User Manual

Strak Pro 5000

INVERTER / CHARGER

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 and reversed connection 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.

INTRODUCTION

This is a multi-function inverter/charger, combining functions of inverter, MPPT solar charger and battery charger to offer uninterruptible power support with portable size. Its comprehensive LCD display offers user-configurable and easy-accessible button operation such as battery charging current, AC/solar charger priority, and acceptable input voltage based on different applications.

Features

- Pure sine wave inverter
- Built-in MPPT solar charge controller
- Configurable input voltage range for home appliances and personal computers via LCD setting
- Configurable battery charging current based on applications via LCD setting
- Configurable AC/Solar Charger priority via LCD setting
- Compatible to mains voltage 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 inverter/charger. It also includes following devices to have a complete running system:
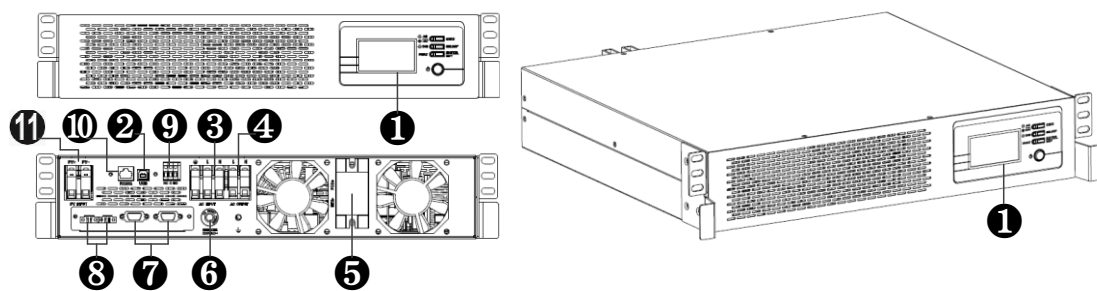- Generator or Utility.
- PV modules (option)

Consult with your system integrator for other possible system architectures depending on your requirements. This inverter can power all kinds of appliances in home or office environment, including motor-type appliances such as tube light, fan, refrigerator and air conditioner.
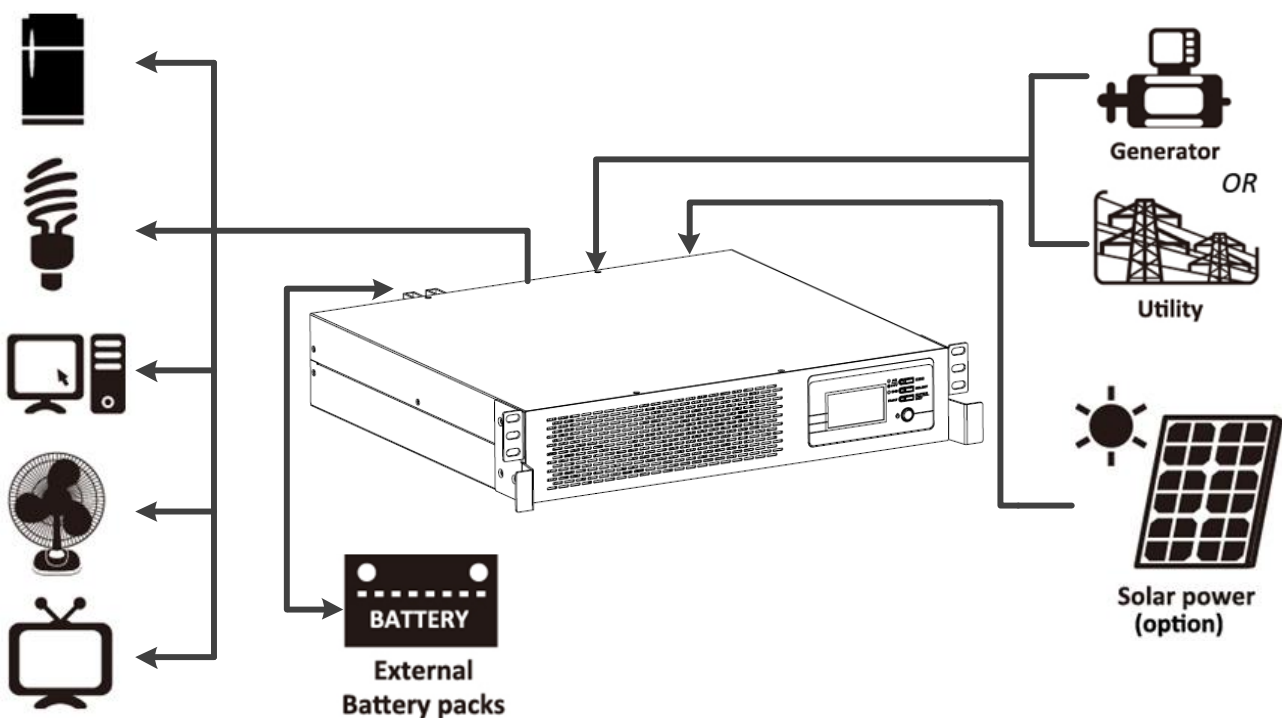
System Diagram

Product Overview

1. Operation panel
2. USB communication port
3. AC input terminal
4. AC output terminal
5. Battery input
6. Circuit breaker
7. Parallel communication ports
8. Share current ports
9. Dry contact
10. RS-232 communication port
11. PV input terminal

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 the package:

- The unit x 1
- User manual x 1
- Parallel cable x 2
- Software CD x 1

Installation

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 40°C to ensure optimal operation.

Rack Mounting

Please follow the diagram below to install the Inverter module in a 19-inch bay (with a depth of 600mm) at the desired height in the upright cabinet. Secure the device adequately and fix it to the cabinet with six screws.
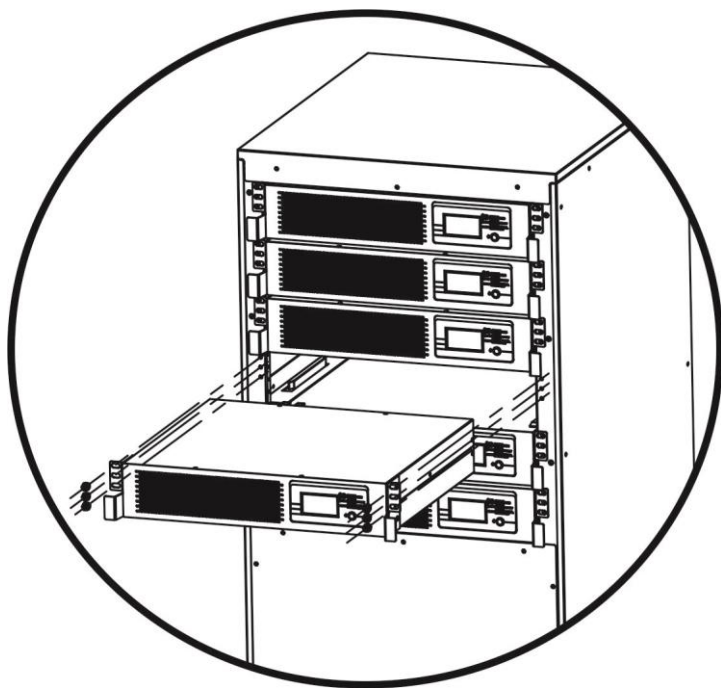
Battery Connection

