



Solis RHI Series Hybrid Inverter

(RHI-3P(3-10)K-HVES-5G) **Instruction Manual**

Ver 1.5

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Please adhere to the actual products in case of any discrepancies in this user manual.
If you encounter any problem on the inverter, please find out the inverter S/N
and contact us, we will try to respond to your question ASAP.



Ginlong Technologies Co., Ltd.

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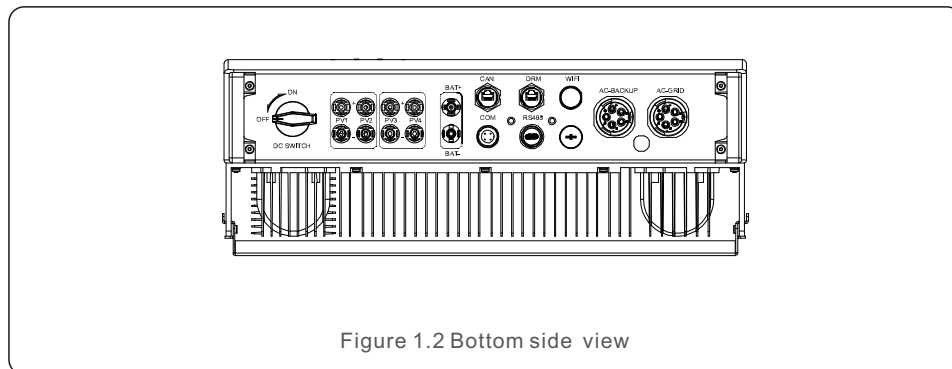
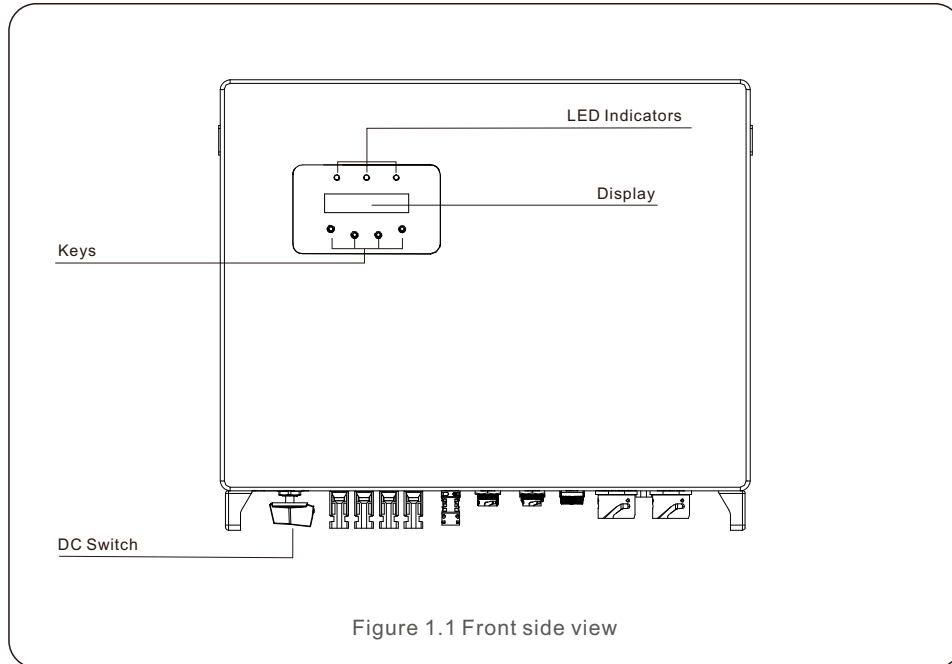
1. Introduction

1.1 Product Description

The Solis RHI series is designed for residential hybrid systems, which can work with batteries to optimize self-consumption. The unit can operate in both off- and on-grid modes.

The Solis RHI series has 6 different models:

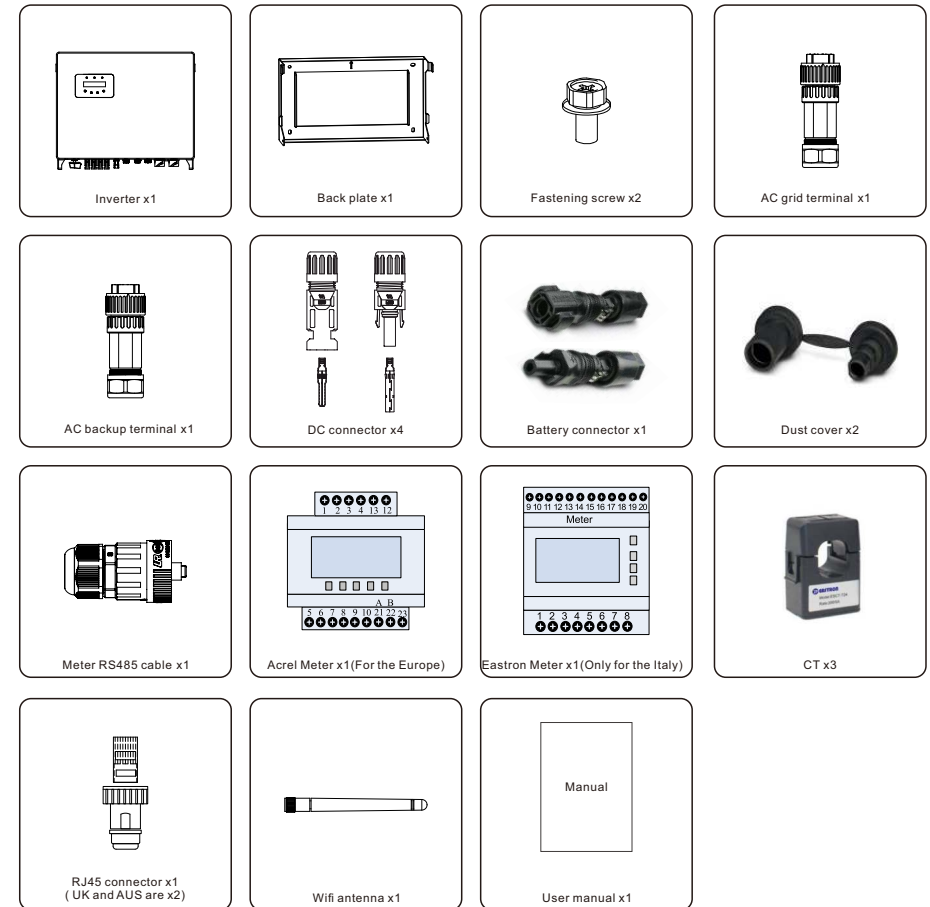
RHI-3P3K-HVES-5G, RHI-3P4K-HVES-5G, RHI-3P5K-HVES-5G, RHI-3P6K-HVES-5G, RHI-3P8K-HVES-5G, RHI-3P10K-HVES-5G



1. Introduction

1.2 Packaging

Please ensure that the following items are included in the packaging with your machine:



If anything is missing, please contact your local Solis distributor.

2. Safety & Warning

2.1 Safety

The following types of safety instructions and general information appear in this document as described below:



DANGER:

“Danger” indicates a hazardous situation which if not avoided, will result in death or serious injury.



WARNING:

“Warning” indicates a hazardous situation which if not avoided, could result in death or serious injury.



CAUTION:

“Caution” indicates a hazardous situation which if not avoided, could result in minor or moderate injury.



NOTE:

“Note” provides tips that are valuable for the optimal operation of your product.

2.2 General Safety Instructions



WARNING:

Only devices in compliance with SELV (EN 69050) may be connected to the RS485 and USB interfaces.



WARNING:

Please don't connect PV array positive (+) or negative (-) to ground, it could cause serious damage to the inverter.



WARNING:

Electrical installations must be done in accordance with the local and national electrical safety standards.



WARNING:

Do not touch any inner live parts until 5 minutes after disconnection from the utility grid and the PV input.

2. Safety & Warning



WARNING:

To reduce the risk of fire, over-current protective devices (OCPD) are required for circuits connected to the inverter. The DC OCPD shall be installed per local requirements. All photovoltaic source and output circuit conductors shall have isolators that comply with the NEC Article 690, Part II. All Solis single phase inverters feature an integrated DC switch.



CAUTION:

Risk of electric shock, do not remove cover. There is no user serviceable parts inside, refer servicing to qualified and accredited service technicians.



CAUTION:

The PV array supplies a DC voltage when they are exposed to sunlight.



CAUTION:

Risk of electric shock from energy stored in capacitors of the Inverter, do not remove cover for 5 minutes after disconnecting all power sources (service technician only). Warranty may be voided if the cover is removed without authorization.



CAUTION:

The surface temperature of the inverter can reach up to 75°C (167 F). To avoid risk of burns, do not touch the surface of the inverter while it's operating. Inverter must be installed out of the reach of children.



NOTE:

PV module used with inverter must have an IEC 61730 Class A rating.



WARNING:

Operations below must be accomplished by licensed technician or Solis authorized person.



WARNING:

Operator must put on the technicians' gloves during the whole process in case of any electrical hazards.



WARNING:

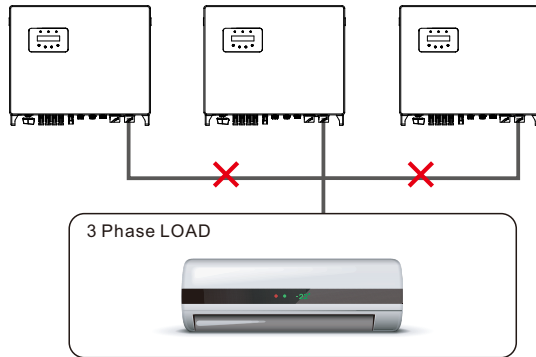
AC-BACKUP of RHI series is forbidden to connect to the grid.

2. Safety & Warning



WARNING:

The RHI series does not support parallel (three- and single-phase) operation on the AC-BACKUP port. Parallel operation of the unit will void the warranty.



WARNING:

Please refer to the specification of the battery before configuration.

2.3 Notice For Use

The inverter has been constructed according to the applicable safety and technical guidelines. Use the inverter in installations that meet the following specifications ONLY:

1. Permanent installation is required.
2. The electrical installation must meet all the applicable regulations and standards.
3. The inverter must be installed according to the instructions stated in this manual.
4. The inverter must be installed according to the correct technical specifications.

3. Overview

3.1 Screen

Solis RHI series adopts LCD screen, it displays the status, operating information and settings of the inverter.

3.2 Keypad

There are four keys in the front panel of the inverter (from left to right): ESC, UP, DOWN and ENTER keys. The keypad is used for:

- Scrolling through the displayed options (the UP and DOWN keys);
- Access and modify the settings (the ESC and ENTER keys).



Figure 3.2 Keypad

3.3 Terminal Connection

Solis RHI series inverter is different from normal on-grid inverter, please refer to the instructions below before start connection.

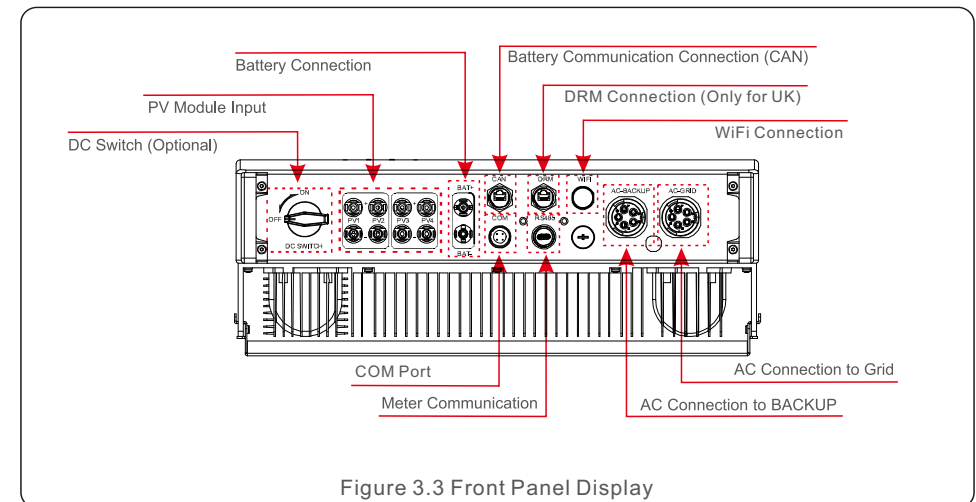


Figure 3.3 Front Panel Display



WARNING:

Please refer to the specification of the battery before configuration.

