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GoodWe EM series, also called hybrid or bidirectional solar inverters, apply to solar system with participation of PV, battery, loads and grid system for energy management. The energy produced by PV system shall be used to optimize self-consumption, excess power charge battery and the rest power could be exported to the grid. Battery shall discharge to support loads when PV power is insufficient to meet self-consumption. If battery power is not sufficient, the system will take power from grid to support loads.

1.1 OPERATION MODES INTRODUCTION

EM system normally has the following work modes based on your configuration and layout conditions:

**Mode I**
- The energy produced by the PV system is used to optimize self-consumption. The excess energy is used to recharge the batteries, then exported to grid.

**Mode II**
- When there is no PV, and the battery is sufficient, it can supply the load together with grid power.

**Mode III**
- When grid fails, the system automatically switches to Back-Up mode. The Back-Up load can be supported by PV and battery.

**Mode IV**
- Battery can be charged by grid, and charging time/power can be set flexibly on PV Master APP.

1.2 SAFETY & WARNING

The EM series inverters of Jiangsu GoodWe Power Supply Technology Co., Ltd. (hereinafter called as GoodWe) strictly comply with related safety rules for product design and testing. Please read and follow all the instructions and cautions on the inverter or user manual during installation, operation or maintenance, as any improper operation might cause personal or property damage.

**• SYMBOLS EXPLANATION**

- **Caution!**
  - Failing to observe a warning indicated in this manual may result in injury.

- **Danger of high voltage and electric shock!**

- **Danger of hot surface!**

- **Components of the product can be recycled.**

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

- **No more than six (6) identical packages being stacked on each other.**

- **Product should not be disposed as household waste.**

- **The package/product should be handled carefully and never be tipped over or slung.**

- **Refer to the operating instructions.**

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

- **Inverter will be touchable or operable after minimum 5 minutes of being turned off or totally disconnected, in case of any electrical shock or injury.**

- **CE Mark**
**SAFETY WARNING**

Any installation and operation on inverter must be performed by qualified electricians, in compliance with standards, wiring rules or requirements of local grid authorities or companies (like AS 4777 and AS/NZS 3000 in Australia).

Before any wiring connection or electrical operation on inverter, all DC and AC power must be disconnected from inverter for at least 5 minutes to make sure inverter is totally isolated to avoid electric shock.

The temperature of inverter surface might exceed 60 °C during working, so please make sure it is cooled down before touching it, and make sure the inverter is untouchable for children.

Do not open inverter cover or change any components without GoodWe’s authorization, otherwise the warranty commitment for the inverter will be invalid.

Usage and operation of the inverter must follow instructions in this user manual, otherwise the protection design might be useless and warranty for the inverter will be invalid.

Appropriate methods must be adopted to protect inverter from static damage. Any damage caused by static is not warranted by GoodWe.

PV negative (PV-) on inverter side is not grounded as default design.

PV modules used on the inverter must have an IEC61730 class A rating, and the total open-circuit voltage of PV string/array is lower than the maximum rated DC input voltage of the inverter. Any damage caused by PV over-voltage is beyond warranty.

The inverter, with built-in RCMU, will exclude possibility of DC residual current to 6mA, thus in the system an external RCD (type A) can be used (≥30mA).

In Australia, the inverter internal switching does not maintain neutral integrity, which must be addressed by external connection arrangements like in the Off-Grid System Connection Diagram in page 16.

IN Australia, output of Back-Up side in switchbox should be labeled ‘Main Switch UPS supply’, the output of normal load side in switch box should be labeled ‘Main Switch Inverter Supply’.

---

### 1.3 PRODUCT OVERVIEW

**LED INDICATORS**

- **ON**: Fault has occurred
- **BLINK**: Overload of Back-Up output / reduce load
- **OFF**: No fault
- **BLINK 1**: Battery is discharging
- **BLINK 2**: Battery is low / SOC is low
- **OFF**: Battery is disconnected / not active
- **ON**: Grid is active and connected
- **BLINK**: Grid is active but not connected
- **OFF**: Grid is not active
- **ON**: Supplying energy to grid / zeroing
- **BLINK 1**: Supplying energy to grid / selling
- **ON**: Wi-Fi connected / active
- **BLINK 1**: Wi-Fi system resetting
- **ON**: System is ready
- **BLINK**: System is starting up
- **OFF**: System is not operating
- **ON**: Back-up is ready / power available
- **OFF**: Back-up is off / no power available

**Diagram Elements**

- **DC Switch** (Optional)
- **Battery Terminals**
- **Wi-Fi Box**
- **Exhaust Valve**
- **On-Grid Port**
- **Back-Up Port**
- **Wi-Fi Reset/Reload Button**
- **BMS Communication Cable**
- **EZMeter Communication Cable**
- **PV Terminals**
- **To Battery**
- **To EzMeter**
- **Reserved RS485**
- **Wi-Fi**
- **ENERGY**
- **BATTERY**
- **COM**
- **BACKUP**
- **SYSTEM**
- **EMERGENCY**
- **FAULT**
- **OFF**
- **ON**
- **BLINK 1**
- **BLINK 2**
- **COM**
- **04**
- **03**
2.1 UNACCEPTABLE INSTALLATIONS

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

- Back-Up Side Cannot Connect to Grid
- Back-Up Cannot Connect in Parallel
- Single PV String Cannot Connect to Two or More Inverters
- Back-Up On-Grid
- On-Grid or Back-Up Side Cannot Connect to Any AC Generator
- Backup Side Cannot Connect to Air Conditioner
- Incompatible Battery
- On-Grid or Back-Up Side Cannot Connect to Any AC Generator

2.2 PACKING LIST

On receiving the inverter, please check to make sure all the components as below are not missing or broken.