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 the table below to select proper amperage, 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 cable and terminal size as recommended below.
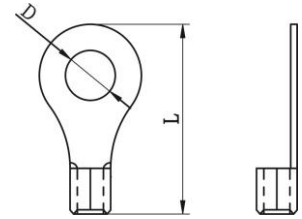
Recommended battery cable and terminal size:

| Model | Typical Amperage | Battery capacity | Wire Size | Ring Terminal | | | Torque value |
				Cable mm^2	Dimensions		
					D (mm)	L (mm)	
5KW	125A	200AH	1*4AWG	22	6.4	33.2	2.5~3 Nm
			2*8AWG	14	6.4	29.2	

Please follow the steps below to implement battery connection:

1. Assemble battery ring terminal based on recommended battery cable and terminal size.
2. Connect all battery packs as the diagram below. It's suggested to connect battery with at least 200Ah capacity.
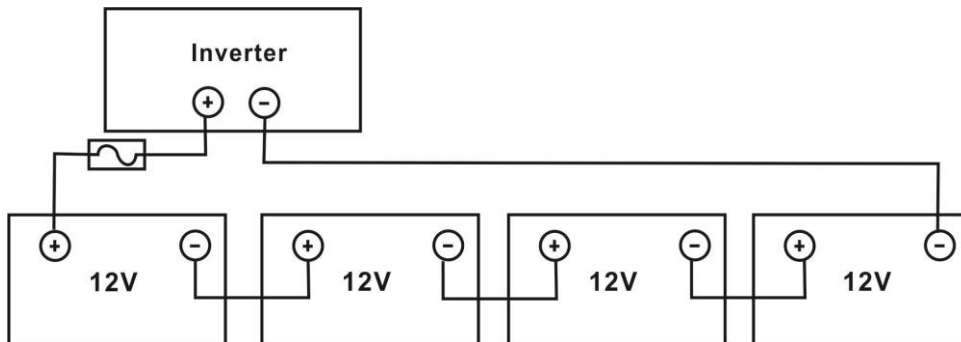
3. Insert the ring terminal of battery cable flatly into battery connector of inverter and make sure the bolts are tightened with torque of 2.5-3 Nm. Make sure polarity at both the battery and the inverter/charge is correctly connected and ring terminals are tightly screwed to the battery terminals.
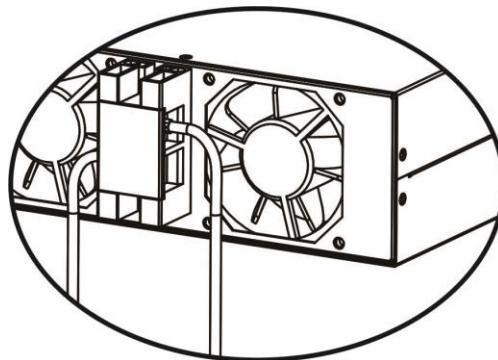
⚠	**WARNING: Shock Hazard** Installation must be performed with care due to high battery voltage in series.

⚠	**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. The recommended spec of AC breaker is 50A.

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 qualified person.

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 cable size as recommended below.

Suggested cable requirement for AC wires

| Model	Gauge	Torque Value
5KW	8~10 AWG	1.4~ 1.6Nm

Please follow the steps below to implement AC input/output connection:
1. Before making AC input/output connection, be sure to disconnect DC protector or breaker on battery terminal first.
2. Remove insulation sleeve 10mm for six conductors.
3. 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)**
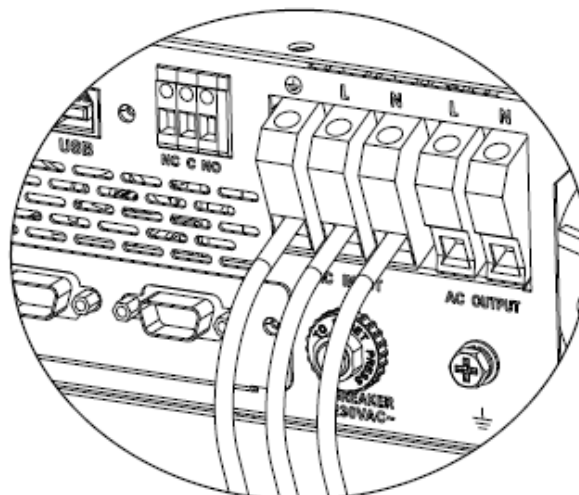
⚠	**WARNING:** Be sure that AC power source is disconnected before attempting to fix the wire of the unit.

4. 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)

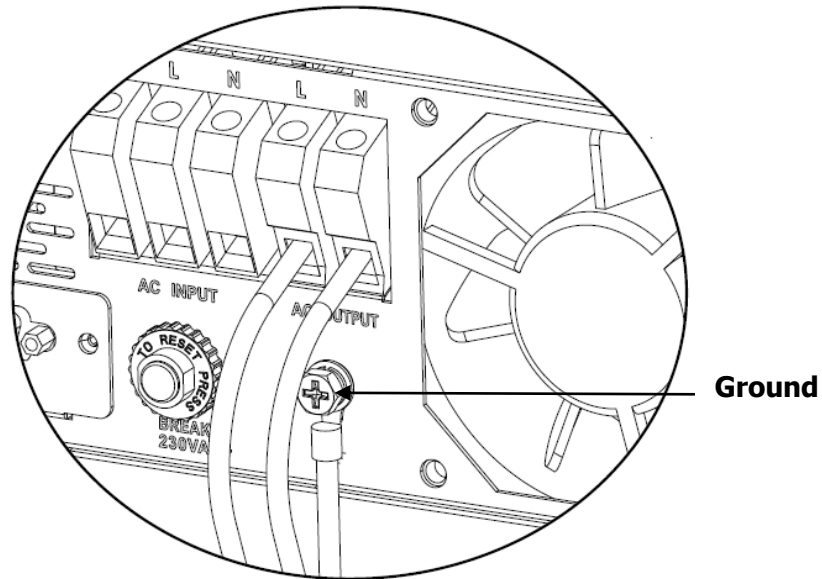**N→Neutral (blue)**

Ground

5. Make sure the wires are securely connected.

CAUTION: Appliances such as air conditioner are required at least 2~3 minutes to restart because it's required to have enough time to balance refrigerant gas inside of circuits. If a power shortage occurs and recovers in a short time, it will cause damage to your connected appliances. To prevent this kind of damage, please check with manufacturer of air conditioner to see if it's equipped with time-delay function before installation. Otherwise, this inverter/charger will detect overload fault and cut off output to protect your appliance but sometimes it still causes internal damage to the air conditioner.