4. Installation

4.1 Select a Location for the Inverter

To select a location for the inverter, the following criteria should be considered:

- Exposure to direct sunlight may cause output power derating. It is recommended to avoid installing the inverter in direct sunlight.
- It is recommended that the inverter is installed in a cooler ambient which doesn't exceed 104F/40C.

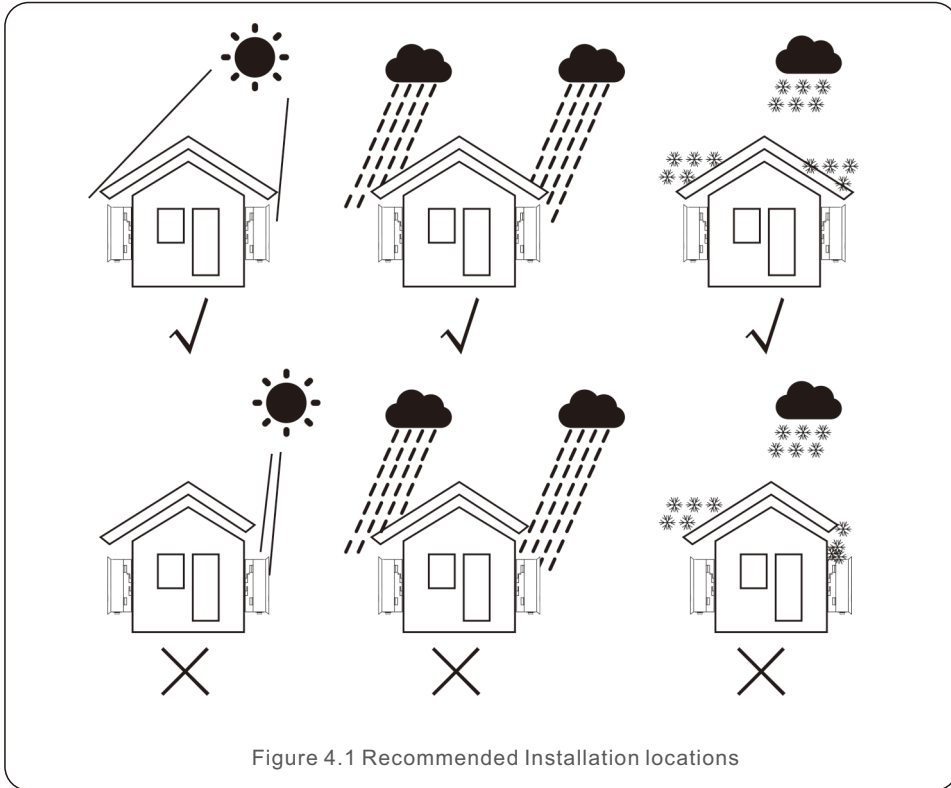


Figure 4.1 Recommended Installation locations



WARNING: Risk of fire

Despite careful construction, electrical devices can cause fires.

- Do not install the inverter in areas containing highly flammable materials or gases.
- Do not install the inverter in potentially explosive atmospheres.

4. Installation

- Install on a wall or strong structure capable of bearing the weight of the machine (24kg).
- Install vertically with a maximum incline of +/- 5 degrees, exceeding this may cause output power derating.
- To avoid overheating, always make sure the flow of air around the inverter is not blocked. A minimum clearance of 500mm should be kept between inverters or objects and 500mm clearance between the bottom of the machine and the ground.

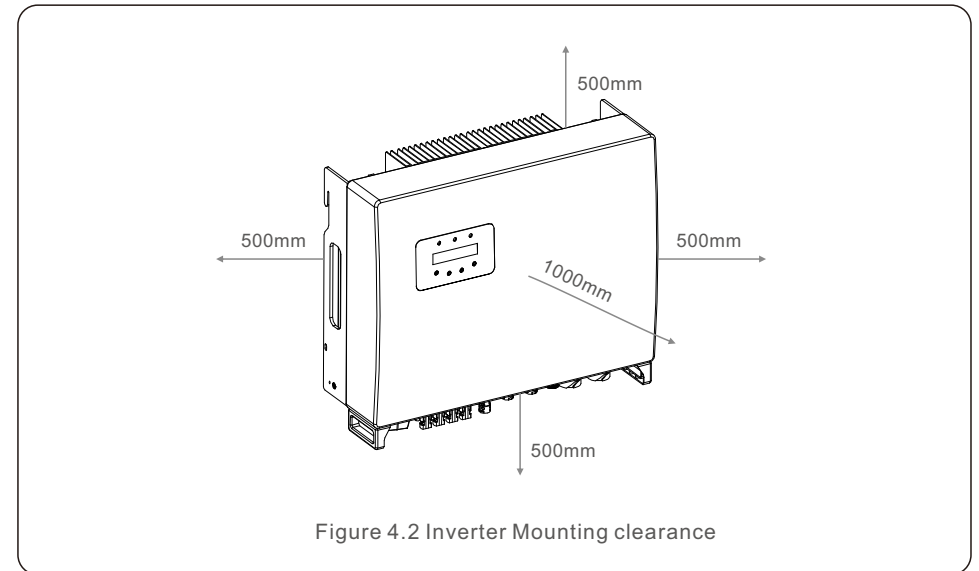


Figure 4.2 Inverter Mounting clearance

- Visibility of the LEDs and LCD should be considered.
- Adequate ventilation must be provided.



NOTE:

Nothing should be stored on or placed against the inverter.

4. Installation

4. Installation

4.2 Mounting the Inverter

Dimensions of mounting bracket:

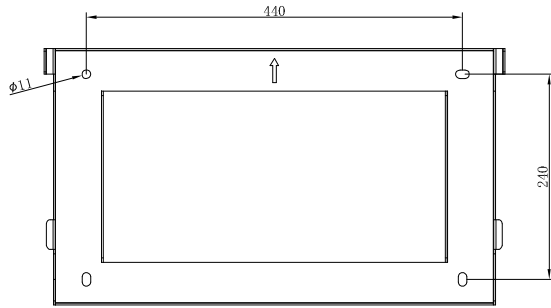


Figure 4.3 Inverter wall mounting

Once a suitable location has been found accordingly to 4.1 using figure 4.3 and figure 4.4 mount the wall bracket to the wall.

The inverter shall be mounted vertically.

The steps to mount the inverter are listed below:

1. Select the mounting height of the bracket and mark the mounting holes.
For brick walls, the position of the holes should be suitable for the expansion bolts.

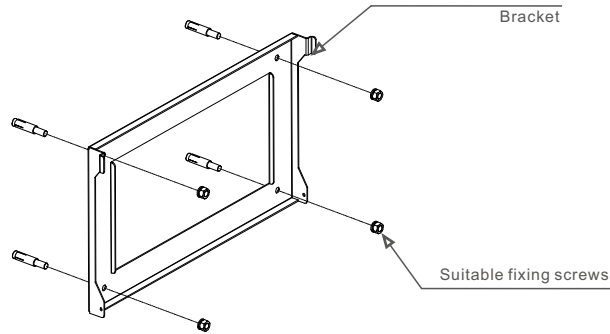


Figure 4.4 Fix bracket on the wall



WARNING:

The inverter must be mounted vertically.

2. Lift up the inverter (be careful to avoid body strain), and align the back bracket on the inverter with the convex section of the mounting bracket. Hang the inverter on the mounting bracket and make sure the inverter is secure (see Figure 4.5)

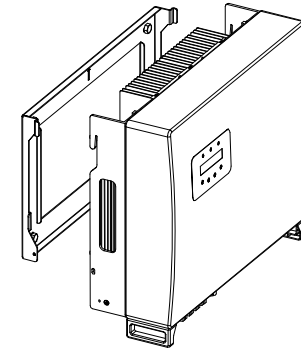


Figure 4.5 Wall Mount Bracket

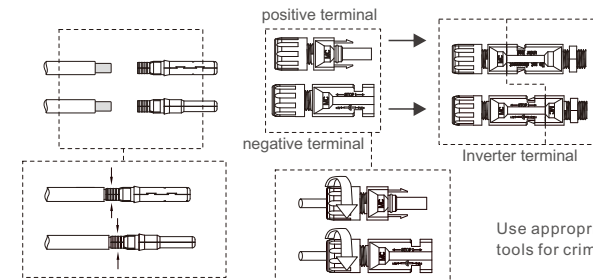
4.3 PV Input Terminal Assembly

Please ensure the following before connecting the inverter:

- Make sure the voltage of the PV string will not exceed the max DC input voltage (1000Vdc).
Violating this condition will void the warranty.
- Make sure the polarity of the PV connectors are correct.
- Make sure the DC-switch, battery, AC-BACKUP, and AC-Grid are all in their off-states.
- Make sure the PV resistance to ground is higher than 20K ohms.

The Solis RHI series inverter uses the MC4 connectors. Please follow the picture below to assemble the MC4 connectors.

PV wire cross-sectional area requirements: 2.5~4mm².



Use appropriate crimping tools for crimping

Figure 4.6

4. Installation

4.4 Battery Terminal Components

Quick connector is used for battery connection. The connector is suitable for tin-plated cables with a conductor cross section of 2.5-6mm² (AWG14-10).
 Battery cable outside diameter range: 5.5mm - 8.0mm.



NOTE:

A bladed screwdriver with a 3-mm wide blade is required to perform the connection.

- Step 1. Strip 15mm off the conductor using a suitable stripping tool for this.
- Step 2. Open the spring using a screwdriver as below. (see figure 4.7)
- Step 3. Insert the stripped wire with twisted litz wires all the way in.
 The wire ends have to be visible in the spring. And then close the spring. (see figure 4.8)
- Step 4. Push the insert into the sleeve and tighten the cable gland with 2N.m torque. (see figure 4.9)
- Step 5. Fit the connectors to the battery ports at the bottom of the inverter with correct polarity and a "click" sound. (see figure 4.10)

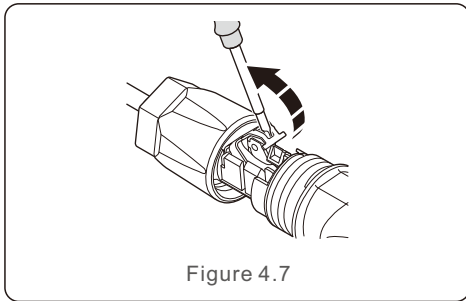


Figure 4.7

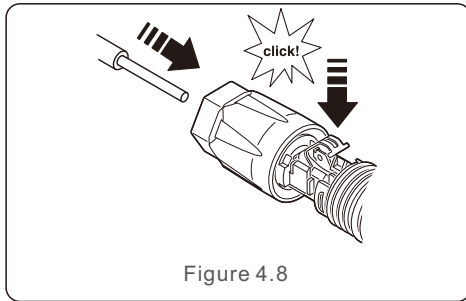


Figure 4.8

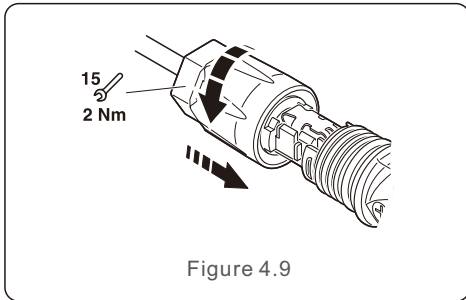


Figure 4.9

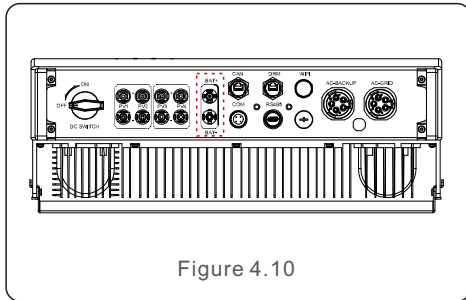


Figure 4.10

4. Installation

4.5 Assembling the AC Connector

There are two AC terminals and the assembly steps for both are the same.

