



## User Manual Off-Grid Inverter



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GF1- 23-V5-2312

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# 1. About This Manual

## 1.1 Scope





The user manual mainly describes the product information, safety and installation guidelines as well as information on wiring and troubleshooting of the unit. This manual is valid for GF1-3K48S1(220Vac), GF1-5K48S1(220Vac), GF1-6K48S1(220Vac), GF1-3K48L1(110Vac).

## 1.2 Target Group

This manual is intended for qualified personnel who are responsible for the installation and commissioning of the inverter. Any electrical installation and maintenance on this inverter must be performed by professional electrical personnel who has obtained the license from local authorities.

## 1.3 Levels of warning messages

Safety instructions will be highlighted with the following symbols.

Symbol	Description
 <b>DANGER</b>	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
 <b>NOTICE</b>	Indicates a situation that, if not avoided, could result in property damage.

## 1.4 How to use this manual

Read the manual and other related documents before performing any operation on the inverter. Documents must be stored carefully and be available at all times.

*The information in this manual is subject to change without notice. Please check [www.livoltek.com](http://www.livoltek.com) for more information.*



## 2. Safety

### 2.1 Safety Instructions



#### WARNING

- Read all safety instructions carefully prior to any work and observe them at all times when working on or with the inverter.
- The safety instructions in this manual cannot cover all the precautions that should be followed. Perform operations considering actual onsite conditions.
- LIVOLTEK shall not be held liable for any damage caused by violation of the safety instructions in this manual.

#### 2.1.1 Personnel Safety

- Have the inverter and the battery mounted, installed and commissioned only by qualified persons with the appropriate skills.
- The qualified persons must be familiar with the safety regulations of electrical system, working process of PV power generation system, and standards of local power grid.
- Prior to performing any work on the inverter or the battery, disconnect the inverter from all voltage sources as described in this manual.
- Do not touch non-insulated cable ends and any live components.
- If an error occurs, have it rectified by qualified persons only.

#### 2.1.2 Inverter Protection



#### WARNING

- The product must only be used as stationary equipment.
- The product is suitable for indoor use.
- Do not disconnect the PV connectors or battery connectors when the inverter is running.
- Wait at least 10 minutes for the internal capacitors to discharge after the battery is turned off.
- Ensure that there is no voltage or current before installing or disconnecting any connectors.
- All safety instructions, warning labels, and nameplate on the inverter should not be removed or covered.



### CAUTION

- Do not touch any hot parts during operation.

### NOTICE

- As soon as receiving the inverter please check if it is damaged during its transportation. If yes, please contact your dealer immediately.
- Only qualified personnel can change the country settings.
- Adequate ventilation must be provided for inverter installation location. Mount the inverter in vertical direction, and ensure that no objects block the heat dissipation.








## 2.1.3 Battery Protection



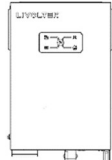





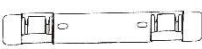



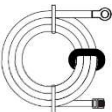

### DANGER

- The battery must comply with the locally applicable standards and directives and must be intrinsically safe.
- The communication interface of the battery must be compatible with the product.
- The entire battery voltage range must be completely within the permissible input voltage range of the product.
- Batteries deliver electric power, resulting in burns or a fire hazard when they are short circuited, or wrongly installed.
- Lethal voltages are present at the battery terminals and cables connecting to the inverter.
- Severe injuries or death may occur if the cables and terminals in the inverter are touched.

## 2.2 Symbol on the Type Label

Symbol	Explanation
	CE mark. The inverter complies with the requirements of the applicable CE guild lines
	Beware of hot surface. The inverter can become hot during operation. Avoid contact during operation.
	Danger of high voltages. Danger to life due to high voltages in the inverter!
	Danger. Risk of electric shock!
	Observe enclosed documentation.
	The inverter cannot be disposed together with the household waste. Disposal information can be found in the enclosed documentation.
	Danger to life due to high voltage. There is residual voltage in the inverter which needs 5 min to discharge. <ul style="list-style-type: none"> <li>• Wait 5 min before you open the upper lid or the DC lid.</li> </ul>

### 3. Scope of Delivery

	A		B		C		D
	E		F		G		H
	I		J		K		L

Item	QTY	Designation
A	1	Inverter
B	2	Expansion Screws for Fixing Mounting Bracket and fix inverter
C	1	Spare FUSE in case of reversal connection of battery
D	1	NTC cable
E	2	Terminal block for battery cables
F	5	Terminal block for AC cables
G	1	Bracket
H	2	2 pairs(3k mode 1 pair) of Positive & Negative PV Plugs
I	1	Tape for NTC cable
J	1	Certificate card
K	1	BMS communication cables
L	1	Parallel communication cables

## 4. Product Introduction

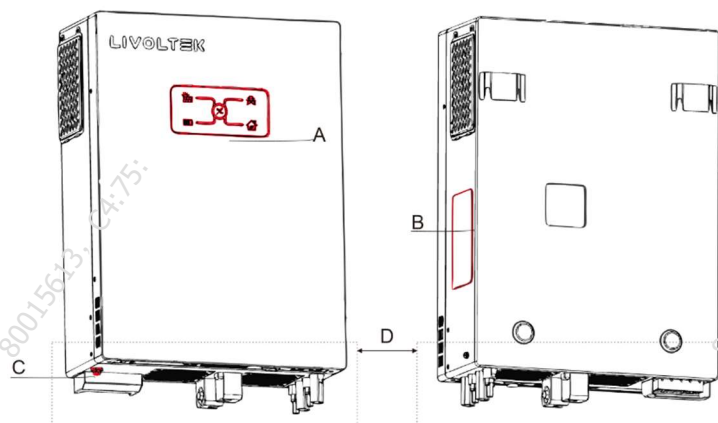
LIVOLTEK GF Series off-grid inverter is an important part of the off-grid solar power supply system, integrated with the MPPT solar charger and battery charger to offer uninterruptible power supply, which is ideal for off-grid backup power and self-consumption applications.

The whole system also needs other devices to achieve complete running such as PV modules, generator, or Utility grid. Please consult with your system integrator for other possible system architectures depending on your requirements.

### 4.1 Features

- Pure sine wave inverter
- Built-in Bluetooth communication
- Built-in MPPT solar charge controller
- 10ms transfer time to protect critical loads
- Compatible with or without a battery
- Compatible to Lead acid & Lithium battery
- Compatible to mains voltage or generator power
- Configurable input voltage range
- Multiple protection function
- Intelligent battery management function
- USB upgrade, easy operation and maintenance
- Parallel operation available (3KW @110Vac; 5KW @230Vac)
- Remote configuration & upgrade (optional)

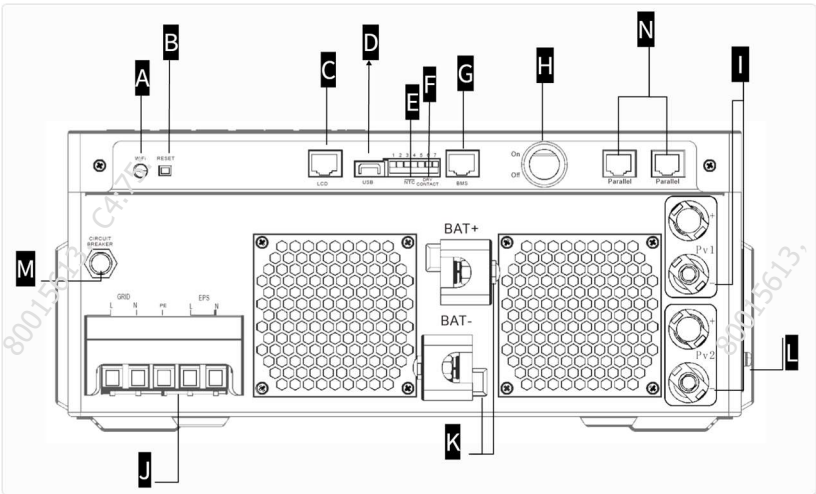
## 4.2 Appearance



View of the GF1 Series off-grid inverter

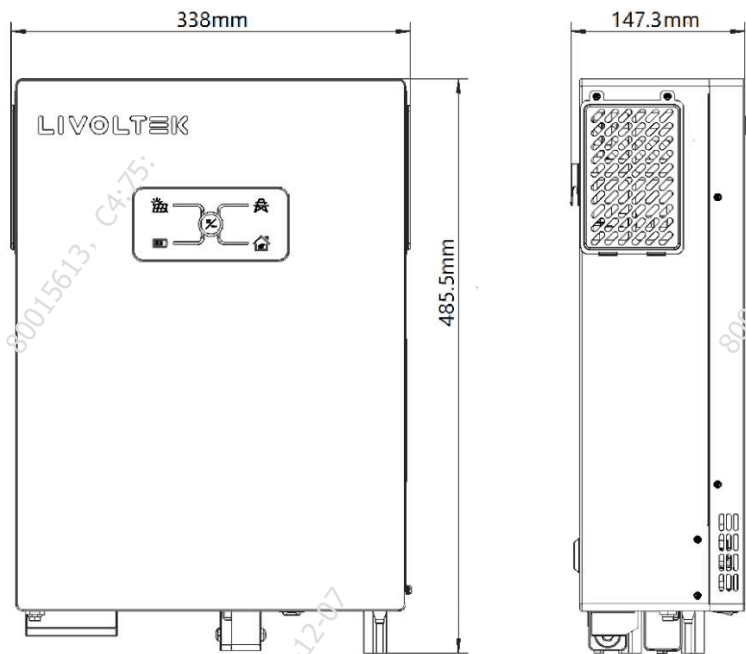
Position	Designation
A	LED indicators Indicates the current working state of the inverter.
B	Type Label The type label uniquely identifies the inverter. You will find the following information on the type label: <ul style="list-style-type: none"> <li>• Inverter device type (Model)</li> <li>• Serial number of the inverter (S/N)</li> <li>• Specific characteristics</li> </ul>
C	Circuit Breaker: The button will pop up to disconnect AC connection in case of AC overcurrent, and needs to be manually pressed to reset.
D	The area of electrical connection terminals. The electrical connection area includes DC & AC & battery & communication terminals, etc.

