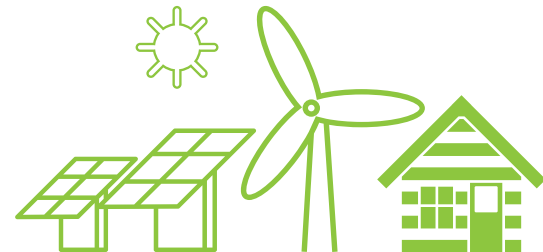




# Off-Grid Inverters



# Contents

**1** Introduction

**2** Operation

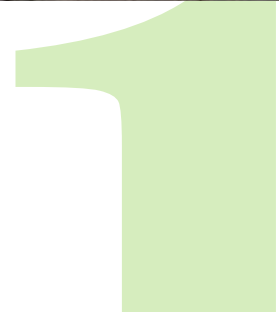
**3** Selection

**4** Installation

**5** Maintenance



# Introduction



# Need of Off-Grid Solution

Combine different energy resources  
like PV etc.

- **Complete self-governing  
without main grid support**

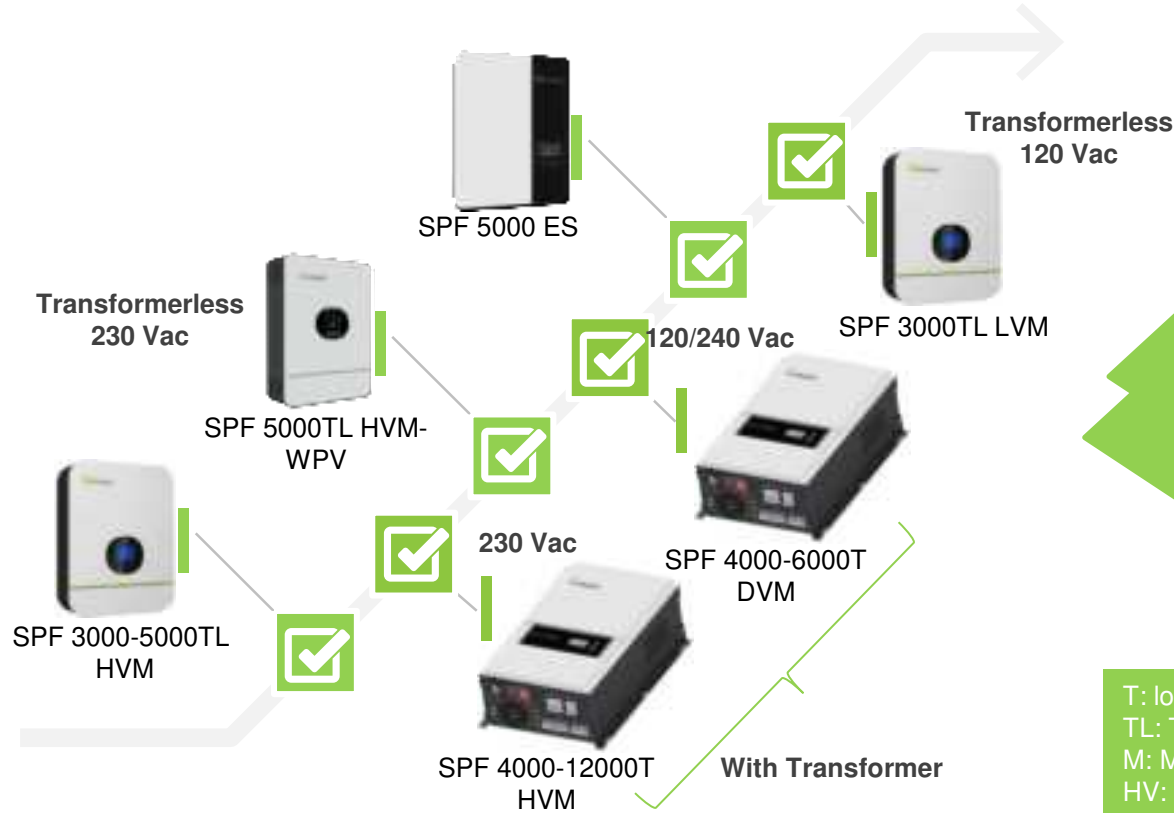
- **Extend or change your system  
on a segmental basis**

Support issues including, household,  
school, small factories, area suffer  
from power instability, replace the  
generation of diesel generators

- **Growatt provides services including  
inverter, MPPT control, Solar  
pump inverter and storage  
with 3-30 kW range**



# Off-Grid Inverters



## Accessories

SC 4860-48120  
MPPT solar charge controller

Wi-Fi-F/GPRS-F

T: low frequency transformer,  
TL: Transformerless,  
M: MPPT solar charge controller  
HV: 230Vac, LV: 120Vac,  
DV: 120/240Vac,  
P: Parallel model, WPV: PV 450Vdc model



# Off-Grid Inverter Battery



## Battery Case



IP55,  
Wall-mounted,  
12kg Cabinet



## US2000

Lithium Battery (48V 50AH)

2.4kWh, 90% DoD  
IP20, 24kg  
Max. 8pcs



**Note:** Each Battery Case can install 2pcs US 2000 Lithium Battery



# Key Features



**SPF 3000TL LVM  
(Offered Split-phase )**



## Support

1. Power factor 1.0
2. MPPT solar charge controller
3. WIFI/GPRS remote monitoring
4. Compatible with generator power
5. Configurable AC/solar input and charging priority
6. Parallel operation available
7. Compatible with lithium battery
8. Low voltage 120Vac output



# Key Features



SPF 3000-5000TL HVM



## Support

1. Power factor 1.0
2. MPPT solar charge controller
3. WIFI/GPRS remote monitoring
4. Compatible with generator power
5. Configurable AC/solar input and charging priority
6. Parallel operation available for 4kw/5kw
7. Compatible with lithium battery
8. High voltage 230Vac output

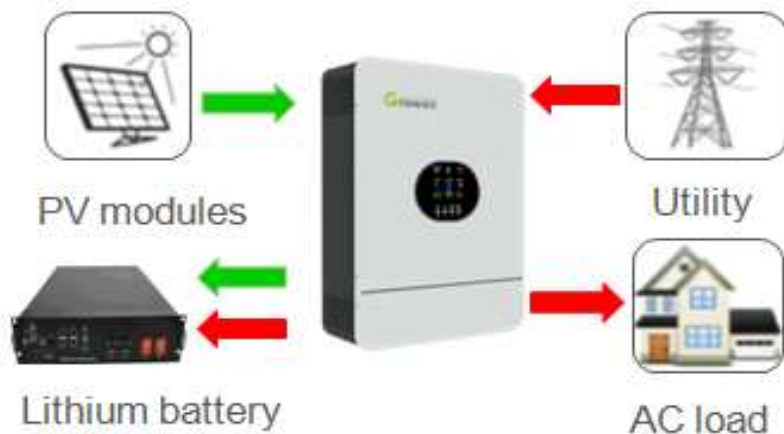




# Key Features



SPF 5000TL HVM-WPV  
(Wide PV Range)

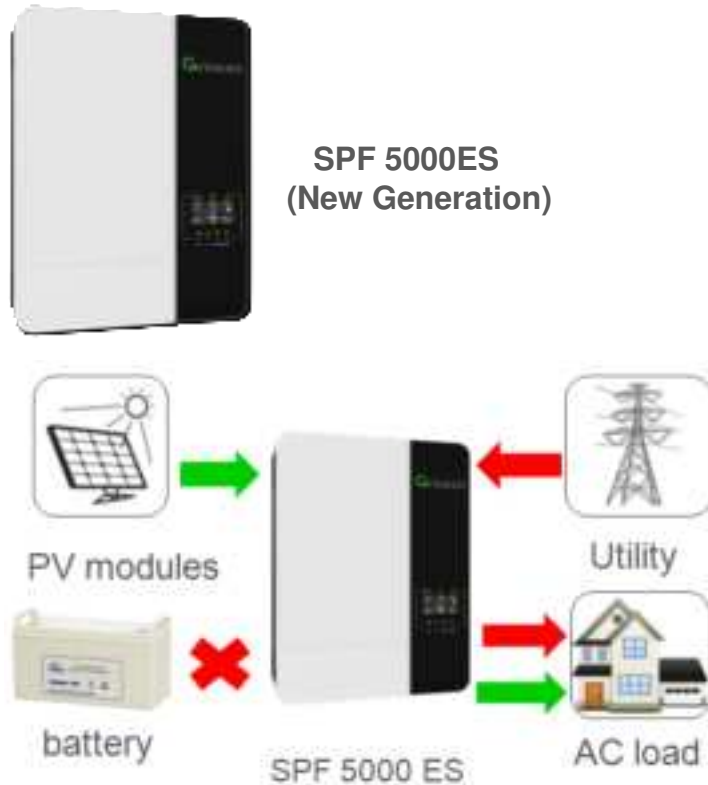


## Support

1. Power factor 1.0
2. MPPT solar charge controller
3. PV input voltage up to 430VDC
4. WIFI/GPRS remote monitoring
5. Compatible with generator power
6. Configurable output and charging priority
7. Parallel operation available
8. Compatible with lithium battery