Take out the AC connector parts from the packaging.

- 1. Make sure you use a cable within the correct specifications as shown in the image below.

Describe	Numerical value
Wire diameter	13~25mm
Traverse cross sectional area	6~13mm ² (10-6AWG)
Exposure Length	13mm

Table 4.1



Internal of AC connector signs "L1", "L2", "L3", "N" and "PE" five connection ports (see Figure 4.13). Three live wires are connected the "L1", "L2" and "L3" terminals respectively; ground wire connects "PE"; neutral wire connects "N" terminal:

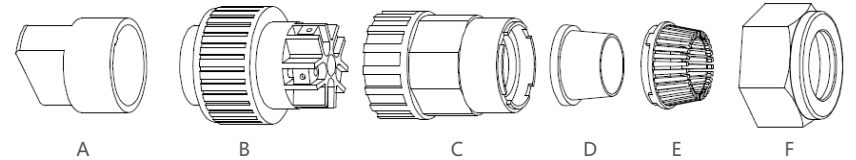


Figure 4.11 AC connector

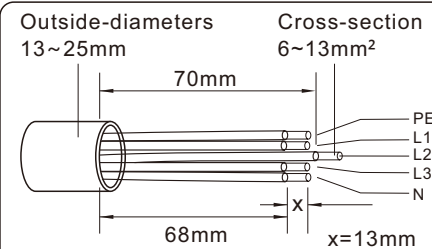


Figure 4.12 Stripped and bared wire

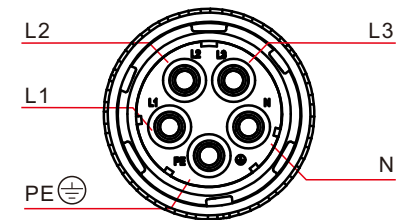


Figure 4.13 Internal structure of AC connector

4. Installation

A) Stripped the insulation sleeve of cable for 70mm, so that bared copper-cored connector reaches for 13mm. Cable through nut and sleeve of socket element, insert corresponding terminals and tighten with allen wrench (see figure 4.14). Torque is 1.5-2.5Nm.

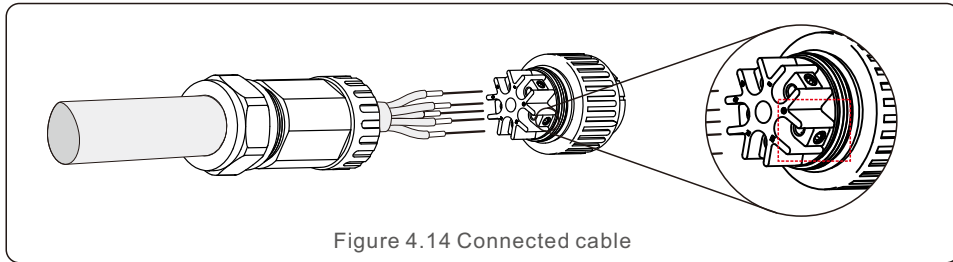


Figure 4.14 Connected cable



Tighten cable with 3 mm allen wrench (focus in dotted box, see figure 4.14). Allen screw is easy to drop off, don't screw out completely.



B) Clip plastic fixture (Auxiliary tighten) in socket element, tighten adapter in socket element, then tighten swivel nut with 2.5-4Nm torque (see figure 4.15).

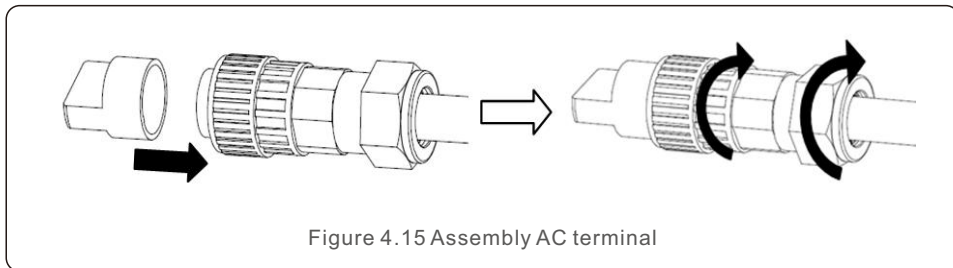


Figure 4.15 Assembly AC terminal

C) Connect AC connector with inverter, then tighten AC connector for clockwise, until hearing a slight clicking sound indicates connection succeed. (see figure 4.16)

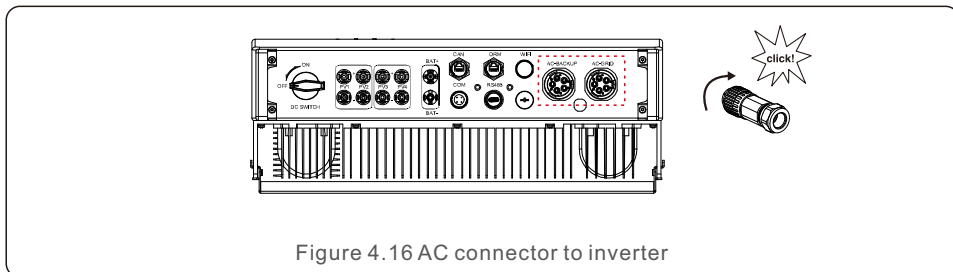


Figure 4.16 AC connector to inverter

4. Installation

4.6 Meter Installation

Solis RHI-(3-10)K-HVES-5G series inverter integrated export power control function, this function need connect a 3-Phase power meter for export power controlling.

4.6.1 Three Phase Meter Installation

Please follow below picture to install the 3-phase power meter and CT.

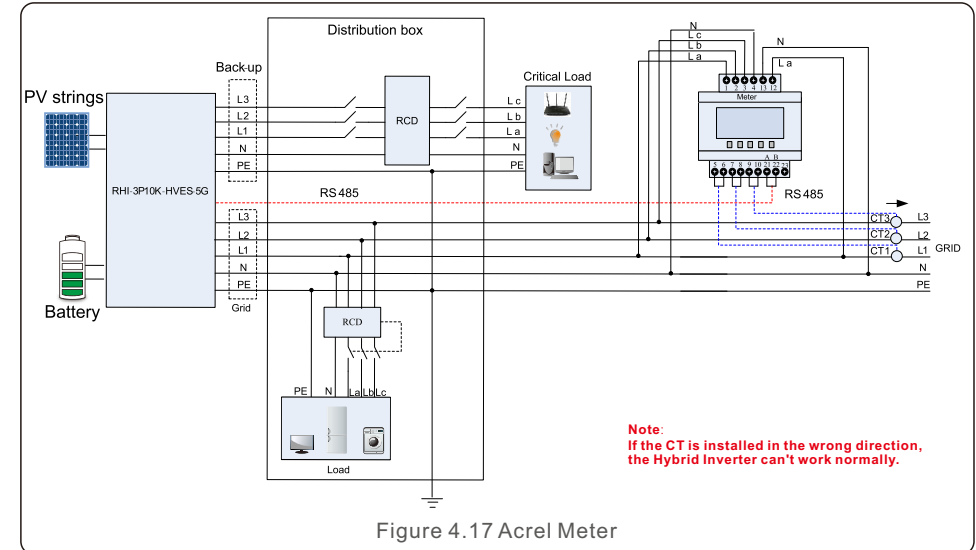


Figure 4.17 Acrel Meter

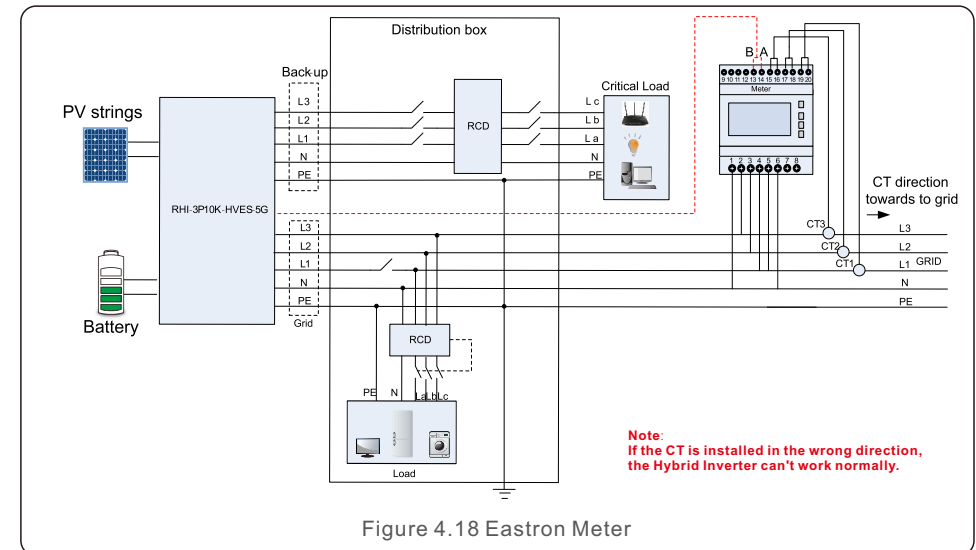


Figure 4.18 Eastron Meter

4. Installation

4.7 Communication Cable Assembly

The RHI series inverter uses RS485 cable to communicate with the Meter and CAN to communicate with the battery's BMS. The image below shows the assembly of the RS485/CAN communication cables.

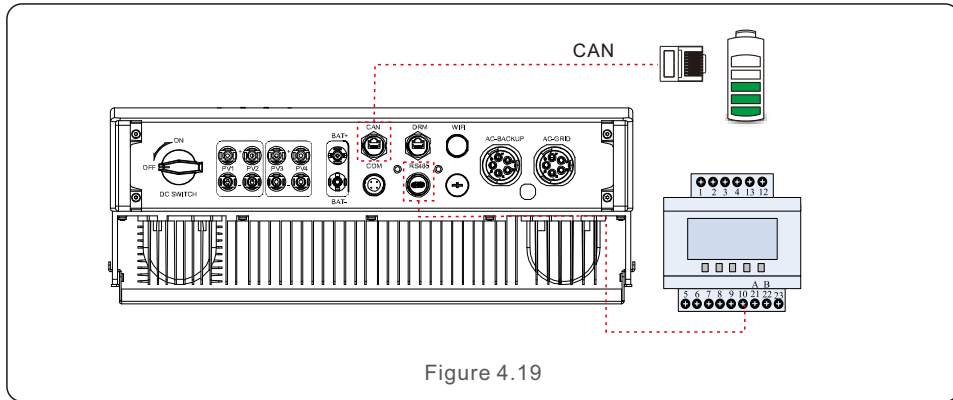


Figure 4.19



NOTE:

The CAN cable enables the communication between the inverter and the Li-ion battery, please check for latest model compatibility before installation.