- Inverter x 1
- EzMeter & CT x 1
- Positive DC Plug x 2
- Negative DC Plug x 2
- AC Plug x 2
- Battery x 2
- Battery cover x 1
- Wall-mounted Bracket x 1
- Expansion Bolt x 6
- Hexagon head screw x 2
- Pan head screw x 6
- User Manual x 1
- Quick Installation Guide x 1

2.3 MOUNTING

2.3.1 SELECT MOUNTING LOCATION

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

**Rule 1.** Inverter should be installed on a solid surface, where is suitable for inverter’s dimensions and weight.

**Rule 2.** Inverter installation should stand vertically or lie on a slop by max 15° (Pic 1)

**Rule 3.** Ambient temperature should be lower than 45°C

**Rule 4.** The installation of inverter should be protected under shelter from direct sunlight or bad weather like snow, rain, lightning etc. (Pic 2)

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

**Rule 6.** Product label on inverter should be clearly visible after installation.

**Rule 7.** Leave enough space around inverter following the values on pic 3.

Inverter cannot be installed near flammable, explosive or strong electro-magnetic equipment. [1]
2.3.2 MOUNTING

Remember that this inverter is heavy! Please be careful when lifting out from the package.¹

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

**Step 1**
- Please use the mounting bracket as a template to drill 6 holes on right positions (10mm in diameter, and 80mm in depth) (Pic 4)
- Use expansion bolts in accessory box and fix the mounting bracket onto the wall tightly

NOTE: Bearing capacity of the wall must be higher than 17KG, otherwise may not be able to keep inverter from dropping.

**Step 2**

Carry the inverter by holding the heating sink on two sides and place the inverter on the mounting bracket. (Pic 5)

NOTE: Make sure the heat sink on inverter is rightly joint with mounting bracket.

**Step 3**

Ground cable shall be connected to ground plate on grid side (Pic 6)

**Step 4**

A lock could be used for anti-theft if it is necessary for individual requirement. (Pic 7)

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2.4 ELECTRICAL WIRING CONNECTION

2.4.1 PV CONNECTION

Before connecting PV panels/strings to inverter, please make sure requirements are followed as below:

- The total short-circuit current of PV string must not exceed inverter’s max DC current
- The minimum isolation resistance to ground of the PV string must exceed 18.33kΩ in case of any shock hazard
- PV strings could not connect to earth/grounding conductor
- Use the DC plugs in the accessory box

NOTE: There will be MC4 or Amphenol DC plugs in accessory box, the detailed connection as below:

**Step 1**

Prepare PV cables and DC plugs (Pic 8)

**Step 2**

Connect PV cable to DC connectors (Pic 9)

**Step 3**

Screw the cap on and plug onto inverter side (Pic 10)

NOTE:
- Please use DC plugs and connectors in GoodWe accessory box
- PV cable should be standard, 2.5-4mm² PV cable
- PV cable must be tightly crimped into the connectors
- For Amphenol connector, the limit buckle cannot be pressed

NOTE: There will be a click sound if connectors are inset correctly into DC plugs

The polarity of PV strings or on the inverter cannot be connected by reverse, otherwise inverter could be damaged.²
2.4.2 BATTERY CONNECTION

• For lithium battery (pack) the capacity should be 50Ah or larger. Lead acid batteries are not allowed to use with GoodWe hybrid inverters without GoodWe’s authority. Battery cable requirement as below. (Pic 11)

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>O.D.</td>
<td>10-12mm</td>
</tr>
<tr>
<td>B</td>
<td>Isolation section</td>
<td>NA</td>
</tr>
<tr>
<td>C</td>
<td>Conductor Core</td>
<td>20-25mm²</td>
</tr>
</tbody>
</table>

• Please be careful against any electric shock or chemical hazard
• Make sure there is an external DC switch (≥63A) connected for battery without attached DC switch

Battery wiring connection steps as below:

NOTE:
1. Please use accessories from GoodWe box
2. Battery power cable should be 20-25 mm²

Make sure battery switch is off and battery nominal voltage meet EM specification before connecting battery to inverter make sure inverter is totally isolated from PV and AC power.

Step 1
Prepare battery cables and accessories and put battery power cable through battery cover (Pic 12)

NOTE:
1. Please use accessories from GoodWe box
2. Battery power cable should be 20-25 mm²

Step 2
Make battery terminals (Pic 13)
• Strip cable coat, revealing 10mm length of metal core
• Use special crimper to compress battery terminal tightly

Step 3
Connect battery terminals onto inverter (Pic 14)

NOTE: Please make sure polarity (+/-) of battery are not reversed

* For the compatible lithium batteries (LG/Pylon/BYD/GCL) connection, please refer to battery connection part in EM QUICK INSTALLATION INSTRUCTIONS.

• FOR LEAD-ACID BATTERIES

Lead-Acid and other similar older-technology battery types require experienced and precise design, installation and maintenance to work effectively. For details, please refer to Approved Battery Option Statement (download from www.goodwe.com)

For lead-acid battery bank, the inconformity between battery cells might lead to battery cell over-charge or discharge, and further might damage battery cells and shorten battery bank life

For EM series inverters there is no temperature compensation, thus customers need do battery settings based on the real working temperature of battery.

For lead-acid battery settings on PV Master App, please honestly refer to battery specifications and the actually battery work condition like work temperature and battery age. Unsuitable settings will lead to higher SOC deviation, weaker battery lifespan and further battery damage.

For lead-acid batteries, battery SOC calculation might not be so accurate result from like battery inconformity between cells, battery aging or other specifications of lead-acid battery etc.