# Key Features



## Support

1. Power factor 1.0
2. MPPT solar charge controller
3. PV input voltage up to 430VDC
4. WIFI/GPRS remote monitoring
5. Compatible with generator power
6. Configurable output and charging priority
7. Parallel operation available
8. Compatible with lithium battery
9. Work with battery or without battery
10. Adjustable inverter charging and output time
11. Equalization charging function



# Key Features



**SPF 4000-6000T DVM**  
(Transformer 120/240Vac output)



## Support

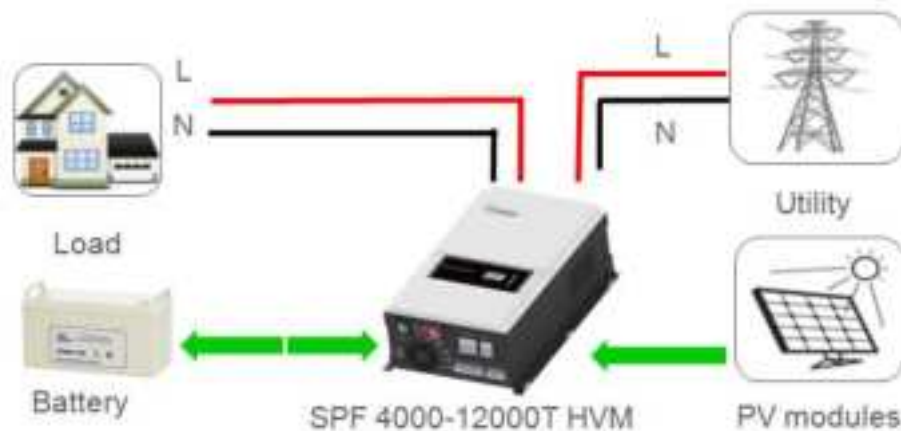
1. Power factor 1.0
2. MPPT solar charge controller
3. Built-in low frequency transformer
4. WIFI/GPRS remote monitoring
5. BTS terminal for lead-acid battery
6. Support (120/240Vac) both of them
7. Compatible with generator power
8. Configurable AC/solar input and charging priority
9. Compatible with lithium battery



# Key Features



**SPF 4000-12000T HVM**  
(Transformer 230Vac output)



## Support

1. Power factor 1.0
2. MPPT solar charge controller
3. Built-in low frequency transformer
4. WIFI/GPRS remote monitoring
5. BTS terminal for lead-acid battery
6. Compatible with generator power
7. Configurable AC/solar input and charging priority
8. Compatible with lithium battery



# Key Features



**SC4860-48120**  
(Solar charger)



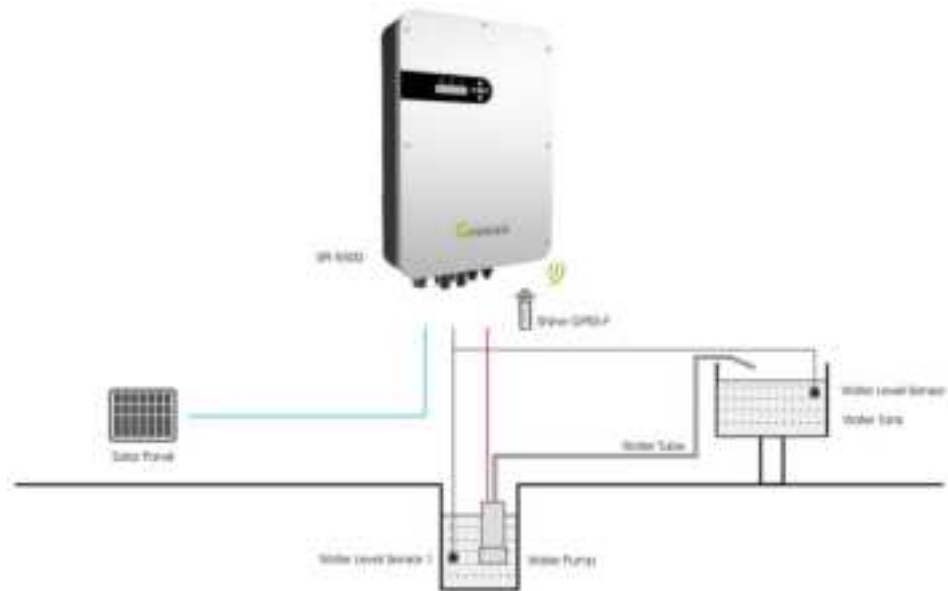
## Support

1. MPPT solar charge controller
2. Compatible with 12/24/48V battery voltage, charging current from 60-120A
3. BTS for battery stability
4. WIFI/GPRS remote monitoring
5. Multifunction LCD display information
6. Three-stage charging for battery
7. Maximum efficiency up to 98%



# Off-Grid (Solar Pumping System)

Growatt Solar Pumping Inverter can be used for irrigation systems, swimming pool pumps, municipal and agricultural water systems



**Note:** WiFi-F and GPRS-F just used for off-grid inverter.

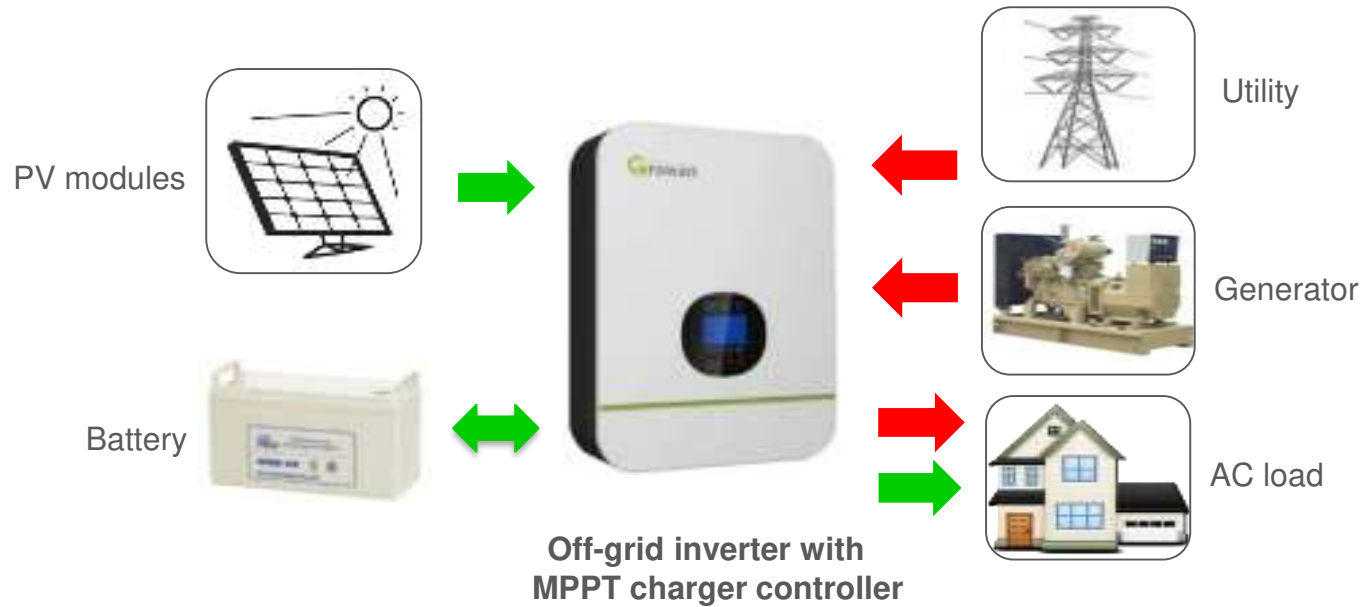
## Features

1. Integrated MPPT controller
2. Smart function and parameter setting via LCD button
3. Optional GPRS remote monitoring
4. Full protection function and self-diagnosis.
5. High Efficiency. Use dynamic VI MPPT control method, MPPT efficiency 99%



# Off-Grid System Overview

Off-grid energy storage system is generally consist of PV modules, off-grid inverter, MPPT charger controller (bidirectional DC/DC converter), battery, generator, monitoring devices and electrical appliances.