### 4.3 Interfaces



A	Wi-Fi indicator light
B	Reboot function key for Wi-Fi module
C	Split/LCD screen communication port
D	USB port for upgrading
E	NTC connection port for Lead-acid battery
F	Dry contact
G	BMS communication port
H	EPS output switch on/off
I	PV strings connection
J	AC input ports / PE port / EPS output ports
K	Battery connection ports
L	Port for connection of a permanent grounded wiring system
M	CIRCUIT BREAKER
N	Parallel ports

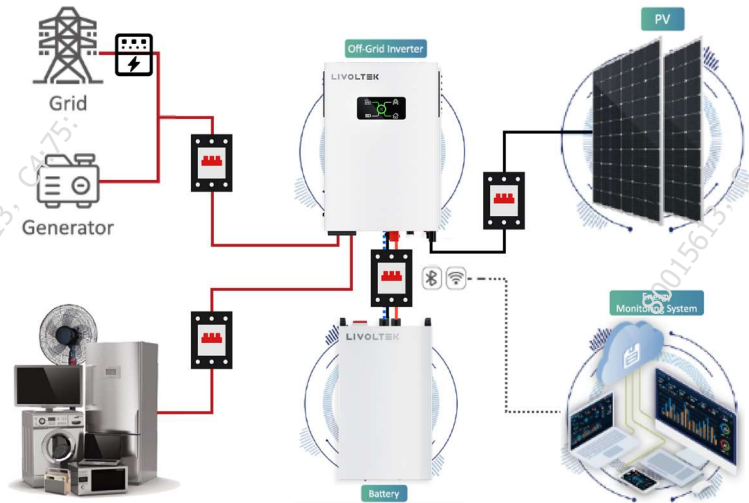
4.4 Dimensions



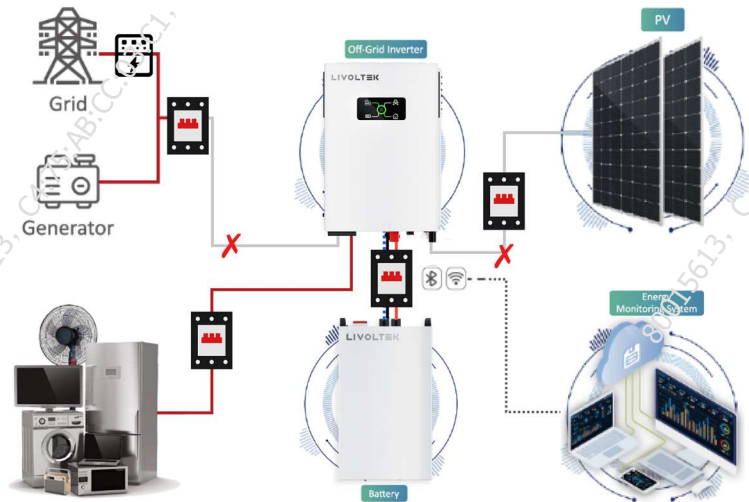


## 4.5 System Diagram

*Solar Power and AC Power available*



*Solar Power and AC Power not available*



## 4.6 Working Modes

LIVOLTEK GF Series off-grid inverters is for autonomous solar energy generation, and incorporate batteries and generators to maintain a constant supply of electricity to your home, shack or farm.

With the intelligent AC and PV complementation power supply function, the unit can switch in auto between different power sources to offer uninterruptible power support. The batteries can also automatically charge and discharge based on your self-define configuration, which helps to use more solar energy and save electricity.

There are two modes (Backup mode, and Economic mode) to ensure the best situation for you.

### 4.6.1 Backup Mode:

This mode allows you to dedicate the full capacity of the battery for backup power supply during utility grid failure, while avoiding overcharging and discharging the battery and extending its life. If you never know when the next grid outage might be, it makes perfect sense to prioritize keeping the battery full.

#### *In Backup Mode:*

- When operating in this mode, solar energy and grid will fully charge battery as first priority at the same time. The loads will be supplied by the surplus solar production supplemented, if necessary by the public electricity grid. The battery will be used only when the grid failure.
- When solar energy is sufficient to power the battery and the loads, Utility will stand by until solar power ceases.
- When the sunlight is insufficient, Utility will power the loads and battery.
- When the sunlight is insufficient and there is no Utility, the inverter automatically switches to off-grid mode and the battery will discharge for loads consumption until reaches its power limit value. Then the generator will be activation if there is a generator connected.
- If enough sunlight or Utility is available, the system will fully charge the battery automatically and simultaneously support the loads.
- Load supply source: Solar >Utility >Generator > Battery
- Battery charging source: Solar > Utility>Generator

#### 4.6.2 Economic Mode (Default)

This mode applies to areas where the electricity price is high, the unit allows you to choose on how to power your loads, which help to optimize self-consumption and reduce electricity costs.

*In Economic Mode:*

- The discharge cut-off voltage (lead-acid battery) or SOC (lithium battery) can be set via APP or LCD(OPTIONAL).
- When solar energy is sufficient, the system supplies power to loads and stores surplus solar energy in the battery.
- When the solar energy is insufficient or there is no sunlight, the battery will discharge for loads consumption until reaches its power limit value. Then Utility will provide power to the loads.
- Power source Priority is Solar > Battery > Utility
- Charging source Priority is Solar > Utility

### 4.7 Storage

The following storage instructions apply if the inverter is not installed immediately.

- Do not unpack the inverter (put desiccant in the original box if the inverter is unpacked).
- The storage temperature must be always between  $-15^{\circ}\text{C}$  and  $+55^{\circ}\text{C}$ , and the storage relative humidity must be always between 0 and 95 %, non-condensing.
- In case of stacking storage, the number of stacking layers should never exceed the limit marked on the outer side of the packing case.
- Do not position the inverter at a front tilt excessive back tilt or side tilt or upside down.
- Conduct periodic inspection during storage Replace the packing materials immediately if any rodent bites are found.
- Ensure that qualified personnel inspect and test the inverter before use if it has been stored for a long time.

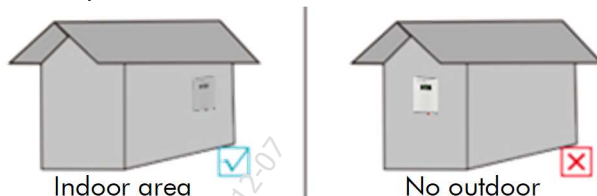
## 5. Mechanical Mounting

### 5.1 Requirements for Mounting

#### NOTICE

- Make sure there is no electrical connection before installation.
- In order to avoid electric shock or other injury, make sure that holes will not be drilled over any electricity or plumbing installations
- Always follow the instructions when moving and positioning the inverter.
- Improper operation may cause injuries or serious wounds. In the case of poor ventilation, the system performance may compromise

#### 5.1.1 Location Requirements



- Select an optimal mounting location for safe operation, long service life and expected performance. During the installation and operation process, please pay attention to install the inverter indoors.
- Don't install the inverter where people may touch its casing and radiator, because these parts will be very hot during operation.

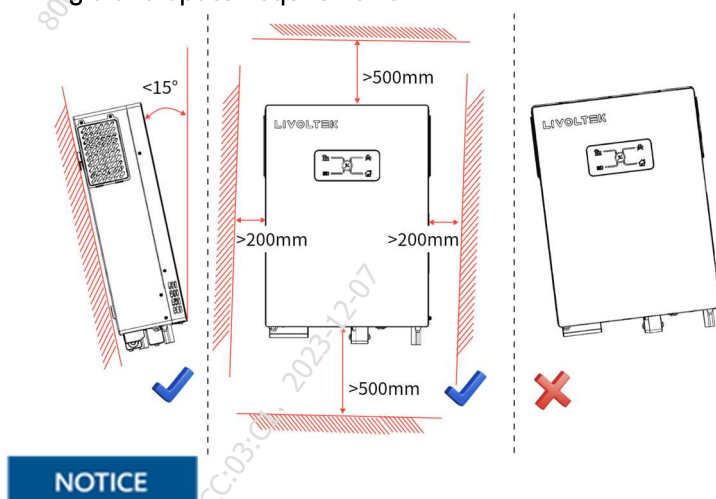
#### 5.1.2 Environment Requirements

The inverter should be installed in a ventilated environment to ensure good heat dissipation. Make sure the installation site meets the following conditions:

- Not in areas where highly flammable materials are stored.
- Not in potential explosive areas.
- Not in the cool air directly.
- Not near the television antenna or antenna cable.
- Not higher than altitude of about 2000m above sea level.
- Not in environment of precipitation or humidity ( $>95\%$ ).

- Under good ventilation condition.
- The ambient temperature in the range of  $-15^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ .
- The slope of the wall should be within  $\pm 5^{\circ}\text{C}$ .
- The wall hanging the inverter should meet conditions below:
- The wall must be solid enough to bear the weight of the inverter.
- Do not install the inverter on a wall made of gypsum boards or similar materials with weak sound insulation to avoid noise disturbance in a residential area.

### 5.1.3 Angle and Space Requirements



Never install the inverter horizontally, or with a forward tilt or with a backward tilt or even with upside down. The horizontal installation can result in damage to the inverter. Install the inverter upright or at a maximum back tilt of 15 degrees to facilitate heat dissipation.

GF Series off-grid inverters is for autonomous solar energy

### Mounting Instructions

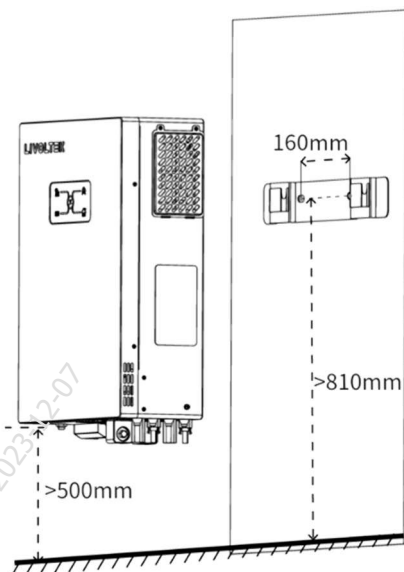
Installation Tools (recommended but not limited to the following ones):

Protective glasses and gloves, Marker, Measuring tape, Multi-meter, Wire crimper, Stripping pliers, Screwdriver, Manual wrench, Hammer drill and drill bit, etc.

**Mounting the Inverter**(Please refer to the quick installation instructions)

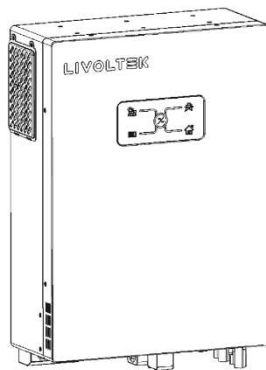
**Step1: Drill holes on the wall**

- Mark the positions of holes of 2 corners of the inverter's bracket by marker pen.
- Drill holes with driller and make sure the holes are deep enough (at least 40mm) to support the inverter
- Insert the expansion tubes into the holes and tighten them.



**Step 2: Install the inverter to the wall**

Install the inverter on the bracket.



**Step 3: Installation Self-check**

Make sure the inverter is well fixed.

## 6. Electrical Connection

This chapter mainly describes the cable connections of the system.

Prior to any electrical connections, keep in mind that the inverter has dual power supplies. It is mandatory for the qualified personnel to wear personal protective equipment (PPE) during the electrical work.



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

- The PV string will generate lethal high voltage when exposed to sunlight.
- Before starting electrical connections, disconnect the DC and AC circuit breakers and prevent them from inadvertent reconnection.
- Ensure that all cables are voltage free before performing cable connection.



- Any improper operations during cable connection can cause device damage or personal injury.
- Only qualified personnel can perform cable connection.
- All cables must be firmly attached, undamaged, properly insulated and adequately dimensioned




- Comply with the safety instructions related to the PV strings and the regulations related to the Utility grid.
- All electrical connections must be in accordance with local and national standards.

***Parallel connection, please refer to the content of this chapter and refer to 6.6 Parallel Connection***

## 6.1 Battery Connection

Please be careful of any electric shock or chemical hazards.

Make sure there is an external DC breaker (3KW>80A, 5KW>150A, 6KW>150A) connected to the battery without build-in DC breaker.

