



PV Master APP



SEMS Portal APP



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**GOODWE**  
YOUR SOLAR ENGINE



**JIANGSU GOODWE POWER SUPPLY TECHNOLOGY CO.,LTD**

No. 90 Zijin Rd., New District, Suzhou, 215011, China

[www.goodwe.com](http://www.goodwe.com)

[service@goodwe.com](mailto:service@goodwe.com)



340-00313-01

# EM SERIES USER MANUAL

HYBRID INVERTER

Rev.1.1  
2021-01-08

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## 01 INTRODUCTION

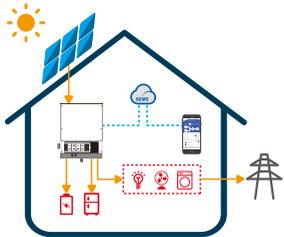
The GoodWe EM series of hybrid/bidirectional solar inverters are designed for use in solar systems that integrate a photovoltaic system (PV), batteries, loads and the local grid for energy management. The energy produced by the PV system is used to optimize system self-consumption. Excess power is used for battery charging, and any remaining power can be exported to the grid. The battery can discharge to support loads when PV power is insufficient to meet self-consumption demands. If both PV power and battery power are insufficient, the system will draw power from the grid to support connected loads.



Note:  
The introduction describes the general behaviour of the EM system. Operating mode can be adjusted via the PV Master app according to the system's layout. The diagram below shows the EM system's general operating modes.

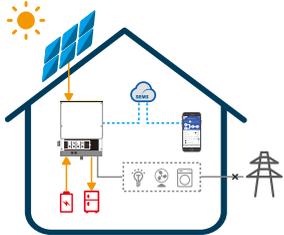
### 1.1 OPERATING MODES INTRODUCTION

The EM system will typically operate in one of the following modes, based on the configuration and layout of your system.



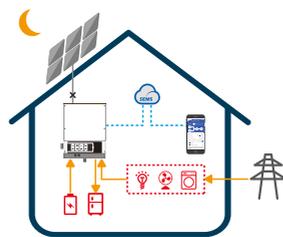
#### Mode I

The energy produced by the PV system is used to optimize self-consumption. Excess energy is used for battery charging. Any remaining excess energy is exported to the grid.



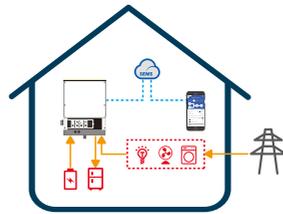
#### Mode III

If the grid fails, the system automatically switches to back-up mode, in which the load can be supplied by the PV or battery.



#### Mode II

When there is no PV present, and the battery has insufficient charge, the EM system will supply the load using grid power.



#### Mode IV

The battery can be charged using grid power, with charge time/power adjustable via the PV Master app.

## 1.2 Safety & Warnings

The EM series of inverters from Jiangsu GoodWe Power Supply Technology Co., Ltd. (also referred to as Goodwe) strictly complies with relevant safety rules for product design and testing. Please read and adhere to all the instructions and warnings on the inverter and in the user manual during installation, operation, and maintenance. Improper use could cause personal injury or damage to property.

### Explanation of Symbols



Caution!  
Failure to observe the warning notices in this manual may result in injury.



Danger of high voltage and electric shock!



Danger of hot surface!



Components in the product can be recycled.



This side up! The package must be transported, handled, and stored such that the arrows always point upwards.



No more than six (6) identical packages to be stacked on top of each other.



Products should not be disposed of as household waste.



Fragile - The package/product should be handled carefully and never tipped over or thrown.



Refer to the operating instructions.



Keep dry! The package/product must be protected from excessive humidity and must be stored under cover.



You must wait at least 5 minutes after disconnecting the inverter from the utility grid and from the PV before touching any live internal parts.



CE mark



### 2.1 Incorrect Installation

Please avoid the following installation errors, which will damage the system or the inverter.

- Diagram 1:** Shows a back-up inverter connected to the grid. **Text:** The back-up side cannot be connected to the grid.
- Diagram 2:** Shows two back-up inverters connected in parallel to a load. **Text:** The back-up side cannot be connected in parallel.
- Diagram 3:** Shows a single PV string connected to two inverters. **Text:** A single PV string cannot be connected to multiple inverters.
- Diagram 4:** Shows two inverters connected to a single smart meter. **Text:** One meter cannot be connected to multiple inverters, and multiple current transformers (CTs) cannot connect to the same cable.
- Diagram 5:** Shows two inverters connected to a single battery bank. **Text:** One battery bank cannot be connected to multiple inverters.
- Diagram 6:** Shows an inverter connected to an AC generator. **Text:** The on-grid or back-up side cannot be connected to an AC generator.
- Diagram 7:** Shows an inverter connected to an air conditioner. **Text:** The back-up side cannot be connected to an air conditioner.
- Diagram 8:** Shows an inverter connected to incompatible batteries. **Text:** The back-up side cannot be connected to incompatible batteries.

### 2.2 Packing List

Upon receiving the hybrid inverter, please check to ensure none of the components shown below are missing or damaged.

- Inverter
- Wall-Mounted Bracket
- Smart Meter With CT
- Positive PV Plug
- Negative PV Plug
- Battery Cover
- AC Plug
- Battery Terminal
- Hexagon screw
- Fixed Screw
- PE Terminal
- Expansion Bolts
- User Manual
- Quick Installation Instructions

### 2.3 Mounting

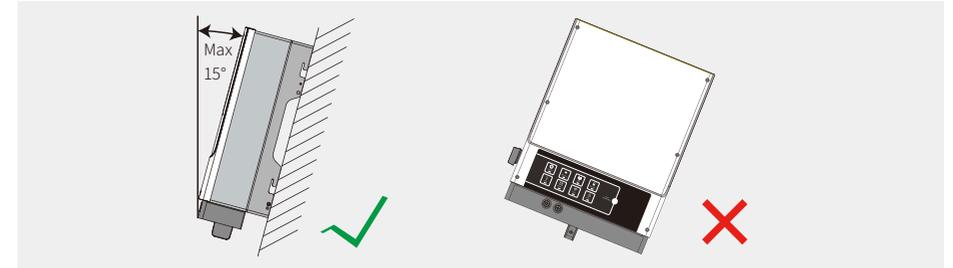
#### 2.3.1 Selecting a Mounting Location

For protection and convenient maintenance of the inverter, the mounting location should be selected carefully based on the following rules:

No part of the system should block the switch or breaker that disconnects the inverter from DC and AC power.

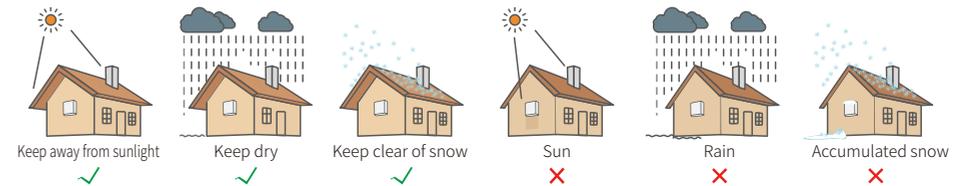
**Rule 1.** The inverter should be installed on a solid surface, suitable for the inverter's dimensions and weight.

**Rule 2.** The inverter should be installed vertically or at an angle not exceeding 15°.



**Rule 3.** Ambient temperature must be lower than 45°C. (High ambient temperature will cause the inverter's power to be derated.)

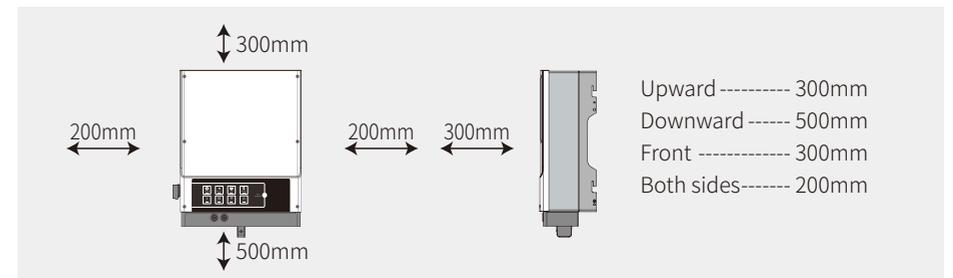
**Rule 4.** The inverter's installation site should be under cover, and protected from direct sunlight and poor weather conditions such as snow, rain, lightning etc.



**Rule 5.** The inverter should be installed at eye level for convenient maintenance.

**Rule 6.** The product label on the inverter should be clearly visible after installation.

**Rule 7.** Leave enough space around the inverter, as shown in the figure below.



**!** The inverter must not be installed near flammable or explosive substances or strong electromagnetic equipment.

## 2.3.2 Mounting

 Remember that this inverter is heavy! Please be careful when removing it from the packaging.

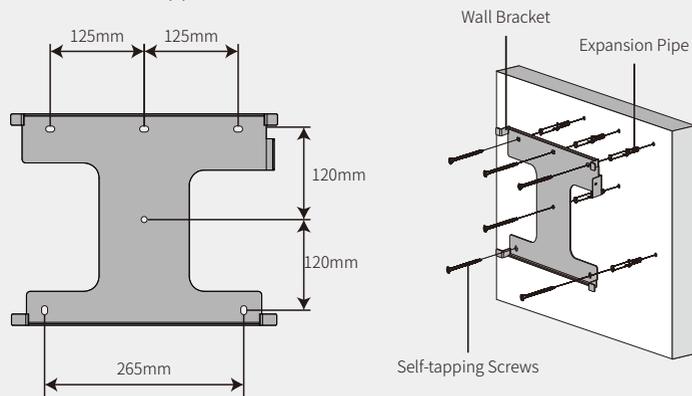
The inverter is suitable for mounting on concrete or other non-combustible surfaces only.