# Monitoring Platform

## Remote monitoring



Shine Phone APP

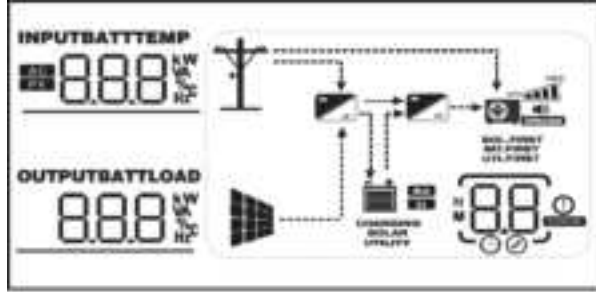


Shine Server



# Monitoring Platform

## Local monitoring



**1. Input information** (PV voltage, AC voltage, frequency, PV generator, battery voltage, charging current)

**2. Output information** (Voltage, load percentage, frequency, load in VA, load in watt, discharging current)



USB cable



PC install monitoring software



PVkeeper platform



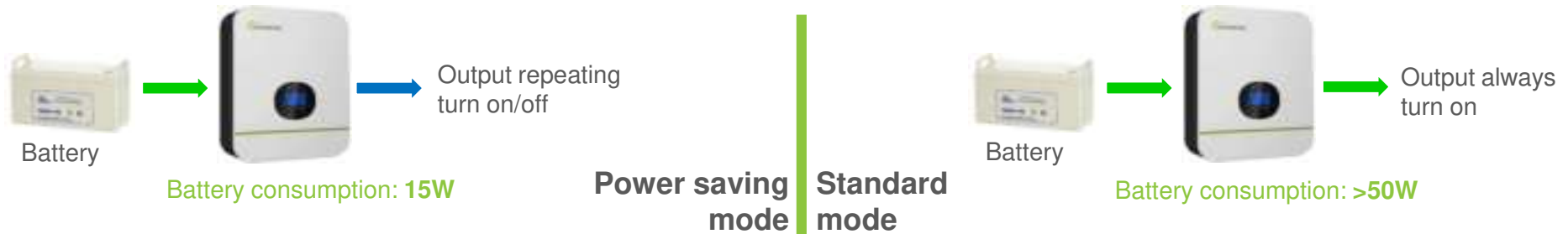
# Operation



# Operation Benefits

## Power Saving Mode

When the load is pretty low or not, inverter will turn off the output (Low consumption from battery)



# Operation Functions

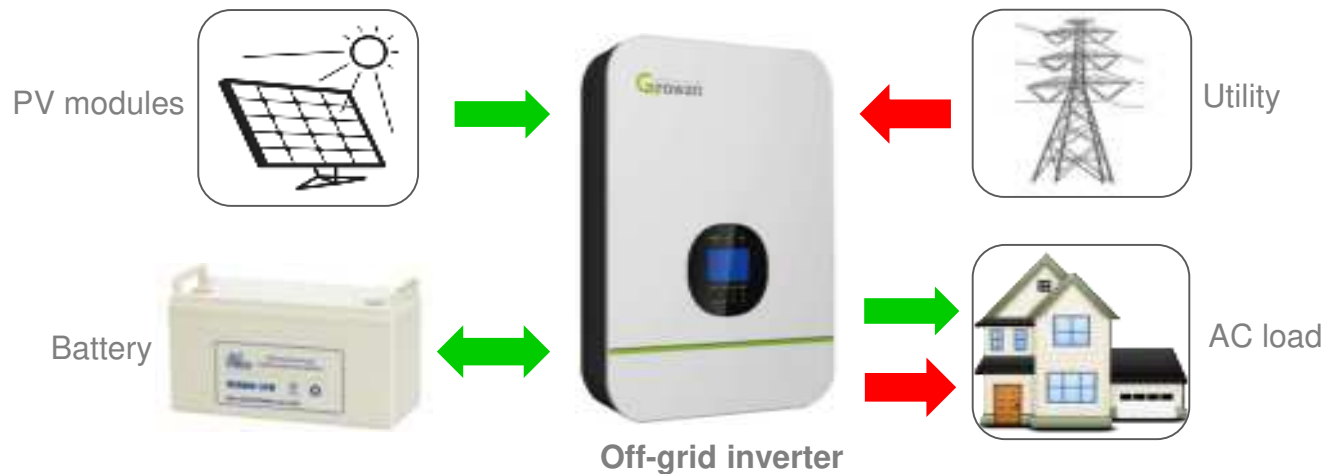
Output priority mode setting:

1. SOL first
2. UTI first
3. SBU first

Charging priority mode setting:

1. CSO first
2. CUT first
3. SNU first
4. OSO

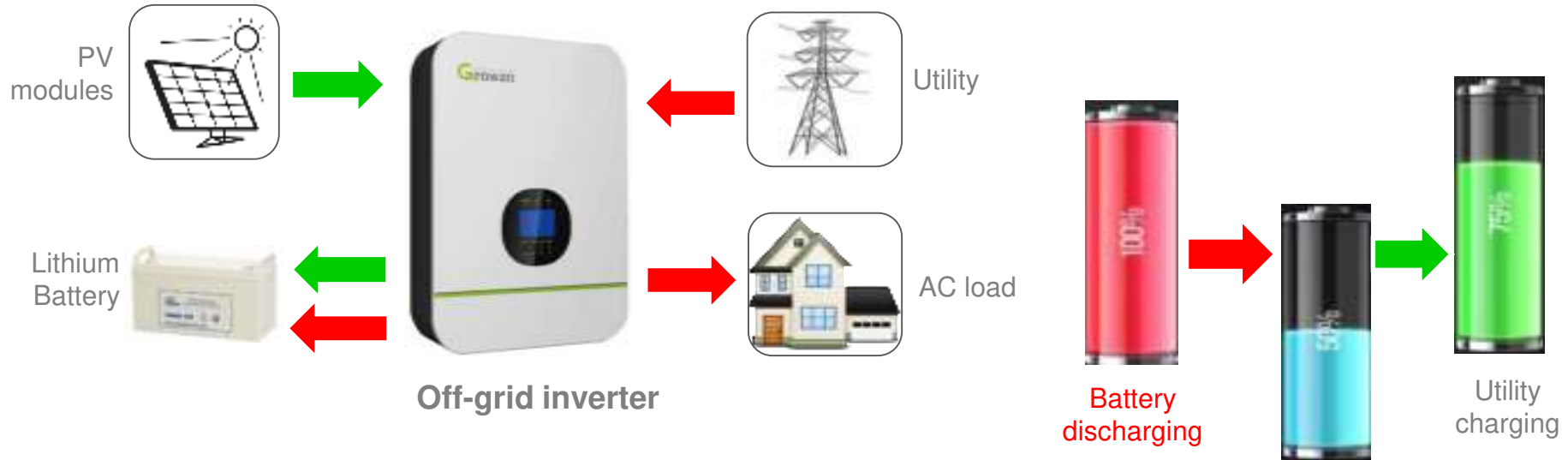
Off-Grid inverter with MPPT charge controller



# Operation Functions

Mode selection setting: Utility or Battery mode:

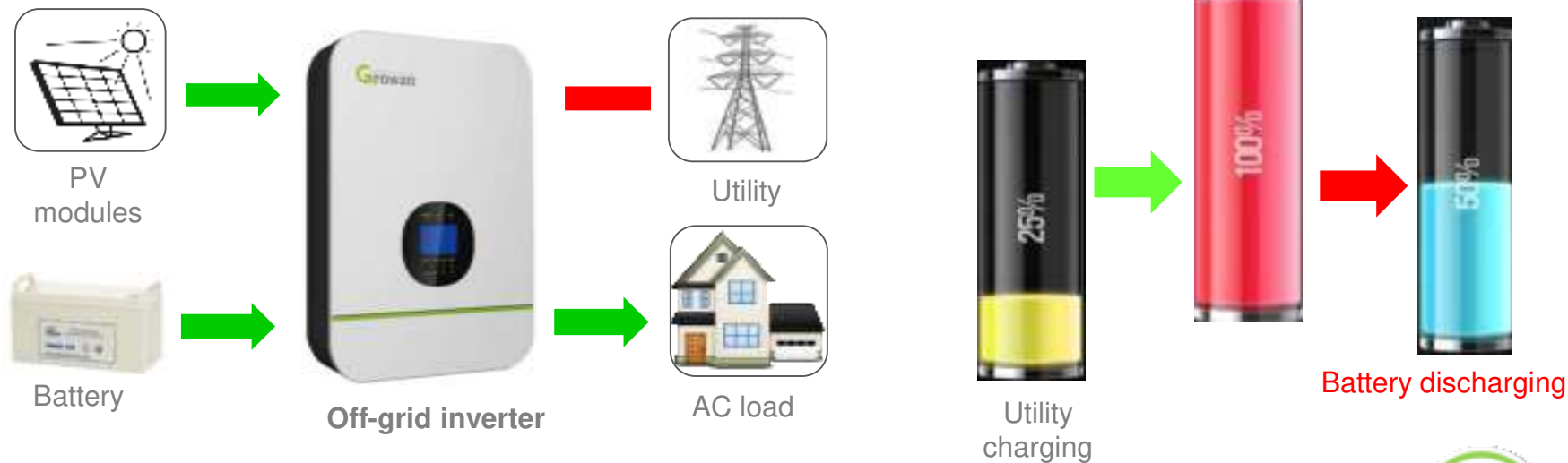
## 1. Back to Utility Mode (Voltage Range: 44-51.2 VDC)



# Operation Functions

Mode selection setting: Utility or Battery mode:

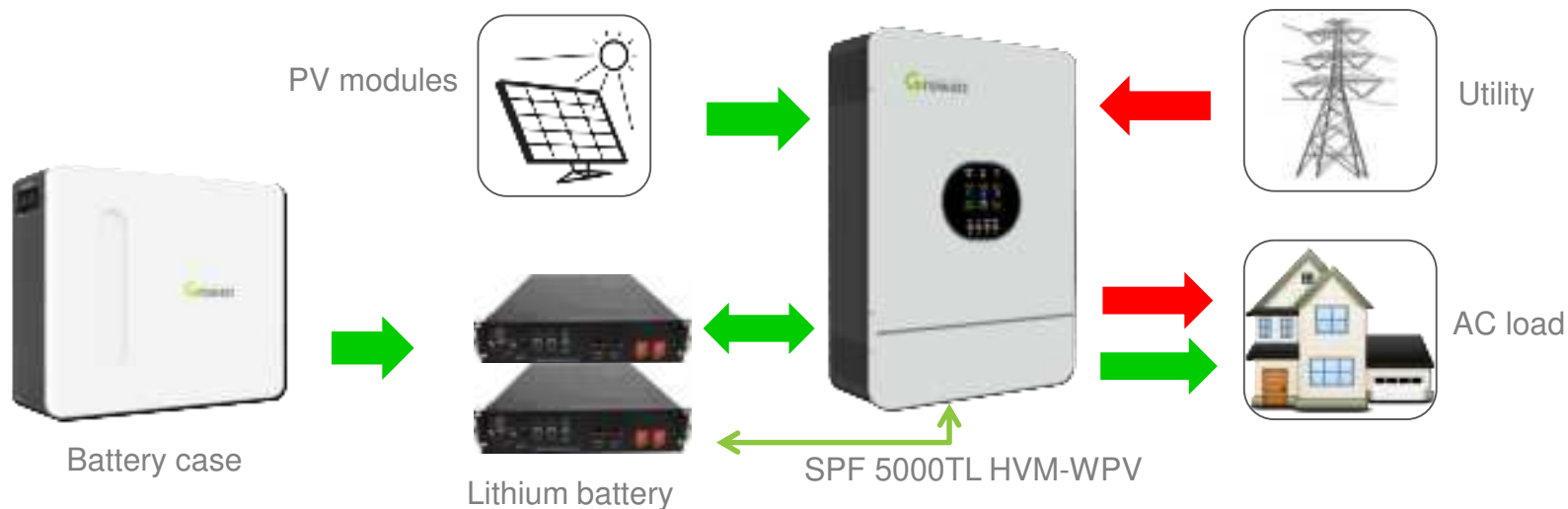
## 2. Back to Battery Mode (Voltage Range: 48-58VDC)



# Operation Functions

Lithium battery :

SPF 5000TL HVM-WPV series provides RS 485 & CAN ports for Li battery. US2000 Li battery can parallel max. 8 PCS and Battery case can integrate 2PCS US2000 batteries inside

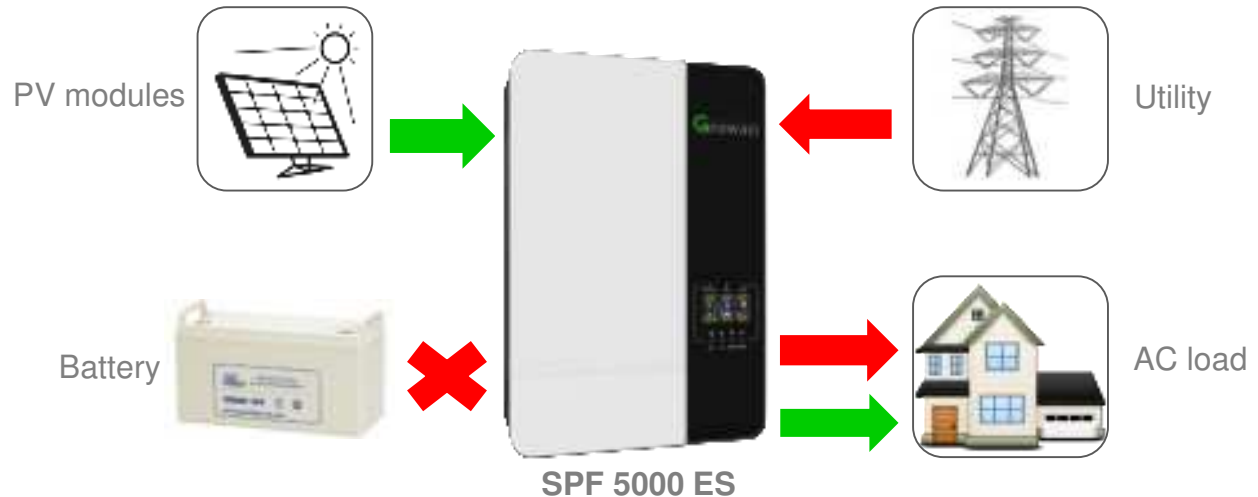


# Operation Functions

Without battery operating model:

SPF 5000 ES series inverters can work without battery and have wide PV input voltage range up to 430Vdc

**Easy installation,  
Save cost of battery  
& PV wire.**





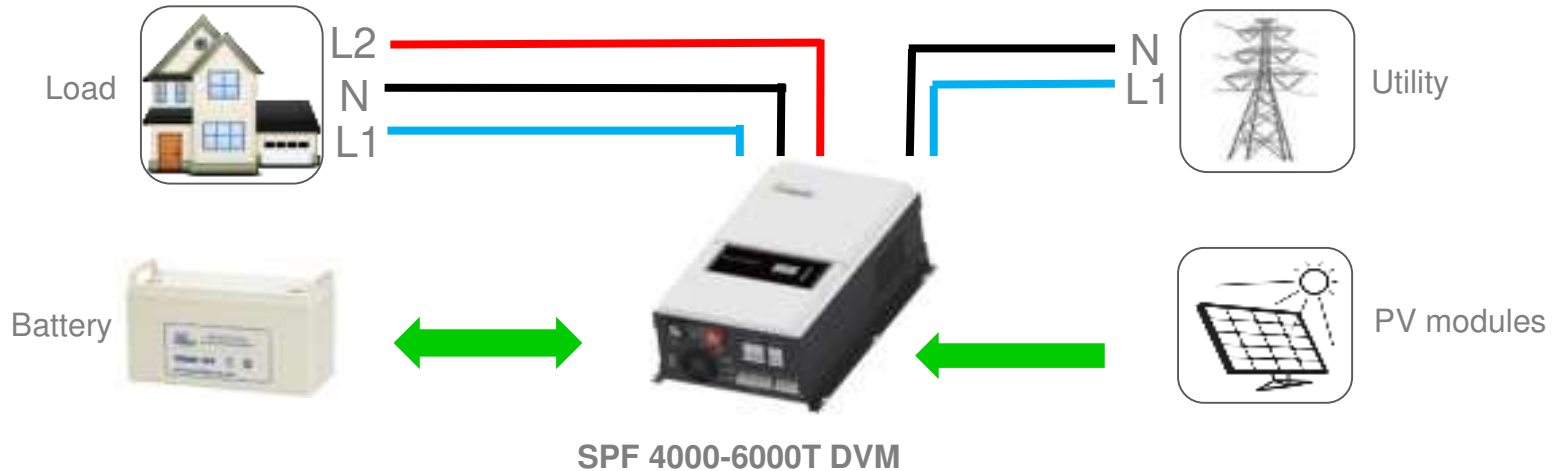
# Operation Functions

Several voltage outputs:

SPF 4000-6000T DVM series inverters have different voltage output that can meet all kinds of single phase equipment require

Output voltage :  
L1-N=120VAC  
L2-N=120VAC  
L1-L2=240VAC

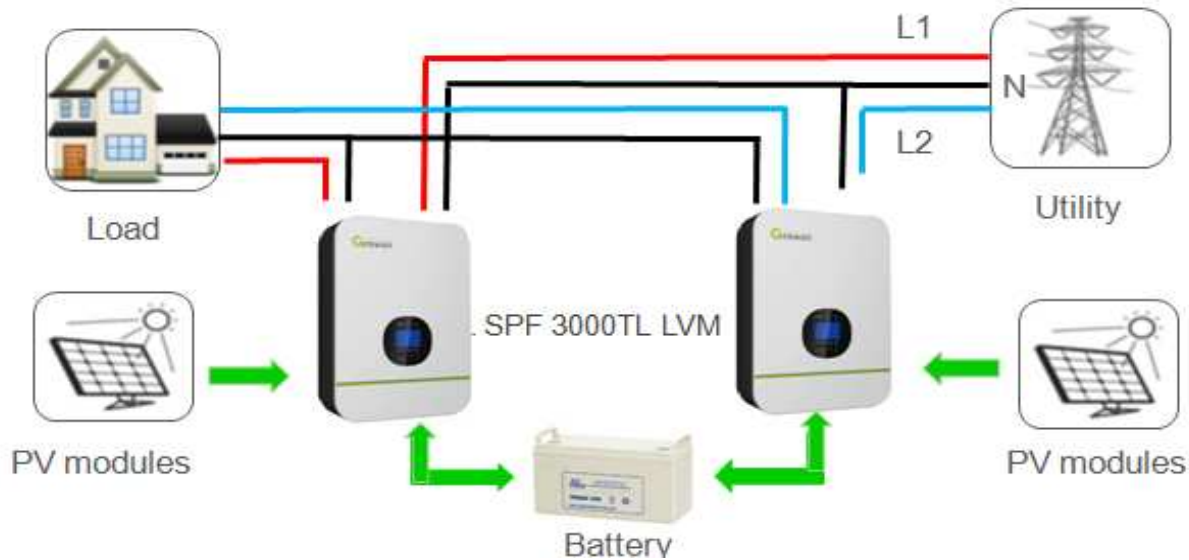
Input voltage : L1-N= 230VAC



# Operation Functions

Split phase L1-N and L2-N:

For 120Vac system, SPF 3000TL LVM series inverter can configuration output L1-L2 of 240V system



# Operation Functions

Parallel mode:

Parallel operation with up to 6 units only for 4/5KVA and 3KVA LVM series transformerless inverter, maximum capacity up to 30kW, and it can also be set to 3-phase system

Three-phase system



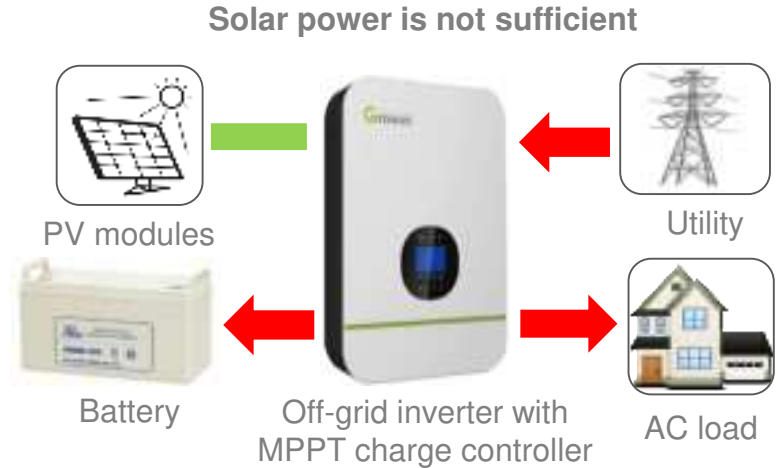
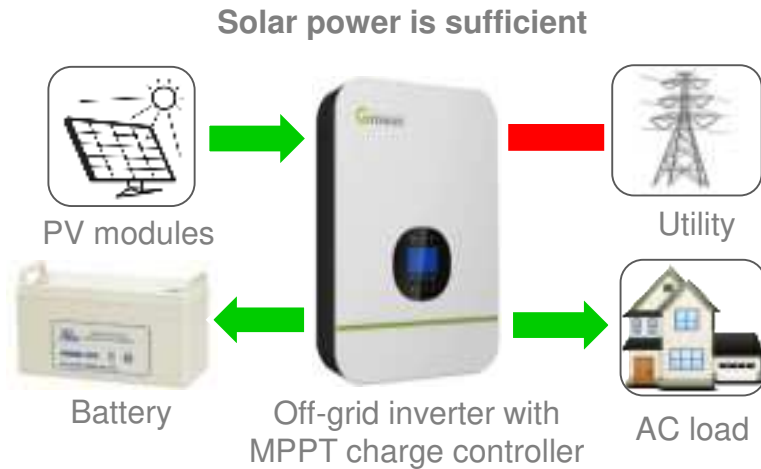
Single-phase system



# Applications

## 1. Enhance battery life (Output : SOL first) → 3K HVM (Default mode)

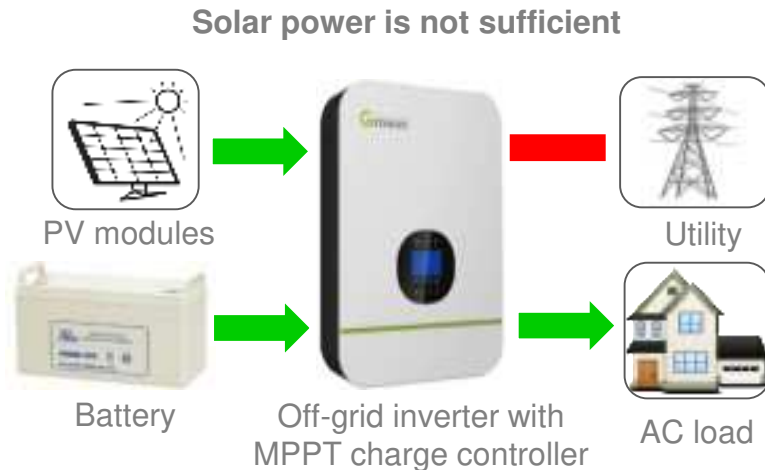
Solar power is sufficient (Feed to load and also charge the battery). When solar power is not available, Utility supply power to the load and charge the battery



# Applications

## 2. Support cost-effective (Output : SBU first)

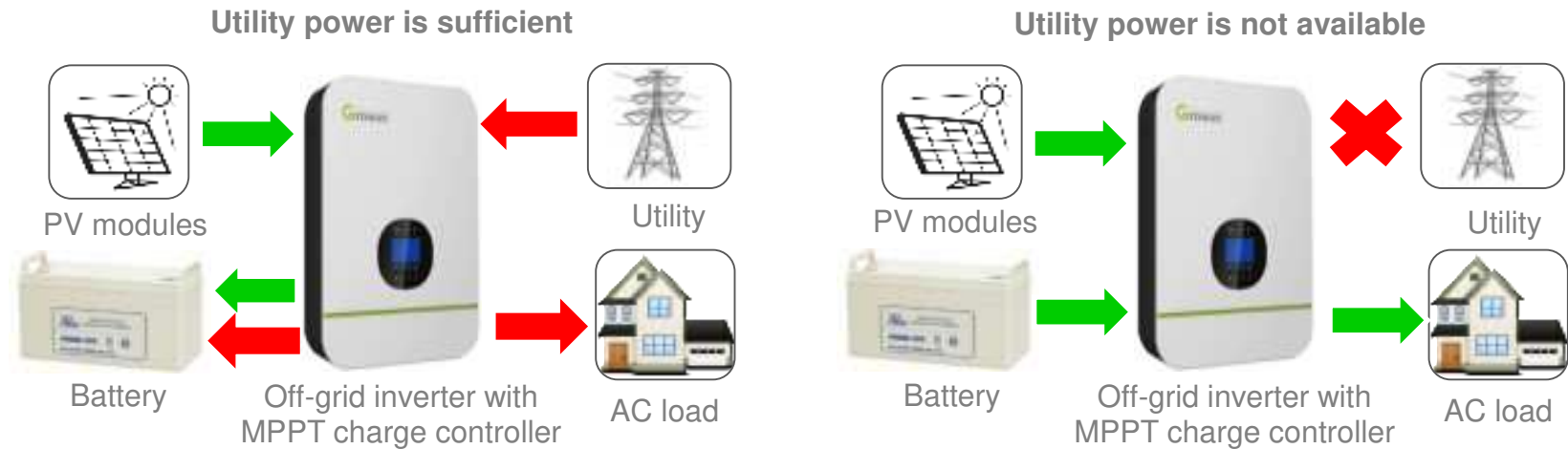
When Solar power is sufficient (it feeds to load and charge the battery). For cost-effective support, Utility feeds power only if the battery feeding is under low-level warning



# Applications

3. Unavailability of sunshine/Raining season (Output : UTI first) → 5K HVM,3K LVM (Default mode)

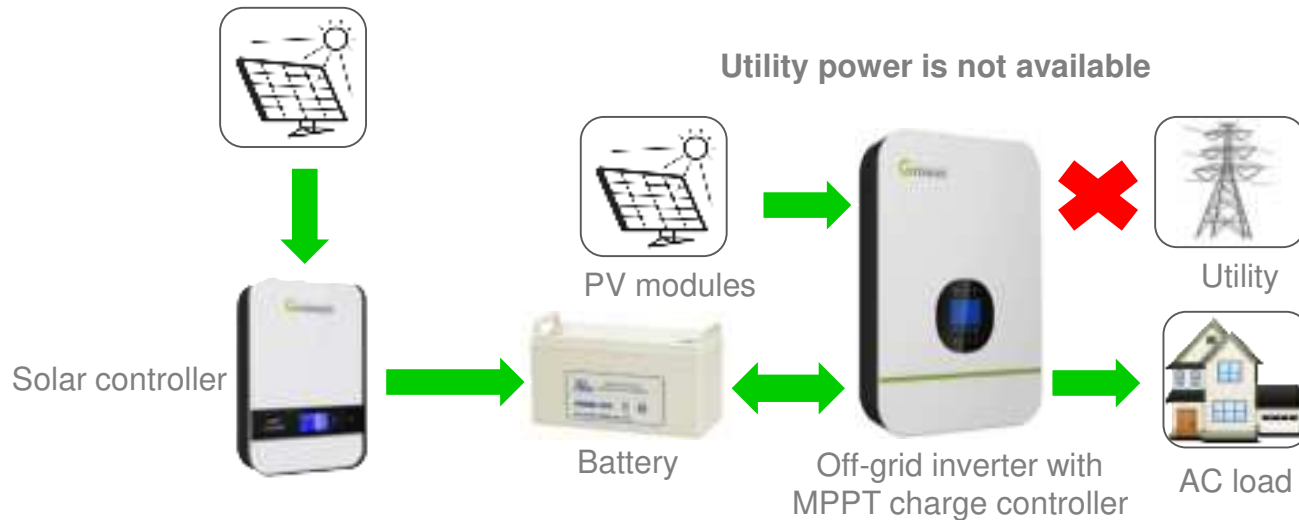
Utility supply power to load as a priority but solar and battery only provides power to load, if the utility power is not available