Procedure for connecting the CAN cable:

1. Take out the CAN cable (terminal marks 'CAN' on one end and 'to Meter' on the other end).
2. Unscrew the swivel nut from CAN port.
3. Insert the RJ45 terminal with CAN label into the CAN port, then fasten the swivel nut.
4. Connect the other end to the battery.



NOTE:

For CAN cable pin 4 (blue) and pin 5 (white-blue) are used for the communication.

Procedure for connecting the RS485 cable:

1. Take out the RS485 cable (terminal marks 'RS485' on one end and 'to Battery' on the other end).
2. Unscrew the swivel nut from RS485 port.
3. Insert the Two-pin terminal with RS485 label into the RS485 port, then fasten the swivel nut.
4. Connect the other end to the Meter.

4. Installation

4.8 External Ground Connection

An external ground connection is provided at the right side of inverter.

Prepare OT terminals: M4. Use proper tooling to crimp the lug to the terminal.

Connect the OT terminal with ground cable to the right side of inverter. The torque is 2N.m.

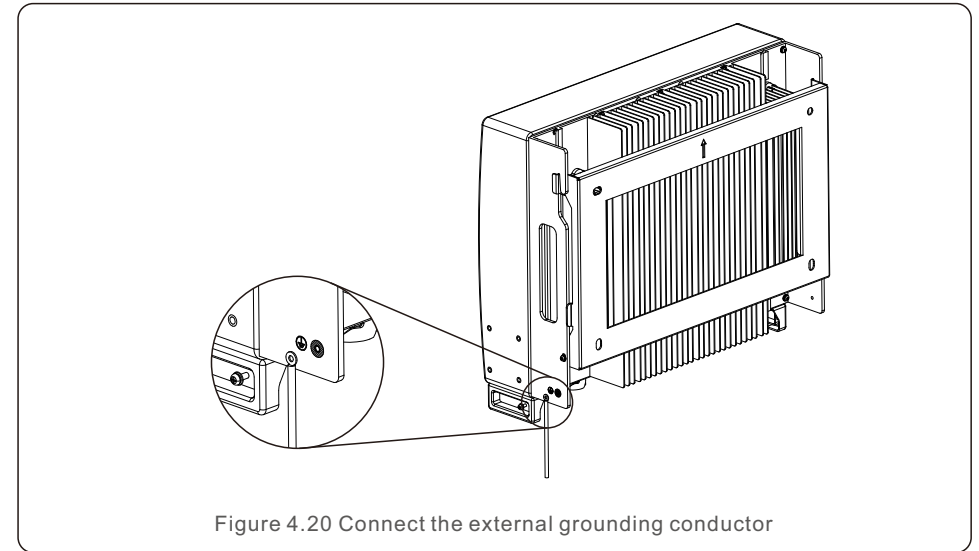


Figure 4.20 Connect the external grounding conductor

4.9 Logic Interface Connection

Logic interface is required by some local regulations that can be operated by a simple switch or contactor(Not available in South Africa).

When the switch is closed the inverter can operated normally. When the switch is opened, the inverter will reduce it's output power to zero within 5s.

Pin5 and Pin6 of RJ45 terminal is used for the logic interface connection.

Please follow below steps to assemble RJ45 connector.

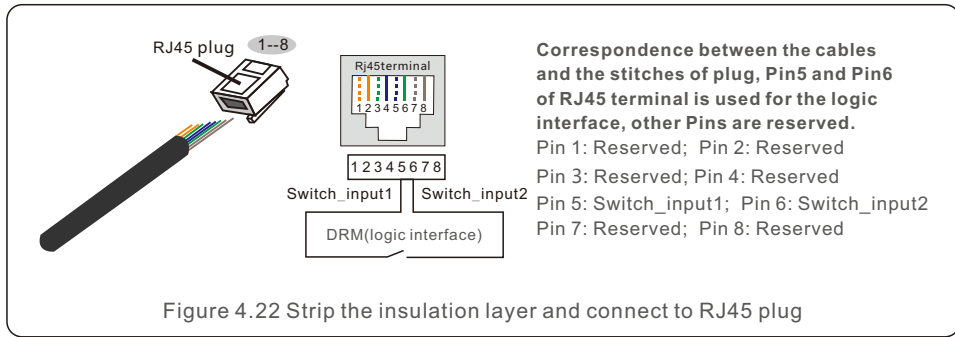
1. Insert the network cable into the communication connection terminal of RJ45.



Figure 4.21 RJ45 communication connection terminals

2. Use the network wire stripper to strip the insulation layer of the communication cable. According to the standard line sequence of figure 4.22 connect the wire to the plug of RJ45, and then use a network cable crimping tool to make it tight.

4. Installation



3.Connect RJ45 to DRM (logic interface) .

NOTE: To use this function, please contact the manufacturer.

4.10 LED Indicates

There are three LED indicators on the RHI inverter (Red, Green, and Orange) which indicate the working status of the inverter.



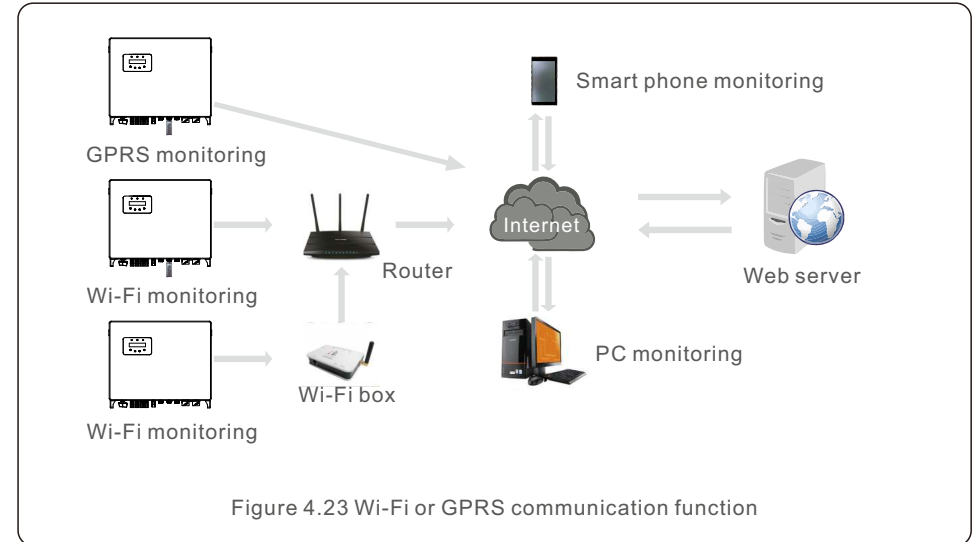
Light	Status	Description
● POWER	ON	The inverter can detect DC power.
	OFF	No DC power.
● OPERATION	ON	The inverter is fully operational.
	OFF	The inverter has stopped operating.
	FLASHING	The inverter is initializing.
● ALARM	ON	Fault condition is detected.
	OFF	No fault condition detected.
	FLASHING	Either the grid or solar cannot be detected.

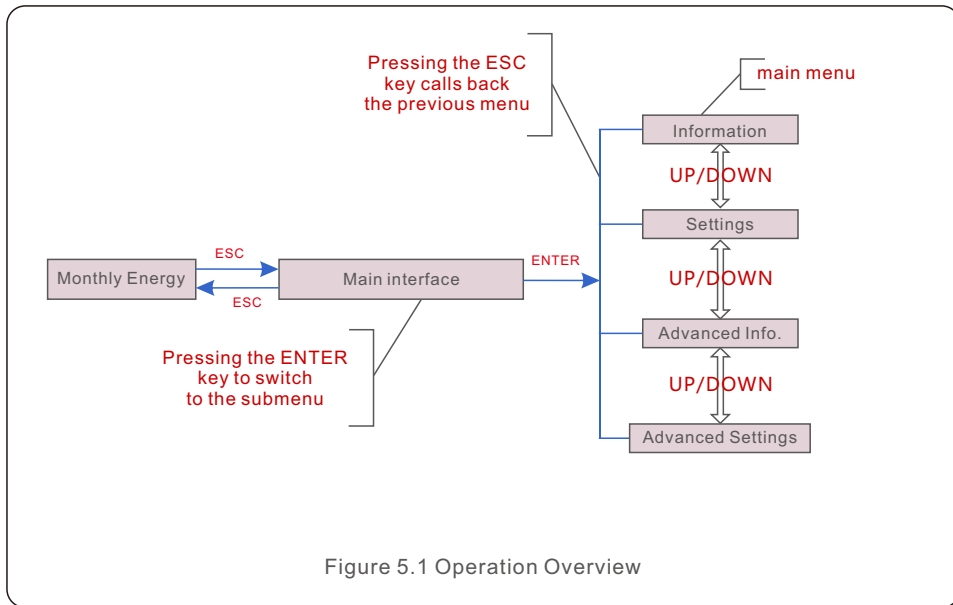
Table 4.2 Status Indicator Lights

4. Installation

4.11 Inverter Monitoring Connection

The inverter can be monitored via Wi-Fi or GPRS. All Solis communication devices are optional. For connection instructions, please refer to the Solis Monitoring Device installation manuals.





5.1 Main Menu

There are four submenu in the Main Menu (see Figure 5.1):

1. Information
2. Settings
3. Advanced Info.
4. Advanced Settings

5.2 Information

In the information section, operating data and information data can be viewed.

Sub-sections include:

1. General Info
2. System Info
3. Energy Records
4. PV Energy Records
5. BMS Info
6. Meter Info

The example displays are shown in the following figures.

Values are for reference only.

Display	Duration	Description
Inverter SN: FFFFFFFFFFFFFF	10 sec	Shows the inverter serial number.
Device: Waiting	10 sec	Shows the status of the device.
Battery: Waiting	10 sec	Shows the status of the battery.
Backup: Waiting	10 sec	Shows the status of the backup circuit.
Grid: Waiting	10 sec	Shows the status of the AC grid.
DRMNO. : 08	10 sec	Shows the DRM operating mode (Effective for UK/AUS).
Model. : 00	10 sec	Shows the model number of the device.
SoftVer. : 000000	10 sec	Shows the firmware version of the device.

Figure 5.2 General Information

Display	Duration	Description
V_DC1: 000.0V I_DC1: 000.0A	10 sec	V_DC1: Shows input 01 voltage value. I_DC1: Shows input 01 current value.
V_DC2: 000.0V I_DC2: 000.0A	10 sec	V_DC2: Shows input 02 voltage value. I_DC2: Shows input 02 current value.
V_A: 000.0V I_A: 000.0A	10 sec	V_A: Shows the grid's voltage value. I_A: Shows the grid's current value.
V_B: 000.0V I_B: 000.0A	10 sec	V_B: Shows the grid's voltage value. I_B: Shows the grid's current value.
V_C: 000.0V I_C: 000.0A	10 sec	V_C: Shows the grid's voltage value. I_C: Shows the grid's current value.
Grid Frequency 00.00Hz	10 sec	Shows the grid's frequency value.
Battery V: 000.0V Battery I: 000.0A	10 sec	Battery V: Shows the battery voltage. Battery I: Shows the battery current.
Backup V: 000.0V Backup P: 00.0kW	10 sec	Backup V: Shows the voltage of the backup port Backup P: Shows the power of the backup port.
Charge P: 00.0kW DisCharge P: 00.0kW	10 sec	Charge P: Shows the battery charging power. Discharge P: Shows the battery discharging power.

Figure 5.3 System Information

Display	Duration	Description
BattChgE Total: 0000000kWh	10 sec	Shows the total battery charged energy.
BattChgE Today: 000.0kWh	10 sec	Shows today's battery charged energy.
BattChgE Lastday: 000.0kWh	10 sec	Shows yesterday's battery charged energy.