### Step 1

Please use the supplied mounting bracket as a template to drill 4 correctly positioned holes (10 mm in diameter, and 80 mm in depth).

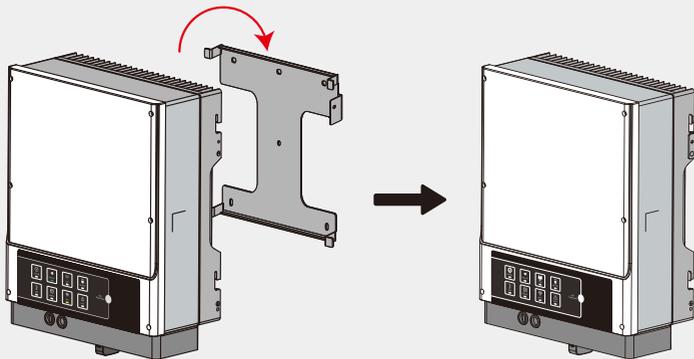
Use the expansion bolts in the accessory box to fix the mounting bracket securely onto the wall.

**Note:** The load-bearing capacity of the wall must be greater than 17kg; otherwise it may not be able to support the inverter.



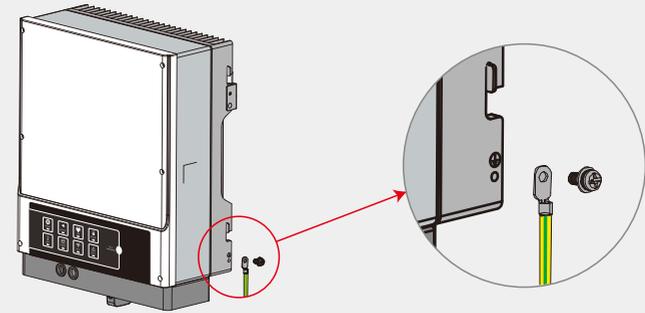
### Step 2

Carry the inverter by holding the heatsink on two sides and place the inverter on the mounting bracket.



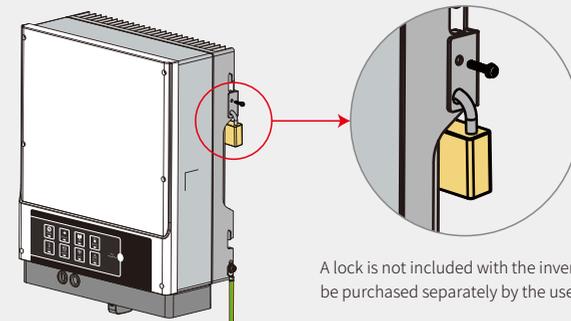
### Step 3

The ground cable should be connected to the ground plate on the grid side.



### Step 4

If required, the inverter can be locked to prevent theft.



A lock is not included with the inverter. It must be purchased separately by the user.

## 2.4 Electrical Wiring Connection

### 2.4.1 PV Wiring Connection

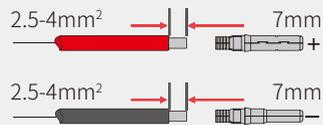
Before connecting PV panels/strings to the inverter, please make sure the following requirements are met:

- The total short-circuit current of a PV string must not exceed inverter's max DC current.
- The PV string's minimum isolation resistance to ground must exceed **18.33kΩ** to prevent risk of shock.
- The PV string must not be connected to an earth/grounding conductor.
- Use the correct PV plugs supplied in the accessory box. (BAT plugs are similar to PV plugs. Please confirm you have chosen the correct plugs.)

Note: MC4 or QC4.10 or Amphenol plugs are included in the accessory box. Instructions for connecting these are provided below:

#### Step 1

Prepare the PV cables and PV plugs.

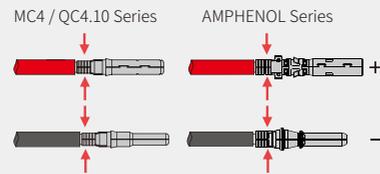


Note:

1. Please use the PV plugs and connectors supplied in the accessory box.
2. PV cable should be standard 2.5–4mm<sup>2</sup>.

#### Step 2

Connect the PV cables to the PV connectors.



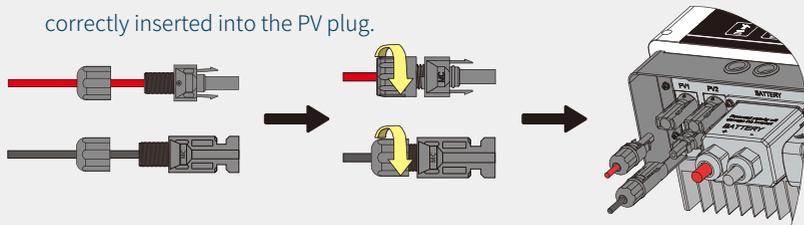
Note:

1. PV cables must be tightly crimped into the connectors.
2. For Amphenol connectors, the limit buckle must not be pressed.
3. There will be an audible click when the connector is correctly inserted into the PV plug.

#### Step 3

Screw on the cap and plug it into the side of the inverter.

Note: There will be an audible click when the connector is correctly inserted into the PV plug.



PV string polarity must not be reversed during connection, to prevent damage to the inverter.

### 2.4.2 Battery Wiring Connection

Please take care to avoid risk of electric shock or chemical hazards.

Make sure there is an external DC breaker ( $\geq 63A$ ) connected to batteries without a built-in DC breaker.



Ensure the breaker is off and the battery's nominal voltage meets EM series specifications before connecting the battery to the inverter. Ensure the inverter is fully isolated from PV and AC power.

The capacity of a lithium battery (pack) must be 50Ah or larger. Battery cabling requirements are as per Figure 2.4.2-1.



Figure 2.4.2-1

Grade	Description	Value
A	Outside Diameter Insulation	10-14 mm
B	Isolation Section	NA
C	Conductor Core Section	20-35 mm <sup>2</sup>

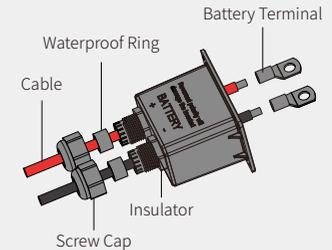
#### Battery wiring connection process

##### Step 1

Prepare battery cables and accessories and insert the battery power cable into the battery cover.

Note:

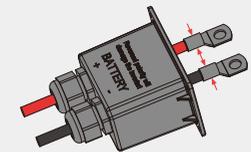
1. Please use the accessories supplied in the accessory box.
2. The battery power cable should be 20–35mm<sup>2</sup>.



##### Step 2

Prepare the battery terminals

- Strip the cable sleeve to expose 10mm of metal core.
- Use an appropriate crimping tool to tightly compress the battery terminal onto the exposed metal core.



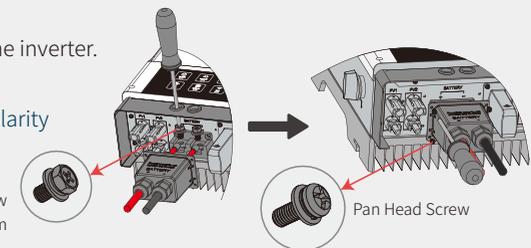
##### Step 3

Connect the battery terminal to the inverter.

Note:

Please make sure the battery's polarity (+/-) is not reversed.

Hexagon Head Screw  
Fastening torsion 6-8N.m



\* To connect compatible lithium batteries (LG / PYLON / BYD / GCL / DYNESS / ALPHA), please refer to the battery connection information in the EM Quick Installation Instructions.

## Battery Protection

The battery will act as a protective charge/discharge current limiter under any of the conditions as below:

- Battery SOC (state of charge) is lower than I-DOD (depth of discharge).
- Battery voltage is lower than the discharge voltage.
- Battery over heating protection.
- Battery communication is abnormal for a lithium battery.
- Battery management system (BMS) limitation for a lithium battery.

When charge/discharge current limit protection occurs:

- In on-grid mode, battery charge/discharge operation may be abnormal.
- In off-grid mode, the back-up supply will shut down.

Note:

- In off-grid mode, if the back-up supply shuts down because of the battery having low SOC or voltage, all PV power will be used to charge the battery until its SOC reaches  $40\% + (1-DOD)/2$ , then the back-up supply will be activated.
- In on-grid mode, the battery is protected from over-discharge by DOD and the discharge voltage. In off-grid mode, it is protected only by the discharge voltage as a priority.
- The battery's DOD setting prevents the inverter from discharging the battery's reserve power. As soon as the DOD limit is reached, the load will only be supplied by either PV power or the grid. After several continuous days in which little or no battery charging occurs, the battery may continue to self-consume energy to support communication with the inverter. Behaviour varies between batteries from different manufacturers, but if the battery's SOC reaches a certain level, the inverter will boost the SOC back up. This protection mechanism safeguards against the battery reaching 0% SOC.