 DANGER	
<ul style="list-style-type: none"><li>• Be careful against any electric shock or chemical hazard.</li><li>• Only use properly insulated tools to prevent accidental electric shock or short circuits. If insulated tools are not available, use electrical tape to cover the entire exposed metal surfaces of the available tools except their tips.</li><li>• Connect battery cables with correct polarity. If battery cables are reversely connected at first time, the battery fuse of inverter may be damaged, and then you can exchange and install the spare one which is in the accessory kit.</li><li>• All wiring must be performed by a professional person.</li><li>• Do not disconnect under the load running! Battery can be placed in a no-load state by shutting down the inverter completely.</li></ul>	
NOTICE	
<ul style="list-style-type: none"><li>• This inverter can be connected to proper capacity lead-acid battery with a nominal voltage at 48V.</li><li>• For lithium batteries, this inverter can only be connected with LIVOLTEK or Pylontech low-voltage lithium batteries with nominal voltage from 40V to 60V now. If you choose other lithium batteries, please consult LIVOLTEK for compatibility. Otherwise inverter will not work normally.</li><li>• For safe operation and compliance, a two-pole DC circuit breaker with overcurrent protection should be installed between the inverter and the battery.</li><li>• If you do not have battery now, you can float BAT terminal, and this hybrid inverter will only work like a PV inverter.</li></ul>	

### Recommended battery cable size

Model	Wire Size	Cable	Breaker	Torque Value(max)
3KVA	4AWG	21.15mm <sup>2</sup>	80V/80A	3N·m
5KVA	2AWG	33.63mm <sup>2</sup>	80V/150A	3N·m
6KVA	2AWG	33.63mm <sup>2</sup>	80V/150A	3N·m

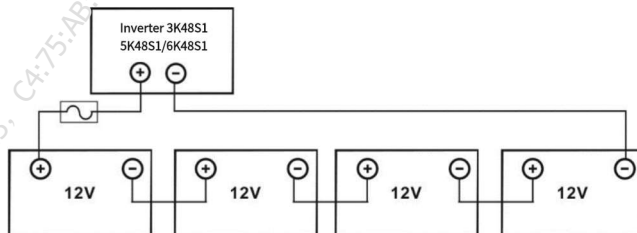
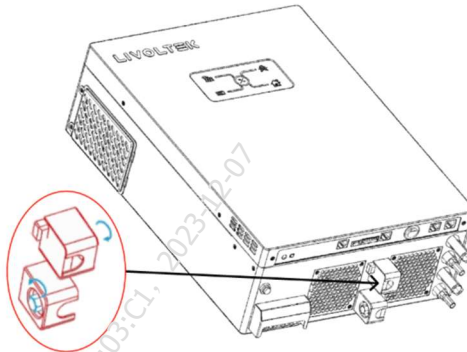


### 6.1.1 Wiring Procedure

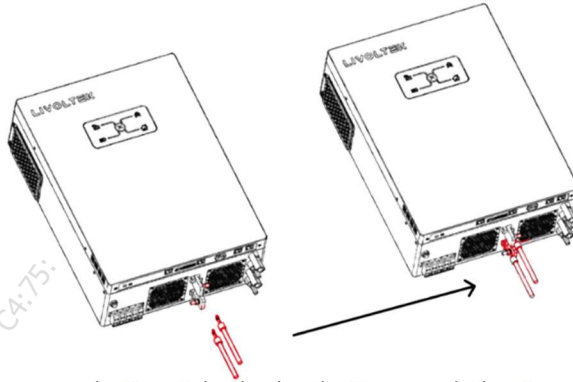
1. Remove insulation sleeve 12-16 mm for positive and negative conductors.
2. Insert the exposed areas of the positive and negative power cables into the metal terminals of the positive and negative connectors respectively and crimp them using a crimping tool.



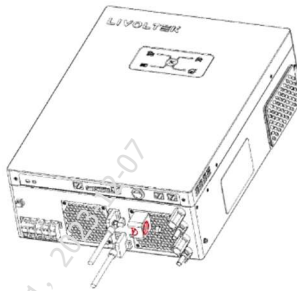
3. Rotate the screws of protective covers at positive and negative connectors anticlockwise and loosen them to take off.



4. Turn the screw anticlockwise to taken down, then insert the battery wires into battery connectors of inverter and make sure the bolts are tightened in clockwise direction.



5. Make sure polarity at both the battery and the inverter/charge is correctly connected and conductors are tightly screwed into the battery terminals. Then, rotate the screws of protective covers clockwise and tighten them to fix on.



**⚠ WARNING**

- Installation must be performed with care due to high battery voltage in series.
- Do not place anything between the flat part of the inverter terminal and the ring terminal. Otherwise, overheating may occur.
- Do not apply anti-oxidant substance on the terminals before terminals are connected tightly.
- Before making the final DC connection or closing DC breaker/disconnection, be sure positive (+) must be connected to positive (+) and negative (-) must be connected to negative (-).

### 6.1.2 BMS Communication for Lithium battery

NOTICE
<ul style="list-style-type: none"><li>• If choosing lithium battery, make sure to connect the BMS communication cable between the battery and the inverter.</li><li>• The CAN cable enables the communication between the inverter and the Lithium Battery.</li><li>• Communication interface between inverter and battery is CAN with a RJ45 connector.</li><li>• The battery communication can only work when the battery BMS is compatible with the inverter.</li></ul>

#### Procedure:

**Step 1:** Communication interface between inverter and battery is CAN with a RJ45 connector. Insert the RJ45 connector with into the port marked with “BMS” on inverter and fasten the cap.

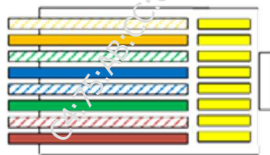
**Step 2:** Insert other side of the BMS cable into COM port on the battery.

#### BMS Pin Definition

## NOTICE

- The BMS Pin Definition for battery from the Pylontech and LIVOLTEK are different.
- Make sure the right wire sequence, otherwise will cause failure.

### BMS Pin Definition for Lithium Battery from LIVOLTEK



Orange white	1. BMS_CAN_H
Orange	2. BMS_CAN_L
Green white	3. NULL
Blue	4. GND
Blue white	5. NULL
Green	6. NULL
Brown white	7. NULL
Brown	8. NULL

### Lithium battery adapter list:

1. LIVOLTEK
2. PYLON 2000
3. Dyness
4. Felicity
5. D.Grid
4. Shot
5. OUKEPU/OUWEI

### 6.1.3 NTC Communication for Lead-acid battery

The inverter has integrated a NTC temperature sampling port for lead-acid batteries. With the external NTC cable installed, it can sample the temperatures of the battery cabinet to avoid damage caused by low or high temperature. The protective temperature of lead-acid battery ranges from  $-25^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .

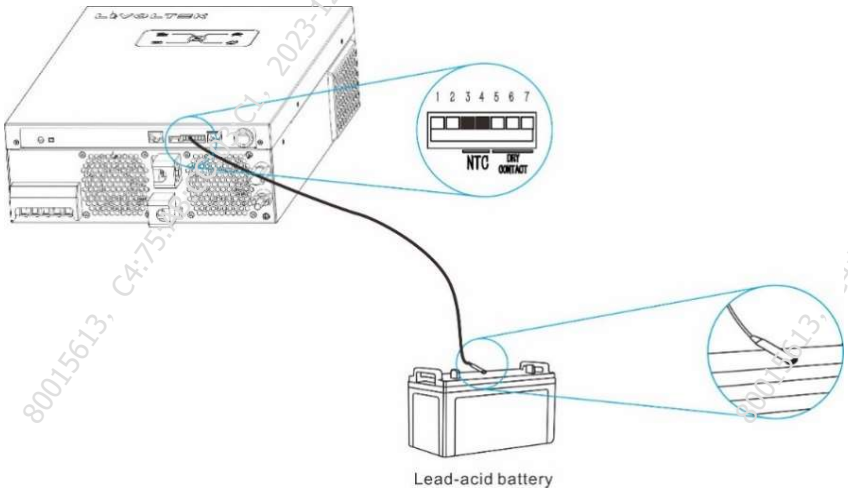
#### Procedure:

**Step 1:** Please find the NTC cable and a piece of tape in the accessories package of inverter.

**Step 2:** Insert the exposed terminals of NTC cable into the NTC port of inverter.

**Step 3:** Please clean the surface part of battery where you will stick cables before sticking (any place but must be nonmetallic).

**Step 4:** Insert the RJ45 port of NTC into BMS port of inverter, and make the interface adhere to the battery interface (any place but must be nonmetallic).



## 6.2 PV Connection

Please only use the PV connectors from the accessory box for connection.

Before connecting, please make sure:

The voltage, current and power ratings of the panels to be connected are within the allowable range of the inverter. Ensure polarity is correct. Please refer to the Technical Data in chapter 10 for voltage and current limits.

- Since the inverter is transformer less, please do not ground either output of the PV panels. Ground the panel frames.
- Before connecting to PV modules, please install separately a DC circuit breaker between inverter and PV modules.
- To avoid any malfunction, do not connect any PV modules with possible current leakage to the inverter. For example, grounded PV modules will cause current leakage to the inverter.
- It's requested to use PV junction box with surge protection. Otherwise, it will cause damage on inverter when lightning occurs on PV modules.



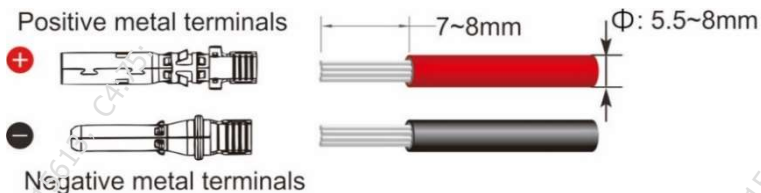
### WARNING

- Use IEC61730 class-A Rating PV modules.
- When exposed to light, PV panels will generate DC voltage.
- Turn off the DC circuit breaker before connecting any wiring.
- All wiring must be performed by qualified personnel.
- It's very important for system safety and efficient operation to use appropriate cable for PV module connection. To reduce risk of injury, please use the proper recommended cable size as below

## Wiring Connection

Please follow below steps to implement PV module connection:

**Step1:** Remove an appropriate length (about 7~8mm) of the insulation layer from the PV Strings power cables.

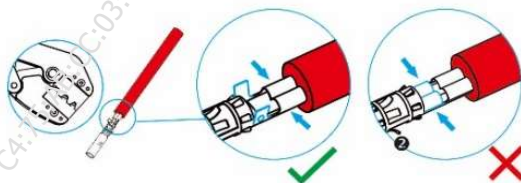


**Step2:** Connect the red wire to the positive metal terminal, and the black to the negative and crimp them using a crimping tool.

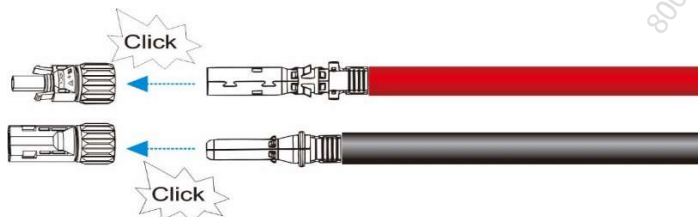
- PV+ crimping method:



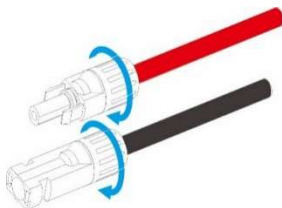
- PV- crimping method:



**Step3:** Insert the crimped positive and negative power cables into the corresponding connectors until a "click" sound is heard.