PV Connection

CAUTION: Before connecting to PV modules, please install **separately** a DC circuit breaker between inverter and PV modules.

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

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

| Model	Typical Amperage	Cable Size	Torque
5KW	80A	6 AWG	1.4~1.6 Nm

PV Module Selection:

When selecting proper PV modules, please be sure to consider below parameters:

1. Open circuit Voltage (Voc) of PV modules not exceeds max. PV array open circuit voltage of inverter.
2. Open circuit Voltage (Voc) of PV modules should be higher than min. battery voltage.

Solar Charging Mode	
INVERTER MODEL	5KW
Max. PV Array Open Circuit Voltage	145Vdc
PV Array MPPT Voltage Range	60~115Vdc
Min. battery voltage for PV charge	34Vdc

Please follow below steps to implement PV module connection:

1. Remove insulation sleeve 10 mm for positive and negative conductors.
2. 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.
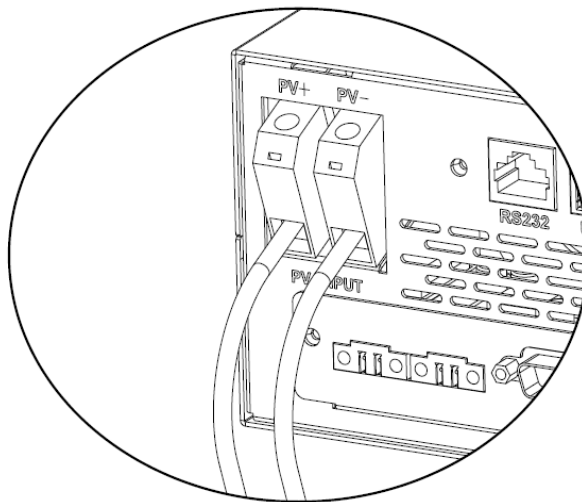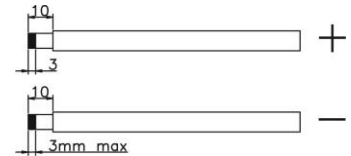
3. Make sure the wires are securely connected.

Communication Connection

Please use supplied communication cable to connect to inverter and PC. Insert bundled CD into a computer and follow on-screen instruction to install the monitoring software. For the detailed software operation, please check user manual of software inside of CD.
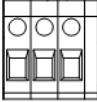
Dry Contact Signal

There is one dry contact (3A/250VAC) available on the rear panel. When program 38 is set as "disable", it could be used to deliver signal to external device when battery voltage reaches warning level. When program 38 is set as "enable" and the unit is working in battery mode, it could be used to trigger the grounding box to connect neutral and grounding of AC output together.

When program 38 is set as "disable" (default setting):

Unit Status	Condition			Dry contact port:	
				NC & C	NO & C
Power Off	Unit is off and no output is powered.			Close	Open
Power On	Output is powered from Utility.			Close	Open
	Output is powered from Battery or Solar.	Program 01 set as Utility	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 or Solar first	Battery voltage < Setting value in Program 12	Open	Close
			Battery voltage > Setting value in Program 13 or battery charging reaches floating stage	Close	Open

When program 38 is set as "enable":

| Unit Status	Condition	Dry contact port:	
		NC & C	NO & C
Power Off	Unit is off.	Close	Open
Power On	Output is powered from Battery or Solar	Open	Close

OPERATION

Power ON/OFF
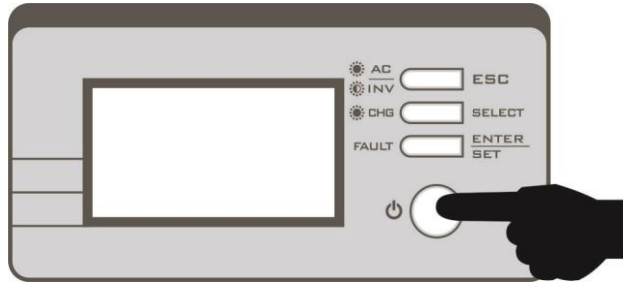
Once the unit has been properly installed and the batteries are connected well, simply press On/Off switch to turn on the unit.

Operation and Display Panel

The operation and display panel, shown in below chart, is on the front panel of the inverter. It includes three indicators, three function keys and a LCD display, indicating the operating status and input/output power information.
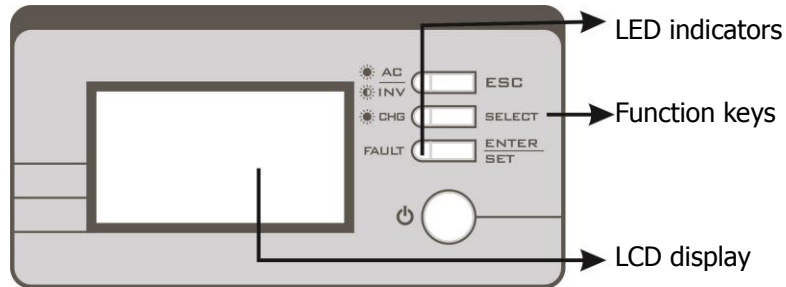
LED Indicators

LED Indicator			Messages
☀AC/☀INV	Green	Solid On	Output is powered by utility in Line mode.
		Flashing	Output is powered by battery in battery mode.
☀CHG	Green	Solid On	Battery is fully charged.
		Flashing	Battery is charging.
⚠FAULT	Red	Solid On	Fault occurs in the inverter.
		Flashing	Warning condition occurs in the inverter.

Function Keys

Function Key	Description
ESC	To exit setting mode
SELECT	To go to next page or next selection
ENTER	To confirm the selection in setting mode or enter setting mode

LCD Display Icons
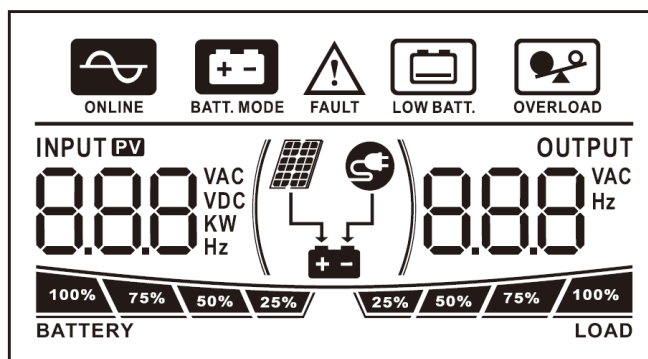
Icon	Function description
Input Source Information	
INPUT PV 8.8.8 VAC VDC KW Hz	Indicates input voltage, input frequency and battery voltage, charging power or setting value.
Output Information	
OUTPUT 8.8.8 VAC Hz	Indicates output voltage, output frequency, setting program NO or fault code.
25% 50% 75% 100% LOAD	Indicates percentage of load
Battery Information	
100% 75% 50% 25% BATTERY	Indicates battery level by 0-24%, 25-49%, 50-74% and 75-100% in battery mode and charging status.
LOW BATT.	Indicates battery voltage is low.