### 2.4.3 On-grid and Back-up Connection

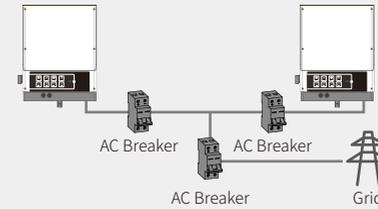
An external AC breaker is required for on-grid connection to isolate the system from the grid when necessary.

Requirements for the on-grid AC breaker are shown below.

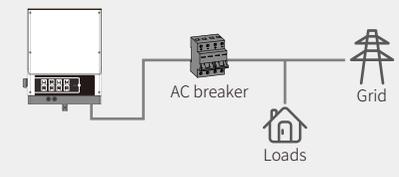
Inverter model	AC breaker specification
GW3048-EM	32A / 230V (e.g. DZ47-60 C32)
GW3648-EM	32A / 230V (e.g. DZ47-60 C32)
GW5048-EM	32A / 230V (e.g. DZ47-60 C32)

Note: The absence of an AC breaker on the back-up side will result in damage to the inverter in the event of a back-up side electrical short-circuit. The back-up function cannot turn off during on-grid operation.

1. Use a separate AC breaker for each individual inverter.



2. On the AC side, the individual breaker should be connected between the inverter and the grid, and before the load.



The procedure for on-grid and back-up connection is shown below:



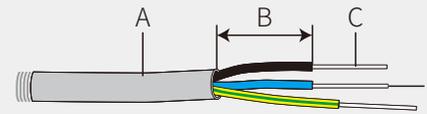
Make sure the inverter is fully isolated from any DC or AC power before connecting the AC cable.

Note:

1. The neutral cable should be blue, the line cable should be black or brown (preferred) and the protective earth cable should be yellow-green.
2. For AC cabling, the PE cable should be longer than the neutral and line cables, such that if the AC cable slips or is pulled out, the protective earth conductor will be the last to remain in place and support any strain.

#### Step 1-1 On-Grid

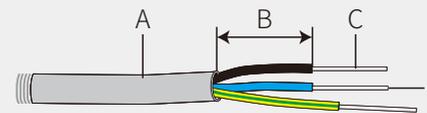
Prepare the terminals and AC cables according to the information in the appropriate table.



Grade	Description	Value
A	Outer Diameter	13-22 mm
B	Separated Wire Length	10-15 mm
C	Conductor Wire Length	12-14 mm
D	Conductor Core Section	8-10 mm <sup>2</sup>

#### Step 1-2 Back-Up

Prepare the terminals and AC cables according to the information in the appropriate table.



Grade	Description	Value
A	Outer Diameter	10-14mm
B	Separated Wire Length	7-10mm
C	Conductor Wire Length	7-9mm
D	Conductor Core Section	4-6 mm <sup>2</sup>

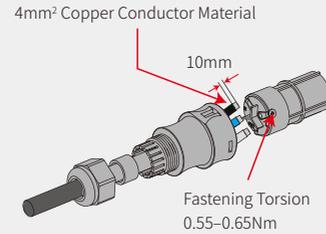
Note: If not using on-grid power or the back-up function to charge the battery, wire with a conductive core of 4-6mm<sup>2</sup> can be used.

## Step 2

1. Prepare the terminals and AC cables.
2. Insert the AC cable into the terminal cover and screw the three cables tightly onto the connectors.

Note:

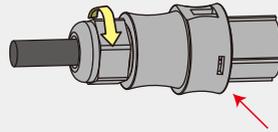
1. Please use the terminals supplied in the components box;
2. Make sure the cable sleeve is not trapped with the conductor.



## Step 3

Lock the terminal cover and fasten the terminal cap.

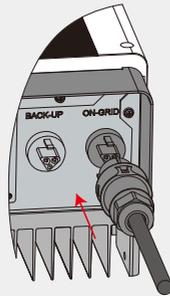
Note: Make sure the terminal cover is correctly locked onto the terminal.



## Step 4-1 On-Grid

Connect the assembled AC terminals onto the inverter.

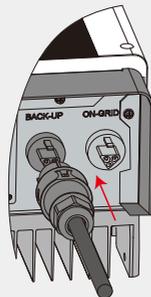
Note: Make sure the terminals are connected to the 'On-Grid' side (the other side is connected to the public grid).



## Step 4-2 Back-Up

Connect the assembled AC terminals to the inverter.

Note: Make sure the terminals are connected to the 'Back-Up' side (the other side is connected to the public grid).



## Adjustable Settings

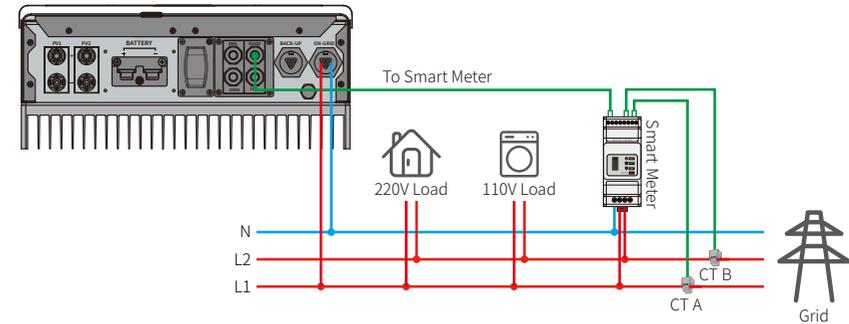
The inverter includes an interface in which the user can set functions, such as trip points, trip time, time of reconnection, active and invalid QU curve and PU curve values etc. using special firmware. Please contact after-sales support to obtain the firmware and details of the adjustment method.

## Adjustable Settings

The inverter includes an interface in which the user can set functions, such as trip points, trip time, time of reconnection, active and invalid QU curve and PU curve values etc. using special firmware. Please contact after-sales support to obtain the firmware and details of the adjustment method.

## Connection for a SPLIT Grid System

There is a solution to enable the inverter to work in on-grid mode in a SPLIT grid system. For details, please check the official application instructions on our website: GoodWe Hybrid Solution For Split Grid Type.



## Declaration for Back-Up Function

EM series hybrid inverter back-up outputs have overload functionality.

For details please refer to the technical parameters section (Page 31).

The inverter will derate for self-protection at high ambient temperatures.

The statement below sets out the general policies governing energy storage inverters of series EH, EM, ES, ET, BH, BT and SBP.

1. For Hybrid inverters (Series EH, EM, ES and ET), a standard PV installation typically includes the inverter, PV panels and a battery. If the system is not connected to a battery, it is strongly recommended not to use the back-up function. The manufacturer will not be liable for any consequences arising from the user's failure to follow this instruction, and the standard warranty will be invalidated.
2. Under normal circumstances, back-up switching time is less than 10ms (the minimum requirement for a UPS). However, external factors may cause the system to fail in back-up mode. As such, we recommend that users be aware of such conditions and follow the instructions below:
  - Do not connect loads that are dependent on a stable energy supply for reliable operation.
  - Do not connect a total load that exceeds the maximum back-up capacity.
  - Try to avoid loads that may create very high start-up current surges, such as inverters, air-conditioners and high-power pumps.
  - Depending on the state of the battery itself, battery current may be limited by factors including but not limited to temperature and weather conditions.

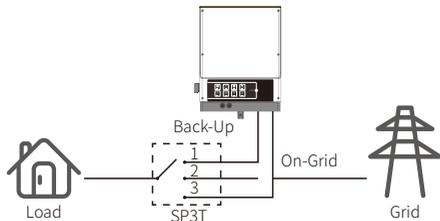
## Accepted Loads:

The EM series inverter is able to supply a continuous 2300VA output or max 3500VA in less than 10 seconds on the back-up side to support back-up loads. The inverter will derate for self-protection at high ambient temperatures.

- Acceptable back-up loads: Television, computer, fridge, fan, illumination lamps, microwave oven, electrical rice cooker and router etc.
- Unacceptable back-up loads: Air conditioner, water pump, heaters, washing machine, electromagnetic oven, compression engine, hair drier and vacuum cleaner etc. Any other loads with high inrush current at start-up are also unacceptable.

### Note:

For convenient maintenance, please install a SP3T switch on the back-up side and the on-grid side. This enables adjustment of supply loads with back-up, grid or default settings.



1. The back-up load is supplied by the back-up side.
2. The back-up load is isolated.
3. The back-up load is supplied from the grid side.

## Declaration for Back-Up Overload Protection

The inverter will restart if overload protection is triggered. Preparation time for restarting will increase in duration (one hour at most) if overload protection is triggered repeatedly. Take the following steps to restart the inverter immediately:

Decrease back-up load power to within maximum limits.

In the PV Master app → Advanced Setting → Click "Reset Back-Up Overload History".

## 2.4.4 Smart Meter & CT Connection



Make sure the AC cable is fully isolated from AC power before connecting the Smart Meter & CT.

