User Manual

Shark
TOPSUN

STS-HYM-4815120P
PV OFF - GRID INVERTER

Table of Contents

ABOUT THIS MANUAL

Purpose

This manual describes the assembly, installation, operation and troubleshooting of this unit. Please read this manual carefully before installations and operations. Keep this manual for future reference.

Scope

This manual provides safety and installation guidelines as well as information on tools and wiring.

SAFETY INSTRUCTIONS

⚠ **WARNING: This chapter contains important safety and operating instructions. Read and keep this manual for future reference.**

1. Before using the unit, read all instructions and cautionary markings on the unit, the batteries and all appropriate sections of this manual.
2. **CAUTION** --To reduce risk of injury, charge only deep-cycle lead acid type rechargeable batteries. Other types of batteries may burst, causing personal injury and damage.
3. Do not disassemble the unit. Take it to a qualified service center when service or repair is required. Incorrect re-assembly may result in a risk of electric shock or fire.
4. To reduce risk of electric shock, disconnect all wirings before attempting any maintenance or cleaning. Turning off the unit will not reduce this risk.
5. **CAUTION** – Only qualified personnel can install this device with battery.
6. **NEVER** charge a frozen battery.
7. For optimum operation of this inverter/charger, please follow required spec to select appropriate cable size. It's very important to correctly operate this inverter/charger.
8. Be very cautious when working with metal tools on or around batteries. A potential risk exists to drop a tool to spark or short circuit batteries or other electrical parts and could cause an explosion.
9. Please strictly follow installation procedure when you want to disconnect AC or DC terminals. Please refer to INSTALLATION section of this manual for the details.
10. Fuses are provided as over-current protection for the battery supply.
11. GROUNDING INSTRUCTIONS -This inverter/charger should be connected to a permanent grounded wiring system. Be sure to comply with local requirements and regulation to install this inverter.
12. NEVER cause AC output and DC input short circuited. Do NOT connect to the mains when DC input short circuits.
13. **Warning!!** Only qualified service persons are able to service this device. If errors still persist after following troubleshooting table, please send this inverter/charger back to local dealer or service center for maintenance.
14. **WARNING:** Because this inverter is non-isolated, only three types of PV modules are acceptable: single crystalline, poly crystalline with class A-rated and CIGS 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. When using CIGS modules, please be sure NO grounding.
15. **CAUTION:** It's required to use PV junction box with surge protection. Otherwise, it will cause damage on inverter when lightning occurs on PV modules.

INTRODUCTION

This is a multi-function inverter, combining functions of inverter, solar charger and battery charger to offer uninterruptible power support in a single package. The comprehensive LCD display offers user-configurable and easy-accessible button operations such as battery charging current, AC or solar charging priority, and acceptable input voltage based on different applications.

Features

- Pure sine wave inverter
- Configurable color with the built-in RGB LED bar
- Built-in Wi-Fi for mobile monitoring (APP is required)
- Supports USB On-the-Go function
- Built-in anti-dusk kit
- Detachable LCD control module with multiple communication ports for BMS (RS485, CAN-BUS, RS232)
- Configurable input voltage ranges for home appliances and personal computers via LCD control panel
- Configurable AC/PV output usage timer and prioritization
- Configurable AC/Solar charger priority via LCD control panel
- Configurable battery charging current based on applications via LCD control panel
- Compatible to utility mains or generator power
- Auto restart while AC is recovering
- Overload / Over temperature / short circuit protection
- Smart battery charger design for optimized battery performance
- Cold start function

Basic System Architecture

The following illustration shows basic application for this unit. It also required the following devices to have a complete running system:
- Generator or Utility mains.
- PV modules

Consult with your system integrator for other possible system architectures depending on your requirements.
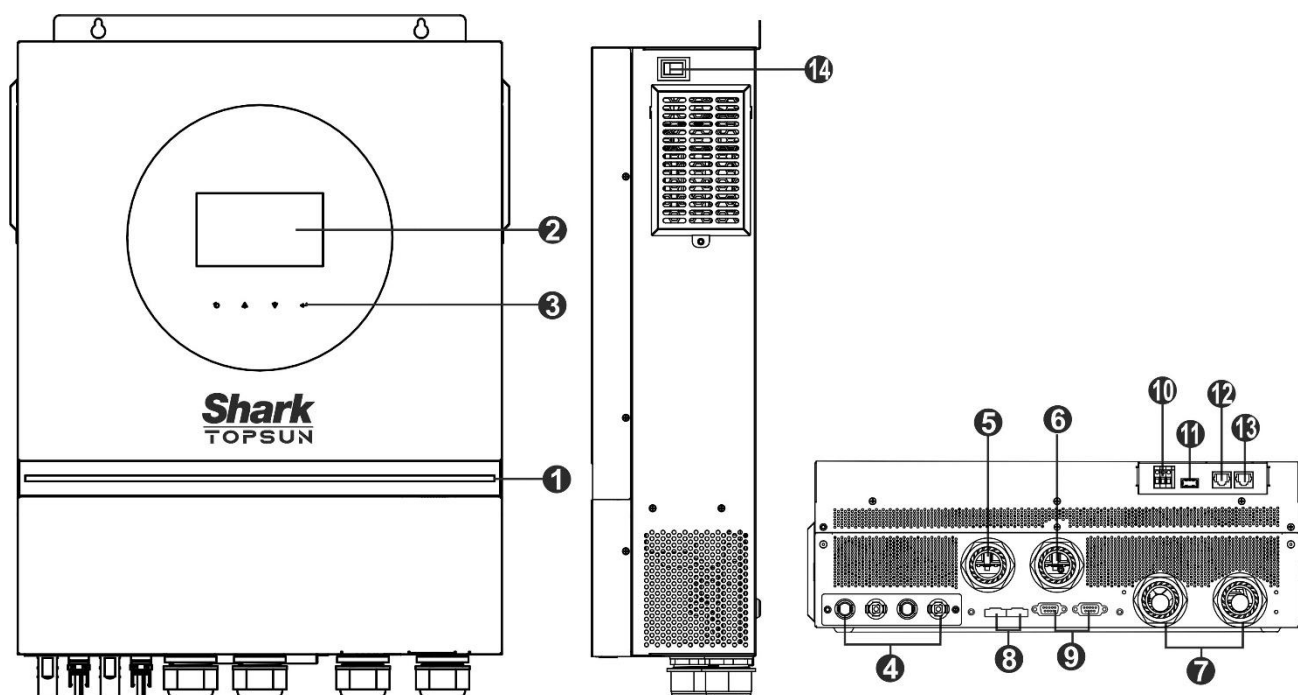
This inverter can power various appliances in home or office environment, including motor-type appliances such as tube light, fan, refrigerator and air conditioners.
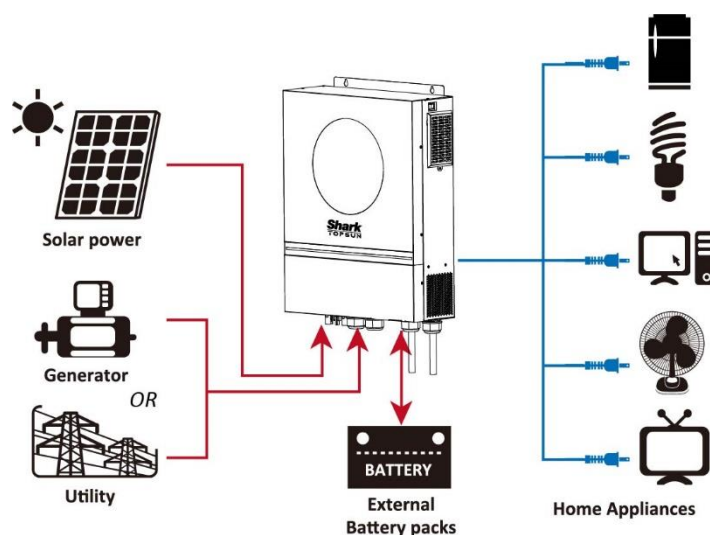
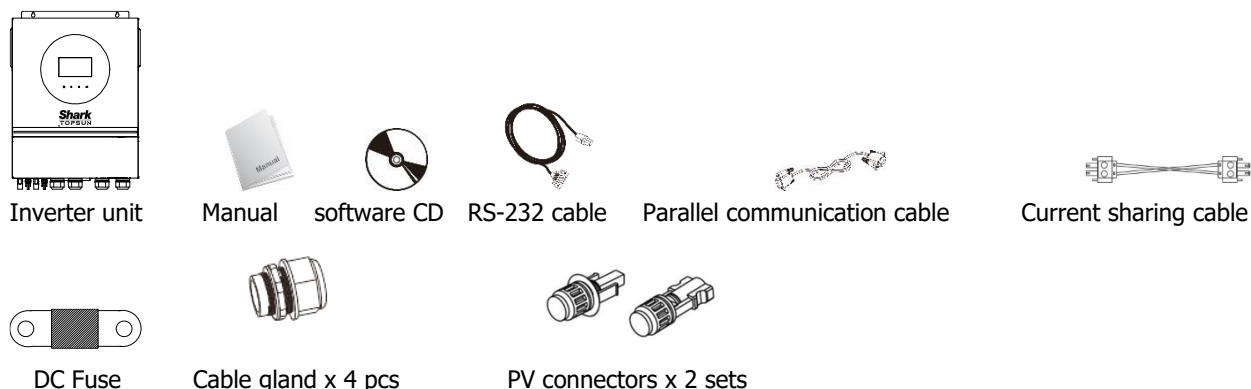**Figure 1 Basic hybrid PV System Overview**

Product Overview

NOTE: For parallel installation and operation, please check *Appendix I.*

1. RGB LED ring (refer to LCD Setting section for the details)
2. LCD display
3. Touchable function keys
4. PV connectors
5. AC input connectors
6. AC output connectors (Load connection)
7. Battery connectors
8. Current sharing port
9. Parallel communication port
10. Dry contact
11. USB port as USB communication port and USB function port
12. RS-232 communication port
13. BMS communication port: CAN, RS-485 or RS-232
14. Power switch

INSTALLATION

Unpacking and Inspection

Before installation, please inspect the unit. Be sure that nothing inside the package is damaged. You should have received the following items inside of package:

| Inverter unit | Manual | software CD | RS-232 cable | Parallel communication cable | Current sharing cable |

| DC Fuse | Cable gland x 4 pcs | PV connectors x 2 sets |

Preparation

Before connecting all wirings, please take off bottom cover by removing five screws. When removing the bottom cover, be carefully to remove three cables as shown below.
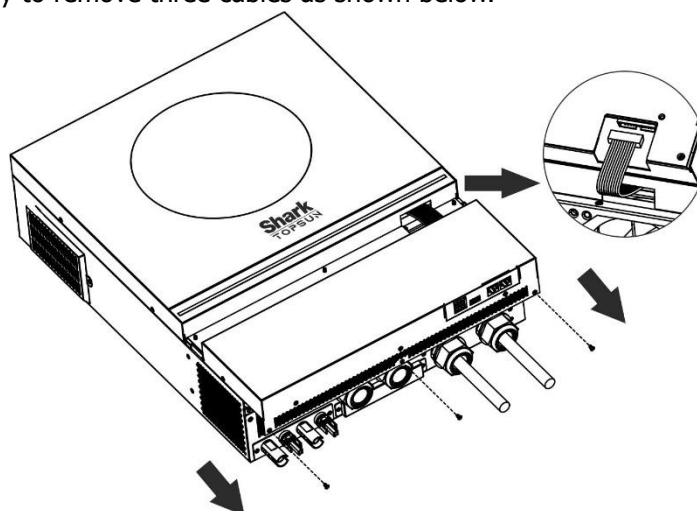
Mounting the Unit

Consider the following points before selecting where to install:
●   Do not mount the inverter on flammable construction materials.
●   Mount on a solid surface
●   Install this inverter at eye level in order to allow the LCD display to be read at all times.
●   The ambient temperature should be between 0°C and 55°C to ensure optimal operation.
●   The recommended installation position is to be adhered to the wall vertically.
●   Be sure to keep other objects and surfaces as shown in the right diagram to guarantee sufficient heat dissipation and to have enough space for removing wires.

⚠ **SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY.**
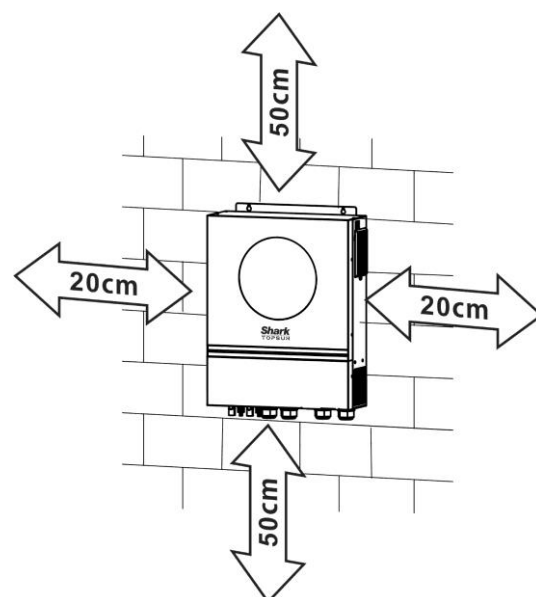
Install the unit by screwing four screws. It's recommended to use M4 or M5 screws.
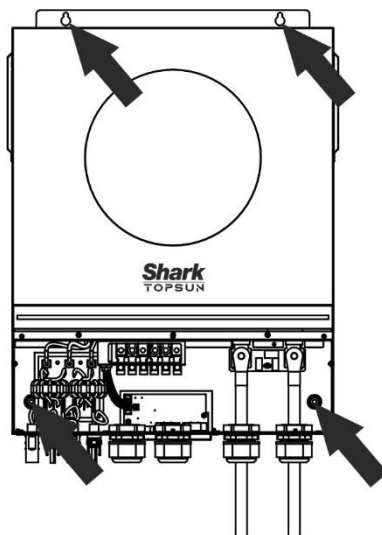

Battery Connection

CAUTION: For safety operation and regulation compliance, it's requested to install a separate DC over-current protector or disconnect device between battery and inverter. It may not be requested to have a disconnect device in some applications, however, it's still requested to have over-current protection installed. Please refer to typical amperage in below table as required fuse or breaker size.

Ring terminal:

WARNING! All wiring must be performed by a qualified personnel.
WARNING! It's very important for system safety and efficient operation to use appropriate cable for battery connection. To reduce risk of injury, please use the proper recommended cable and terminal size as below.
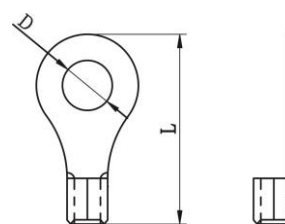
Recommended battery cable and terminal size:

Model	Typical Amperage	Battery capacity	Wire Size	Cable mm² (each)	Ring Terminal Dimensions		Torque value
					D (mm)	L (mm)	
STS-HYM-4815120P	278A	250AH	1*3/0AWG	85.0	8.4	54	5 Nm

Please follow below steps to implement battery connection:
1. Assemble battery ring terminal based on recommended battery cable and terminal size.
2. Fix two cable glands into positive and negative terminals.
3. Insert the ring terminal of battery cable flatly into battery connector of inverter and make sure the nuts are tightened with torque of 5 Nm. Make sure polarity at both the battery and the inverter/charge is correctly connected and ring terminals are tightly screwed to the battery terminals.
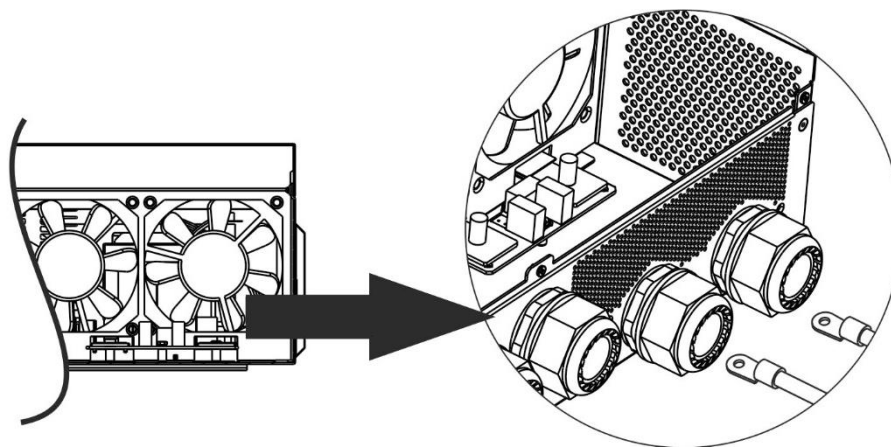
| ⚠ | **WARNING: Shock Hazard**
Installation must be performed with care due to high battery voltage in series. |

| ⚠ | **CAUTION!!** Do not place anything between the flat part of the inverter terminal and the ring terminal. Otherwise, overheating may occur.
CAUTION!! Do not apply anti-oxidant substance on the terminals before terminals are connected tightly.
CAUTION!! Before making the final DC connection or closing DC breaker/disconnector, be sure positive (+) must be connected to positive (+) and negative (-) must be connected to negative (-). |

AC Input/Output Connection

CAUTION!! Before connecting to AC input power source, please install a **separate** AC breaker 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.

CAUTION!! There are two terminal blocks with "IN" and "OUT" markings. Please do NOT mis-connect input and output connectors.

WARNING! All wiring must be performed by a qualified personnel.

WARNING! 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.

Suggested cable requirement for AC wires

Model	Gauge	Torque Value
STS-HYM-4815120P	6 AWG	1.4~ 1.6Nm

Please follow below steps to implement AC input/output connection:
1. Before making AC input/output connection, be sure to open DC protector or disconnector first.
2. Remove insulation sleeve 10mm for six conductors. And shorten phase L and neutral conductor N 3 mm.
3. Fix two cable glands into input and output sides.
4. Insert AC input wires according to polarities indicated on terminal block and tighten the terminal screws. Be sure to connect PE protective conductor (⏚) first.

    ⏚→**Ground (yellow-green)**
    L→LINE (brown or black)
    N→Neutral (blue)
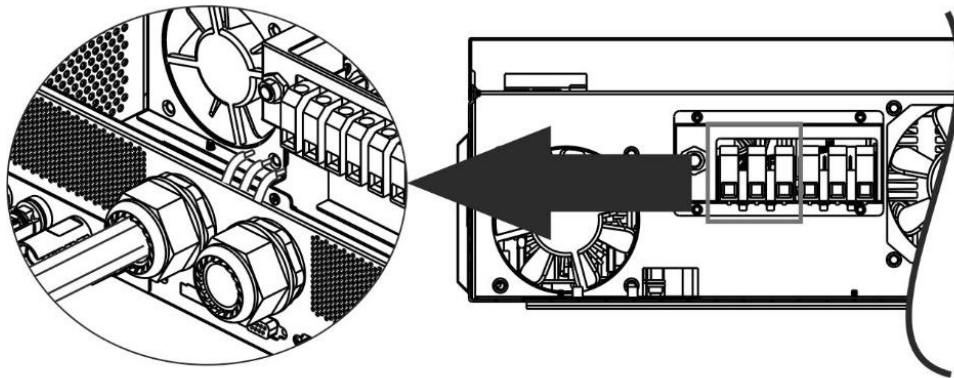
⚠	**WARNING:** Be sure that AC power source is disconnected before attempting to hardwire it to the unit.

5. Then, insert AC output wires according to polarities indicated on terminal block and tighten terminal screws. Be sure to connect PE protective conductor (⏚) first.

⏚ →**Ground (yellow-green)**
L→LINE (brown or black)
N→Neutral (blue)
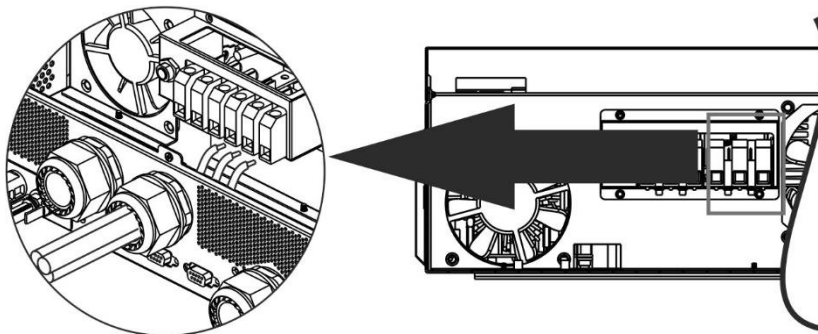
6. Make sure the wires are securely connected.

CAUTION: Important

Be sure to connect AC wires with correct polarity. If L and N wires are connected reversely, it may cause utility short-circuited when these inverters are worked in parallel operation.

PV Connection

CAUTION: Before connecting to PV modules, please install **separately** DC circuit breakers between inverter and PV modules.
NOTE1: Please use 600VDC/30A circuit breaker.
NOTE2: The overvoltage category of the PV input is II.
Please follow the steps below to implement PV module connection:

WARNING: Because this inverter is non-isolated, only three types of PV modules are acceptable: single crystalline and poly crystalline with class A-rated and CIGS 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. When using CIGS modules, please be sure NO grounding.
CAUTION: It's required to use PV junction box with surge protection. Otherwise, it will cause damage on inverter when lightning occurs on PV modules.

Step 1: Check the input voltage of PV array modules. This system is applied with two strings of PV array. Please make sure that the maximum current load of each PV input connector is 27A.

CAUTION: Exceeding the maximum input voltage can destroy the unit!! Check the system before wire connection.	

Step 2: Disconnect the circuit breaker and switch off the DC switch.

Step 3: Assemble provided PV connectors with PV modules by the following steps.
Components for PV connectors and Tools:

Female connector housing	
Female terminal	
Male connector housing	
Male terminal	
Crimping tool and spanner	

Prepare the cable and follow the connector assembly process:

Strip one cable 8 mm on both end sides and be careful NOT to nick conductors.
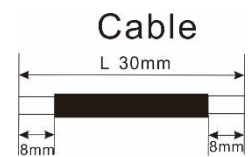
Insert striped cable into female terminal and crimp female terminal as shown below.

Insert assembled cable into female connector housing as shown below.

Insert striped cable into male terminal and crimp male terminal as shown below.

Insert assembled cable into male connector housing as shown below.

Then, use spanner to screw pressure dome tightly to female connector and male connector as shown below.

Step 4: Check correct polarity of connection cable from PV modules and PV input connectors. Then, connect positive pole (+) of connection cable to positive pole (+) of PV input connector. Connect negative pole (-) of connection cable to negative pole (-) of PV input connector.
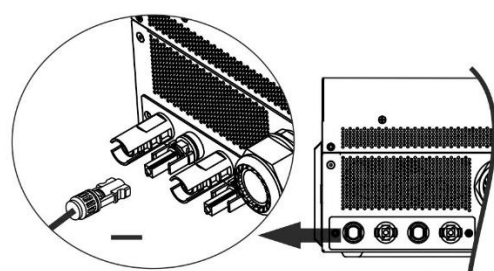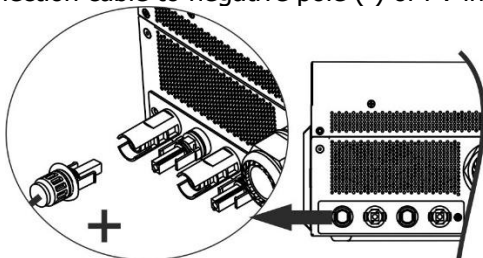
WARNING! For safety and efficiency, it's very important to use appropriate cables for PV module connection. To reduce risk of injury, please use the proper cable size as recommended below.

Conductor cross-section (mm²)	AWG no.
4~6	10~12

CAUTION: Never directly touch the terminals of inverter. It might cause lethal electric shock.

Recommended Panel Configuration

When selecting proper PV modules, please be sure to consider the following parameters:
1. Open circuit Voltage (Voc) of PV modules not to exceed maximum PV array open circuit voltage of the inverter.
2. Open circuit Voltage (Voc) of PV modules should be higher than the start-up voltage.

INVERTER MODEL	STS-HYM-4815120P
Max. PV Array Power	15000W
Max. PV Array Open Circuit Voltage	500Vdc
PV Array MPPT Voltage Range	90Vdc~450Vdc
Start-up Voltage (Voc)	80Vdc

Recommended solar panel configuration:

Solar Panel Spec. (reference)	SOLAR INPUT 1	SOLAR INPUT 2	Q'ty of panels	Total Input Power
- 500Wp	**Min in series: 2pcs, per input**			
- Vmp: 42.8V	**Max. in series: 11pcs, per input**			
- Imp: 11.69A	2pcs in series	x	2pcs	1000W
- Voc: 51.7Vdc	x	2pcs in series	2pcs	1000W
- Isc: 12.28A	9pcs in series	x	9pcs	4500W
- Cells: 150	x	9pcs in series	9pcs	4500W
	5pcs in series	5pcs in series	10pcs	5000W
	11pcs in series	11pcs in series	22pcs	11000W
	6 pcs in series, 2 sets in parallel	6 pcs in series, 2 sets in parallel	24 pcs	12000W
	7 pcs in series, 2 sets in parallel	7pcs in series, 2 sets in parallel	28 pcs	14000W

Solar Panel Spec. (reference)	SOLAR INPUT 1	SOLAR INPUT 2	Q'ty of panels	Total Input Power
- 620Wp	**Min in series: 3pcs, per input**			
- Vmp: 35.7V	**Max. in series: 11pcs, per input**			
- Imp: 17.37A	3pcs in series	x	3pcs	1860W
- Voc: 42.9Vdc	x	3pcs in series	3pcs	1860W
- Isc: 18.31A	11pcs in series	x	11pcs	6820W
- Cells: 120	x	11pcs in series	11pcs	6820W
	6pcs in series	6pcs in series	12pcs	7440W
	11pcs in series	11pcs in series	22pcs	13640W

Final Assembly

After connecting all wirings, re-connect three cables and then put bottom cover back by screwing five screws as shown below.
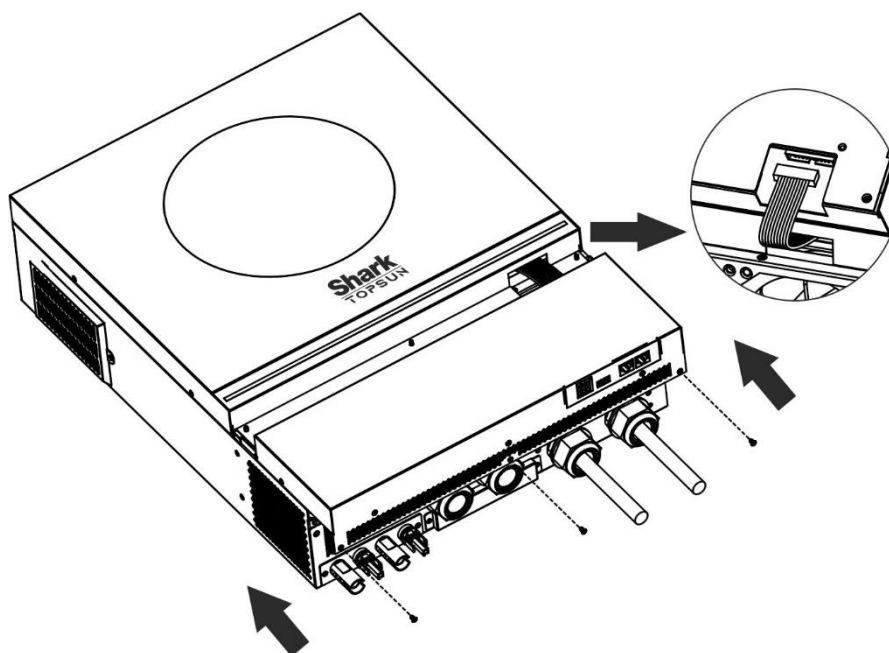
Communication Connection

Follow below chart to connect all communication wiring.
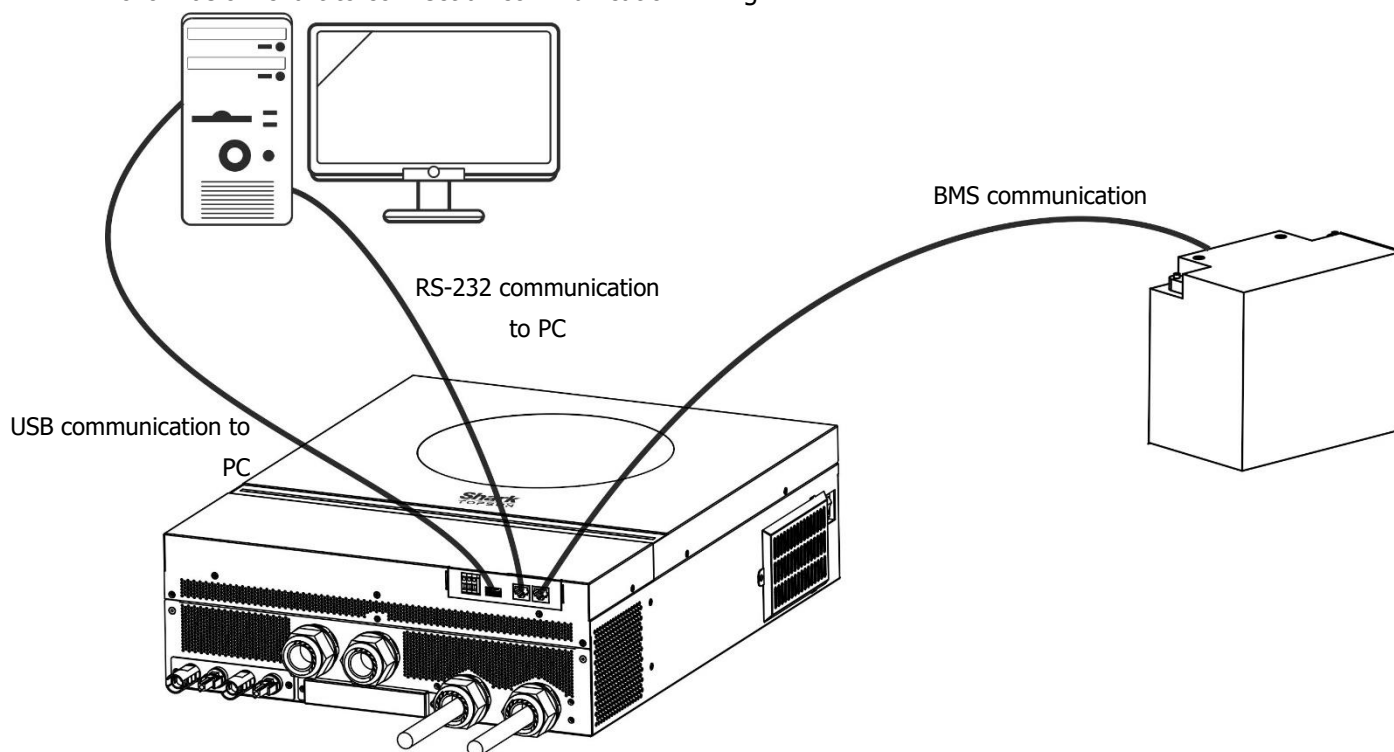
Serial Connection

Please use the supplied serial cable to connect between the inverter and your PC. Install the monitoring software from the bundled CD and follow the on-screen instructions to complete your installation. For detailed software operation, refer to the software user manual on the bundled CD.