# Applications

## 4. Utility is not available (Output: SOL first)

Solar supply power to load and also charge the battery. But when solar power is not sufficient than battery also feed power to the load. Backup support can be provided through solar controller charging for the battery



# Applications



Nigeria 5kw single phase system



South Africa 30kw three phase system





# Applications



South Africa 15kw there-phase system



China 15kw  
there-phase  
system







South Africa  
10kw single-  
phase system





# Selection

3

# Utility Power & Load Selection

Voltage	Transformer Type	Single Phase	Three Phase	Home appliance capacity < 5kw	Home appliance capacity > 5kw
<b>Utility Voltage: 230 VAC</b>	Transformerless 	SPF 3000-5000TL HVM; SPF 5000TL HVM-WPV SPF 5000ES	SPF 5000TL HVM ( 3 PCS or more units for parallel)	SPF 3000-5000TL HVM; SPF 5000TL HVM-WPV	SPF 5000TL HVM-P SPF 5000TL HVM-WPV ( 2 PCS or more units for parallel)
	Transformer 	SPF 4000-6000T DVM (Input 230VAC, output 120/240VAC);  SPF 4000-12000T HVM	NO	SPF 6000T DVM (Input 230VAC, output 120/240VAC);  SPF 6000-12000T HVM	SPF 6000T DVM (Input 230VAC, output 120/240VAC);  SPF 6000-12000T HVM
<b>Utility Voltage: 120VAC</b>	Transformerless 	SPF 3000TL LVM	SPF 3000TL LVM ( 3 PCS or more units for parallel)	SPF 3000TL LVM	SPF 3000TL LVM ( 2 PCS or more units for parallel)
	Transformer 	SPF4000- 6000T DVM (Input 230VAC, output 120/240VAC);	NO	SPF 4000-6000T DVM (Input 230VAC, output 120/240VAC);	SPF 6000T DVM (Input 230VAC, output 120/240VAC);

# Battery Selection

Voltage	Transformer Type	Lithium Battery	BTS Sensor	Split Phase	Without battery operation
Utility Voltage: 230 VAC	Transformerless 	SPF 3000-5000TL HVM; SPF 5000TL HVM-WPV SPF 5000 ES	NO	NO	SPF 5000 ES
	Transformer 	SPF 6000-12000T HVM	SPF 4000-12000T HVM	NO	NO
Utility Voltage: 120VAC	Transformerless 	SPF 3000TL LVM	NO	SPF 3000TL LVM	NO
	Transformer 	SPF 6000T DVM (Input 230VAC, output 120/240VAC);	SPF 4000-6000T DVM (Input 230VAC, output 120/240VAC);	SPF 4000-6000T DVM (Input 230VAC, output 120/240VAC);	NO

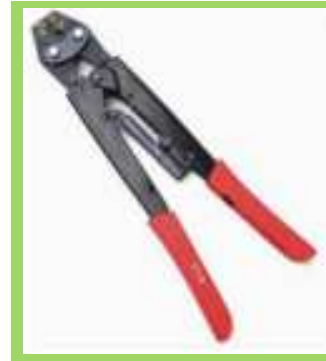
# Installation



# Preparation

## 1. Tools

Multi-meter  
Screw-driver  
Ampere-meter  
Other installation tools



## 2. Calculate items (It will influence inverter's capacity)

**Load type:** Home appliance, motor type load ( 3-6 times rate power).

**Load working time:** Peak power working time.

**Back-up time:** Battery discharge time.

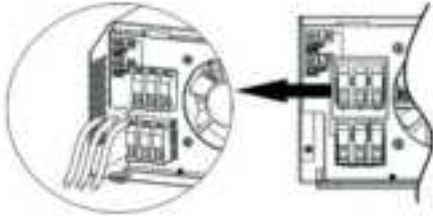
**Sunlight situation:** Peak radiation time per day.

**Utility power situation:** Grid power is available or not?

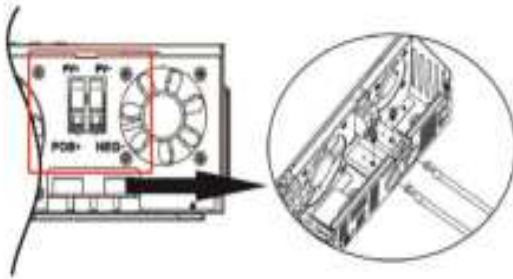
# Preparation

## Note:

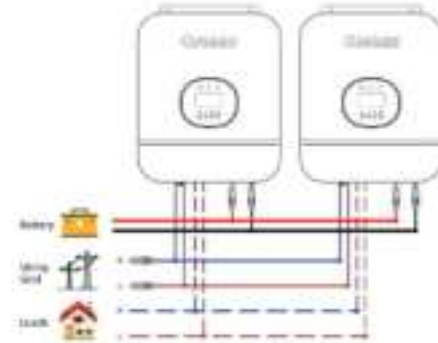
1. All wiring must be well-fastened to avoid shedding.



2. Make sure that the polarity of PV and batteries connected to the product is correct.



3. Should install utility, battery and PV input switch to ensure safety.



4. Battery and solar panel connections must be within the parameters of the product.

# Preparation

## Note:

5. During the operation of the system, do not disconnect the battery.



6. The number of parallel batteries should not be more than 3 groups.



7. Inverter protection degree is IP20



8. In areas with large dust, regular cleaning is required to avoid too much dust affecting heat dissipation.



# Wire Selection

## 1. Battery Input:

Model	Max input current	Battery capacity	Wire size	Switch size
2KVA (24V)	109A	100AH	1*4AWG	150A/32VDC
			2*8AWG	
3KVA (24V)	164A	100AH	1*2AWG	200A/32VDC
		200AH	2*6AWG	
2KVA (48V)	55A	100AH	1*6AWG	80A/60VDC
			2*10AWG	
3KVA (48V)	82A	100AH	1*4AWG	100A/60VDC
		200AH	2*8AWG	
4KVA	110A	200AH	1*4AWG	150A/60VDC
			2*8AWG	
5KVA	137A	200AH	1*2AWG	150A/60VDC

## 2. PV Input:

Model	Max input current	Wire size	Switch size
2KVA/3KVA @24V model	50A	8AWG	50A/100VDC
2KVA/3KVA @48V model	30A	10AWG	32A/150VDC
4KVA	80A	6AWG	80A/150VDC
5KVA	80A	6AWG	80A/150VDC



# Wire Selection

## 3. AC Input:

Model	Max input current	Wire size	Switch size
2KVA	12.6A	12AWG	16A/230VAC
3KVA	17A	10AWG	25A/230VAC
4KVA	30.5A	8AWG	40A/230VAC
5KVA	34.8A	8AWG	

## 4. AC Output:

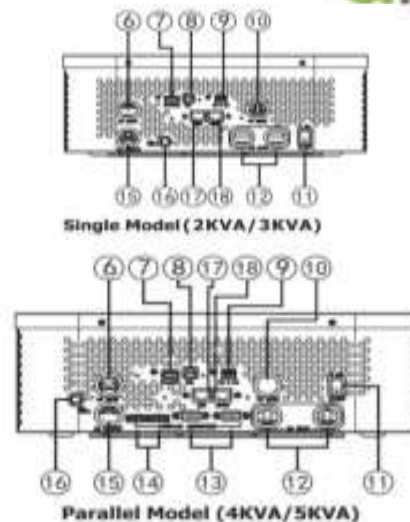
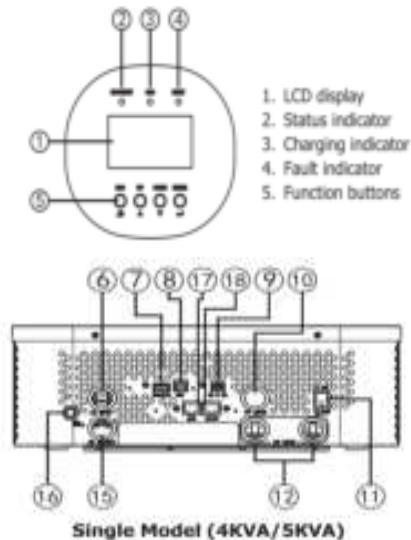
Model	Max input current	Wire size	Switch size
2KVA	8.7A	14AWG	16A/230VAC
3KVA	13A	12AWG	16A/230VAC
4KVA	17.4A	10AWG	25A/230VAC
5KVA	21.8A	10AWG	32A/230VAC