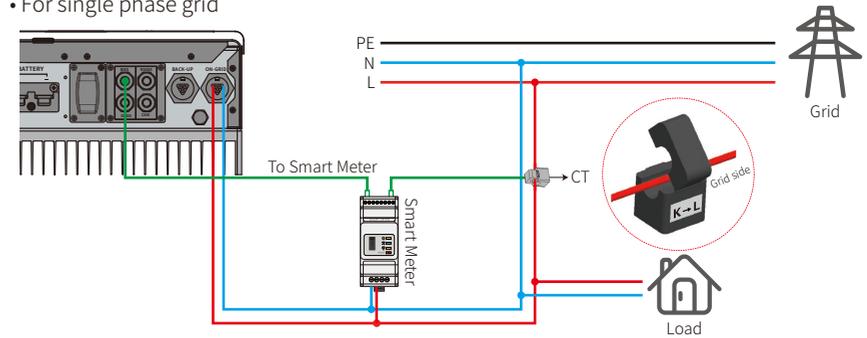
The Smart Meter with integral current transformer (CT) included with the product is compulsory for EM system installation. It is used to detect grid voltage, current direction and magnitude. It also communicates with the inverted RS485 communication.

### Note:

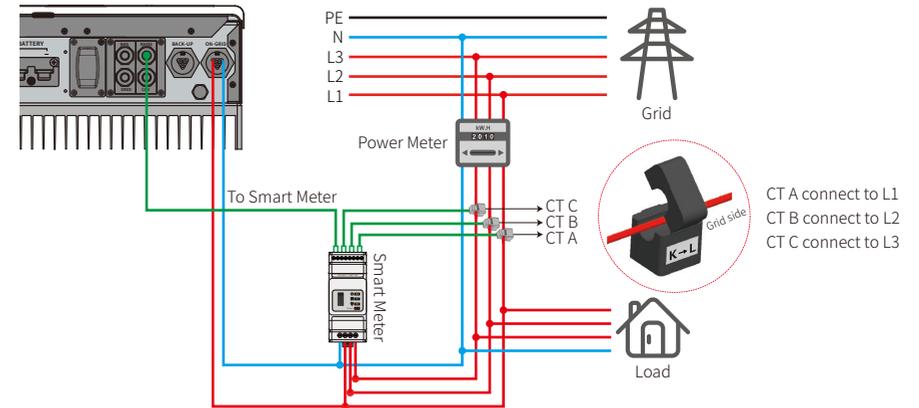
1. The Smart Meter & CT is correctly configured. Please do not alter any settings on the Smart Meter.
2. Only one Smart Meter can be used for each EM series inverter.
3. Three CTs must be used for one Smart Meter, and must be connected on the same phase with Smart Meter power cable.

## Smart Meter & CT Connection Diagram

- For single phase grid



- For three phase grid

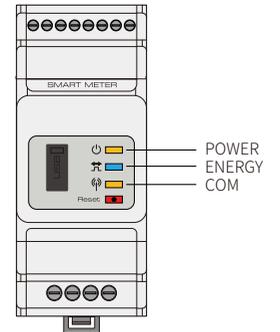


### Note:

1. Please use the Smart Meter with 3 CTs supplied with the product.
2. The CT cable is 3m as default, but can be extended to a maximum of 5m.
3. The Smart Meter communication cable (RJ45) is attached to the inverter ("To Smart Meter" cable). It can be extended to a maximum of 100m, and must use a standard RJ45 cable and plug, as below:

## Smart Meter LED Indications

STATUS	OFF	ON	Blinking
POWER	Not working	Working	/
ENERGY	/	Importing	Exporting
COM	Blink once when transferring data to the inverter		



## Detailed Pinout for Each Port on the Inverter

BMS: CAN communication is configured by default. If RS485 communication is to be used, please contact after-sales support to obtain the correct communication cable.

Position	Colour	BMS Function	Smart Meter Function	EMS
1	Orange-white	485_A2	NC	485_A
2	Orange	NC	NC	485_B
3	Green-white	485_B2	485_B1	485_A
4	Blue	CAN_H	NC	NC
5	Blue-white	CAN_L	NC	NC
6	Green	NC	485_A1	485_B
7	Brown-white	NC	485_B1	NC
8	Brown	NC	485_A1	NC



## 2.5 DRED and Remote Shutdown Device Connection

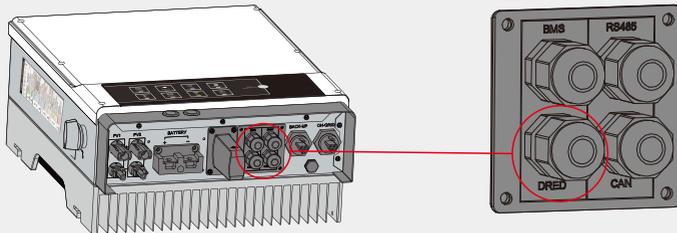
A DRED (demand response enabling device) is required for installation in Australia and New Zealand (and can also be used for remote shutdown in European countries), in compliance with Australia and New Zealand safety requirements (or those of European countries). The inverter includes the required control logic and DRED interface, but the DRED itself is not provided by the inverter manufacturer.

Connection details for DRED and remote shutdown are shown below:

### Step 1

Unscrew the plate from the inverter.

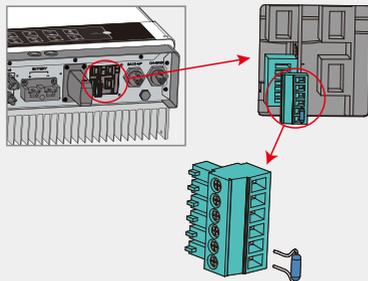
Note: DRED should be connected via the "DRED Port" as the figure shows.



### Step 2

1. Unplug the 6-pin terminal and disconnect the resistor.
2. Remove the resistor and retain the 6-pin terminal for the next step.

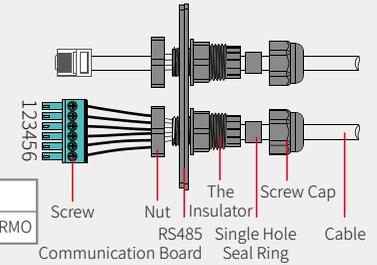
Note: The 6-pin terminal in the inverter has the same pinout as the DRED. Please leave it in the inverter if no external device is connected.



### Step 3-1 For DRED

1. Push the DRED cable through the plate.
2. Connect the DRED cable to the 6-pin terminal.  
The function of each position on the connector is shown below.

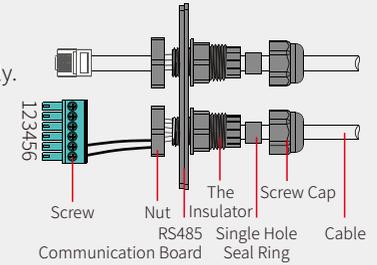
NO.	1	2	3	4	5	6
Function	DRM1/5	DRM2/6	DRM3/7	DRM4/8	REFGEN	COM / DRMO



### Step 3-2 For Remote Shutdown

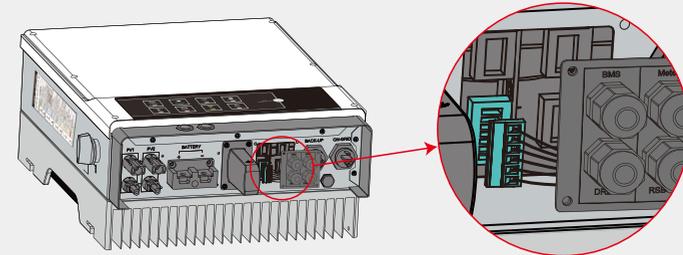
1. Push the cable through the plate.
2. Wiring for connector positions 5 and 6, respectively.

NO.	5	6
Function	REFGEN	COM / DRMO



### Step 4

Connect the DRED terminal at the correct location on the inverter.



## 2.6 Earth Fault Alarm Connection

The EM series inverter complies with IEC 62109-2 13.9. The fault indicator LED on the inverter cover will light up and the system will email fault information to customer.

The inverter should be installed at eye level for convenient maintenance.

## 2.7 SEMS Portal

SEMS Portal is an online monitoring system. After installation of the communication connection is complete, you can access [www.semsportal.com](http://www.semsportal.com) or download the app by scanning the QR code to monitor your PV plant and device.