Wi-Fi Connection
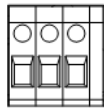
This unit is equipped with a Wi-Fi transmitter. Wi-Fi transmitter can enable wireless communication between off-grid inverters and monitoring platform. Users can access and control the monitored inverter with downloaded APP.   You may find "Energy-Mate" app from the Apple® Store or "Energy-Mate Wi-Fi" in Google® Play Store. All data loggers and parameters are saved in iCloud. For quick installation and operation, please check Appendix III.

BMS Communication Connection

It is recommended to purchase a special communication cable if you are connecting to Lithium-Ion battery banks. Please refer to Appendix II - BMS Communication Installation for details.

Dry Contact Signal

There is one dry contact (3A/250VAC) available on the rear panel. It could be used to deliver signal to external device when battery voltage reaches warning level.

Unit Status	Condition			Dry contact port: NC C NO	
				NC & C	NO & C
Power Off	Unit is off and no output is powered.			Close	Open
Power On	Output is powered from Battery power or Solar energy.	Program 01 set as USB (utility first) or SUB (solar first)	Battery voltage < Low DC warning voltage	Open	Close
			Battery voltage > Setting value in Program 13 or battery charging reaches floating stage	Close	Open
		Program 01 is set as SBU (SBU priority)	Battery voltage < Setting value in Program 12	Open	Close
			Battery voltage > Setting value in Program 13 or battery charging reaches floating stage	Close	Open

Power ON/OFF

Once the unit has been properly installed and the batteries are connected well, simply press power switch for 2 seconds to turn on the unit.
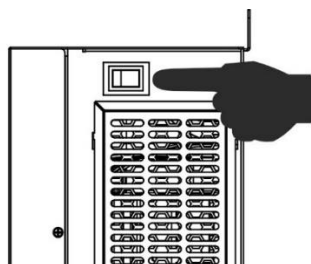
Operation and Display Panel

The operation and the LCD module, shown in the chart below, includes one RGB LED ring, one power switch, four touchable function keys and a LCD display to indicate the operating status and input/output power information.

LCD display

Touchable function keys

RGB LED
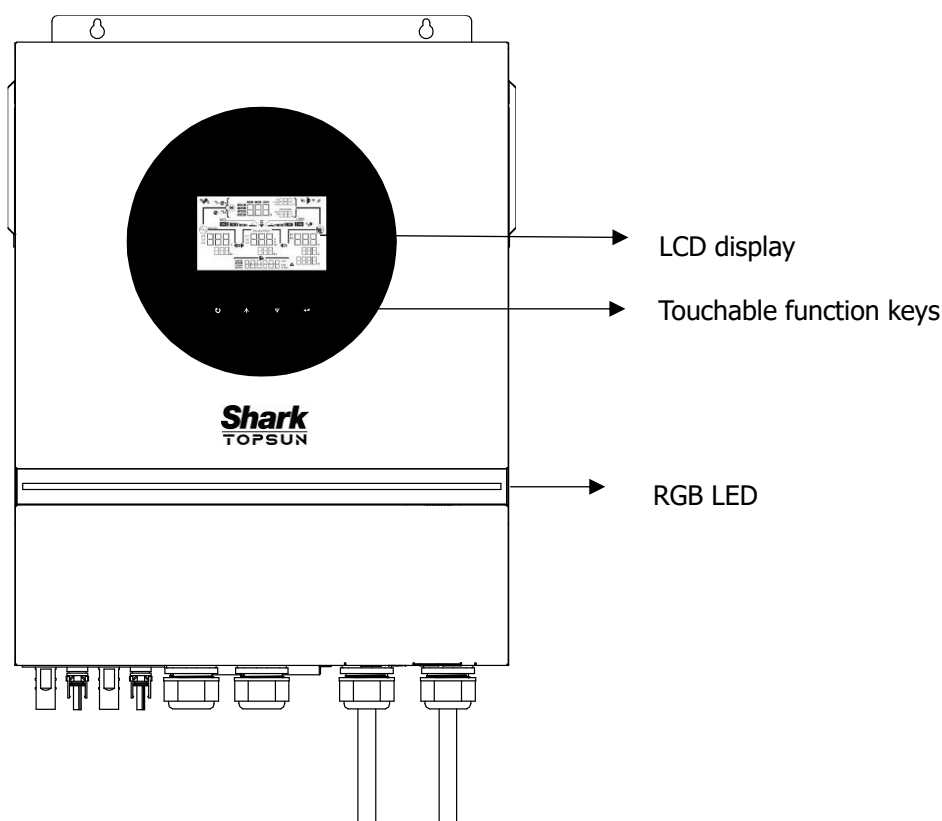
Touchable Function Keys

Function Key		Description
⏻	ESC	To exit the setting
	Access USB setting mode	To enter USB setting mode
▲	Up	To last selection
▼	Down	To next selection
↵	Enter	To confirm/enter the selection in setting mode
▲ + ▼	UP + Down	Press these two keys at the time to switch RGB LED bar for output source priority and battery discharge/charge status

LCD Display Icons

Master or slave unit

Battery type/Battery voltage/ Charging status

Configured battery parameters/ Charging or discharging status

Grid Voltage/Frequency

PV voltage/Current/Power

Output Voltage/Current/Power

Real time clock/ generated power in daily, monthly, yearly and total
Setting menu/ Fault code
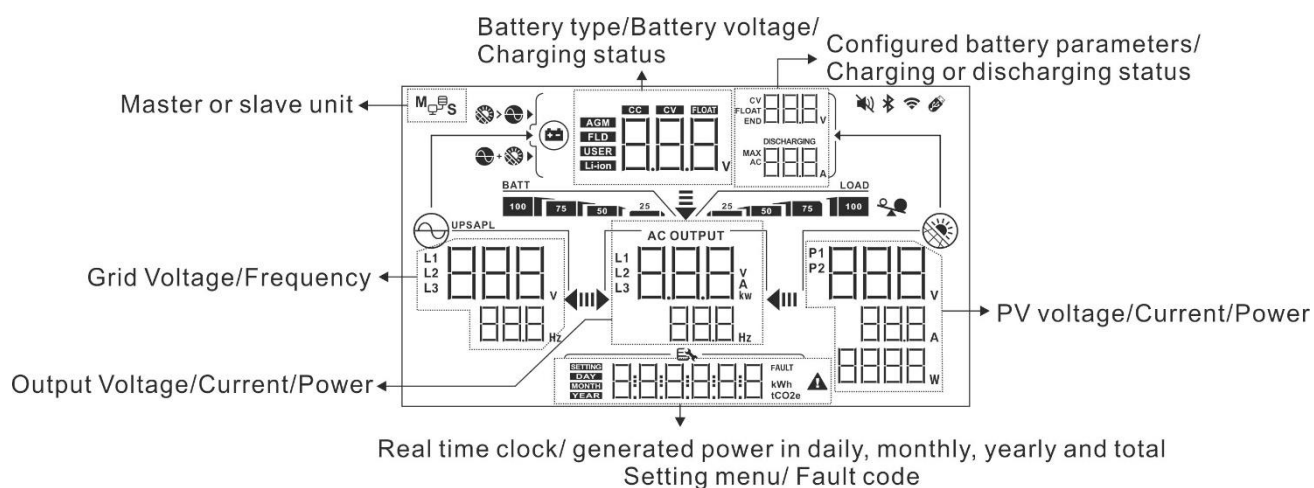
Battery Information	
BATT 100 75 50 25	Indicates battery level by 0-24%, 25-49%, 50-74% and 75-100% in battery mode and charging status in line mode.

When battery is charging, it will present battery charging status.

Status	Battery voltage	LCD Display
C.C. mode C.V. mode	<2V/cell	4 bars will flash in turns.
	2 ~ 2.083V/cell	The right bar will be on and the other three bars will flash in turns.
	2.083 ~ 2.167V/cell	The right two bars will be on and the other two bars will flash in turns.
	> 2.167 V/cell	The right three bars will be on and the left bar will flash.
Floating mode. Batteries are fully charged.		4 bars will be on.

In battery mode, it will present battery capacity.

Load Percentage	Battery Voltage	LCD Display
Load >50%	< 1.85V/cell	BATT 25
	1.85V/cell ~ 1.933V/cell	BATT 50 25
	1.933V/cell ~ 2.017V/cell	BATT 75 50 25
	> 2.017V/cell	BATT 100 75 50 25
Load < 50%	< 1.892V/cell	BATT 25
	1.892V/cell ~ 1.975V/cell	BATT 50 25
	1.975V/cell ~ 2.058V/cell	BATT 75 50 25
	> 2.058V/cell	BATT 100 75 50 25

Load Information	
🔊	Indicates overload.
LOAD 25 50 75 100	Indicates the load level by 0-24%, 25-49%, 50-74% and 75-100%.
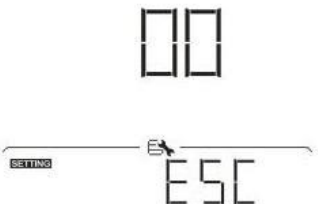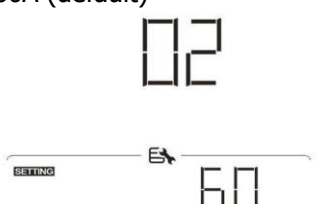
Charger Source Priority Setting Display	
☀ > ∿ ▶	Indicates setting program 16 "Charger source priority" is selected as "Solar first".
∿ + ☀ ▶	Indicates setting program 16 "Charger source priority" is selected as "Solar and Utility".
☀ ▶	Indicates setting program 16 "Charger source priority" is selected as "Solar only".

Output source priority setting display	
(symbol)	Indicates setting program 01 "Output source priority" is selected as "Utility first".
(symbol)	Indicates setting program 01 "Output source priority" is selected as "Solar first".
(symbol)	Indicates setting program 01 "Output source priority" is selected as "SBU".

AC Input Voltage Range Setting Display	
UPS	Indicates setting program 03 is selected as "UPS". The acceptable AC input voltage range will be within 170-280VAC for 8KW and 90-140VAC for 6.5KW.
APL	Indicates setting program 03 is selected as "APL". The acceptable AC input voltage range will be within 90-280VAC for 8KW and 80-140VAC for 6.5KW.

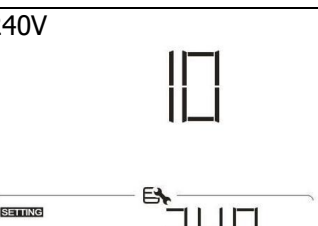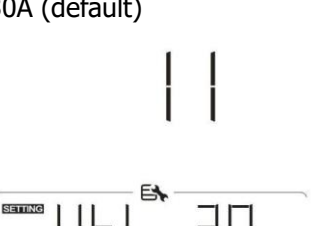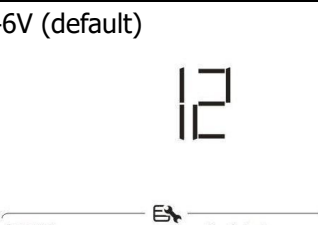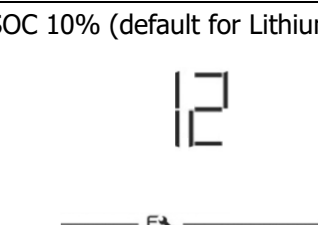| Operation Status Information	
(mains symbol)	Indicates unit connects to the mains.
(PV panel symbol)	Indicates unit connects to the PV panel.
AGM FLD USER Li-ion	Indicates battery type.
M⎕S	Indicates parallel operation is working.
(mute symbol)	Indicates unit alarm is disabled.
(Wi-Fi symbol)	Indicates Wi-Fi transmission is working.
(USB symbol)	Indicates USB disk is connected.
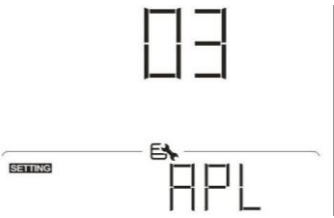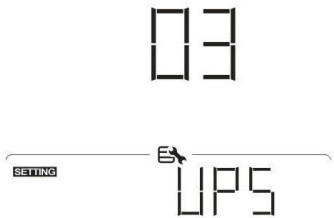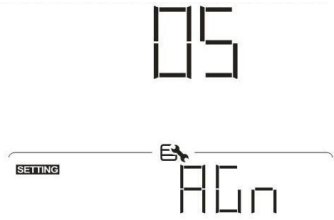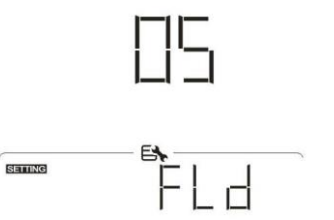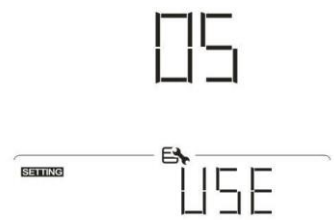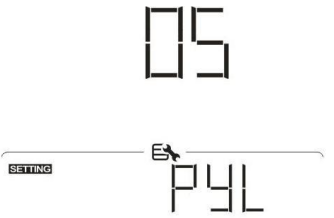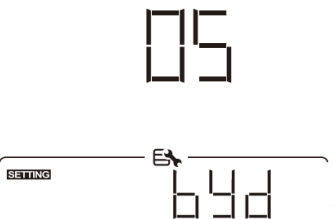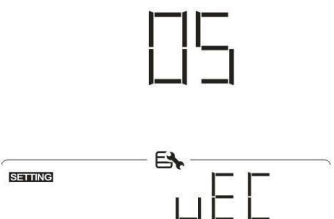
LCD Setting

General Setting
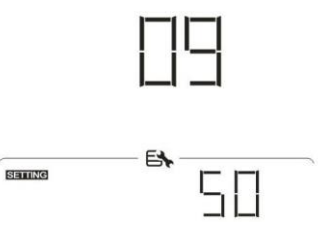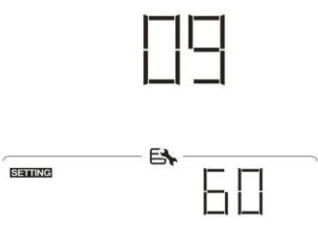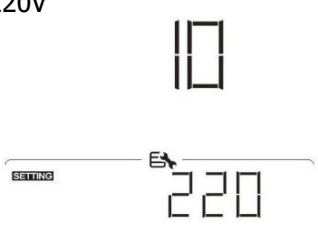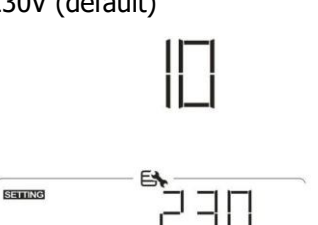
After pressing and holding "↵" button for 3 seconds, the unit will enter the Setup Mode. Press "▲" or "▼" button to select setting programs. Press "↵" button to confirm you selection or "⟳" button to exit.
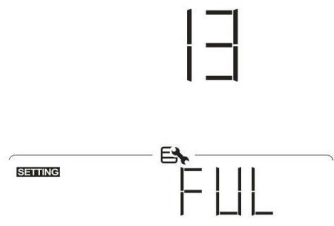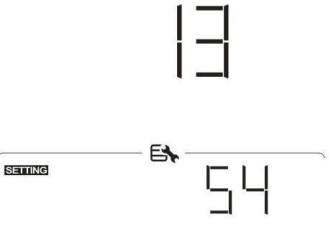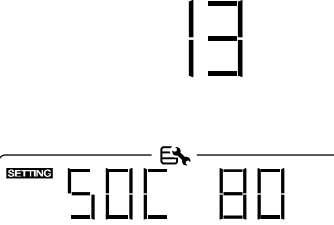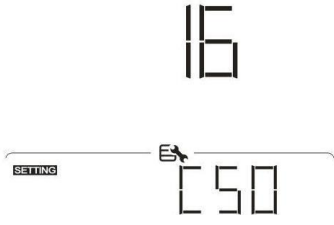
Setting Programs:
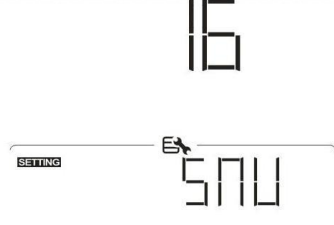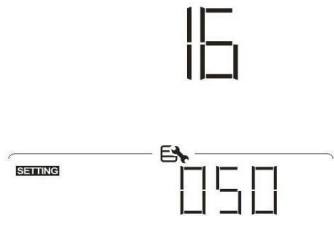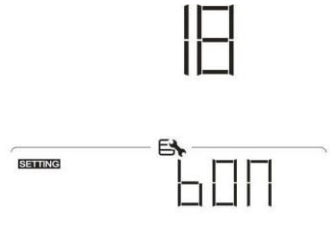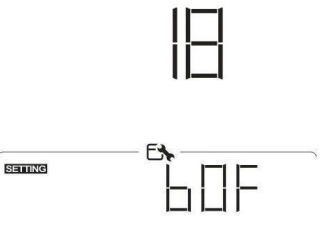
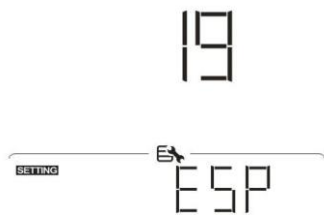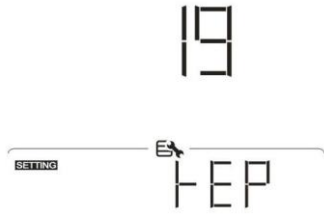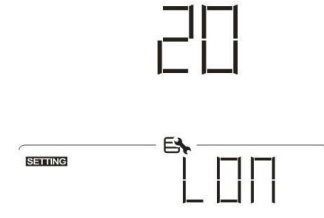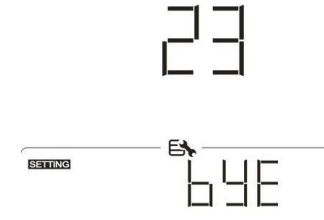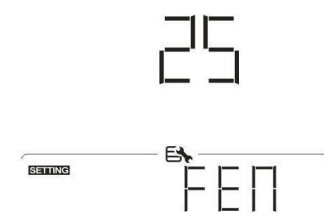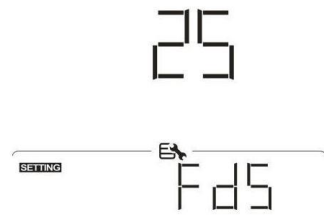| Program	Description	Selectable option	
00	Exit setting mode	Escape 00 SETTING ESC	
01	Output source priority: To configure load power source priority	Utility first (default) 01 SETTING USb	Utility will provide power to the loads as first priority. Solar and battery energy will provide power to the loads only when utility power is not available.
		Solar first 01 SETTING SUb	Solar energy provides power to the loads as first priority. If solar energy is not sufficient to power all connected loads, Utility energy will supply power to the loads at the same time.
		SBU priority 01 SETTING SbU	Solar energy provides power to the loads as first priority. If solar energy is not sufficient to power all connected loads, battery energy will supply power to the loads at the same time. Utility provides power to the loads only when battery voltage drops to either low-level warning voltage or the setting point in program 12.
02	Maximum charging current: To configure total charging current for solar and utility chargers. (Max. charging current = utility charging current + solar charging current)	60A (default) 02 SETTING 60	Setting range is from 10A to 200A. Increment of each click is 10A.
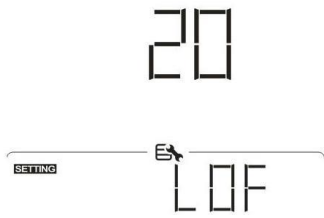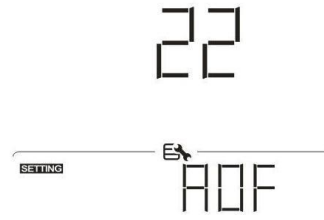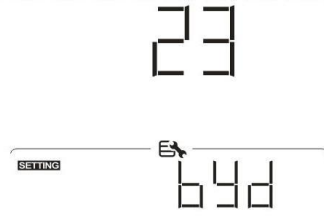
03	AC input voltage range	Appliances (default) 03 SETTING APL	If selected, acceptable AC input voltage range will be within 90-280VAC for 8KW and 80-140VAC for 6.5KW..
		UPS 03 SETTING UPS	If selected, acceptable AC input voltage range will be within 170-280VAC.

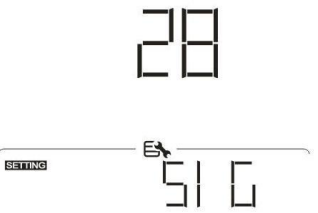| 05	Battery type	AGM (default) 05 SETTING AGn	Flooded 05 SETTING FLd
		User-Defined 05 SETTING USE	If "User-Defined" is selected, battery charge voltage and low DC cut-off voltage can be set up in program 26, 27 and 29.
		PylonTech battery 05 SETTING PYL	If selected, programs of 02, 26, 27 and 29 will be automatically set up. No need for further setting.
		BYD battery 05 SETTING bYd	If selected, programs of 02, 26, 27 and 29 will be automatically set up. No need for further setting.
		WECO battery 05 SETTING uEC	If selected, programs of 02, 12, 26, 27 and 29 will be auto-configured per battery supplier recommended. No need for further adjustment.

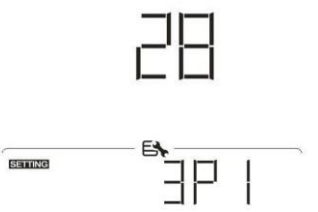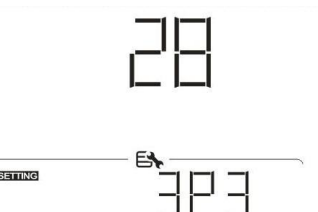| 05	Battery type	Soltaro battery 05 SETTING SOL	If selected, programs of 02, 26, 27 and 29 will be automatically set up. No need for further setting.
		LIA-protocol compatible battery 05 SETTING LIA	Select "LIA" if using Lithium battery compatible to Lib protocol. If selected, programs of 02, 26, 27 and 29 will be automatically set up. No need for further setting.
		LIb-protocol compatible battery 05 SETTING LIb	Select "LIb" if using Lithium battery compatible to Lib protocol. If selected, programs of 02, 26, 27 and 29 will be automatically set up. No need for further setting.
		3rd party Lithium battery 05 SETTING LIC	If selected, programs of 02, 26, 27 and 29 will be automatically set up. No need for further setting. Please contact the battery supplier for installation procedure.
06	Auto restart when overload occurs	Restart disable (default) 06 SETTING Ltd	Restart enable 06 SETTING LtE
07	Auto restart when over temperature occurs	Restart disable (default) 07 SETTING ttd	Restart enable 07 SETTING ttE
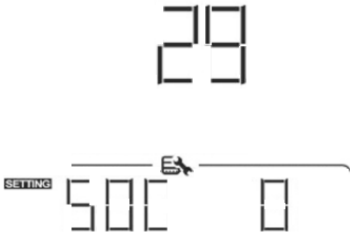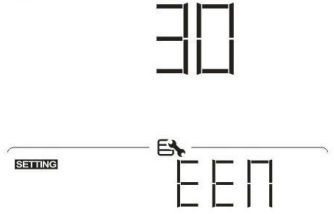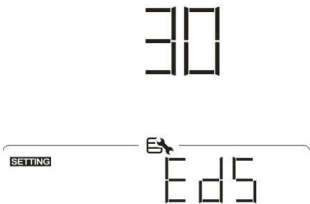
09	Output frequency	50Hz (default for 8KW model)	60Hz
		09 SETTING 50	09 SETTING 60

10	Output voltage	Available options for 8KW model	
		220V 10 SETTING 220	230V (default) 10 SETTING 230
		240V 10 SETTING 240	

11	Maximum utility charging current Note: If setting value in program 02 is smaller than that in program in 11, the inverter will apply charging current from program 02 for utility charger.	30A (default) 11 SETTING UtI 30	Setting range is from 2A, then 10A to 200A. Increment of each click is 10A.

12	Setting voltage point or SOC percentage back to utility source when selecting "SBU" (SBU priority) in program 01.	46V (default) 12 SETTING 46	Setting range is from 44V to 56V. Increment of each click is 1V.
		SOC 10% (default for Lithium) 12 SETTING SOC 10	If any types of lithium battery is selected in program 05, setting value will change to SOC automatically. Adjustable range is 5% to 95%. Increment of each click is 5%.

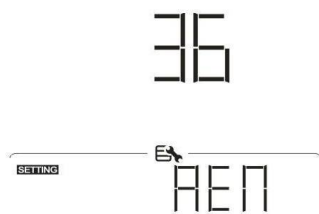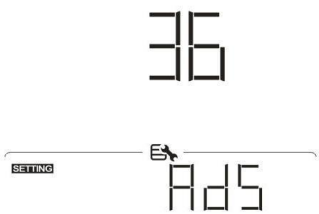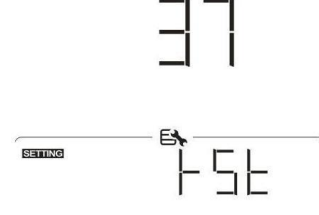| 13	Setting voltage point back to battery mode when	Setting range is FUL and from 48V to 62V. Increment of each click is 1V.	
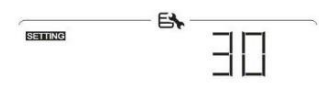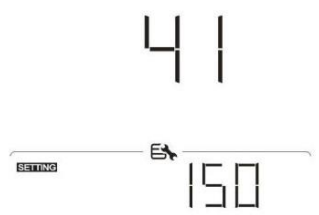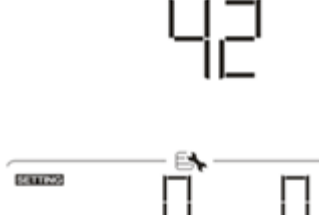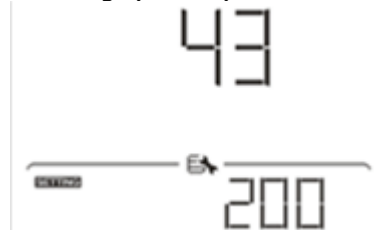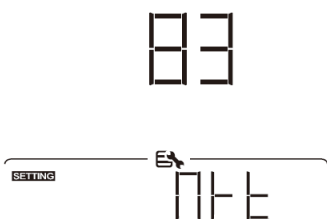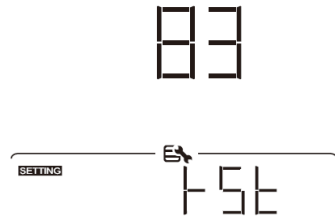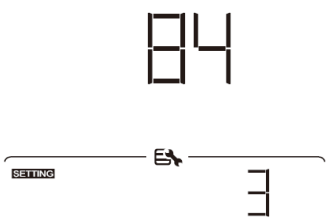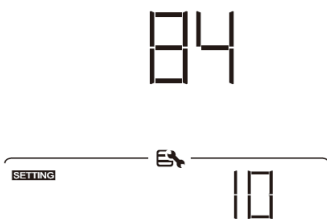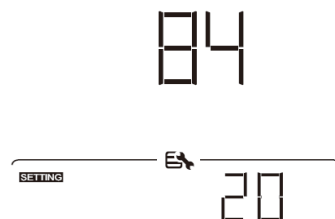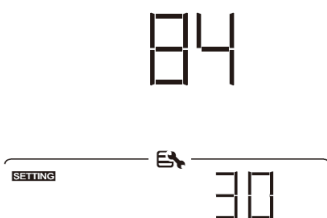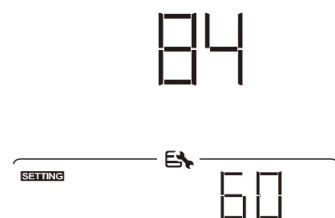
	selecting "SBU" (SBU priority) in program 01.	Battery fully charged `13` SETTING `FUL`	54V (default) `13` SETTING `54`
13	Setting voltage point back to battery mode when selecting "SBU" (SBU priority) in program 01.	SOC 80% (default for Lithium) `13` SETTING `SOC 80`	If any types of lithium battery is selected in program 05, setting value will change to SOC automatically. Setting range is 10% to 100%.
16	Charger source priority: To configure charger source priority	If this inverter/charger is working in Line, Standby or Fault mode, charger source can be programmed as below:	
		Solar first `16` SETTING `CSO`	Solar energy will charge battery as first priority. Utility will charge battery only when solar energy is not available.
		Solar and Utility (default) `16` SETTING `SNU`	Solar energy and utility will charge battery at the same time.
		Only Solar `16` SETTING `OSO`	Solar energy will be the only charger source no matter utility is available or not.
18	Alarm control	Alarm on (default) `18` SETTING `bON`	Alarm off `18` SETTING `bOF`
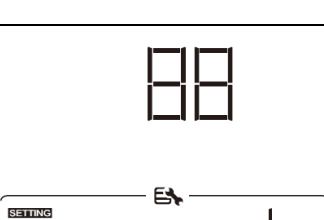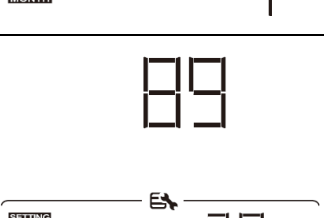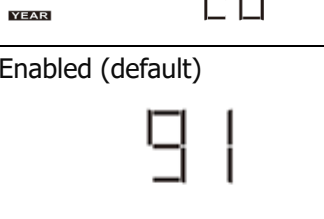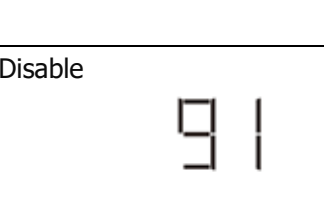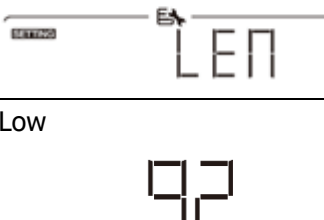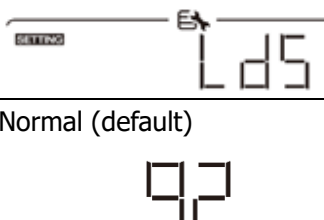
19	Auto return to default display screen	Return to default display screen (default) 19 SETTING ESP	If selected, no matter how users switch display screen, it will automatically return to default display screen after no button is pressed for 1 minute.
		Stay at latest screen 19 SETTING tEP	If selected, the display screen will stay at latest screen user finally switches.
20	Backlight control	Backlight on (default) 20 SETTING LON	Backlight off 20 SETTING LOF
22	Beeps while primary source is interrupted	Alarm on (default) 22 SETTING AON	Alarm off 22 SETTING AOF
23	Overload bypass: When enabled, the unit will transfer to line mode if overload occurs in battery mode.	Bypass disable (default) 23 SETTING bYd	Bypass enable 23 SETTING bYE
25	Record Fault code	Record enable (default) 25 SETTING FEN	Record disable 25 SETTING FdS
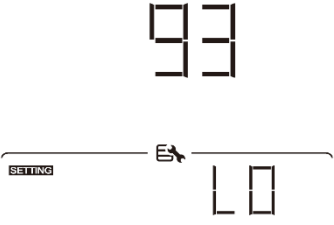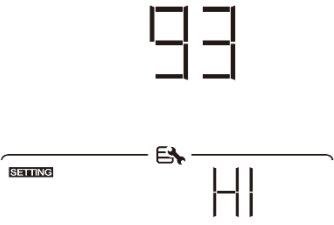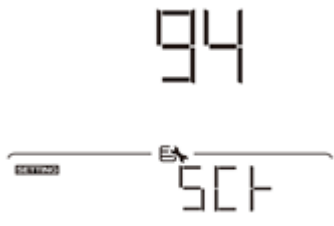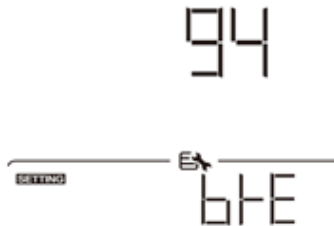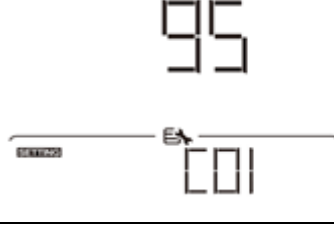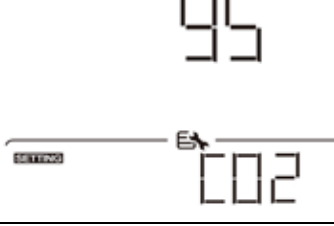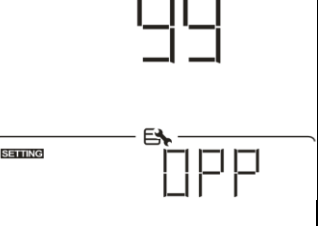
26	Bulk charging voltage (C.V voltage)	56.4V (default) 26 SETTING CV56.4	If user-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 62.0V. Increment of each click is 0.1V.
27	Floating charging voltage	54V (default) 27 SETTING FL54.0	If user-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 62.0V. Increment of each click is 0.1V.
28	AC output mode *This setting is only available when the inverter is in standby mode (Switch off).	Single: This inverter is used in single phase application. 28 SETTING SIG	Parallel: This inverter is operated in parallel system. 28 SETTING PAL

When the inverter is operated in 3-phase application, set up inverter to be operated in specific phase.