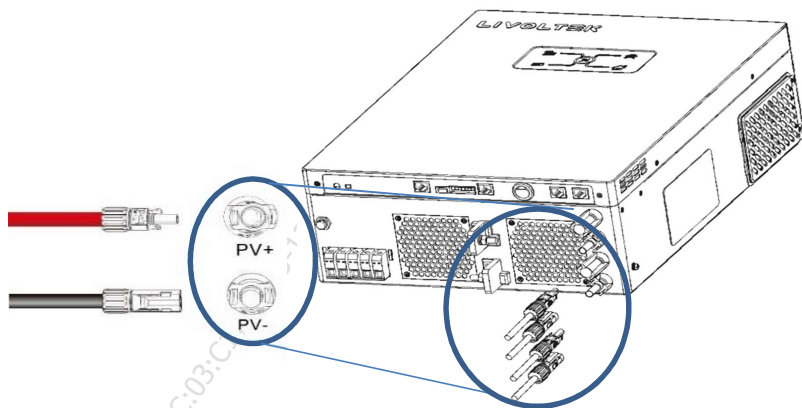


**Step4:** Tighten the locking nuts on the positive and negative connectors.



**Step5:** Measure the voltage of every route Strings using a multimeter. Ensure that the polarities of the DC input power cables are correct.

**Step6:** Insert the positive and negative connectors into their corresponding terminals of the inverter until a click sound is heard.



## 6.3 AC Connection

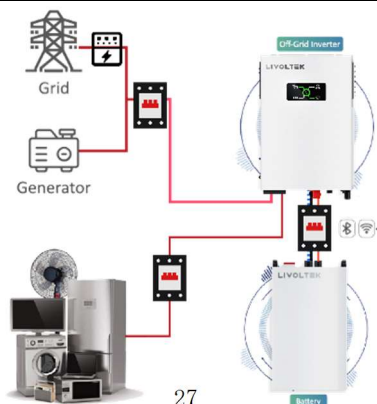
### WARNING

- The grid voltage and frequency must be in the permissible range.
- An external AC breaker ( $\geq 25A@GF1-3K48S1$ ,  $\geq 41A@GF1-3K48L1$ ,  $\geq 40A@GF1-5K48S1$ ,  $\geq 40A@GF1-6K48S1$ ) must be installed between inverter and AC input power source. This will ensure the inverter can be securely disconnected during maintenance and fully protected from over current of AC input.
- There are two terminal blocks with “GRID” and “EPS” markings. Please do NOT misconnect grid input and EPS output connectors.
- All wiring must be performed by a qualified personnel.
- Before making AC connection, be sure to open DC protector or disconnection first.
- Disconnect the AC circuit breaker and secure it against reconnection.

### *Suggested cable requirement for AC wires*

It's very important for system safety and efficient operation to use appropriate cable for AC input connection. To reduce risk of injury, please use the proper recommended cable size as below.

Model	Wire Size	Cable	Beaker	Torque Value (max)
3KVA@230V	12AWG	3.3mm <sup>2</sup>	23A	1.6N·m
3KVA@110V	10AWG	5.3mm <sup>2</sup>	40A	1.6N·m
5KVA@230V	10AWG	5.3mm <sup>2</sup>	40A	1.6N·m
6KVA@230V	10AWG	5.3mm <sup>2</sup>	40A	1.6N·m

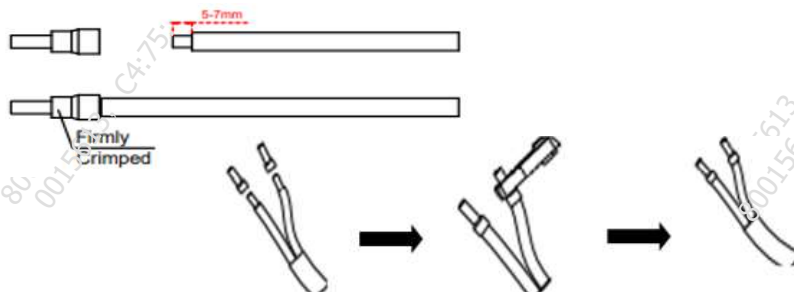




## Procedure:

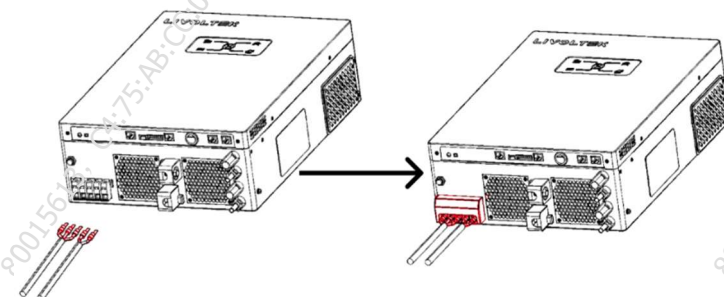
### Step1: Assembling the AC Input and EPS Connectors

- Remove the cable jacket and strip the wire insulation by 5–7 mm.
- Insert the conductors to the corresponding terminal and crimp them.
- Pull cables outward to check whether they are firmly installed.



### Step 2: Installing the AC Connector

- Pull out the terminal protective cover diagonally upwards.
- Insert GRID input and EPS output wires according to polarities indicated on terminal block and tighten the terminal screws.
- Connect “PE” conductor to the grounding electrode. Connect “L” and “N” conductors to the AC circuit breaker.
- Make sure the wires are securely connected and slide the catch of the cover downwards to fix on.



### Declarations for the EPS Function:

The EPS output of GF inverters have over load ability.

For details, please refer to the technical parameters of GF series inverter section.

And the inverter has self-protection derating at high ambient temperature.

The below statement lays out general policies governing the off grid inverters of the series GF.

1. For off grid inverters (Series GF), the standard PV installation typically consists of the connection of the inverter with both panels and batteries. In the case where the system is not connected to the batteries, the back-up function is strongly not advised for use.
2. Manufacturer shall not cover the standard warranty and be liable for any consequences arising from users not following this instruction.
3. Under normal circumstances, the back-up switching time is less than 10ms (the minimal condition to be considered as the UPS level). However, some external factors may cause the system failing on back-up mode. As such, we recommend the users to be aware of conditions and follow the instructions as below:
  - Do not connect loads when they are dependent on a stable energy supply for a reliable operation.
  - Do not connect the loads which may in total exceed the maximum back-up capacity.
  - Try to avoid those loads which may create very high start-up current surges such as inverter air-conditioner, high-power pump etc.
  - Due to the condition of the battery itself, battery current might be limited by some factors including but not limited to the temperature, weather etc.

**Acceptable Loads Are as Below:**

GF series inverter is able to supply a continuous rated output or maintain a double rated output for less than 10 seconds on back-up side to support loads. The inverter also has self-protection against derating at high ambient temperature.

\*\*\* **Inductive loads and capacitive loads** can be briefly referred to as **shock loads**.

\*\*\* **Shock loads** may experience shock currents or surges during startup, which can cause voltage fluctuations, current inrushes, motor vibrations, and voltage surges. These anomalies may exceed the load-bearing capacity of the inverter, resulting in damage or even failure. Therefore, it is necessary to control the total amount of inductive and capacitive loads connected to the inverter to ensure safe and stable operation.

- When selecting an inverter, the loading capacity should be taken into consideration to ensure that the total amount of connected inductive and capacitive loads fall within its rated capacity.
- When connecting **Shock loads** to the off-grid inverter, it is necessary to limit the total load capacity according to the following table to ensure safe and reliable operation of the inverter. Please refer to the table for the allowed load capacities for each load type.

	Continuous output	Max output (<10S)	Maximum individual Shock load power Maximum total load power
3K48V @110Vac @230Vac	3000VA	6000VA	≤1KVA (Individual Shock load) ≤1.9KVA(Total Loads include Shock load) ≤2.4KVA(Total Load without Shock load)
5K48V @230Vac	5000VA	10000VA	≤1.7KVA (Individual Shock load) ≤3.2KVA(Total Loads include Shock load) ≤4KVA(Total Load without Shock load)
6K48V @230Vac	6000VA	10000VA	≤2KVA (Individual Shock load) ≤3.8KVA (Total Load include Shock load) ≤4KVA(Total Load without Shock load)

### WARNING

- Earth connection essential before connecting supply
- Be sure that AC power source is disconnected before attempting to hardwire it to the unit.

### NOTICE

- It is important to make sure that the combined power required for all devices connected to this EPS output does not exceed the power rating of the inverter.
- Appliances such as air conditioner are required at least 2~3 minutes to restart because it's required to have enough time to balance refrigerant

gas inside of circuits. If a power shortage occurs and recovers in a short time, it will cause damage to your connected appliances.

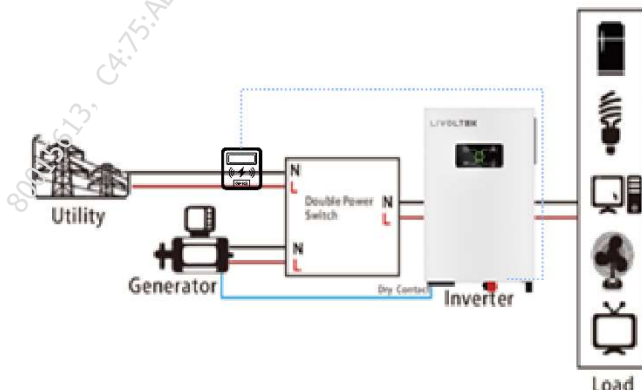
- To prevent this kind of damage, please check manufacturer of air conditioner if it is equipped with time-delay function before installation. Otherwise, this inverter will trig overload fault and cut off output to protect your appliance but sometimes it still causes internal damage to the air conditioner.

## 6.4 Dry Contact Signal for Generator

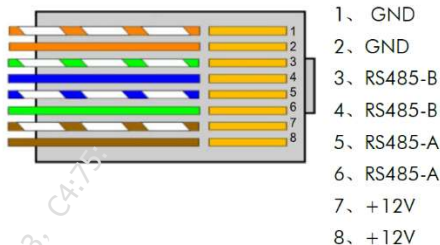
GF1 series inverter has the function of being able to connect to the generator, and the generator function provides the system function of uninterrupted power supply for some areas with long-term power outages.

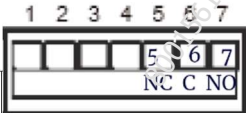
GF1 series inverter is connected to the generator through a dry contact (3A/250VAC) on the back panel of the inverter. It can be used to send a signal to a diesel generator when the battery voltage reaches a warning level. In addition, a dual power switch control needs to be connected between the inverter and the generator. When there no Utility, the switch is connected to the generator side, and the generator supplies power; when there is Utility, the switch is switched to disconnect the generator and switch to the Utility, the Utility supply power;

**Remarks:** The generator used in connection must have the function of inputting dry contacts.



## Definition of communication lines for smart meters



Unit Status	Condition		
		NC & C	NO & C
Power Off	Inverter is off and no output is powered	Close	Open
Power On	Output is powered from Utility.	Close	Open
	Output is powered from Battery or Solar Battery voltage < Setting value or Low DC warning value	Open	Close
	Battery voltage > Setting value or battery charging reaches floating stage.	Close	Open

## 6.5 Installation Verification

Check the following items after the inverter is installed.

- No other objects put on the inverter.
- All screws especially the screws used for electrical connections are tightened.
- The inverter is installed correctly and securely.
- Ground, AC, DC and Communications cables are connected tightly correctly and securely.
- Check there is no open circuit or short circuits at AC and DC terminals using multi-meter.
- All safety warning symbols are intact and complete on the inverter.

