

***DUCO***



# Hybrid Inverter User Manual

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# 1. Introduction

## 1.1 Important Safety Instructions



### Danger!

- Danger to life due to high voltages in the inverter!
- All work must be carried out by qualified electrician.
- The appliance is not to be used by children or persons with reduced physical sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction.
- Children should be supervised to ensure that they do not play with the appliance.



### Caution!

- Danger of burn injuries due to hot enclosure parts!
- During operation, the upper lid of the enclosure and the enclosure body may become hot.
- Only touch the lower enclosure lid during operation.



### Caution!

- Possible damage to health as a result of the effects of radiation!
- Do not stay closer than 20 cm to inverter for any length of time.



### Note!

- Grounding the PV generator.
- Comply with the local requirements for grounding the PV modules and the PV generator. It is recommended connecting the generator frame and other electrically conductive surfaces in a manner which ensures continuous conduction and ground these in order to have optimal protection of system and persons.



### Warning!

- Ensure input DC voltage  $\leq$  Max. DC voltage. Over voltage may cause permanent damage to inverter or other losses, which will not be included in warranty!



### Warning !












- Authorized service personnel must disconnect both AC and DC power from inverter before attempting any maintenance or cleaning or working on any circuits connected to inverter.
- Risk of electric shock!

- Accessories only together with the inverter shipment are recommended here. Otherwise may result in a risk of fire, electric shock, or injury to person.
- Make sure that existing wiring is in good condition and that wire is not undersized.
- Do not disassemble any parts of inverter which are not mentioned in installation guide. It contains no user-serviceable parts. See Warranty for instructions on obtaining service. Attempting to service the inverter yourself may result in a risk of electric shock or fire and will void your warranty.
- Keep away from flammable, explosive materials to avoid fire disaster.
- The installation place should be away from humid or corrosive substance.
- Authorized service personnel must use insulated tools when installing or working with this equipment.
- PV modules shall have an IEC 61730 class A rating.
- Never touch either the positive or negative pole of PV connecting device. Strictly prohibit touching both of them at the same time.
- The unit contains capacitors that remain charged to a potentially lethal voltage after the MAINS, battery and PV supply has been disconnected.
- Hazardous voltage will present for up to 5 minutes after disconnection from power supply.
- CAUTION-RISK of electric shock from energy stored in capacitor, Never operate on the inverter couplers, the MAINS cables, Battery cables, PV cables or the PV generator when power is applied. After switching off the PV, battery and Mains, always wait for 5 minutes to let the intermediate circuit capacitors discharge before unplugging DC, battery inplug and MAINS couplers.
- When accessing the internal circuit of inverter, it is very important to wait 5 minutes before operating the power circuit or demounting the electrolyte capacitors inside the device. Do not open the device before hand since the capacitors require time sufficiently discharge!

## 1.2 Explanation of Symbol

This section gives an explanation of all the symbols shown on the inverter and on the type label.

- Symbols on the Type Label

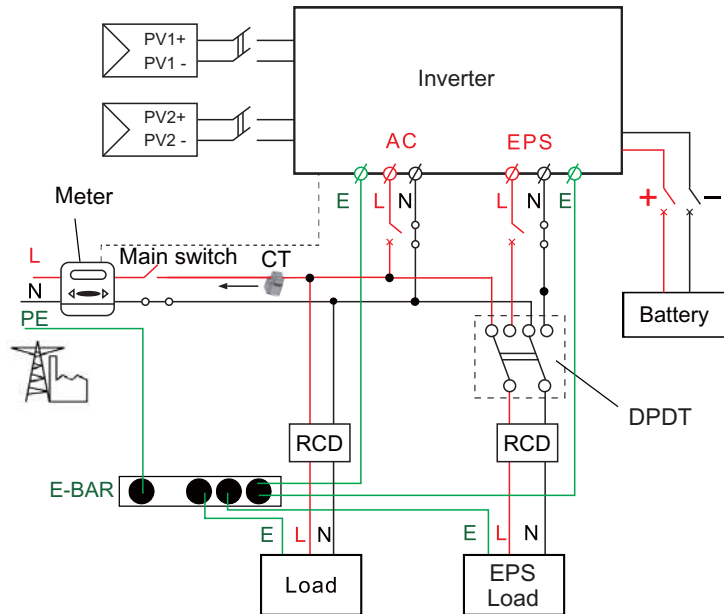
Symbol	Explanation
	CE mark. The inverter complies with the requirements of the applicable CE guidelines.
	TUV certified.
	RCM remark.
	SAA certification.
	Beware of hot surface. The inverter can become hot during operation. Avoid contact during operation.
	Danger of high voltages. Danger to life due to high voltages in the inverter!
	Danger. Risk of electric shock!
	Observe enclosed documentation.
	The inverter can not be disposed together with the household waste. Disposal information can be found in the enclosed documentation.
	Do not operate this inverter until it is isolated from battery, mains and on-site PV generation suppliers.
	Danger to life due to high voltage. There is residual voltage existing in the inverter after powering off, which needs 5 min to discharge. • Wait 5 min before you open the upper lid or the DC lid.

### 1.3 Basic features

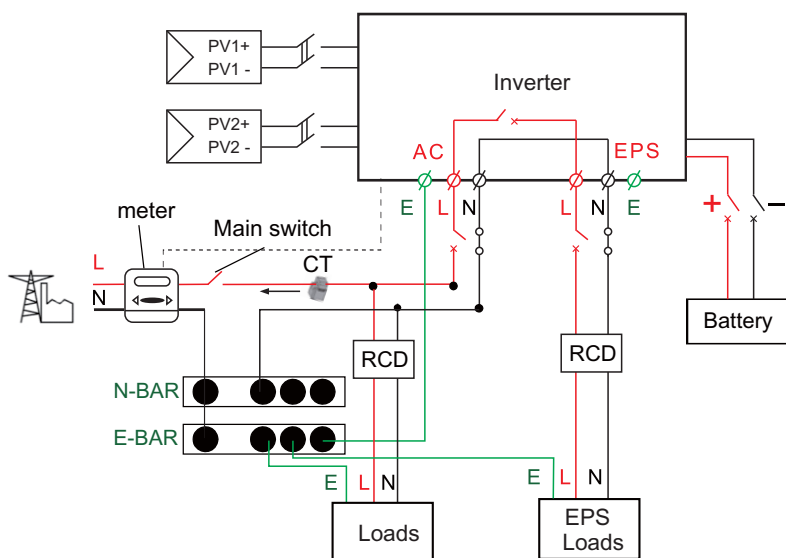
Hybrid Inverter Seires is a high quality inverter which can convert solar energy to AC energy and store energy into battery.

