 connection. | 1. Disconnect the DC switch.<br>2. Check the polarity of the PV inputs.<br>3. Reconnect the PV strings if the polarity is incorrect. |
| 029 | Reverse polarity of the PV2 connection. | |
| 037 | Inner over-temperature fault.<br>The ambient temperature inside the inverter exceeds the upper limit. | 1. Check and clean the heat sink.<br>2. Check whether the inverter is installed in sunlight or the ambient temperature of the enclosure exceeds 45℃. If not, please contact SUNGROW for a solution. |
| 038 | Relay fault on the grid side. | Wait 5 minutes for inverter recovery or restart the system. |
| 039 | PV insulation resistance fault. | 1. Check whether the PV cable connection is intact.<br>2. Wait for a sunny day to check whether the system can run well. |
| 041, 622 | Leakage current sampling fault. | Wait 5 minutes for inverter recovery or restart the system. |
| 043 | Inner under-temperature fault.<br>The ambient temperature inside the inverter is too low | The inverter will recover once the ambient temperature rises above -25℃. |
| 044 | INV open-loop self-check fault. | Wait 5 minutes for inverter recovery or restart the system. |
| 045 | PV1 boost circuit fault. | |
| 046 | PV2 boost circuit fault. | |
| 048 | Phase current sampling fault. | |
| 051 | Load overpower fault in the off-grid mode. | If the fault persists, disconnect some non-key loads. |

| Code | Specification | Troubleshooting |
|---|---|---|
| 052 | INV under-voltage fault in the off-grid mode. | Wait 5 minutes for inverter recovery or restart the system. |
| 063 | The version of CPLD (complex programmable logic device) cannot be detected. | Power off the system and program the CPLD. |
| 064 | INV over-voltage fault in the off-grid mode. | Wait 5 minutes for inverter recovery or restart the system. |
| 065 | INV under-frequency fault in the off-grid mode. | |
| 066 | INV over-frequency fault in the off-grid mode. | |
| 067 | Transient grid over-voltage in the off-grid mode. | |
| 075 | RS485 communication error between two inverters in parallel. | 1. Check the RS485 cable connection.<br>2. Check whether the parallel settings of two inverters are enabled and they are set to master and slave respectively on the LCD panel. |
| 083 | Fan2 abnormal speed warning. | 1. Check if the fan is blocked.<br>2. Restart the system. |
| 084 | Warning for reverse cable connection of the Sungrow Meter. | 1. Check whether the power cable connections are correct.<br>2. For Sungrow single-phase meter, check whether the CT clamp of the 1-phase sensor is correctly placed. Refer to “7.5.1 Energy Meter Installation and Connection”. |
| 100 | INV hardware over-current fault.<br>The AC current exceeds the protective value. | Wait 5 minutes for inverter recovery or restart the system. |
| 101 | Grid over-frequency.<br>The grid frequency exceeds the protective value, which is higher than the protective value of error 008. (stage II) | 1. Check the grid frequency.<br>2. If the grid frequency exceeds the permissible range, ask the grid company for a solution.<br>3. If the grid frequency is within the permissible range, contact SUNGROW for a solution. |
| 102 | Grid under-frequency.<br>The grid frequency is below the protective value, which is lower than the protective value of error 009. (stage II) | |
| 106 | The inverter is not grounded.<br>Neither the PE terminal on the AC connection block nor the second PE terminal on the | 1. Check whether there is a reliable grounding connection.<br>2. Check whether the L-line and N-line are connected correctly. |

| Code | Specification | Troubleshooting |
|---|---|---|
| | enclosure is reliably connected. | 3. If there is an access to the ground, and the error persists, please contact SUNGROW for a solution. |
| 107 | DC injection over-voltage fault in the off-grid mode.<br>The DC injection of INV voltage exceeds the upper limit. | The inverter will recover once the DC injection voltage falls below the recovery value. |
| 113 | Temporary bypass over-current. | 1. Check whether the power of emergency loads exceeds the upper limit of the BACKUP port.<br>2. Wait a moment for inverter recovery or restart the system.<br>3. If the error persists, please contact SUNGROW for a solution. |
| 200 | Bus hardware over-voltage fault.<br>The bus voltage exceeds the protection value. | Wait 5 minutes for inverter recovery or restart the system. |
| 201 | Bus under-voltage fault. | |
| 202 | PV hardware over-current fault.<br>The PV1 or PV2 current exceeds the protective value. | |
| 203 | The PV input voltage exceeds the bus voltage. | Check the functionality of the PV connection terminals. |
| 204 | PV1 boost short-circuit fault | The inverter may be damaged. Contact SUNGROW for a solution. |
| 205 | PV2 boost short-circuit fault | |
| 300 | INV over-temperature fault. | 1. Check and clean the heat sink.<br>2. Check whether the inverter is installed in sunlight or the ambient temperature of the enclosure exceeds 45℃-60℃.<br>3. Restart the system. |
| 303 | Bypass relay fault. | Wait 5 minutes for inverter recovery or restart the system. |
| 304 | Off-grid relay fault. | Wait 5 minutes for inverter recovery or restart the system. |
| 308 | Slave DSP redundant fault. | Restart the system. |
| 309 | Phase voltage sampling fault. | |
| 312 | DC injection sampling fault. | |
| 315 | PV1 current sampling fault. | |
| 316 | PV2 current sampling fault. | |
| 317 | PV1 MPPT current sampling fault. | |
| 318 | PV2 MPPT current sampling fault. | |
| 319 | System power supply failure fault. | |

| Code | Specification | Troubleshooting |
|---|---|---|
| 320 | Leakage current CT self-check fault. | |
| 321 | SPI communication failure. Communication faults between the master DSP and the slave DSP. | |
| 322 | Master DSP communication fault. | |
| 401-408 | Permanent faults. | Restart the system. |
| 409 | All temperature sensors failed fault. | Forced restart the system. |
| 501 | FRAM1 reading warning. | 1. Inverter can normally be connected to the grid.<br>2. Restart the system. |
| 503-506, 511 | Temperature sensor warnings. | |
| 507 | Error alarm of DO power settings. | Modify the DO power according to the load power. Refer to "**Optimized Control**". |
| 509 | Clock reset fault. | Manually reset the clock or synchronize the clock with the network time. This will clear the fault. |
| 510 | PV over-voltage fault. | 1. Check whether the configuration of the PV strings exceeds the permissible range of the inverter.<br>2. Wait a moment for inverter recovery or restart the system. |
| 513 | Fan1 abnormal speed warning. | 1. Check if the fan is blocked.<br>2. Restart the system. |
| 514 | Abnormal communication warning of the Sungrow Meter. (Inverter can be normally connected to the grid.) | 1. Check whether the power cable connections of the meter are correct.<br>2. Check whether the RS485 connection is correct.<br>3. Check if the 120 Ohm (2) resistor for RS485_2 is pushed to "ON" when the length of RS485 cable is longer than 100 m. |
| 600 | Transient BDC charging over-current fault. | Wait a moment for system recovery or restart the system. |
| 601 | Transient BDC discharging over-current fault. | |
| 603 | Transient clamping capacitor over-voltage fault. | Wait a moment for system recovery or restart the system. |
| 608 | BDC circuit self-check fault. | |
| 612 | BDC over-temperature fault. | 1. Check and clean the heat sink. |

| Code | Specification | Troubleshooting |
|---|---|---|
| | | 2. Check whether the inverter is installed in sunlight or the ambient temperature of the enclosure exceeds 45℃.<br>3. Restart the system. |
| 616 | BDC hardware over-current fault. | The system will resume once the battery charge/discharge current falls below the upper limit or restart the system. |
| 620 | BDC current sampling fault. | Wait a moment for system recovery or restart the system. |
| 623 | Slave DSP communication fault. | |
| 624 | BDC soft-start fault. | |
| 800,802<br>804,807 | BDC internal permanent faults. | Restart the system |
| 900,901 | BDC temperature sensor warnings | 1. Check and clean the heat sink.<br>2. Check whether the inverter is installed in sunlight or the ambient temperature of the enclosure exceeds 45℃.<br>3. Restart the system. |
| 910 | FRAM2 warning | Restart the inverter. |

### For Battery Side

For the battery faults, please consult the battery manufacturer for a solution.

| Code | Specification | Troubleshooting |
|---|---|---|
| 703 | Battery average under-voltage fault. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Wait a moment for system recovery or restart the system. |
| 707 | Battery over-temperature fault. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Check the ambient temperature of the battery location.<br>3. Wait a moment for system recovery or restart the system. |
| 708 | Battery under-temperature fault. | |
| 711 | Instantaneous battery over-voltage. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Wait a moment for system recovery or restart the system. |
| 712 | Battery average over-voltage fault. | |
| 714 | Abnormal communication | 1. The inverter can normally be connected to the grid but |

| Code | Specification | Troubleshooting |
|---|---|---|
| | between battery and the hybrid inverter. | charge/discharge has stopped.<br>2. Check the battery type and communication connection. For lead-acid batteries, you should manually set the battery type. Refer to "**10.4.5 Setting the Battery Type**".<br>3. Wait a moment for system recovery or restart the system. |
| 715 | Battery hardware over-voltage fault. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Wait a moment for system recovery or restart the system. |
| 732 | Battery over-voltage protection. | 1. The inverter can normally be connected to the grid. Charge has stopped but discharge is allowed.<br>2. Wait a moment for system recovery. |
| 733 | Battery over-temperature protection. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Check the ambient temperature of the battery location.<br>3. Wait a moment for system recovery or restart the system. |
| 734 | Battery under-temperature protection. | |
| 735 | Battery charging/discharging over-current protection. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Wait a moment for system recovery or restart the system. |
| 739 | Battery under-voltage protection. | 1. The inverter can normally be connected to the grid. Discharge has stopped but charge is allowed.<br>2. Wait a moment for system recovery or restart the system. |
| 832 | Battery FET fault or electrical switch failure. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Check the battery port voltage and the battery communication cable connection.<br>3. Force a shutdown and restart the inverter and battery system.<br>4. Wait a moment for system recovery or restart the system. |
| 834 | Battery charging/discharging over-current permanent fault. | |
| 836 | CAN ID competing failure. | Restart the system, if the fault persists, please contact SUNGROW for a solution. |
| 839 | Mismatched software version. | Contact SUNGROW for a solution. |

| Code | Specification | Troubleshooting |
|---|---|---|
| 844 | Software self-verifying failure. | Restart the system, if the fault persists, please contact SUNGROW for a solution. |
| 864 | Battery cell over-voltage fault. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Wait a moment for system recovery or restart the system. |
| 866 | Battery precharge voltage fault. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Check the battery port voltage and the communication cable connection.<br>3. Force a shutdown and restart the inverter and battery system.<br>4. Wait a moment for system recovery or restart the system. |
| 867 | Battery under-voltage fault. | |
| 868 | Battery cell voltage imbalance fault. | |
| 870 | Battery cable connection fault. | |
| 909 | Low SOH (State of Health) warning. | 1. The inverter can normally be connected to the grid and the charge/discharge function is normal.<br>2. Batteries are beyond the scope of the warranty. It is recommended to contact the distributor for replacements. |
| 932 | Battery over-voltage warning. | 1. The inverter can normally be connected to the grid. Charge has stopped but discharge is allowed.<br>2. The system will resume after a certain time of discharging. |
| 933 | Battery over-temperature warning. | 1. The inverter can normally connected be to the grid but charge/discharge has stopped.<br>2. Check the ambient temperature of the battery location.<br>3. Wait a moment for system recovery or restart the system. |
| 934 | Battery under-temperature warning. | |
| 935 | Battery charging/discharging over-current warning. | 1. The inverter can normally be connected to the grid but charge/discharge has stopped.<br>2. Wait a moment for system recovery or restart the system. |
| 937 | Battery tray voltage imbalance warning. | 1. The inverter can normally be connected to the grid and the charge/discharge functions are normal.<br>2. Check whether the cable connection of the battery is correct. |
| 939 | Battery under-voltage warning. | 1. The inverter can normally be connected to the grid. Discharge has stopped but charge is allowed. |

| Code | Specification | Troubleshooting |
|---|---|---|
| | | 2. The system will resume after a certain time of charging. |
| 964 | Battery internal warning. | Consult the battery manufacturer for a solution. |