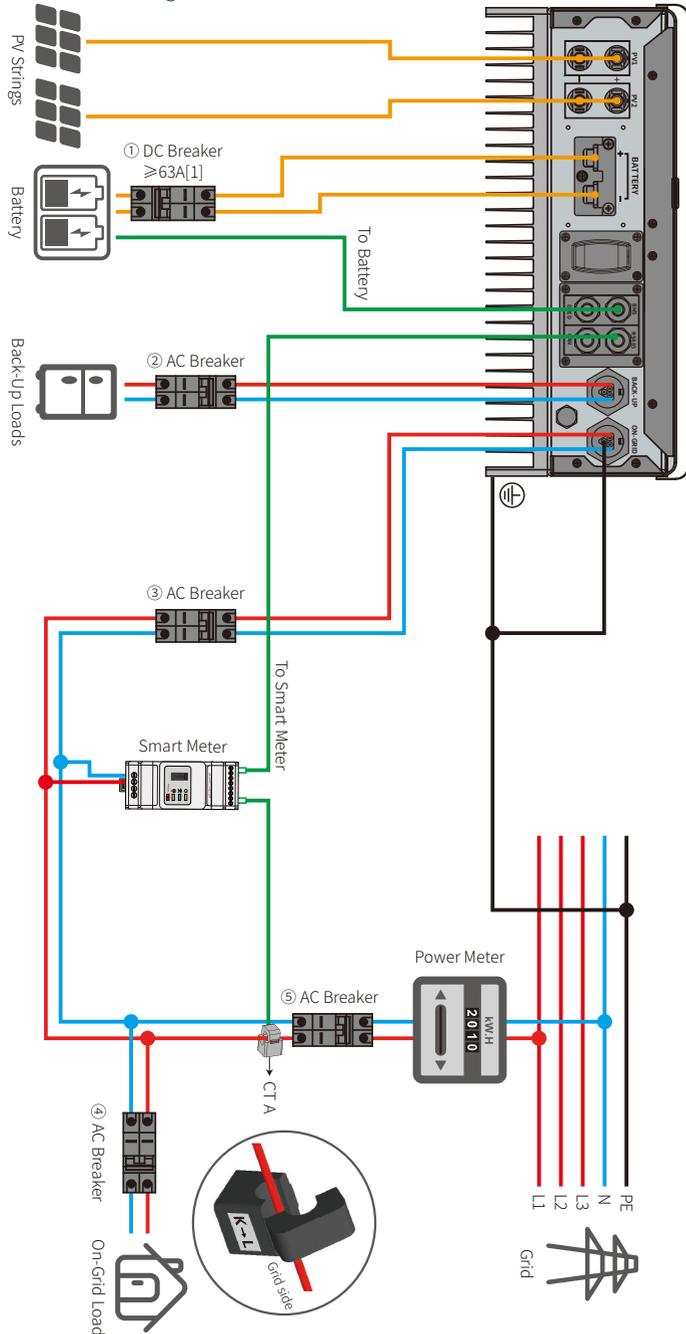
Please contact the after-sales team for more information on how to use SEMS Portal.



SEMS Portal App

## 2.8 Wiring Scheme for EM Series Hybrid Inverters

Note: This diagram illustrates the wiring scheme for the EM series hybrid inverter, not the electrical wiring standard.



Please select a breaker according to the specifications below

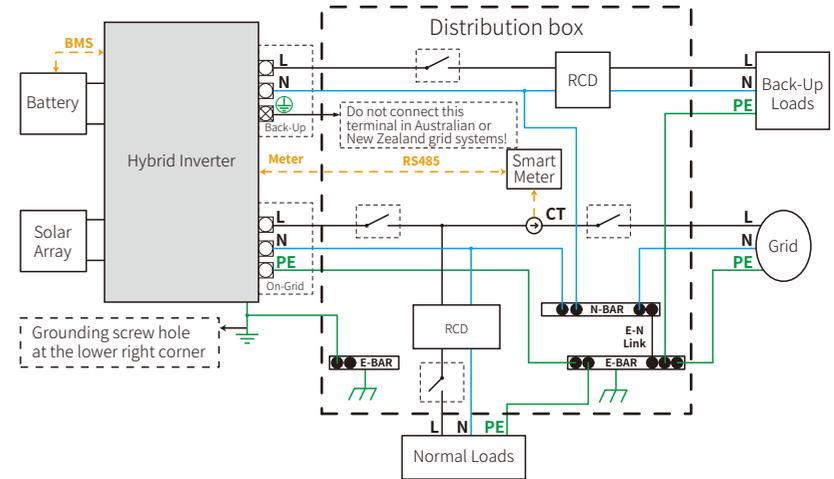
Inverter	①	②	③	④	⑤
GM30/48-EM	63A/60V DC Breaker	32A/400V AC breaker	32A/400V AC breaker	32A/400V AC breaker	Depends on household loads
GM36/48-EM					
GM50/48-EM					

1. For batteries with attached breaker, the external DC breaker can be omitted.
2. Only for lithium batteries with BMS communication.
3. CT must not be connected in reverse. Please follow "House→Grid" instructions for correct connection.

## System Connection Diagrams

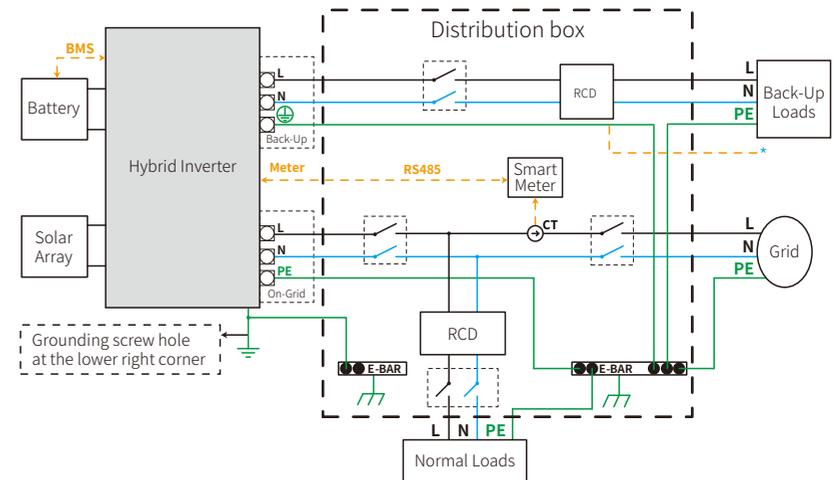
Note: In accordance with Australian safety regulations, the neutral cables of the on-grid side and the back-up side must be connected together, otherwise the back-up function will not work.

This diagram shows an example application where neutral is connected to PE in the distribution box.  
Applies to: Australia, New Zealand, South Africa, etc. (Please follow local wiring regulations!)



This diagram shows an example configuration for grid systems without special requirements for electrical wiring connections.

Note: The back-up PE line and earthing bar must be grounded properly and effectively. Otherwise the back-up function may perform abnormally when the grid fails.



### 3.1 Wi-Fi Configuration

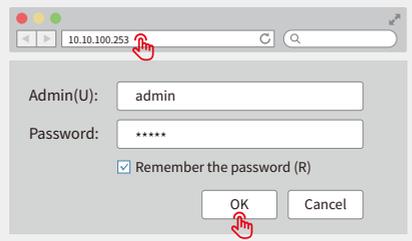
This section illustrates configuration via the web interface. You can also complete configuration using the PV Master app. Wi-Fi configuration is essential for online monitoring and maintenance.

#### Preparation:

1. The inverter must be powered up with battery or grid power.
2. A router with internet access to the website [www.semsportal.com](http://www.semsportal.com) is required.

#### Step 1

1. Connect Solar-WiFi\* to your PC or smart phone (\* Its name is the last 8 character of the inverter's serial number).
2. Open a browser and login at 10.10.100.253 Admin (User): admin; Password: admin.
3. Click "OK".



#### Step 2

1. Click "Start Setup" to choose your router.
2. Click "Next".

**Device information**

Firmware version	1.6.9.3.38.2.1.38
MAC address	60:C5:A8:60:33:E1
Wireless AP mode	Enable
SSID	Solar-WiFi
IP address	10.10.100.253
Wireless STA mode	Disable
Router SSID	WiFi_Burn-in
Encryption method	WAP/WAP2-PSK
Encryption algorithm	AES
Router Password	WiFi_Burn-in

**Failure to join the network may be caused by:**  
No router / weak Wi-Fi signal / incorrect password

★ **Help: The Wizard will help you to complete settings within one minute.**

Start Setup

**Please select your current wireless network**

SSID	AUTH/ENCRY	RSSI	Channel
<input type="radio"/> WiFi_Burn-in	WPAPSKWPA2PSK/TKIPAES	66	1
<input type="radio"/> WiFi_Burn-in	WPAPSKWPA2PSK/TKIPAES	100	1
<input type="radio"/> WiFi_Burn-in	WPAPSKWPA2PSK/TKIPAES	70	1
<input type="radio"/> WiFi_Burn-in2	WPAPSKWPA2PSK/TKIPAES	72	1

Refresh

★ **Help:** When the received signal strength indicator (RSSI) for the selected Wi-Fi network is lower than 15%, the connection may be unstable. Please select another available network or reduce the distance between the device and router. If your wireless router does not broadcast SSID, please click "Next" and add a wireless network manually.

Back Next

#### Step 3

1. Enter the password for the router, then click "Next".
2. Click "Complete".

**Add wireless network manually**

Network name (SSID)	WiFi-Test
Encryption method	WPA/WPA2-PSK
Encryption algorithm	AES

**Please enter the wireless network password:**

Password (8-63 bytes)	Router password
	show psk

**Note:** SSID and password are case sensitive. Please make sure all wireless network parameters match those of the router, including the password.

Back Next

**Note:**  
If the Wi-Fi module fails to connect to the network after entering the correct password, the hotspot password may contain special characters not supported by the module.

**Save success!**  
Click "Complete", and the current configuration will take effect after restart.

If you still need to configure details on the other pages, please proceed to complete those as required.

Configuration is now complete. You can log on to the Management page to restart device by clicking on the "OK" button.

Confirm to complete?

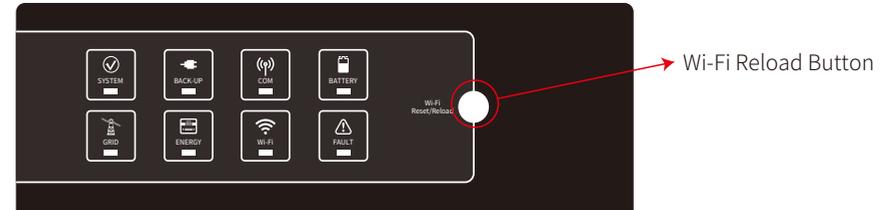
Back Complete

Note:

1. Please make sure the password and encryption method/algorithm are the same as the router's.
2. If everything is ok, the Wi-Fi LED on the inverter will change from a pattern of two blinks to four blinks and then to a constant state, indicating successful Wi-Fi connection to the server.
3. Wi-Fi configuration can also be completed using the PV Master app. For details please see the PV Master app.