L1 phase: 28 SETTING 3P1	L2 phase: 28 SETTING 3P2
L3 phase: 28 SETTING 3P3	

| 29 | Low DC cut-off voltage:
● If battery power is only power source available, inverter will shut down.
● If PV energy and battery power are available, inverter will charge battery without AC output.
If PV energy, battery power and utility are all available, inverter will transfer to line mode | 42.0V (default)

29

SETTING CO42.0 | If user-defined is selected in program 5, this program can be set up. Setting range is from 42.0V to 48.0V. Increment of each click is 0.1V. Low DC cut-off voltage will be fixed to setting value no matter what percentage of load is connected. |

		SOC 0% (default for Lithium)	If any types of lithium battery is selected in program 05, setting value will change to SOC automatically. Adjustable range is 0% to 90%. Increment of each click is 5%.
		29 **SETTING** 50C 0	
30	Battery equalization	Battery equalization 30 **SETTING** EEn	Battery equalization disable (default) 30 **SETTING** EdS
		If "Flooded" or "User-Defined" is selected in program 05, this program can be set up.	
31	Battery equalization voltage	58.4V (default) 31 **SETTING** EU58.4	Setting range is from 48.0V to 62.0V. Increment of each click is 0.1V.
33	Battery equalized time	60min (default) 33 **SETTING** 60	Setting range is from 5 min to 900 min. Increment of each click is 5 min.
34	Battery equalized timeout	120min (default) 34 **SETTING** 120	Setting range is from 5 min to 900 min. Increment of each click is 5 min.
35	Equalization interval	30days (default) 35 **SETTING** 30d	Setting range is from 0 to 90 days. Increment of each click is 1 day
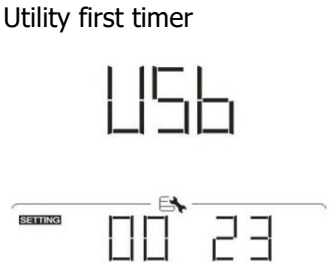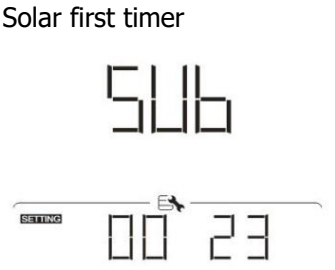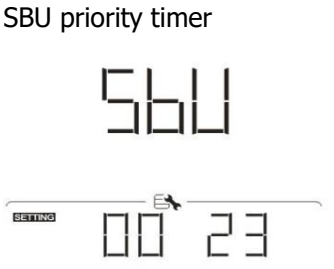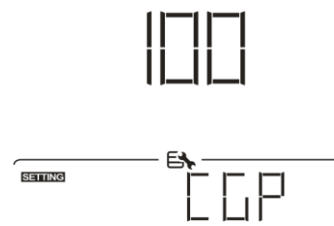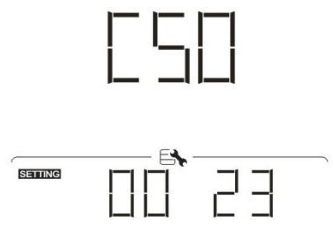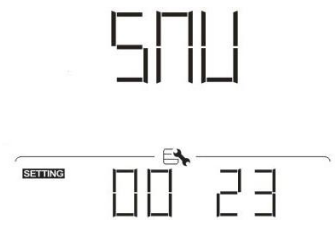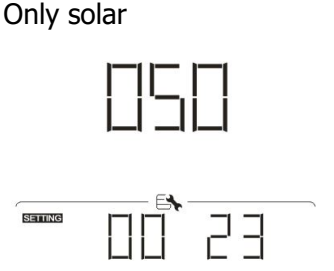
36	Equalization activated immediately	Enable	Disable (default)
		36 SETTING 🖉 AEN	36 SETTING 🖉 AdS
		If equalization function is enabled in program 30, this program can be set up. If "Enable" is selected in this program, it's to activate battery equalization immediately and LCD main page will show "E9". If "Disable" is selected, it will cancel equalization function until next activated equalization time arrives based on program 35 setting. At this time, "E9" will not be shown in LCD main page.	
37	Reset all stored data for PV generated power and output load energy	Not reset(Default) 37 SETTING 🖉 NrE	Reset 37 SETTING 🖉 rSt
41	Maximum battery discharging current	Disable (Default) 41 SETTING 🖉 ddS	If selected, battery discharge protection is disabled.
		30A 41 SETTING 🖉 30	The setting range is from 30 A to 200 A. Increment of each click is 10A. If discharging current is higher than setting value, battery will stop discharging. At this time, if the utility is available, the inverter will operate in bypass mode. If no utility is available, the inverter will shut down after 5-minute operation in battery mode.
		150A 41 SETTING 🖉 150	
42	Adjustment parameter for EARTH LED	If unit is not in Line mode, it will show nothing. 42 SETTING 🖉	If unit is in Line mode, it will show following. (default) 42 SETTING 🖉 0 0

		If EARTH LED of meter is on, it can be off by adjusting the parameter. If the unit is in Line mode, this program can be set up. Setting range is from -30 to 30. Increment of each click is 1. The condition of program changed automatically.	
43	Adjustment parameter for REVERSE LED	If unit is not in Line mode, it will show following. 43	If unit is in Line mode, it will show following. (default) 43 200
		If REVERSE LED of meter is on, it can be off by adjusting the parameter. If the unit is in Line mode, this program can be set up. Setting range is from 0 to 300. Increment of each click is 10.	
83	Erase all data log	Not reset (Default) 83 ПНᴱ	Reset 83 ᴴSᴱ
84	Data log recorded interval *The maximum data log number is 1440. If it's over 1440, it will re-write the first log.	3 minutes 84 3	5 minutes 84 5
		10 minutes (default) 84 10	20 minutes 84 20
		30 minutes 84 30	60 minutes 84 60
85	Time setting – Minute	85 ΠΙΠ 0	For minute setting, the range is from 0 to 59.

86	Time setting – Hour	**86** SETTING HOU 0	For hour setting, the range is from 0 to 23.
87	Time setting– Day	**87** SETTING DAY 1	For day setting, the range is from 1 to 31.
88	Time setting– Month	**88** SETTING MONTH 1	For month setting, the range is from 1 to 12.
89	Time setting – Year	**89** SETTING YEAR 20	For year setting, the range is from 17 to 99.

		Enabled (default)	Disable
91	On/Off control for RGB LED *It's necessary to enable this setting to activate RGB LED lighting function.	**91** SETTING LEN	**91** SETTING LdS

		Low	Normal (default)
92	Brightness of RGB LED	**92** SETTING LO	**92** SETTING NOr
		High	
		92 SETTING HI	

93	Lighting speed of RGB LED	Low 93 SETTING 🔋 LO	Normal (default) 93 SETTING 🔋 ∏OՒ
		High 93 SETTING 🔋 HI	
94	RGB LED effects	Scrolling 94 SETTING 🔋 SCՒ	Breathing 94 SETTING 🔋 bՒE
		Solid on (Default) 94 SETTING 🔋 SOL	
95	Color combination of RGB LED to show energy source and battery charge/discharge status: ● Grid-PV-Battery ● Battery charge/discharge status	C01: (Default) ● Violet-White-Sky blue ● Pink-Honey 95 SETTING 🔋 COI	C02: ● White-Yellow-Green ● Royal blue-Lime yellow 95 SETTING 🔋 CO2
99	Timer Setting for Output Source Priority 99 SETTING 🔋 OPP	Once access this program, it will show "OPP" in LCD. Press "↵" button to select timer setting for output source priority. There are three timers to set up. Press "▲" or "▼" button to select specific timer option. Then, press "↵" to confirm timer option. Press "▲" or "▼" button to adjust starting time first and the setting range is from 00 to 23. Increment of each click is one hour. Press "↵" to confirm starting time setting.Next, the cursor will jump to right column to set up end time. Once end time is set completely, press "↵" to confirmall setting.	

		Utility first timer	Solar first timer
		USb SETTING 00 23	SUb SETTING 00 23
		SBU priority timer	
		SbU SETTING 00 23	
100	Timer Setting for Charger Source Priority 100 SETTING CGP	Once access this program, it will show "CGP" in LCD. Press "↵" button to select timer setting for charger source priority. There are three timers to set up. Press "▲" or "▼" button to select specific timer option. Then, press "↵" to confirm timer option. Press "▲" or "▼" button to adjust starting time first and the setting range is from 00 to 23. Increment of each click is one hour. Press "↵" to confirm starting time setting.Next, the cursor will jump to right column to set up end time. Once end time is set completely, press "↵" to confirmall setting.	
		Solar first	Sloar and utility
		CSO SETTING 00 23	SNU SETTING 00 23
		Only solar	
		OSO SETTING 00 23	

USB Function Setting

There are three USB function setting such as firmware upgrade, data log export and internal parameter re-write from the USB disk. Please follow below procedure to execute selected USB function setting.

Procedure	LCD Screen
Step 1: Insert an OTG USB disk into the USB port (❶).	UPG
Step 2: Press "⟳" button to enter USB function setting.	SETTING ⮌

Step 3: Please select setting program by following the procedure.

Program#	Operation Procedure	LCD Screen
Upgrade firmware	After entering USB function setting, press "←┘" button to enter "upgrade firmware" function. This function is to upgrade inverter firmware. If firmware upgrade is needed, please check with your dealer or installer for detail instructions.	UPG SETTING ⮌
Re-write internal parameters	After entering USB function setting, press "▼" button to switch to "Re-write internal parameters" function. This function is to over-write all parameter settings (TEXT file) with settings in the USB disk from a previous setup or to duplicate inverter settings. Please check with your dealer or installer for detail instructions.	SEt SETTING ⮌
Export data log	After entering USB function setting, press "▼" button twice to switch to "export data log" function and it will show "LOG" in the LCD. Press "←┘" button to confirm the selection for export data log. If the selected function is ready, LCD will display "┠dY". Press "←┘" button to confirm the selection again.	LOG SETTING ⮌ LOG SETTING ⮌ ┠dY
	• Press "▲" button to select "Yes" to export data log. "YES" will disappear after this action is complete. Then, press "⟳" button to return to main screen. • Or press "▼" button to select "No" to return to main screen.	LOG SETTING ⮌ YES NO

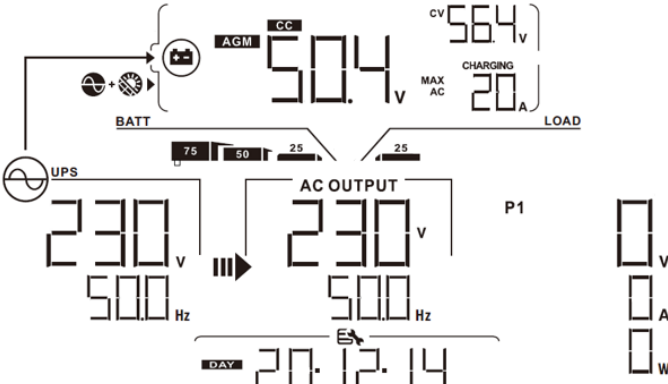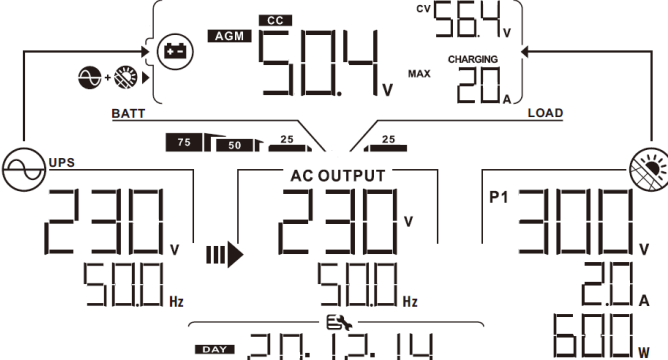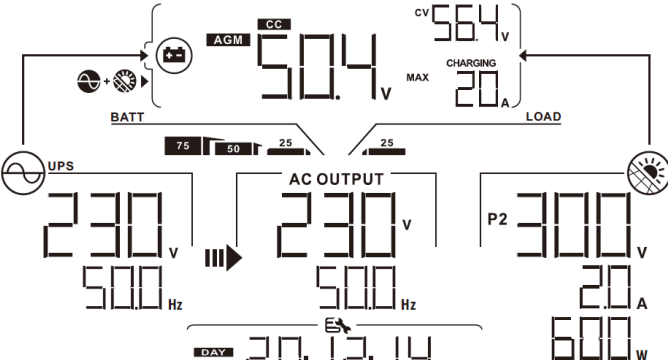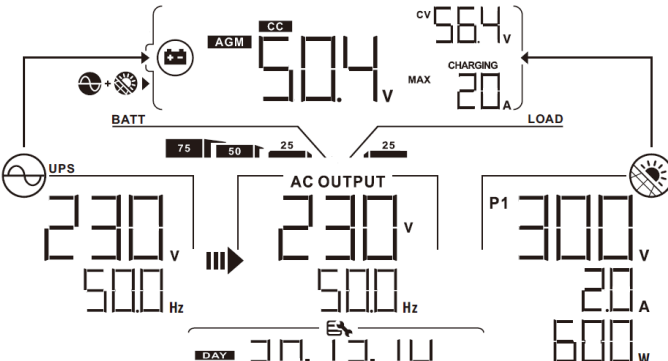If no button is pressed for 1 minute, it will automatically return to main screen.
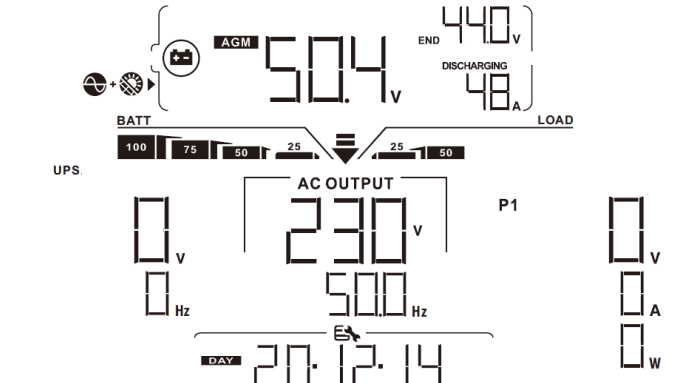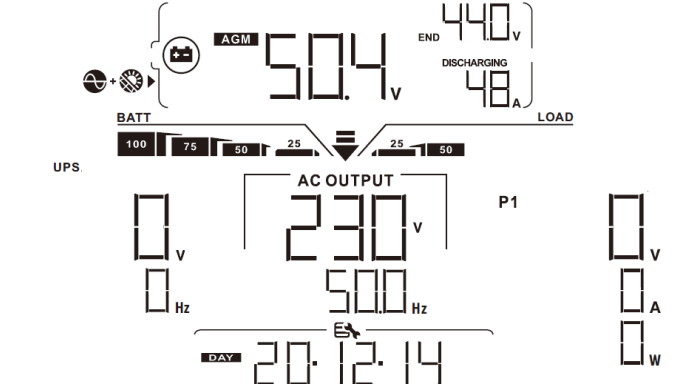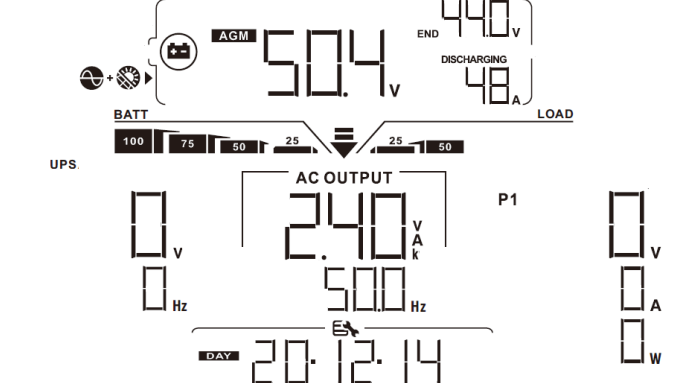
Error message:
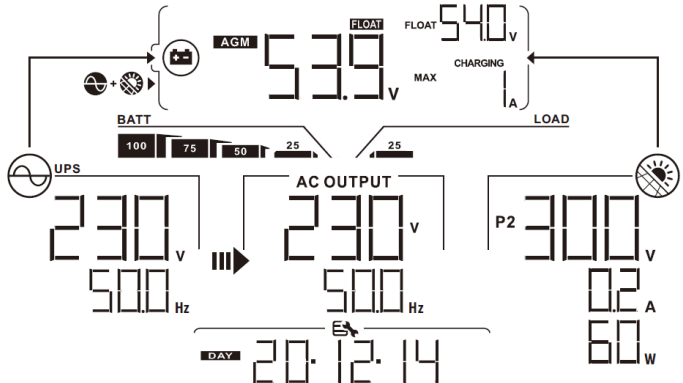
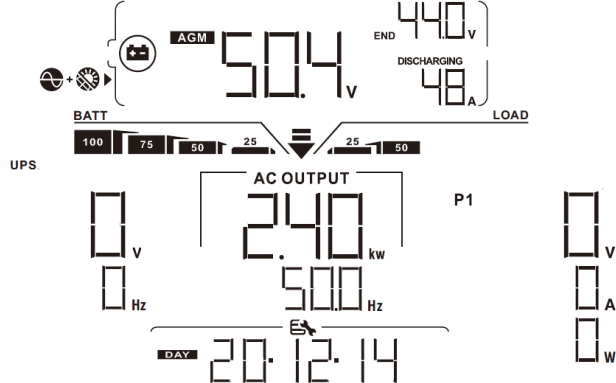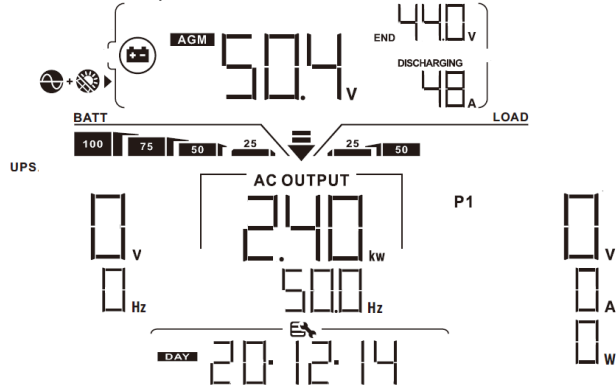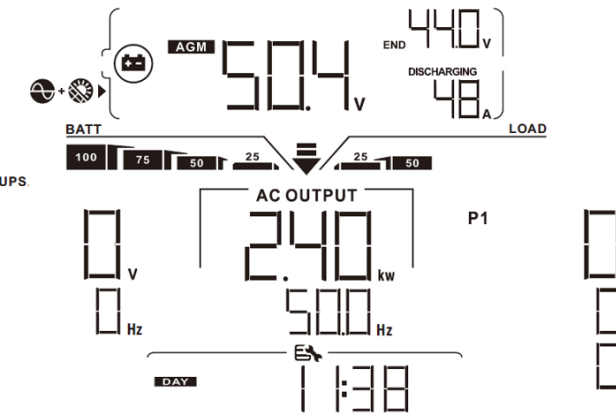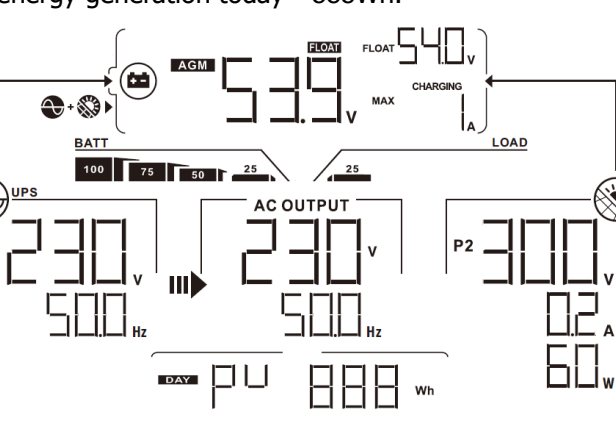| Error Code	Messages
U01	No USB disk is detected.
U02	USB disk is protected from copy.
U03	Document inside the USB disk with wrong format.

If any error occurs, error code will only show 3 seconds. After 3 seconds, it will automatically return to display screen.

LCD Display

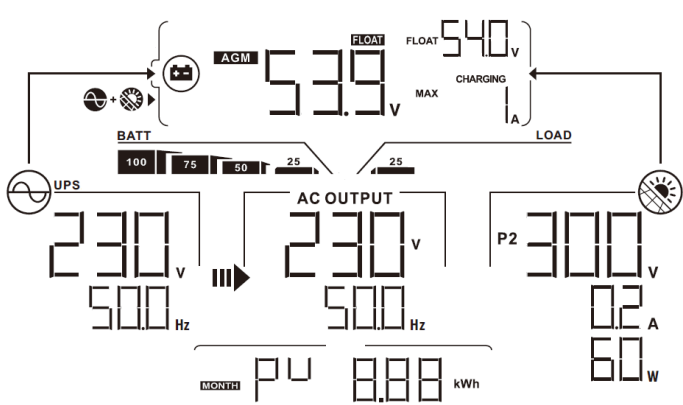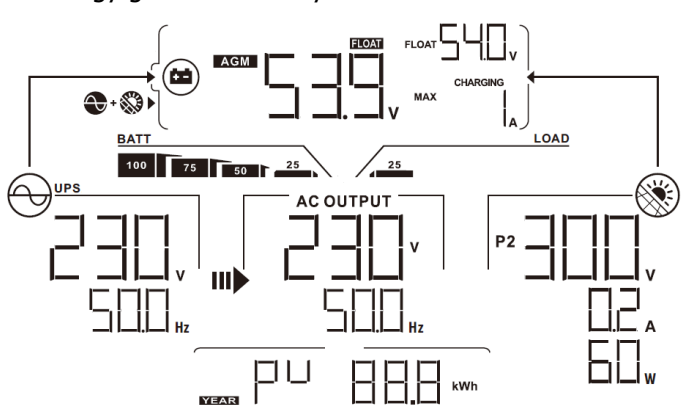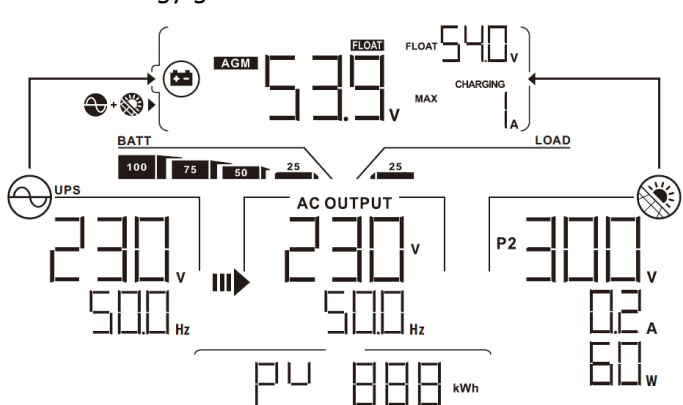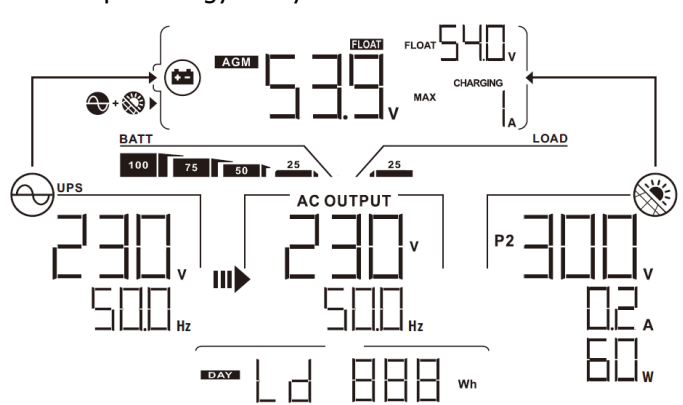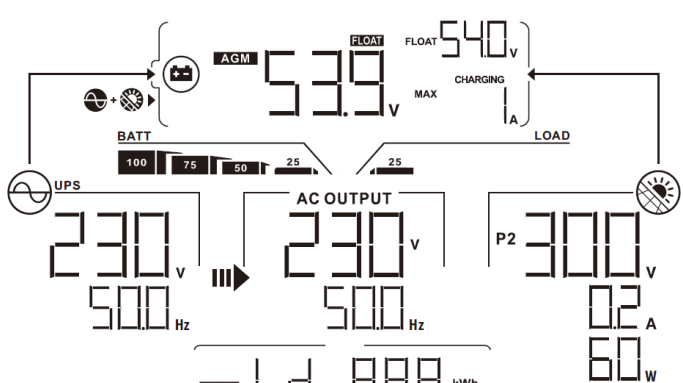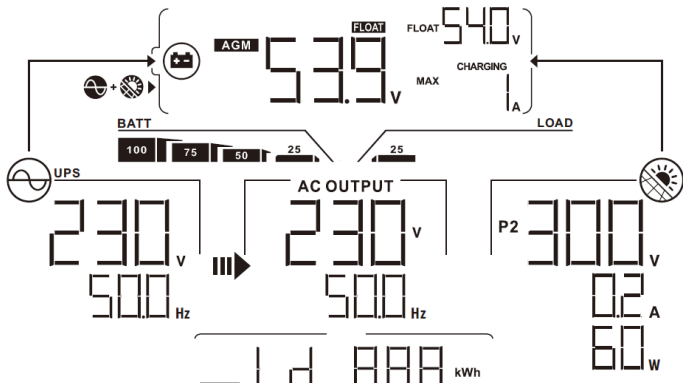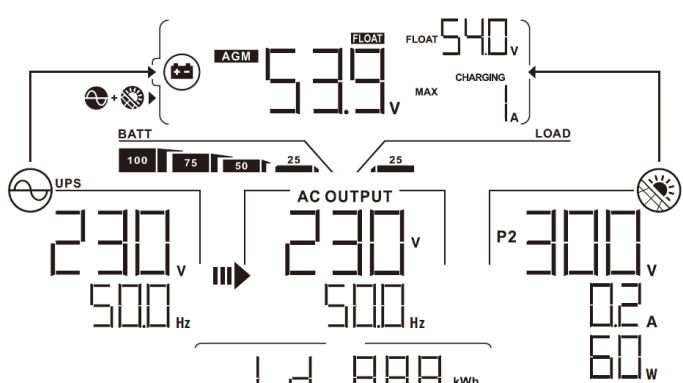The LCD display information will be switched in turn by pressing the "▲" or "▼" button. The selectable information is switched as the following table in order.

Selectable information		LCD display
Default Display Screen	Utility voltage/ Utility frequency	Input Voltage=230V, Input frequency=50Hz
	PV voltage/ PV current/ PV power (PV1 and PV2 switch every 5 seconds)	PV1 voltage=300V, PV1 current=2.0A, PV1 power=600W
		PV2 voltage=300V, PV2 current=2.0A, PV2 power=600W
	Battery voltage, charging stage/ Configured battery parameters/ Charging or discharging current	Battery voltage=50.4V, Bulk charging voltage=56.4V, Charging current=20A

Default Display Screen	Battery voltage, charging stage/ Configured battery parameters/ Charging or discharging current	Battery voltage=53.9V, Floating charging voltage=54.0V, Charging current=1A
		Battery voltage=50.4V, Low DC cut-off voltage=44.0V, Discharging current=48A
	Output voltage, load in VA, load in Watt switch every 5 second/ Output frequency	Output voltage=230V, Output frequency=50Hz
		Load in VA=2.4kVA, Output frequency=50Hz

Default Display Screen	Output voltage, load in VA, load in Watt switch every 5 second/ Output frequency	Load in Watt=2.4kW, Output frequency=50Hz
	Real date.	Real date Dec 14, 2020.
Real time.		Real time 11:38.
PV energy generation today		PV energy generation today =888Wh.

PV energy generation this month	PV energy generation this month =8.88kWh.
PV energy generation this year	PV energy generation this year =88.8kWh.
Total PV energy generation	Total PV energy generation =888kWh.
Load output energy today	Load output energy today =888Wh.