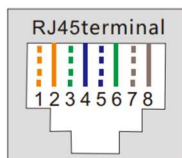
## 6.6 Parallel Connection (Optional)

The parallel function of inverters is to expand the system capacity and provide users with higher power. This inverter supports single-phase parallel operation (additional parallel kits need to be purchased), and can achieve parallel operation of up to 3 units. For more detailed information, please refer to the parallel instructions.

### 6.6.1 \* Connect the parallel communication cable

The parallel function can be achieved by using regular network cables.

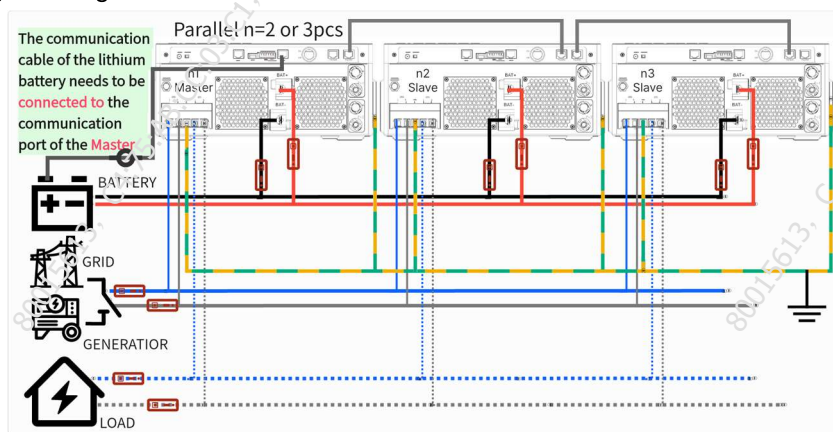
\* If you need to make your own parallel communication cable, you can refer to the definition of parallel communication



Pin Definition	CAN/RS485	Pin Definition	CAN/RS485
Pin 1	+5V	Pin 5	Para CAN_L
Pin 2	RX1	Pin 6	SGND
Pin 3	SGND	Pin 7	Para 485B
Pin 4	Para CAN_H	Pin 8	Para 485A

### 6.6.2 Parallel wiring and safety inspection

When using the parallel function, it is necessary to ensure that the inputs are connected in parallel and the outputs are connected in parallel. The batteries of each unit also need to be used in parallel, and a good grounding check should be conducted



### 6.6.3 \* Parallel parameter settings

(APP parameter settings section, see 8. APP Operation)

## 7. System Operation

### 7.1 Powering ON the Inverter

**Step 1:** Switch ON the DC and AC circuit breaker

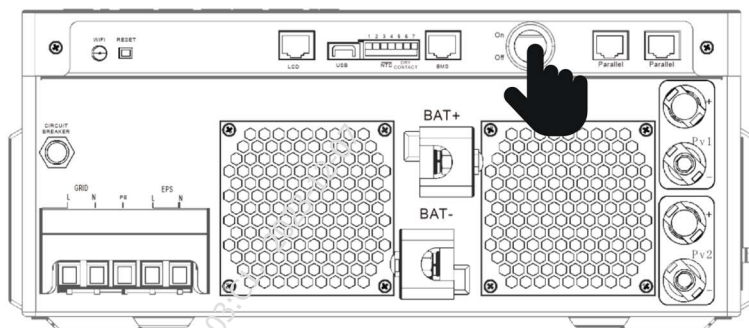
Wait a few seconds and the inverter will start a self-test procedure when the indicator light flashes, when it is done successfully, the green led should be solid on and the graphical display should start displaying.

**Step 2:** Switch ON the circuit breaker on the battery side

For Lithium battery, turn on the isolator firstly, then switch on the battery; Then the battery icon and its parameters should be shown on the screen.

**Step 3:** Press EPS Output On/Off switch

The EPS Output on/off switch is used to control the relay of the EPS port, when the switch is off means that there is no output from the EPS port.



**Step 4:** Switch on the loads

The load parameters should show. It's recommended to turn on one by one, to avoid triggering the protection action due to a large instantaneous impact when the load is turned on at the same time.

### 7.2 Powering OFF the Inverter for reinstall or repair

**Step 1:** Turn off the loads.

**Step 2:** Turn off the PV.

**Step 3:** Turn off battery (For Lithium battery, switch off the battery firstly, then disconnect the isolator.)

**Step 4:** Turn off the AC switch.

**Step 5:** Wait for at least 5 minutes after the LED and graphical display black out for the internal circuits to discharge energy.

**Step 6:** Disconnect all the power cables and communication cables if needed.

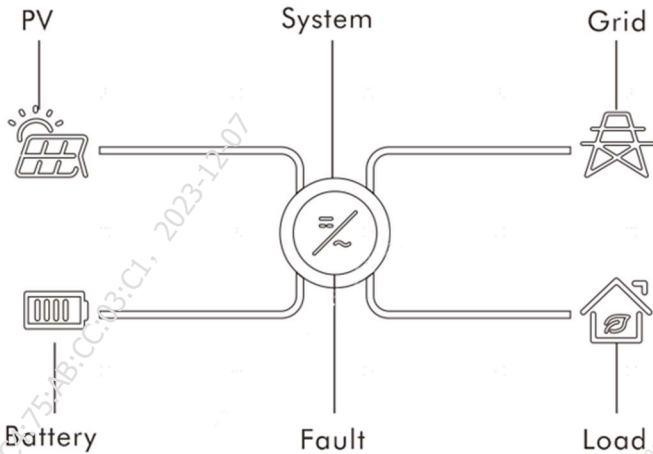


### WARNING

After the inverter powers off the remaining electricity and heat may still cause electrical shock and body burns. Please only begin servicing the inverter ten minutes after the power-off.

## 7.3 LEDs Display

The inverter operation status can be obtained from observing LED indicator status.



Color	Status	Description
Green	on	The inverter is running normally
	off	Other statuses except Running
Red	on	Fault occurs
	off	No fault occurs
Green/Red	blink	System startup

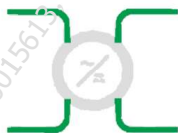


For more details, refer to Table LED indicator status below.



Any one or multiple of these four icons being lit indicates that the corresponding part or parts are already connected.

If the four icon light up sequentially, it means that the inverter is undergoing a firmware upgrade.



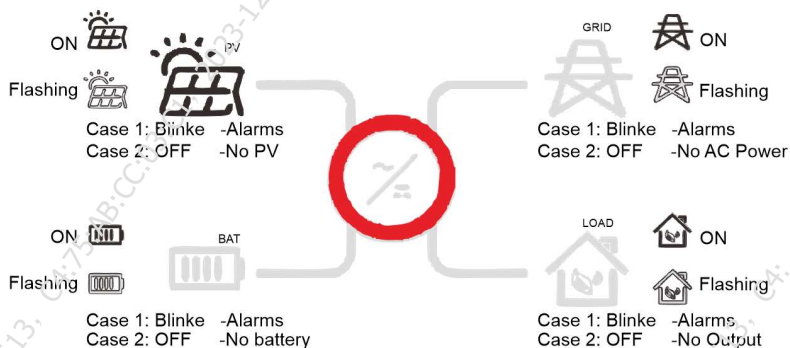
Any one or multiple of these four connection lines turning green indicates that the corresponding part or parts are completely connected and in a normal status.



The icon turning red here represents a malfunction



At the time of boot-up or when general alarm occurs the yellow light will light up



## 8. APP Operation

"My Livoltek" APP is a platform to communicate with your device via Wi-Fi or Bluetooth, you can login on LIVOLTEK web portal(link as below) on your computer, also you can scan the QR code (as below) to download the APP on your phone to achieve real-time display and remote control.

Web link2: <https://evs.livoltek-portal.com> (For Asia, Latin American, Australia and others.)

Web link1: <https://www.livoltek-portal.com> (For Europe, Middle East Regions, Africa.)

APP: Search "My Livoltek" on Apple App Store, Google Play and you can scan the QR code to download the latest installation package.

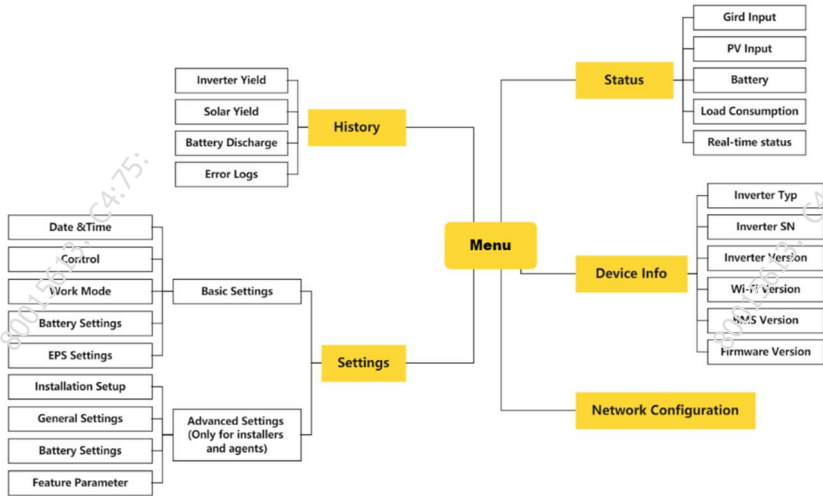


My Livoltek



Download

# 8.1 User interface on the APP



**Notes:**

The advanced setting and Maintenance settings can only be checked and set via local mode on the APP or the web platform of installers and distributors” accounts.