## 8.2 Maintenance

### 8.2.1 Routine Maintenance

| Item | Method | Period |
|---|---|---|
| General state of the system | • Visual check for any damage or deformation of the inverter.<br>• Check any abnormal noise during the operation.<br>• Check each operation parameter.<br>• Be sure that nothing covers the heat sink of the inverter. | Every 6 months |
| Electrical connection | Check whether there is damage to the cables, especially the surface in contact with metal. | 6 months after commissioning and then once or twice a year. |

### 8.2.2 Replacing the Button Battery

**DANGER**

**Disconnect the inverter from the grid first, then the PV strings and the battery before any maintenance work.**

**Lethal voltage still exists in the inverter. Please wait at least 10 minutes and then perform maintenance work.**

There is a button battery on the inner PCB board of the LCD. Contact SUNGROW for replacement when the relevant fault alarm occurs.

Check the fastener, appearance, voltage, and resistance quarterly and annually.

# 9 System Decommissioning

## 9.1 Decommissioning the Inverter

NOTICE

**Please strictly follow the following procedure. Otherwise it will cause lethal voltages or unrecoverable damage to the inverter.**

**Powering off the Inverter**

1. Stop the inverter via the LCD menu. For details, see "**10.3 Starting and Stopping the Inverter**".
2. Disconnect the AC circuit breaker and secure against reconnection.
3. Rotate the DC switch to "OFF". The DC switch may be integrated in the hybrid inverter or installed by the customer.
4. Disconnect the DC circuit breaker between the battery and the inverter.

⚠ CAUTION

**Risk of burn injuries and electric shock!**

**Wait at least 10 minutes after disconnecting the inverter from the utility grid and the PV input before touching any inner live parts.**

NOTICE

**Don't power on the system again until 1 minute after this disconnection.**

5. Wait for about **10** minutes until the capacitors inside the inverter have completely discharged.
6. Measure and ensure that no voltage is present at the AC output on the inverter.
7. Refer to "**6.4 Grid Connection**", disconnect the AC connector from the inverter in reverse procedure.
8. Release the locking part of DC connectors by pressing on the ribbing of the locking hooks with nipper pliers and pull it outwards.
9. Use the multimeter to measure the port voltage of the battery. Disconnect the power cables after the voltage is zero.

### Dismantling the Inverter

Refer to **Chapter 5** and **Chapter 6**, dismantle the cables in reverse procedure. Remove the wall-mounting bracket from the wall if necessary.

### Disposing of the Inverter

Users should take the responsibility for the disposal of the inverter.

NOTICE

**Some parts and devices of the inverter, such as, LCD displayer, batteries, capacitors, may cause environment pollution.**

**Users must comply with the related local regulations to avoid the potential pollution.**

## 9.2 Decommissioning the Battery

Decommission the battery in the system after the inverter is decommissioned, following the steps for a Li-ion battery or lead-acid battery below.

### Decommissioning Li-ion Battery

1. Disconnect the DC circuit breaker between the battery and the inverter.
2. Disconnect the communication cable between the battery and the inverter.
3. **(Optional)** Turn off the switch on the battery if applicable.
4. Wait about 1 minute and use the multimeter to measure the port voltage of the battery.
5. If the battery port voltage is zero, disconnect the power cables between the battery and the inverter.

### Decommissioning Lead-acid Battery

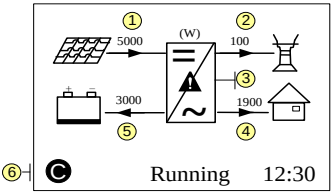
1. Disconnect the DC switch between the battery and the inverter.
2. Turn off the switch on the battery.
3. Disconnect all the cables between the battery and the inverter.

# 10 Appendix I: LCD Operation

Refer to **Fig. 7-1** for button operations when setting parameters.

## 10.1 Main Screen

After successful commissioning, the LCD screen will enter the main screen.




| No. | Description |
|---|---|
| 1 | Current PV input power |
| 2 | Current feed-in power |
| 3 | Warning information |
| 4 | Total load consumption |
| 5 | Battery charge/discharge power |
| 6 | System status bar |

: The inverter and iSolarCloud server are successfully connected.

**Running**: The inverter is in its normal running state.

**12:30**: Current system time.

Neither the grid power nor the load power will be displayed on the main screen in case of no Sungrow meter installed.

If there is no button operation for:

- 1 minute, the LCD backlight is OFF;
- 2 minutes, system returns to the default menu (main screen).

**Tab. 10-1** State Descriptions

| State | Description |
|---|---|
| Running | After being energized, the inverter tracks the PV strings' maximum power point (MPP) and runs with the combination of the energy management system. This mode is the normal mode. |
| Maintain | The system is running normally, with the battery in maintenance process. (Only for lead-acid battery) |
| Forced | The system is running normally, with the EMS in forced mode. |
| Ext. EMS | The system is running normally and is controlled by external EMS. |

| State | Description |
|---|---|
| Standby | The inverter waits for sufficient sunlight or battery level, then the DC voltage recovers. The standby time can be set on at www.iSolarCloud.com. |
| Turn off | The inverter will stop running by manual “OFF” through the LCD menu or with the DRM0 command from the DRED. Set to “ON” if you want to restart the inverter. |
| Startup | The inverter is initializing and synchronizing with the grid. |
| Upgrade | The DSP or LCD software is in its upgrading process. |
| Error | If an error occurs, the inverter will automatically stop operation, trigger the AC relay and show “Error” on the LCD with the indicator lit.<br>Once the error is removed in recovery time, the inverter will automatically resume running. The recovery time can be set at www.iSolarCloud.com. |
| Off-grid | The system is disconnected from utility grid and runs as a stand-alone system. |

NOTICE

**If the device is in standby mode for more than 10 minutes, please check:**

- **Whether the insolation is sufficient and the PV connection is correct.**
- **Whether the battery level is sufficient and the cable connection is correct.**
- **If no anomaly is found, disconnect the DC switch and the main switch to restart.**
- **If it still does not work, contact SUNGROW.**

## 10.2 LCD Menu

### Abbreviations

| Abbreviation | Complete | Abbreviation | Complete |
|---|---|---|---|
| Csmp | Consumption | Tot | Total |
| Chrg | Charge | Tmp | Temperature |
| Bat | Battery | SOH | State of Health |
| SOC | State of Charge | Curr | Current |
| Vtg | Voltage | Inv | Inverter |
| Stt | State | Frq | Frequency |
| Pwr | Power | DRM | Demand respond mode |
| Cap | Capacity | Ref. | Reference |

| Abbreviation | Complete | Abbreviation | Complete |
|---|---|---|---|
| Ver. | Version | MDCV | Max. discharging current value |
| CSTVtgChrg | Constant charging voltage | MCCV | Max. charging current value |
| DChrg | Discharge | Multi. | Multiple |
| Prot. | Protection | DChrgEndVtg | Final discharg voltage |
| Comm. | Communication | En. | Enable |

The following figure shows the menu of the LCD display.

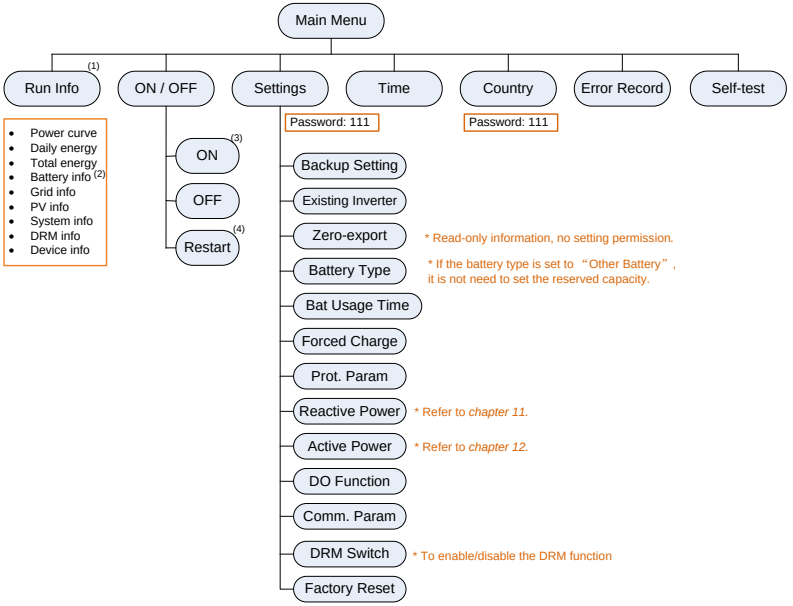



**Fig. 10-1** LCD Menu Tree

(1) The power value indicated represents the average value during the time interval. The energy yields displayed are indicative only. For the actual yields, please refer to the electric energy meter.

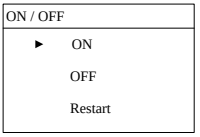
(2) The value of battery SOH will be displayed as "--" for GCL batteries that do not have this parameter. The SOC value for lead-acid batteries is for reference only.

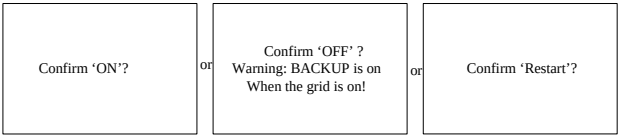
(3) For Australia and New Zealand, the DRM0 state will prohibit the "ON".