Figure 5.4 Energy Records

Display	Duration	Description
PV E Total: 0000000kWh	10 sec	Shows the total PV generation.
PV E Today: 000.0kWh	10 sec	Shows today's PV generation.
PV E Lastday: 000.0kWh	10 sec	Shows yesterday's PV generation.
PV E ThisMonth: 0000000kWh	10 sec	Shows PV generation of this month.
PV E LastMonth: 0000000kWh	10 sec	Shows PV generation of last month.
PV E Thisyear: 0000000kWh	10 sec	Shows PV generation of this year.
PV E Lastyear: 0000000kWh	10 sec	Shows PV generation of last year.

Figure 5.5 PV Energy Records

Display	Duration	Description
Battery V: 000.0V Battery I: +00.0A	10 sec	Battery V: Shows battery voltage(From BMS). Battery I: Shows battery current(From BMS).
ChargeLmt: 000.0A DischargeLmt: 000.0A	10 sec	ChargeLmt: Shows battery charge current limit(From BMS). DischargeLmt: Shows battery discharge current limit(From BMS).
ChargeVLmt: 000.0V DischargeVLmt: 000.0V	10 sec	ChargeVLmt: Shows battery charge voltage limit(From BMS) DischargeVLmt: Shows battery discharge voltage limit(From BMS).
SOC Value: 000.0% SOH Value: 000.0%	10 sec	SOC value: Shows battery state of charge. SOH value: Shows battery state of health..
BMS Status: CAN Fail	10 sec	Shows that Battery BMS communication status.

Figure 5.6 BMS Information

Display	Duration	Description
PhaseA Power: +000000W	10 sec	Shows phase A power on the meter.
PhaseB Power: +000000W	10 sec	Shows phase B power on the meter.
PhaseC Power: +000000W	10 sec	Shows phase C power on the meter.
Meter Energy: 0000000.00kWh	10 sec	Shows the energy record on the meter.
Output Energy: 0000000.00kWh	10 sec	Shows the export energy record on the meter.
Input Energy: 0000000.00kWh	10 sec	Shows the import energy record on the meter.
Meter Status: RS485 Fail	10 sec	Shows meter communication status.

Figure 5.7 Meter Information

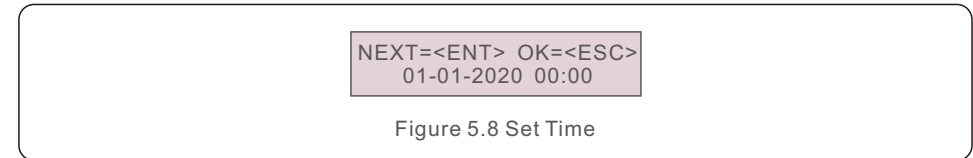
5.3 Settings

The following submenus are displayed when the Settings menu is selected:

1. Set Time/Date
2. Set Address

5.3.1 Set Time/Date

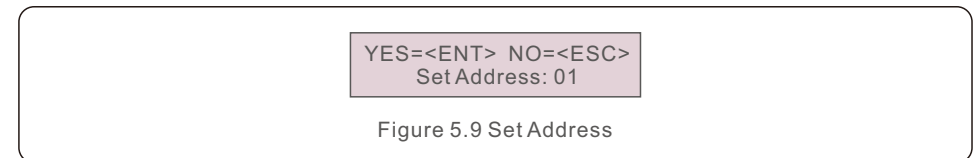
This function allows time and date setting. When this function is selected, the LCD will display a screen as shown in Figure 5.8.



Press the UP/DOWN keys to set time and data. Press the ENTER key to move from one digit to the next (from left to right). Press the ESC key to save the settings and return to the previous menu.

5.3.2 Set Address

This function is used to set the address when muti inverters are connected to three monitor. The address number can be assigned from "01" to "99". The default address is "01".



Press the UP/DOWN keys to set the address. Press the ENTER key to save the settings. Press the ESC key to cancel the change and return to the previous menu.

5. Operation

5.4 Advanced Information



NOTE:

To access to this area is for fully qualified and accredited technicians only. Enter menu "Advanced Info."(Password "0010").

Select "Advanced Info." from the Main Menu. The screen will require the password as below:

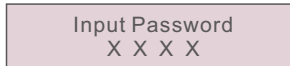


Figure 5.10 Enter password

After enter the correct password the Main Menu will display a screen and be able to access to the following information.

- 1. Alarm Message
- 2. Warning Message
- 3. Running Status
- 4. Communication Data
- 5. Yield Profile

The screen can be scrolled manually by pressing the UP/DOWN keys. Pressing the ENTER key gives access to a submenu. Press the ESC key to return to the Main Menu.

5.4.1 Alarm Message

The display shows the 100 latest alarm messages. Screens can be scrolled manually by pressing the UP/ DOWN keys. Press the ESC key to return to the previous menu.



Figure 5.11 Alarm Message

5. Operation

5.4.2 Warning Message

The display shows the 100 latest warn messages. Screens can be scrolled manually by pressing the UP/ DOWN keys. Press the ESC key to return to the previous menu.



Figure 5.12 Warning Message

5.4.3 Running Status

This function is for maintenance person to get running message such as internal temperature, Standard NO. etc. (Values are for reference only).

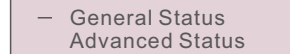


Figure 5.13 Running Status

Display	Duration	Description
DC Bus Voltage: 000.0V	10 sec	Shows DC bus voltage.
Power Factor: +00.0	10 sec	Shows power factor of the inverter.
Power Limit%: 000%	10 sec	Shows the power output percentage of the inverter.
Inverter Temp: +000.0degC	10 sec	Shows internal IGBT temperature of the inverter.
Grid Standard:	10 sec	Shows current effective grid standard.
Flash State: 00000000	10 sec	Reserved for Solis Technicians

Figure 5.14 General Status



NOTE:

The advanced status is reserved for Solis technicians.

5. Operation

5.4.4 Communication Data

The screen shows the internal data of the Inverter, which is for service technicians only.

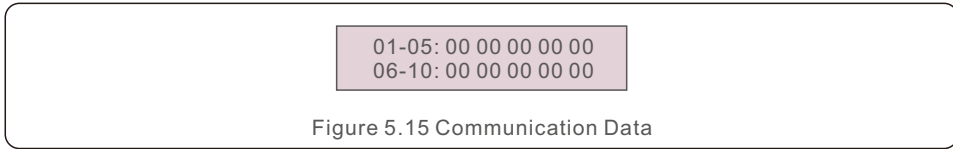


Figure 5.15 Communication Data

5.4.5 Yield Profile

The yield profile includes: Energy Battery, Energy Grid and Energy Backup.
All the historical energy generation records can be easily viewed in this section.

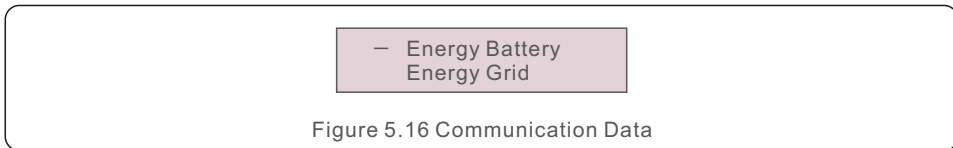


Figure 5.16 Communication Data

5. Operation

5.5 Advanced Settings



NOTE:

To access to this area is for fully qualified and accredited technicians only.
Enter menu "Advanced settings" (Password "0010").

Select "Advanced Settings." from the Main Menu.
The screen will require the password as below:

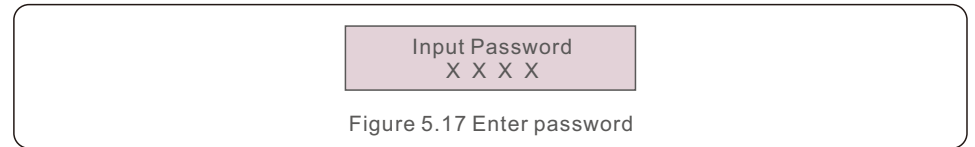


Figure 5.17 Enter password

Select Advanced Settings from the Main Menu to access the following options:

1. **Select Standard**
2. **Grid Switches**
3. **Battery Control**
4. **Backup Control**
5. **Storage Energy Set**
6. **STD. Mode Settings**
7. **Software Update**
8. **Export Power Set**
9. **Reset Password**
10. **Restart HMI**
11. **Self Test CEI 0-21**
12. **Compensation Set**

5.5.1 Selecting Standard

This function is used to select the grid's reference standard.

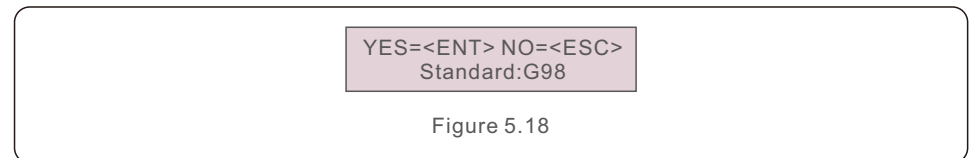


Figure 5.18

Press the UP/DOWN keys to select the standard (G98, G99, VDE4015, EN50549L, CEI021, AS4777-15, NRS097, User-Def, etc).

Press the ENTER key to confirm the setting.

Press the ESC key to cancel changes and returns to previous menu.



NOTE

For different countries, the grid standard needs to be set as different according to local requirements. If there is any doubt, please consult Solis service technicians for details.

5. Operation

5.5.2 Grid Switches

This function is used to start or stop the generation of the inverter.

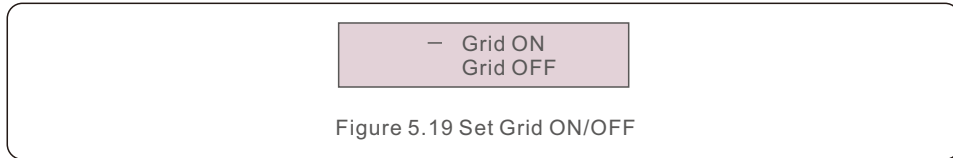


Figure 5.19 Set Grid ON/OFF

Screens can be scrolled manually by pressing the UP/DOWN keys.

Press the ENTER key to save the setting.

Press the ESC key to return to the previous menu.

5.5.3 Battery Control

This section is used to select the corresponding battery and set the battery wakeup function.

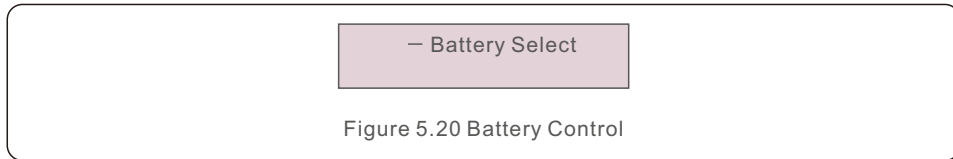


Figure 5.20 Battery Control

5.5.3.1 Battery Select

This product is compatible with the following battery modules:

Brand	Model	Setting
Pylontech	H48074(CEI 0-21)/H48050(CEI 0-21)/ Force H1(CEI 0-21)/Force H2(CEI 0-21)	Select "Pylon"
AOBOET	Uhome-LFP 2400/ 5000 Battery	Select "AoBo"
Soluna	Soluna 10K Pack HV/Soluna 15K Pack HV	Select "Soluna"

If hybrid inverter is not connected to a battery, then select "No Battery" to avoid alarms.

For above compatible battery modules, Only two parameters need to be defined:

* OverDischg SOC (10%~40%, default 20%)

--Inverter will not discharge the battery when the OverDischg SOC is reached.