GoodWe will keep the right for explanation on all the settings suggested and all the problems happened on lead-acid batteries or the whole system. And GoodWe is not responsible for any damage caused by unsuitable settings, battery beyond warranty or battery quality etc.

• BATTERY PROTECTION DESCRIPTION

Battery will act a protective charge/discharge current limitation under any condition as below:

• Battery SOC is lower than 1-DOD
• Battery voltage lower than discharge voltage
• Battery over temperature protection
• Battery communication abnormal for lithium battery
• BMS limitation for lithium battery

When charge/discharge current limitation protection happens:

• Under on-grid mode, battery charge/discharge operation could be abnormal
• Under off-grid mode, Back-Up supply will shut down

NOTE:
• Under off-grid mode, if Back-Up supply shuts off because of battery of low battery SOC or voltage, PV power will all be used to charge battery till battery SOC reaches 40% + (1-DOD)/2, then Back-Up supply will be activated up.
• Under on-grid mode, battery is protected from over discharge by DOD and discharge voltage, under off-grid mode, it is protected by only discharge voltage and DOD.
• The DOD setting of a battery prevents the inverter from discharging battery reserve power. As soon as the DOD is reached the load of building will only be supported by either PV power or from the grid. If there are continuous days when little or no battery charging occurs, the battery may continue to self-consume energy to support communications with the inverter. This behaviour is different between battery manufactures products, however, if the SOC of the battery reaches a certain level the inverter will boost the SOC back up. This protection mechanism safeguards the battery to falling to 0% SOC.
2.4.3 ON-GRID & BACK-UP CONNECTION

An external AC switch (≥32A) is needed for On-Grid connection to isolate from grid when necessary. Below are the requirements on AC switch use:

1. Use a separate AC switch for individual inverter (Pic 15)

2. On AC side, the individual switch should be connected before loads (between inverter and loads) (Pic 16)

• On-Grid wiring connection process is as below:

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prepare the terminals and AC cables</td>
<td>1. Prepare the terminals and AC cables</td>
<td>Connect the assembled AC terminals onto inverter</td>
</tr>
<tr>
<td>2. Put AC cable through terminal cover and screw the three cables tightly on the connectors (Pic 17)</td>
<td>2. Put AC cable through terminal cover and screw the three cables tightly on the connectors (Pic 21)</td>
<td>Note: Make sure it is connected to 'On-Grid' side (other side connected to public grid) (Pic 19)</td>
</tr>
</tbody>
</table>

NOTE:
1. Please use the terminals in GoodWe components box;
2. Make sure cable jacket is not locked with conductor

Special Adjustable Settings
The inverter has field adjustable setting like tripping point, tripping time, reconnect time, active and invalid of QU/PU curves etc. by special firmware. Please contact GoodWe after-sales for the special firmware and adjust methods.

Connection for SPLIT Grid System
In SPLIT grid system, there is a solution to allow inverter work under on-grid condition (Pic 20). But the export power and load power might be detected inaccurately as the nominal output power of inverter is 230V and there could be loads of 110V or 220V

• Back-Up wiring connection process is as below:

An external AC switch (≥32A) is needed for Back-Up connection to be isolated when necessary. Note: The absence of AC breaker on Back-Up side will lead to inverter damage if only electrical short-circuit happen on Back-Up side. And Back-Up function cannot turn off under on-grid condition.

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prepare the terminals and AC cables</td>
<td>Lock terminal cover and screw up the terminal cap</td>
<td>Connect the assembled AC terminals onto inverter</td>
</tr>
<tr>
<td>2. Put AC cable through terminal cover and screw the three cables tightly on the connectors (Pic 21)</td>
<td>Make sure terminal cover is locked up here.</td>
<td>Note: Make sure it is connected to 'Back-Up' side (other side connected to public grid) (Pic 23)</td>
</tr>
</tbody>
</table>

Declaration For Back-Up Loads
GoodWe EM inverter is able to supply a continuous 2300VA output or max 3500VA in less than 10 seconds on Back-Up side to support Back-Up loads. And the inverter has self-protection derating at high ambient temperature.

• Accepted 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 Dust Cleaner etc. and other loads with high inrush current at start-up.

Declaration For Back-Up Overload Protection
Inverter will restart itself as overload protection happens. The preparation time for restarting will be longer and longer (max one hour) if overload protection protection repeats. Take following steps to restart inverter immediately:

• Decrease Back-Up load power within max limitation
• On PV Master →Advanced Setting →Click “Reset Back-Up Overload History”
2.4.4 EZMETER & CT CONNECTION

Make sure AC cable is totally isolated from AC power before connecting EzMeter and CT.[4]

The EzMeter with CT in GoodWe product box is compulsory for EM system installation, used to detect grid voltage and current direction and magnitude, further to instruct the operation condition of EM inverter via RS485 communication.