(4) The "Restart" option will appear only if an unrecoverable fault occurs.

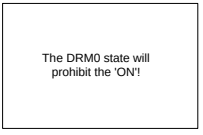
## 10.3 Starting and Stopping the Inverter

Notice:
The Restart item will appear only if an unrecoverable fault occurs.
Confirm your choice by pressing **ENT**.




For Australia and New Zealand, when the DRM state is DRM0, the "ON" option will be prohibited.

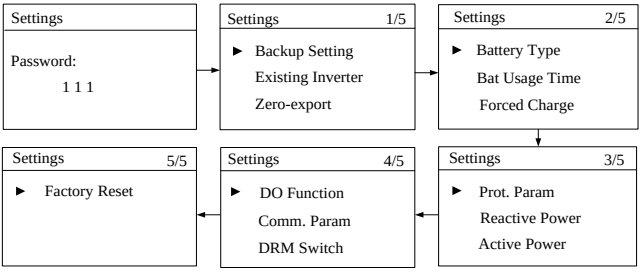



## 10.4 Advanced Settings

### 10.4.1 Inputting Password

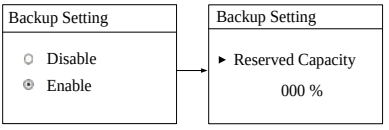
The parameter settings are protected with a password. If you want to set the inverter's parameters, you have to input the correct password.

**Press** ▲ to add the value and **Press ENT** to move the cursor to input the password **111**. **Press ENT** to confirm the password and enter the submenu.



### 10.4.2 Setting the Backup Function

The reserved capacity is the on-grid minimum battery discharge level. The reserved battery capacity will be supplied to the emergency loads in the off-grid system.




If the battery type is set to “Other Battery”, it is not need to set the reserved capacity.

If the backup function is enabled, the buzzer inside the inverter will beep intermittently for 20 s when the battery level is lower than the threshold value specified in the following table.

**Tab. 10-2** Threshold Values of Different Batteries

| Battery Type | SOC Threshold |
|---|---|
| Sungrow (retrofitting system) / LG | ≤ 6 % |
| BYD | ≤ 11 % |
| GCL | ≤ 16 % |
| Pylon (US2000B), TAWAKI | ≤ 21 % |
| Lead-acid | ≤ 45 V |

### 10.4.3 Adding the Existing Inverter

Refer to the description in “**7.4.2 Adding the Existing Inverter**”.

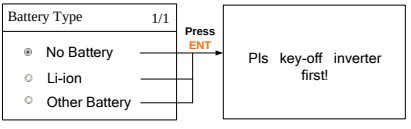
### 10.4.4 Setting Feed-in Power

Refer to the description in “**7.4.3 Setting Feed-in Power**”.

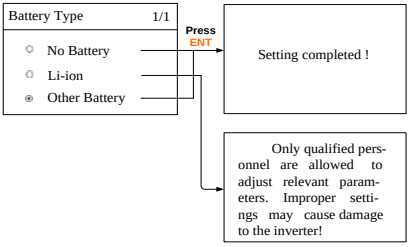
### 10.4.5 Setting the Battery Type

For Li-ion batteries, the type can be automatically identified and set to “Li-ion” on the LCD. Manually set the type to “Other Battery” for lead-acid batteries. Proceed as follows to modify the settings.

Refer to “**10.3 Starting and Stopping the Inverter**” to stop the inverter before modifying the battery type.

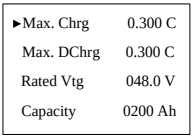


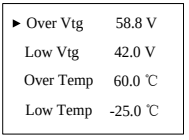
**Press** ▲/▼ to select and **Press** ENT to confirm.



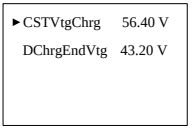

For lead-acid batteries, you should manually set the battery type.

Max. Chrg / Max. DChrg:
Make sure that the charge or discharge current is not beyond the upper limit (65 A) to protect the battery from overcharging or deep discharging.
The unit ***C*** is the "capacity", which refers to the maximum amount of charge that a battery can store. Refer to the manufacturer's specifications for details. If the max. charge or discharge is set to more than 65 A (e.g. C = 600 Ah, 0.3C = 180 A), then the inverter will limit the charge and discharge current to 65 A.
The charge or discharge voltage is not beyond the upper limit (63 V / 70 V).
If the battery voltage or temperature is beyond the allowable range, the related error codes will be triggered and the protection function will be activated to stop charging or discharging.




DChrgEndVtg:
Stop discharging at a voltage not lower than DChrgEndVtg, so as to protect the battery from deep discharging.
The ***DChrgEndVtg*** setting value should be higher than the ***Low Vtg*** setting value.




**Tab. 10-3** Parameter Description for Other Battery

| Parameter | Description | Range |
|---|---|---|
| Max. Chrg | The upper limit of the charging current | 0.05C to 2C |
| Max. DChrg | The upper limit of the discharging current | 0.1C to 2C |
| Rate Vtg | The rated voltage of the equipped battery | 30 V to 60 V |
| Capacity | Capacity of the battery tray | 10 Ah to1000 Ah |
| Over Vtg | The upper limit of battery voltage when charging | 48 V to 70 V |
| Low Vtg | The lower limit of battery voltage when discharging | 32 V to 48 V |
| Over Temp | The upper limit of battery temperature | 20℃ to 70℃ |
| Low Temp | The lower limit of battery temperature | -30℃ to 10℃ |
| CSTVtgChar | The voltage of constant-voltage charging. | 40 V to 63 V |

| Parameter | Description | Range |
|---|---|---|
| DChrgEndVtg | The voltage at which the discharging is stopped | 30 V to 53 V |

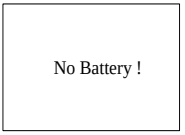
NOTICE

**The parameters can only be set by qualified personnel.**

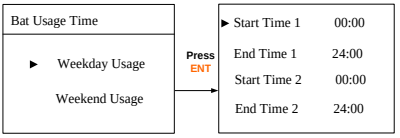
**Consult the battery manufacturer for an advice before any modification.**

### 10.4.6 Setting the Battery Usage Time

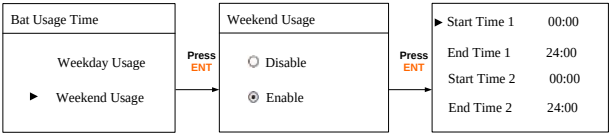
When there is no battery equipped in the system, a prompt will appear. **Press ENT** to continue the setting.




- Battery usage enabled (Weekday):

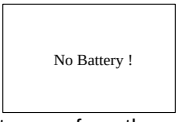


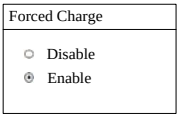

- Battery usage enabled (Weekend):



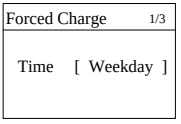

### 10.4.7 Setting Forced Charge

In the system without a battery, a prompt will appear. **Press ENT** to continue the setting.



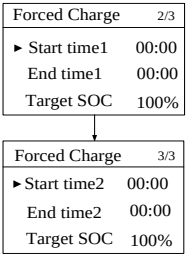




When there is no PV power, the import power from the grid charges the energy system during the time period until the target SOC is reached.



It is recommended to set the time period in off-peak tariff time. The time period 1 is in priority to the time period 2 if two periods overlap.

The charging energy comes from the excess PV energy in priority to the energy from the grid. The inverter will sink the charging power from the grid in the case of PV energy shortage.




## 10.4.8 Setting the Protective Parameters

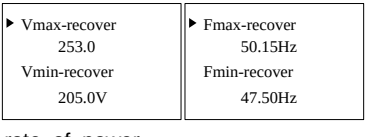
Protective parameters are designed for the threshold values that can trigger the protective function of the inverter. The threshold values are compliant with the requirements of local safety standards and the utility grid.

If the protection function is triggered, the inverter will automatically disconnect from the grid. In this case, the system can be automatically switched to off-grid running if the backup function has been enabled via the LCD menu. Otherwise the inverter will stop running with the ”Error” state displayed on the LCD main screen.

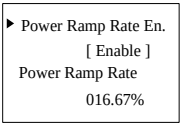
For more parameter settings, please visit the iSolarCloud App or the iSolarCloud server.

For the function of interface protection system (SPI) for Italy, see “**6.10.2 SPI Connection (“IT”)**”.

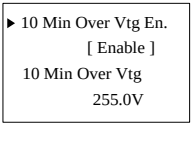
After the grid voltage or frequency recovers to the specified range, the corresponding error code displayed on the LCD will be cleared and the inverter will resume on-grid running.




**Power Ramp Rate**: the ramp up/down rate of power variation.
The power rate limit mode is enabled by default.
Set to *Disable* to turn off the function.




10-minute over-voltage protection:
The inverter will automatically disconnect from the grid within 3 s when the average voltage for a 10 min period exceeds the set-point of *10 Min Over Vtg*.
Set to *Disable* to turn off the function.



**Tab. 10-4** Recovery Parameter Explanation

| Parameter | Explanation |
|---|---|
| Vmax-recover | Recovery value for over-voltage fault. Inverter can start operating only when the grid voltage is below this value. |
| Vmin-recover | Recovery value for under-voltage fault. Inverter can start operating only when the grid voltage is above this value. |
| Fmax-recover | Recovery value for over-frequency fault. Inverter can start operating only when the grid frequency is below this value. |
| Fmin-recover | Recovery value for under-frequency fault. Inverter can start operating only when the grid frequency is above this value. |
| Power Ramp Rate | The ramp rate of power variation. |
| 10-min Over Vtg | Over-voltage protection value of 10-min average voltage |

**Tab. 10-5** Default Values of Protective Parameters in Australia

| Parameter | Range | Default | AG | EE | EG | PN | PC | WP |
|---|---|---|---|---|---|---|---|---|
| Vmax-recover (V) | 230.0–299.0 | 253.0 | 258.0 | 258.0 | 258.0 | 258.0 | 258.0 | 258.0 |
| Vmin-recover (V) | 130.0–230.0 | 205.0 | 202.0 | 182.0 | 182.0 | 182.0 | 182.0 | 182.0 |
| Fmax-recover (Hz) | 50.00–55.00 | 50.15 | 51.98 | 51.98 | 51.98 | 51.98 | 51.98 | 51.48 |
| Fmin-recover (Hz) | 45.00–50.00 | 47.50 | 48.02 | 47.02 | 47.02 | 47.02 | 47.02 | 47.02 |
| Power Ramp Rate (%) | 5 –100 | 16.67 | 16.67 | 16.67 | 16.67 | 16.67 | 16.67 | 16.67 |
| 10 Min Over Vtg (V) (1) | 244.0–258.0 | 255.0 | 255.0 | 255.0 | 257.0 | 255.0 | 255.0 | 258.0 |

**Tab. 10-6** Default Values of Protective Parameters

| Parameter | LUX | IT | DE | NL | BRA | | AT | BE |
|---|---|---|---|---|---|---|---|---|
| | | | | | 220V | 240V | | |
| Vmax-recover (V) | 253.0 | 253.0 | 251.0 | 251.0 | 240.0 | 262.0 | 253.0 | 253.0 |
| Vmin-recover (V) | 195.5 | 197.5 | 195.5 | 195.5 | 178.0 | 194.0 | 207.0 | 195.5 |
| Fmax-recover (Hz) | 50.05 | 50.10 | 50.10 | 50.05 | 60.10 | 60.10 | 50.05 | 50.05 |
| Fmin-recover (Hz) (1) | 47.52 | 49.90 | 47.52 | 48.02 | 59.90 | 59.90 | 47.52 | 47.52 |
| Power Ramp Rate (%)(2) | 10.00 | 16.67 | 10.00 | 10.00 | 20.00 | 20.00 | 10.00 | 10.00 |
| 10 Min Over Vtg (V) (3) | 253.0 | 253.0 | 253.0 | - | 255.0 | 255.0 | 257.6 | 253.0 |

(1) The default value of Fmin-recover is 47.52 Hz for Great Britain ("GB").