## 8.2 WIFI Configuration

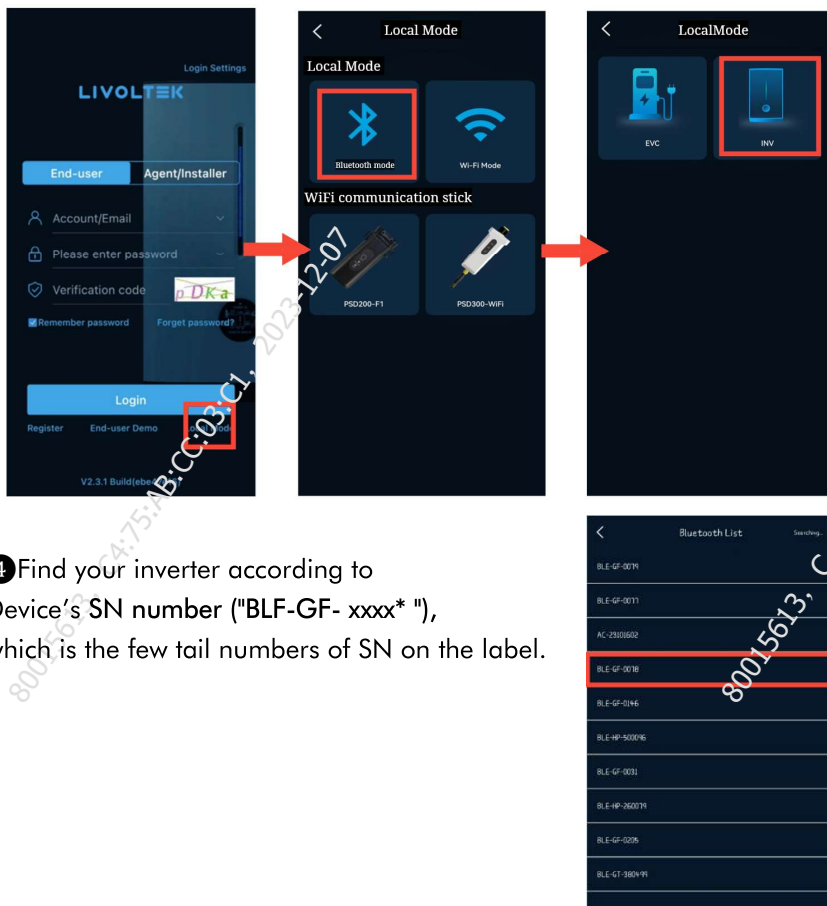
### Preparation

Power on inverter

Power on router and check the wireless networks that your mobile phone joined

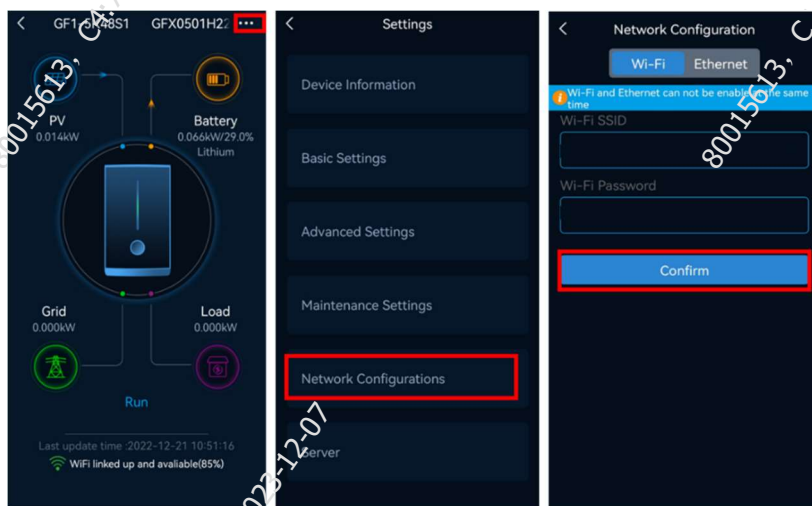
Open the "My Livoltek" APP

- 1 Click on "Local Mode".
- 2 Click on "Bluetooth Mode".
- 3 Click on "INV".



- 4 Find your inverter according to Device's SN number ("BLE-GF- xxxx\* "), which is the few tail numbers of SN on the label.

- ④ Click on "..." to click on setting.
- ⑤ Click on "Network Configurations".
- ⑥ Choose "Wi-Fi".
- ⑦ Enter wireless network name & password
- ⑧ Click on "Confirm" and wait 10s, "Success" will display on the APP if connection is successful.



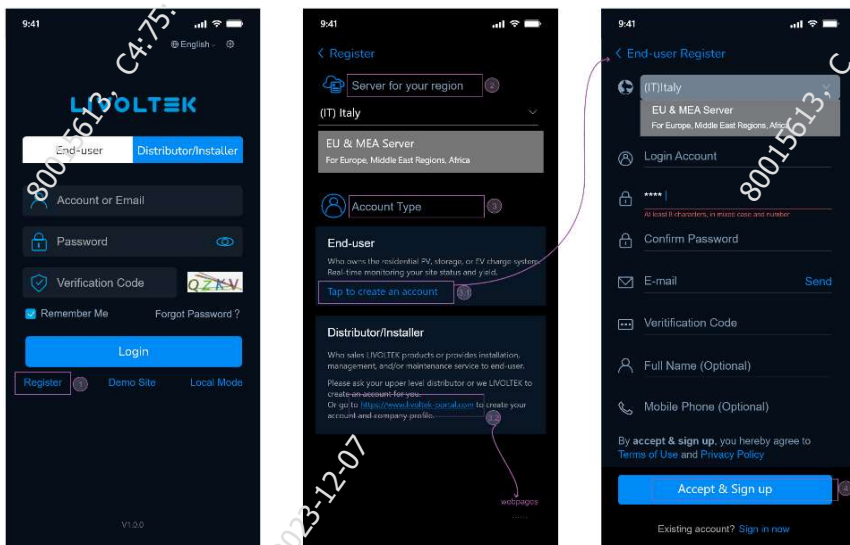
**Notice:** Local real-time monitoring via Bluetooth.

- \* Local real-time monitoring via Bluetooth.
- \* Refers to the last four digits of inverter's SN.
- \* If it's not possible to connect to the wireless network, or you do not want to do so, select the "Ethernet" to connect by LAN connection.



## 8.3 Register an account

Open the “My Livoltek” APP or LIVOLTEK Web Platform (the link shown above at “8.APP operation”) and login with the username & password. Register it first if you don’t have an account, which provides access to the remote monitoring and management.



### Steps:

- 1 Click the “Register” button.
- 2 Choose your “Server” according to your country and region.
- 3 Choose “Account Type”. For end-users, please tap to create an account, if you are distributors/installers, go to browse livoltek-portal web platform to create an account.
- 4 Fill in your personal details in the registration form (end-user).  
You will receive an email in your inbox to confirm your account (If you do not have the email in your inbox, please check the spam folder).

### Notice:

Meanwhile, for end-user can also ask the installer to create an account for him/her. The login account and initial password will be sent to the end-user’s register email after created. Please note that the initial password needs to be changed at the first time your login.

#### NOTICE

- There are two different accounts for end users and business (agents/installers), with different account authorizations.
- Business accounts can only be registered through web.
- Only end user accounts can be registered through the APP.
- The agent/installer can create a sub-account for the end user after the power site (PV plant) is created. The login account and initial password will be sent to the end-user's register email after created.

## 8.4 Create a site and add the inverter to the site

You can edit the site (PV Plant) information, add the new inverter to the site, delete the site, expand the list of added inverters of the site and set time-of-use tariff of your site.

### 8.4.1 Add the first Site and device

For the first login, there is the guidance to create the first site.

If have a LIVOTEK device, please touch "CREATE A SITE NOW" to start your journey. Filling up the site Basic info, PV capacity and tariff of your site, then add your device.



- Choose your site installer and complete your site name, time zone, and location your address.

**\*Note:** if forget to check the access allows, the end-users' installer may not be able to serve.

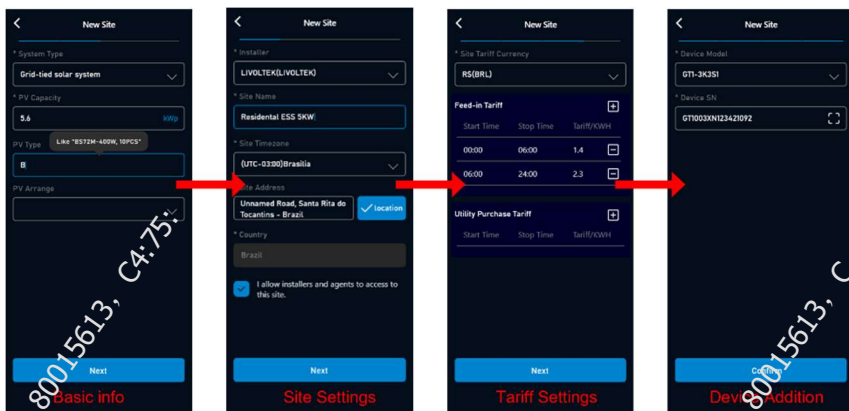
- Configure your system type and PV info including PV capacity, PV type (optional, fill like "BS72M-400W, 10PCS"), PV arrange (optional, please select the electrical arrange of PV array).

- Set time-of-use tariff of your site.

**\*Note:** The time of use tariff must meet the requirements of 24 hours for both feed-in and self-use (or purchase) tariffs.

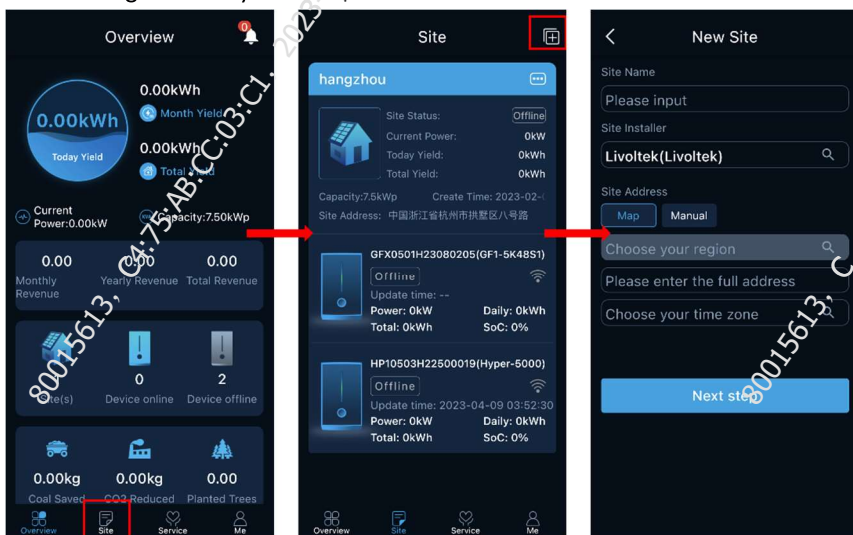
- Add device by filling device model and its serial number.

**\*Support scan QR Code/Bar Code to add device.**



## 8.4.2 Add Another Site

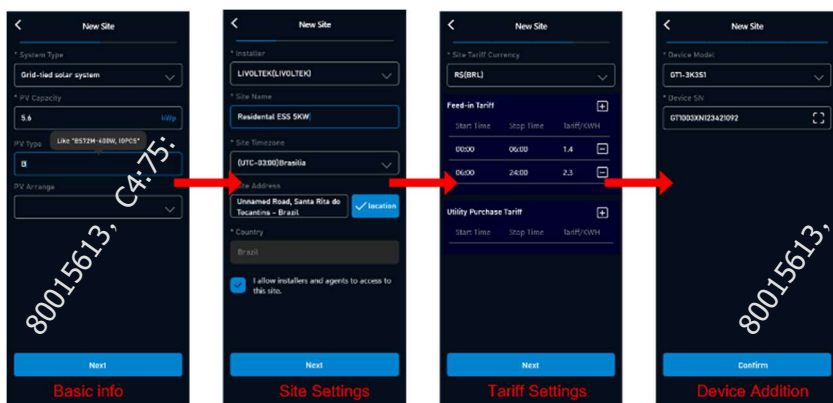
- Open the app and login with the username & password.
- Enter the "Site" Page, touch "Add" button [⊕] at the top right of the page.
- Choose the Installer, enter the Plant Name, Time Zone, location and other basic information.
- For the location, click the "Map", system will automatically fill in the details according to what you enter.



Notes: Tick "I agree installers to access to this site", then your installer can assist you to set the inverter remotely.