Load output energy this month	Load output energy this month =8.88kWh. 53.9v FLOAT 54.0v AGM FLOAT MAX CHARGING A BATT 100 75 50 25 25 LOAD UPS 230v 230v AC OUTPUT P2 300v 50.0Hz 50.0Hz 0.2A 60W MONTH Ld 8.88 kWh
Load output energy this year	Load output energy this year =88.8kWh. 53.9v FLOAT 54.0v AGM FLOAT MAX CHARGING A BATT 100 75 50 25 25 LOAD UPS 230v 230v AC OUTPUT P2 300v 50.0Hz 50.0Hz 0.2A 60W YEAR Ld 88.8 kWh
Total load output energy	Total load output energy =888kWh. 53.9v FLOAT 54.0v AGM FLOAT MAX CHARGING A BATT 100 75 50 25 25 LOAD UPS 230v 230v AC OUTPUT P2 300v 50.0Hz 50.0Hz 0.2A 60W Ld 888 kWh
Main CPU version checking.	Main CPU version 00050.72. 50.4v AGM END 44.0v DISCHARGING 20A BATT 100 75 50 25 25 LOAD UPS 0v 230v AC OUTPUT P1 0v 0Hz 60.0Hz 0A 0W U 15072

Secondary CPU version checking.	Secondary CPU version 00022.01. U22201
Wi-Fi version checking	Wi-Fi version 00088.88. U38888
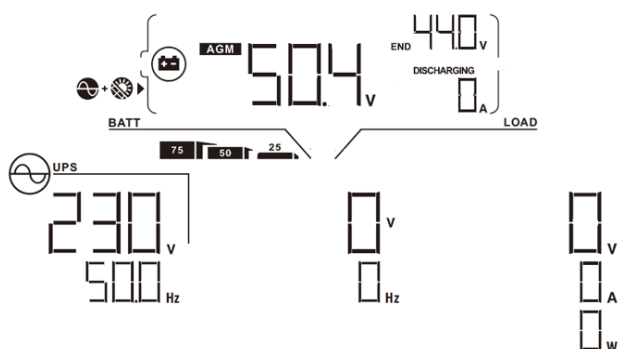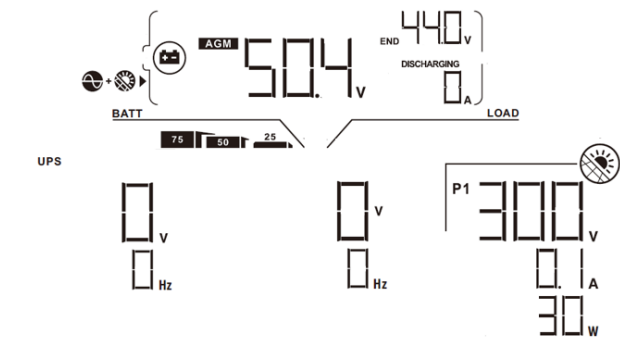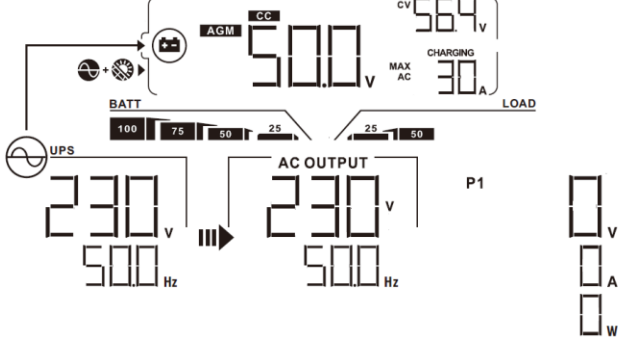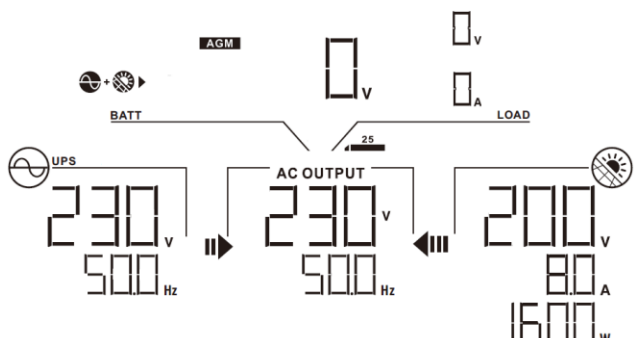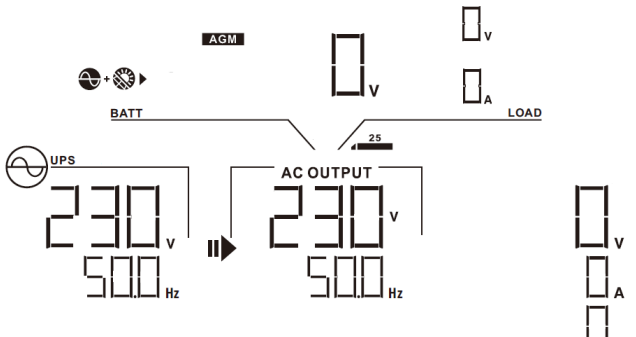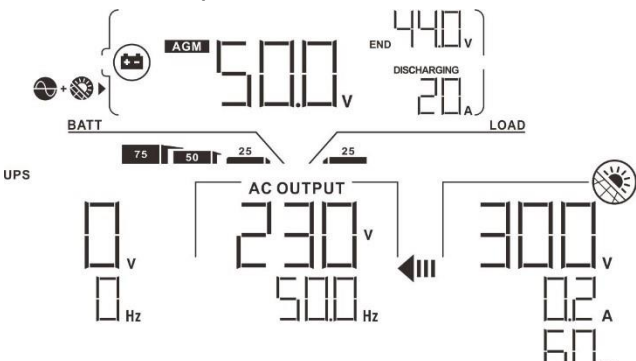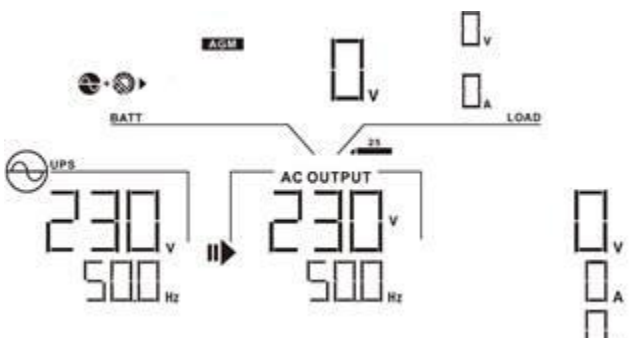
Operating Mode Description

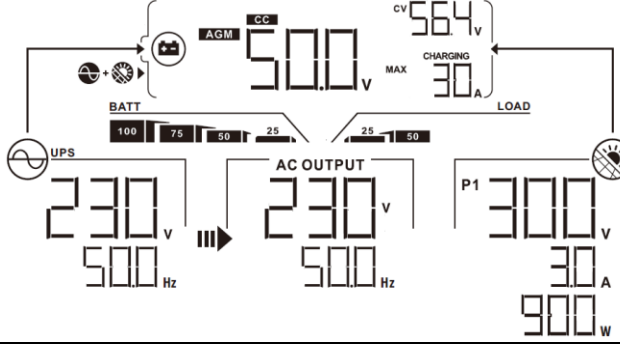| Operation mode	Description	LCD display
Standby mode **Note:** *Standby mode: The inverter is not turned on yet but at this time, the inverter can charge battery without AC output.	No output is supplied by the unit but it still can charge batteries.	Charging by utility and PV energy. Charging by utility. Charging by PV energy. No charging.
Fault mode Note: *Fault mode: Errors are caused by inside circuit error or external reasons such as over temperature, output short circuited and so on.	No charging at all no matter if grid or PV power is available.	Grid and PV power are available.

Operation mode	Description	LCD display
Fault mode Note: *Fault mode: Errors are caused by inside circuit error or external reasons such as over temperature, output short circuited and so on.	No charging at all no matter if grid or PV power is available.	Grid is available. PV power is available. No charging.
Line Mode	The unit will provide output power from the mains. It will also charge the battery at line mode.	Charging by utility and PV energy. Charging by utility.

Operation mode	Description	LCD display
Line Mode	The unit will provide output power from the mains. It will also charge the battery at line mode.	If "SUB" (solar first) is selected as output source priority and solar energy is not sufficient to provide the load, solar energy and the utility will provide the loads and charge the battery at the same time. If either "SUB" (solar first) or "SBU" is selected as output source priority and battery is not connected, solar energy and the utility will provide the loads. Power from utility
Battery Mode	The unit will provide output power from battery and/or PV power.	Power from battery and PV energy.

Operation mode	Description	LCD display
Battery Mode	The unit will provide output power from battery and/or PV power.	PV energy will supply power to the loads and charge battery at the same time. No utility is available.
		Power from battery only.
		Power from PV energy only.

Faults Reference Code

Fault Code	Fault Event	Icon on
01	Fan is locked when inverter is off.	F01
02	Over temperature	F02
03	Battery voltage is too high	F03
04	Battery voltage is too low	F04
05	Output short circuited.	F05
06	Output voltage is too high.	F06
07	Overload time out	F07
08	Bus voltage is too high	F08
09	Bus soft start failed	F09
10	PV over current	F 10
11	PV over voltage	F 11
12	DCDC over current	F 12
13	Battery discharge over current	F 13
51	Over current	F51
52	Bus voltage is too low	F52
53	Inverter soft start failed	F53
55	Over DC voltage in AC output	F55
57	Current sensor failed	F57
58	Output voltage is too low	F58

Warning Indicator

Warning Code	Warning Event	Audible Alarm	Icon flashing
01	Fan is locked when inverter is on.	Beep three times every second	01 ⚠
02	Over temperature	None	02 ⚠
03	Battery is over-charged	Beep once every second	03 ⚠
04	Low battery	Beep once every second	04 ⚠
07	Overload	Beep once every 0.5 second	07 ⚠ LOAD 25 50 75 100
10	Output power derating	Beep twice every 3 seconds	10 ⚠
15	PV energy is low.	Beep twice every 3 seconds	15 ⚠
16	High AC input (>280VAC) during BUS soft start	None	16 ⚠
32	Communication failure between inverter and display panel	None	32 ⚠
E9	Battery equalization	None	E9 ⚠

BATTERY EQUALIZATION

Equalization function is added into charge controller. It reverses the buildup of negative chemical effects like stratification, a condition where acid concentration is greater at the bottom of the battery than at the top. Equalization also helps to remove sulfate crystals that might have built up on the plates. If left unchecked, this condition, called sulfation, will reduce the overall capacity of the battery. Therefore, it's recommended to equalize battery periodically.

● **How to Apply Equalization Function**

You must enable battery equalization function in monitoring LCD setting program 33 first. Then, you may apply this function in device by either one of following methods:

1. Setting equalization interval in program 37.
2. Active equalization immediately in program 39.

● **When to Equalize**

In float stage, when the setting equalization interval (battery equalization cycle) is arrived, or equalization is active immediately, the controller will start to enter Equalize stage.
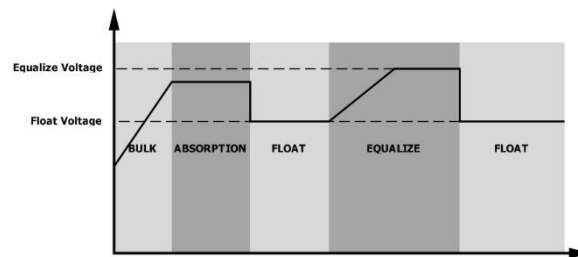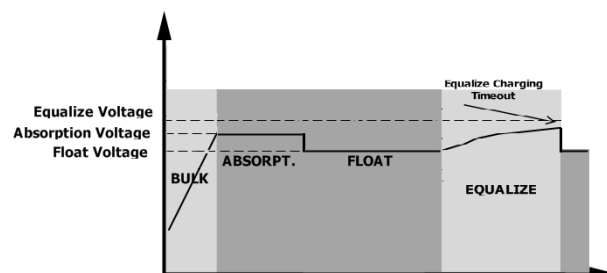

● **Equalize charging time and timeout**

In Equalize stage, the controller will supply power to charge battery as much as possible until battery voltage raises to battery equalization voltage. Then, constant-voltage regulation is applied to maintain battery voltage at the battery equalization voltage. The battery will remain in the Equalize stage until setting battery equalized time is arrived.
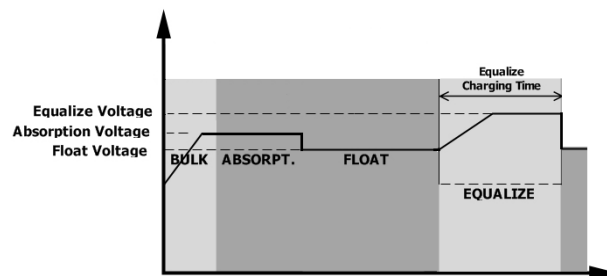
However, in Equalize stage, when battery equalized time is expired and battery voltage doesn't rise to battery equalization voltage point, the charge controller will extend the battery equalized time until battery voltage achieves battery equalization voltage. If battery voltage is still lower than battery equalization voltage when battery equalized timeout setting is over, the charge controller will stop equalization and return to float stage.

SPECIFICATIONS

Table 1 Line Mode Specifications

MODEL	STS-HYM-4815120P
Input Voltage Waveform	Sinusoidal (utility or generator)
Nominal Input Voltage	230Vac
Low Loss Voltage	170Vac±7V (UPS) 90Vac±7V (Appliances)
Low Loss Return Voltage	180Vac±7V (UPS); 100Vac±7V (Appliances)
High Loss Voltage	280Vac±7V
High Loss Return Voltage	270Vac±7V
Max AC Input Voltage	300Vac
Max AC Input Current	70A
Nominal Input Frequency	50Hz / 60Hz (Auto detection)
Low Loss Frequency	40±1Hz
Low Loss Return Frequency	42±1Hz
High Loss Frequency	65±1Hz
High Loss Return Frequency	63±1Hz
Output Short Circuit Protection	Line mode: Circuit Breaker (70A) Battery mode: Electronic Circuits
Efficiency (Line Mode)	>95% (Rated R load, battery full charged)
Transfer Time	10ms typical (UPS); 20ms typical (Appliances)
Output power de-rating: When AC input voltage under 170V the output power will be de-rated.	

Table 2 Inverter Mode Specifications

MODEL	STS-HYM-4815120P
Rated Output Power	12000W
Output Voltage Waveform	Pure Sine Wave
Output Voltage Regulation	230Vac±5%
Output Frequency	60Hz or 50Hz
Peak Efficiency	93%
Overload Protection	100ms@≥180% load;5s@≥120% load; 10s@105%~120% load
Surge Capacity	2* rated power for 5 seconds
Low DC Warning Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	46.0Vdc 42.8Vdc 40.4Vdc
Low DC Warning Return Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	48.0Vdc 44.8Vdc 42.4Vdc
Low DC Cut-off Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	44.0Vdc 40.8Vdc 38.4Vdc
High DC Recovery Voltage	61Vdc
High DC Cut-off Voltage	63Vdc
DC Voltage Accuracy	+/-0.3V@ no load
THDV	<5% for linear load,<10% for non-linear load @ nominal voltage
DC Offset	≦100mV
Power Limitation When battery voltage is lower than 48Vdc, output power will be derated. If connected load is higher than this derated power, the AC output voltage will decrease until the output power reduces to this derated power. The minimum AC output voltage is 220V.	

Table 3 Charge Mode Specifications

Utility Charging Mode		
MODEL	**STS-HYM-4815120P**	
Charging Current (UPS) @ Nominal Input Voltage	200A	
Bulk Charging Voltage	**Flooded Battery**	58.4Vdc
	AGM / Gel Battery	56.4Vdc
Floating Charging Voltage	54Vdc	
Overcharge Protection	63Vdc	
Charging Algorithm	3-Step	
Charging Curve		
Solar Input		
MODEL	**STS-HYM-4815120P**	
Rated Power	15000W	
Max. PV Array Open Circuit Voltage	500Vdc	
PV Array MPPT Voltage Range	90Vdc~450Vdc	
Max. Input Current	27A x 2 (Max. 45A)	
Max. Charging Current	200Amp	
Start-up Voltage	80V +/- 5Vdc	
Power Limitation		

Table 4 General Specifications

MODEL	STS-HYM-4815120P
Safety Certification	CE
Operating Temperature Range	-10°C to 50°C
Storage temperature	-15°C~ 60°C
Humidity	5% to 95% Relative Humidity (Non-condensing)
Dimension (D*W*H), mm	147.4x 432.5 x 553.6
Net Weight, kg	18.4

Table 5 Parallel Specifications

Max parallel numbers	6
Circulation Current under No Load Condition	Max 2A
Power Unbalance Ratio	<5% @ 100% Load
Parallel communication	CAN
Transfer time in parallel mode	Max 50ms
Parallel Kit	YES

Note: Parallel feature will be disabled when only PV power is available.

TROUBLE SHOOTING

| Problem	LCD/LED/Buzzer	Explanation / Possible cause	What to do
Unit shuts down automatically during startup process.	LCD/LEDs and buzzer will be active for 3 seconds and then complete off.	The battery voltage is too low (<1.91V/Cell)	1. Re-charge battery. 2. Replace battery.
No response after power on.	No indication.	1. The battery voltage is far too low. (<1.4V/Cell) 2. Battery polarity is connected reversed.	1. Check if batteries and the wiring are connected well. 2. Re-charge battery. 3. Replace battery.
Mains exist but the unit works in battery mode.	Input voltage is displayed as 0 on the LCD and green LED is flashing.	Input protector is tripped	Check if AC breaker is tripped and AC wiring is connected well.
	Green LED is flashing.	Insufficient quality of AC power. (Shore or Generator)	1. Check if AC wires are too thin and/or too long. 2. Check if generator (if applied) is working well or if input voltage range setting is correct. (UPS→Appliance)
	Green LED is flashing.	Set "Solar First" as the priority of output source.	Change output source priority to Utility first.
When the unit is turned on, internal relay is switched on and off repeatedly.	LCD display and LEDs are flashing	Battery is disconnected.	Check if battery wires are connected well.
Buzzer beeps continuously and red LED is on.	Fault code 07	Overload error. The inverter is overload 110% and time is up.	Reduce the connected load by switching off some equipment.
	Fault code 05	Output short circuited.	Check if wiring is connected well and remove abnormal load.
		Temperature of internal converter component is over 120°C. (Only available for 1-3KVA models.)	Check whether the air flow of the unit is blocked or whether the ambient temperature is too high.
	Fault code 02	Internal temperature of inverter component is over 100°C.	
	Fault code 03	Battery is over-charged.	Return to repair center.
		The battery voltage is too high.	Check if spec and quantity of batteries are meet requirements.
	Fault code 01	Fan fault	Replace the fan.
	Fault code 06/58	Output abnormal (Inverter voltage below than 190Vac or is higher than 260Vac)	1. Reduce the connected load. 2. Return to repair center
	Fault code 08/09/53/57	Internal components failed.	Return to repair center.
	Fault code 51	Over current or surge.	Restart the unit, if the error happens again, please return to repair center.
	Fault code 52	Bus voltage is too low.	
	Fault code 55	Output voltage is unbalanced.	
	Fault code 56	Battery is not connected well or fuse is burnt.	If the battery is connected well, please return to repair center.

Appendix I: Parallel function

1. Introduction

This inverter can be used in parallel with two different operation modes.

1. Parallel operation in single phase is with up to 6 units. The supported maximum output power is 72KW/72KVA.
2. Maximum six units work together to support three-phase equipment. Maximum four units support one phase.

2. Mounting the Unit

When installing multiple units, please follow below chart.
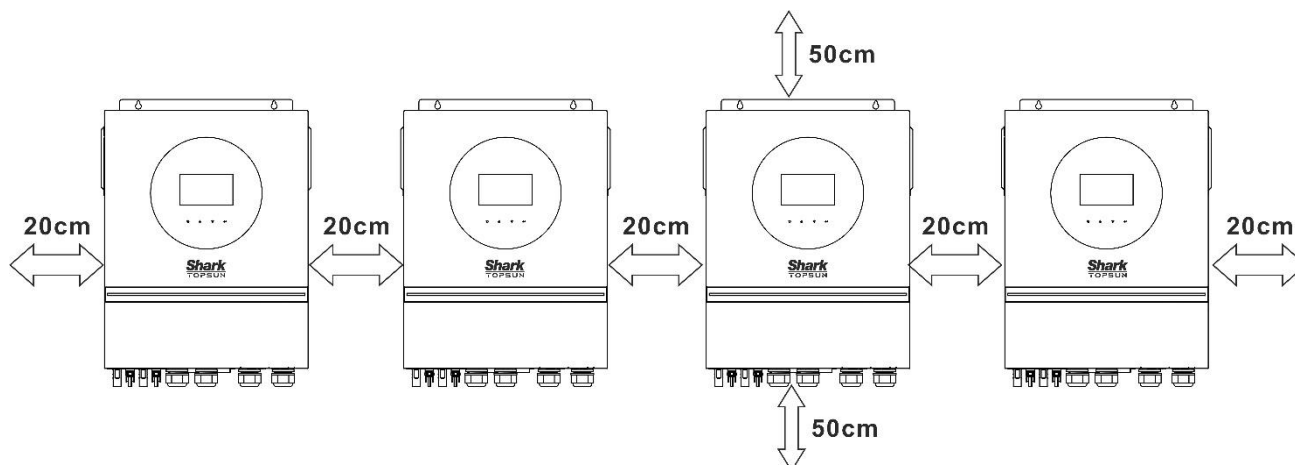
NOTE: For proper air circulation to dissipate heat, allow a clearance of approx. 20 cm to the side and approx. 50 cm above and below the unit. Be sure to install each unit in the same level.

3. Wiring Connection

WARNING: It's REQUIRED to connect battery for parallel operation.

The cable size of each inverter is shown as below:

Recommended battery cable and terminal size for each inverter:

Wire Size	Cable mm² (each)	Ring Terminal Dimensions		Torque value
		D (mm)	L (mm)	
1*3/0AWG	85	8.4	54	5 Nm

Ring terminal:

WARNING: Be sure the length of all battery cables is the same. Otherwise, there will be voltage difference between inverter and battery to cause parallel inverters not working.
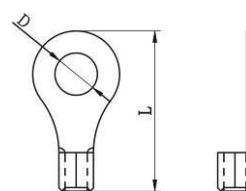
Recommended AC input and output cable size for each inverter:

Model	AWG no.	Torque
STS-HYM-4815120P	6 AWG	1.4~ 1.6 Nm

You need to connect the cables of each inverter together. Take the battery cables for example: You need to use a connector or bus-bar as a joint to connect the battery cables together, and then connect to the battery terminal. The cable size used from joint to battery should be X times cable size in the tables above. "X" indicates the number of inverters connected in parallel.

Regarding AC input and output, please also follow the same principle.

CAUTION!! Please install the breaker at the battery and AC input side. This will ensure the inverter can be securely disconnected during maintenance and fully protected from over current of battery or AC input.

Recommended breaker specification of battery for each inverter:

Model	1 unit*
STS-HYM-4815120P	300A/70VDC

*If you want to use only one breaker at the battery side for the whole system, the rating of the breaker should be X times current of 1 unit. "X" indicates the number of inverters connected in parallel.

Recommended breaker specification of AC input with single phase:

Model	2 units	3 units	4 units	5 units	6 units
STS-HYM-4815120P	140A/230VAC	210A/230VAC	280A/230VAC	350A/230VAC	420A/230VAC

Note 1: Also, you can use 60A breaker with only 1 unit and install one breaker at its AC input in each inverter.

Note 2: Regarding three-phase system, you can use 4-pole breaker directly and the rating of the breaker should be compatible with the phase current limitation from the phase with maximum units

Recommended battery capacity

Inverter parallel numbers	2	3	4	5	6
Battery Capacity	200AH	400AH	400AH	600AH	600AH

WARNING! Be sure that all inverters will share the same battery bank. Otherwise, the inverters will transfer to fault mode.

4-1. Parallel Operation in Single phase

Two inverters in parallel:
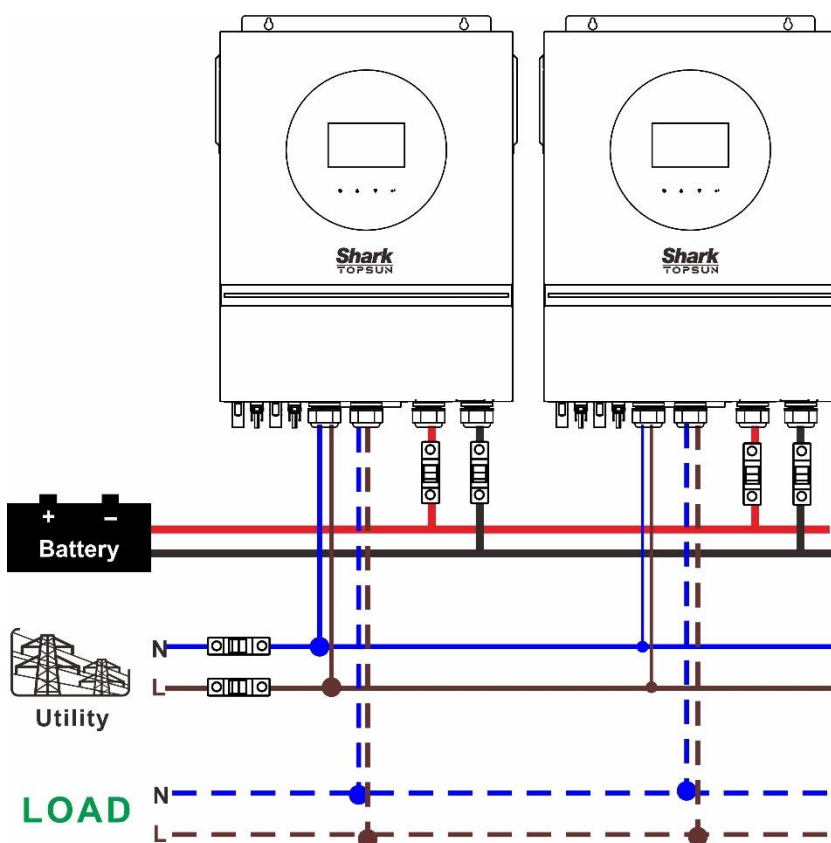
Power Connection

Communication Connection
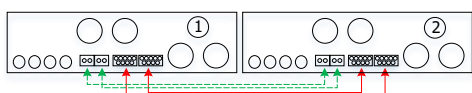
Three inverters in parallel:
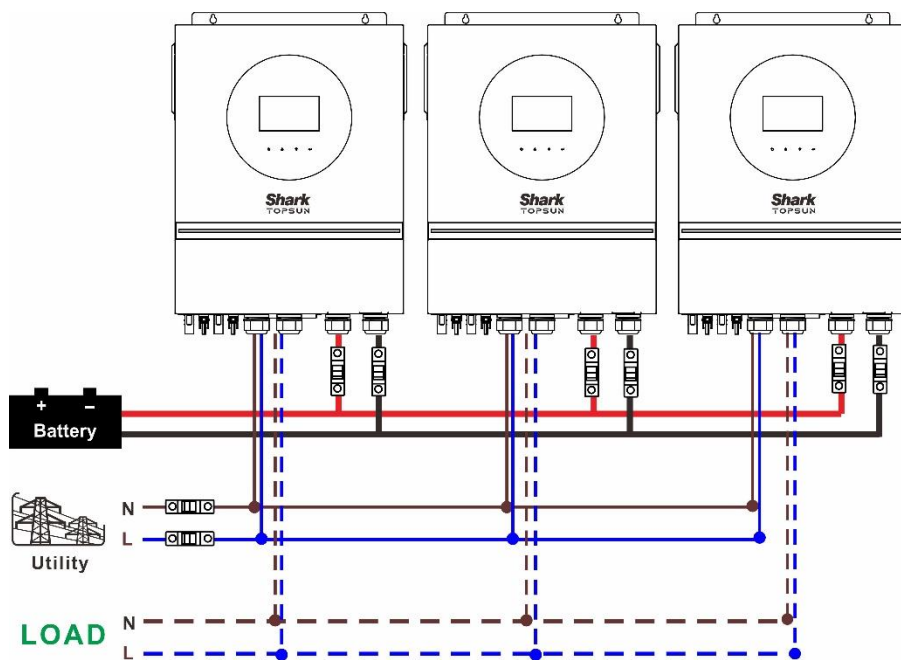
Power Connection

Communication Connection
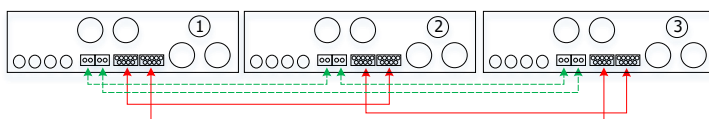
Four inverters in parallel:
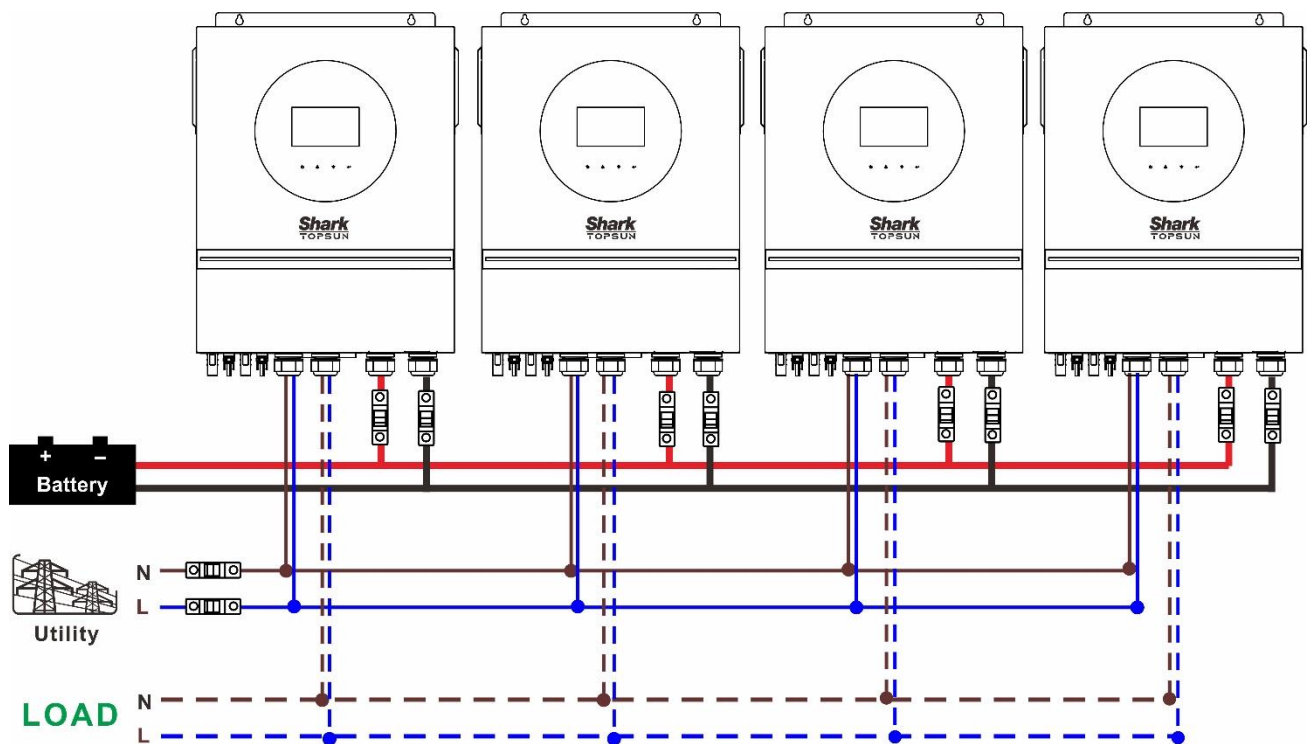
Power Connection