(2) The default value of power ramp rate is 10.00% for South Africa ("SA").

(3) The 10-minute over-voltage protection is not applicable to country Netherlands (NL). The default value of 10-minute over-voltage is 248.0 V for New Zealand ("NZ").

### 10.4.9 Setting Reactive Power Regulation

For details, see "**11 Appendix II: Reactive Power Regulation**".

### 10.4.10 Setting Active Power Response

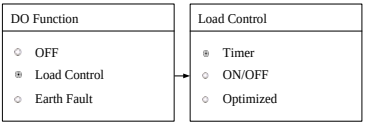
For details, see "**12 Appendix III: Active Power Response**".

### 10.4.11 DO Function Setting

#### Setting Load Control

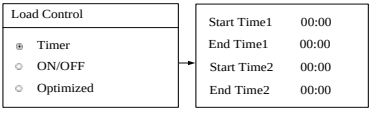
After connecting the load to the DO terminals, a relay control signal will be transmitted. Users can flexibly set the control mode via the LCD menu.

**Press** ▲/▼ to choose the control mode. **Press ENT** to confirm.




- Timer Control

  In this mode, set the Start time and End time, the system will control the load operation during the interval. Take 09:00 am–09:30 am as an example.



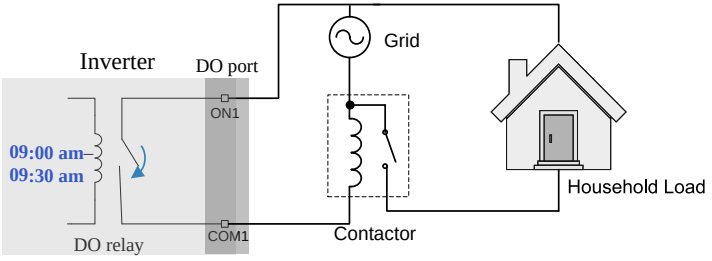
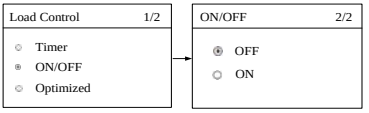




**Fig. 10-2** DO Operation in Timer Control

- ON/OFF Control

In this mode, the system will control the load operation according to the setting. Set to ***OFF*** in the following example.



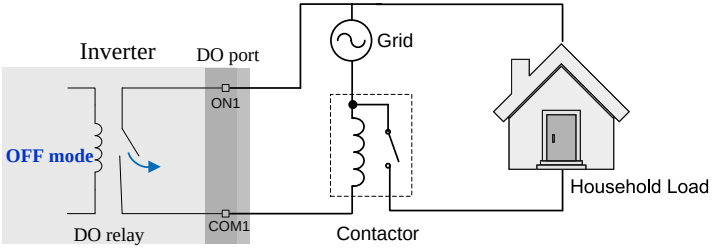
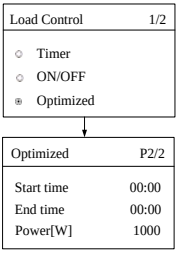




**Fig. 10-3** DO Operation in ON/OFF Control

- Optimized Control

The system will control the load operation according to the power optimization algorithm of energy management.




During the setting interval, the DO function will be enabled to power on the load if the excess PV energy exceeds the optimized power value.

Notice:

- The optimized mode is disabled in an off-grid system.
- When the existing system is enabled, the upper limit of optimized power is the sum of the rated power of the hybrid inverter and the rated power of the existing PV system.
- Once the optimized mode is enabled, the DO relay will not disconnect until 20 minutes after the DO connection.

Take 09:00 am–09:30 am and the optimized power of 1000 W as an example.

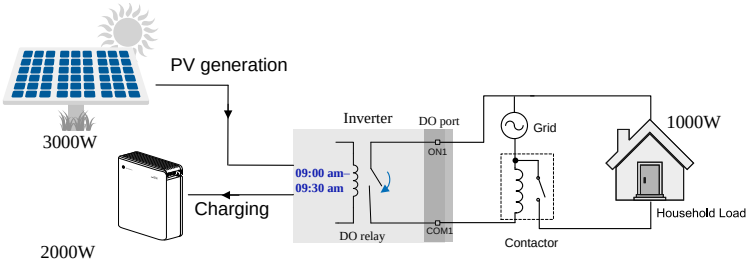
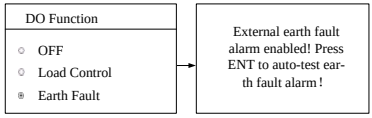



**Fig. 10-4** DO Operation in Optimized Control

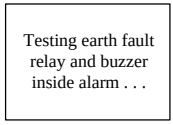
### Testing Earth Fault

Test earth fault alarm and then automatically return to main menu after 3s.

**Press ENT** to confirm the earth fault alarm function. A prompt will appear.

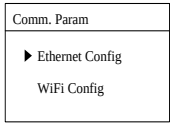



If you **press ENT** to go on the test, the DO relay will switch on automatically to signal the external alarm if a light indicator and/or buzzer is connected. The buzzer inside the inverter will beep.



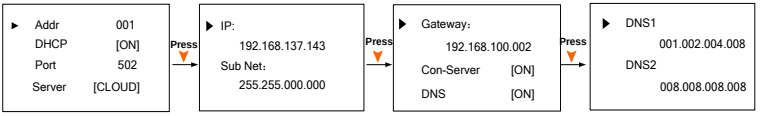

The PV insulation resistance fault (code 039) will trigger the DO relay to signal the external alarm.

## 10.4.12 Setting the Communication Parameters



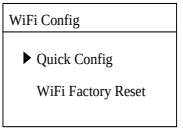

### Ethernet

- The communication address ranges from 1 to 247.
- The IP, sub net, gateway, DNS1 and DNS2 can be modified only when the DHCP is set to OFF.
- Acquire the IP, subnet mask, gateway, DNS1 and DNS2 from the network professional.
- Set the Server to “CLOUD” if the data is uploaded to www.isolarcloud.com.




**Wi-Fi**

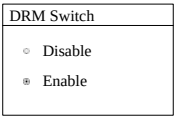
Quick Configuration: **Press ENT** to enable this function and then you can connect the inverter Wi-Fi to your home router quickly with the App.




## 10.4.13 DRM Switch Setting

The DRM function to the DRED (demand response enabling device) is enabled by default.

Set to *Disable* to turn off the function.

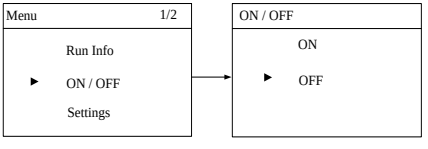



## 10.4.14 Factory Reset

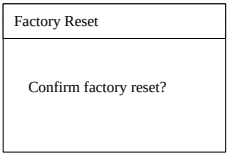
NOTICE

**All history information will be irrecoverably cleared and all parameters will return to the default values except the protection parameters and time once the "Factory Reset" is performed.**

Firstly, set the inverter to "OFF" via the LCD menu.




Enter the "Settings" menu and navigate to "Factory Reset". **Press ENT** to confirm.



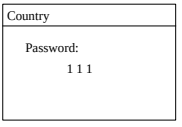
## 10.5 Setting the Time

For details, see "**7.4.4 Setting System Time**".

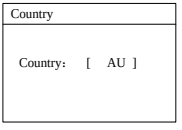
## 10.6 Setting the Country

The country setting is protected with a password. Each country code represents corresponding local protective parameters that have been preset before delivery.

**Press** ▲ and **Press ENT** to input the password **111**.
**Press ENT** to confirm the password.




For the countries "AU", "NZ" and "BRA, you should set the grid standard according to the description in "7.4.1 Setting the Country Code".




**Tab. 10-7** Descriptions of the country codes

| Country Code | Full Name | Language |
|---|---|---|
| GB | Great Britain | English |
| DE | Germany | German |
| FR | France | French |
| IT | Italy | Italian |
| ES | Spain | English |
| AT | Austria | German |
| AU | Australia | English |
| CZ | Czech | English |
| BE | Belgium | French |
| DK | Denmark | English |
| GR_L | Greece Land | English |
| GR_IS | Greece Island | English |
| NL | Netherlands | Dutch |
| LUX | Luxembourg | Dutch |
| PT | Portugal | English |
| CN | China | Chinese |
| SE | Sweden | English |
| US | America | English |
| SA | South Africa | English |
| NZ | New Zealand | English |
| Other | Country not included above | English |

**Tab. 10-8** Description of Multi. Stage Protective Parameters

| Parameter | Explanation | Range |
|---|---|---|
| **Max-V prot.** | Over-voltage protection | |
| 1-$V_{max}$ | Grid over-voltage 1 (V>) | 230 V–299 V |
| 1-Time | Grid over-voltage 1 (V>) tripping time | 0–600 s |
| 2-$V_{max}$ | Grid over-voltage 2 (V>>) | 230 V–299 V |
| 2-Time | Grid over-voltage 2 (V>>) tripping time | 0–600 s |
| **Min-V prot.** | Under-voltage protection | |
| 1-$V_{min}$ | Grid under-voltage 1 (V<) | 46 V–230 V |
| 1-Time | Grid under-voltage 1 (V<) tripping time | 0–600 s |
| 2-$V_{min}$ | Grid under–voltage 2 (V<<) | 46 V–230 V |
| 2-Time | Grid under–voltage 2 (V<<) tripping time | 0–600 s |
| **Max-F prot.** | Over-frequency protection | |
| 1-$F_{max}$ | Grid over-frequency 1 (F>) | 50.00 Hz–55.00 Hz |
| 1-Time | Grid over-frequency 1 (F>) tripping time | 0–600 s |
| 2-$F_{max}$ | Grid over-frequency 2 (F>>) | 50.00 Hz–55.00 Hz |
| 2-Time | Grid over-frequency 2 (F>>) tripping time | 0–600 s |
| **Min-F prot.** | Under-frequency protection | |
| 1-$F_{min}$ | Grid under-frequency 1 (F<) | 45.00 Hz–50.00 Hz |
| 1-Time | Grid under-frequency 1 (F<) tripping time | 0–600 s |
| 2-$F_{min}$ | Grid under-frequency 2 (F<<) | 45.00 Hz–50.00 Hz |
| 2-Time | Grid under-frequency 2 (F<<) tripping time | 0–600 s |

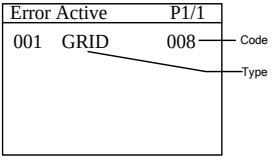
NOTICE

**In the off-grid parallel system, refer to "10.3 Starting and Stopping the Inverter" to stop the inverter before modifying country or grid setting.**

## 10.7 Viewing the Error Codes

### Viewing Active Error

For the ⚠ icon or the "Error" state on the main screen, **press** ▼ to view the current faults. Refer to "**8.1.2 Troubleshooting of the Errors**" for error description and troubleshooting.