The inverter can be used to optimize self consumption, store in the battery for future use or feedin to public grid. Work mode depends on PV energy and user's preference. It can provide power for emergency use during the grid lost by using the energy from battery and inverter (generated from PV). In addition, the parallel function is available (off grid model).

System Diagram 1 (applies to most countries )

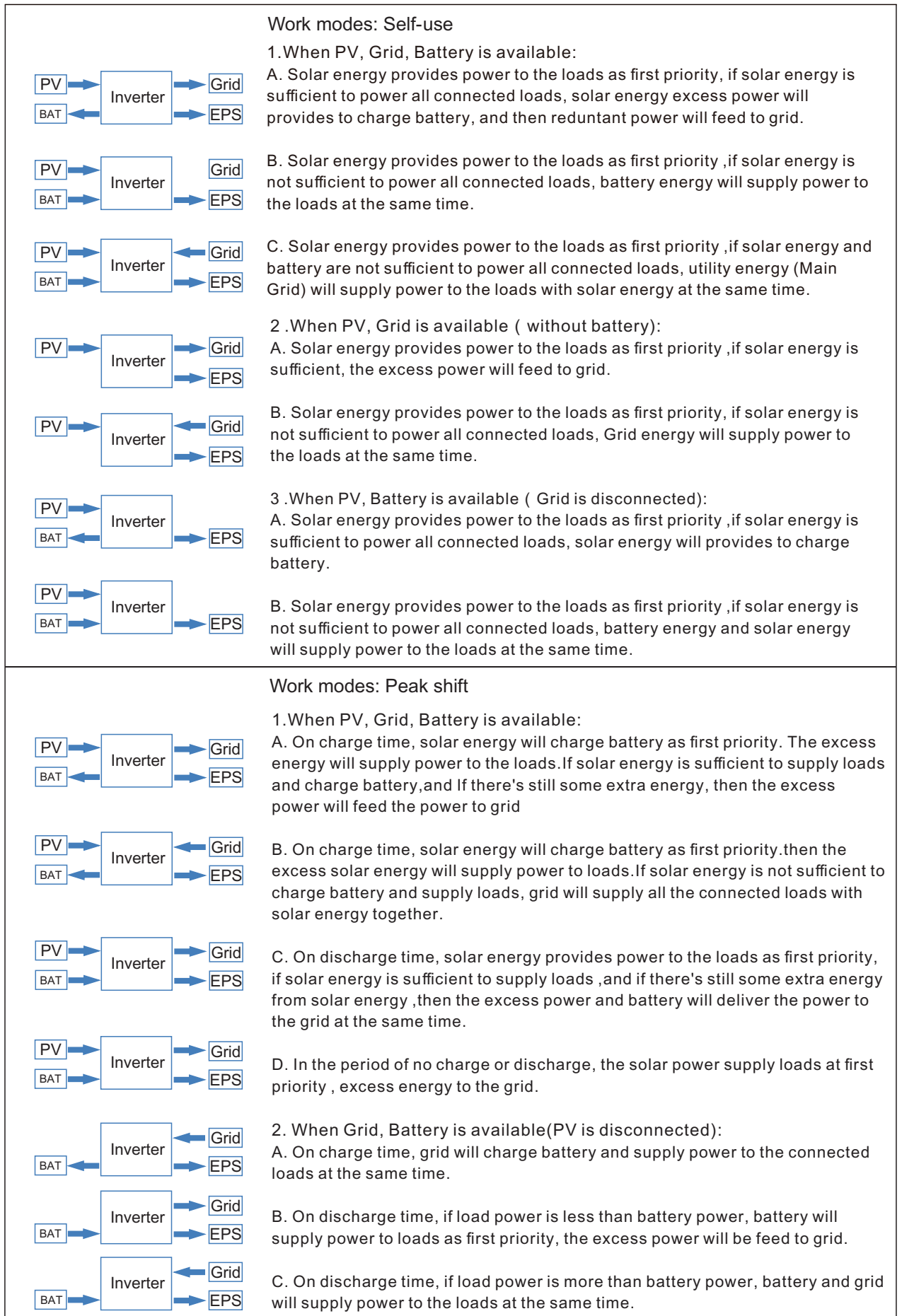


System Diagram 2 (applies to wiring rules AS/NZS\_3000:2012 for Australia and New Zealand )



## 1.4 Work Modes

Hybrid Inverter provides multiple work modes based on different requirements.



### Work modes: Bat priority



#### 1. When PV, Grid, Battery is available:

A. Solar energy will charge battery as first priority, if solar energy is excess, the excess power will supply load. If there's still some extra energy, then the excess power will feed the power to grid .



B. Solar energy will charge battery as first priority, if solar energy is excess, the excess power will supply load. If solar energy is not sufficient to charge battery and supply loads, grid will supply power to loads.



#### 2. When Grid, Battery is available ( PV is disconnected):

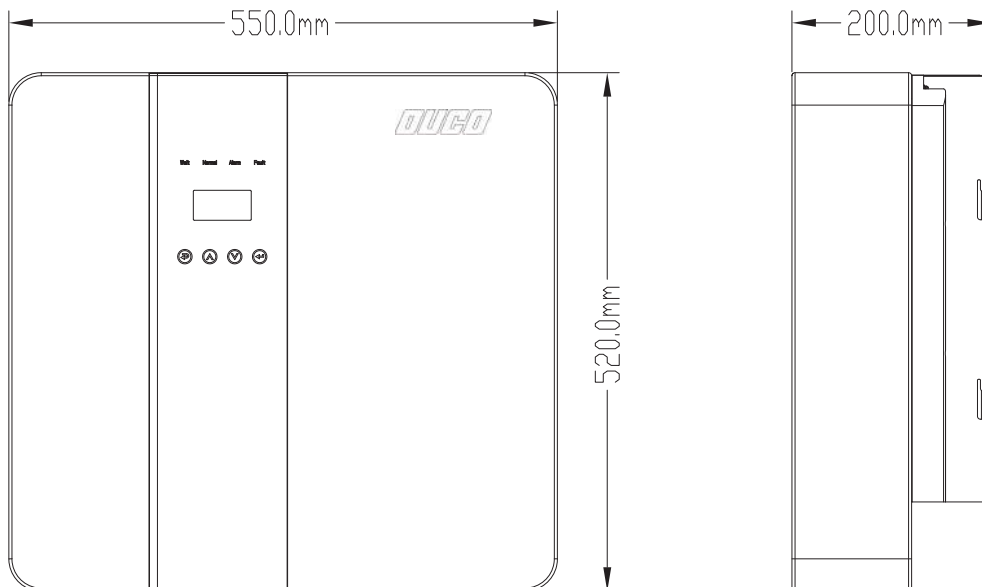
Grid will supply power to load and charge battery at the same time.