Communication Connection
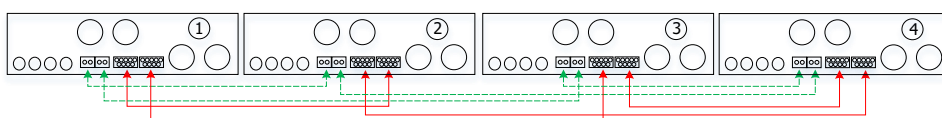
Five inverters in parallel:
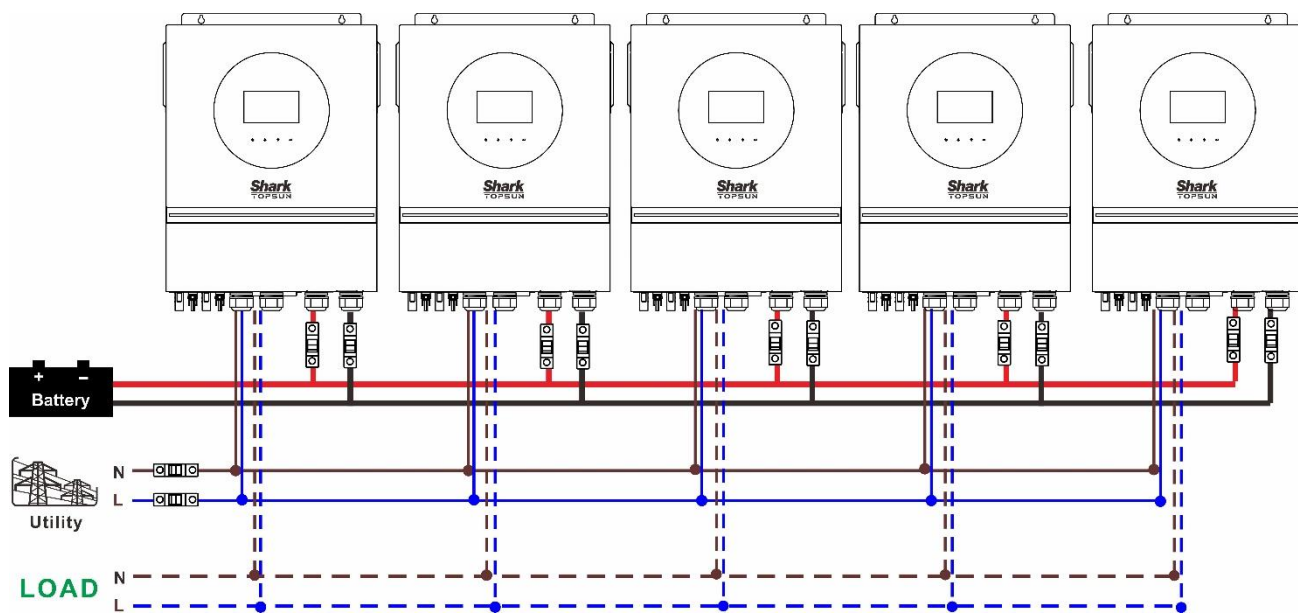
Power Connection

Communication Connection
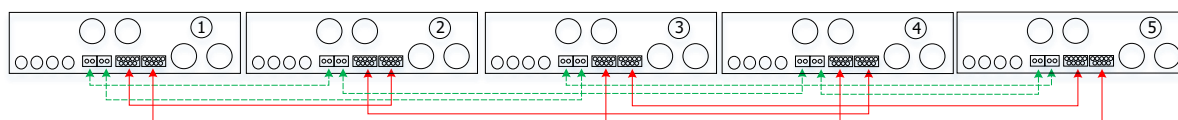
Six inverters in parallel:
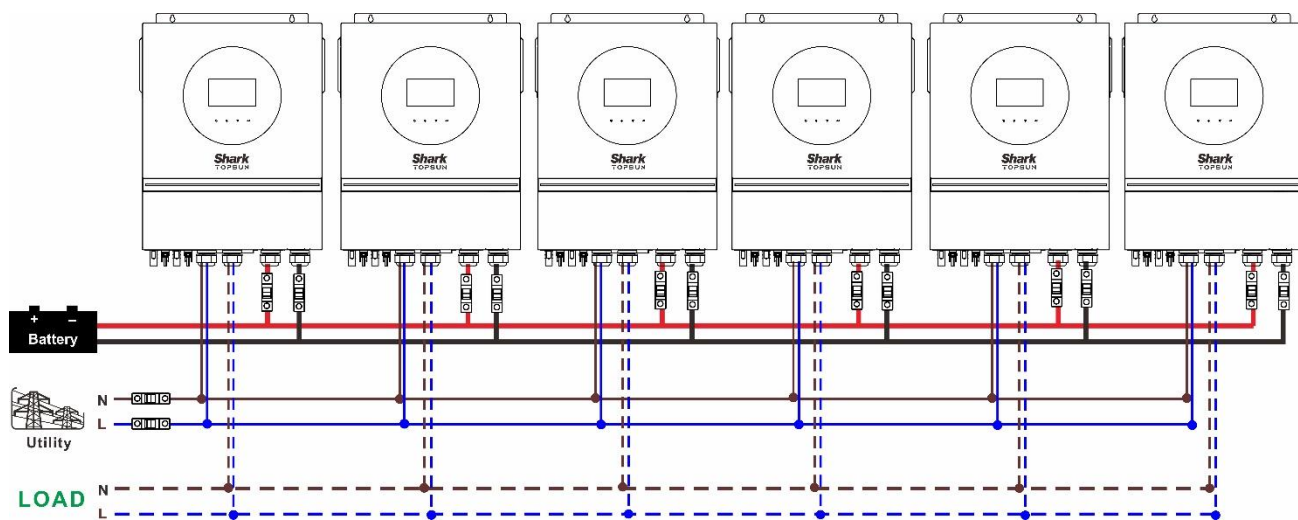
Power Connection

Communication Connection
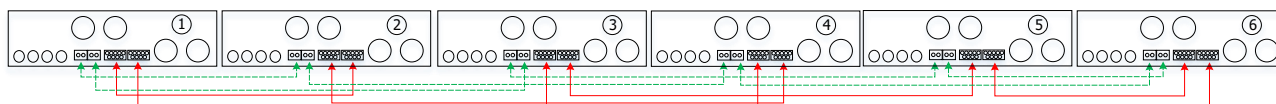
4-2. Support 3-phase equipment

Two inverters in each phase:

Power Connection
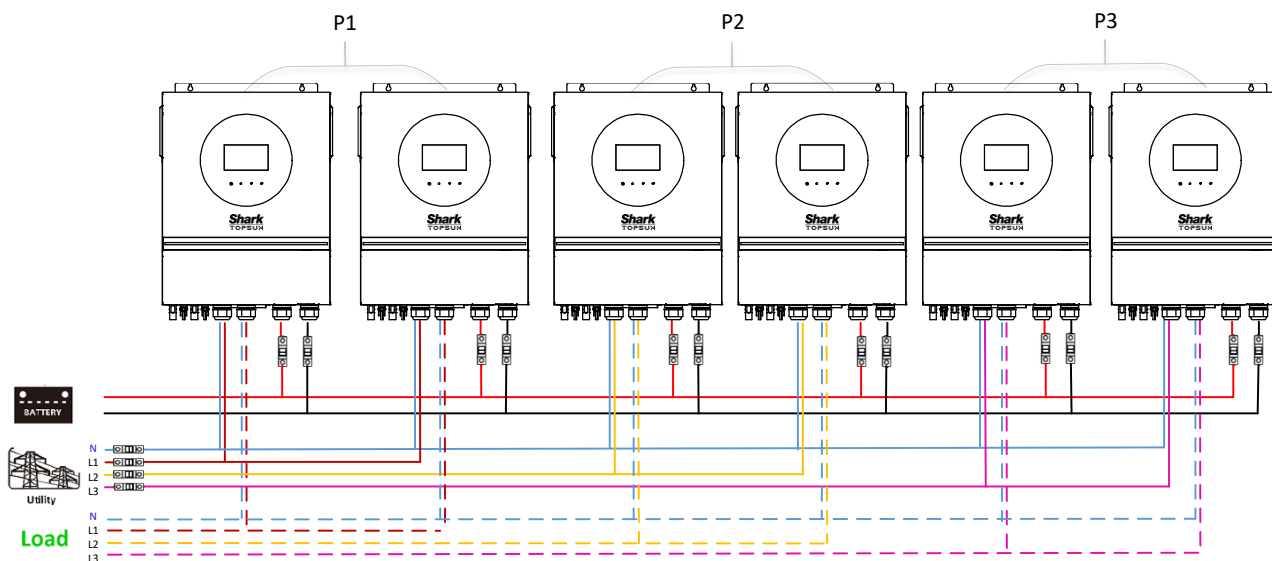
Communication Connection
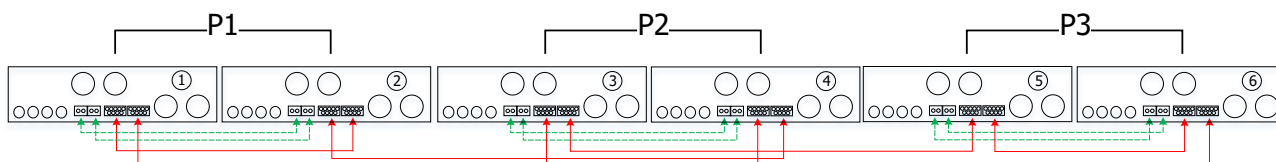
Four inverters in one phase and one inverter for the other two phases:

Power Connection
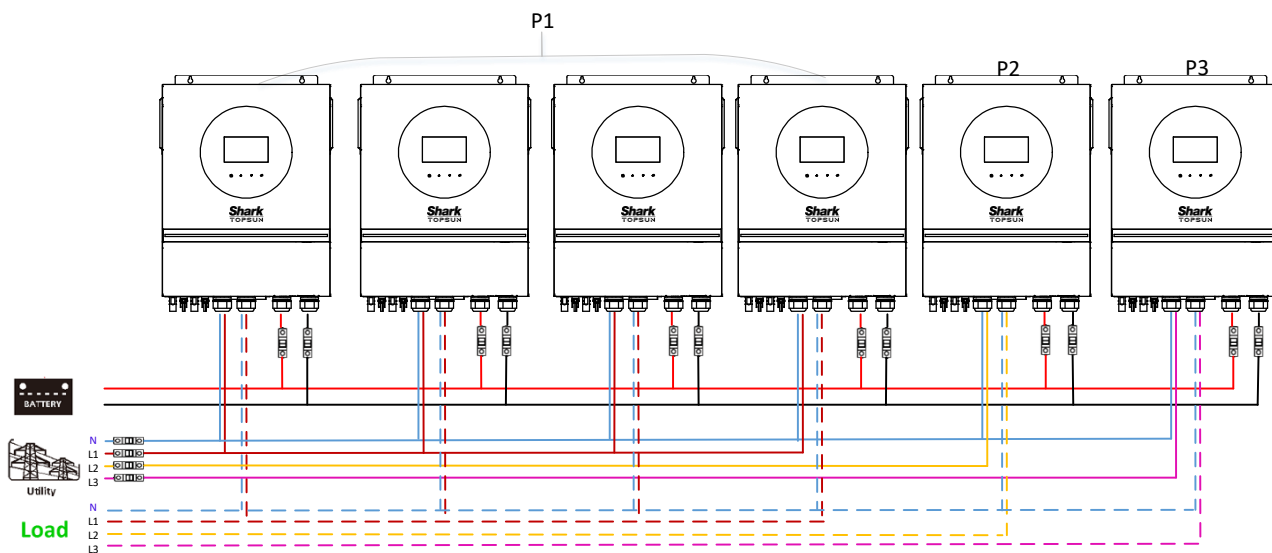
Communication Connection
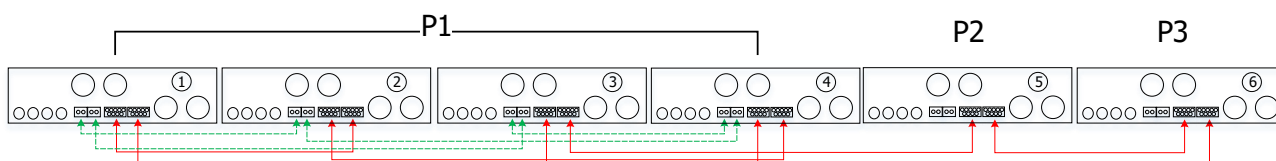
Three inverters in one phase, two inverters in second phase and one inverter for the third phase:

Power Connection
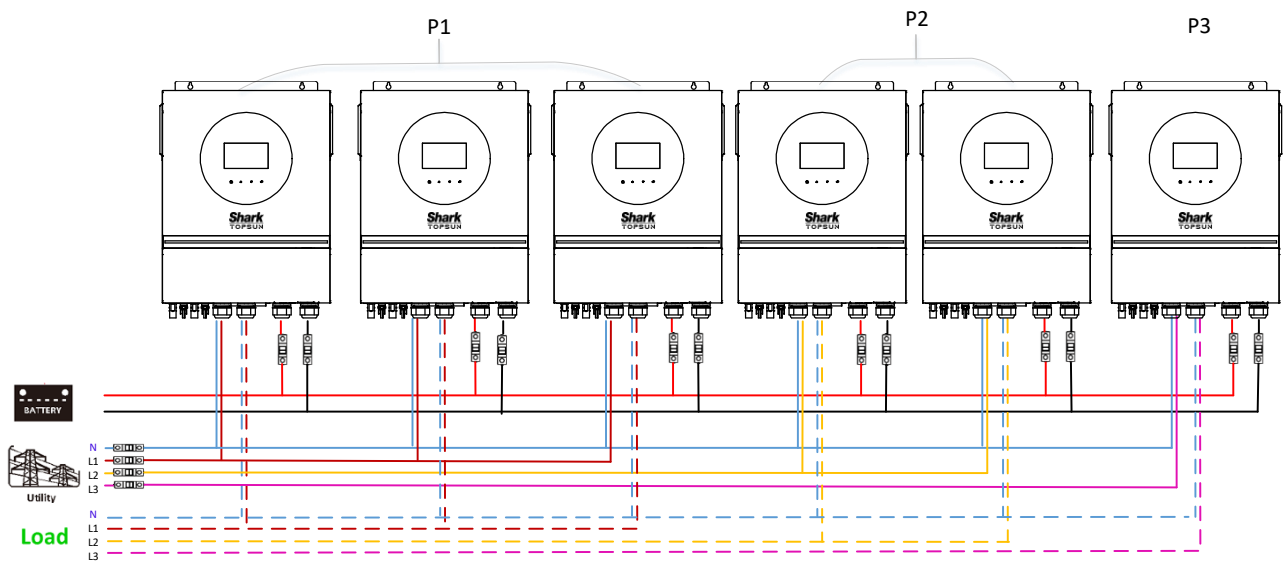
Communication Connection
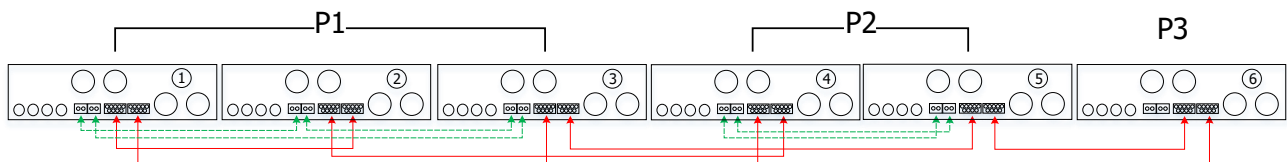
Three inverters in one phase and only one inverter for the remaining two phases:

Power Connection
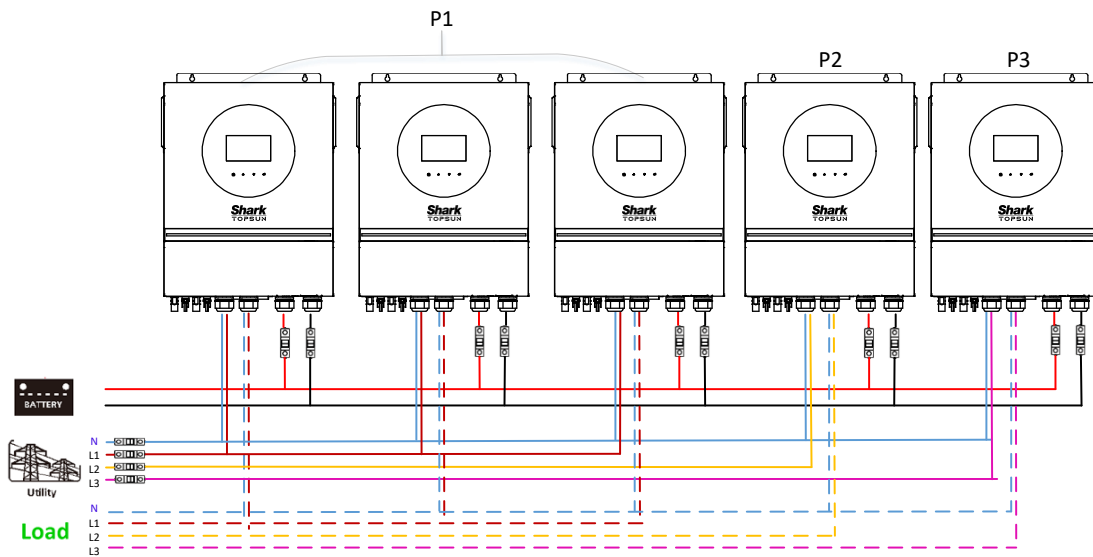
Communication Connection
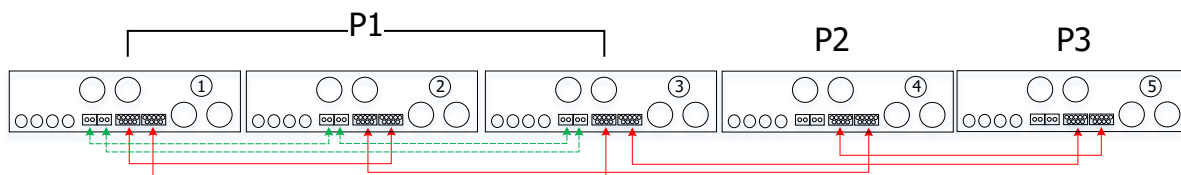
Two inverters in two phases and only one inverter for the remaining phase:

Power Connection
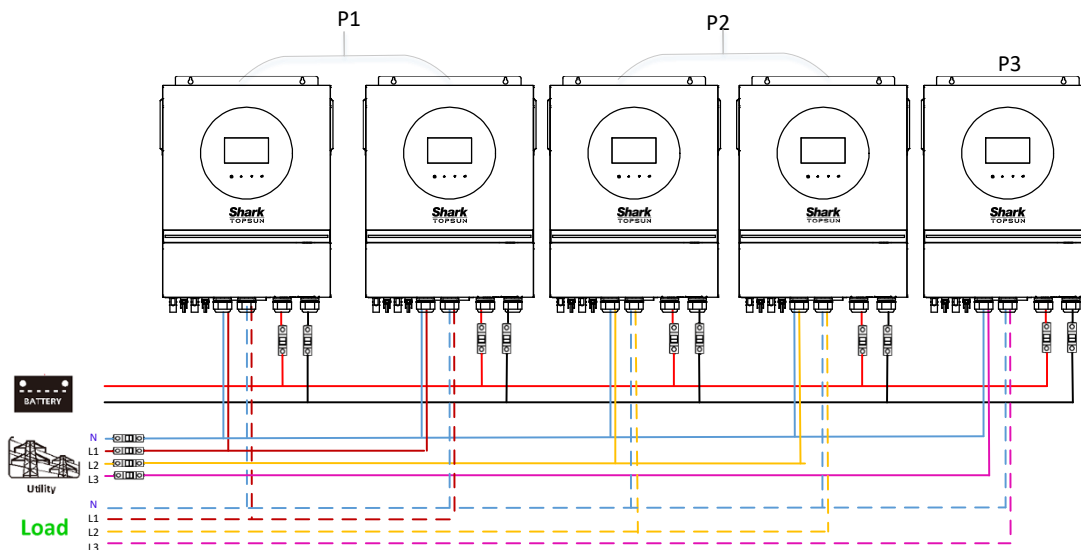
Communication Connection
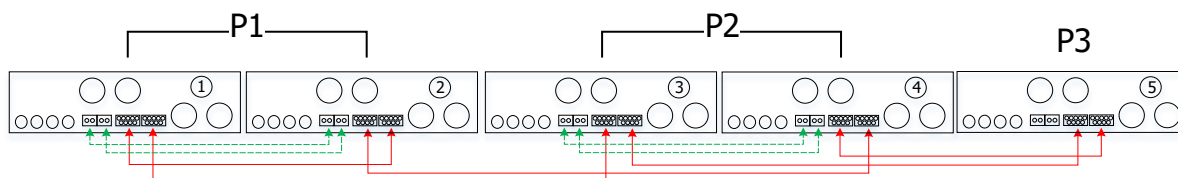
Two inverters in one phase and only one inverter for the remaining phases:

Power Connection
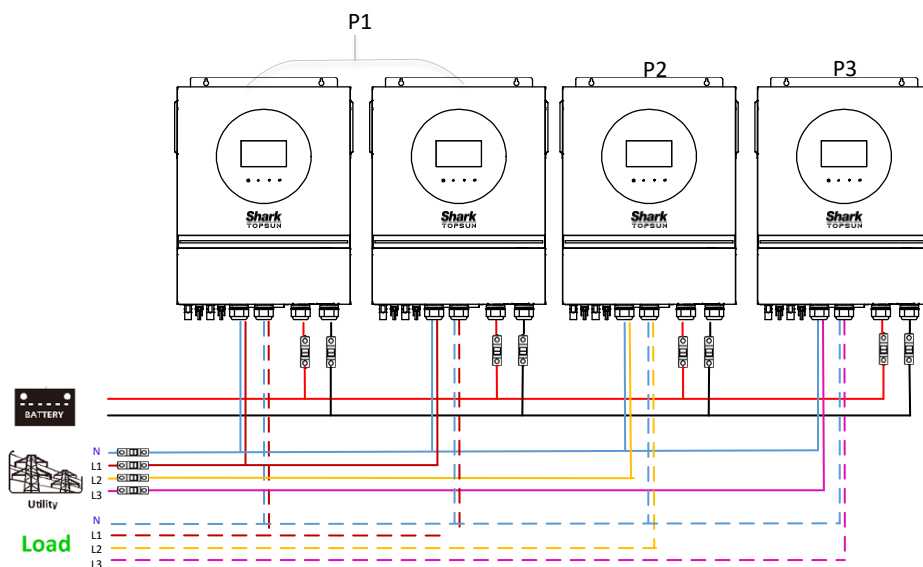
Communication Connection
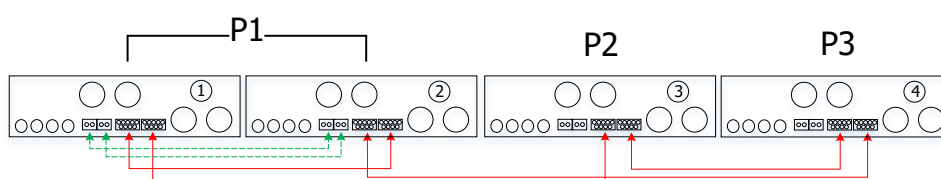
One inverter in each phase:

Power Connection
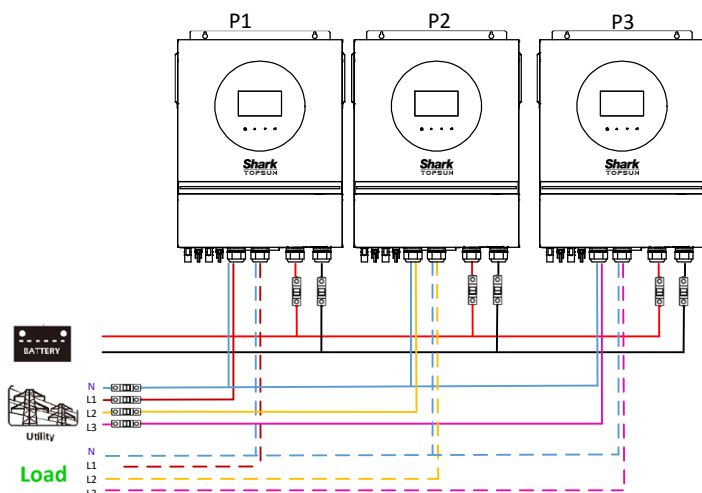
Communication Connection
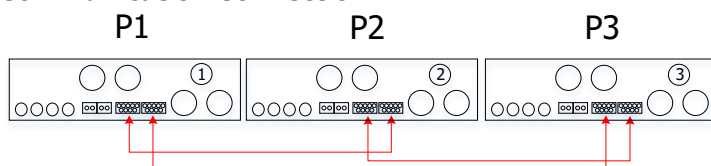
WARNING: Do not connect the current sharing cable between the inverters which are in different phases. Otherwise, it may damage the inverters.

5. PV Connection
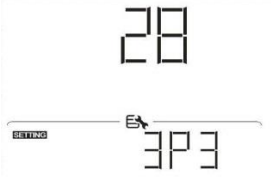
Please refer to user manual of single unit for PV Connection.

CAUTION: Each inverter should connect to PV modules separately.

6. LCD Setting and Display

Setting Program:

Program	Description	Selectable option	
28	AC output mode *This setting is able to set up only when the inverter is in standby mode. Be sure that on/off switch is in "OFF" status.	Single	When the unit is operated alone, please select "SIG" in program 28.
		Parallel	When the units are used in parallel for single phase application, please select "PAL" in program 28. Please refer to 5-1 for detailed information.
		L1 phase:	When the units are operated in 3-phase application, please choose "3PX" to define each inverter. It is required to have at least 3 inverters or maximum 6 inverters to support three-phase equipment. It's required to have at

| | | L2 phase:

28

SETTING 3P2 | least one inverter in each phase or it's up to four inverters in one phase. Please refers to 4-2 for detailed information. Please select "3P1" in program 28 for the inverters connected to L1 phase, "3P2" in program 28 for the inverters connected to L2 phase and "3P3" in program 28 for the inverters connected to L3 phase.

Be sure to connect share current cable to units which are on the same phase.
Do NOT connect share current cable between units on different phases. |
| | | L3 phase:

28

SETTING 3P3 | |

Fault code display:

Fault Code	Fault Event	Icon on
60	Power feedback protection	F60
71	Firmware version inconsistent	F71
72	Current sharing fault	F72
80	CAN fault	F80
81	Host loss	F81
82	Synchronization loss	F82
83	Battery voltage detected different	F83
84	AC input voltage and frequency detected different	F84
85	AC output current unbalance	F85
86	AC output mode setting is different	F86

Code Reference:

Code	Description	Icon on
NE	Unidentified unit master or slave	NE
HS	Master unit	HS
SL	Slave unit	SL

# 7. Commissioning

Parallel in single phase

Step 1: Check the following requirements before commissioning:
- Correct wire connection
- Ensure all breakers in Line wires of load side are open and each Neutral wires of each unit are connected together.

Step 2: Turn on each unit and set "PAL" in LCD setting program 28 of each unit. And then shut down all units.
NOET: It's necessary to turn off switch when setting LCD program. Otherwise, the setting cannot be programmed.

Step 3: Turn on each unit.

LCD display in Master unit	LCD display in Slave unit
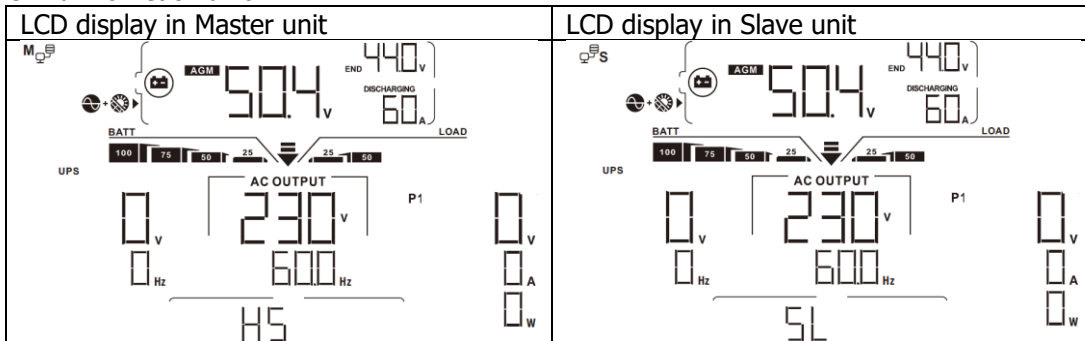
NOTE: Master and slave units are randomly defined.

Step 4: Switch on all AC breakers of Line wires in AC input. It's better to have all inverters connect to utility at the same time. If not, it will display fault 82 in following-order inverters. However, these inverters will automatically restart. If detecting AC connection, they will work normally.

LCD display in Master unit	LCD display in Slave unit
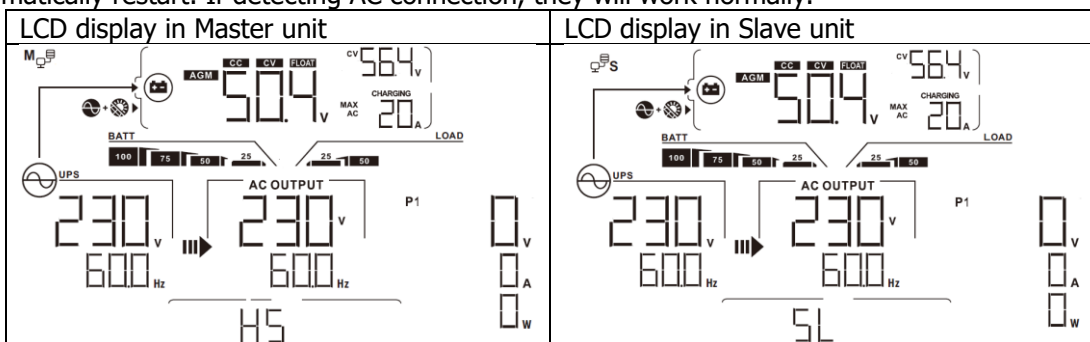
Step 5: If there is no more fault alarm, the parallel system is completely installed.