Refer to the following table for error type explanations.

| Error Type | Explanation |
|---|---|
| GRID | Grid faults (AC side) |
| PV | PV faults (DC side) |

| Error Type | Explanation |
|---|---|
| SYS | System errors (inverter) |
| PER | Permanent faults |
| WARN | Warnings |
| BDCF | Faults of battery charge/discharge circuit |
| BDCPF | Permanent faults of battery charge/discharge circuit |
| BATW | Battery warnings |
| BATP | Battery protection |
| BATF1 | Battery faults |
| BATF2 | |

### Viewing Error Record

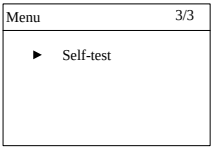
**Press** ▲/▼ to turn pages and view all error records.
1: the error is triggered.
0: the error is cleared.

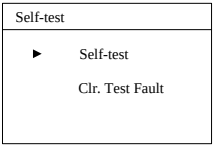
| Error Record | | P1/20 |
|---|---|---|
| 18110309:30:37 | 010 | 0 |
| 18110309:30:37 | 010 | 1 |
| 18110217:23:30 | 703 | 1 |
| 18110217:23:21 | 010 | 1 |
| 18110217:23:21 | 514 | 0 |

## 10.8 Self-test (Italy)

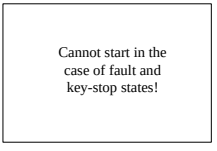
The inverter is integrated with interface protection functions and provides an auto test system to verify the maximum / minimum frequency and maximum / minimum voltage functions. The “Self-test” item can only display when the country code is set to “IT” (Italy), so the screenshots introduced in this section will be in Italian.

**Press ENT** to confirm “Self-test” and start the auto test.




If the inverter is in the status of “Error” or “Turn off”, it cannot start the test and a prompt interface will appear.




During normal auto testing, the LCD will automatically cycle through the grid protection testing items.

(1) 81>.S1: over-frequency test (stage I)

(2) 81<.S1: under-frequency test (stage I)

(3) 59.S1: over-voltage test (stage I)

(4) 27.S1: under-voltage test (stage I)

(5) 81>.S2: over-frequency test (stage II)

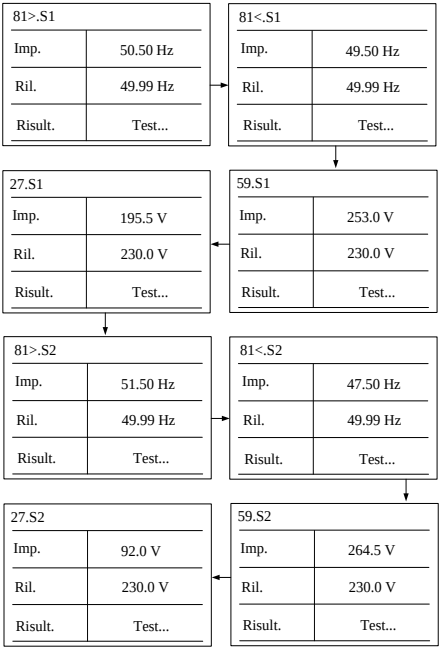
(6) 81<.S2: under-frequency test (stage II)

(7) 59.S2: over-voltage test (stage II)

(8) 27.S2: under-voltage test (stage II)

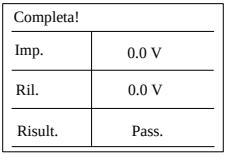
***Imp.***: the default protection threshold

***Ril.***: the actual sample value




- For over- frequency / voltage protection testing, the default protection threshold (***Imp.***) is linearly decreased with a ramp <= 0.05 Hz/s or <= 0.05 Vn/s. The protection function will be triggered if the threshold is lower than the actual sample value (***Ril.***).
- For under- frequency / voltage protection testing, the default protection threshold (***Imp.***) is linearly increased with a ramp <= 0.05 Hz/s or <= 0.05 Vn/s. The protection function will be triggered if the threshold is higher than the actual sample value (***Ril.***).

If the protection function is triggered, the LED indicator will be lit red and the corresponding error code will be displayed on the main screen. When the test is completed, the interface as shown will appear. **Press** ▼ to view the test result and the trip time.



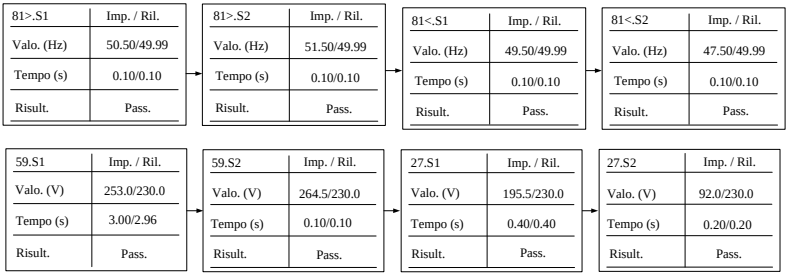
NOTICE

**Do not press ESC to exit this interface, otherwise the test results will be cleared and you need to do the test again.**

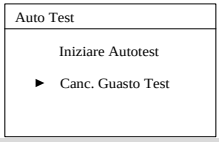
For each test, the values of frequency / voltage and the trip times will be visualized as well as the current values of the frequency and voltage measured by the inverter. **Press** ▲/▼ to scroll pages and **press ESC** to exit.

The thresholds (***Imp.***) are compliant with standard CEI 0-21 and the actual values (***Ril.***) are for your reference only.
***Pass.***: The inverter will restore the normally used settings and automatically reconnect to the grid.

***Fail***: The inverter will report the error **105**. The inverter cannot reconnect to the network until the test faults are cleared.




If the auto test fails, **Press ENT** to confirm "Canc. Guasto Test" and clear the test faults.

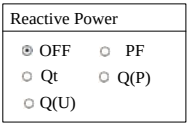



NOTICE

**If an external command aimed at changing the frequency protection thresholds is sent to the inverter during the testing process, the test results will be invalid. You should restart the system and re-do the auto test.**

# 11 Appendix II: Reactive Power Regulation

Refer to "**10.2 LCD Menu**" for the navigation.
**Press** ▲/▼ to select the desired option and
**Press** ENT to confirm.
**OFF**: The reactive power regulation function is disabled. The power factor (PF) is limited to +1.000.

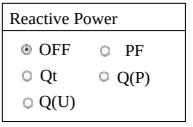


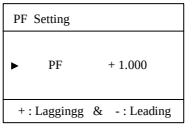

## 11.1 "*PF*" mode

The inverter is capable of operating with fixed power factor. The PF ranges from 0.8 leading to 0.8 lagging.

**Leading**: the inverter is sourcing reactive power to the grid.

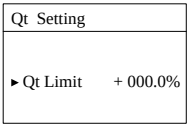
**Lagging**: the inverter is sinking reactive power from the grid.




## 11.2 "*Qt*" Mode

*Qt limit*: the maximum ratio of reactive power to rated apparent power in %.
The Qt limit ranges from -60.0 % to +60.0 %.



# 11.3 "*Q(P)*" Mode

## 11.3.1 Country Italy ("IT")

The PF of the inverter output varies in response to the output power of the inverter.

| | |
|---|---|
| ▸PA | 020.0% |
| PB | 050.0% |
| PC | 100.0% |
| PF MAX | 0.950 |

| | |
|---|---|
| ▸Uin | 105.0% |
| Uout | 100.0% |

**Tab. 11-1** Italy "*Q(P)*" Mode Parameters Explanation

| Parameter | Explanation | Default | Range |
|---|---|---|---|
| PA | Active power at point A *(in %)* | 20 % | 20 %-100 % |
| PB | Active power at point B *(in %)* | 50 % | 20 %-100 % |
| PC | Active power at point C *(in %)* | 100 % | 20 %-100 % |
| Max. PF | Power factor at point C | 0.95 | 0.90-1 |
| Uin | Enter into the Q(P) regulation mode when the grid voltage is above Uin | 105 % | 100 %-110 % |
| Uout | Exit from the Q(P) regulation mode when the grid voltage is below Uout | 100 % | 90 %-100 % |

* PA < PB≤ PC, Uin > Uout

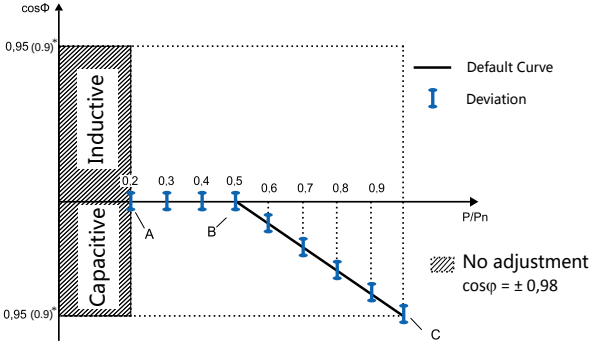



**Fig. 11-1** Reactive Power Regulation Curve in "IT" Q(P) Mode

* The maximum PF depends on the total rated power of the system. The Max. PF is 0.95 by default for a system not greater than 11.08 kW. Set it to 0.9 if the system capacity is beyond 11.08 kW.