#### Note!



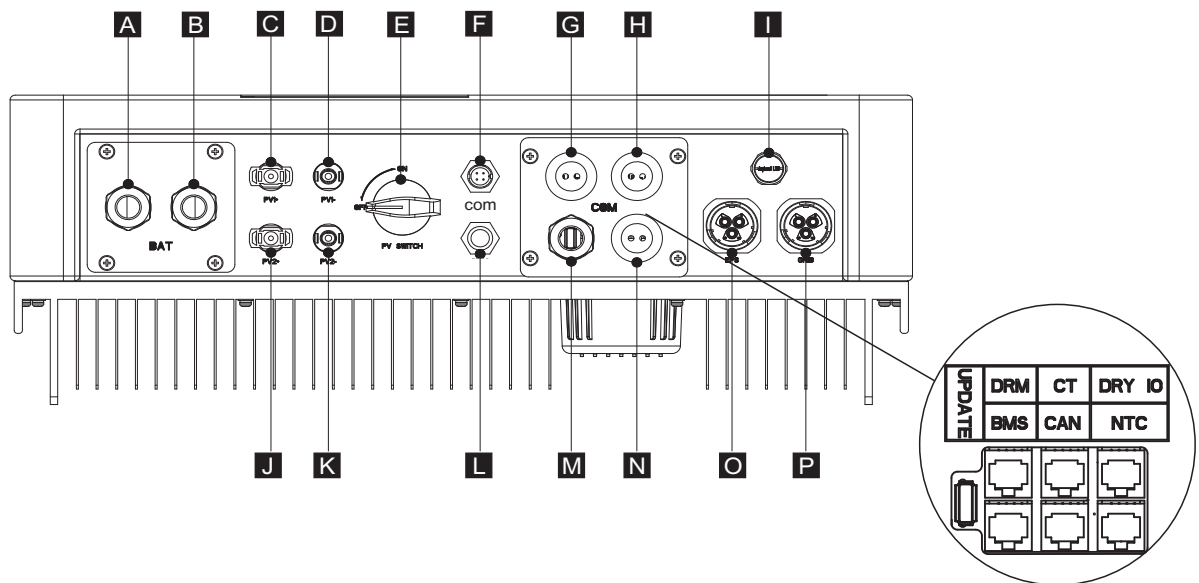
If set anti-Reverse function allowable, Once on the work mode of Self-use, Peak shift, battery priority, the system will not feed power to grid.

### 1.5 Dimension



## 2. Interface definition and Technical Data

### 2.1 Interface definition



Object	Description
A/B	Battery +/Battery -
C/D	PV1+/PV1-
J/K	PV2+/PV2-
E	DC switch
F	WiFi port for external WiFi
L	Reserved port
G	DRM/BMS
H	Grid current / DRY IO
M	USB port for upgrading
N	POWER CAN /LEAD-NTC
I	Pressure valve
O	EPS output
P	Grid output



## 2.2 Technical Data

Model	M3KES	M3K6ES	M4KES	M4K6ES	M5KES	M6KES
<b>DC input</b>						
Max. recommended DC power [W]	4600	4600	6000	6000	7000	7000
Max. DC voltage[V]	550	550	550	550	550	550
Normal DC operating voltage[V]	360	360	360	360	360	360
MPPT voltage range [V]	125-500	125-500	125-500	125-500	125-500	125-500
MPPT voltage range@full load [V]	150-500	150-500	170-500	170-500	220-500	220-500
Max. input current [A]	14/14	14/14	14/14	14/14	14/14	14/14
Max. short circuit current [A]	17.5/17.5	17.5/17.5	17.5/17.5	17.5/17.5	17.5/17.5	17.5/17.5
Start input voltage [V]	125	125	125	125	125	125
No. of MPP trackers	2	2	2	2	2	2
Strings per MPP tracker	1	1	1	1	1	1
Max. inverter backfeed current to array	0	0	0	0	0	0
DC disconnection switch	/					
<b>AC output</b>						
Normal AC power[VA]	3000	3600	4000	4600	5000	6000
Max. apparent AC power[VA]	3000	3600	4000	4600	5000	6000
Rated grid voltage(range)[V]	230 (176 to 270)					
Rated grid frequency[Hz]	50/60					
Normal AC current[A]	13	16	17.4	20	21.7	26
Max.AC current[A]	13	16	17.4	20	21.7	26
Displacement power factor	0.99 leading...0.99 lagging					
Total harmonic distortion(THDI)	< 2%					
Load control	optional					
<b>AC input</b>						
Normal AC power[VA]	3000	3600	4000	4600	5000	6000
Rated grid voltage(range)[V]	230(176 to 270)					
Rated grid frequency[Hz]	50/60					
Normal AC current[A]	13	16	17.4	20	21.7	26
Max.AC current[A]	13	16	17.4	20	21.7	26
Displacement power factor	0.99 leading...0.99 lagging					
AC inrush current	35	35	35	35	35	35
<b>EPS output</b>						
EPS rated power[VA]	3000	3600	4000	4600	5000	6000
Max. EPS power[VA]	3000	3600	4000	4600	5000	6000
EPS rated voltage, Frequency	230VAC, 50/60Hz					
EPS rated current[A]	13	16	17.4	20	21.7	26
Max. EPS current[A]	13	16	17.4	20	21.7	26
Switch time[s]	<500ms					
Total harmonic distortion(THDv)	<2%					
Parallel operation	Yes					
Compatible with the generator	Yes(signal provided only)					
<b>Battery parameter</b>						
Battery type	Lithium battery/Lead-ACID					
Battery voltage range[V]	40-58					
Recommended battery voltage[V]	48					
Cut Off Voltage[V]	40					
Max. charging Voltage[V]	58					
Max. Protective Voltage[V]	59					
Max. charge/discharge current[A]	95/62.5	95/75	95/83.3	95/95.8	95/104.2	95/110
Peak charge/discharge current[A]	95/62.5	95/75	95/83.3	95/95.8	95/104.2	95/110
Communication interfaces	CAN/RS485/Wifi/LAN/DRM					
Reverse connect protection	Yes					
<b>Efficiency</b>						
MPPT efficiency	99.9%					
Euro efficiency	97%					
Max. efficiency	97.6%					
Max. Battery charge efficiency	95%					
Max. Battery discharge efficiency	95%					

## 2.3 Basic Data

Model	M3KES	M4KES	M5KES
	M3K6ES	M4K6ES	M6KES
Dimension [W/H/D](mm)	550*520*200		
Dimension of packing [W/H/D](mm)	665*635*330		
Net weight [kg]	25		
Gross weight [kg]	31		
Installation	modularization		
Operating temperature range[°C]	-25~+60 (derating at 45)		
Storage temperature [°C]	-25~+60		
Storage/Operation relative humidity	4%~100% (Condensing)		
Altitude [m]	<2000		
Ingress Protection	IP65(for outdoor use)		
Protective Class	I		
Night-time consumption	<3W		
Over Voltage Category	III(MAINS),II(PV,Battery)		
Pollution Degree	II		
cooling	Nautral		
Noise level	<40dB		
Inverter Topology	non-isolated		
Active anti-islanding method	Power variation		
Communication interface	CAN/RS485/Wifi/LAN/DRM		