NOTE:
1. The EzMeter and CT is well configured, please do not change any setting on EzMeter;
2. One EzMeter& CT can only be used for one EM inverter;
3. CT must be connected on the same phase with EzMeter power cable

• EzMeter & CT Connection Diagram (Pic 25)

NOTE:
1. Please use the EzMeter and CT in GoodWe product box;
2. CT cable is 3m as default, could be extended to max 5m
3. EzMeter communication cable (RJ45) is attached on the inverter (“To EzMeter” cable), could be extended to max 100m, and must use standard RJ45 cable and plug, as below:

<table>
<thead>
<tr>
<th>Position</th>
<th>Color</th>
<th>EPM Function</th>
<th>EzMeter Function</th>
<th>RS485</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Orange&amp;white</td>
<td>485_A2</td>
<td>NC</td>
<td>485_A</td>
</tr>
<tr>
<td>2</td>
<td>Orange</td>
<td>NC</td>
<td>NC</td>
<td>485_B</td>
</tr>
<tr>
<td>3</td>
<td>Green&amp;white</td>
<td>485_B2</td>
<td>485_B1</td>
<td>485_A</td>
</tr>
<tr>
<td>4</td>
<td>Blue</td>
<td>CAN_H</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>5</td>
<td>Blue&amp;white</td>
<td>CAN_L</td>
<td>NC</td>
<td>NC</td>
</tr>
<tr>
<td>6</td>
<td>Green</td>
<td>NC</td>
<td>485_A1</td>
<td>485_B</td>
</tr>
<tr>
<td>7</td>
<td>Brown&amp;white</td>
<td>NC</td>
<td>485_B1</td>
<td>NC</td>
</tr>
<tr>
<td>8</td>
<td>Brown</td>
<td>NC</td>
<td>485_A1</td>
<td>NC</td>
</tr>
</tbody>
</table>

• EzMeter LED Indications

CUSTOMER can also check if EzMeter communication OK on PV Master by clicking Grid symbol on home page of Local Configuration - EzMeter Communication Status, where should be “OK”

2.5 DRED & EARTH FAULT ALARM

2.5.1 DRED CONNECTION

DRED is only for Australian and New Zealand installations, in compliance with Australian and New Zealand safety requirements. And DRED device is not provided by GoodWe.

Detailed connection of DRED device is shown below:

Step 1

Screw this plate off from inverter (Pic 26)
Note: DRED device should be connected through “DRED port” as on the figure shows.

Step 2

1. PLUG OUT the 6-Pin terminal and dismantle the resistance on it (Pic 27)
2. PLUG THE RESISTANCE OUT, leave the 6-Pin terminal for next step.
Note: the 6-Pin terminal in the inverter has the same function of DRED device. Please leave it on the inverter if no external device connected.

Step 3

1. Put DRED cable through the plate as shown on pic 28
2. Connect DRED cable on the 6-pin terminal.
The function of each connection position as below:

<table>
<thead>
<tr>
<th>Position</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DRM1/5</td>
</tr>
<tr>
<td>2</td>
<td>DRM2/6</td>
</tr>
<tr>
<td>3</td>
<td>DRM3/7</td>
</tr>
<tr>
<td>4</td>
<td>DRM4/8</td>
</tr>
<tr>
<td>5</td>
<td>REFGEN</td>
</tr>
<tr>
<td>6</td>
<td>COM/DRMO</td>
</tr>
</tbody>
</table>

Customer can also check if DRED communication OK on PV Master by clicking Grid symbol on home page of Local Configuration - DRED Communication Status, where should be “OK”

2.5.2 EARTH FAULT ALARM CONNECTION

GoodWe EM series inverter complies with IEC 62109-2 13.9. Fault indicator LED on inverter cover will light up and the system will email the fault information to customer.
NOTE: For Australian safety country, the neutral cable of On-Grid side and Back-Up side must be connected together, otherwise Back-Up function will not work.
3.1 Wi-Fi Configuration

- This part shows configuration on web page
- Wi-Fi configuration is absolutely necessary for online monitoring and after-sales maintenance

PREPARATION:
1. Inverter must be powered up with only PV power
2. Need a router with available internet access to GoodWe portal www.goodwe-power.com

Step 1
1. Connect Solar-WiFi* to your PC or smart phone (the last 8 characters of the inverter serial No.)
2. Open browser and login 10.10.100.253
   Admin (U): admin; Password: admin
3. Then click “OK”

Step 2
1. Click “Start Setup” to choose your router
2. Then click “Next”

Step 3
1. Fill in the password of the router, then click “Next”
2. Click “Complete”

3. 3.2 PV Master APP Operation

PV Master is an external monitoring/configuration application for GoodWe hybrid inverters, used on smart phones or pad for both Android and iOS system, main functions as below:

1. Edit system configuration to make the system work as customer needs
2. Monitor and check performance of the hybrid system
3. Wi-Fi configuration

Please download PV Master OPERATION INSTRUCTIONS from www.goodwe.com

3.3 CEI Auto-Test Function

PV Auto-Test function of CEI is integrated in PV Master App for Italy safety country requirements. For detailed instruction of this function please refer to PV Master OPERATION INSTRUCTIONS

- Wi-Fi Reset & Reload

Wi-Fi Reset means restarting Wi-Fi module, Wi-Fi settings will be reprocessed and saved.
Wi-Fi Reload means setting Wi-Fi module settings back to default factory setting.

NOTE: Wi-Fi Reset & Reload function are only used when:
1. Wi-Fi loses connection to internet or cannot connect to PV Master App successfully
2. Cannot find “Solar-WiFi signal” or have other Wi-Fi configuration problem
3. Please do not use this button if Wi-Fi monitoring works well

NOTE:
1. Please make sure the password, Encryption Method/Algorithm is right the same with the router’s
2. If everything is right well, the Wi-Fi LED on inverter will change from double blink to quartic blink then to solid status, which means Wi-Fi is connected to GoodWe icloud successfully.
3. Wi-Fi configuration could also be done on PV Master, details please check on PV Master APP
### 4.1 ERROR MASSAGE AND TROUBLESHOOTINGS

**ERROR MASSAGE**

The error massages below will be displayed on PV Master App or report by Email if the error really happen.