### 11.3.2 Country Brazil (“BRA”)

The PF of the inverter output varies in response to the output power of the inverter.

| | |
|---|---|
| Leading PF | 1.000 |
| Lagging PF | 0.950 |
| Upper Power | 100.0% |
| Lower Power | 50.0% |

| | |
|---|---|
| Uin | 104.0% |
| Uout | 100.0% |

### 11.3.3 Countries except "IT" and “BRA”

The PF of the inverter output varies in response to the output power of the inverter.

| | |
|---|---|
| Leading PF | 1.000 |
| Lagging PF | 0.900 |
| Upper Power | 100.0% |
| Lower Power | 50.0% |

The *Q(P)* parameter setting via LCD menu is only available for countries “BRA”, “AU” and “NZ”. For other countries, please set the *Q(P)* parameters via the iSolarCloud App or the iSolarCloud server.

**Tab. 11-2** “*Q(P)*” Mode Parameter Explanations

| Parameter | Explanation | Default | Range |
|---|---|---|---|
| Leading PF | Power factor of the lower power point | 1.000 | 0.900–1.000 |
| Lagging PF | Power factor of the upper power point | 0.900 | 0.900–1.000 |
| Lower Power* | Lower limit of the output power (in %) | 50 % | 0–50 % |
| Upper Power* | Upper limit of the output power (in %) | 100 % | 50 %–100 % |

*Lower Power <Upper Power

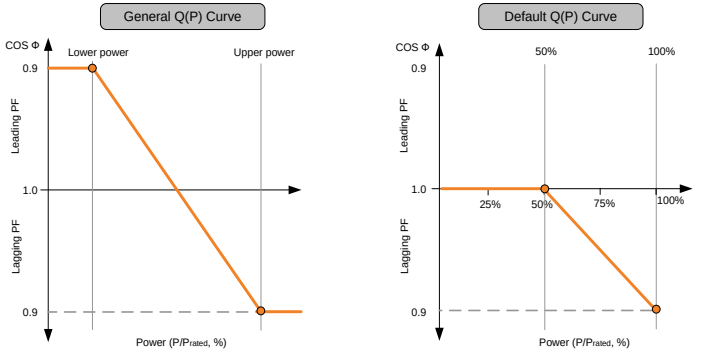



**Fig. 11-2** Reactive Power Regulation Curve in Q(P) Mode

# 11.4 "*Q(U)*" Mode

## 11.4.1 Country Italy ("IT")

Define the response curve with four grid voltages. The reactive power output of the inverter will vary in response to the grid voltage.

The *Q(U)* parameters can only be set via the iSolarCloud App or the iSolarCloud server.

**Tab. 11-3** Italy "*Q(U)*" Mode Parameters Explanation

| Parameter | Explanation | Default | Range |
|---|---|---|---|
| V2i* | Grid voltage at point A (in %) | 90 % | 90 %...110 % |
| V1i* | Grid voltage at point B (in %) | 92 % | 90 %...110 % |
| V1s* | Grid voltage at point C (in %) | 108 % | 90 %...110 % |
| V2s* | Grid voltage at point D (in %) | 110 % | 90 %...110 % |
| k | The ratio of the base reactive power (in %) | 10 % | 0...100 % |
| Pin** | Enter into the Q(U) regulation mode when the power is above Pin | 20 % | 20%...100% |
| Pout** | Exit from the Q(U) regulation mode when the power is below Pout | 5 % | 1 %...20 % |
| Qmax | The max. ratio of reactive power (in %) | 32.8 % | 0...60 % |

*V2i < V1i < V1s < V2s **Pin > Pout

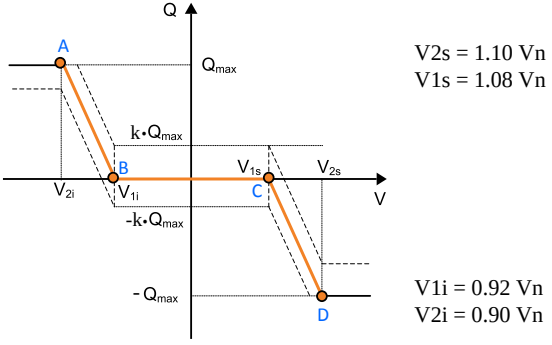
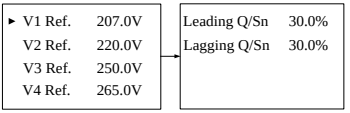



**Fig. 11-3** Reactive Power Regulation Curve in "IT" Q(U) Mode

## 11.4.2 Countries except "IT"

The reactive power output of the inverter varies in response to the grid voltage.




The Q(U) parameter setting via LCD menu is only available for countries “AU” and “NZ”. For other countries, please set the *Q(U)* parameters via the iSolarCloud App or the iSolarCloud server.

**Tab. 11-4** “Q(U)” Parameter Explanation

| Parameter | Description |
|---|---|
| V1 Ref. | Grid voltage limit (in %) of point P1 in the Q(U) mode curve |
| V2 Ref. | Grid voltage limit (in %) of point P2 in the Q(U) mode curve |
| V3 Ref. | Grid voltage limit (in %) of point P3 in the Q(U) mode curve |
| V4 Ref. | Grid voltage limit (in %) of point P4 in the Q(U) mode curve |
| Leading Q/Sn | Leading Q/Sn value of point P1 in the Q(U) mode curve |
| Lagging Q/Sn | Lagging Q/Sn value of point P4 in the Q(U) mode curve |
| Hysteresis* | Hysteresis voltage width (in %) |

* V2 Ref. + Hysteresis < V3 Ref. Hysteresis

**Tab. 11-5** Q(U)” Mode Parameter Value and Range (AU, NZ)

| Parameter | Default | | Range |
|---|---|---|---|
| | AU | NZ | |
| V1 Ref. | 207.0 V | 207.0 V | Not applicable |
| V2 Ref. | 220.0 V | 220.0 V | 216 V–230 V |
| V3 Ref. | 250.0 V | 244.0 V | 235 V–255 V |
| V4 Ref. | 265.0 V | 255.0 V | 244 V–265 V |
| Leading Q/Sn | 30 % | 30 % | 0–60 % |
| Lagging Q/Sn | 30 % | 30 % | 0–60 % |

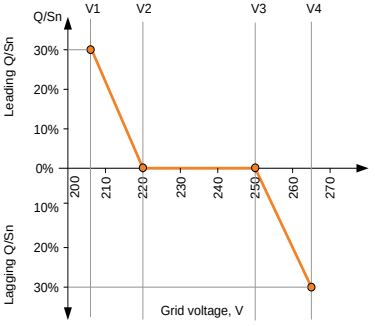



**Fig. 11-4** Reactive Power Regulation Curve in Q(U) Curve (“AU” for example)

**Tab. 11-6** "Q(U)" Mode Parameter Value and Range (DE, BE, LUX, NL)

| Parameter | Range | Default | | |
|---|---|---|---|---|
| | | DE | BE, LUX, NL | Other |
| V1 Ref. | 80 %...94 % | 93 % | 90 % | 80 % |
| V2 Ref. | 95 %...100 % | 97 % | 92 % | 95 % |
| V3 Ref. | 100 %...105 % | 103 % | 108 % | 105 % |
| V4 Ref. | 106 %...120 % | 107 % | 110 % | 115 % |
| Leading Q/Sn | 0...60 % | 60 % | 60 % | 30 % |
| Lagging Q/Sn | 0...60 % | 60 % | 60 % | 30 % |
| Hysteresis | 0...5 % | 0 % | 0 % | 3 % |

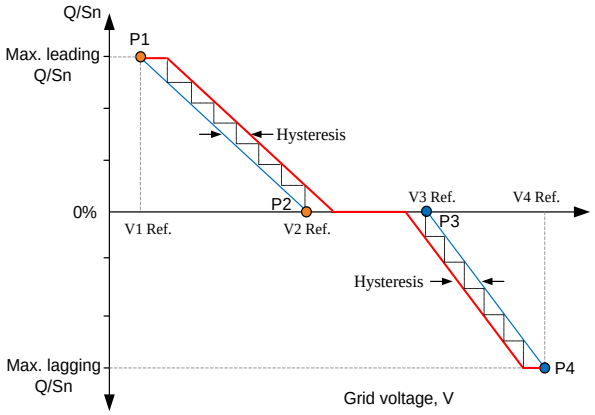
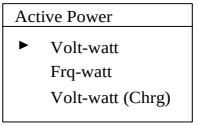



**Fig. 11-5** Reactive Power Control Curve in Q(U) Curve ("DE" for example)

# 12 Appendix III: Active Power Response

The submenu is as shown on the right.
Refer to "**10.2 LCD Menu**" for the navigation.

**Press** ▲/▼ to select the desired option and
**Press ENT** to confirm.



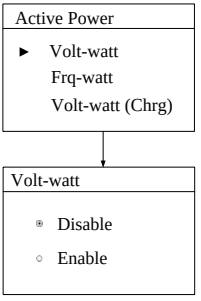

## 12.1 Volt-watt Response

### 12.1.1 Country Italy ("IT")

**Press ENT** to confirm the choice. The active power reduction function for voltage values is disabled by default.

If the function is enabled, the active power output will be reduced when the grid voltage stated on the LCD screen has a value higher than 112 % $V_n$ (nominal voltage). The charge power drawn from the grid will be at least equal to 80 % * $P_{cmax}$, within 5 minutes, where the $P_{cmax}$ is the maximum charge power of the system.

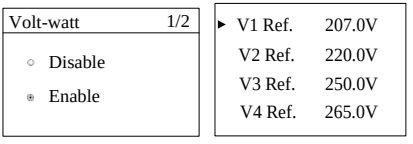
When the grid voltage falls lower than 108 % $V_n$, the inverter will response and the active power output will return then to the values consistent with the power available by the DC side.




### 12.1.2 For Countries except Italy

Only countries "AU" and "NZ" support this response mode.

The Volt-watt response mode is enabled by default. Set four grid voltage reference values. The output power of the inverter will vary in response to the grid voltages.



**Tab. 12-1** "*Volt-Watt*" Mode Parameter Explanations

| Parameter | Explanation | Default | | Range |
|---|---|---|---|---|
| | | AU | NZ | |
| V1 Ref. | Grid voltage reference value 1 | 207.0 V | 207.0 V | Not applicable |
| V2 Ref. | Grid voltage reference value 2 | 220.0 V | 220.0 V | 216 V–230 V |
| V3 Ref. | Grid voltage reference value 3 | 250.0 V | 244.0 V | 235 V–255 V |
| V4 Ref. | Grid voltage reference value 4 | 265.0 V | 255.0 V | 244 V–265 V |

The response curve is defined by the voltage reference values and corresponding power levels.