## 2.4 Safety and Protection

Safety & Protection	
Over/under voltage protection	YES
DC isolation protection	YES
Monitoring ground fault protection	YES
Grid protection	YES
DC injection monitoring	YES
Back feed current monitoring	YES
Residual current detection	YES
Anti-islanding protection	YES
Over load protection	YES
Over heat protection	YES
Max. output fault current	55A
Max. output over current	28.7A

### 3. Installation

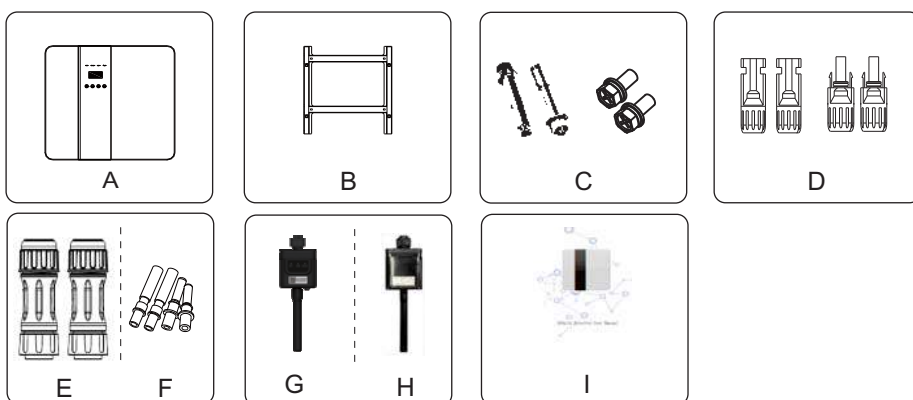
#### 3.1 Check for Physical Damage

Make sure the inverter is intact during transportation. If there is any visible damage, such as cracks, please contact your dealer immediately.

#### 3.2 Packing List

Open the package and take out the product, please check the accessories first.

The packing list shown as below.



Object	Description
A	Inverter
B	Bracket
C	Expansion screws and pan-head screws
D	PV connectors (2*positive, 2*negative)
E	AC terminals
F	PV pin connectors (2*positive, 2*negative)
G	Wi fimodule (optional)
H	GPRS module (optional)
I	User manual

#### 3.3 Tools required for installation.

Installation tools : crimping pliers for binding post and RJ 45, screwdriver, manual wrench etc.



### 3.4 Mounting

#### ➤ Space Requirement

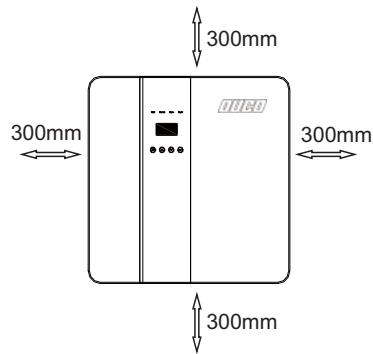
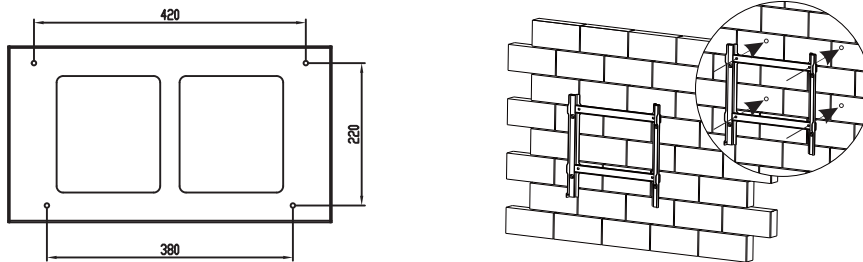


Table Available Space Size

Position	Min.size
Left	300mm
Right	300mm
Top	300mm
Bottom	300mm
Front	300mm

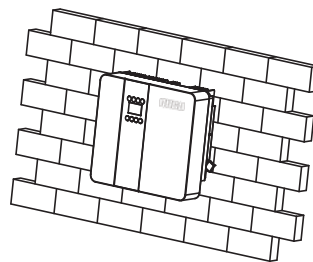
#### Step 1: Screw the wall bracket on the wall

- 1.1 Place the bracket on the wall and mark down the position of the 4 holes.
- 1.2 Drill holes with driller, make sure the holes are deep enough (at least 60mm) to support the inverter.
- 1.3 Install the expansion tubes in the holes, and tighten them. Then install the wall bracket with the expansion screws.



Step 1

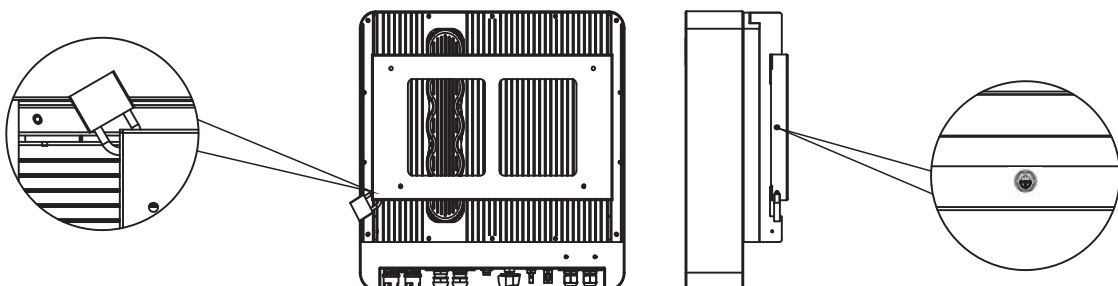
#### Step 2: Place the inverter on the wall mounted bracket by holding the handle on the side.