Battery self-discharge is unavoidable, SOC may go lower than the limit if the battery can't get charged for a long period of time.

5. Operation

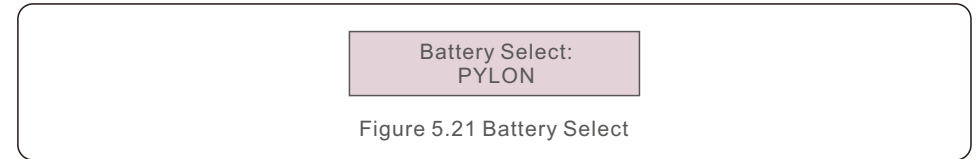


Figure 5.21 Battery Select

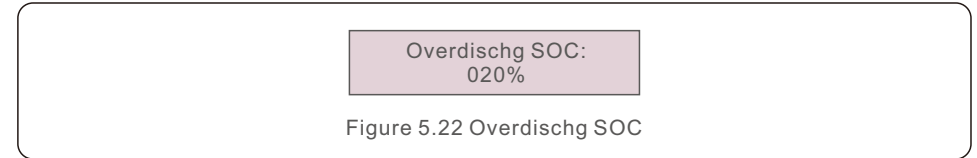


Figure 5.22 Overdischg SOC

5.5.4 Backup Control

This section is used to set the configuration of the backup port.

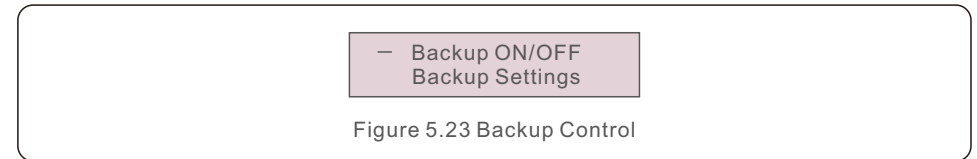


Figure 5.23 Backup Control

5.5.4.1 Backup ON/OFF

This switch can enable/disable the electrical connection of the backup port.

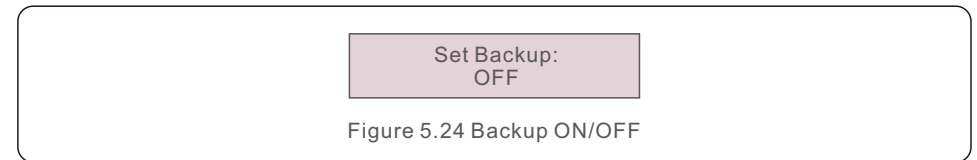


Figure 5.24 Backup ON/OFF

5.5.4.2 Backup Settings

This section shows the parameter of the backup port.

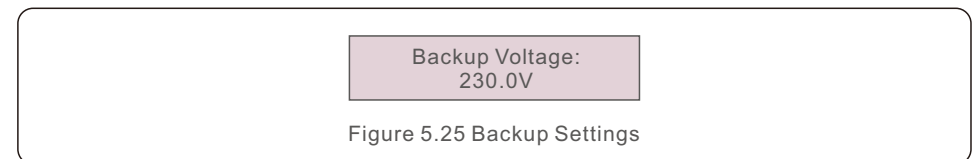


Figure 5.25 Backup Settings

5.5.5 Storage Energy Set

There are two settings available in this section: Meter select and Storage Mode Select.

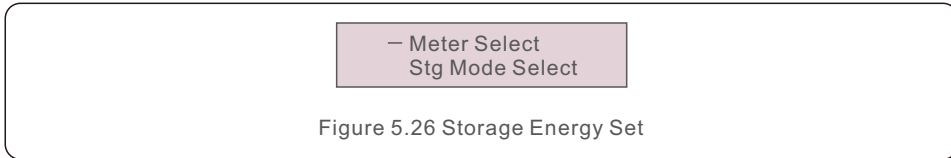


Figure 5.26 Storage Energy Set

5.5.5.1 Meter Select

The setting is used to select the meter type based on the actual configuration.

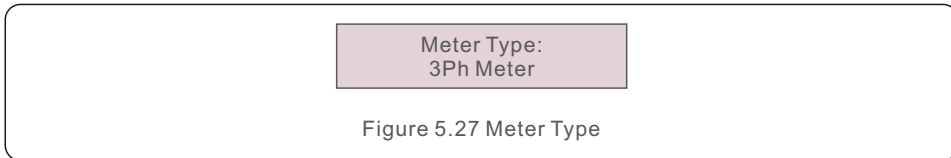


Figure 5.27 Meter Type

5.5.5.2 Storage Mode Select

There are two optional modes:

1. Time Charging
2. Off-grid Mode

The default mode is called "AUTO" mode (which is not shown and can not be selected). The "AUTO" mode logic is: Store excess PV energy into the battery and then use it to support loads instead of exporting to the grid. (Maximize system self-consumption rate). To change back to the default mode, simply set all the other modes as OFF.

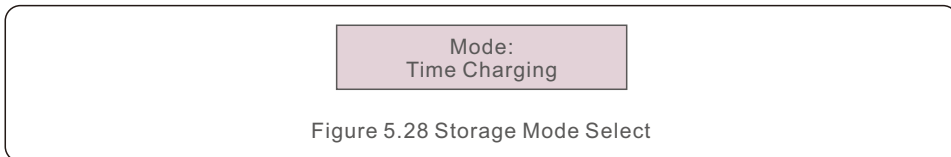


Figure 5.28 Storage Mode Select

Time Charging Mode:

"Optimal Income" is the switch to turn on/off the Time Charging Mode.

Customer can define the charge/discharge current as well as when to charge/discharge the battery.

Display	Duration	Description
Time-of-Use: Run	10 sec	Turn ON/OFF the mode
Charge Limit: 010.0A	10 sec	Set the charge current limit
Discharge Limit: 010.0A	10 sec	Set the discharge current limit
Charge Time: 00:00 - 00:00	10 sec	Define the charge time
Discharge Time: 00:00 - 00:00	10 sec	Define the discharge time
Chg Total Time: 00:00	10 sec	Define the total charge time

Figure 5.29 Time Charging Mode

Off Grid Mode:

Enable the mode for off-grid systems.

The AC Grid Port must be physically disconnected.

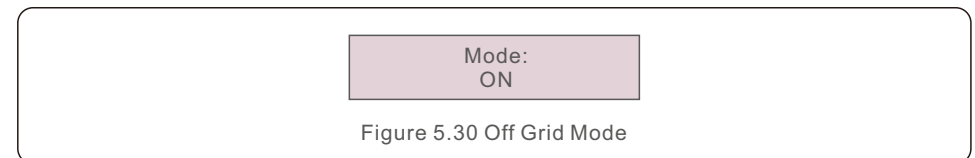


Figure 5.30 Off Grid Mode

5. Operation

5.5.6 STD.Mode Settings

These settings are reserved for maintenance personnel and technicians. Do not change anything without instructions.

Selecting "STD Mode. Settings" displays the sub-menu shown below:

1. Working Mode Set
2. Power Rate Limit
3. Freq. Derate Set
4. 10mins Voltage Set
5. 3Tau Settings
6. Initial Settings

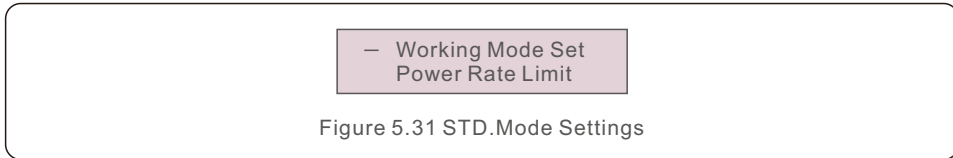


Figure 5.31 STD.Mode Settings

5.5.7 Software Update

The software update includes the HMI and DSP. Corresponding firmware version can be checked in this setting. Press "ENT" to enter the upgrading mode.

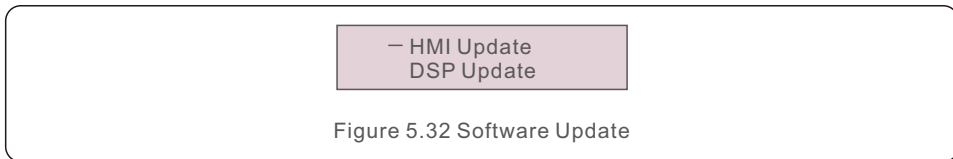


Figure 5.32 Software Update

5.5.8 Export power Set

This function is to set the export power control.

1. **EPM ON/OFF** 2. **Backflow Power** 3. **Failsafe ON/OFF**

Setting 2 and 3 are only valid when Setting 1 is set to "ON".

5.5.8.1 EPM ON/OFF

Enable/Disable the function.

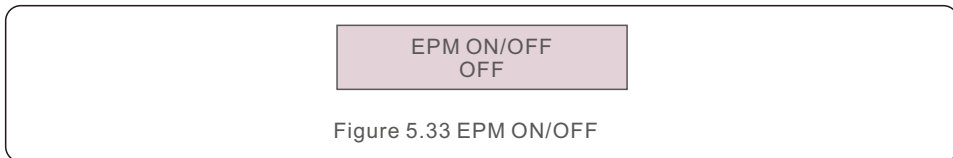


Figure 5.33 EPM ON/OFF

5. Operation

5.5.8.2 Backflow Power

Determine the allowed backfeed power. (System export to the grid)

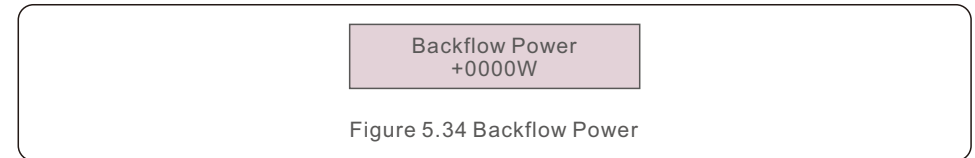


Figure 5.34 Backflow Power

5.5.8.3 FailSafe ON/OFF

When this Failsafe function is ON, the inverter will shutdown once it loses communication with the meter in case of any backflow power exceeds the limit.

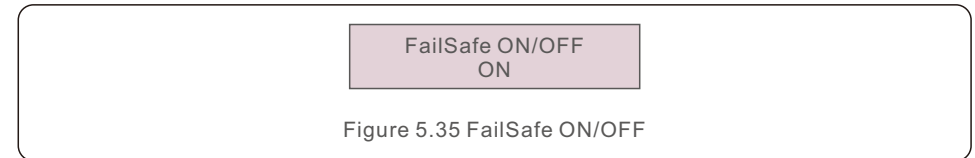


Figure 5.35 FailSafe ON/OFF

5.5.9 Reset Password

Reset Password: In this menu, user can reset the inverter password, but the admin password is always valid.

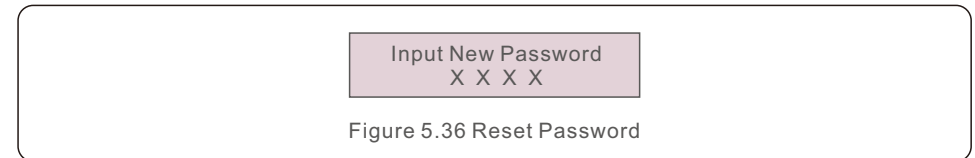


Figure 5.36 Reset Password

5.5.10 Restart HMI

This function is to reboot the LCD screen.

5.5.11 Self Test CEI 0-21

This function is only available when Italian standard CEI021 is selected.

5.5.12 Compensation Set

This function is used to calibrate inverter output energy and voltage.
Two sections are included: Power Parameter and Voltage Parameter.