In line mode, it will present battery capacity as below table when unit is charging.

Status	Battery voltage	LCD Display
Constant Current mode / Constant Voltage mode	<2V/cell	BATTERY — 4 bars will flash in turns.
	2 ~ 2.083V/cell	BATTERY 25% — 25% bar will be on and the other three bars will flash in turns.
	2.083 ~ 2.167V/cell	BATTERY 50% 25% — Two bars will be on and the other two bars will flash in turns.
	> 2.167 V/cell	BATTERY 75% 50% 25% — Three bars will be on and the leftmost bar will flash.
Floating mode. Batteries are fully charged.		BATTERY 100% 75% 50% 25% — 4 bars will be on.

In battery mode, it will present battery capacity.

Load Percentage	Battery Voltage	LCD Display
Load >50%	< 1.717V/cell	BATTERY 25%
	1.717V/cell ~ 1.8V/cell	BATTERY 50% 25%
	1.8 ~ 1.883V/cell	BATTERY 75% 50% 25%
	> 1.883 V/cell	BATTERY 100% 75% 50% 25%

	< 1.817V/cell	`25% BATTERY`
50%> Load > 20%	1.817V/cell ~ 1.9V/cell	`50% 25% BATTERY`
	1.9 ~ 1.983V/cell	`75% 50% 25% BATTERY`
	> 1.983	`100% 75% 50% 25% BATTERY`
	< 1.867V/cell	`25% BATTERY`
Load < 20%	1.867V/cell ~ 1.95V/cell	`50% 25% BATTERY`
	1.95 ~ 2.033V/cell	`75% 50% 25% BATTERY`
	> 2.033	`100% 75% 50% 25% BATTERY`

Load Information

Icon	Description			
OVERLOAD	Indicates unit is overload.			
`25% 50% 75% 100% LOAD`	Indicates the load level by 0-24%, 25-50%, 50-74% and 75-100%.			
	0%~25%	25%~50%	50%~75%	75%~100%
	`25% LOAD`	`25% 50% LOAD`	`25% 50% 75% LOAD`	`25% 50% 75% 100% LOAD`

Mode Operation Information

Icon	Description
ONLINE	Indicates the load is supplied by utility power.
BATT. MODE	Indicates the load is supplied by battery or solar.
FAULT	Indicates alarm or fault is happened.
(solar charger icon)	Indicates the solar charger circuit is working.
(utility charger icon)	Indicates the utility charger circuit is working.

LCD Setting

After pressing and holding ENTER button for 3 seconds, the unit will enter setting mode. Press "SELECT" button to select setting programs. And then, press "ENTER" button to confirm the selection or ESC button to exit.

Setting Programs:

Program	Description	Selectable option	
00	Exit setting mode	Escape ESC　　00	
01	Output source priority: To configure load power source priority	Solar first SOL　　01	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 the loads at the same time. Utility provides power to the loads only when any one condition happens: - Solar energy is not available - Battery voltage drops to either low-level warning voltage or the setting point in program 12.
		Utility first (default) UtI　　01	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.
		SBU priority SbU　　01	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)	10A `10    02`	20A `20    02`
		30A `30    02`	40A `40    02`
		50A `50    02`	60A (default) `60    02`
		70A `70    02`	80A `80    02`
		90A `90    02`	100A `100    02`
		110A `110    02`	120A `120    02`
		130A `130    02`	140A `140    02`
03	AC input voltage range	Appliances (default) `APL    03`	If selected, the transfer time is within 20ms between battery mode and line mode
		UPS `UPS    03`	If selected, the transfer time is within 10ms between battery mode and line mode
04	Power saving mode enable/disable	Saving mode disable (default) `SdS    04`	If disabled, no matter connected load is low or high, the on/off status of inverter output will not be effected.
		Saving mode enable `SEn    04`	If enabled, the output of inverter will be off when connected load is pretty low or not detected.
05	Battery type	AGM (default) `AGn    05`	Flooded `FLd    05`
		User-Defined `USE    05`	If "User-Defined" is selected, battery charge voltage and low DC cut-off voltage can be set up in program 26, 27 and 29.
06	Auto restart when overload occurs	Restart disable (default) `Lrd    06`	Restart enable `LrE    06`
07	Auto restart when over temperature occurs	Restart disable (default) `trd    07`	Restart enable `trE    07`
08	Output voltage	220V `220 VAC    08`	230V (default) `230 VAC    08`
		240V `240 VAC    08`	

09	Output frequency	50Hz (default) 50.ₕ 09	60Hz 60.ₕ 09	
11	Maximum utility charging current	2A 2A 11	10A 10A 11	
		20A 20A 11	30A (default) 30A 11	
		40A 40A 11	50A 50A 11	
		60A 60A 11		
12	Setting voltage point back to utility source when selecting "SBU priority" or "Solar first" in program 01.	44V 44.0 VDC 12	45V 45.0 VDC 12	
		46V (default) 46.0 VDC 12	47V 47.0 VDC 12	
		48V 48.0 VDC 12	49V 49.0 VDC 12	
		50V 50.0 VDC 12	51V 51.0 VDC 12	
13	Setting voltage point back to battery mode when selecting "SBU priority" or "Solar first" in program 01.	Battery fully charged FUL VDC 13	48V 48.0 VDC 13	
		49V 49.0 VDC 13	50V 50.0 VDC 13	
		51V 51.0 VDC 13	52V 52.0 VDC 13	
		53V 53.0 VDC 13	54V (default) 54.0 VDC 13	
		55V 55.0 VDC 13	56V 56.0 VDC 13	
		57V 57.0 VDC 13	58V 58.0 VDC 13	