Step 2

#### Step 3: Tighten the fixing screws on both sides of the inverter.

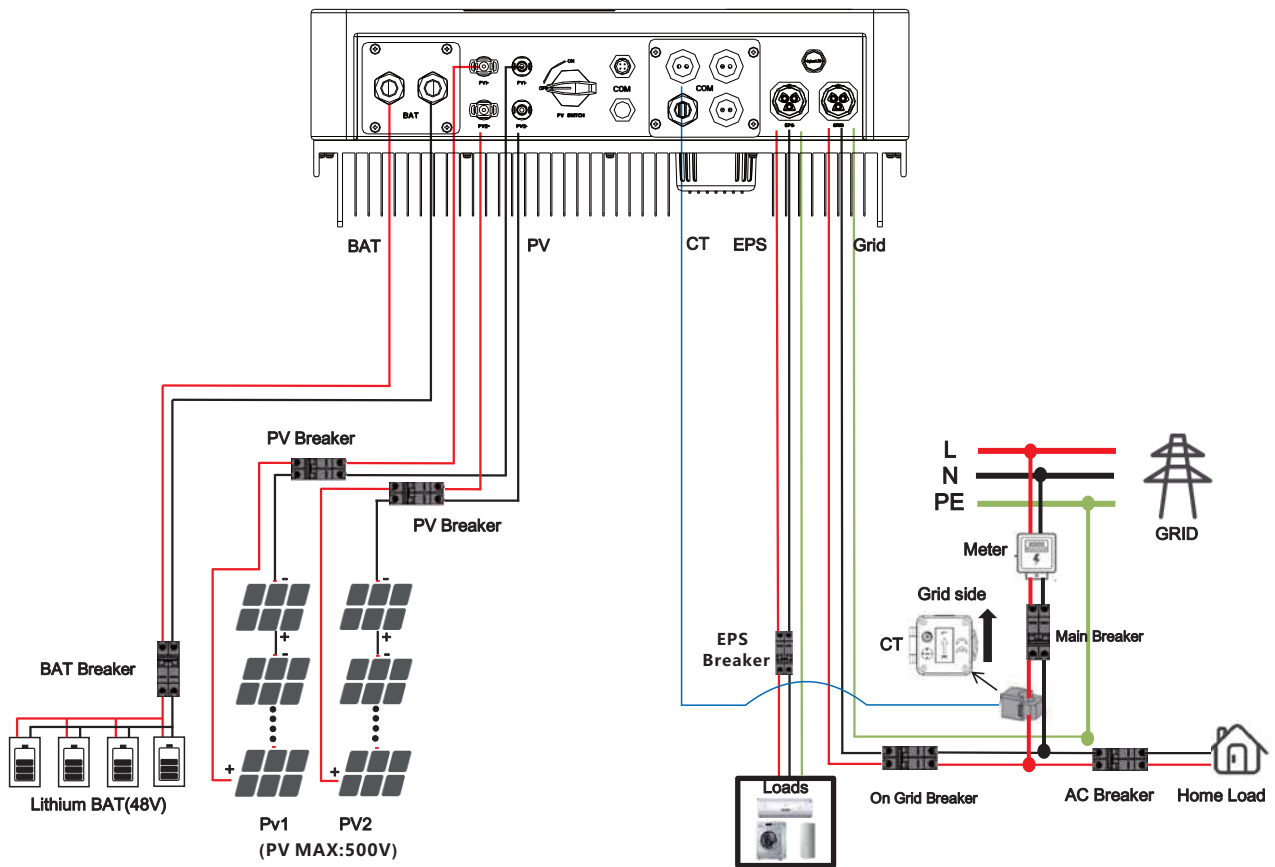
#### Step 4: If necessary, customer can install an anti-theft lock on the left-bottom of the inverter.



Step 3、Step 4

## 4. Electrical Connection

- Electrical connection diagram



### 4.1 Grid connection and EPS connection

Hybrid inverter are designed for single phase grid. Voltage is 220/230/240V, frequency is 50/60Hz.

Other technical requests should comply with the requirement of the local public grid.

Table 1 Cable and Micro-breaker recommended

Model	M3KES	M3K6ES	M4KES	M4K6ES	M5KES	M6KES
Cable	4-5 mm <sup>2</sup>			5-6mm <sup>2</sup>		
Micro-breaker	20A			32A		

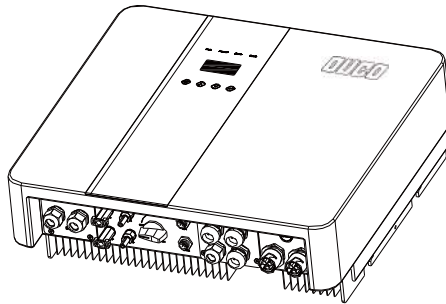
Micro-breaker should be installed between inverter and grid, any load should not be connected with inverter directly.

Step1. Check the grid voltage.

1.1 Check the grid voltage and compare with the permissive voltage range (Please refer to technical data).

1.2 Disconnect the circuit board from all the phases and secure against re-connection.

Step2. Remove the waterproof lid from the grid port on the inverter.



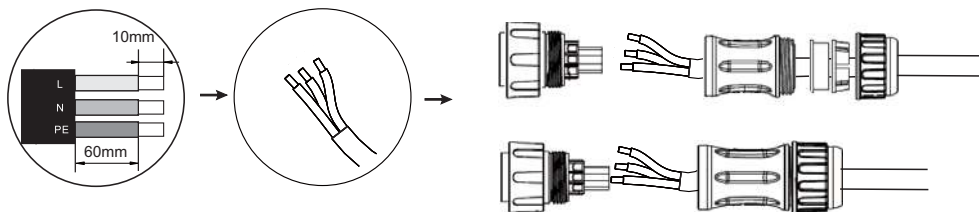
Step3. Make AC and EPS wires.

3.1 Choose the appropriate wire(Cable size: refer to Table 1).

3.2 Reserve about 60mm of conductor material sectional area and remove 10mm of insulation from the end of wire.

3.3 Separate the docking screw cap of the AC terminal from the housing portion and insert stripped wires into AC terminal and tighten the screws with a hexagonal wrench.

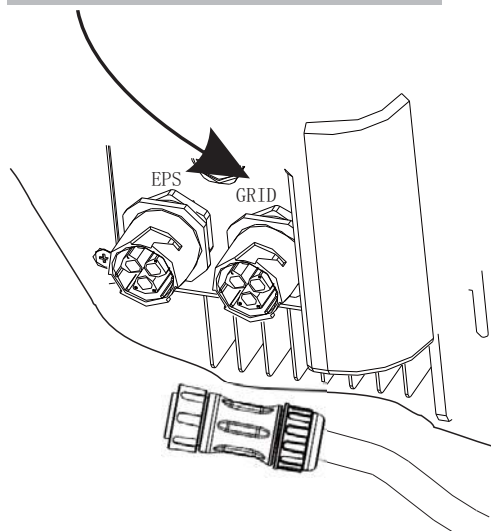
3.4 Tighten the docking screw cap and housing portion of the AC terminal.



Step4. Connect the AC connector to the GRID port of the inverter and tighten the screw cap .

Connect the LOAD connector to the EPS port of the inverter and tighten the screw cap .

Note: Connect the AC connector to the GRID into grid interface.




## 4.2 PV connection

Hybrid Inverter can be connected in series with 2-strings PV modules for 3KW,3.6KW,4KW,4.6KW, 5KW and 6KW.

Select PV modules with excellent function and reliable quality. Open-circuit voltage of module arrays connected in series should be <Max. DC input voltage;operating voltage should be conformed to MPPT voltage range.