– Power Parameter
Voltage Parameter

Figure 5.37 Compensation Set

YES=<ENT> NO=<ESC>
Power Para.:1.000

Figure 5.38 Power Parameter

– Vg-A-Zero:+0.0
Vg-B-Zero:+0.0

Figure 5.39 Voltage Parameter

5.6 AFCI function

Inverters have the built-in AFCI function which can detect the arc fault on the DC circuit and shut down the inverter to prevent a fire disaster.

5.6.1 Enable the AFCI function

The AFCI function can be enabled in the following.

Path: Advanced Setting -> Password: 0010 ->Special Settings -> AFCI Set -> AFCI ON/OFF -> ON

→ AFCI ON/OFF
AFCI Level

→ ON
OFF

Figure 5.40 Enable AFCI function



NOTE:

If you find your inverters's user interface is different from what's in the fast installation guide, please contact after-sales engineer or technical support.



WARNING:

The "AFCI Level" is reserved for technicians ONLY. Do not change the sensitivity otherwise it will lead to frequent false alarms or malfunctions. Manufacturer is not responsible for any further damages caused by unauthorized modifications.



WARNING:

The setting corresponds to the current status as well which can be used to inspect the ON/OFF state of the AFCI function.

5.6.2 AFCI function

During the normal operation, if an DC arc is detected, the inverter will shut down and give out the following alarm:

ARC-FAULT
Restart Press ESC 3s

Figure 5.41 Arc Fault

Installer needs to thoroughly inspect the DC circuit to ensure all the cables are correctly fastened.

Once the DC circuit issue has been fixed or it is confirmed to be OK, press "ESC" for 3s and wait for the inverter to restart.

6. Commissioning

6.1 Preparation of Commissioning

- Ensure all the devices are accessible for operation, maintenance and service.
- Check and confirm that the inverter is firmly installed.
- Space for ventilation is sufficient for one inverter or multiple inverters.
- Nothing is left on the top of the inverter or battery module.
- Inverter and accessories are correctly connected.
- Cables are routed in safe place or protected against mechanical damage.
- Warning signs and labels are suitably affixed and durable.

6.2 Commissioning Procedure

If all the items mentioned above meet the requirements, proceed as follows to start up the inverter for the first time.

1. Turn on inverter DC switch
2. Turn on battery breaker or battery switch button on the battery.
3. Select the grid standard code.
4. Configure the parameters.
5. Switch on AC backup and AC grid.
6. Verify inverter initializing.

6.3 Shutdown procedure

1. Turn off the AC isolator at the grid connection point.
2. Turn off the DC switch of the inverter.
3. Turn off the DC switch between inverter and battery.
4. Waiting for the LCD of inverter to turn off and the system shutdown is completed.

7. Troubleshooting

Solis RHI Series inverter does not require any regular maintenance. However, cleaning the heatsink will help inverter dissipating heat and increase the lifetime of inverter. The dirt on the inverter can be cleaned with a soft brush.



CAUTION:

Do not touch the surface when the inverter is operating. Some parts may be hot and cause burns. Turn OFF the inverter (refer to Section 6.2) and let it cool down before you do any maintenance or cleaning of inverter.

The LCD and the LED status indicator lights can be cleaned with cloth if they are too dirty to be read.



Note:

Never use any solvents, abrasives or corrosive materials to clean the inverter.

The inverter has been designed in accordance with international grid tied standards for safety, and electromagnetic compatibility requirements.

Before delivering to the customer the inverter has been subjected to several test to ensure its optimal operation and reliability.

In case of a failure the LCD screen will display an alarm message.

In this case the inverter may stop feeding energy into the grid.

The alarm descriptions and their corresponding alarm messages are listed in Table 7.1:

7. Troubleshooting

When faults occur, the "Fault" state will be shown on the main screen.

Follow the steps below to check what fault occurs.

Steps: Enter → Down → Advanced Information → Enter → Alarm Message.

Step1: Press ENTER.

Step2: Press DOWN to select Advanced Information, then press ENTER.

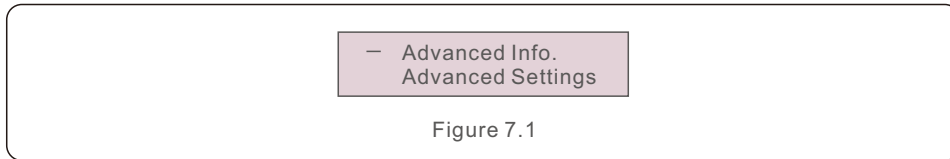


Figure 7.1

Step3: Enter password.

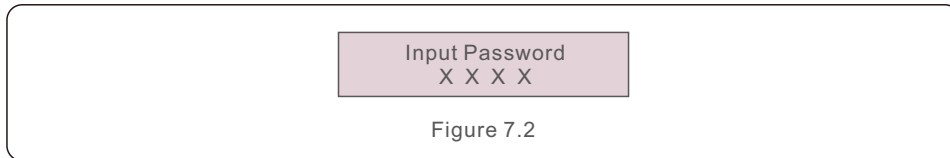


Figure 7.2

Step3: Press DOWN to select Alarm Message, then press ENTER.

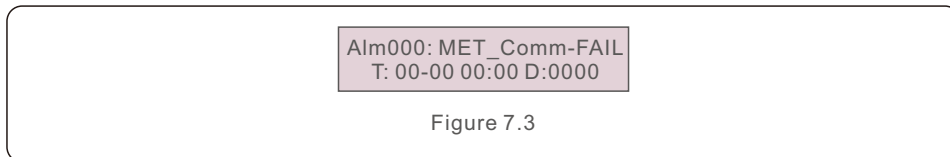


Figure 7.3

7. Troubleshooting

Alarm Message	Failure description	Solution
ARC-FAULT	ARC detected in DC circuit	1. Check if there's arc in PV connection and restart inverter.
AFCI Check FAULT	AFCI module self check fault	1. Restart inverter or contact installer.
DCinj-FAULT	High DC injection current	1. Restart inverter or contact installer.
DSP-B-FAULT	Comm. failure between main and slave DSP	1. Restart inverter or contact installer.
DC-INTF	DC input overcurrent	1. Restart inverter. 2. Identify and remove the string to the fault MPPT. 3. Change power board.
G-IMP	High grid impedance	1. Use user define function to adjust the protection limit if it's allowed by electrical company.
GRID-INTF01/02	Grid interference	1. Restart inverter. 2. Change power board.
IGBT-OV-I	Over IGBT current	1. Restart inverter or contact installer.
IGFOL-F	Grid current tracking fail	
IG-AD	Grid current sampling fail	
lLeak-PRO 01/02/03/04	leakage current protection	1. Check AC and DC connection. 2. Check inverter inside cable connection.
INI-FAULT	Initialization system fault	1. Restart inverter or contact installer.
LCD show initializing all the time	Can not start-up	1. Check if the connector on main board or power board are fixed. 2. Check if the DSP connector to power board are fixed.
NO-Battery	Unconnected battery	1. Check the wire of battery power is connected correctly or not. 2. Check the output voltage of battery is correctly or not.
No power	Inverter no power on LCD	1. Check PV input connections. 2. Check DC input voltage (single phase >120V, three phase >350V). 3. Check if PV+/- is reversed.
NO-GRID	No grid voltage	1. Check connections and grid switch. 2. Check the grid voltage inside inverter terminal.
OV-BUS	Over DC bus voltage	1. Check inverter inductor connection. 2. Check driver connection.

7. Troubleshooting

Alarm Message	Failure description	Solution
OV-DC01/02/03/04	Over DC voltage	1. Reduce the module number in series.
OV-DCA-I	DC input overcurrent	1. Restart inverter. 2. Identify and remove the string to the fault MPPT. 3. Change power board.
OV-G-V01/02/03/04	Over grid voltage	1. Resistant of AC cable is too high. Change bigger size grid cable. 2. Adjust the protection limit if it's allowed by electrical company.
OV-G-I	Over grid current	1. Restart inverter. 2. Change power board.
OV-G-F01/02	Over grid frequency	1. Use user define function to adjust the protection limit if it's allowed by electrical company.
OV-IgTr	AC side transient overcurrent	1. Restart inverter. 2. Return-factory repair.
OV-ILLC	LLC hardware overcurrent	
OV-VBackup	Bypass overvoltage fault	
OV-TEM	Over Temperature	1. Check inverter surrounding ventilation. 2. Check if there's sunshine direct on inverter in hot weather.
OV-Vbatt1	The detection of battery overvoltage	1. Check the protect point for over voltage sets correctly or not. 2. Restart inverter.
OV-Vbatt-H	Battery overvoltage hardware fault	1. Check the circle whether the circuit for battery power jumps. 2. Restart inverter.
Over-Load	Bypass overload fault	1. Check the load of Backup port is over rating output power or not. 2. Reduce the load of Backup port, then restart inverter.
PV ISO-PRO01/02	PV isolation protection	1. Remove all DC input, reconnect and restart inverter one by one. 2. Identify which string cause the fault and check the isolation of the string.
RelayChk-FAIL	Relay check fail	1. Restart inverter or contact installer.

7. Troubleshooting

Alarm Message	Failure description	Solution
UN-BUS01/02	Under DC bus voltage	1. Check inverter inductor connection. 2. Check driver connection.
UN-G-F01/02	Under grid frequency	1. Use user define function to adjust the protection limit if it's allowed by electrical company.
UN-G-V01/02	Under grid voltage	
12Power-FAULT	12V power supply fault	1. Restart inverter or contact installer.

Table 7.1 Fault message and description



NOTE:

If the inverter displays any alarm message as listed in Table 7.1; please turn off the inverter and wait for 5 minutes before restarting it. If the failure persists, please contact your local distributor or the service center.

Please keep ready with you the following information before contacting us.

1. Serial number of Solis Single Phase Inverter;
2. The distributor/dealer of Solis Single Phase Inverter (if available);
3. Installation date.
4. The description of problem (i.e. the alarm message displayed on the LCD and the status of the LED status indicator lights. Other readings obtained from the Information submenu (refer to Section 6.2) will also be helpful.);
5. The PV array configuration (e.g. number of panels, capacity of panels, number of strings, etc.);
6. Your contact details.