# Installation Overview



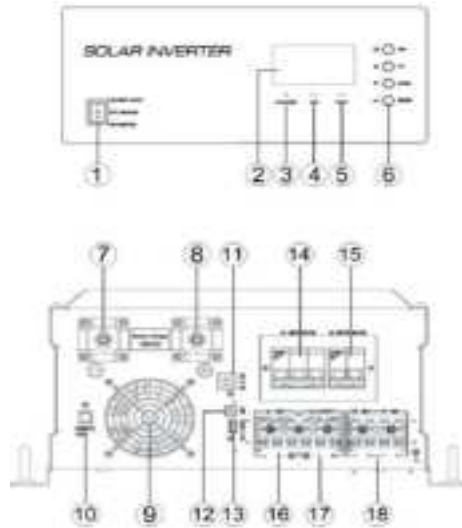
**SPF 3000TL LVM**  
**SPF 2000-5000TL HVM**



# Installation Overview



**SPF 4000-6000T DVM**  
**SPF 8000-12000T HVM**



- 1. ON/OFF power switch
- 3. Status indicator
- 5. Fault indicator
- 7. Battery “-”
- 9. Fan
- 11. Dry contact
- 13. WiFi/GPRS device port
- 15. AC output switch
- 17. AC output

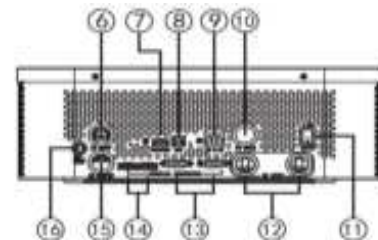
- 2. LCD display
- 4. Charging indicator
- 6. Function buttons
- 8. Battery “+”
- 10. Remote control port
- 12. USB port
- 14. AC input switch
- 16. AC input
- 18. PV input

# Connection



**SPF 3000TL LVM**  
**SPF 2000-5000TL HVM**

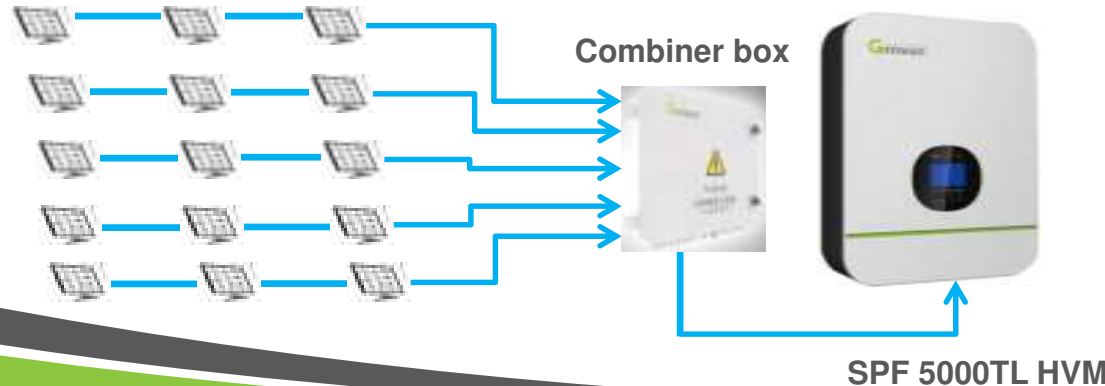
1. Remove bottom cover by screwdriver
2. Connect battery input
3. Turn on “Power on/off ” switch (check inverter normal working or not?)
4. Connect PV input (when step 3 inverter can normal working)
5. Connect AC input and output wire



# PV Connection

## Solar panel specification:

Module Type	290	295	300	305	310
Max Power (Pmax/W)	290	295	300	305	310
OC Voltage (Voc/V)	39.2	39.4	39.6	39.8	40
SC Current (Isc/A)	9.36	9.47	9.58	9.69	9.80
Peak power voltage (Vmp/V)	32.6	32.7	32.9	33.1	33.2
Peak power current (Imp/A)	8.90	9.01	9.11	9.22	9.33
Module efficiency (%)	17.5	17.8	18.1	18.4	18.7



### Calculation:

- 1. Number of panels:**  
Max PV Power/ solar panel power
- 2. Number of panels in one string:**  
Max MPPT voltage / solar panel Vmp
- 3. Number of string:**  
Number of panels / Number of panels in one string



- 1.  $4500W/300W=15PCS$**
- 2.  $115V/32.9V=3.495 \approx 3 PCS$  in string**
- 3.  $15/3 =5$  Strings**



# Monitoring

## Shine Phone APP

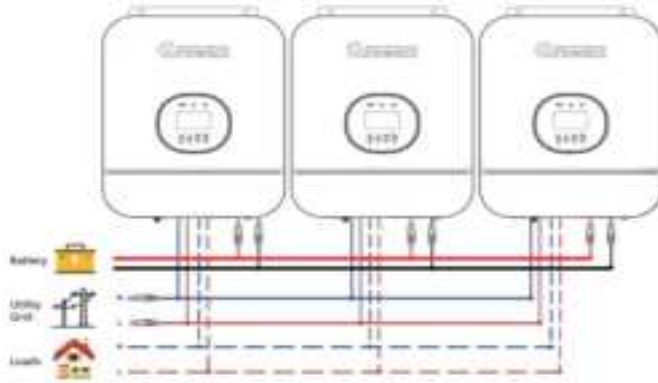
1. Connect **“WIFI-F”** device to inverter “WIFI/GPRS” terminal.
2. Registration and adding device  
**Scan the QR code** or **search shine phone** in IOS or Google play store.
3. **Scan or input WIFI-F barcode** and check code then click register button it will **move to “ my plant ”** page.

**Note:** For details, please refer to the user manual.

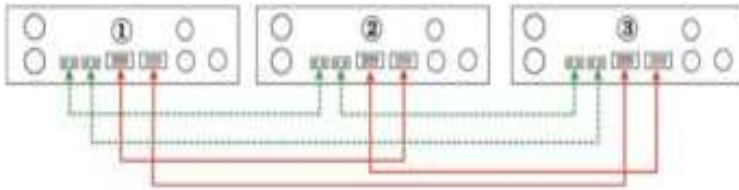


# Parallel Connection

## Single phase parallel:



## Communication connection:



When the units are used in **parallel with single-phase**, please **select "PAL"** in program 23.

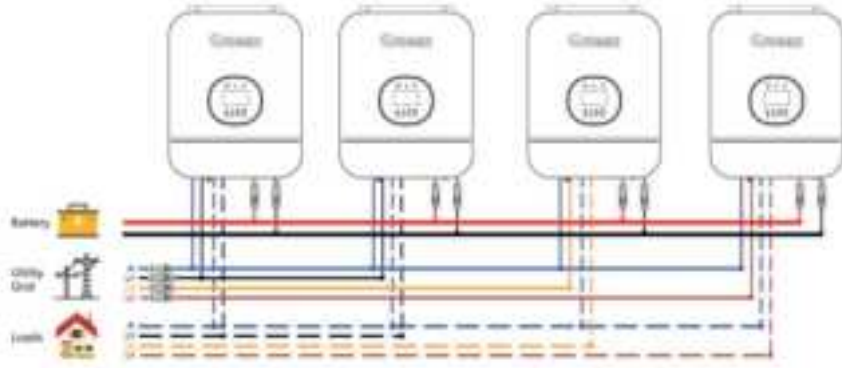
Single:  
OUTPUT  
SI G 23

Parallel:  
OUTPUT  
PAL 23

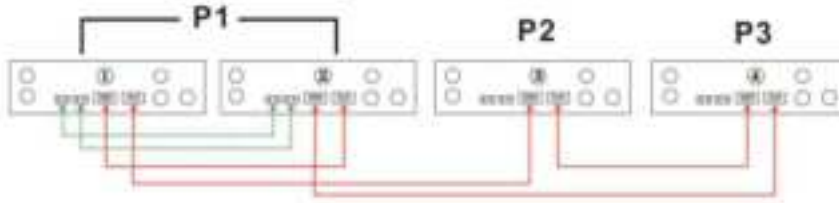


# Parallel Connection

## Three phase parallel:



## Communication connection:



When units are used in **parallel** with **three-phase**, please select "3P1" for L1, "3P2" for L2, and "3P3" for L3 in program 23. All neutral lines must be connected.