Max.DC Voltage Limitation

Model	M3KES	M3K6ES	M4KES	M4K6ES	M5KES	M6KES
Max. DC Voltage (V)	550					
MPPT Voltage Range(V)	125-500					



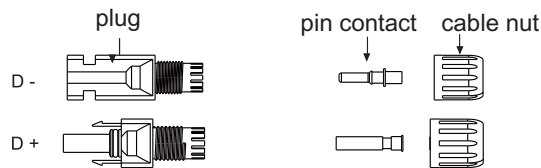
**Warning!**

- PV module voltage is very high, which already achieve dangerous voltage range, please comply with electric safety rules when connecting.
- Please do not make PV positive or negative ground!

### Connection Steps:

Step1. Checking PV module to ensure PV is in open circuit state and ensure the PV+ and PV- ports of the PV string are correct.

Step2. Separating the DC connector.

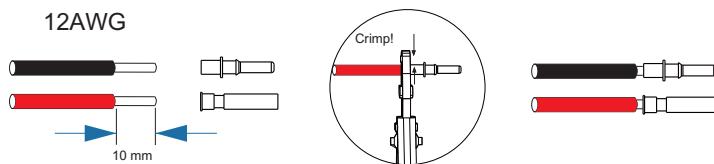


### Step3. Wiring

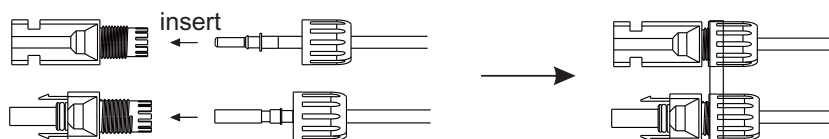
3.1 Choose the 12 AWG wire to connect with the cold-pressed terminal.

3.2 Remove 10mm of insulation from the end of wire.

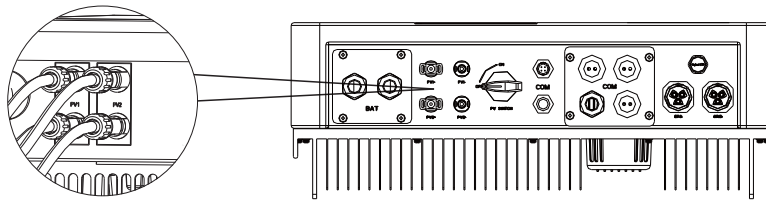
3.3 Insert the insulation into pin contact and use crimping plier to clamp it.



Step4. Insert pin contact through the cable nut to assemble into back of the male or female plug. When you feel or heard a “click” sound the pin contact assembly is seated correctly.



Step5. Plug the PV connector into the corresponding PV connector on inverter.



### 4.3 Battery Connection

➤ Note

1. Before choosing battery, please note the maximum voltage of battery can not exceed 59V and the rated voltage of battery can not exceed 48V, and the battery communication should be compatible with Hybrid inverter.
2. Before connecting to battery, please install a nonpolarized DC(125A) breaker to make sure inverter can be securely disconnected during maintenance.
3. The connecting cable between the battery and the inverter shall be at least 4AWG.
4. The battery communication can only work when the battery BMS is compatible with the inverter.
5. To replace the battery, you need to turn off all switches and unplug the system communication line.
6. All the above wiring and operations must be carried out after the whole machine is powered down, and all of them need professional personnel to complete

➤ Power Connection Steps:

Step1. Choose the 2 AWG wire and strip the cable to 15mm.

Step2. Select two O-terminals with an aperture of M6.

Step3. Insert the stripping line into the O-terminal and clamp it with a crimping clamp.

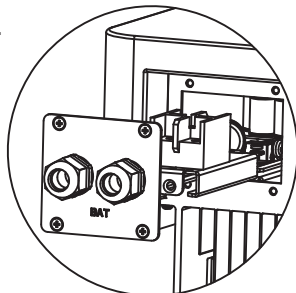
Step1,2,3.



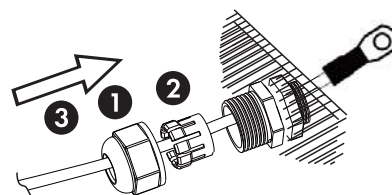
Step4. Remove waterproof cover plate.

Step5. Disassemble the waterproof connector and pass the cable through the waterproof connector.

Step4.



Step5.

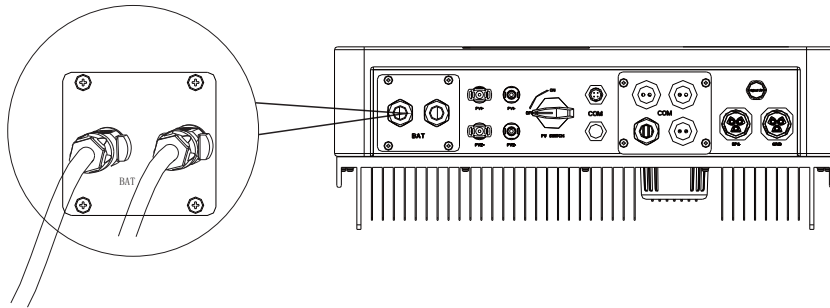





Step6. Connect the cable to the terminal of the inverter .

Step7. Assemble waterproof connectors and waterproof covers plate.

Step6 , 7



 **Note !**  
 Positive and negative lines are not allowed to reverse.  
 The positive pole on the left and the negative pole on the right.

#### 4.4 Communication interface definition

##### ➤ BMS PIN Definition

Communication interface between inverter and battery is RS485 or CAN with a RJ45 connector. The wiring sequence of the crystal head conforms to the 568B standard: orange white, orange, green white, blue, blue white, green, brown white and brown.



	PIN	1	2	3	4	5	6	7	8
CAN	Definition	X	X	X	BMS_CANH	BMS_CANL	X	X	X
Rs485	Definition	X	X	X	X	X	GND	BMS_485A	BMS_485B

##### ➤ DRY\_IO (RJ45 PIN) Definition

Communication interface between inverter and meter is RS485 with a Rj45 connector.



	1	2	3	4	5	6	7	8
DRYO_1A	DRYO_1A	DRYO_1B	DRYO_1C	DRYO_1	DRYO_1B	DRYO_2A	DRYO_2B	DRYO_2C

##### ➤ DRM Connection

DRM is provided to support several demand response modes by emitting control signals as below.

Note: Only PIN6(DRM0) is available now, and other PIN functions are being developed.