<table>
<thead>
<tr>
<th>ERROR MASSAGE</th>
<th>EXPLANATION</th>
<th>REASON</th>
<th>SOLUTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility Loss</td>
<td>Not available of public grid power (power loss or on-grid connection fail)</td>
<td>Inverter does not detect the connection of grid</td>
<td>1. Check (use multi-meter) if AC side has voltage, make sure grid power is available</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Make sure AC cables are connected tightly and right well</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. If all is well, please try to turn off AC breaker and turn on again after 5 mins</td>
</tr>
<tr>
<td>VAC Failure</td>
<td>Grid voltage is not within permissible range</td>
<td>Inverter detects that AC voltage is beyond the normal range required by the safety country</td>
<td>1. Make sure safety country of the inverter is set right</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Check (use multi-meter) if AC voltage (Between L&amp;N) is within a normal range (Also on AC breaker side)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>a. If AC voltage is high, then make sure AC cable complies with that required on user manual and AC cable is not too long</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. If voltage is low, make sure AC cable is connected well and the jacket of AC cable is not compressed into AC terminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Make sure the grid voltage of your area is stable and within normal range.</td>
</tr>
<tr>
<td>FAC Failure</td>
<td>Grid Efficiency is not within permissible range</td>
<td>Inverter detects that Grid frequency is beyond the normal range required by the safety country</td>
<td>1. Make sure safety country of the inverter is set right</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. If safety country is right, then please check on inverter display if AC frequency (Fac) is within a normal range</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. If FAC failure only appear a few times and resolved soon, it should be caused by occasional grid frequency unstability.</td>
</tr>
<tr>
<td>PV Over Voltage</td>
<td>DC total voltage of PV string is too high</td>
<td>The total voltage (short-circuit voltage) of each PV string is higher than the max DC input voltage of the inverter.</td>
<td>Check PV string VOC is lower than Max PV Input Voltage of the inverter.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If VOC of PV string is high, please decrease panels to make sure VOC is with the max DC input voltage of the inverter.</td>
</tr>
<tr>
<td>Over Temperature</td>
<td>Temperature inside of the inverter is too high</td>
<td>Inverter working environment leads to a high temperature condition</td>
<td>1. Try to decrease surrounding temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Make sure the installation complies with the instruction on inverter user manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Try to close inverter for 15 mins, then start up again.</td>
</tr>
<tr>
<td>Isolation Failure</td>
<td>Ground insulation impedance of PV string is too low</td>
<td>Isolation failure could be caused by multi reasons like PV panels are not grounded well, DC cable is broken, PV panels are aged or surrounding humidity is comparatively heavy, etc.</td>
<td>1. Try to decrease surrounding temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Make sure the installation complies with the instruction on inverter user manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. Try to close inverter for 15 mins, then start up again.</td>
</tr>
<tr>
<td>Ground I Failure</td>
<td>Ground leakage current is over-high</td>
<td>Ground failure could be caused by multi reasons like neutral cable on AC side is not connected well or surrounding humidity is comparatively heavy, etc.</td>
<td>Check use multi-meter if there is voltage value (normally should be close to 0V) between earth &amp; inverter frame.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If there is a voltage, it means the Neutral &amp; ground cable are not connected well on AC side. If it happened only at early morning, dawn or on rainy days with high air humidity and recover soon, it should be normal</td>
</tr>
<tr>
<td>Relay Check Failure</td>
<td>Self checking of relay fails</td>
<td>Neutral &amp; ground cable are not connected well on AC side or just occasional failure</td>
<td>Check use multi-meter if there is high voltage (normally should be lower than 10V) between NBPE cable on AC side.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If the voltage higher than 10V, it means the Neutral &amp; ground cable are not connected well on AC side or restart inverter.</td>
</tr>
<tr>
<td>DC Injection High</td>
<td>/</td>
<td>Inverter detects a higher DC component in AC output</td>
<td>Try to restart inverter, check if it still happens, if not, means it is just an occasional situation or contact GoodWe</td>
</tr>
<tr>
<td>EEPROM Read/Write Failure</td>
<td>/</td>
<td>Caused by a strong external magnetic field etc.</td>
<td>Try to restart inverter, check if it still happens, if not, means it is just an occasional situation or contact GoodWe</td>
</tr>
<tr>
<td>SPI Failure</td>
<td>Internal communication failure</td>
<td>Caused by a strong external magnetic field etc.</td>
<td>Try to restart inverter, check if it still happens, if not, means it is just an occasional situation or contact GoodWe</td>
</tr>
<tr>
<td>DC Bus High</td>
<td>BUS voltage is over-high</td>
<td>/</td>
<td>Try to restart inverter, check if it still happens, if not, means it is just an occasional situation or contact GoodWe</td>
</tr>
<tr>
<td>Back-Up Over Load</td>
<td>Back-up side is over loaded</td>
<td>Total Back-Up load power is higher than the nominal backup output power</td>
<td>Decrease Back-Up loads to make sure the total load power is lower than Back-Up nominal output power (please refer to page 12)</td>
</tr>
</tbody>
</table>

Note: All the errors about battery happen only on Lithium battery with BMS communication.
**TROUBLESHOOTINGS**

**Checking Before Starting EM Up**

- **PV Input Connection:** Confirm the connection between EM inverter and PV panels: polarity (+/-) not reversed, refer to pic 30.
- **Battery Connection:** Confirm the connection between EM inverter and battery: polarities (+/-) not reversed, refer to pic 31.
- **On-Grid & Back-Up Connection:** Confirm On-Grid connected to public grid and Back-Up to loads: polarity (L/N) not reversed, refer to pic 32.
- **EzMeter & CT Connection:** Make sure CT are connected between house loads and grid, and follow the House→Grid direction sign on CT. (Pic 33)

**Checking as Start EM Up and Turn On AC Power**

- **EzMeter Communication:** Turn off PV and battery, turn on Loads, check if R-P led is solid or not (Pic 34). If “R-P” is not solid, means CT connected by reversed or on a wrong phase, please check:
  1. if connection between EzMeter and CT (port 1 and 4 on EzMeter) is OK
  2. Make sure CT connected between house loads and grid, follow the House→Grid direction on CT (Pic 34).
  3. Make sure CT is connected on the same phase with the power cable of EzMeter.
- **Battery Settings, BMS Communication and Safety Country:** After connecting Solar-WiFi (* means the last 8 characters of the inverter serial No.), check on PV Master APP Param to make sure battery type is right what you have installed, and Safety Country is right. If not right, please set it right in “Set” (Pic 35).