		If this inverter/charger is working in Line, Standby or Fault mode, charger source can be programmed as below:	
16	Charger source priority: To configure charger source priority	Solar first CSO 16	Solar energy will charge battery as first priority. Utility will charge battery only when solar energy is not available.
		Utility first CUt 16	Utility will charge battery as first priority. Solar energy will charge battery only when utility power is not available.
		Solar and Utility SNU 16	Solar energy and utility will charge battery at the same time.
		Only Solar OSO 16	Solar energy will be the only charger source no matter utility is available or not.
		If this inverter/charger is working in Battery mode or Power saving mode, only solar energy can charge battery. Solar energy will charge battery if it's available and sufficient.	
18	Alarm control	Alarm on (default) bON 18	Alarm off bOF 18
19	Auto return to default display screen	Return to default display screen (default) ESP 19	If selected, no matter how users switch display screen, it will automatically return to default display screen (Input voltage /output voltage) after no button is pressed for 1 minute.
		Stay at latest screen HEP 19	If selected, the display screen will stay at latest screen user finally switches.
20	Backlight control	Backlight on(default) LON 20	Backlight off LOF 20
22	Beeps while primary source is interrupted	Alarm on (default) AON 22	Alarm off AOF 22
23	Overload bypass: When enabled, the unit will transfer to line mode if overload occurs in battery mode.	Bypass disable (default) bYd 23	Bypass enable bYE 23
25	Record Fault code	Record enable FEN 25	Record disable (default) FdS 25
26	Bulk charging voltage (C.V voltage)	default setting: 56.4V 56.4ᵛᵈᶜ 26	
		If self-defined is selected in program 5, this program can be set up. Setting range is from 24.0V to 29.2V for 24V model and 48.0V to 58.4V for 48V model. Increment of each click is 0.1V.	
27	Floating charging voltage	default setting: 54.0V 54.0ᵛᵈᶜ 27	

		If self-defined is selected in program 5, this program can be set up. Setting range is from 48.0V to 58.4V. Increment of each click is 0.1V.	
29	Low DC cut-off voltage	default setting: 42.0V `42.0`vtc `29`	
		If self-defined is selected in program 5, this program can be set up. Setting range is from 40.0V 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.	
31	Solar power balance: When enabled, solar input power will be automatically adjusted according to connected load power.	Solar power balance enable (Default): `SbE` `31`	If selected, solar input power will be automatically adjusted according to the following formula: Max. input solar power = Max. battery charging power + Connected load power.
		Solar power balance disable: `Sbd` `31`	If selected, the solar input power will be the same to max. battery charging power no matter how much loads are connected. The max. battery charging power will be based on the setting current in program 02. (Max. solar power = Max. battery charging power)
32	Bulk charging time(C.V stage)	Automatically (Default): `AUt` `32`	If selected, inverter will judge this charging time automatically.
		5 min `5` `32`	The setting range is from 5 min to 900 min. Increment of each click is 5 min.
32	Bulk charging time(C.V stage)	900 min `900` `32`	The setting range is from 5 min to 900 min. Increment of each click is 5 min.
		If "USE" is selected in program 05, this program can be set up.	
33	Battery equalization	Battery equalization `EEn` `33`	Battery equalization disable (default) `EdS` `33`
		If "Flooded" or "User-Defined" is selected in program 05, this program can be set up.	
34	Battery equalization voltage	Default setting: 58.4V. Setting range is from 48V ~ 58.4V. Increment of each click is 0.1V. `58.4`vdc `34`	
35	Battery equalized time	60min (default) `60` `35`	Setting range is from 5min to 900min. Increment of each click is 5min.
36	Battery equalized timeout	120min (default) `120` `36`	Setting range is from 5min to 900 min. Increment of each click is 5 min.
37	Equalization interval	30days (default) `30d` `37`	Setting range is from 0 to 90 days. Increment of each click is 1 day

38	Allow neutral and grounding of AC output is connected together: When enabled, inverter can deliver signal to trigger grounding box to short neutral and grounding	Disable: Neutral and grounding of AC output is disconnected. (Default)	
		dI5 38	
		Enable: Neutral and grounding of AC output is connected.	
		ENA 38	
		This function is only available when the inverter is working with external grounding box. Only when the inverter is working in battery mode, it will trigger grounding box to connect neutral and grounding of AC output.	
39	Equalization activated immediately	Enable	Disable (default)
		AEN 39	AdS 39
		If equalization function is enabled in program 33, 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 shows "Eq". If "Disable" is selected, it will cancel equalization function until next activated equalization time arrives based on program 37 setting. At this time, "Eq" will not be shown in LCD main page.	

Display Setting
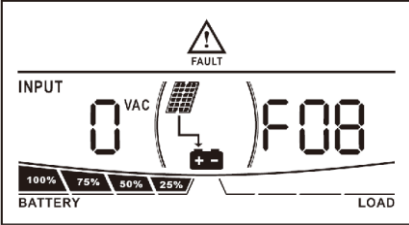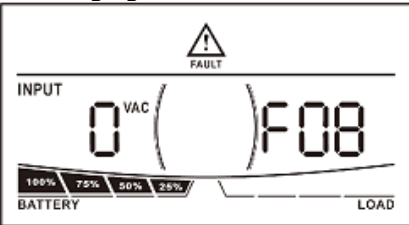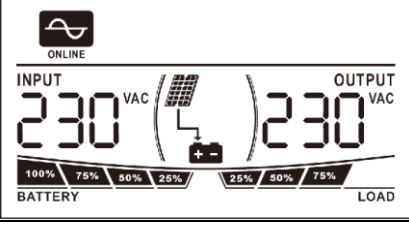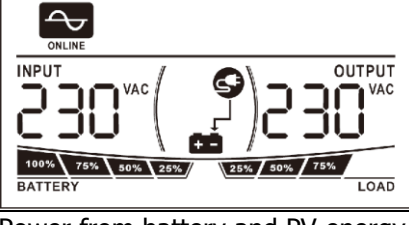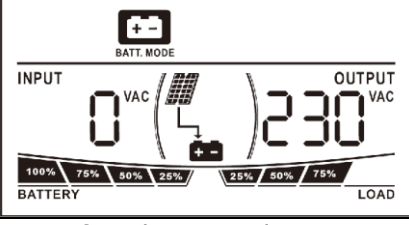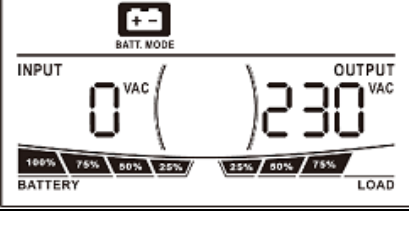
The LCD display information will be switched in turns by pressing "SELECT" key. The selectable information is switched to display in order as below: input voltage/output voltage, input frequency, PV voltage, total charging power, solar charging power, battery voltage/output frequency, main CPU Version and second CPU Version.