	1	2	3	4	5	6	7	8
DRM1/5	DRM1/5	DRM2/6	DRM3/7	DRM4/8	+5V	DRM0	GND	GND

## 4.5 WiFi And GPRS Connection(optional)

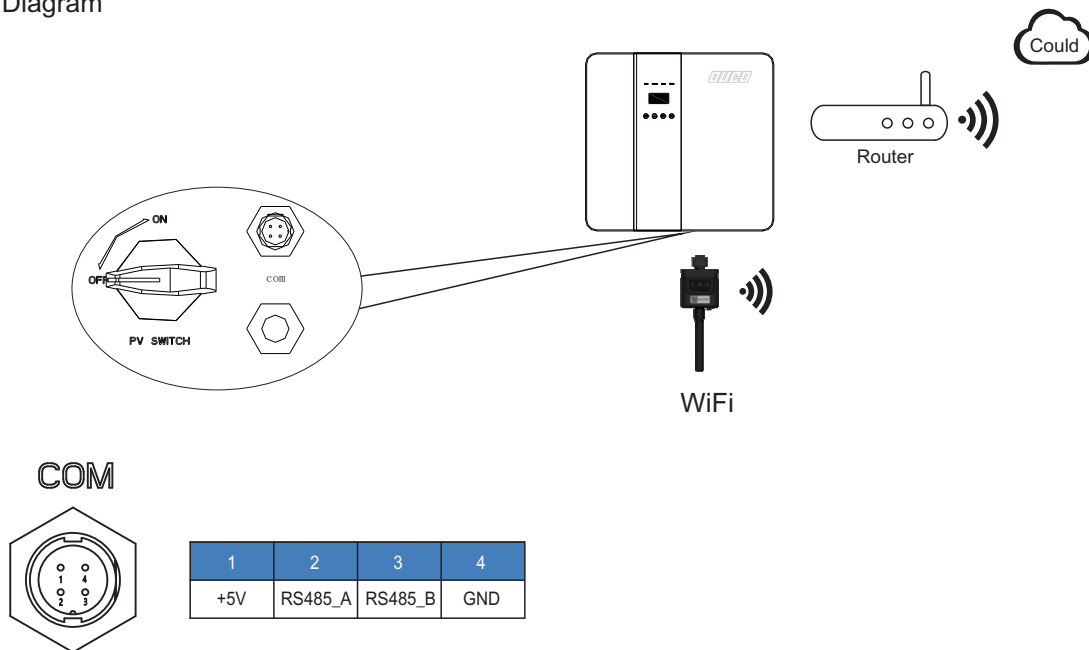
Inverter provides a WiFi port which can collect data from inverter and transmit it to monitoring-website by WiFi.

Step1. Plug Wifi into “COM” port at the bottom of the inverter.

Step2. Build the connection between the inverter and router.

Step3. Create a user account online.( Please check the WiFi user manual for more details).

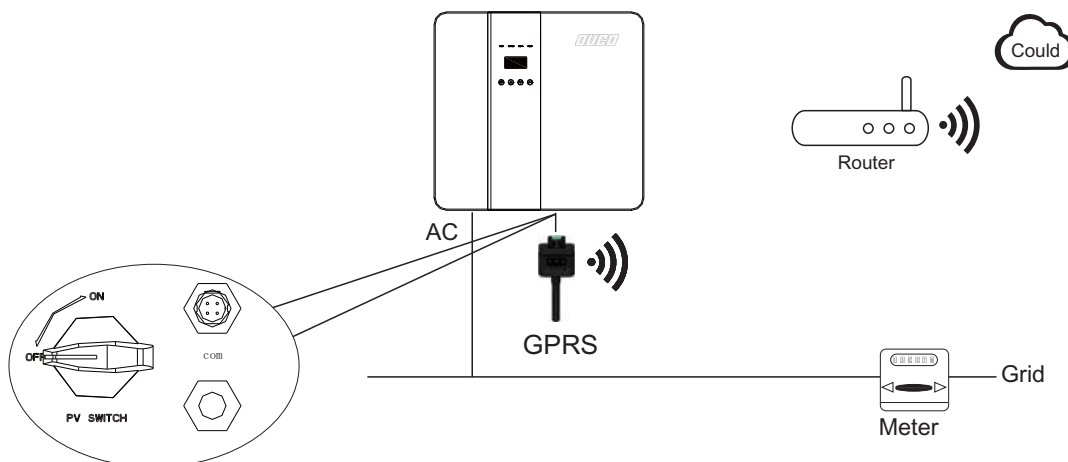
### ➤ Diagram



### ➤ GPRS Connection :

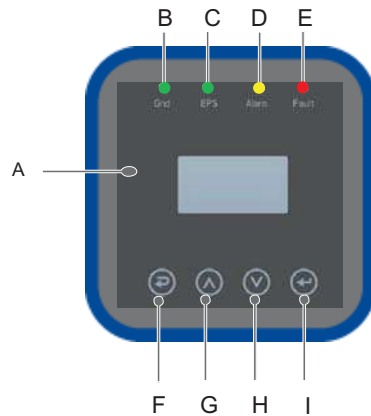
GPRS connection interface is consistent with WIFI interface, Please refer to the GPRS user manual for detailed connection steps.