**Problems During Operation**

- **EM not Start Up With ONLY Battery**
  Solution:
  1. Make sure the voltage of battery is higher than 48V, otherwise battery cannot start EM up.

- **EM not Start Up With ONLY PV**
  Solution:
  1. Make sure the voltage of PV is higher than 150V (need 200V to enter on-grid mode)
  2. Make sure load power is higher than 150W

- **No Discharge or Output From EM at Night Without PV or PV Power Lower Than Load Power**
  Solution:
  1. Communication between EM and EzMeter is OK or not;
  2. Make sure load power is higher than 150W
  a. battery will not discharge continuously unless load power is higher than 150W;
  b. If battery still not discharge when load power is higher than 150W, then please check EzMeter & CT connection and direction;
  3. Make sure SOC is higher than 1-DOD. Or if battery discharged to below 1-DOD, then battery will only discharge again when SOC charged to 20% + (1-DOD) / 2 and SOC > 105% -DOD (if need battery discharge immediately, battery should be restarted)
  4. Check on APP if it is set as charge time, during charge time, battery will not discharge (battery will charge in priority during coincident time of charge/discharge)

- **Battery Not Charge When PV Power Higher Than Load Power**
  Solution:
  1. Check if charge voltage on App (Set→Basic Setting) is properly set (for lead-acid battery) as battery cannot charge if battery voltage reaches charge voltage.
  2. Check if it is during discharge time set on App.
  3. Check if battery is fully charged or not, or battery voltage reach “charge voltage” or not.

- **High Power Fluctuation Battery Charge or Discharge**
  Solution:
  1. Make sure BMS communication is OK on PV Master (for lithium batteries);
  2. Check if CT connected in the right position and to right direction as on the user manual page 13;
  3. Check if the total load power is much higher than PV power.
Questions & Answers (Q & A)

About Wi-Fi Configuration
Q: Why cannot see Solar-WiFi signal on mobile devices?
A: Normally Solar-WiFi signal could be searched right after inverter powered up. But Solar-WiFi signal will disappear when EM connected to internet. If need change settings, can connect to the router to change. If cannot see WiFi signal even not connect to router, then please try to reload WiFi (please refer to EM user manual page 18).

Q: Why cannot see Solar-WiFi signal on mobile devices?
A: For Back-Up supply, the “Back-Up Function” on PV Master App must be turned on. Under off-grid mode or grid power is disconnected, “Off-Grid Out” function must be turned on as well.
Note: As turn “Off-Grid Output” on, don’t restart inverter or battery, otherwise the function will switch off automatically.

Q: Why battery does not discharge when grid is not available, while it discharge normally when grid is available?
A: On APP, Off-Grid Output and backup function should be turned on to make battery discharge under off-grid mode.

Q: Why there is output on Back-Up side?
A: For Back-Up supply, the “Back-Up Function” on PV Master App must be turned on. Under off-grid mode or grid power is disconnected, “Off-Grid Out” function must be turned on as well.

Q: Why battery switch always trip when starts it up (Lithium battery)?
A: For lithium battery like LG, normally the switch trips for flowing reason: 1. BMS communication fails, or battery SOC is so low to protect itself, 2. Battery SOC is too low, battery trips to protect itself, 3. An electrical short-cut happened on battery connection side. Or other reasons please contact GoodWe for details.

Q: Which battery should I use for EM?
A: For EM inverters, it could connect lithium or lead-acid batteries, with nominal voltage 48V, max charge voltage 60V.
Compatible lithium batteries for now: LG RESU3.3/6, 5/10, BYD B-Box 2.5/5/7, 5/10, GCL5.6KWh, Pylon US2000B (1—4 packs). For lead-acid batteries: please contact GoodWe to confirm if it is suitable to use.

About Battery Operation
Q: Why battery does not discharge when grid is not available, while it discharge normally when grid is available?
A: On APP, Off-Grid Output and backup function should be turned on to make battery discharge under off-grid mode.

Q: Why battery switch always trip when starts it up (Lithium battery)?
A: For lithium battery like LG, normally the switch trips for flowing reason: 1. BMS communication fails, or battery SOC is so low to protect itself, 2. Battery SOC is too low, battery trips to protect itself, 3. An electrical short-cut happened on battery connection side. Or other reasons please contact GoodWe for details.

About PV Master Operation and Monitoring
Q: Why Cannot save settings on PV Master App?
A: This could be caused by losing connection to Solar-WiFi. 1. Make sure you connected Solar-WiFi (make sure no other devices connected) or router (if connected Solar-WiFi to router) and on APP home page shows connection well. 2. Make sure EM under waiting mode (on APP) before you change any settings on PV Master APP — disconnect grid/load/battery, only leave PV connected and then restart EM till see work mode as “wait” on APP.

About EzMeter and Power Limit Function
Q: Why there is still power exporting to grid after I set power limit as 0W?
A: Export limit could theoretically to minimum 0W, but there will have a deviation of around 50-100W for EM system.