Selectable information	LCD display
Input voltage/Output voltage (Default Display Screen)	Input Voltage=230V, output voltage=230V
Input frequency	Input frequency=50Hz
PV voltage	PV voltage=60V
Total charging power	Total charging power=1600W
Solar charging power	Solar charging power=1000W

Battery voltage/ Output frequency	Battery voltage=28.0V, output frequency = 50.0Hz ![LCD display showing 28.0 VDC and 50.0 Hz OUTPUT, ONLINE] 28.0 VDC 50.0 Hz
Main CPU version checking	Main CPU version 1.00 ![LCD display showing U1 1.00, ONLINE] U1 1.00
Secondary CPU version checking	Secondary CPU version 1.00 ![LCD display showing U2 1.00, ONLINE] U2 1.00

Operating Mode Description

Operation mode	Description	LCD display
Standby mode / Power saving mode **Note:** *Standby mode: The inverter is not turned on yet but at this time, the inverter can charge battery without AC output. *Power saving mode: If enabled, the output of inverter will be off when connected load is pretty low or not detected.	No output is supplied by the unit but it still can charge batteries.	Charging by utility. ![LCD display INPUT 230 VAC, OUTPUT 0 VAC] Charging by PV energy. ![LCD display INPUT 0 VAC, OUTPUT 0 VAC, PV panel] No charging. ![LCD display INPUT 0 VAC, OUTPUT 0 VAC]

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.	PV energy and utility can charge batteries.	Charging by PV energy. No charging.
Line Mode	The unit will provide output power from the mains. It will also charge the battery at line mode.	Charging by PV energy Charging by utility.
Battery Mode	The unit will provide output power from battery and PV power.	Power from battery and PV energy. Power from battery only.

Fault 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
05	Output short circuited or over temperature is detected by internal converter components.	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
51	Over current or surge	F51
52	Bus voltage is too low	F52
53	Inverter soft start failed	F53
55	Over DC voltage in AC output	F55
56	Battery connection is open	F56
57	Current sensor failed	F57
58	Output voltage is too low	F58

Warning Indicator

Warning Event	Audible Alarm	Icon flashing
Fan is locked when inverter is on.	Beep three times every second	⚠ FAULT
Battery is over-charged	Beep once every second	100% 75% 50% 25% BATTERY
Low battery	Beep once every second	LOW BATT.
Overload	Beep once every 0.5 second	OVERLOAD
Output power derating	Beep twice every 3 seconds	
Battery equalization		EQ ⚠

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.
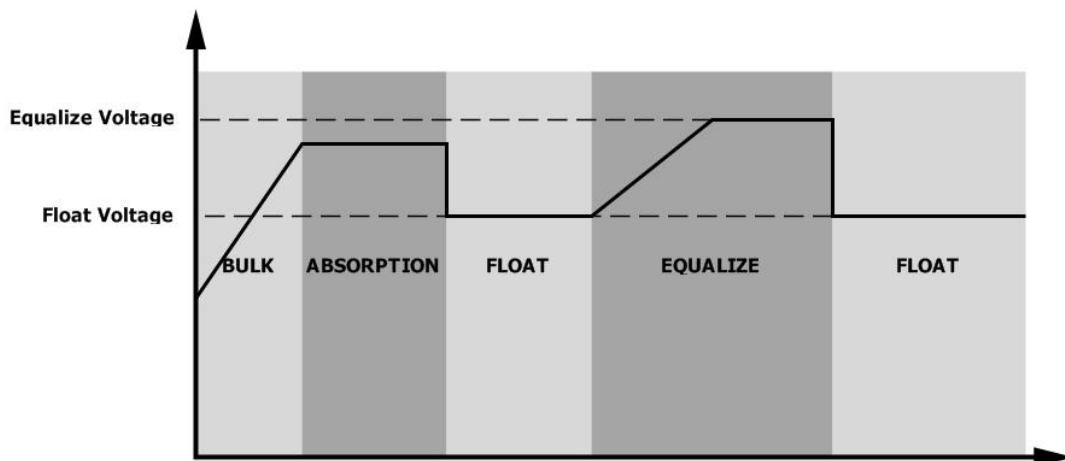
● **Equalize charging time and timeout**

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.
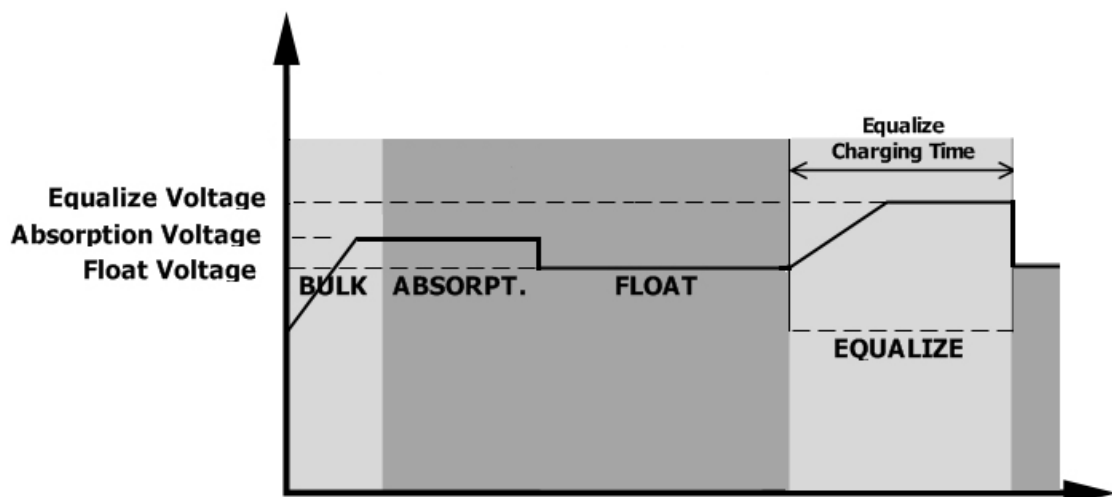
However, in Equalize stage, when battery equalized time is expired and battery voltage doesn't rise to battery equalization voltage point, the charge controller will extend the battery equalized time until battery voltage achieves battery equalization voltage. If battery voltage is still lower than battery equalization voltage when battery equalized timeout setting is over, the charge controller will stop equalization and return to float stage.
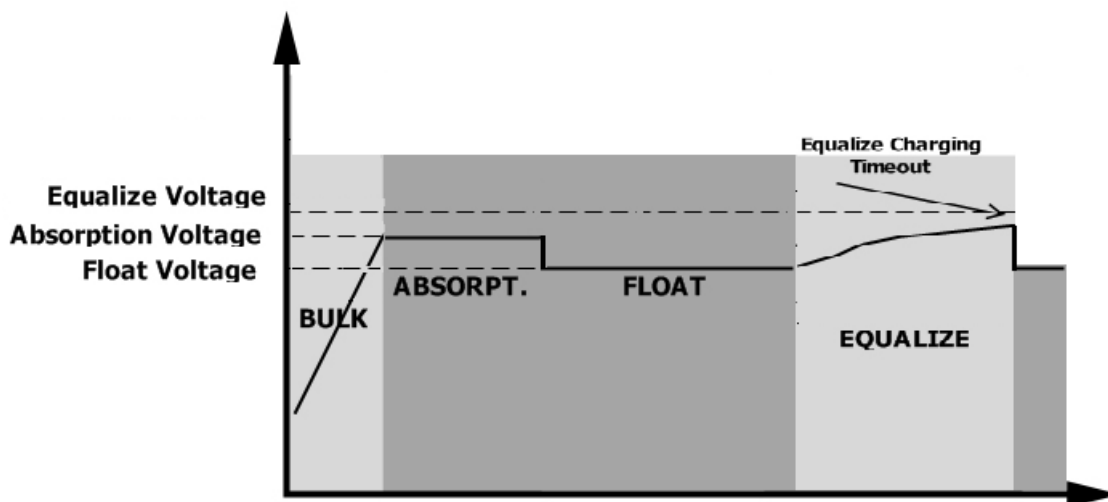
SPECIFICATIONS