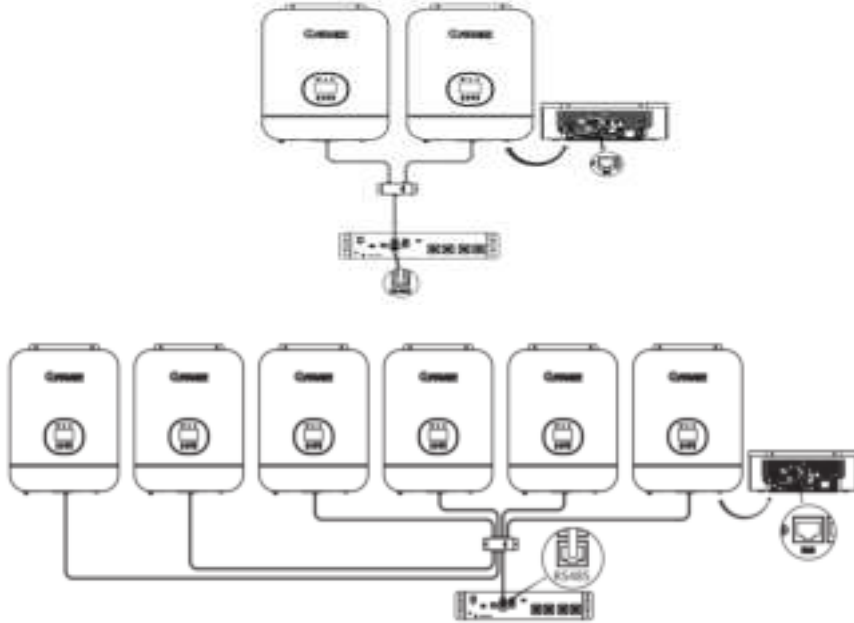
L1 phase:  
OUTPUT  
3P1 23

L2 phase:  
OUTPUT  
3P2 23

L3 phase:  
OUTPUT  
3P3 23

# Lithium Battery Connection

## Lithium battery connection and setting:



1. An external **RS485/CAN** is required between inverter and Li Battery, If it is necessary to use communication with **BMS in parallel**.
2. If you want to connect Lithium battery, must set the **Battery Type** to “**LI**” in **program 5**, also need **set SOC** in **program 12,13,21 and 36**, more information please check user manual Page 8.

AGM (default)

AGM 05

Flooded

FLD 05

Lithium (only suitable when communicated with BMS)

LI 05

User-Defined

USE 05



# Maintenance



# Spare Parts (5 kVA/3 kVA)



Main Board



CNTL Board



SCR Board



MPPT Board



COMM Board



Parallel Board

# Spare Parts (3 kVA)



Main Board



CNTL Board



MPPT Board



COMM Board

# Troubleshooting

## 1. No response on the inverter (LCD does not light up and the fan does not running)

- A) Check whether the **battery wiring** is in good contact;
- B) Check the **polarity of a battery** connected to the product is correct or not ;
- C) Check whether the **battery voltage** is within the specified range;
- D) Check whether the **switch is damaged**;

## 2. Inverter gives no output, and after a while shut down?

- A) Confirm whether the battery **voltage is more than 46V**, less voltage will not support inverter to cold start;

## 3. Failure 01 code (Fan lock failure)

- A) Check if the **fan is stuck**.
- B) Whether the wiring from the **fan to the main board** is loose or connection is not good;
- C) **Fan damage**.



# Troubleshooting

## 4. Failure 02 code (Inverter over-temperature protection)

- A) Confirm whether the high **temperature** of the surrounding;
- B) Confirm whether the **NTC on the mainboard** and **MPPT board** is loose or falling off;

## 5. Failure 03 code (Battery voltage is too high)

- A) Check whether the battery voltage is **higher than 60V**;
- B) Confirm whether the **external controller** is set properly;
- C) If a lithium battery is used, confirm whether the **voltage set in items 19 & 20** is appropriate;
- D) Restart inverter, if it still display fault code, please contact the manufacturer.

## 6. Failure 04 code (Battery voltage is too low)

- A) Check whether the battery voltage is **lower than 44V**;

## 7. Failure 05 code (Output short circuit fault)

- A) Confirm whether the **output is short-circuited**;
- B) Confirm whether the output **connection with high power inductive load** is proper;
- C) **Disconnect all load and restart inverter**, If still the same problem, please contact the manufacturer.



## 8. Failure 06 code (Output voltage is too low)

A) Confirm whether **connected with high power load**;

B) Disconnect all load and restart inverter.

If still the same problem, please contact the manufacturer;

## 9. Failure 07 code (Output overload)

A) Confirm whether **connected with high power load**;

B) Disconnect all load and restart inverter. If still the same problem, please contact the manufacturer;

## 10. Failure 08 code (BUS capacitor voltage is too high)

A) Check whether the **battery voltage is too high**;

B) Confirm whether the **external controller** is set properly;

C) If a lithium battery is used, confirm whether the **voltage set in items 19 & 20** is appropriate;

D) Restart inverter, if still display fault code, please contact the manufacturer;





# Troubleshooting

## 11. Failure 09 code (BUS capacitance soft-start failure)

- A) Check whether the **battery wiring** is in good connection;
- B) Restart inverter, if still display fault code, please contact the manufacturer;

## 12. Alarm 10 code (Power output de-rating)

- A) Utility power voltage is **lower than 170VAC**;

## 13. Alarm 13 code (PV voltage is too high)

- A) Check whether the PV input voltage is **higher than 145V**;

## 14. Alarm 15 code (Utility power source is different in parallel system)

- A) Check whether the mains input wire of each machine in the parallel system is tightened and properly connected;
- B) Check whether the main **input voltage, frequency, and phase** of each inverter in the parallel system is consistent;

## 15. Alarm 16 code (System power input phase is inconsistent)

- A) Check whether input is **connected correctly**;
- B) **Change of P2 and P3** inputs for the three-phase system;
- C) Restart the inverter. If you still display with the same alarm code, please contact the manufacturer.



## 16. Alarm 17 code (Parallel system output phase loss)

- A) Confirm whether **each phase of the inverter is turned on** in the three-phase parallel system;
- B) Confirm whether the **parallel communication wire** between machines of each phase are in good connection;
- C) Restart inverter. If you still display with the same alarm code, please contact the manufacturer.

## 17. Alarm 20 code (BMS communication failure)

- A) If inverter **connected with lead-acid battery**, confirm whether setting item 5 is set to LI, please **change LI to AGM**;
- B) If inverter connected with lithium battery, confirm whether the **protocol of setting item 36 is selected correctly**;
- C) Confirm whether the BMS communication wire is an **inappropriate connection**;
- D) Confirm whether the **sequence of the BMS communication** wire corresponds to the **inverter port**.
- E) Restart the inverter. If you still display the same alarm code, please contact the manufacturer.

## 18. Failure 52 code (BUS voltage is too low)

- A) Confirm whether the connected output is a **high power load**;
- B) Confirm whether the **battery capacity is sufficient**. Fault may occur if the connected load is higher than the battery capacity;
- C) Disconnect all load, restart the inverter. If you still display the same alarm code, please contact the manufacturer.



## 19. Failure 53 code (Inverter soft start failure)

- A) Confirm whether the output connected with a **high power load**;
- B) Confirm whether the **battery capacity is sufficient**;
- C) Disconnect all load, restart the inverter. If still display same Failure code, please contact the manufacturer.

## 20. Failure 56 code (Battery disconnected)

- A) Confirm whether the output connected with a **high power load**;
- B) Confirm whether the **battery capacity** is sufficient (Battery voltage is lower than **32V@48, 16V@24** );
- C) Disconnect all load, restart the inverter. If still display same Failure code, please contact the manufacturer.

## 21. Failure 58 code (Output voltage is too low)

- A) Confirm whether the output connected with a **high power load**;
- B) Confirm whether the **battery capacity is sufficient** (battery voltage is lower than **32V@48, 16V@24**);
- C) Disconnect all load, restart the inverter. If you still display the same Failure code, please contact the manufacturer.



## 22. Failure 60 code (Inverter output connected to AC source)

- A) Confirm whether the **input and output end** is connected correctly;
- B) Whether the single-phase parallel system **current sharing wire** is connected appropriately;
- C) Disconnect all load, restart the inverter. If still display the same Failure code, please contact the manufacturer.

## 23. Failure 80 code (CAN communication failure)

- A) Check whether all the **parallel communication wire** of the parallel system are **connected properly**;
- B) Confirm whether the **wires are faulty**;
- C) Disconnect all load, restart the inverter. If you still display the same Failure code, please contact the manufacturer.

## 24. Failure 81 code (Parallel system host lost)

- A) Check whether all the **parallel communication lines** of the parallel system are **connected properly**;
- B) Confirm whether the **wires are defective**;
- C) In the three-phase parallel system, confirm whether **setting item 23** is: the **first phase is set to 3P1**, the **second phase is set to 3P2**, and the **third phase is set to 3P3**;
- D) Disconnect all load, restart the inverter. If you still display with same Failure code, please contact the manufacturer.





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