Step 6: Please switch on all breakers of Line wires in load side. This system will start to provide power to the load.

Support three-phase equipment

Step 1: Check the following requirements before commissioning:
- Correct wire connection
- Ensure all breakers in Line wires of load side are open and each Neutral wires of each unit are connected together.

Step 2: Turn on all units and configure LCD program 28 as P1, P2 and P3 sequentially. And then shut down all units.
NOET: It's necessary to turn off switch when setting LCD program. Otherwise, the setting cannot be programmed.

Step 3: Turn on all units sequentially.

LCD display in L1-phase unit	LCD display in L2-phase unit	LCD display in L3-phase unit
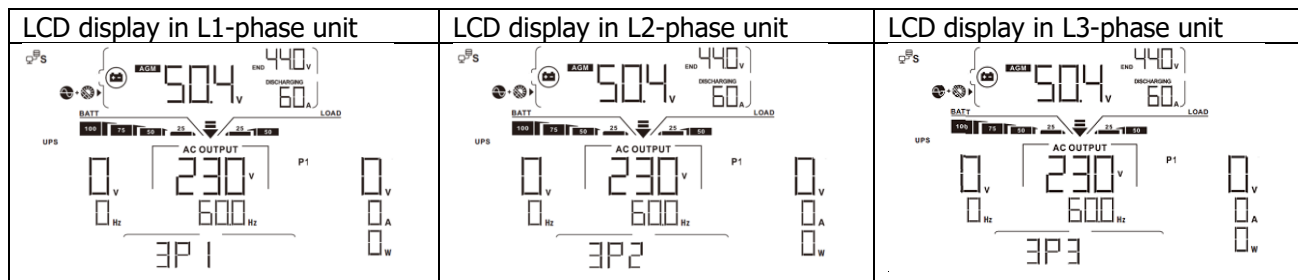
Step 4: Switch on all AC breakers of Line wires in AC input. If AC connection is detected and three phases are matched with unit setting, they will work normally. Otherwise, the AC icon ⊖ will flash and they will not work in line mode.

LCD display in L1-phase unit	LCD display in L2-phase unit	LCD display in L3-phase unit
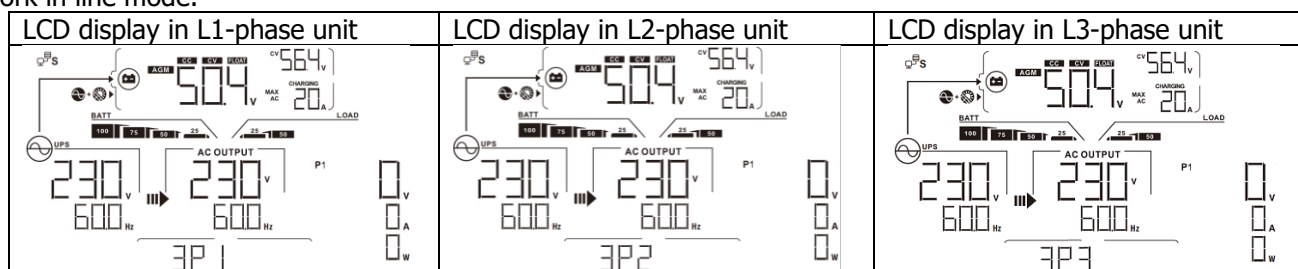
Step 5: If there is no more fault alarm, the system to support 3-phase equipment is completely installed.

Step 6: Please switch on all breakers of Line wires in load side. This system will start to provide power to the load.

Note 1: To avoid overload occurring, before turning on breakers in load side, it's better to have whole system in operation first.
Note 2: Transfer time for this operation exists. Power interruption may happen to critical devices, which cannot bear transfer time.

8. Trouble shooting

Situation			Solution
Fault Code	Fault Event Description		
60	Current feedback into the inverter is detected.		1. Restart the inverter. 2. Check if L/N cables are not connected reversely in all inverters. 3. For parallel system in single phase, make sure the sharing are connected in all inverters. For supporting three-phase system, make sure the sharing cables are connected in the inverters in the same phase, and disconnected in the inverters in different phases. 4. If the problem remains, please contact your installer.
71	The firmware version of each inverter is not the same.		1. Update all inverter firmware to the same version. 2. Check the version of each inverter via LCD setting and make sure the CPU versions are same. If not, please contact your instraller to provide the firmware to update. 3. After updating, if the problem still remains, please contact your installer.
72	The output current of each inverter is different.		1. Check if sharing cables are connected well and restart the inverter. 2. If the problem remains, please contact your installer.
80	CAN data loss		1. Check if communication cables are connected well and restart the inverter. 2. If the problem remains, please contact your installer.
81	Host data loss		
82	Synchronization data loss		
83	The battery voltage of each inverter is not the same.		1. Make sure all inverters share same groups of batteries together. 2. Remove all loads and disconnect AC input and PV input. Then, check battery voltage of all inverters. If the values from all inverters are close, please check if all battery cables are the same length and same material type. Otherwise, please contact your installer to provide SOP to calibrate battery voltage of each inverter. 3. If the problem still remains, please contact your installer.
84	AC input voltage and frequency are detected different.		1. Check the utility wiring conncetion and restart the inverter. 2. Make sure utility starts up at same time. If there are breakers installed between utility and inverters, please be sure all breakers can be turned on AC input at same time. 3. If the problem remains, please contact your installer.
85	AC output current unbalance		1. Restart the inverter. 2. Remove some excessive loads and re-check load information from LCD of inverters. If the values are different, please check if AC input and output cables are in the same length and material type. 3. If the problem remains, please contact your installer.
86	AC output mode setting is different.		1. Switch off the inverter and check LCD setting #28. 2. For parallel system in single phase, make sure no 3P1, 3P2 or 3P3 is set on #28. For upporting three-phase system, make sure no "PAL" is set on #28. 3. If the problem remains, please contact your installer.

Appendix II: BMS Communication Installation

1. Introduction

If connecting to lithium battery, it is recommended to purchase a custom-made RJ45 communication cable. Please check with your dealer or integrator for details.

This custom-made RJ45 communication cable delivers information and signal between lithium battery and the inverter. These information are listed below:

- Re-configure charging voltage, charging current and battery discharge cut-off voltage according to the lithium battery parameters.
- Have the inverter start or stop charging according to the status of lithium battery.

2. Pin Assignment for BMS Communication Port

	Definition
PIN 1	RS232TX
PIN 2	RS232RX
PIN 3	RS485B
PIN 4	NC
PIN 5	RS485A
PIN 6	CANH
PIN 7	CANL
PIN 8	GND
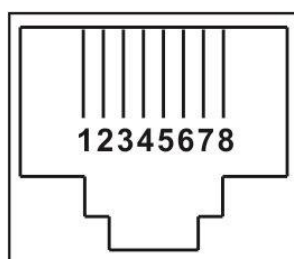
3. Lithium Battery Communication Configuration

LIO-4810-150A
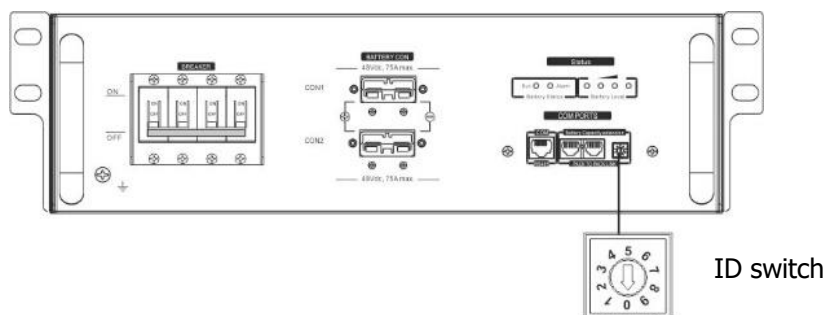
ID switch

ESS LIO-I 4810
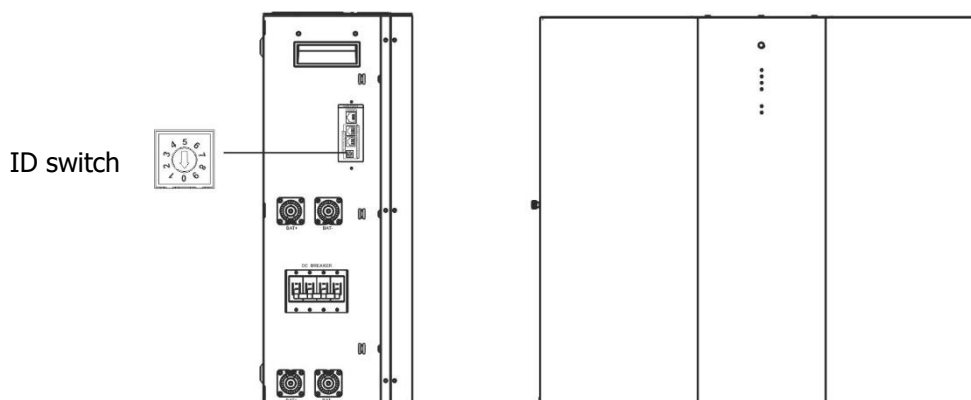
ID switch

ID Switch indicates the unique ID code for each battery module. It's required to assign a unique ID to each battery module for normal operation. We can set up the ID code for each battery module by rotating the PIN number on the ID switch. From number 0 to 9, the number can be random; no particular order. Maximum 10 battery modules can be operated in parallel.

PYLONTECH
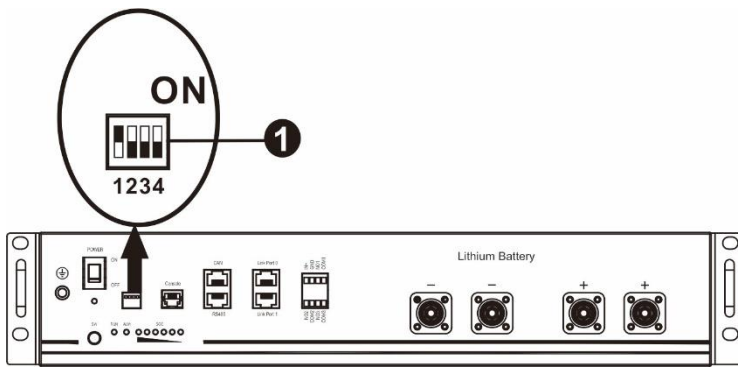
①Dip Switch: There are 4 Dip Switches that sets different baud rate and battery group address. If switch position is turned to the "OFF" position, it means "0". If switch position is turned to the "ON" position, it means "1".

Dip 1 is "ON" to represent the baud rate 9600.
Dip 2, 3 and 4 are reserved for battery group address.
Dip switch 2, 3 and 4 on master battery (first battery) are to set up or change the group address.

NOTE: "1" is upper position and "0" is bottom position.

Dip 1	Dip 2	Dip 3	Dip 4	Group address
1: RS485 baud rate=9600 **Restart to take effect**	0	0	0	Single group only. It's required to set up master battery with this setting and slave batteries are unrestricted.
	1	0	0	Multiple group condition. It's required to set up master battery on the first group with this setting and slave batteries are unrestricted.
	0	1	0	Multiple group condition. It's required to set up master battery on the second group with this setting and slave batteries are unrestricted.
	1	1	0	Multiple group condition. It's required to set up master battery on the third group with this setting and slave batteries are unrestricted.
	0	0	1	Multiple group condition. It's required to set up master battery on the fourth group with this setting and slave batteries are unrestricted.
	1	0	1	Multiple group condition. It's required to set up master battery on the fifth group with this setting and slave batteries are unrestricted.

NOTE: The maximum groups of lithium battery is 5 and for maximum number for each group, please check with battery manufacturer.

4. Installation and Operation

LIO-4810-150A/ESS LIO-I 4810

After ID no. is assigned for each battery module, please set up LCD panel in inverter and install the wiring connection as following steps.

Step 1: Use supplied RJ11 signal cable to connect into the extension port (P1 or P2).
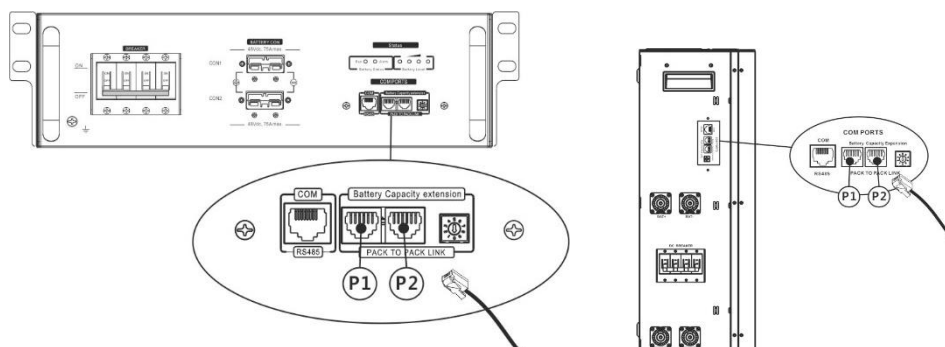
Step 2: Use supplied RJ45 cable (from battery module package) to connect inverter and Lithium battery.
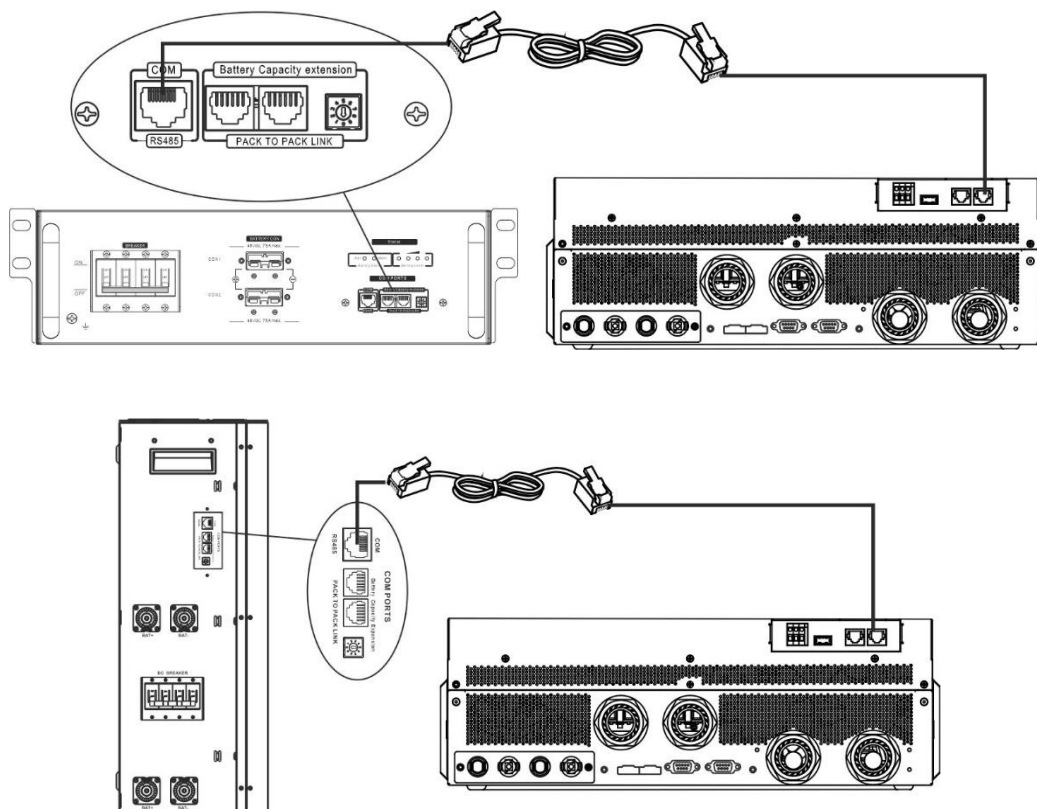
* For multiple battery connection, please check battery manual for the details.

Note for parallel system:
1. Only support common battery installation.
2. Use custom-made RJ45 cable to connect any inverter (no need to connect to a specific inverter) and Lithium battery. Simply set this inverter battery type to "LIB" in LCD program 5. Others should be "USE".

Step 3: Turn the breaker switch "ON". Now, the battery module is ready for DC output.

Step 4: Press Power on/off button on battery module for 5 secs, the battery module will start up.
*If the manual button cannot be approached, just simply turn on the inverter module. The battery module will be automatically turned on.

Step 5: Turn on the inverter.
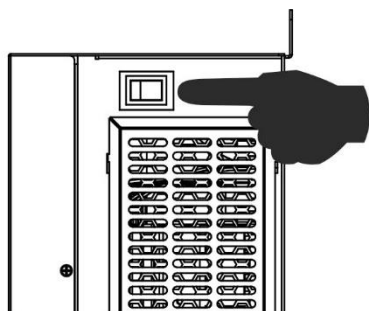
Step 6. Be sure to select battery type as "LIB" in LCD program 5.

If communication between the inverter and battery is successful, the battery icon on LCD display will flash. Generally speaking, it will take longer than 1 minute to establish communication.

PYLONTECH

After configuration, please install LCD panel with inverter and Lithium battery with the following steps.

Step 1. Use custom-made RJ45 cable to connect inverter and Lithium battery.
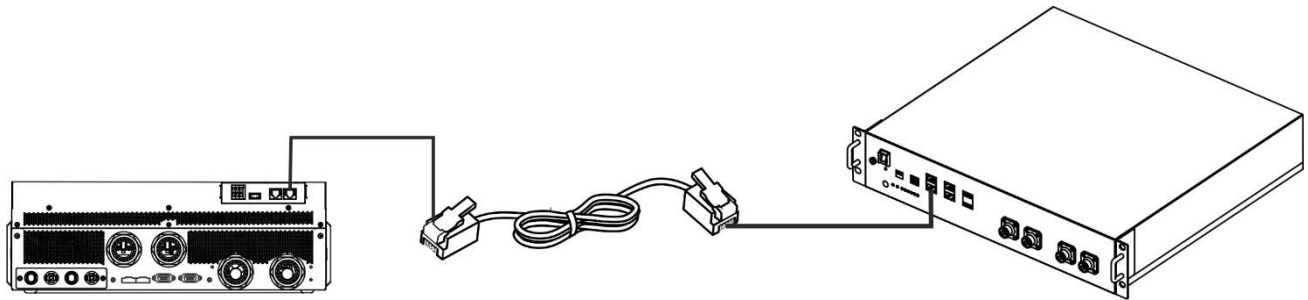
Note for parallel system:

3. Only support common battery installation.
4. Use custom-made RJ45 cable to connect any inverter (no need to connect to a specific inverter) and Lithium battery. Simply set this inverter battery type to "PYL" in LCD program 5. Others should be "USE".
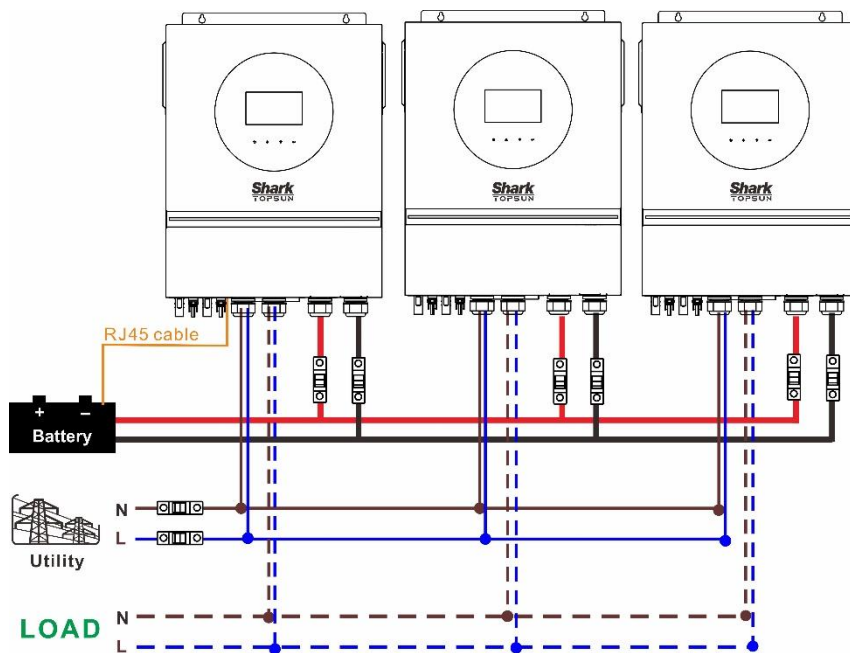
Step 2. Switch on Lithium battery.
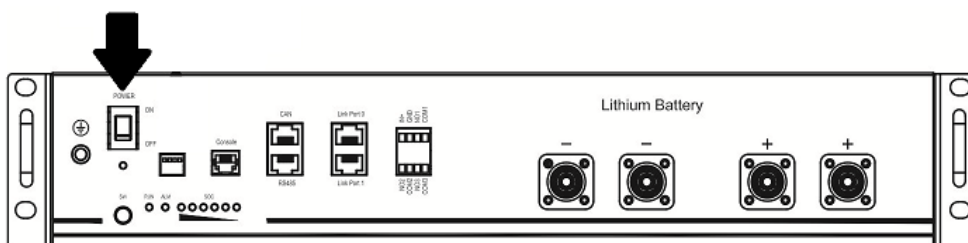
Step 3. Press more than three seconds to start Lithium battery, power output ready.
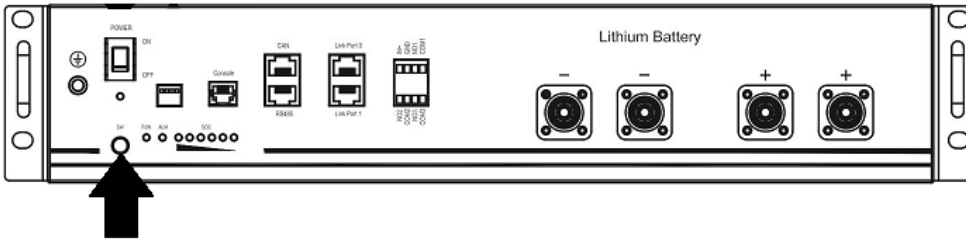
Step 4. Turn on the inverter.
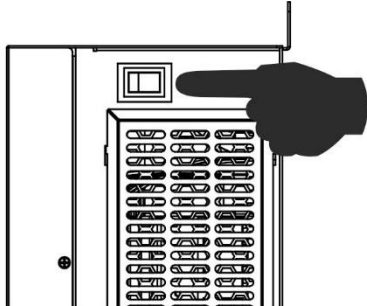
Step 5. Be sure to select battery type as "PYL" in LCD program 5.

```
05
```

SETTING PYL

If communication between the inverter and battery is successful, the battery icon [battery icon] on LCD display will flash. Generally speaking, it will take longer than 1 minute to establish communication.

Active Function

This function is to activate lithium battery automatically while commissioning. After battery wiring and commissioning is successfully, if battery is not detected, the inverter will automatically activate battery if the inverter is powered on.

4. LCD Display Information

Press "▲" or "▼" button to switch LCD display information. It will show battery pack and battery group number before "Main CPU version checking" as shown below.

Selectable information	LCD display
Battery pack numbers & Battery group numbers	Battery pack numbers = 3, battery group numbers = 1

5. Code Reference

Related information code will be displayed on LCD screen. Please check inverter LCD screen for the operation.

Code	Description
60 ⚠	If battery status is not allowed to charge and discharge after the communication between the inverter and battery is successful, it will show code 60 to stop charging and discharging battery.
61 ⚠	Communication lost (only available when the battery type is not setting as "AGM", "Flooded" or "User-Defined".) ● After battery is connected, communication signal is not detected for 3 minutes, buzzer will beep. After 10 minutes, inverter will stop charging and discharging to lithium battery. ● Communication lost occurs after the inverter and battery is connected successfully, buzzer beeps immediately.
62 ⚠	Internal communication failure in batteries.
69 ⚠	If battery status is not allowed to charge after the communication between the inverter and battery is successful, it will show code 69 to stop charging battery.
70 ⚠	If battery status must to be charged after the communication between the inverter and battery is successful, it will show code 70 to charge battery.
71 ⚠	If battery status is not allowed to discharge after the communication between the inverter and battery is successful, it will show code 71 to stop discharging battery.

Appendix III: The Wi-Fi Operation Guide

1. Introduction

Wi-Fi module can enable wireless communication between solar inverters and the monitoring platform. Users can remotely monitor and control their inverters when they combine the Wi-Fi module with Energy-Mate APP. The App uses the Wi-Fi chip to provide remote monitoring data services, which is beneficial for the daily data monitoring of the inverter, querying the real-time data in the device, sending commands from the device, and operating the device remotely. The app is available for both iOS and Android.

2. Energy-Mate App

2-1.Download and install APP

Please find "Energy-Mate" app from Apple® store or Google® Play Store. Install this app in your mobile phone.

Or scan the following QR code with your smart phone and download Energy-Mate App.

(Android system)   (iOS system)

2-2.Initial Setup

You can choose local Wi-Fi or Bluetooth to configure the Wi-Fi module network through Energy-mate APP.

Local Wi-Fi Configuration

If you have configured the network through Bluetooth, please skip this section.
- Turn on the unit.
- Open the Wi-Fi settings from your smart phone.
- Connect your smart phone to the Wi-Fi module. The Wi-Fi module PN number is 18 digits.
- Default password for the Wi-Fi module is: 12345678.
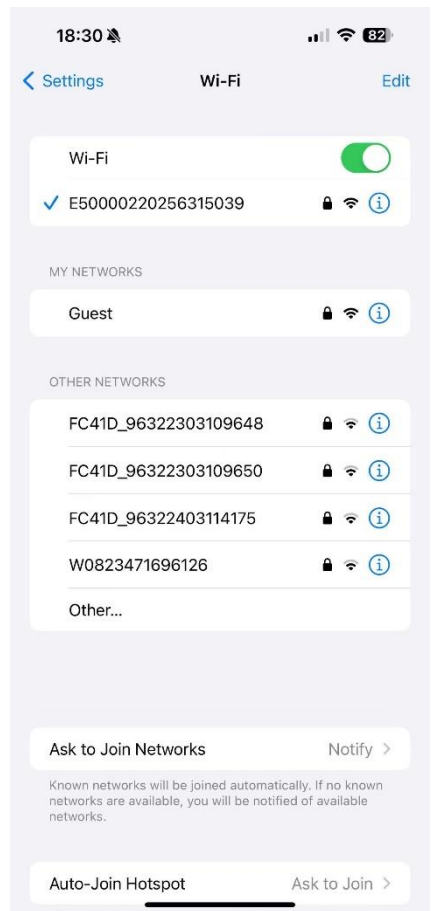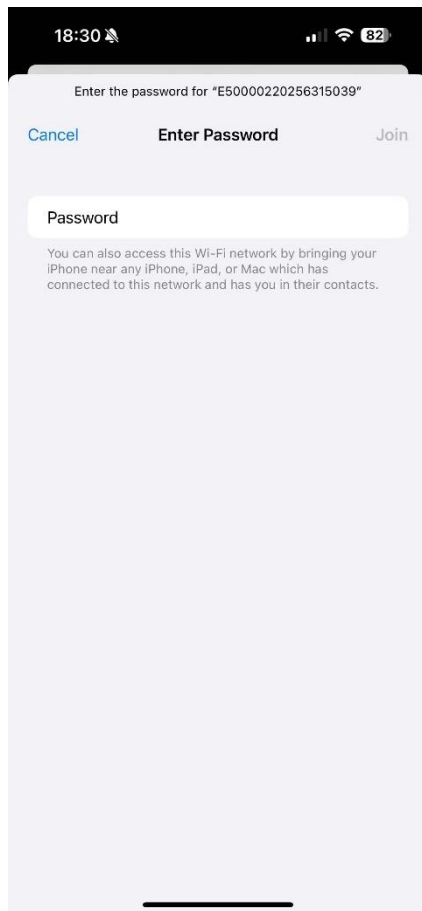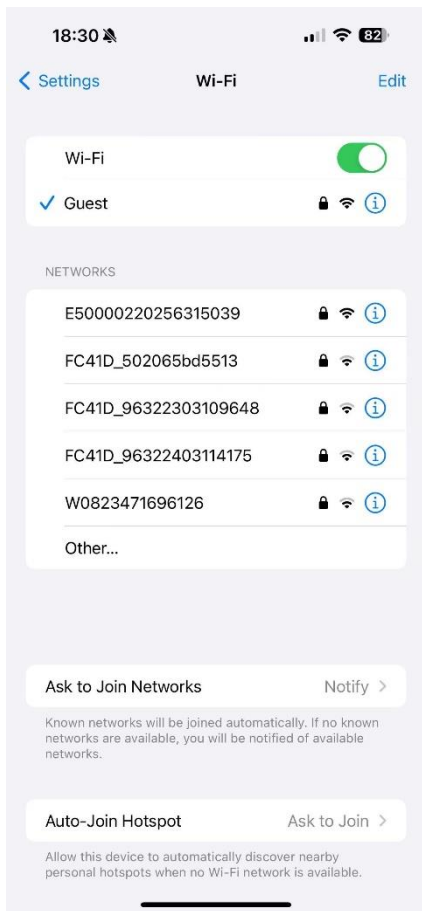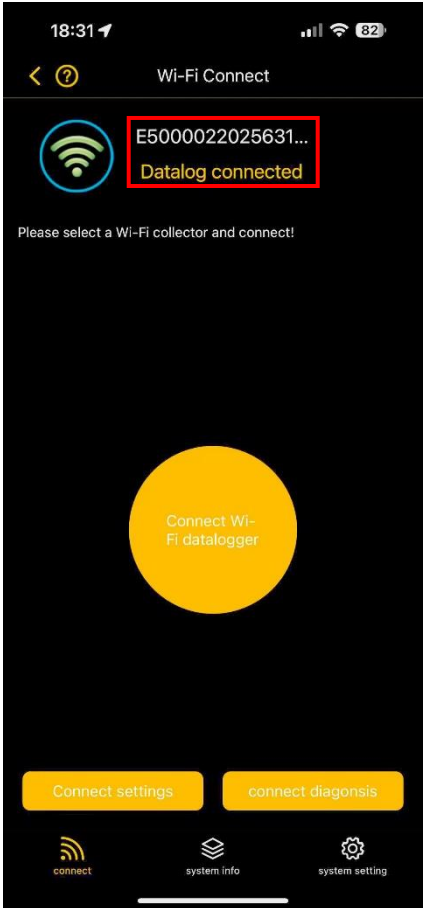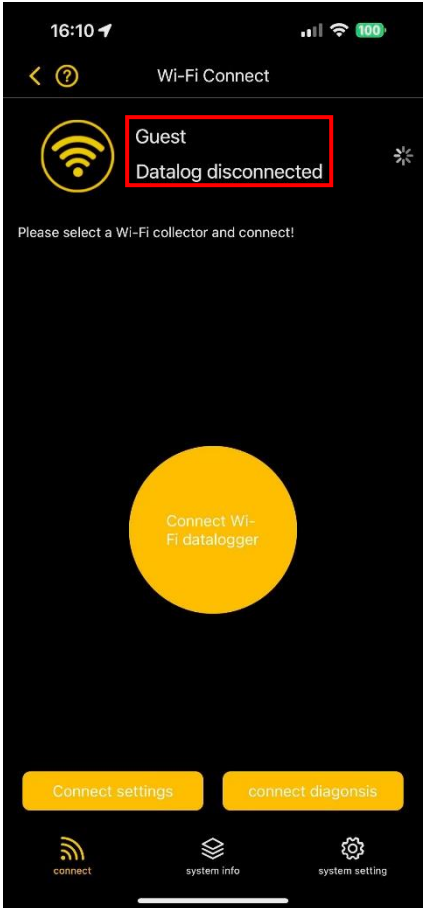
- Once the Wi-Fi connection is successful, click the Energy-Mate APP installed in the phone to enter the login page. Then, click the "Toolbox" and choose "Wi-Fi Config" to enter the Wi-Fi configuration page.