Table 1 Line Mode Specifications

INVERTER MODEL	EPS-M 5KW
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
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 Battery mode: Electronic Circuits
Efficiency (Line Mode)	>95% (Rated R load, battery full charged)
Transfer Time	10ms typical (UPS); 20ms typical (Appliances)
Output power derating: When AC input voltage drops to 95V or 170V depending on models, the output power will be derated.	

*Transfer time may be longer than specified figure when the unit is operating in parallel system.

Table 2 Inverter Mode Specifications

INVERTER MODEL	EPS-M 5KW
Rated Output Power	5KVA/5KW
Output Voltage Waveform	Pure Sine Wave
Output Voltage Regulation	220Vac±5%
Output Frequency	60Hz or 50Hz
Peak Efficiency	90%
Overload Protection	5s@≥150% load; 10s@110%~150% load
Surge Capacity	2* rated power for 5 seconds
Nominal DC Input Voltage	48Vdc
Cold Start Voltage	46.0Vdc
Low DC Warning Voltage @ load < 20% @ 20% ≤ load < 50% @ load ≥ 50%	 44.0Vdc 42.8Vdc 40.4Vdc

Low DC Warning Return Voltage	
@ load < 20%	46.0Vdc
@ 20% ≤ load < 50%	44.8Vdc
@ load ≥ 50%	42.4Vdc
Low DC Cut-off Voltage	
@ load < 20%	42.0Vdc
@ 20% ≤ load < 50%	40.8Vdc
@ load ≥ 50%	38.4Vdc
High DC Recovery Voltage	58Vdc
High DC Cut-off Voltage	60Vdc
No Load Power Consumption	<50W
Saving Mode Power Consumption	<15W

Table 3 Charge Mode Specifications

Utility Charging Mode	
INVERTER MODEL	**EPS-M 5KW**
Charging Current (UPS) @ Nominal Input Voltage	Default: 30A, Max.: 60A
Bulk Charging Voltage	56.4Vdc
Floating Charging Voltage	54Vdc
Overcharge Protection	60Vdc
Charging Algorithm	3-Step
Charging Curve	

Table 4 Solar Charging Mode

INVERTER MODEL	EPS-M 5KW
Rated Power	4KW
Efficiency	98.0% max.
Max. PV Array Open Circuit Voltage	145Vdc
PV Array MPPT Voltage Range	60~115Vdc
Min battery voltage for PV charge	34Vdc
Standby Power Consumption	2W
Battery Voltage Accuracy	+/-0.3%
PV Voltage Accuracy	+/-2V
Charging Algorithm	3-Step
Joint Utility and Solar Charging	
Max Charging Current	140Amp
Default Charging Current	60Amp

Table 5 General Specifications

INVERTER MODEL	EPS-M 5KW
Safety Certification	CE
Operating Temperature Range	0°C to 40°C
Storage temperature	-15°C~ 60°C
Dimension (D*W*H), mm	400 x 438 x 86.3
Net Weight, kg	10.5

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.

- Parallel operation in single phase with up to 9 units. The maximum supported output power is 45KW.
- Nine units work together at its maximum to support three-phase equipment. Seven units support one phase at its maximum. The maximum supported output power is 45KW and one phase can be up to 35KW.

2. Package Contents

In the package, you will find the following items:

Parallel communication cable   Current sharing cable

3. Wiring Connection

The cable size of each inverter is shown as below:

Recommended battery cable and terminal size for each inverter:

Ring terminal:

| Model | Wire Size | Ring Terminal | | | Torque value |
| | | Cable mm² | Dimensions | | |
			D (mm)	L (mm)	
5KW	1*4AWG	22	6.4	33.2	2~ 3 Nm
	2*8AWG	14	6.4	29.2	
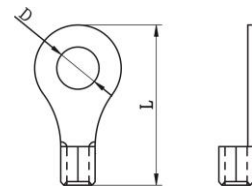
WARNING: Be sure the length of all battery cables is the same. Otherwise, there will be difference in voltage between inverter and battery which may cause parallel inverters not to work

Recommended cable size for AC input and output each inverter:

Model	AWG no.	Torque
5KW	8 AWG	1.4~1.6Nm

You need to connect the cables of each inverter. Take the battery cables for example: You need to use a connector or bus-bar as a joint to connect the battery cables, and then connect it to the battery terminal. The cable size used from joint to battery should be X times to the 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!! Make sure that the output neutral of all inverters should be combined together anytime.

CAUTION!! Please install the breaker at the side of battery and AC input. This will ensure the inverter securely is disconnected during maintenance and fully protected from over current of battery or AC input. The recommended mounted location of the breakers is shown in the chart in sections 4-1 and 4-2.

Recommended specification of battery breaker for each inverter:

Model	One unit*
5KW	100A/60VDC

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

Recommended specification of AC input breaker for single-phase application:

Inverter # Model	2 units	3 units	4 units	5 units	6 units	7 units	8 units	9 units
5KW	100A	150A	200A	250A	300A	350A	400A	450A

Note 1: It's accepted to use 50A breaker for each unit in parallel system and a breaker should be installed for each inverter in the AC input.

Note 2: In three-phase parallel system, you can use one 4-pole breaker. The accepted rating of breaker is based on the current for each phase with the maximum units. Otherwise, please follow the instruction in Note 1 mentioned above.

Recommended battery capacity

Inverter parallel numbers	2	3	4	5	6	7	8	9
Battery Capacity	400AH	600AH	800AH	1000AH	1200AH	1400AH	1600AH	1800AH
Recommended total charging current	80A	120A	160A	200A	240A	280A	320A	360A

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

Regarding the solar connection, please follow PV Connection section from page 7. Each inverter should be connected to solar panels individually.