#### Wi-Fi Reset & Reload

Wi-Fi reset restarts the Wi-Fi module. Wi-Fi settings will be reprocessed and saved automatically. Wi-Fi reload will restore the Wi-Fi module's default factory settings.



#### Wi-Fi Reset

Short press reset button.  
Wi-Fi LED will blink for a few seconds.

- Note:**  
Wi-Fi reset & reload functions should only be used when:
1. Wi-Fi loses connection to the internet or cannot connect to the PV Master app successfully.
  2. The "Solar-WiFi signal" cannot be detected, or you have other Wi-Fi configuration problems.

#### Wi-Fi Reload

Long press reset button (longer than 3s).  
Wi-Fi LED will double blink until Wi-Fi is configured again.

### 3.2 PV Master App

PV Master is an external monitoring/configuration application for hybrid inverters. It can be used on Android and iOS smartphones and tablets. Its main functions are as described below:

1. Edit the system configuration to operate as required by the customer.
2. Monitor and check performance of the hybrid system.
3. Wi-Fi configuration.

Please download the PV Master app from the Google Play Store or Apple App Store. You can also download the app by scanning the QR code on the back of this user manual.

Please download "PV Master Operation Instructions" from [www.goodwe.com](http://www.goodwe.com)



### 3.3 CEI Auto-Test Function

A PV auto-test function for CEI is included in the PV Master app to meet Italy's requirements. For detailed instruction for this function please refer to "PV Master Operation Instructions".

## 4.1 Error Messages

The error messages below will be displayed on the PV Master app or reported by e-mail if an error occurs.

Error Message	Explanation	Reason	Solutions
Utility Loss	Public grid power is not available (power is lost or on-grid connection fails)	Inverter cannot detect the connection of grid	<ol style="list-style-type: none"> <li>1. Use a multi-meter to check whether there is a voltage present on the AC side. Make sure grid power is available.</li> <li>2. Ensure AC cables are properly and securely connected.</li> <li>3. If all is well, please turn off the AC breaker and turn it back on after 5 minutes.</li> </ol>
VAC Failure	Grid voltage is not within permissible range	Inverter detects that AC voltage exceeds the normal range required by the safety country.	<ol style="list-style-type: none"> <li>1. Ensure the inverter's safety country is set correctly.</li> <li>2. Use a multi-meter to check that the AC voltage (Between L and N) is within the normal range. Repeat this check on the AC breaker side. <ol style="list-style-type: none"> <li>a. If the AC voltage is high, make sure the AC cable complies with the requirements stated in the user manual, and is not too long.</li> <li>b. If the voltage is low, make sure the AC cable is properly connected and the AC cable sleeve is not compressed into the AC terminal.</li> </ol> </li> <li>3. Make sure the grid voltage in your area is stable and within normal range.</li> </ol>
FAC Failure	Grid frequency is not within permissible range	Inverter detects that the grid frequency is outside the normal range required by the safety country.	<ol style="list-style-type: none"> <li>1. Make sure the inverter's safety country is set correctly.</li> <li>2. If the safety country is correct, please check the inverter display to ensure the AC frequency (FAC) is within a normal range.</li> <li>3. If FAC failure only appears a few times and resolves quickly, it may be caused by occasional grid frequency instability.</li> </ol>
PV Over Voltage	Total DC voltage of the PV string is too high	The total voltage (short-circuit voltage) of each PV string is higher than the maximum DC input voltage of the inverter.	<p>Check the PV string VOC is lower than the max PV input voltage of the inverter</p> <p>If the VOC of the PV string is high, please decrease the number of panels to make sure VOC does not exceed the maximum DC input voltage of the inverter.</p>
Over Temperature	Temperature inside the inverter is too high	The inverter's working environment has caused a high temperature condition	<ol style="list-style-type: none"> <li>1. Try to decrease ambient temperature around the inverter.</li> <li>2. Make sure the installation complies with the instructions in the inverter's user manual.</li> <li>3. Try to shut down the inverter for 15 mins, then restart it.</li> </ol>
Isolation Failure	ISO failure could occur for multiple reasons, such as poor PV panel grounding, a faulty DC cable, ageing of PV panels, or comparatively high ambient humidity etc.	Isolation failure could occur for multiple reasons, such as poor PV panel grounding, a faulty DC cable, ageing of PV panels, or comparatively high ambient humidity etc.	<ol style="list-style-type: none"> <li>1. Use a multi-meter to check whether the resistance between earth and the inverter frame is close to zero. If it is not, please ensure that the connection is adequate.</li> <li>2. Excessive humidity can cause isolation failure.</li> <li>3. Check the resistance between PV1+/PV2+/BAT+/PV- and earth. If the resistance is lower than 33.3k, check the system's wiring connections.</li> <li>4. Try to restart the inverter. Check whether the fault still occurs. If not, it may have been caused by an intermittent problem. Please contact the after-sales team for further support.</li> </ol>
Ground Failure	Ground leakage current is too high	Ground failure could occur for multiple reasons, such as poor connection of the neutral cable on the AC side, or comparatively high ambient humidity etc.	Using a multi-meter, check for a voltage between earth and the inverter frame. This should normally be around 0V. If a voltage is present, it suggests the neutral and ground cables are not properly connected on the AC side. If this only occurs when air humidity is higher than normal, such as early morning, at dawn or on rainy days, and only lasts a short time, this is normal behaviour.
Relay Check Failure	Self-checking for relay failure	Neutral and ground cables are not connected well on the AC side or just an occasional failure	Using a multi-meter, check for high voltage high voltage between the N and PE cable on the AC side. This should normally be lower than 10V. If the voltage is higher than 10V, this suggests the neutral and ground cables are not properly connected on the AC side. You may need to restart the inverter.
DC Injection High	/	The inverter detects a higher DC component in the AC output	Try to restart the inverter. Check if the fault still occurs. If not, it is just an intermittent condition. Otherwise, contact after-sales support immediately.
EEPROM R/W Failure	/	Caused by a strong external magnetic field etc.	Try to restart the inverter. Check if the fault still occurs. If not, it is just an intermittent condition. Otherwise, contact after-sales support immediately.
SPI Failure	Internal communication fails	Caused by a strong external magnetic field etc.	Try to restart the inverter. Check if the fault still occurs. If not, it is just an intermittent condition. Otherwise, contact after-sales support immediately.
DC Bus High	BUS voltage is over-high	/	Try to restart the inverter. Check if the fault still occurs. If not, it is just an intermittent condition. Otherwise, contact after-sales support immediately.
Back-Up Overload	Back-up side is overloaded	Total back-up load power is higher than the back-up nominal output power	Reduce back-up loads to ensure the total load power is less than the nominal back-up output power (please refer to page 11).

## 4.2 Troubleshooting

### Checks Before Turning On AC Power

- **Battery Connection:** Check the connection between the EM inverter and the battery: Polarities (+/-) must not be reversed (refer to figure 4.2-1).
- **PV Input Connection:** Check the connection between the EM inverter and PV panels: Polarities (+/-) must not be reversed (refer to figure 4.2-2).
- **On-Grid and Back-Up Connection:** Check the on-grid connection to the power grid, and the back-up connection to the loads: Polarities (L1/L2/L3/N should be in sequence) must not be reversed (refer to figure 4.2-3).
- **Smart Meter and CT Connection:** Ensure the Smart Meter and CT are connected between the house loads and grid, and match the Smart Meter direction markings on the CT (refer to figure 4.2-4).

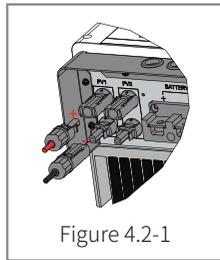


Figure 4.2-1

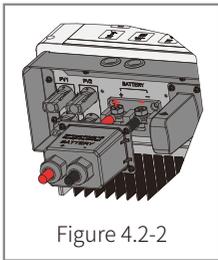


Figure 4.2-2

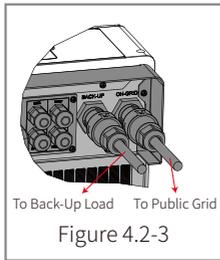


Figure 4.2-3

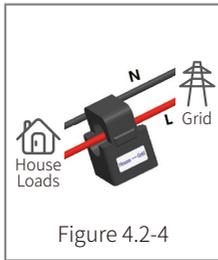
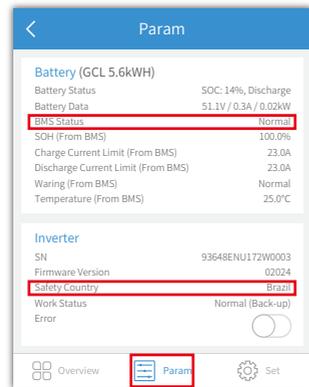
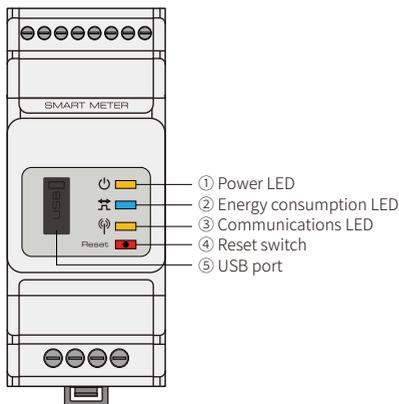


Figure 4.2-4

### Checks When Starting the EM and Turning On AC Power

#### Battery Settings, BMS Communication and Safety Country:

After connecting Solar-WiFi\* (\*The name of the Wi-Fi connection is the last 8 characters of the inverter's serial number), check "Param" settings in the PV Master app to ensure the battery type selected matches the battery installed and that the "Safety Country" Setting is correct. Please change these settings in "Set" if they are not correct.