Q: Can I use other brand Meter to take over EzMeter in EM system or change some settings on EzMeter?
A: Cannot, because there the communication protocol is inset between inverter and EzMeter, other brand Meter cannot communicate. Also any manual setting change could cause EzMeter communication failure.

Q: What is the max current allowed going through CT on EzMeter?
A: The max current for CT is 120A.

Other Questions
Q: Is there a quick way to make the system work?
A: The shortest way, please refer to EM QUICK INSTALLATION INSTRUCTIONS and PV MASTER APP INSTRUCTION.

Q: What kind of load can I connect on Back-Up side?
A: Please refer to user manual on page 12.

Q: Whether the warranty of the inverter still valid if the installation or operation does not follow the user manual instructions, for some special conditions when we cannot 100% follow them?
A: Normally if any problem caused by disobey the instructions on user manual, we can provide technical support to help solve the problem, but cannot guarantee a replacement or returns. So if there is any special condition when you cannot 100% follow the instructions, please contact GoodWe for suggestions.
4.2 DISCLAIMER

The EM series hybrid inverters are transported, used and operated under environmental and electrical conditions. GoodWe has the right not providing after-sales services or assistance under following conditions:

- Inverter is damaged during transferring
- Inverter is out of warranty year and extended warranty is not bought
- Inverter is installed, refitted or operated in improper ways without authority from GoodWe
- Inverter is installed or used under improper environment or technical condition mentioned in this user manual, without authority from GoodWe
- Installation or configuration of the inverter does not follow requirements mentioned in this user manual
- The inverter is installed or operated against the requirements or warnings that are mentioned in this user manual
- Inverter is broken or damaged by any force majeure like lightening, earthquake, fire hazard, storm and volcanic eruption etc.
- Inverter is disassembled, changed or updated on software or hardware without authority from GoodWe
- Inverter is installed, used or operated against any related items in international or local policies or regulations
- Any non-compatible batteries, solar panels, loads or other devices connected to EM system

Note: GoodWe will keep right to explain all the contents in this user manual.

4.3 TECHNICAL PARAMETERS AND CERTIFICATES

**• TECHNICAL PARAMETERS OF EM INVERTERS**

<table>
<thead>
<tr>
<th>Battery Input Data</th>
<th>GW3048-EM</th>
<th>GW3648-EM</th>
<th>GW5048-EM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported Battery Type</td>
<td>Li-ion or Lead-acid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Battery Voltage (V)</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Charge Voltage (V)</td>
<td>≤60 (Configurable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Charge Current (A)</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Discharge Current (A)</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery Capacity (Ah)</td>
<td>50~2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge Pattern for Li-ion battery</td>
<td>Self-adaption to BMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV String Input Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. DC Input Power (W)</td>
<td>3900</td>
<td>4600</td>
<td>6500</td>
</tr>
<tr>
<td>Max. DC Input Voltage (V)</td>
<td>550</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPPT Voltage Range (V)</td>
<td>100~500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start-up Voltage (V)</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPPT Voltage Range for Full Load (V)</td>
<td>280~500</td>
<td>170~500</td>
<td>230~500</td>
</tr>
<tr>
<td>Nominal DC Input Voltage (V)</td>
<td>360</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Input Current (A)</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Max. Short Current (A)</td>
<td>13.8</td>
<td>13.8</td>
<td>13.8/13.8</td>
</tr>
<tr>
<td>PV Over-current Protection (A)</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PV Back-feed Current (A)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of MPP Tracker</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>String No. per MPP Tracker</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Overvoltage Category</td>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Inverter backfeed current to array</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Output Data (Back-Up)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Output Apparent Power (VA)</td>
<td>2300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Output Apparent Power (VA)</td>
<td>3500, 10s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic Switch Time (ms)</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Output Voltage (V)</td>
<td>230 (+/-2%) single phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Output Frequency (Hz)</td>
<td>50/60(+/-0.2%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back-Up Over Current Protection (A)</td>
<td>30A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Short Current (Peak/Duration)</td>
<td>55A, 3µs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Output Current (A)</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Output Fault Current (Peak/Duration)</td>
<td>43A, 10s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output THDv (linear load)</td>
<td>&lt;3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[1] Lead acid battery use refers to Approved Battery Statement
[2] For off-grid system, battery capacity should be ≥100Ah
[3] Maximum operation DC voltage is 530V
[4] If there is no battery connected, inverter starts feeding into grid only if PV voltage > 200V
[5] On condition of battery and PV power being enough

* Maintenance

The inverter requires periodically maintenance, details as below:

NOTE: Make sure inverter is totally isolated from all DC and AC power for at least 5 mins before maintenance

Heat sink: please use clean towel to clean up heat sink once a year

Torque: please use torque wrench to tighten AC and battery wiring connection once a year

DC switch: check DC switch regularly, active the DC switch 10 times in a row once a year, operating DC switch will clean contacts and extend lifespan of DC switch