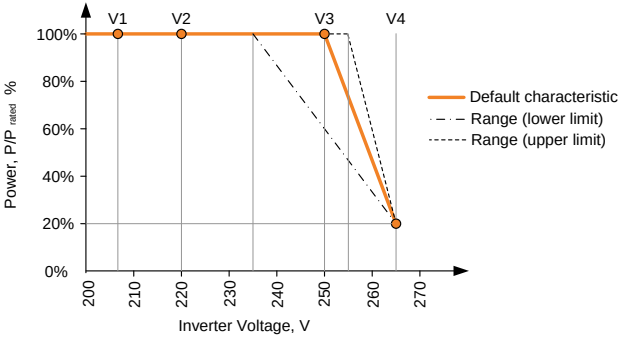
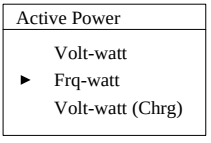



**Fig. 12-1** Volt-Watt Response Curve ("AU" for example)

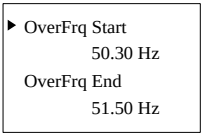
# 12.2 Frq-Watt Response

## 12.2.1 Country Italy ("IT")

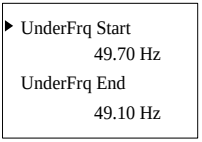
**Press** ▼ to select *Frq-watt* and **Press ENT** to confirm.



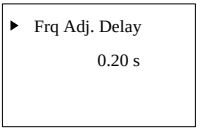

The variation of the active power generated by the system will take place for exceeding of the threshold values in the over-frequency adjustable between 50 and 52 Hz (default of 50.25 Hz).



The variation of the active power absorbed by the system will take place for exceeding of the threshold values in the under-frequency adjustable between 47 and 50 Hz (default of 49.75 Hz).




The power control of function active for transient over- and under-frequency has an activation delay can be set from 0 to 1s with 50 ms steps (default of 0.20 s).




The quadrilateral in the following figure shows the active power control in the conditions of over- and under-frequency. The area included in the central rectangular zone defines the possible points of normal operation in which the storage system may be at work and from these points the system will have to change its active power and move to the vertices of the quadrilateral according to the thresholds of over- or under-frequency (see dashed lines).

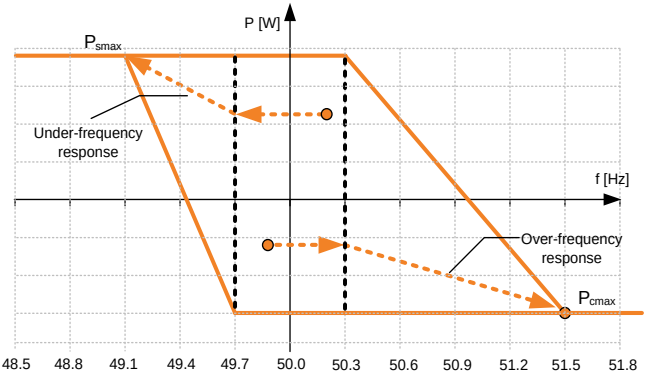



**Fig. 12-2** Control of Active Power in Conditions of Over- and under-frequency

* $P_{smax}$: the maximum discharge power; $P_{cmax}$: the maximum charge power

When the grid frequency returns back to 50 ± 0.1 Hz (default setting) for a minimum continuous time of 300 s, the system will end the frequency response and return to its ordinary operation linearly with a transitional time not less than 300 s, as shown in the figure below.

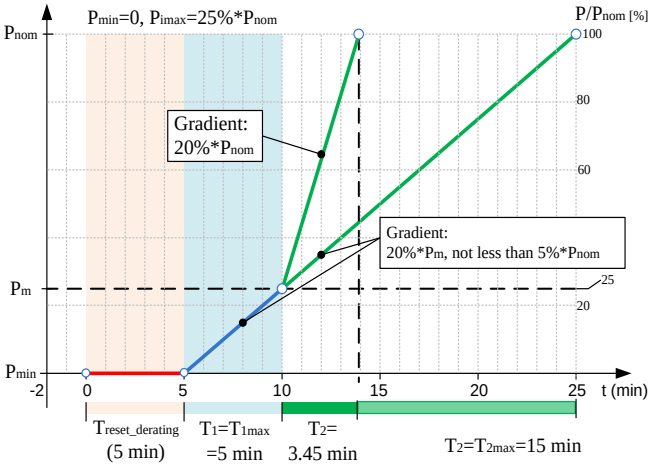



**Fig. 12-3** Power Restoration in Condition of Transient Over-frequency

- Pm : active power delivered instantly exceeded 50.3 Hz (setting value)
- Pnom : nominal power of the hybrid inverter
- Pmin : minimum power obtained during the transient over-frequency

## 12.2.2 For Countries except Italy

**Tab. 12-2** Description of Frq-watt Parameters

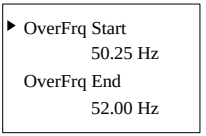
| Parameter | Description |
|---|---|
| OverFrq Start | The Start frequency value for over-frequency response |
| OverFrq End | The Stop frequency value for over-frequency response |
| UnderFrq Start | The Start frequency value for under-frequency response |
| UnderFrq End | The Stop frequency value for under-frequency response |

**Tab. 12-3** Default Values of Frq-watt Parameters

| Parameter | 50 Hz | | 60 Hz | | AT, DE, NL, BE, LUX |
|---|---|---|---|---|---|
| | Default | Range | Default | Range | |
| OverFrq Start (Hz) | 50.25 | 50.00 – 55.00 | 60.50 | 60.00 – 65.00 | 50.20 |
| OverFrq End (Hz) | 52.00 | 50.00 – 55.00 | 62.00 | 60.00 – 65.00 | 51.50 |
| UnderFrq Start (Hz) | 49.75 | 45.00 – 50.00 | 59.75 | 55.00 – 60.00 | 49.75 |
| UnderFrq End (Hz) | 49.00 | 45.00 – 50.00 | 59.00 | 55.00 – 60.00 | 49.00 |

### Response to an increase in grid frequency:

When there is an increase in grid frequency which exceeds the Start value (*50.25 Hz*), the inverter will reduce the power output linearly with an increase of frequency until the End value (*52.00 Hz*) is reached.
When the frequency exceeds the End value, the inverter output shall be ceased (i.e. 0 W).




The output power will remain at or below the lowest power level reached in response to an over-frequency event between 50.25 Hz and 52 Hz. This is to provide hysteresis in the control of the inverter.

When the grid frequency has decreased back to 50.15 Hz or less for at least 60 s, the power level will be increased at a rate no greater than the power ramp rate limit, which can be set according to "**10.4.8 Setting the Protective Parameters**".

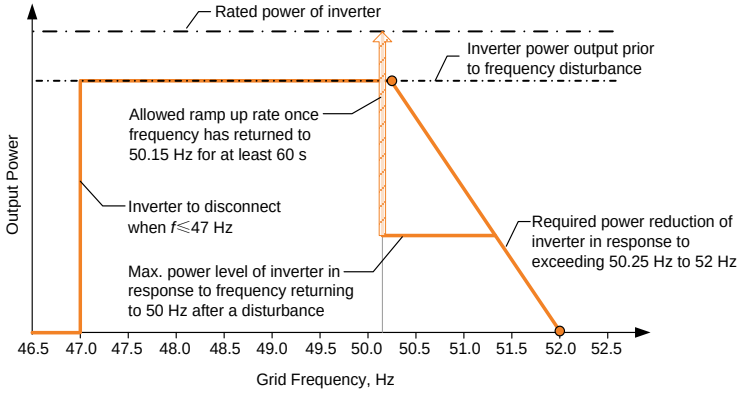
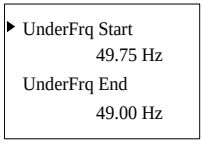



**Fig. 12-4** Frq-Watt Mode for Over-frequency Conditions

### Response to a decrease in grid frequency:

Only countries "AU" and "NZ" support this response mode.

When there is a decrease in grid frequency which falls below the Start value (*49.75 Hz*), the inverter will reduce the sinking power from the grid linearly with a decrease of frequency until the End value (*49.00 Hz*) is reached.
When the frequency falls below the End value, the inverter should have ceased sinking power from the grid (i.e. 0 W).



The import power for charging the storage system will remain at or below the lowest charge rate reached in response to a low-frequency event between 49 Hz and 49.75 Hz. This is to provide hysteresis in the control of the inverter.

When the grid frequency has increased back to 49.85 Hz or more for at least 60 s, the charge rate of the storage system may be increased at a rate no greater than the power ramp rate limit, which can be set according to "**10.4.8 Setting the Protective Parameters**".

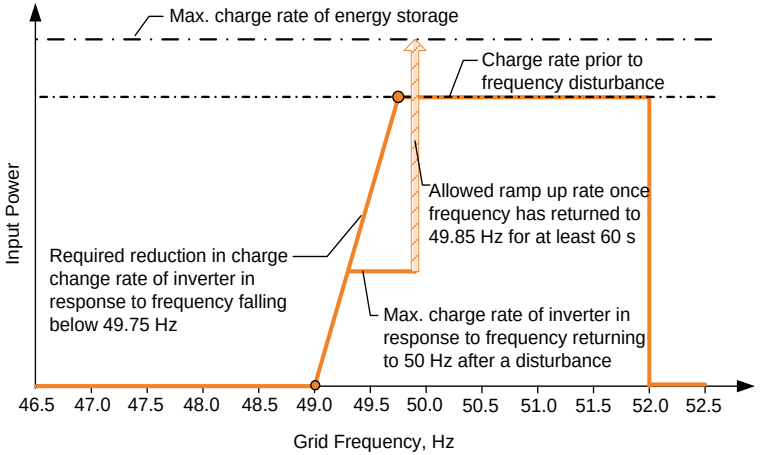


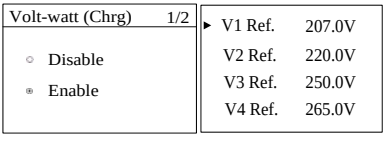

**Fig. 12-5** Frq-Watt Mode for Under-frequency Conditions

## 12.3 Volt-watt Response (Charging)

Only countries "AU" and "NZ" support this response mode.

When the power from the grid is required to charge the energy storage system, the import power from the grid varies in response to the grid voltages. The response curve is defined by the voltage reference values and the corresponding power consumption from the grid for charging energy storage.

The Volt-watt response mode for battery charging is enabled by default.
Set four grid voltage reference values. The output power of the inverter will vary in response to the grid voltages. Refer to **Tab. 12-1** for the parameter explanations and ranges.