66
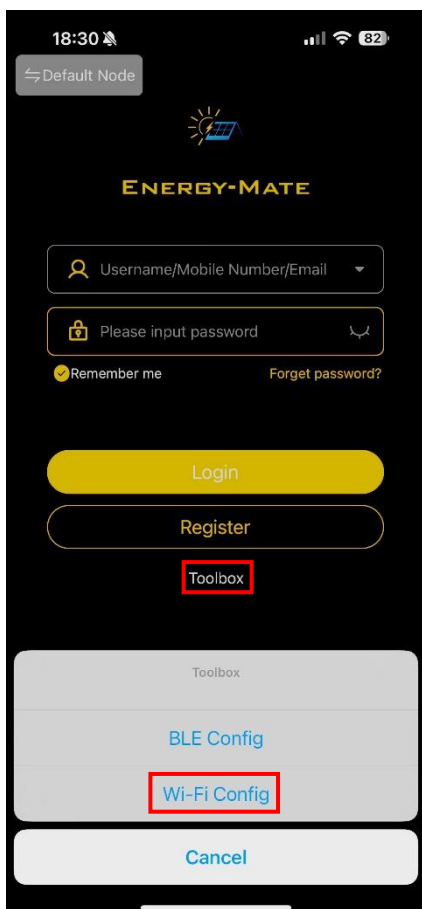
- After entering the Wi-Fi configuration page, please note that the connected Wi-Fi name **must** be the **same as your Wi-Fi module PN number**, and the status **must** be **connected**. If not, please return to the login page, connect your smart phone to the Wi-Fi module, and re-enter the Wi-Fi configuration page.

The Wi-Fi module connection is **successfully**	The Wi-Fi module connection **failed**
You can proceed to the next step to configure the network.	Please return to the login page, connect your smart phone to the Wi-Fi module, and re-enter the Wi-Fi configuration page.

- Click "Connect settings" to manually enter the router name or click [icon] to choose the router name. Then, enter the router password and click the "Setting" to complete the setting.

  The Wi-Fi module only could connect the router at **2.4GHz**.
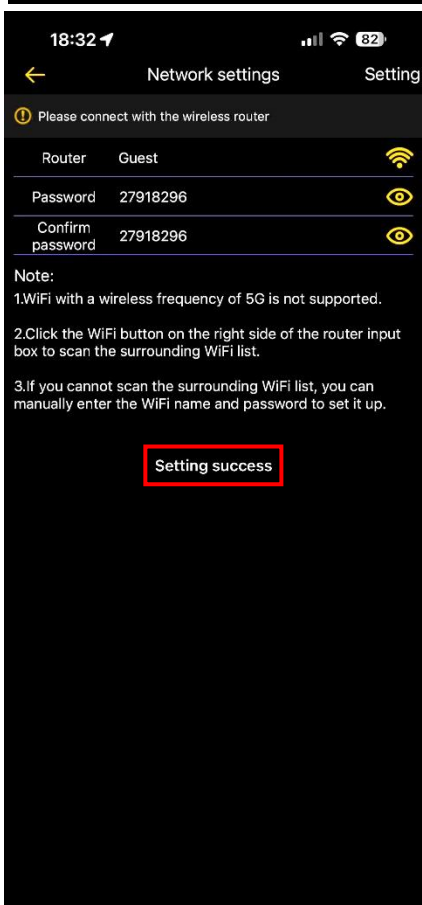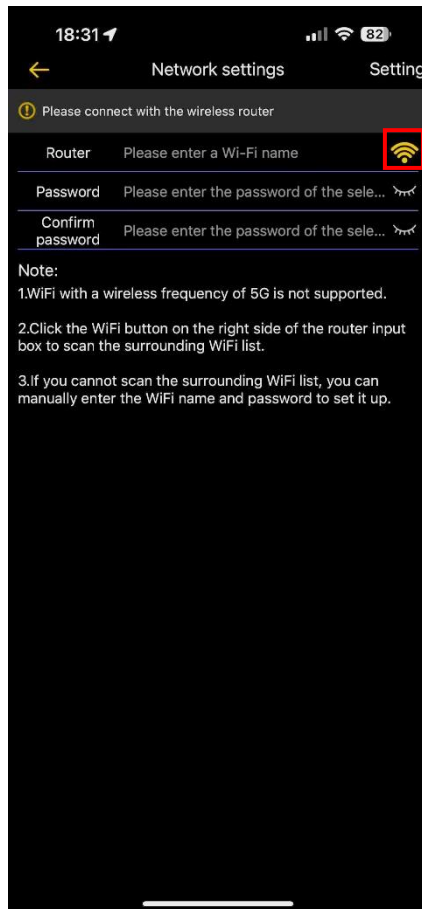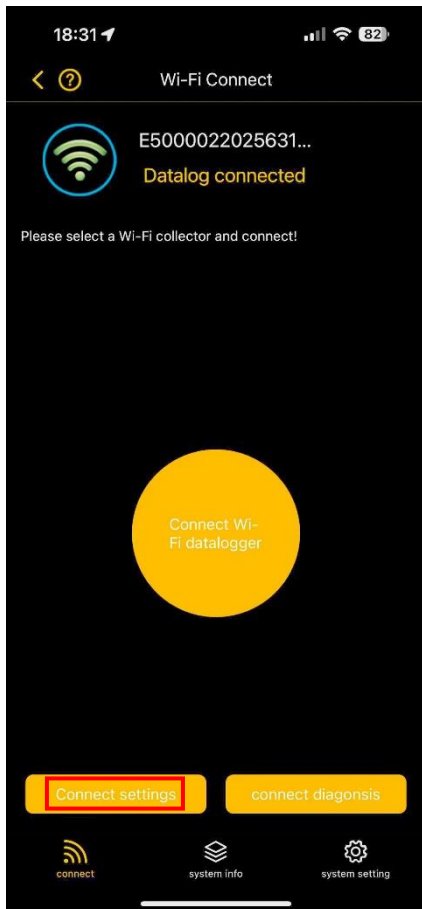
- Click to return to the Wi-Fi configuration page. Click "Connect diagnosis" to check the connection status.
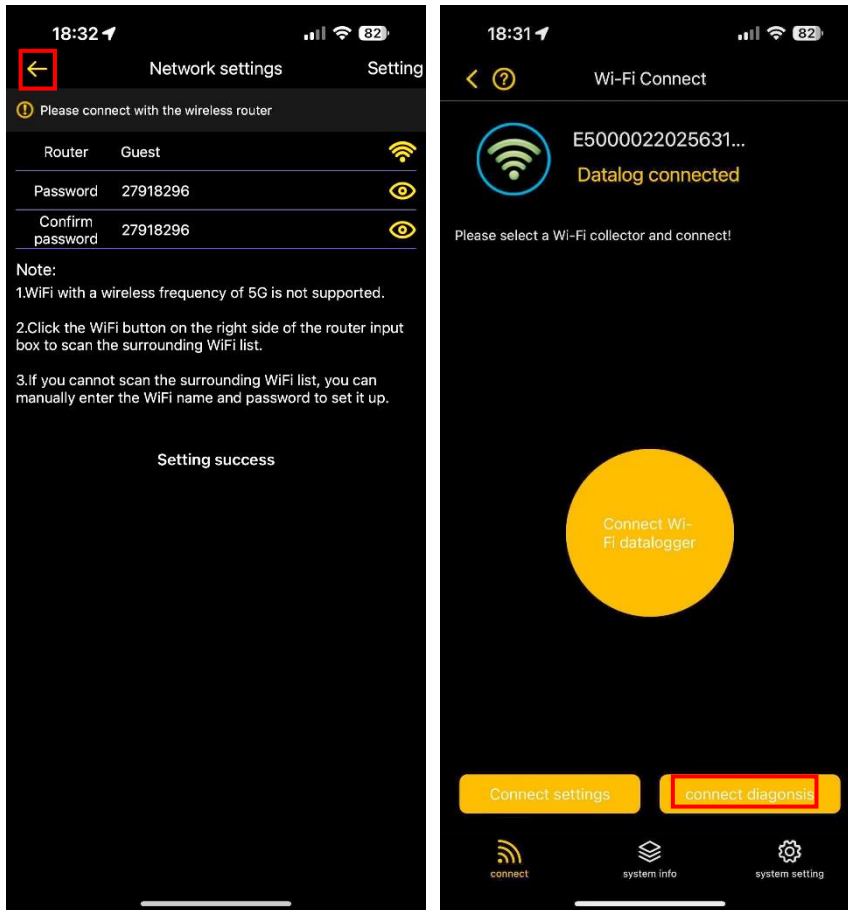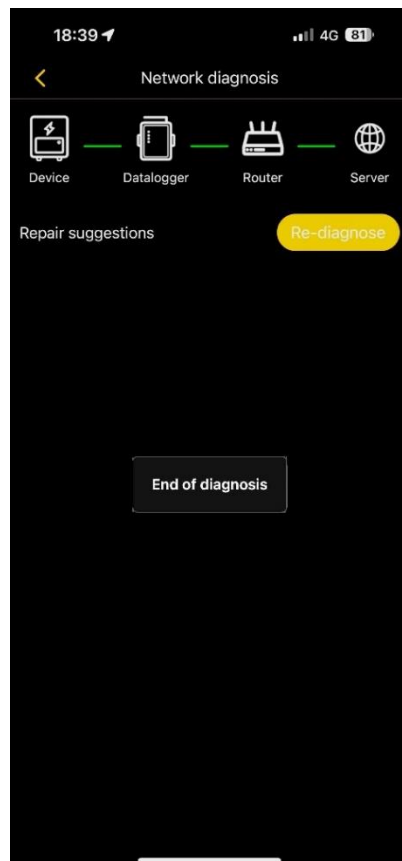
The configuration is **successfully**	The configuration **failed**
Green lines between device, datalogger, router, and server.	Red crosses between device, datalogger, router, and server. Please refer to APP instructions to re-configure.
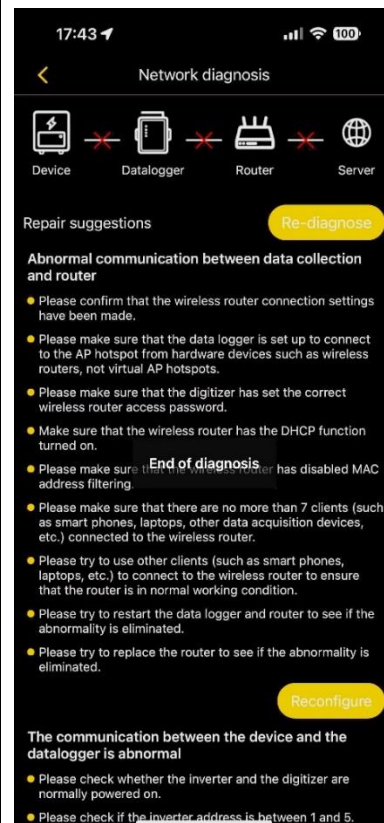
- After Wi-Fi configuration, please **forget** the Wi-Fi module of the Wi-Fi connection on the smartphone to avoid automatic connection and unable to access the network. The login page will prompt "Server not found".
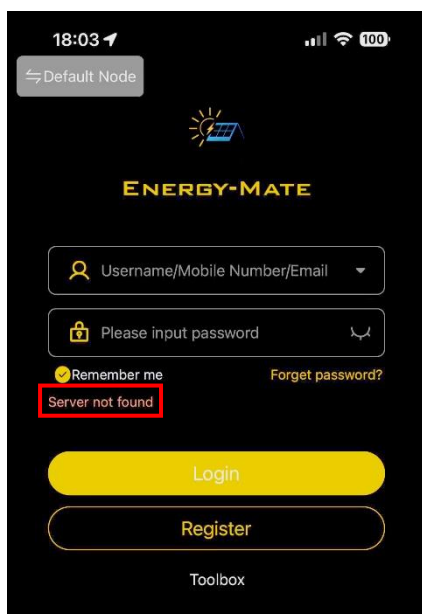
Bluetooth Configuration

If you have configured the network through Wi-Fi, please skip this section.

- Turn on the unit.
- Open the Bluetooth from your smart phone.
- Click the Energy-Mate APP installed in the phone to enter the login page. Then, click the "Toolbox" and choose "BLE Config" to enter the Bluetooth configuration page.
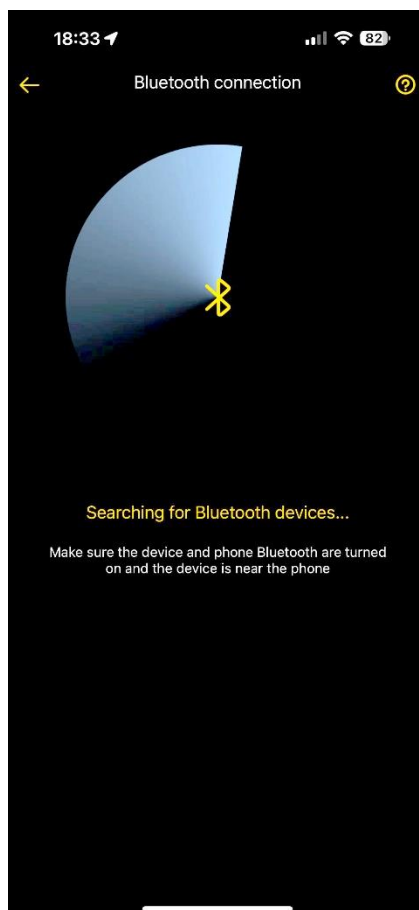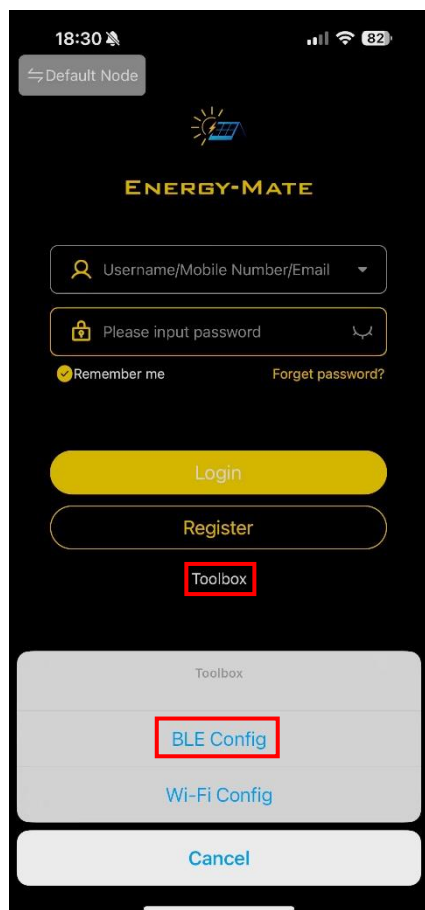
- Connect your smart phone to the Wi-Fi module through Bluetooth.
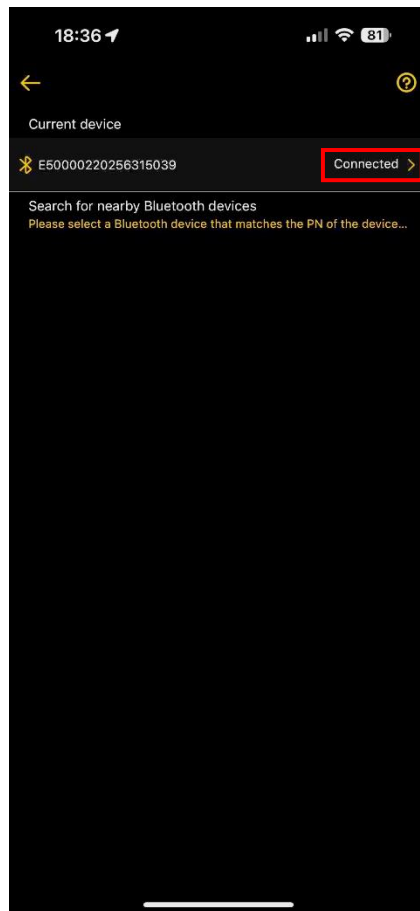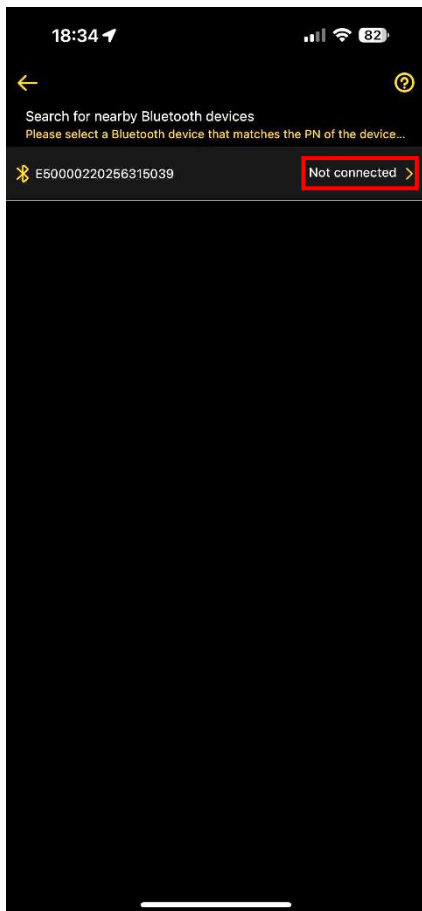
- Manually enter the router name or click to choose the router name, enter the router password, and then click the "Setting" to complete the setting.
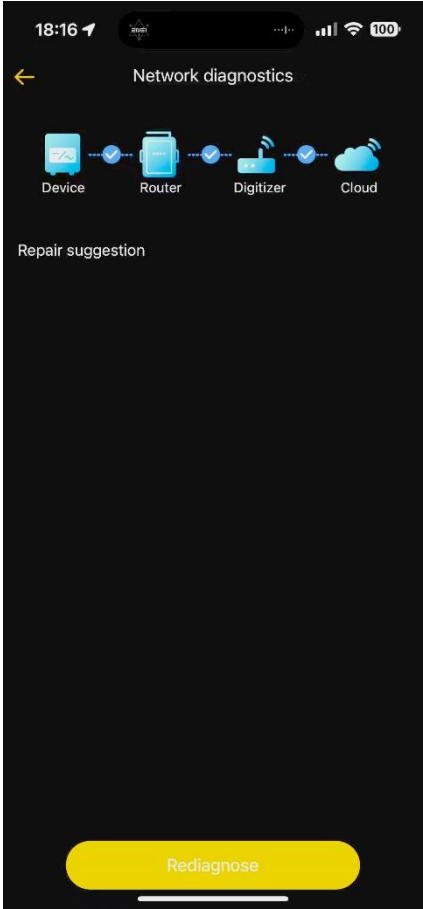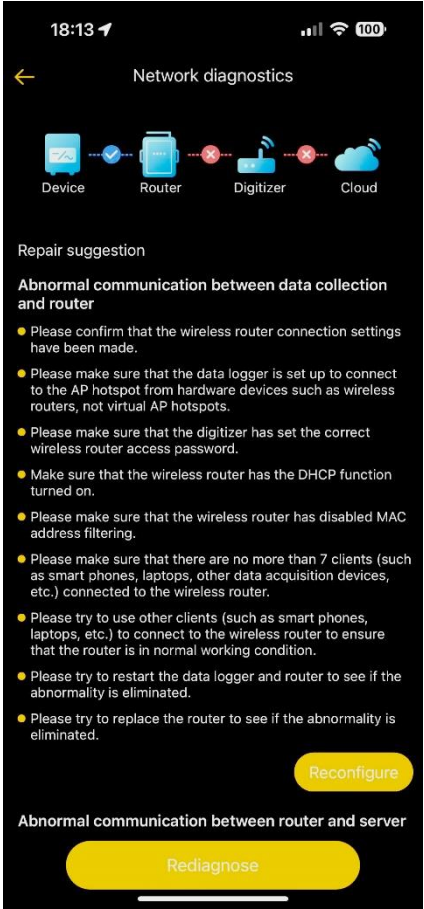
    The Wi-Fi module only could connect the router at **2.4GHz**.
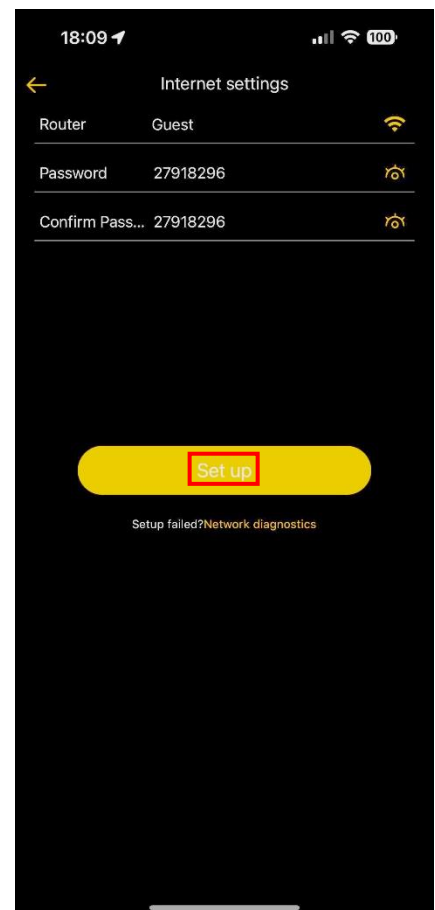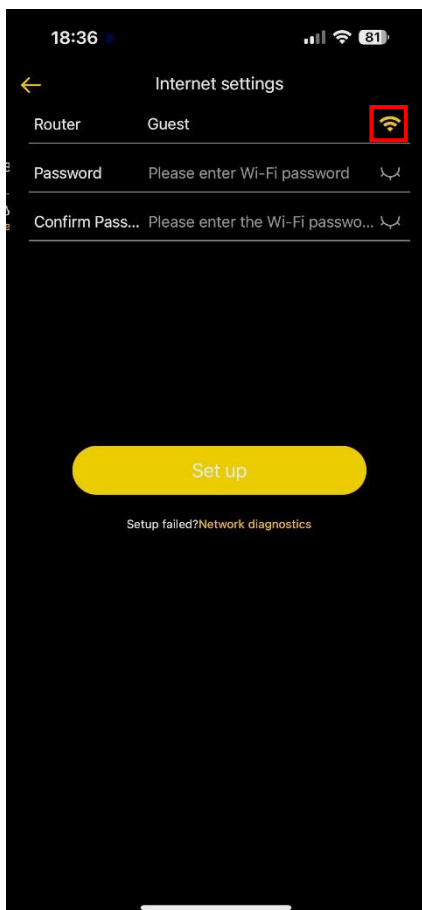
● Click "Network diagnosis" to check the connection status.
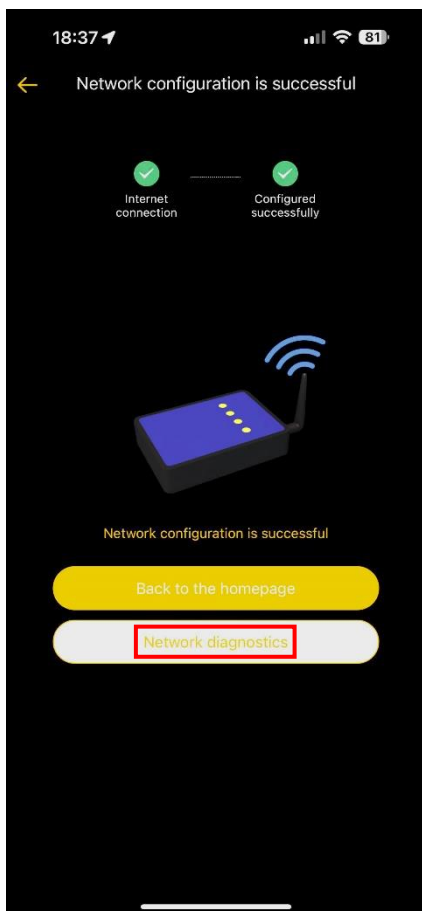
The configuration is **successfully**	The configuration **failed**
Green lines between device, datalogger, router, and server.	Red crosses between device, datalogger, router, and server. Please refer to APP instructions to reconfigure.

- After Bluetooth configuration, please **disconnect** the Wi-Fi module of the Bluetooth connection on the smartphone to avoid automatic connection and unable to access the network. The login page will prompt "Server not found".
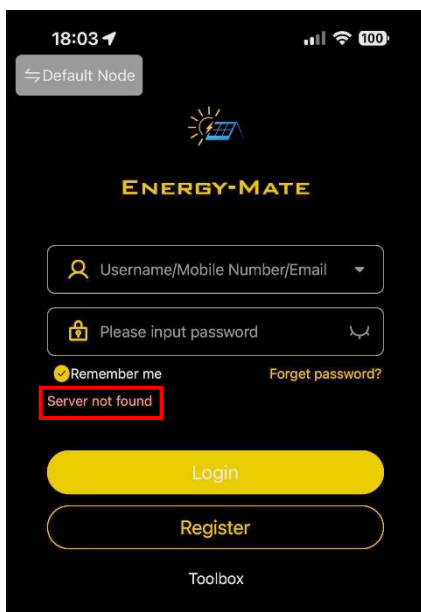
2-3 Registration and login

- Connect your smart phone to the router.
- Registration at first time.
- Click the "Register" to enter registration page and fill in the information. Once registration is complete, click "Sign in" or click to return to the home page. Then, enter the registered username and password to log in.
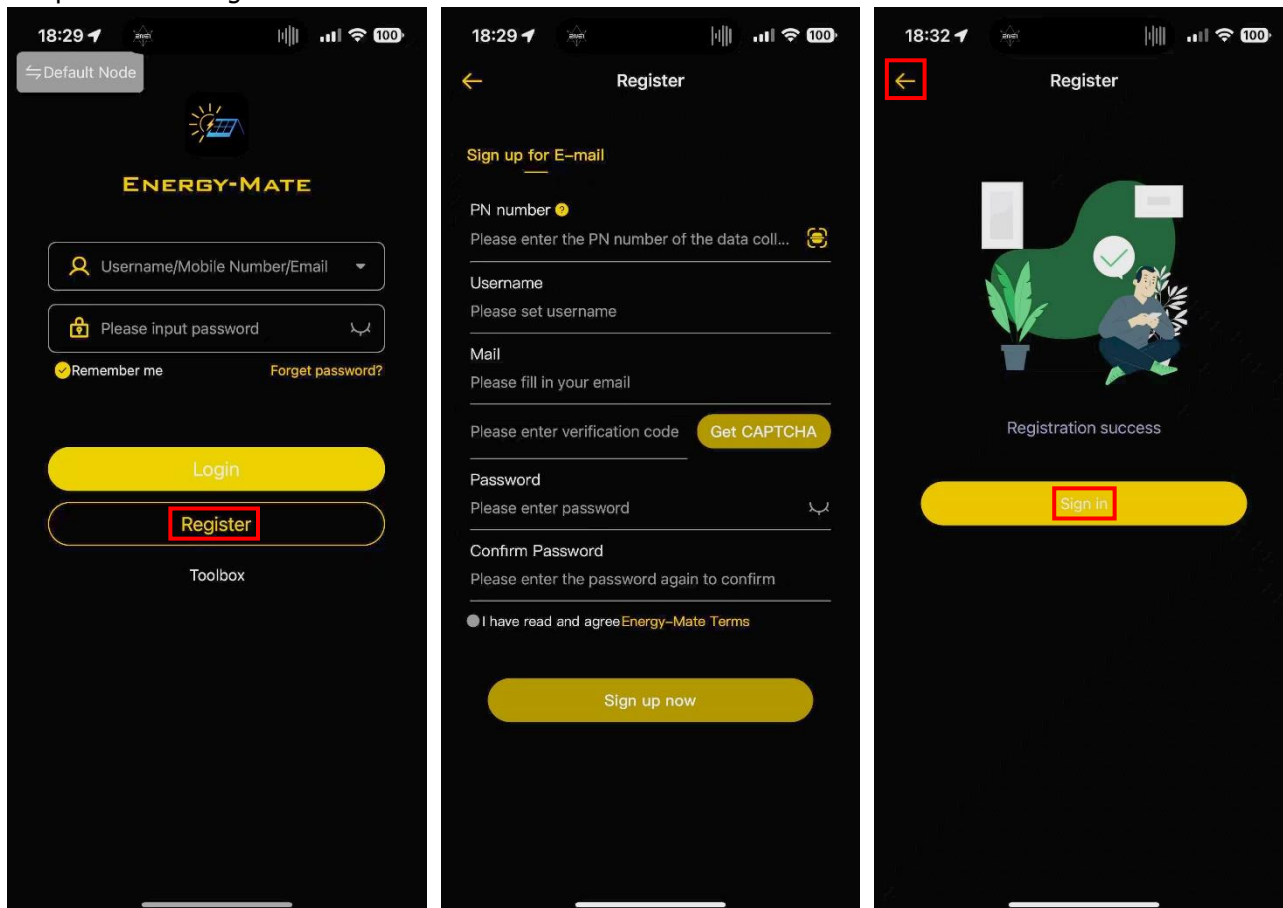
2-4 Datalogger

- After login, the default Home page will appear.
- Choose Datalogger page to see the Wi-Fi module list.
  - ◆ Gray icon means Wi-Fi module is offline. Please refer to 2-2 Initial Setup to choose local Wi-Fi or Bluetooth configure Wi-Fi module network.
  - ◆ Green icon means Wi-Fi module is online.

- Click to see the Wi-Fi module information.

- Click ⚙ to rename device, data debugging, restart the datalogger, and delete datalogger.

  ◆ Rename device: rename the Wi-Fi module name.

  ◆ Data debugging: send RS232 commands to the inverter in hexadecimal format.

  ◆ Restart the datalogger: restart the Wi-Fi module.