### ➤ Diagram



# 5 Setting

## 5.1 Control Panel

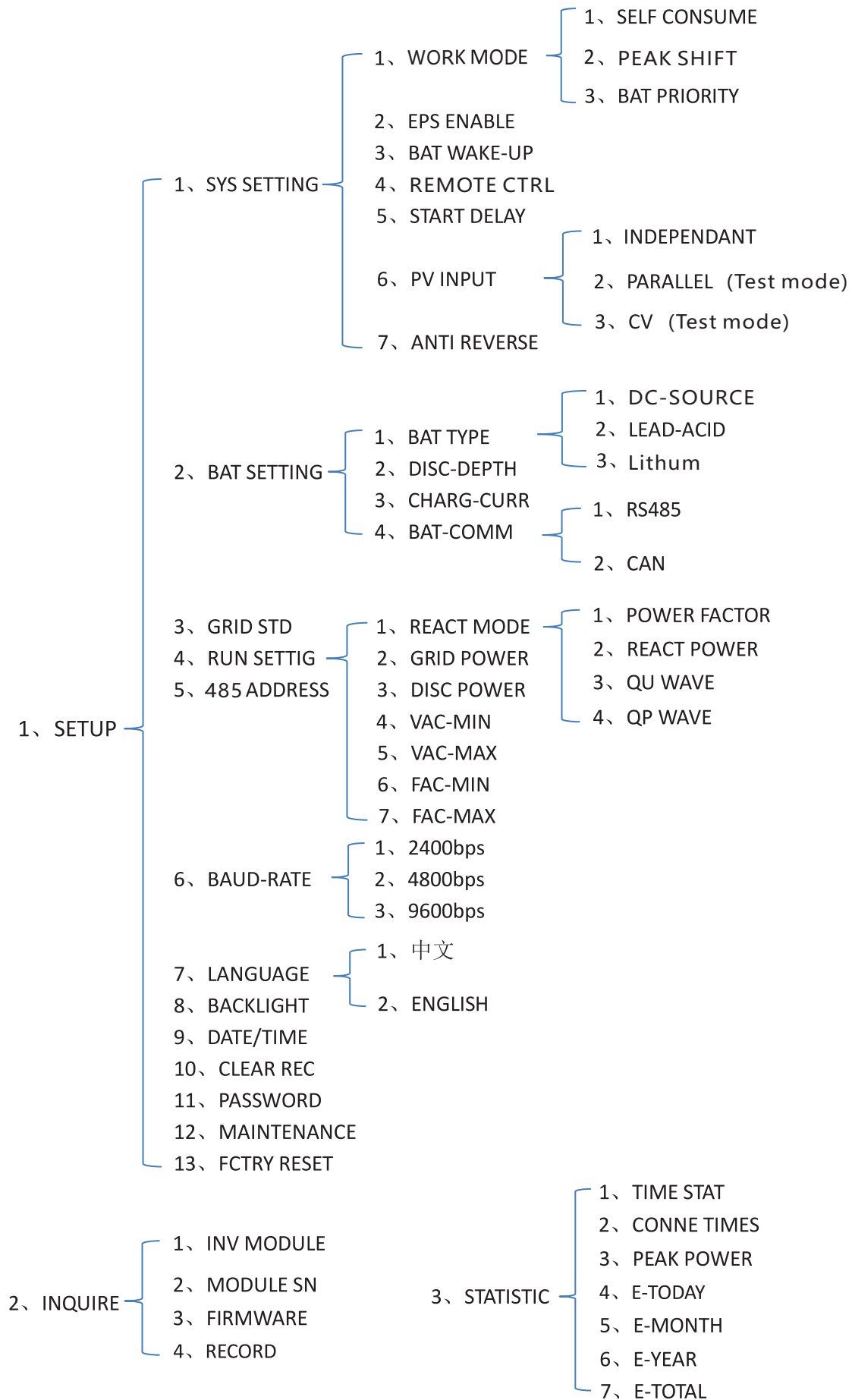


Object	Name	Description
A	LCD Screen	Display the information of the inverter.
B	Indicator LED	lit in green: The inverter is in grid mode. Off: The inverter is in not in grid mode.
C		lit in green: The inverter is in off-grid mode. Off: The inverter is in not in off-grid mode.
D		lit in Yellow: The inverter is in Warning . Off: The inverter has no Inverter Warning
E		lit in red: The inverter is in fault status. Off: The inverter has no errors.
F	Function Button	Esc: Return from current interface or function.
G		Up: Move cursor to upside or increase value.
H		Down: Move cursor to downside or decrease value.
I		Enter: Confirm the selection.

## 5.2 Instructions for LED Indicator

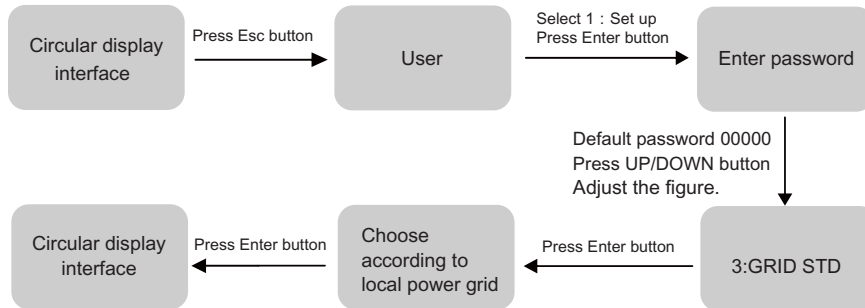
	Grid ( Green )	EPS ( Green )	Alarm (Yellow)	Fault (Red)
Initialization	off	off	off	off
Stand-by	off	off	off	off
Grid mode	on	off	off	off
Off-Grid	off	on	off	off
Bypass of mains	off	on	on	off
Fault	off	off	off	on

### 5.3 Instructions for the use of three modes

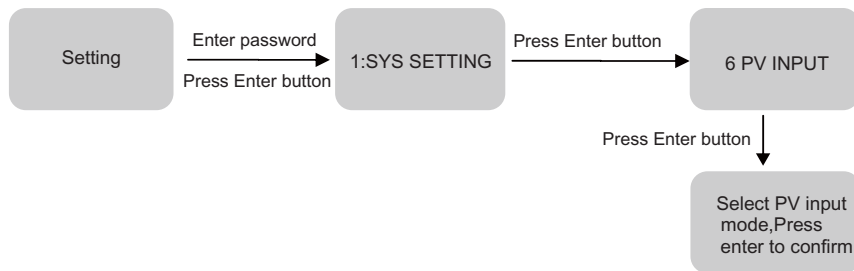


For example, Before selecting the mode, you can set it up according to the local power grid, PV input mode and battery type.

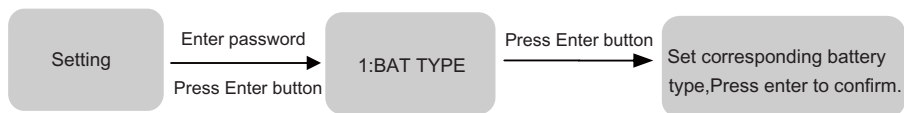
Power grid :



PVinput mode :



Battery parameters :



## 6. Fault diagnosis and solutions

The inverter is easy to maintain. When you encounter the following problems, please refer to the Solutions below, and contact the local distributor if the problem remains unsolved. The following table lists some of the basic problems that may occur during the actual operation as well as their corresponding basic solutions.

Fault diagnosis table

Content	Cause	Solutions
Over load	The load power exceeds the inverter power or the output port is short-circuited.	1. Check whether the load is in compliance with the maximum power of the machine. 2. Cut off all the power and shut down all the machines; disconnect the load and plug in to restart machines, then check whether the load is short circuited if the fault has been eliminated.
Bat Disconnect	The battery is not connected to the inverter or the battery port has no output voltage.	Check whether there is voltage at BAT port of measuring inverter.
Bat under vol	1. The battery charge is too low. 2. The battery BMS sends an instruction to prohibit discharging.	1. If the battery is too low, charge it in time. 2. Check the battery communication protocol
Bat low vol	The battery voltage is lower than the normal working voltage value.	Charge the battery as soon as possible
Bus over vol	1. The PV input voltage exceeds the MPPT voltage. 2. The load port and the power grid port are connected inversely.	1. Check whether PV input voltage is within MPPT voltage range. 2. Power down the whole machine, and then power up after the display screen goes out.
BMS Comm.fail	There is no normal communication between the battery and the inverter.	Check whether the communication between inverter and battery is normal.
Fan Fail	Poor contact of fan	Power down the whole machine, and then power up after the display screen goes out.

V1.3