8. Specifications

Technical Data	RHI-3P3K-HVES-5G*	RHI-3P4K-HVES-5G*
Input DC (PV side)		
Recommended max. PV power	4800W	6400W
Max. input voltage	1000V	
Rated voltage	600V	
Start-up voltage	160V	
MPPT voltage range	200-850V	
Full load MPPT voltage range	200-850V	200-850V
Max. input current	13A/13A	
Max. short circuit current	16.5A/16.5A	
MPPT number/Max input strings number	2/2	
Battery		
Battery Type	Li-ion	
Communication	CAN/RS485	
Battery Voltage range	160 - 600Vdc	
Maximum charging Power	3kW	4kW
Maximum Charge/discharge current	25A	
Output AC(Grid-side)		
Rated output power	3kW	4kW
Max. apparent output power	3.3kVA	4.4kVA
Operation phase	3/N/PE	
Rated grid voltage	380V/400V	
The grid voltage range	320-480V	
Rating grid frequency	50 Hz/60 Hz	
AC grid frequency range	45-55 Hz/ 55-65Hz	
Rating grid output current	4.5A/4.3A	6.1A/5.8A
Max. output current	5.1A/4.8A	6.8A/6.4A
Power factor	> 0.99 (0.8 leading to 0.8 lagging)	
THDi	< 2%	

8. Specifications

Technical Data	RHI-3P3K-HVES-5G*	RHI-3P4K-HVES-5G*
Output AC(Back-up)		
Rated output power	3kW	4kW
Peak apparent output power	10000VA, 60 sec	10000VA, 60 sec
Back-up switch time	< 40ms	
Rated output voltage	3/N/PE, 380V/400V	
Rated frequency	50 Hz/60 Hz	
Rated output current	4.5A/4.3A	6.1A/5.8A
THDv(@linear load)	<2%	
Efficiency		
Max. efficiency of Solar Inverting	98.4%	
EU efficiency of Solar Inverting	97.7%	
MPPT efficiency	99.9%	
Battery charge/discharge efficiency	97.5%	
Protection		
Anti-islanding protection	Yes	
Insulation Resistor detection	Yes	
Residual current monitoring unit	Yes	
Output over current protection	Yes	
Output short protection	Yes	
Output over voltage protection	Yes	
DC switch	Yes	
DC reverse polarity protection	Yes	
PV overvoltage protection	Yes	
Battery reverse protection	Yes	

8. Specifications

Technical Data	RHI-3P3K-HVES-5G*	RHI-3P4K-HVES-5G*
General data		
Dimensions(W/H/D)	535*455*181mm	
Weight	25.1kg	
Topology	Transformerless	
Self consumption (Night)	<7 W	
Operation temperature range	-25°C ~ +60°C	
Relative humidity	0-100%	
Ingress protection	IP65	
Noise emission	<30 dB (A)	
Cooling concept	Natural convection	
Max.operation altitude	4000m	
Grid connection standard	G98 or G99, VDE-AR-N 4105 / VDE V 0124, EN 50549-1, VDE 0126 / UTE C 15/VFR:2019, RD 1699/RD 244 / UNE 206006 / UNE 206007-1, CEI 0-21, C10/11, NRS 097-2-1, TOR, EIFS 2018.2, IEC 62116, IEC 61727, IEC 60068, IEC 61683, EN 50530, MEA, PEA	
Safty/EMC standard	IEC 62109-1/-2 ,EN 61000-6-1/-3	
Features		
DC connection	MC4 connector	
AC connection	Quick Connection plug	
Display	LCD, 2X20 Z	
Communication	RS485, Optional:Wi-Fi, GPRS	
Warranty	5 years (extend to 20 years)	

*RHI-3P3K-HVES-5G and RHI-3P4K-HVES-5G are not available in Belgium.

8. Specifications

Technical Data	RHI-3P5K-HVES-5G	RHI-3P6K-HVES-5G
Input DC (PV side)		
Recommended max. PV power	8000W	9600W
Max. input voltage	1000V	
Rated voltage	600V	
Start-up voltage	160V	
MPPT voltage range	200-850V	
Full load MPPT voltage range	200-850V	240-850V
Max. input current	13A/13A	
Max. short circuit current	16.5A/16.5A	
MPPT number/Max input strings number	2/2	
Battery		
Battery Type	Li-ion	
Communication	CAN/RS485	
Battery Voltage range	160 - 600Vdc	
Maximum charging Power	5kW	6kW
Maximum Charge/discharge current	25A	
Output AC(Grid-side)		
Rated output power	5kW	6kW
Max. apparent output power	5.5kVA (5kVA for Belgium)	6.6kVA (6kVA for Belgium)
Operation phase	3/N/PE	
Rated grid voltage	380V/400V	
The grid voltage range	320-480V	
Rating grid frequency	50 Hz/60 Hz	
AC grid frequency range	45-55 Hz/ 55-65Hz	
Rating grid output current	7.6A/7.2A	9.1A/8.7A
Max. output current	8.4A/8.0A	10.0A/9.6A
Power factor	> 0.99 (0.8 leading to 0.8 lagging)	
THDi	< 2%	

8. Specifications

Technical Data	RHI-3P5K-HVES-5G	RHI-3P6K-HVES-5G
Output AC(Back-up)		
Rated output power	5kW	6kW
Peak apparent output power	10000VA, 60 sec	12000VA, 60 sec
Back-up switch time	< 40ms	
Rated output voltage	3/N/PE, 380V/400V	
Rated frequency	50 Hz/60 Hz	
Rated output current	7.6A/7.2A	9.1A/8.7A
THDv(@linear load)	<2%	
Efficiency		
Max. efficiency of Solar Inverting	98.4%	
EU efficiency of Solar Inverting	97.7%	
MPPT efficiency	99.9%	
Battery charge/discharge efficiency	97.5%	
Protection		
Anti-islanding protection	Yes	
Insulation Resistor detection	Yes	
Residual current monitoring unit	Yes	
Output over current protection	Yes	
Output short protection	Yes	
Output over voltage protection	Yes	
DC switch	Yes	
DC reverse polarity protection	Yes	
PV overvoltage protection	Yes	
Battery reverse protection	Yes	

8. Specifications

Technical Data	RHI-3P5K-HVES-5G	RHI-3P6K-HVES-5G
General data		
Dimensions(W/H/D)	535*455*181mm	
Weight	25.1kg	
Topology	Transformerless	
Self consumption (Night)	<7 W	
Operation temperature range	-25°C ~ +60°C	
Relative humidity	0-100%	
Ingress protection	IP65	
Noise emission	< 30 dB (A)	
Cooling concept	Natural convection	
Max.operation altitude	4000m	
Grid connection standard	G98 or G99, VDE-AR-N 4105 / VDE V 0124, EN 50549-1, VDE 0126 / UTE C 15/VFR:2019, RD 1699/RD 244 / UNE 206006 / UNE 206007-1, CEI 0-21, C10/11, NRS 097-2-1, TOR, EIFS 2018.2, IEC 62116, IEC 61727, IEC 60068, IEC 61683, EN 50530, MEA, PEA	
Safty/EMC standard	IEC 62109-1/-2 ,EN 61000-6-1/-3	
Features		
DC connection	MC4 connector	
AC connection	Quick Connection plug	
Display	LCD, 2X20 Z	
Communication	RS485, Optional:Wi-Fi, GPRS	
Warranty	5 years (extend to 20 years)	

8. Specifications

Technical Data	RHI-3P8K-HVES-5G	RHI-3P10K-HVES-5G
Input DC (PV side)		
Recommended max. PV power	12800W	16000W
Max. input voltage	1000V	
Rated voltage	600V	
Start-up voltage	160V	
MPPT voltage range	200-850V	
Full load MPPT voltage range	210-850V	200-850V
Max. input current	26A/13A	26A/26A
Max. short circuit current	32.5A/16.5A	32.5A/32.5A
MPPT number/Max input strings number	2/3	2/4
Battery		
Battery Type	Li-ion	
Communication	CAN/RS485	
Battery Voltage range	160 - 600Vdc	
Maximum charging Power	8kW	10kW
Maximum Charge/discharge current	25A	
Output AC(Grid-side)		
Rated output power	8kW	10kW
Max. apparent output power	8.8kVA (8kVA for Belgium)	10kVA
Operation phase	3/N/PE	
Rated grid voltage	380V/400V	
The grid voltage range	320-480V	
Rating grid frequency	50 Hz/60 Hz	
AC grid frequency range	45-55 Hz/ 55-65Hz	
Rating grid output current	12.2A/11.5A	15.2A/14.4A
Max. output current	13.4A/12.8A	15.2A/14.4A
Power factor	> 0.99 (0.8 leading to 0.8 lagging)	
THDi	< 2%	

8. Specifications

Technical Data	RHI-3P8K-HVES-5G	RHI-3P10K-HVES-5G
Output AC(Back-up)		
Rated output power	8kW	10kW
Peak apparent output power	16000VA, 60 sec	
Back-up switch time	< 40ms	
Rated output voltage	3/N/PE, 380V/400V	
Rated frequency	50 Hz/60 Hz	
Rated output current	12.2A/11.5A	15.2A/14.4A
THDv(@linear load)	<2%	
Efficiency		
Max. efficiency of Solar Inverting	98.4%	
EU efficiency of Solar Inverting	97.7%	
MPPT efficiency	99.9%	
Battery charge/discharge efficiency	97.5%	
Protection		
Anti-islanding protection	Yes	
Insulation Resistor detection	Yes	
Residual current monitoring unit	Yes	
Output over current protection	Yes	
Output short protection	Yes	
Output over voltage protection	Yes	
DC switch	Yes	
DC reverse polarity protection	Yes	
PV overvoltage protection	Yes	
Battery reverse protection	Yes	

8. Specifications

Technical Data	RHI-3P8K-HVES-5G	RHI-3P10K-HVES-5G
General data		
Dimensions(W/H/D)	535*455*181mm	
Weight	25.1kg	
Topology	Transformerless	
Self consumption (Night)	<7 W	
Operation temperature range	-25°C ~ +60°C	
Relative humidity	0-100%	
Ingress protection	IP65	
Noise emission	<30 dB (A)	
Cooling concept	Natural convection	
Max.operation altitude	4000m	
Grid connection standard	G98 or G99, VDE-AR-N 4105 / VDE V 0124, EN 50549-1, VDE 0126 / UTE C 15/VFR:2019, RD 1699/RD 244 / UNE 206006 / UNE 206007-1, CEI 0-21, C10/11, NRS 097-2-1, TOR, EIFS 2018.2, IEC 62116, IEC 61727, IEC 60068, IEC 61683, EN 50530, MEA, PEA	
Safty/EMC standard	IEC 62109-1/-2 ,EN 61000-6-1/-3	
Features		
DC connection	MC4 connector	
AC connection	Quick Connection plug	
Display	LCD, 2X20 Z	
Communication	RS485, Optional:Wi-Fi, GPRS	
Warranty	5 years (extend to 20 years)	

9. Appendix

9.1 Grid standard selection guide



NOTE:

Please check if the grid code setting comply with local requirement.

For different countries and regions, corresponding grid code needs to be selected in the inverter LCD to meet the requirements of local network provider.

This instruction indicates how to change the grid code and what code should be selected in different places.

This following list illustrates the grid standard options in the inverter which are subject to change. It is for your reference only. If customer has any doubts or uncertainty, please consult Solis service department for confirmation.

To set the correct grid code, please enter the following path:

Advanced Settings -> Password:0010 -> Select Standard

Detailed protection limits can be viewed when choosing the code.

Please select "Save&Send" to enforce the code.

NO.	Code in LCD	Country/Region	Comments
1	VDE4015	Germany	For German Low Voltage Grid.
2	EN50549 PO	Poland	For Polish Low Voltage Grid
3	EN50549 NL	Netherland	For Dutch Low Voltage Grid
4	EN50438 L	-	General EN50438 Requirement. Possible to be used in Austria, Cyprus, Finland, Czech Republic, Slovenia, etc.
5	EIFS- SW	Sweden	For Swedish Low Voltage Grid
6	France	France	For French Low Voltage Grid
7	C10/11	Belgium	For Belgian Low Voltage Grid
8	NRS097	South Africa	For South African Low Voltage Grid
9	CEI0-21	Italy	For Italian Low Voltage Grid
10	EN50549L (EN50549-1)	-	General EN50549-1 requirement which meets local requirements of most European countries
11	G98	UK	For UK Low Voltage Grid <16A
12	G99	UK	For UK Low Voltage Grid >16A

9. Appendix

NO.	Code in LCD	Country/Region	Comments
13	G98 NI	North Ireland	For North Ireland Low Voltage Grid <16A
14	G99 NI	North Ireland	For North Ireland Low Voltage Grid >16A
15	User-define	-	Customized Protection Limits
16	Gen50	-	Generator Connected, Frequency-Derating, 50Hz
17	Gen 60	-	Generator Connected, Frequency-Derating, 60Hz
18	DK1	East Denmark	For East Danish low voltage grid
19	DK2	West Denmark	For West Danish low voltage grid
20	50438IE	Ireland	For Irish low voltage grid
21	RD1699	Spain	For Spanish low voltage grid
22	EN50549 L	-	General EN50549 Requirement. Possible to be used in Cyprus, Finland, Czech Republic, Slovenia, Jamaica