Note: For compatible lithium batteries, BMS status will display "Normal" after selecting the correct battery manufacturer.

### Problems During Operation

#### Inverter does not start up with battery only

##### Solution:

Ensure the battery voltage is greater than 48V, otherwise battery will be unable to start the EM inverter.

#### Inverter not started up with PV only

##### Solution:

1. Ensure the PV voltage is greater than 125V (200V is required to enter on-grid mode).
2. Check the connection between EM and PV panels: Polarities (+/-) must not be reversed.

#### The inverter doesn't discharge or output without PV or when PV is lower than load power

##### Solution:

1. Check that the EM inverter and Smart Meter are able to communicate.
2. Ensure load power is higher than 150W.
  - a. The battery will not discharge continuously unless load power is greater than 150W.
  - b. If the battery does not discharge when meter power is greater than 150W, please check the Smart Meter & CT connection and polarity.
3. Make sure SOC (state of discharge) is higher than 1-DOD (depth of discharge). If the battery discharges to below 1-DOD, it will only discharge again when SOC is charged to  $(20\% + 1 - DOD) / 2$  and  $SOC > 105\% - DOD$ . (If immediate battery discharge is required, the user should restart battery.)
4. Use the app to check whether charge time has been set already, since the battery cannot discharge whilst charging. (The battery will prioritise charging when charge/discharge times coincide).

#### Battery does not charge when PV power is greater than load power

##### Solution:

1. Check the discharge time setting on the app.
2. Check whether the battery is fully charged and the battery voltage reaches "charge voltage".

#### High power fluctuation during battery charge or discharge

##### Solution:

1. Check whether there is a fluctuation in load power.
2. Check whether there is a fluctuation in PV power.

## Battery does not charge:

### Solution:

1. Ensure BMS communication is OK using the PV Master app (for lithium batteries).
2. Check that the CT is connected in the correct position and direction, as per chapter 2.4.4: Smart Meter & CT Connection.
3. Check whether the total load power is much greater than PV power.

## Questions & Answers (Q & A)

### Wi-Fi Configuration

#### Q: Why can't I find the Solar-WiFi\* signal on mobile devices?

A: Normally the Solar-WiFi\* signal can be detected immediately after powering up the inverter. However, the Solar-WiFi signal will disappear when the EM unit connects to the internet. If you need to change settings, connect via the router instead. If you can't find the Wi-Fi signal or connect to the router, please try to reload the Wi-Fi settings (refer to 3.1 Wi-Fi Configuration).

#### Q: Why can't I connect to the Solar-WiFi\* signal on my phone?

A: The Wi-Fi module can only connect to one device at a time. If the signal is already connected to another device, you will be unable to connect to it using your phone.

#### Q: Why does the Wi-Fi module fail to connect to the network after I select the correct router hotspot and enter the right passwords?

A: It's possible that your hotspot password contains special characters not supported by the module. Please modify your password to include only Arabic numerals and or uppercase/low-ercase letters.

### Battery Operation

#### Q: Why does the battery not discharge when the grid is not available, while it discharges normally when grid is available?

A: On the app, the off-grid output and back-up functions must be enabled for the battery to discharge in off-grid mode.

#### Q: Why is there no output on the back-up side?

A: To enable the back-up supply, "Back-Up Supply" on the PV Master app must be turned on. In off-grid mode or when grid power is disconnected, the "Off-Grid Output Switch" function must also be turned on.

Note: When enabling the "Off-Grid Output Switch" function, don't restart the inverter or battery, otherwise the function will be switched off automatically.

#### Q: With lithium batteries, why does the battery switch always trip when it is started up?

A: The lithium battery switch will normally trip for the following reasons:

1. BMS communication fails.
2. Battery SOC is too low, and the battery trips to protect itself.
3. An electrical short-circuit occurred on the battery connection side. There may be other reasons. Please contact after-sales support for further information.

#### Q: Which battery should I use with the EM series inverter?

A: Lithium batteries compatibility with EM series inverters, and with a nominal voltage of 48V can be used. For compatible lithium batteries please refer to the battery list in the PV Master app.

### PV Master Operation and Monitoring

#### Q: Why can't I save settings in the PV Master app?

A: This could be caused by loss of connection to the Solar-WiFi \* signal.

1. Ensure you have already connected to Solar-WiFi\* directly (if no other devices are connected) or via the router (if you have connected Solar-WiFi\* to your router). The app's homepage should display if the connection is working.
2. Make sure you restart the inverter 10 minutes after changing settings, since the inverter will save settings every 10 minutes during normal operation. We recommend changing settings when inverter is in standby mode.

#### Q: Why is the information displayed on the homepage different from that on the param page, for e.g., parameters such as charge/discharge, PV value, load value or grid value?

A: The data refresh frequency varies, so there may be inconsistencies between information displayed on different pages in the app, as well as between the portal and the app.

#### Q: Some columns (e.g. battery SOH) display NA. Why does this happen?

A: NA indicates that the app has not received data from the inverter or server due to a communication problem e.g., with battery communication or communication between the inverter and the app.

## About Smart Meter and Power Limit Function

### Q: How do I activate the output power limit function?

A: In an EM system, this function can be implemented as follows:

1. Ensure the Smart Meter is connected and communicating properly.
2. Turn on the export power limit function and set the max output power to grid in the app.

Note: Even if the output power limit is set to 0W, there may still be a deviation of max 100W when exporting to the grid.

### Q: Why is power still being exporting to the grid after I set the power limit to 0W?

A: The export limit can be 0W in theory, but this may deviate by around 50-100W in an EM system.

### Q: Can I replace the Smart Meter supplied with the EM system with another brand of meter or change some of the settings in the Smart Meter?

A: No. The inverter and Smart Meter use a dedicated communications protocol that is not supported by other brands of meter. Additionally, manually changing the meter's settings could cause communication failure.

### Q: What is the maximum current allowed through the CT on the Smart Meter?

A: The max current for the CT is 120A.

## Other Questions

### Q: Is there a quick way to get the system working?

A: For the shortest setup, please refer to the "EM Quick Installation Instructions" and "PV Master App Instruction".

### Q: What kind of load can connect to the back-up side?

A: Please refer to section 2.4.3 On-Grid & Back-Up Connection: Declaration for Back-Up Overload Protection

### Q: Will the inverter's warranty of the inverter still be valid if, for some particular reason, we cannot completely follow the instructions in the user manual for installation or operation?

A: Normally we would still provide technical support for problems caused by failing to adhere to the instructions in the user manual. However we cannot guarantee to provide replacements or accept returns. Therefore, if there are particular reasons why you cannot fully comply with the instructions, please contact the after-sales team for advice in the first instance.

## 4.3 Disclaimer

EM series inverters must be transported, installed and operated under specified environmental and electrical conditions. The manufacturer has the right not to provide after-sales services or assistance under the following conditions:

- The inverter is damaged during transportation.
- The inverter is outside its one-year warranty and an extended warranty was not purchased.
- The inverter has been installed, refitted or operated improperly, without the manufacturer's prior consent.
- The inverter has been installed or operated under improper environmental or technical conditions, as described in this user manual, without the manufacturer's prior consent.
- The requirements described in this manual were not adhered to during installation or configuration of the inverter.
- The inverter has been installed or operated contrary to the requirements or warnings provided in this user manual.
- The inverter is broken or damaged by any force majeure e.g., lightning, earthquake, fire hazard, storm, or volcanic eruption.
- The inverter's hardware or software has been disassembled, modified or updated in any way without the manufacturer's prior consent.
- The inverter has been installed or operated contrary to any relevant international or local policies or regulations.
- Any non-compatible batteries, loads or other devices have been connected to the EM system.

Note:

The manufacturer retains the right to explain all the contents in this user manual. To insure IP65 rating compliance, inverter must be well sealed: Please install the inverter within one day of unpacking; otherwise please seal all unused terminals/holes such that there is no risk of water or dust ingress.

## Maintenance

The inverter requires periodical maintenance. Details are provided below:

- Ensure the inverter is fully isolated from all DC and AC power for at least 5 minutes before starting any maintenance work.
- Heat sink: Please use a clean towel to clean up the heat sink once a year.
- Torque: Please use a torque wrench to tighten AC and DC wiring connections once a year.
- DC breaker: Check the DC breaker regularly, and activate it 10 times in a row once a year.
- Operating the DC breaker will clean its contacts and extend its lifespan.
- Waterproof plate: Replace the waterproof plate of the RS485 connector and other parts once a year.