  ◆ Delete datalogger: delete the Wi-Fi module. The inverter information in the device page will **also be deleted**. Once deleted, you **can** add datalogger under another account.
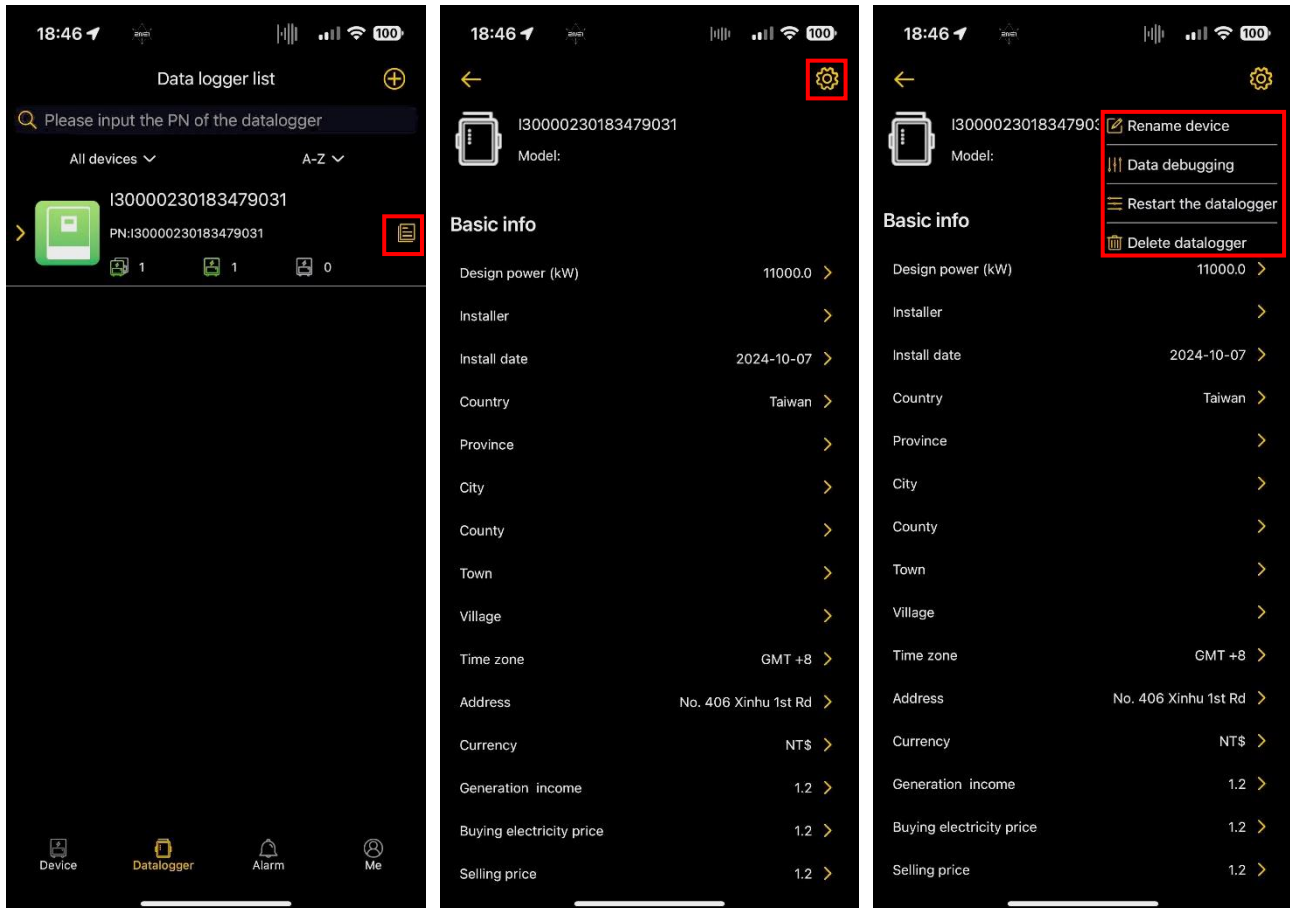
2-5 Device

- Choose Device page to see the inverter list.

  ◆ Gray icon means inverter is offline.

  ◆ Green icon means inverter is online and no warnings and faults.

  ◆ Yellow icon means inverter is online and has a warning.

  ◆ Red icon means inverter is online and has a fault.
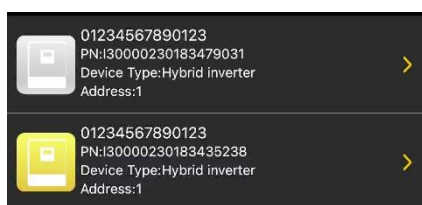
- Click ❯ to see the inverter information.

- Click ••• to rename device and delete device.

  ◆ Rename device: rename the inverter name.

  ◆ Delete device: delete the inverter. The Wi-Fi module information in the datalogger page will **not be**

deleted. Even if deleted, you **cannot** add Wi-Fi module under another account.
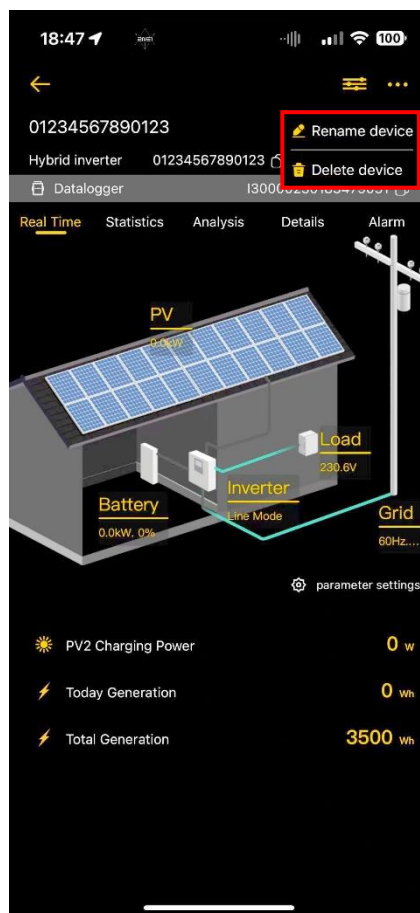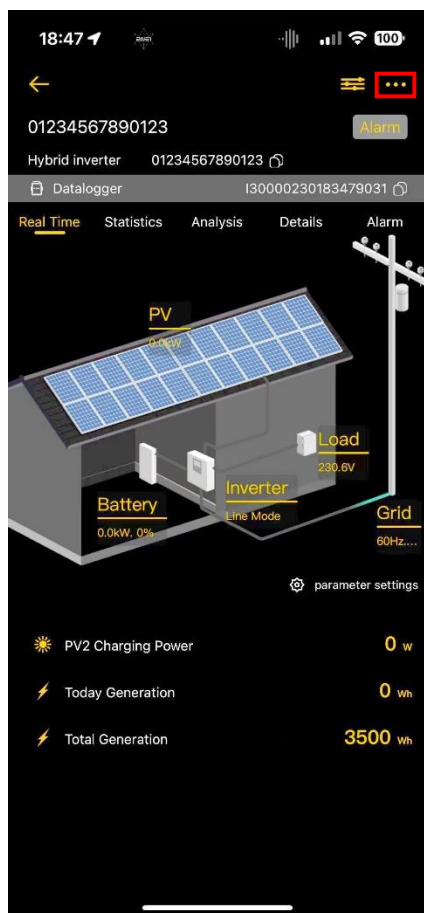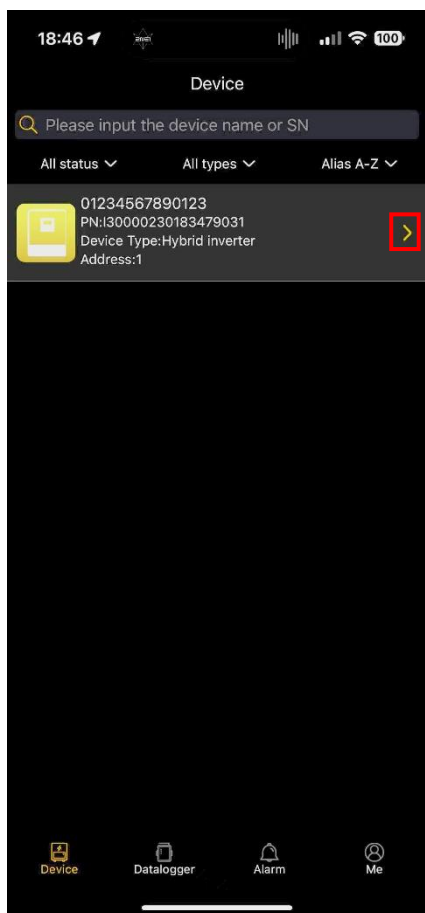
- Click to enter setting parameters page. The setting items on the parameter page will be different based on different models.
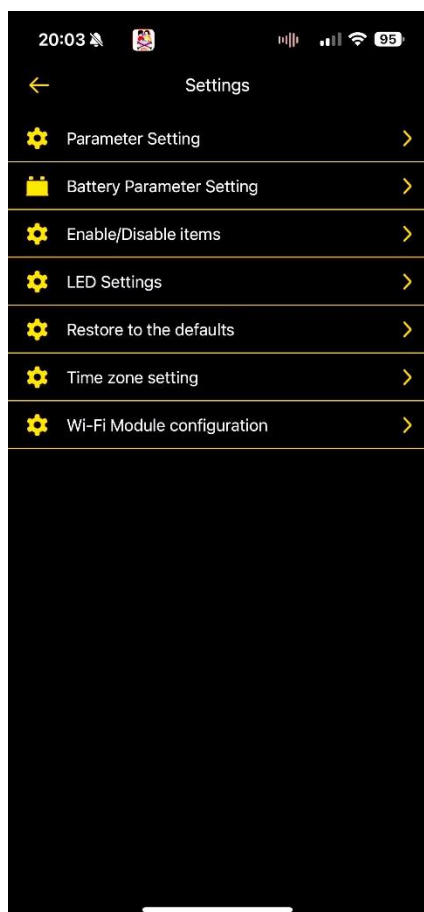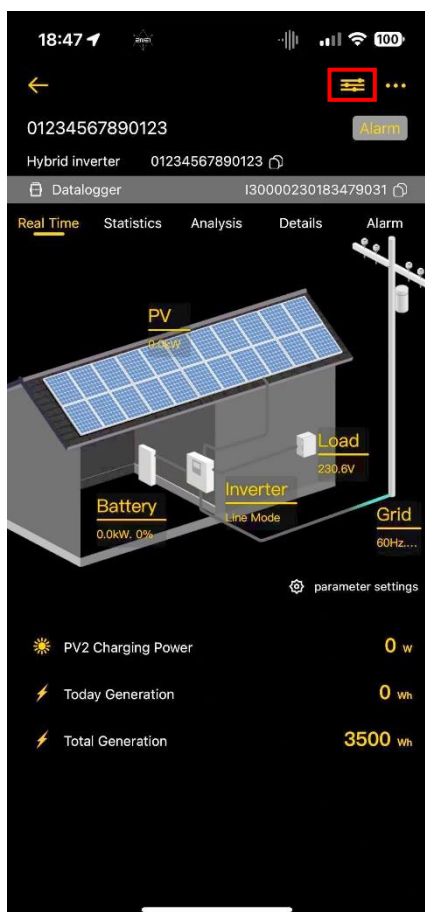
- Click "Real Time" to see the inverter real-time data. Click "parameter settings" to choose data you want to

see on the real time page. You can choose up to **10 data**.
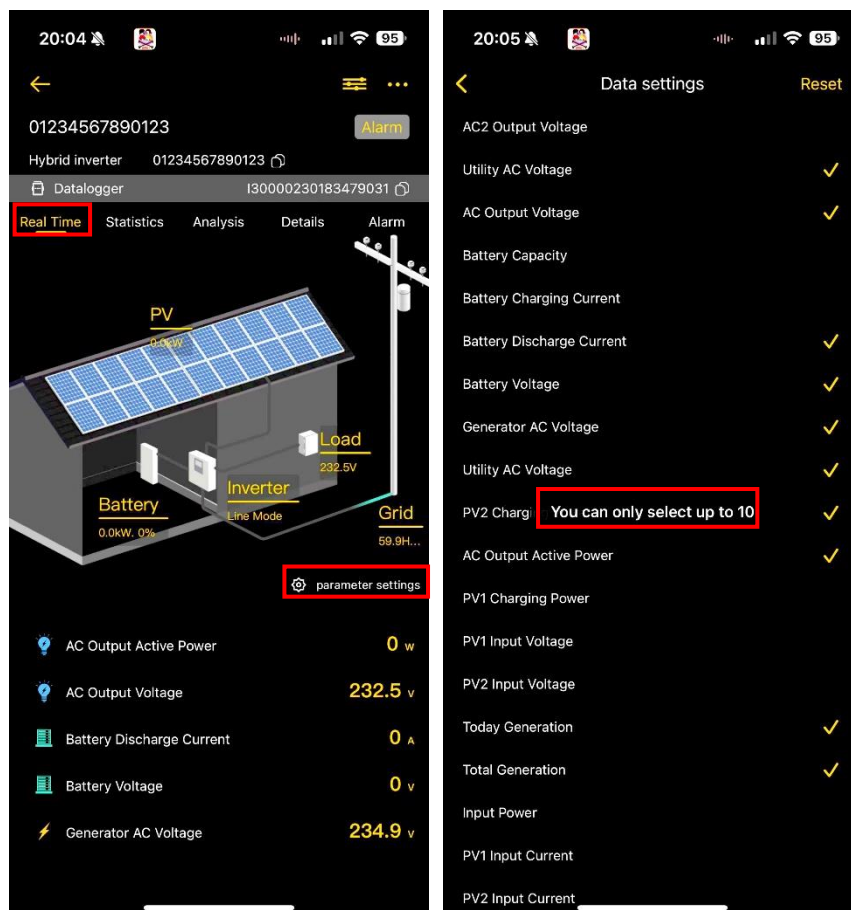
- Click "Statistics" to see the inverter solar power per hour, day, month and year.

  Day: Click the button to query the hourly power generation data of the current day.

  Month: Click the button to query the daily power generation data of the current month.

  Year: Click the button to query the monthly power generation data of the current year.

  Total: Click the button to query the annual power generation data.
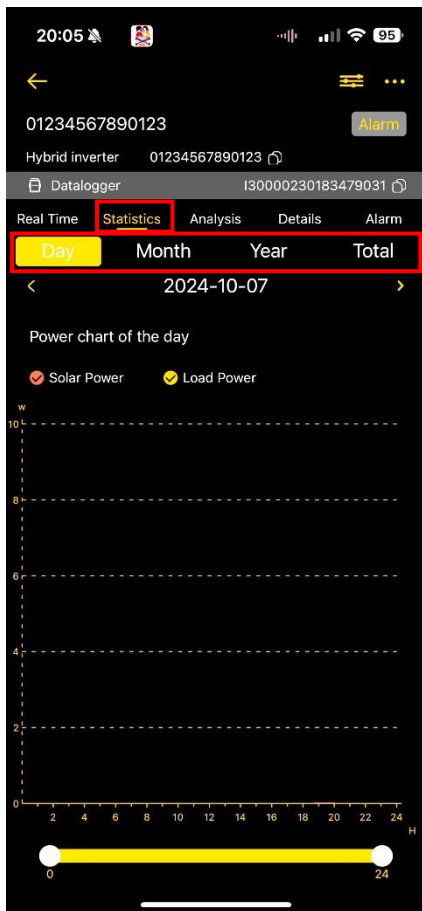
- Click "Analysis" to see the inverter data per hour. Click "SelectedXTerm" to choose the data you want to compare. You can choose up to **2 different units** such as energy (kWh) and current (A).
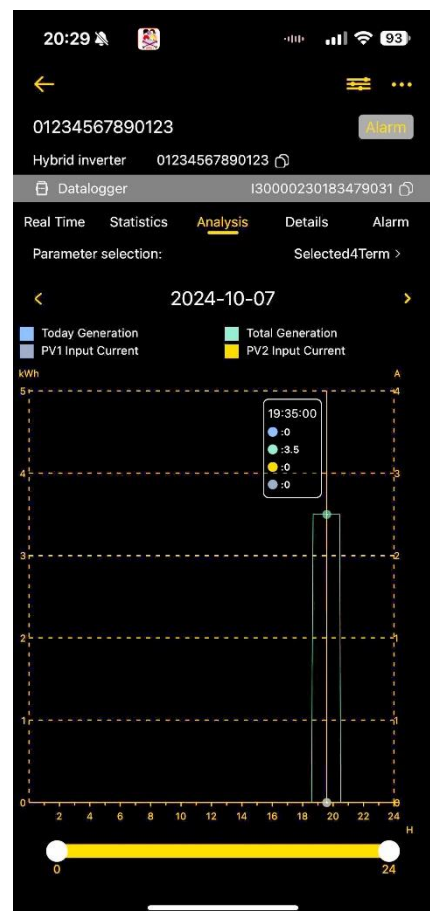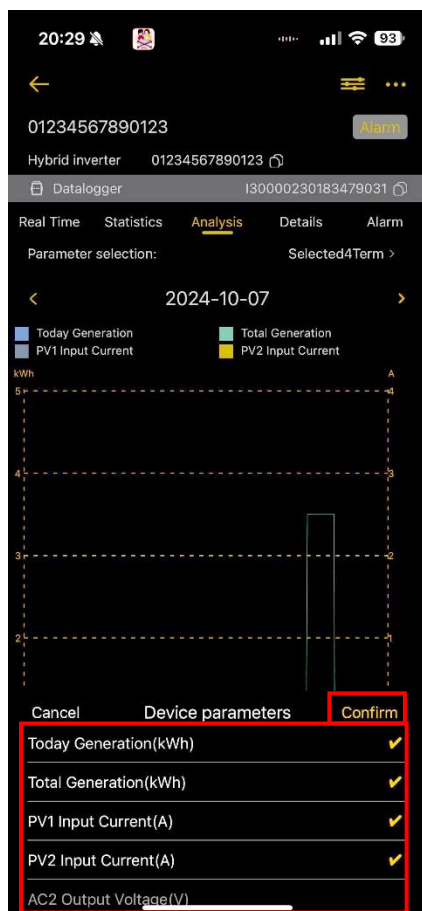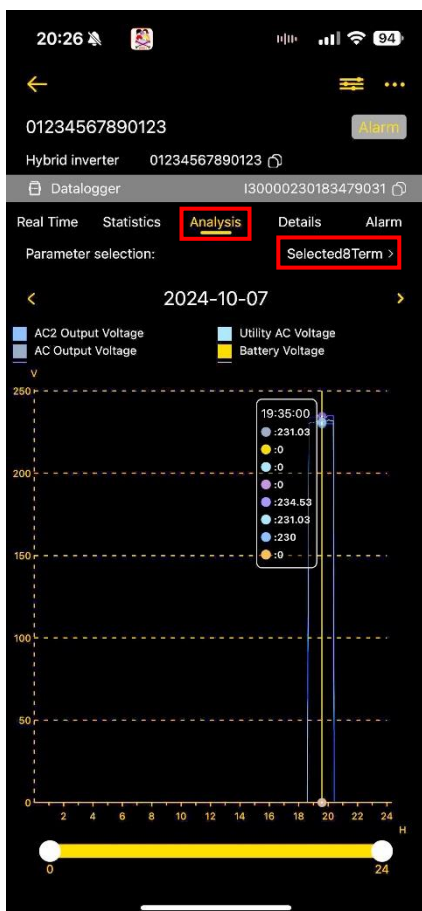
- Click "Details" to see the inverter history.

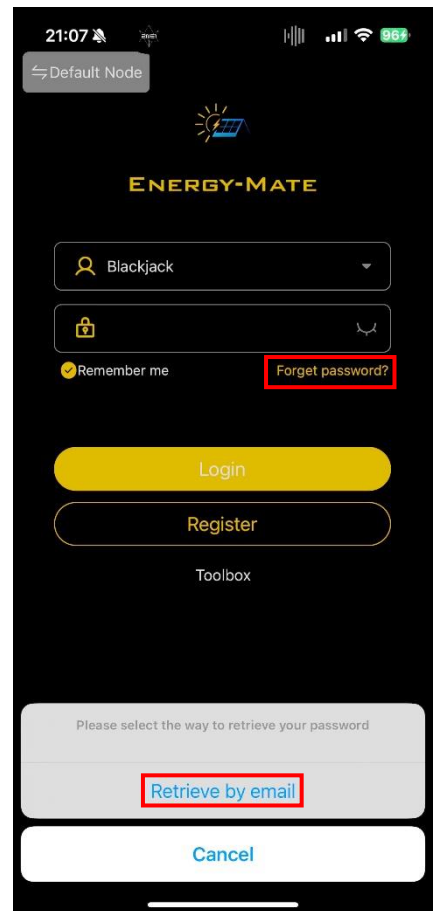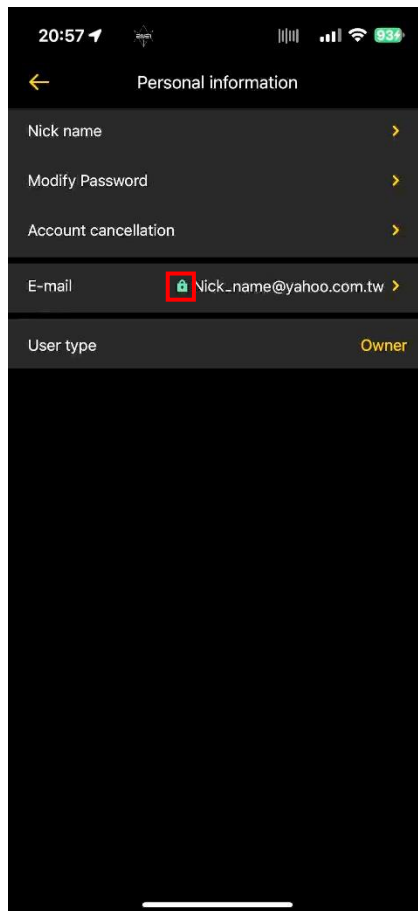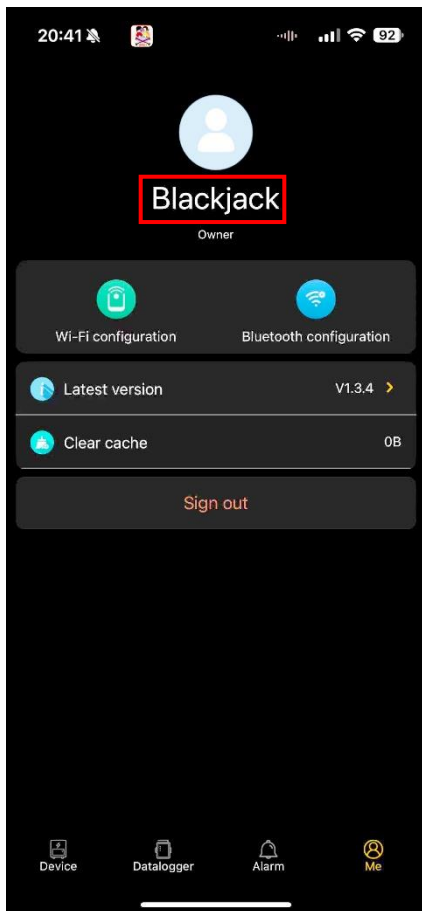- Click "Alarm" to see the inverter warning and fault.

2-6 Alarm

- Choose Alarm page to see the warning and fault list of all inverters.
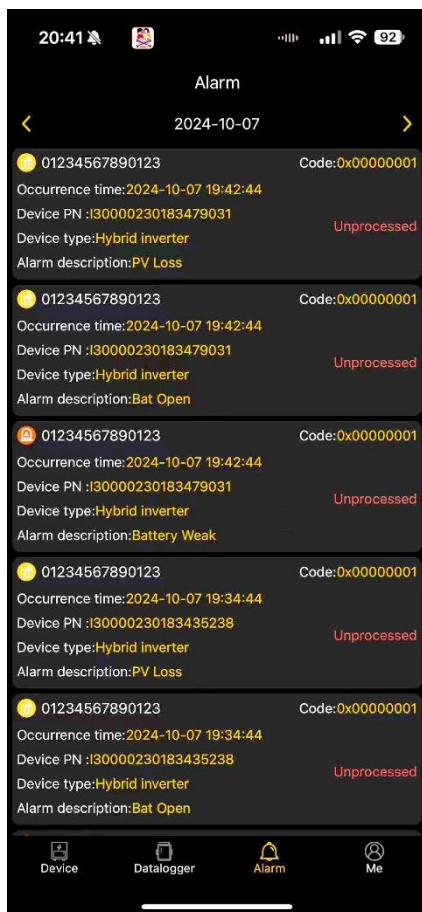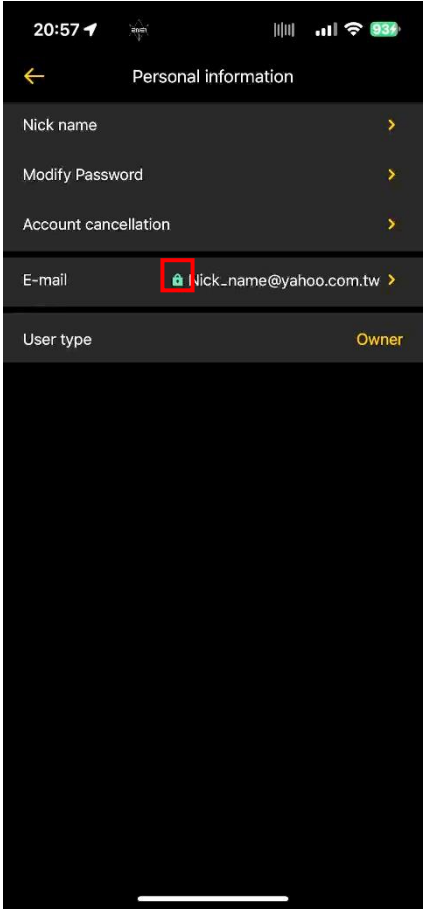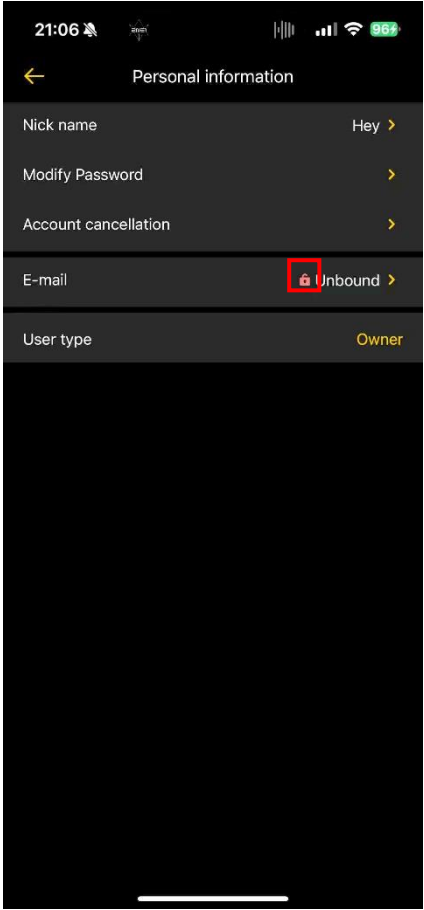

2-7 Me

- Choose Me page to see account information and app version.
- Click "Username" to modify nick name and password, and check if the mail has been bound. If the mail is bound, you can retrieve password through mail.

- If the mail is not bound, please bind it as soon as possible. If you forget your username, please contact your installer.
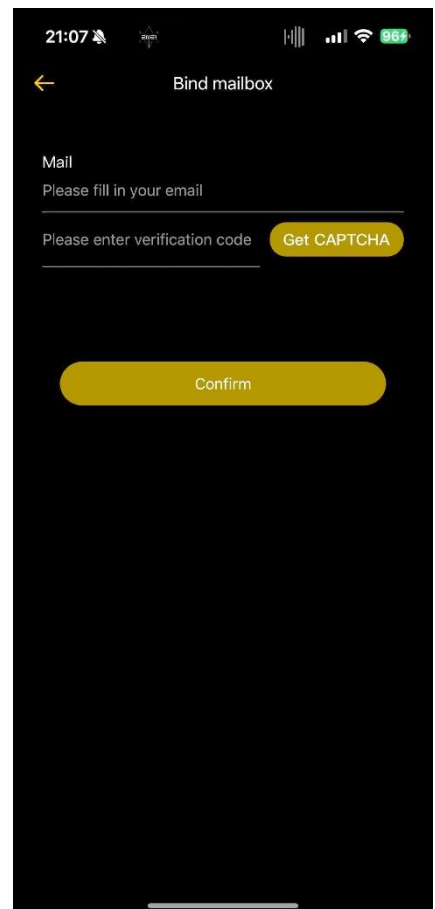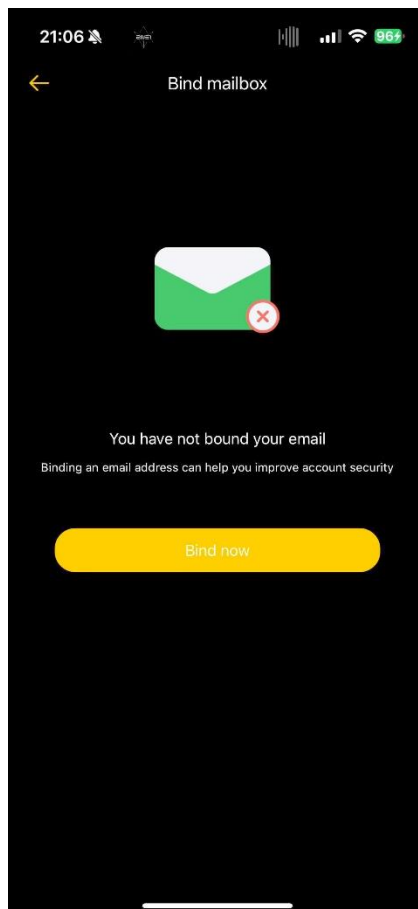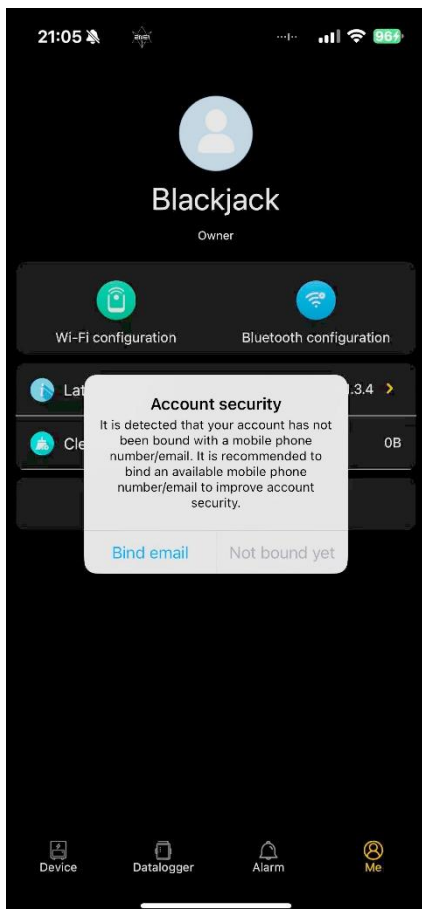
Mail is bound.	Mail is not bound.

- Click to check the app is the latest version.