Water-proof covers: check if water-proof covers of RS485 and other part are fasten once a year
<table>
<thead>
<tr>
<th>Nominal Power Output to Grid (W)</th>
<th>GW3048-EM</th>
<th>GW3648-EM</th>
<th>GW5048-EM</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000</td>
<td>3000</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>Max. Apparent Power Output to Grid (VA)</td>
<td>3000</td>
<td>3680</td>
<td>5000</td>
</tr>
<tr>
<td>Max. Apparent Power From Grid (A)</td>
<td>5300</td>
<td>5100</td>
<td>5000</td>
</tr>
<tr>
<td>Nominal Output Voltage (V)</td>
<td>230 single phase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal Output Frequency (Hz)</td>
<td>50/60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. AC Output Current to Grid (A)</td>
<td>13.6</td>
<td>16</td>
<td>22.8</td>
</tr>
<tr>
<td>Max. AC Current from Grid (A)</td>
<td>23.6</td>
<td>23.6</td>
<td></td>
</tr>
<tr>
<td>AC Over Current Protection (A)</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Backfeed Current (A)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Inrush Current (Peak/Duration)</td>
<td>43A, 0.2s</td>
<td>55A, 3µs</td>
<td>60A, 5µs</td>
</tr>
<tr>
<td>Input Inrush Current (Peak/Duration)</td>
<td>60A, 5µs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Power Factor</td>
<td>~1 (Adjustable from 0.8 leading to 0.8 lagging)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output THDi (@Nominal Output)</td>
<td>&lt;3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC Overvoltage Category</td>
<td>III</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Efficiency**

- Max. Efficiency: 97.6%
- Max. Battery to Load Efficiency: 94.5%
- Europe Efficiency: 97.0%
- MPPT Efficiency: 99.9%

**General Data**

| Operation Temperature Range (°C) | -25~60 |
| Storage Temperature Range (°C)   | -30~65 |
| Relative Humidity                | 0~95%  |
| Moisture Location Category       | 4K4H   |
| External Environment Pollute Degree | Grade 1.23 |
| Environment Category             | Indoor & Outdoor |
| Operation Altitude (m)           | ≤4000  |
| Cooling system                   | Nature Convection |
| Noise (dB)                       | <25    |
| User Interface                    | LED, APP |
| Communication With BMS           | CAN, RS485 |
| Communication With EzMeter       | RS485  |
| Communication With Portal        | WIFI   |
| Weight (kg)                      | 16 17 17 |
| Size (Width*Height*Depth mm)     | 347*432*175 |
| Mounting                         | Wall Bracket |
| IP Rating                        | IP65   |
| Protective Class                 | 1      |
| Standby Self-Consumption (W)     | <13    |
| Topology                         | Transformerless |

**Protection**

- Anti-islanding Protection: Integrated
- PV String Input Polarity Reverse Protection: Integrated
- Isolation Resistor Detection: Integrated
- Residual Current Monitoring Unit: Integrated
- Output Over-current Protection: Integrated
- Short Protection: Integrated
- Output Over-voltage Protection: Integrated
- Integrated PV String Input Polarity Reverse Protection
- Certifications & Standards
  - Grid Regulation: RD1699, UNE-EN50606, EN50482, AS/NZS 4777.2:2015, G83/2, G100, CEI 0-21, VDE-AR-N 4105, VDE0126-1-1, NRS 097-2-1
  - Safety Regulation: IEC62109-1 & -2, IEC62040-1
  - EMC: EN61000-6-1, EN61000-6-2, EN61000-6-3, EN61000-6-4, EN61000-4-14, EN61000-4-18, EN61000-4-29

**SURETEST**

- G100, IEC62109-1
- CEI 0-21
- RD1699
- VDE0126-1-1
- VDE-AR-N 4105
- NRS 097-2-1

**OTHER TEST**

- For Australian requirements, in the THDi test, there should add Zref between inverter and mains.
- RA, XB for Line conductor
- RN, XN for Neutral conductor
- Zref: RA=0.24, XB=0.15 at 50Hz;
  RN=0.16, XN=0.10 at 50Hz.

**4.4 Warning Quick Check List**

- Inverter cannot be installed near flammable, explosive or strong electro-magnetic equipment. [Page 6]
- Remember that this inverter is heavy! Please be careful when lifting out from the package. [Page 7]
- The polarity of PV strings or on the inverter cannot be connected by reverse, otherwise inverter could be damaged. [Page 8]
- Make sure battery switch is off and battery nominal voltage meet EM specification before connecting battery to inverter make sure inverter is totally isolated from PV and AC power. [Page 9]
- Make sure inverter is totally isolated from any DC or AC power before connecting AC cable. [Page 11]
- Make sure AC cable is totally isolated from AC power before connecting EzMeter and CT. [Page 13]
**Appendix: Protection Category Definition**

### Overvoltage Category Definition

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

### Moisture Location Category Definition

<table>
<thead>
<tr>
<th>Moisture Parameters</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3K3</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>0°C ~ +40°C</td>
</tr>
<tr>
<td>Humidity Range</td>
<td>5% ~ 85%</td>
</tr>
</tbody>
</table>

### Environment Category Definition

<table>
<thead>
<tr>
<th>Environment Condition</th>
<th>Ambient Temperature</th>
<th>Relative Humidity</th>
<th>Applied to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor</td>
<td>-20 ~ 50°C</td>
<td>4% ~ 100%</td>
<td>PD3</td>
</tr>
<tr>
<td>Indoor Unconditioned</td>
<td>-20 ~ 50°C</td>
<td>5% ~ 95%</td>
<td>PD3</td>
</tr>
<tr>
<td>Indoor Conditioned</td>
<td>0 ~ 40°C</td>
<td>5% ~ 85%</td>
<td>PD2</td>
</tr>
</tbody>
</table>

### Pollution Degree Definition

<table>
<thead>
<tr>
<th>Pollution Degree</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.</td>
</tr>
<tr>
<td>II</td>
<td>Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected.</td>
</tr>
<tr>
<td>III</td>
<td>Conductive pollution occurs, or dry, non-conductive pollution occurs, which becomes conductive due to condensation, which is expected.</td>
</tr>
<tr>
<td>IV</td>
<td>Persistent conductive pollution occurs, for example, the pollution caused by conductive dust, rain and snow.</td>
</tr>
</tbody>
</table>