## 4.4 Technical Parameters

Technical Data	GW3048D-EM	GW3648D-EM	GW5048D-EM
<b>Battery Input Data</b>			
Battery Type	Li-Ion	Li-Ion	Li-Ion
Nominal Battery Voltage (V)	48	48	48
Max. Charging Voltage (A)	≤60 (Configurable)	≤60 (Configurable)	≤60 (Configurable)
Max. Charging Current (A) [1]	50	50	50
Max. Discharging Current (A) [1]	50	50	50
Battery Capacity (Ah) [2]	50~2000	50~2000	50~2000
Charging Strategy for Li-Ion Batteries	Self-adaption to BMS	Self-adaption to BMS	Self-adaption to BMS
<b>PV String Input Data</b>			
Max. DC Input Power (W)	3900	4600	6500
Max. DC Input Voltage (V) [3]	550	550	550
MPPT Range (V)	100~500	100~500	100~500
Start-up Voltage (V)	125	125	125
Min. Feed-in Voltage (V) [4]	150	150	150
MPPT Range for Full Load (V)	280~500	170~500	230~500
Nominal DC Input Voltage (V)	360	360	360
Max. Input Current (A)	11/11	11/11	11/11
Max. Short Current (A)	13.8	13.8/13.8	13.8/13.8
No. of MPP Trackers	1	2	2
No. of Strings per MPP Tracker	1	1	1
<b>AC Output Data (On-grid)</b>			
Nominal Power Output to Utility Grid(W)	3000	3680	5000 [5]
Max. Apparent Power Output to Utility Grid (VA) [6]	3000	3680	5000
Max. Apparent Power from Utility Grid (VA)	5300	5300	5300
Nominal Output Voltage (V)	230	230	230
Nominal Output Frequency (Hz)	50/60	50/60	50/60
Max. AC Current Output to Utility Grid (A)	13.6	16	22.8 [7]
Max. AC Current From Utility Grid (A)	23.6	23.6	23.6
Output Power Factor	~1 (Adjustable from 0.8 leading to 0.8 lagging)		
Output THDi (@Nominal Output)	<3%	<3%	<3%

[1] Actual charge and discharge currents also depend on the battery.

[2] In off-grid mode, battery capacity should be greater than 100Ah.

[3] Maximum operating DC voltage is 530V.

[4] When there is no battery connected, the inverter only starts feeding in if the string voltage exceeds 200V.

[5] 4600 for VDE0126-1-1&VDE-AR-N4105 & CEI 0-21 (GW5048-EM).

Technical Data	GW3048D-EM	GW3648D-EM	GW5048D-EM
<b>AC Output Data (Back-up)</b>			
Max. Output Apparent Power (VA)	2300	2300	2300
Peak Output Apparent Power (VA)*8	3500, 10 sec	3500, 10 sec	3500, 10 sec
Automatic Switch Time (ms)	10	10	10
Nominal Output Voltage (V)	230 (±2%)	230 (±2%)	230 (±2%)
Nominal Output Frequency (Hz)	50/60 (±0.2%)	50/60 (±0.2%)	50/60 (±0.2%)
Max. Output Current (A)	10	10	10
Output THDv (@Linear Load)	<3%	<3%	<3%
<b>Efficiency</b>			
Max. Efficiency	97.6%	97.6%	97.6%
Max. Battery to Load Efficiency	94.5%	94.5%	94.5%
Europe Efficiency	97.0%	97.0%	97.0%
MPPT Efficiency	99.9%	99.9%	99.9%
<b>Protection</b>			
Anti-islanding Protection	Integrated		
PV String Input Reverse Polarity Protection	Integrated		
Insulation Resistor Detection	Integrated		
Residual Current Monitoring Unit	Integrated		
Output Over Current Protection	Integrated		
Output Short-circuit Protection	Integrated		
Output Over Voltage Protection	Integrated		
<b>General Data</b>			
Operation Temperature Range (°C)	-25~60	-25~60	-25~60
Relative Humidity	0~95%	0~95%	0~95%
Operating Altitude (m)	4000	4000	4000
Cooling	Nature Convection	Nature Convection	Nature Convection
Noise (dB)	<25	<25	<25
User Interface	LED & APP	LED & APP	LED & APP
Communication with BMS [9]	RS485; CAN	RS485; CAN	RS485; CAN
Communication with Meter	RS485	RS485	RS485
Communication with Portal	Wi-Fi	Wi-Fi	Wi-Fi
Weight (kg)	16	17	17
Size (Width*Height*Depth mm)	347*432*175	347*432*175	347*432*175
Mounting	Wall Bracket	Wall Bracket	Wall Bracket
Protection Degree	IP65	IP65	IP65
Standby Self-consumption (W)	<13	<13	<13
Topology	Battery Isolation	Battery Isolation	Battery Isolation

[6] For CEI 0-21 GW3048-EM is 3300,GW3648-EM is 4050,GW5048-EM is 5100;for VDE-AR-N4105 GW5048-EM is 4600.

[7] 21.7A for AS4777.2.

Technical Data	GW3048D-EM	GW3648D-EM	GW5048D-EM
<b>Certifications and Standards [10]</b>			
Grid Regulation	VDE-AR-N4105; VDE 0126-1-1 EN 50549-1;G98,G100; CEI 0-21;AS/NZS 4777.2 NRS 097-2-1	VDE-AR-N4105; VDE 0126-1-1 EN 50549-1;G98,G100; CEI 0-21;AS/NZS 4777.2 NRS 097-2-1	VDE-AR-N4105; VDE 0126-1-1 EN 50549-1;G99,G100; CEI 0-21;AS/NZS 4777.2 NRS 097-2-1
Safety Regulation	IEC/EN62109-1&2, IEC62040-1	IEC/EN62109-1&2, IEC62040-1	IEC/EN62109-1&2, IEC62040-1
EMC	EN61000-6-1, EN61000-6-2, EN61000-6-3, EN61000-6-4 EN 61000-4-16, EN 61000-4-18, EN 61000-4-29	EN61000-6-1, EN61000-6-2, EN61000-6-3, EN61000-6-4 EN 61000-4-16, EN 61000-4-18, EN 61000-4-29	EN61000-6-1, EN61000-6-2, EN61000-6-3, EN61000-6-4 EN 61000-4-16, EN 61000-4-18, EN 61000-4-29

[8] Can be reached only if PV and battery power are sufficient.

[9] CAN communication is configured by default. If RS485 communication is used, please replace the corresponding communication line.

[10] Not all certifications and standards are listed. Please see the official website for further details.

#### 4.5 Other Tests

For Australian requirements, in the THDi test, Zref should be added between inverter and mains.

RA, XA for Line conductor

RN, XN for Neutral conductor

Zref:

RA=0, 24; XA=j0,15 at 50Hz;

RN=0, 16; XN=j0,10 at 50Hz

#### 4.6 Quick Check List to Avoid Danger

1. The inverter must not be installed near flammable or explosive materials, or strong electromagnetic equipment. Please refer to 2.3.1 Select Mounting Location.
2. Remember that this inverter is heavy! Please be careful when removing it from the packaging. Please refer to 2.3.2 Mounting.
3. Ensure the battery breaker is off and the battery's nominal voltage complies with EM series specifications before connecting the battery to the inverter, and ensure the inverter is fully isolated from PV and AC power. Please refer to 2.4 Electrical Wiring Connection.
4. Ensure the inverter is fully isolated from DC and AC power before connecting the AC cable. Please refer to 2.4.3 On-Grid and Back-Up Connection.
5. Ensure the AC cable is fully isolated from AC power before connecting the Smart Meter & CT, please refer to 2.4.4 Smart Meter & CT Connection.

#### Appendix Protection Category Definition

Overvoltage category definition

<b>Category I</b>	Applies to equipment connected to a circuit where measures have been taken to reduce transient overvoltage to a low level.
<b>Category II</b>	Applies to equipment not permanently connected to the installation. Examples are appliances, portables tools and other items of plug-connected equipment.
<b>Category III</b>	Applies to fixed equipment downstream of and including the main distribution board. Examples are switchgear and other industrial equipment.
<b>Category IV</b>	Applies to equipment permanently connected at the installation point (upstream of the main distribution board). Examples are electricity meters, primary over-current protection equipment and other items of equipment connected directly to outdoor open lines.

Moisture Location Category Definition

Moisture Parameters	Level		
	3K3	4K3	4K4H
<b>Temperature Range</b>	0~+40°C	-33~+40°C	~20~+55°C
<b>Moisture Parameters</b>	5%~85%	15%~100%	4%~100%

Environment category definition

Environment Condition	Ambient Temperature	Relative Humidity	Applies to
<b>Outdoor</b>	-20~50°C	4%~100%	PD3
<b>Indoor Unconditioned</b>	-20~50°C	5%~95%	PD3
<b>Indoor conditioned</b>	0~40°C	5%~85%	PD2

## Pollution degree definition

<b>Pollution Degree I</b>	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
<b>Pollution Degree II</b>	Normally only non-conductive pollution occurs. Occasionally, temporary conductivity caused by condensation must be expected.
<b>Pollution Degree III</b>	Conductive pollution occurs, or dry non-conductive pollution that becomes conductive due to condensation occurs, which is as expected.
<b>Pollution Degree IV</b>	Persistent conductive pollution occurs, for example, pollution caused by conductive dust, rain or snow.