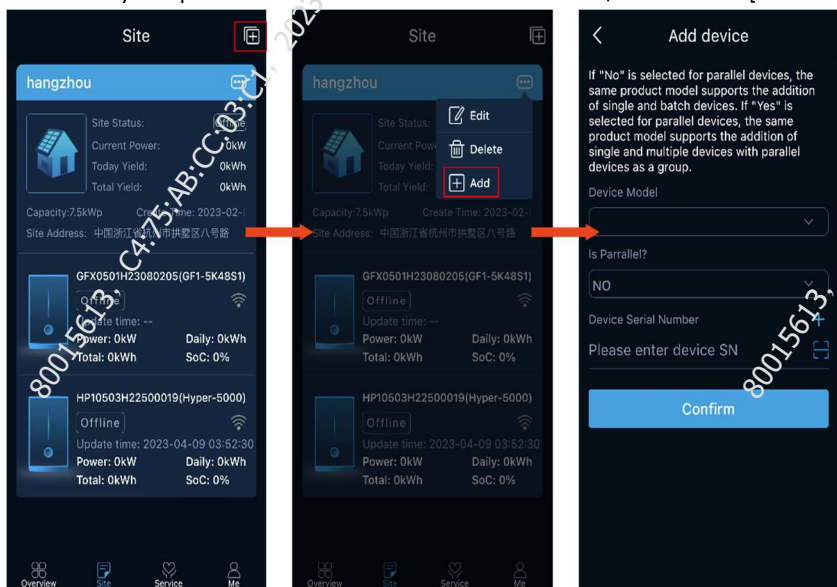
The subsequent steps are the same as the previous: “8.4.1 Add the first Site and device”.




Notes: The time frame must be 24-hour electricity tariffs.

### 8.4.3 ① Add Device

- Touch "Add" button [🔍] at the top right of the PV site page to add a device.
- Choose your product model and enter SN number, then touch [confirm].



- The SN number can be found on the label of inverter and click the [  ] which supports scanning QR Code/ Bar Code to add device.

## 8.5 Settings on the APP

### 8.5.1 Home Page Overview

You can check Parameters of System. The status and data on this page might be a few minutes delay from the real-time inverter data

By touch the icons on the diagram, it will show the historical data of each part.

This screen is the homepage after user logging in.

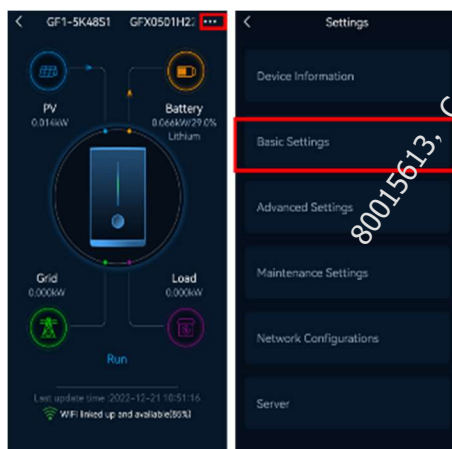
You can touch Overview tab to get into this screen as well.

In this screen, you have full insight with site status, including generations, revenues and social contributions.



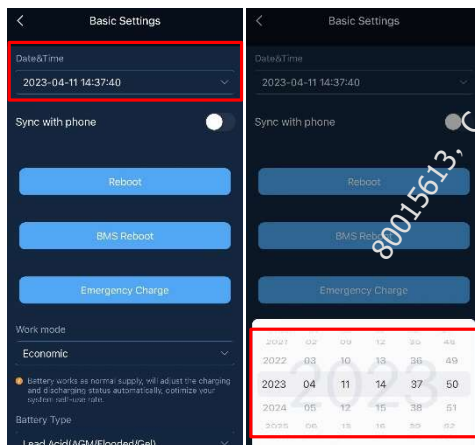
### 8.5.2 Basic Settings

You can set the inverter time, Restart the inverter, choosing work modes, battery type and buzzer in Basic settings.

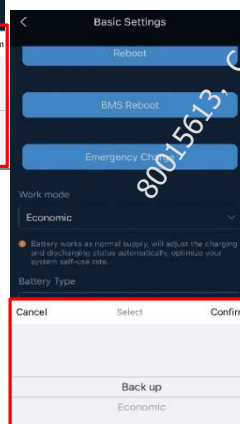
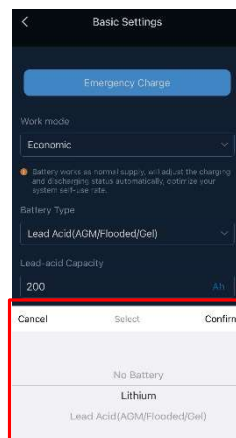


- Date&Time  
( Basic Settings>Date&Time)

The date and time of device is synchronized with phone by default.  
It can also be set by yourself.



- Battery Type  
(Basic Settings>Battery Type)  
You would select battery Type here, and the lithium brand must have been compatible with Livoltek.



- Work mode  
( Basic Settings> Work mode)  
There are two modes provided for you to choose: Back up, Economic.  
When the grid failure appears, it will switch into Off-grid mode automatically.

### 8.5.2.1 Emergency Charge

- Emergency Charge is design to avoid the damage caused by long time excessive discharge .
- It is recommended to manually click this button to charge the battery after installing the battery for the first time.
- The inverter cannot respond to the discharge command during emergency charge.
- In this mode, the battery will be charged to 54V, and it will exit this mode after 2 hours. But you can exit this mode by clicking "Restart" during this process.



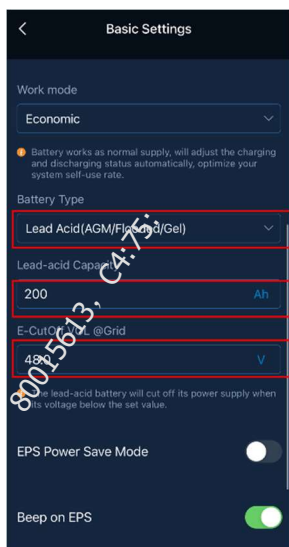
### 8.5.2.2 Select Battery type and Work Modes

In the battery type, you can choose proper capacity lead acid battery with a nominal voltage at 48V. And you need to choose battery type as "Lead-acid".

If you choose lithium battery, you are allowed to use the lithium battery only which we have configured. Also, you need to choose battery type as "Li-ion".

If you have no battery now, you can also float BAT terminal, and this inverter will only work like a PV inverter.

Work Modes decides the operation logic of the hybrid system. So make sure what you select is exactly what you want. The detailed description about the working modes, please refer to the chapter 4.6 Working Modes.



Lead-acid(default), Lithium, no battery

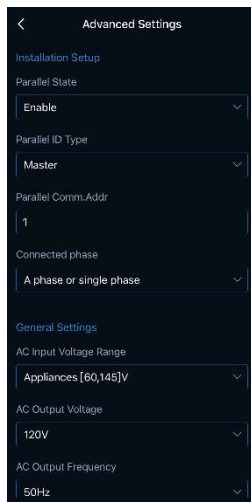
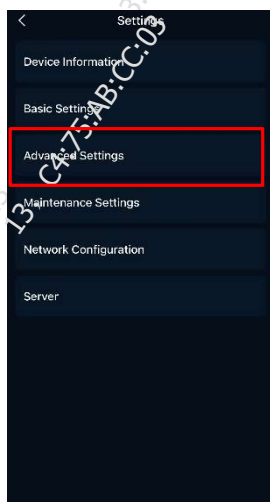
Backup or Economic mode

The voltage of battery can be set

### 8.5.3 Advanced Settings

Advanced settings are generally customization for lead-acid battery and protection value of grid. All the settings must be 100% honest to the battery specifications first.

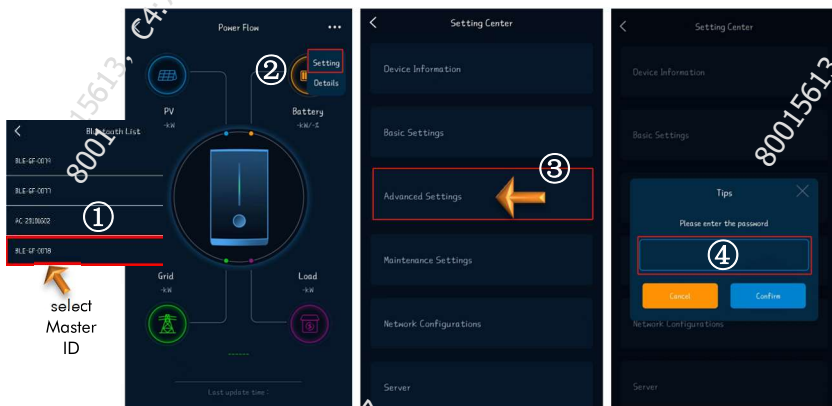
**Note:** \*This function interface is only exposed to the installers and distributors" accounts. Please contact your installer or factory if needed.



## 8.6 \*Parallel Settings

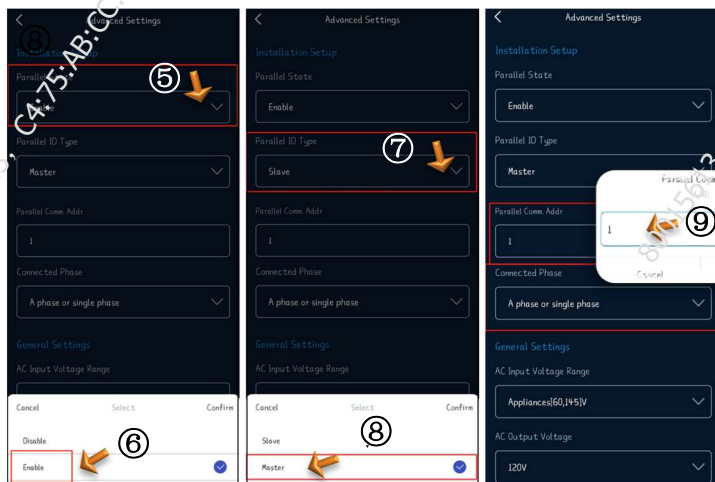
### 8.6.1 Set the Master in parallel

Open the app, follow the prompts shown in the image below, First select the ID of the Master and enter the Master APP interface, click "Settings", select "Advanced Settings", and enter the settings interface. The default password is hx123456



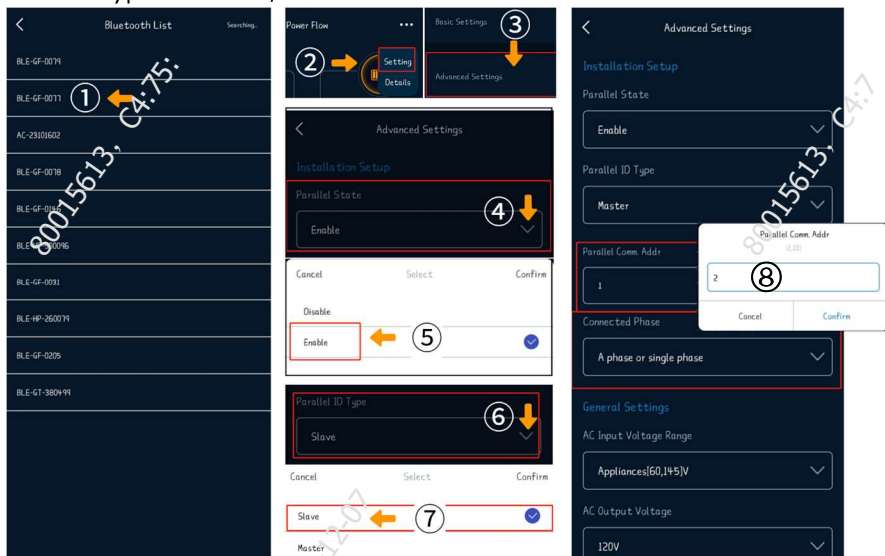
In the advanced settings, set the "Parallel State" to "Enable", and then set the "Parallel ID Type" to "Master", and set the "Parallel Comm. Addr" to "1".

Note: The phase (Connect Phase) of the off-grid inverter is set the "Connected Phase" to "A phase" by default. If not, manually set it to "A phase".