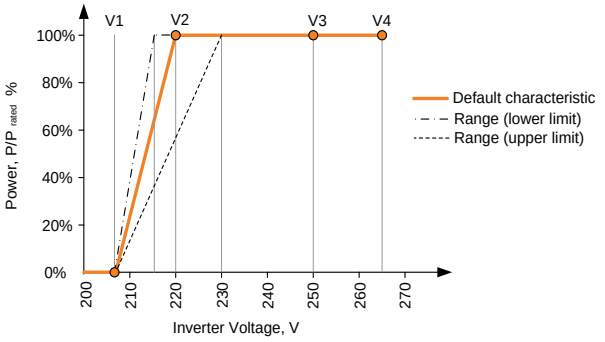



**Fig. 12-6** Vtg-Watt Response Mode for Battery Charging Curve (“AU” for example)

# 13 Appendix IV: Technical Data

## 13.1 Inverter

| **PV Input Data** | **SH3K6-30** | **SH4K6-30** | **SH5K-30** |
|---|---|---|---|
| Max. PV input power | 6600 W | | |
| Max. PV input voltage | 600 V | | |
| Startup voltage | 125 V | | |
| Nominal input voltage | 350 V | | |
| MPP voltage range | 125 V–560 V | | |
| MPP voltage range for nominal power | 180 V–520 V | 220 V–520 V | 240 V–520 V |
| No. of MPPTs | 2 | | |
| Max. number of PV strings per MPPT | 1/1 | | |
| Max. PV input current | 11 A / 11 A | | |
| Max. current for input connector | 12 A / 12 A | | |
| Short circuit current of PV input | 12 A / 12 A | | |
| Max. inverter backfeed current to strings | 0 A | | |
| **Battery Data** | | | |
| Battery type | Li-ion battery / Lead-acid battery | | |
| Battery voltage | 48 V (32 V–70 V) | | |
| Max. charge / discharge current | 65 A / 65 A | | |
| **AC Input and Output Data** | | | |
| Nominal AC output power | 3680 W | 4600 W | 5000 W (5) |
| Max. AC output apparent power | 3680 VA | 4600 VA | 5000 VA (5) |
| Nominal AC output current | 16.7 A (1) | 20.9 A (3) | 22.7 A (6) |
| Max. AC output current | 16.7 A (1) | 20.9 A (3) | 22.7 A (6) |
| Max. AC input power | 6680 W | 7600 W | 8000 W |
| Max. AC input current | 30.4 A (2) | 34.5 A (4) | 36.4 A (7) |
| Max. inrush current (peak/duration) | 10 A / 12 ms | 10 A / 12 ms | 10 A / 12 ms |
| Max. output fault current (peak/duration) | 100 A / 3.2 ms | 100 A / 3.2 ms | 100 A / 3.2 ms |
| Max. output over-current protection | 40 A | 45 A | 45 A |
| Nominal AC voltage | 220 Vac / 230 Vac / 240 Vac | | |
| AC voltage range | 176 Vac–276 Vac (this may vary with grid standards) | | |
| Nominal grid frequency | 50 Hz / 60 Hz | | |

| | | | |
|---|---|---|---|
| Grid frequency range | 45 Hz–55 Hz / 55 Hz–65 Hz<br>(this may vary with grid standards) | | |
| Total Harmonic Distortion (THD) | < 3 % (of nominal power) | | |
| DC current injection | < 0.5 % (of nominal current) | | |
| Power factor | > 0.99 at default value at nominal power<br>(adj. 0.8 overexcited/leading–0.8 underexcited/lagging) | | |
| **Protection** | | | |
| Anti-islanding protection | Yes | | |
| AC short circuit protection | Yes | | |
| Leakage current protection | Yes | | |
| DC fuse (battery) | Yes | | |
| DC switch (solar) | Yes | | Optional |
| Over-voltage category | III [Main], II [PV] [Battery] | | |
| **System Data** | | | |
| Max. efficiency | 97.70 % | | |
| European efficiency | 96.80 % | 97.00 % | 97.10 % |
| Max. charge / discharge efficiency | 94.00 % | | |
| Isolation method (solar) | Transformerless | | |
| Isolation method (battery) | HF | | |
| Ingress protection (IP) rating | IP65 | | |
| Pollution degree outside/inside the enclosure | 3 / 2 | | |
| Operating ambient temperature range | -25℃ to 60℃ (> 45℃ derating) | | |
| Allowable relative humidity range | 0% – 100 % | | |
| Cooling method | Natural convection | | |
| Max. operating altitude | 2000 m | | |
| Display | Graphic LCD | | |
| Communication | 2 x RS485, Ethernet, Wi-Fi, CAN | | |
| Power management | 1 x Digital output | | |
| Earth fault alarm | email, buzzer inside | | |
| DC connection type | MC4 | | |
| AC connection type | Clamping yoke connector | | |

| | | | |
|---|---|---|---|
| Certification | VDE-AR-N-4105, DIN VDE0126-1-1, G98, G99, CEI 0-21, IEC 62109-1, IEC62109-2, EN 62477-1, EN 61000-6-1/-3 | | AS4777, IEC 62109-1, IEC 62109-2, IEC 62477-1, IEC 62040-1, EN 61000-6-1/-3, NRS 097-2-1:2017, ABNT NBR 16149: 2013, ABNT NBR 16150: 2013 |
| **Mechanical Data** | | | |
| Dimensions (W x H x D) | 457 mm x 515 mm x 170 mm | | |
| Mounting method | Wall-mounting bracket | | |
| Weight | 22 kg | | |
| **Backup Data** | | | |
| Nominal voltage | 220Vac/230Vac/240Vac (±2%) | | |
| Total harmonic factor output | 2 % (full resistive load) | | |
| Frequency range | 50 Hz / 60 Hz(±0.2 %) | | |
| Switch time to emergency mode | < 20 ms | | |
| Power factor | 0.8 overexcited/leading to 0.8 underexcited/lagging | | |
| Backup nominal AC output power | 3000 W/ 3000 VA | | |
| Max. output power | 3680 W / 3680 VA | 4600 W / 4600 VA | 5000 W / 5000 VA |
| Max. output power (battery) | 3000 W / 3000 VA | | |
| Peak output power, duration | 6000 VA, 10s | | |

## 13.2 Energy Meter

| Item | Single-phase | Three-phase |
|---|---|---|
| Nominal voltage | 240 Vac | 230 Vac / 400 Vac |
| Input voltage range | 180 Vac–286 Vac | 180 Vac–276 Vac |
| Power consumption | < 2 W (10 VA) | < 2 W (10 VA) |
| Max. operating current | 100 A | 65 A |
| Grid frequency | 50 Hz / 60 Hz | |
| Measurement accuracy | Class I | |
| Interface and communication | RS485 | |
| Ingress protection rating | IP20 | |
| Operating ambient temperature | -25℃ to 75℃ | -25℃ to 70℃ |

| | | |
|---|---|---|
| Relative humidity | 0–95 % | |
| Mounting method | 35 mm DIN-rail | |
| Dimensions (W x H x D) | 18 x 117 x 65 (mm) | 85 x 72 x 72 (mm) |
| Weight | 0.2 kg | 0.4 kg |

(1) Nominal / Max. AC output current of SH3K6 (G98): 16 A.

(2) Max. AC input current from grid of SH3K6 (G99): 29 A.

(3) Nominal / Max. AC output current of SH4K6 (VDE 4105): 20 A.

(4) Max. AC input current from grid of SH4K6 (VDE 4105): 33 A.

(5) Nominal AC output power to grid of SH5K-30 (AS4777): 4990 W.
Max. AC output apparent power to grid of SH5K-30 (AS4777): 4990 VA.

(6) Nominal / Max. AC output current of SH5K-30 (AS4777): 21.7 A.

(7) Max. AC input current from grid of SH5K-30 (AS4777): 34.8 A.

## 13.3 Quality Assurance

When product faults occur during the warranty period, SUNGROW will provide free service or replace the product with a new one.

### Evidence

During the warranty period, the customer shall provide the product purchase invoice and date. In addition, the trademark on the product shall be undamaged and legible. Otherwise, SUNGROW has the right to refuse to honor the quality guarantee.

### Conditions

- After replacement, unqualified products shall be processed by SUNGROW.
- The customer shall give SUNGROW a reasonable period to repair the faulty device.

### Exclusion of Liability

In the following circumstances, SUNGROW has the right to refuse to honor the quality guarantee:

- If the free warranty period for the whole machine/components have expired.
- If the device is damaged during transport.
- If the device was incorrectly installed, refitted, or used.
- If the device is operated in a very improper environment, as described in this manual.

- If the fault or damage was caused by installation, repairs, modification, or disassembly performed by a service provider or personnel other than this company.
- If the fault or damage was caused by the use of non-standard or non-SUNGROW components or software.
- If the installation and use range are beyond stipulations of relevant international standards.
- If the damage was caused by an abnormal natural environment.

For faulty products in any of above cases, if the customer requests maintenance, paid maintenance service may be provided based on the judgment of SUNGROW.

### Software Licenses

- It is prohibited to use data contained in firmware or software developed by SUNGROW, in part or in full, for commercial purposes by any means.
- It is prohibited to reverse engineer, crack, or perform any other operations that compromise the original program design of the software developed by SUNGROW.

### Contact Information

Should you have any question about this product, please contact us.

We need the following information to provide you the best assistance:

- Type of the inverter
- Serial number of the inverter
- Error code/name
- Brief description of the problem

| | |
|---|---|
| China (HQ) | Australia |
| Sungrow Power Supply Co., Ltd | Sungrow Australia Group Pty. Ltd. |
| Hefei | Sydney |
| +86 551 65327834 | +61 2 9922 1522 |
| service@sungrowpower.com | service@sungrowpower.com.au |

| | |
|---|---|
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| Germany<br>Sungrow Deutschland GmbH<br>München<br>+49 89 324 914 761<br>service.germany@sungrow.co | Greece<br>Service Partner – Survey Digital<br>+30 2106044212<br>service.greece@sungrow.co |
| India<br>Sungrow (India) Private Limited<br>Gurgaon<br>+91 080 41201350<br>service@in.sungrowpower.com | Italy<br>Sungrow Italy<br>Milano<br>service.italy@sungrow.co |
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| Romania<br>Service Partner - Elerex<br>+40 241762250<br>service.romania@sungrow.co | Turkey<br>Sungrow Deutschland GmbH Turkey Istanbul Representative Bureau<br>Istanbul<br>+90 212 731 8883<br>service.turkey@sungrow.co |
| UK<br>Sungrow Power UK Ltd.<br>Milton Keynes<br>+44 (0) 0908 414127<br>service.uk@sungrow.co | U.S.A, Mexico<br>Sungrow USA Corporation<br>Phoenix Arizona<br>+1 833 747 6937<br>techsupport@sungrow-na.com |
| Vietnam<br>Sungrow Vietnam<br>Hanoi<br>+84 918 402 140<br>service@vn.sungrowpower.com | - |