## 8.6.2 Set the Slave in parallel

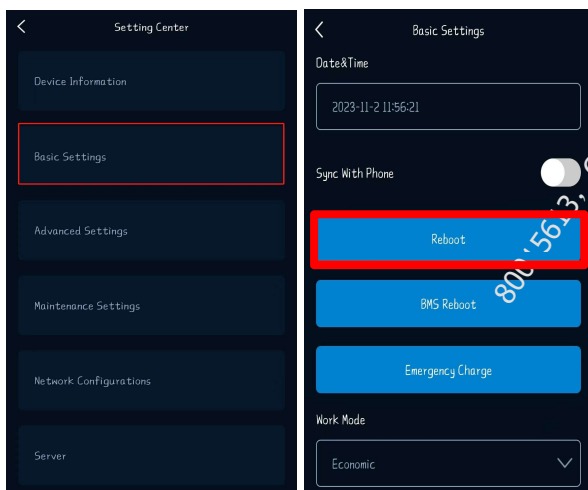
First select the ID of the slave and enter the slave APP interface, click "Settings", select "Advanced Settings", "Enable" the Parallel State, set the Parallel Type to "Slave", set the "Parallel Comm. Addr" to "2".



## 8.6.3 Restart the inverter

After completing the settings for the Master and Slave, you need to restart the inverter.

Select "Basic Settings" in the settings and click "Reboot" to restart the inverter.



## 9. Troubleshooting

This chapter is a guide for troubleshooting problems of GF series inverters. When the inverter has an exception, its basic common warning and exception handling methods are shown in the table below.

Error Message	Explanation/Possible causes	Suggestion
PV over Volt	PV input voltage is not within permissible range.	Check if voltage and number of PV modules are meet requirements and adjust it if need.
PV over current	PV input current is not within permissible range.	1. Check the PV input power and configuration. 2. Wait a moment for inverter recovery or restart the system.
Low battery	The battery voltage/capacity is too low.	1.Re-charge battery. 2.If the alarm occurs repeatedly, contact your dealer for technical support.
PV energy weak	Insufficient power supply from PV string.	1. When sunlight intensity weakens, PV modules voltage decreases. No action is needed. 2. If such phenomena occur when sunlight intensity does not weaken, check if there is shielded, or short circuit, open circuit etc. in the PV strings.
AC Volt Fault	AC voltage is not within permissible range.	1. If the alarm occurs accidentally, possibly the AC power is abnormal accidentally. No extra action is needed. 2. If the alarm persists for a long time, check if the AC circuit breaker/AC terminals is disconnected or not, or if the grid or generator (if applied) is working well, or if input voltage range setting is correct.(UPS->appliance)
AC Freq Fault	AC frequency is not within permissible range.	
Inter CKT Fault	BUS Voltage (AC Side) is too high.	1. Wait for a while to check if it can automatically recover to the normal operating status after the fault is rectified. 2. Restart the inverter, If the problem remains, please contact your dealer for technical support.
Inter CKT Fault	Over current fault detected by software.	
Inter CKT Fault	Inverter current component failure.	



EPS Volt Fault	Output Voltage abnormal (Inverter voltage below than 190Vac or is higher than 260Vac)	<ol style="list-style-type: none"> <li>1. Make sure the load power is within the EPS power range.</li> <li>2. Check if the AC output wires are connected well.</li> <li>3. Check if the host setting is correct in parallel situation.</li> </ol>
EPS Over Load	Overload error. The inverter is overload 110% and time is up (more than Five time)	<ol style="list-style-type: none"> <li>1. Reduce the connected load by switching off some equipment, and wait for a while to check if it can automatically recover to the normal operating status after the fault is rectified.</li> <li>2. Restart the inverter, If the problem remains, please contact your dealer for technical support.</li> </ol>
Inter Temp High	Internal temperature of component is too high.	<ol style="list-style-type: none"> <li>1. Check if the air flow of the unit is blocked or whether the ambient temperature is too high.</li> <li>2. Try to close inverter for 30 mins, then restart the inverter, If the problem remains, please contact your dealer for technical support.</li> </ol>
BAT Temp High	Battery (Lead-Acid) temperature is not within permissible range.	<ol style="list-style-type: none"> <li>1. Check if the environment temperature of battery is in the range of specification.</li> <li>2. Wait for a while to check if it can automatically recover, if not, contact your dealer for technical support.</li> </ol>
BAT Volt Fault	Battery voltage is not within permissible range.	<ol style="list-style-type: none"> <li>1. Check if spec and quantity of batteries are meet requirements.</li> <li>2. Check if the batteries are connected well.</li> <li>3. Wait for a while to check if it can automatically recover, if not, contact your dealer for technical support.</li> </ol>
PV Strings Reverse	The cables of PV strings are connected reversely.	Check if the cables of PV strings are correctly connected. If they are connected reversely reconnect the cables.
Fan abnormal	Fan fault	<ol style="list-style-type: none"> <li>1. Check if the fan is jammed by abnormal objects.</li> <li>2. Restart the inverter, If the problem remains, please contact your dealer for technical support.</li> </ol>
LCD Fault	External screen Communication lost.	<ol style="list-style-type: none"> <li>1. Check if the distance and cables between LCD and inverter are meet requirements and adjust it if need.</li> <li>2. Restart inverter and reconnect the LCD, If the problem remains, please contact your dealer for technical support.</li> </ol>
BMS Lost	BMS Communication lost.	<ol style="list-style-type: none"> <li>1. Check if the lithium Battery is open.</li> <li>2. Check if the BMS cable is loose or broken.</li> <li>3. Reconnect the BMS cable, If the problem remains, please contact your dealer for technical support.</li> </ol>

Firmware Fault	Software version incompatibility	1.Check if the firmware version is correct from LCD or Livoltek-portal. 2. Restart inverter, If the problem remains, please contact your dealer for technical support.
Low battery	The battery voltage is too low.	1.Re-charge battery. 2.If the problem remains, please contact your dealer for technical support.
Inter CKT Fault	Over current occurs during battery charging or discharging.	1.Restart inverter and check if it still occurs. If not, it's just an occasional situation. 2. If the problem remains, please contact your dealer for technical support.
Inter CKT Fault	BUS Voltage (Middle) is too high.	
Inter CKT Fault	Internal Relay failed	
Inter CKT Fault	Internal EEPROM Component (DSP) damaged.	
Inter Com Fault	Internal Communication failure (ARM&DSP).	
EEPROM Fault	Internal EEPROM Component (ARM) damaged.	
PV over current	PV input current is not within permissible range.	
BMS Fault	BMS communication failure.	
BMS Error	BMS communication abnormal.	

## 10. Technical Data

Model	GF1-3K48L1	GF1-3K48S1	GF1-5K48S1	GF1-6K48S1
<b>Capacity</b>				
Rated Power(VA/W)	3000/3000	3000/3000	5000/5000	6000/6000
Peak Power(VA)	6000	6000	10000	10000
<b>PV Input Data</b>				
Max. PV Input Power(Wp)	3600	3600	6000	6000
Max. PV Input Voltage(Vdc)	480			
MPPT Voltage Range(Vdc)	120~450			
Rated Power MPPT Voltage Range(Vdc)	250~450			
Max. PV Current(A)	14	14	25	25
Max.Short Circuit Current(A)	17	17	31.25	31.25
No. of MPPTs/Strings per MPPT	1/1	1/1	1/2	1/2
<b>AC Input Data</b>				
Input Voltage Waveform	Sinusoidal			
Rated Input Voltage(Vac)	110	230	230	230
Selectable Voltage Range(Vac)	85~140 (Computers) 70~140 (Appliances)	170~280 (Computers) 90~280 (Appliances)	170~280 (Computers) 90~280 (Appliances)	170~280 (Computers) 90~280 (Appliances)
Rated Input Frequency(Hz)	50/60			
Frequency Range(Hz)	45-55 /55-65			
Max. AC to DC Efficiency	>95%			
Max. Input Current(A)	27.2	13.0	21.7	26
<b>AC Output Data</b>				
Output Waveform	Pure Sine Wave			
Rated Power(VA/W)	3000 /3000	3000 /3000	5000 /5000	6000 /6000
Peak Power(VA)	6000	6000	10000	10000
Rated Voltage(Vac)	110/120/127 ±5%	220/230/240 ±5%	220/230/240 ±5%	220/230/240 ±5%
Typical Transfer Time(ms)	10			
Surge Power	10sec (110% ~ 150%), 2sec (150% ~ 200%)			

Max. Efficiency (PV to AC)	98%			
Max. Efficiency (Overall Equipment Effectiveness)	95%			96%
Rated Grid Frequency(Hz)	50/60			
Grid Frequency Range(Hz)	45-55 /55-65			
Power Factor	1			
THDv, Rated Power[%]	<3%			
Battery & Charger				
Battery Type	Lead-acid/Lithium			
Rated Battery Voltage(V)	48			
Charging Algorithm	3-Step			
Communication with BMS	CAN			
Solar Charger Type	MPPT			
Max. Solar Charging Current(A)	60	60	100	100
Max. AC Charging Current(A)	60	60	100	100
Max. Charging Current(A)	60	60	100	100
General Data				
Dimension(W*H*D mm)	338*485.5*147.3 mm			
Weight(kg)	12kg	11kg	12 kg	
Protection Degree	IP21			
Cooling	Fan			
Operating Temperature Range	- 10℃ ~ 55℃(Derating at 45℃)			
Standby power consumption	< 15W			
Display	LED+APP/ LCD (Optional)			
Communication	CAN/USB/Dry Contact/Bluetooth/NTC/RS485/ Wi-Fi (Optional)/LCD (Optional)			

- ★ Certifications may vary according to different regions.
- ★ All Specifications are subject to change without notice.

## 11. Disclaimer

The GF1 series inverters are transported, used and operated under limited condition, such as environmental, electrical etc. Livoltek shall not be liable to provide the service, technical support or compensation under conditions listed below, including but not limited to:

- Inverter is damaged or broken by force majeure (such as earthquake, flooding, thunderstorm, lighting, fire hazard, volcanic eruption etc.).
- Inverter's warranty is expired and doesn't buy extended warranty.
- Can't provide the inverter's SN, warranty card or invoice.
- Inverter is damaged by man-made cause.
- Inverter is used or operated against any items in local policy.
- Inverter's installation, configuration, commissioning doesn't follow the requirements mentioned in this manual.
- Inverter is installed, refitted or operated in improper ways mentioned in this manual without authority from Livoltek.
- Inverter is installed, operated under improper environment or electrical condition mentioned in this manual without authority from Livoltek.
- Inverter is changed, updated or disassembled on hardware or software without authority from Livoltek.
- Obtain the communication protocol from other illegal channels.
- Build monitoring, control system without authority from Livoltek.
- Livoltek will keep right to explain all the contents in this user manual.

# Warranty Card Registration

# LIVOLTEK

Dear customer, thank you for choosing LIVOLTEK product.  
For registering product warranty, please prepare everything  
ready and register on  
<https://www.livoltek.com/registration.html>.

Product Information	
Product Type	
Product S/N	
Installation date	
Installation Company	
Personal Information	
Your name	
Your contact number	
Your Email address	
Your home address	

\*Warranties should be registered within 36 months of installation, however it is recommended that they are registered no more than 6 weeks following the successful installation and commissioning of the Product where possible, thanks for your cooperation.





## Contacts

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