4-1. Parallel Operation in Single phase

Two inverters in parallel:
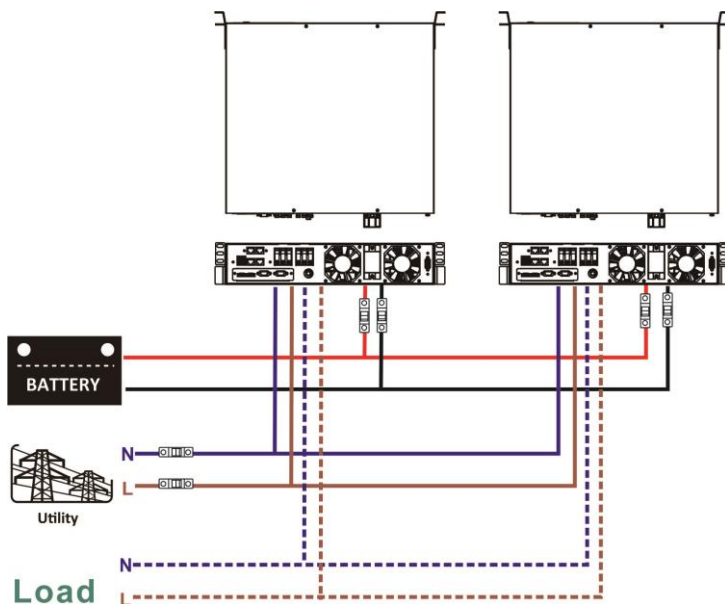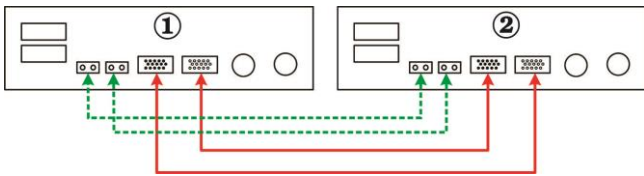
Power Connection

Communication Connection

Three inverters in parallel:
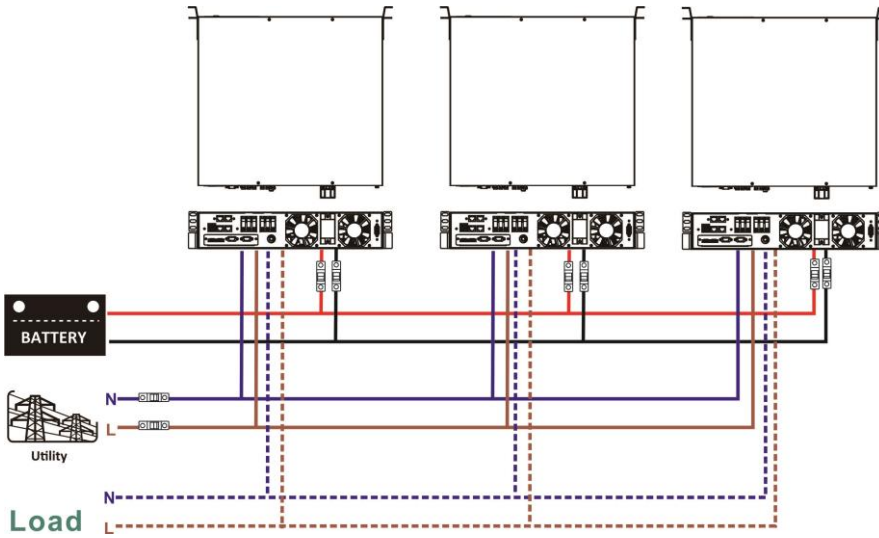
Power Connection

BATTERY

N
L
Utility

N
L
Load

Communication Connection

Four inverters in parallel:

Power Connection

BATTERY

N
L
Utility

N
Load L
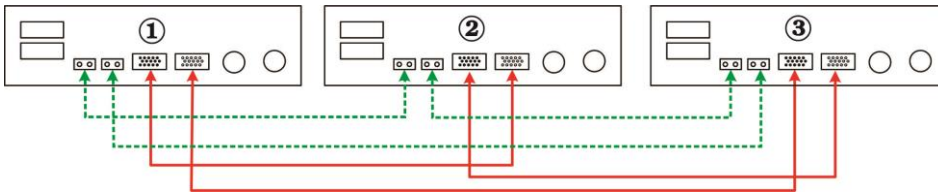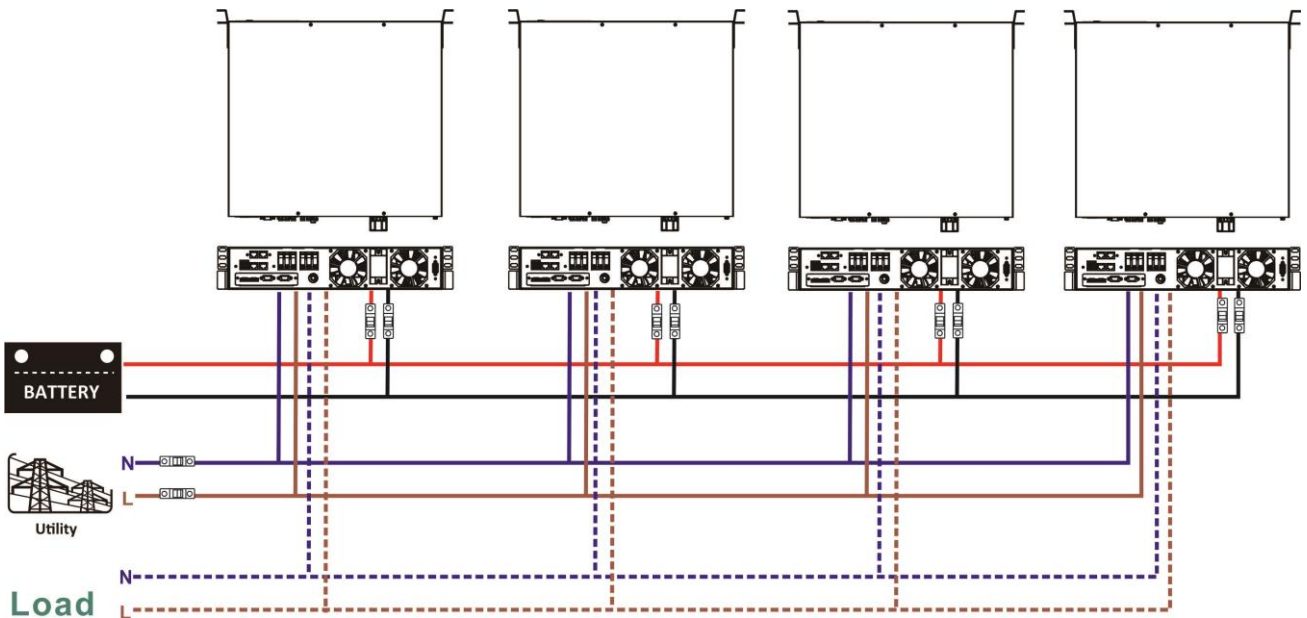
Communication Connection
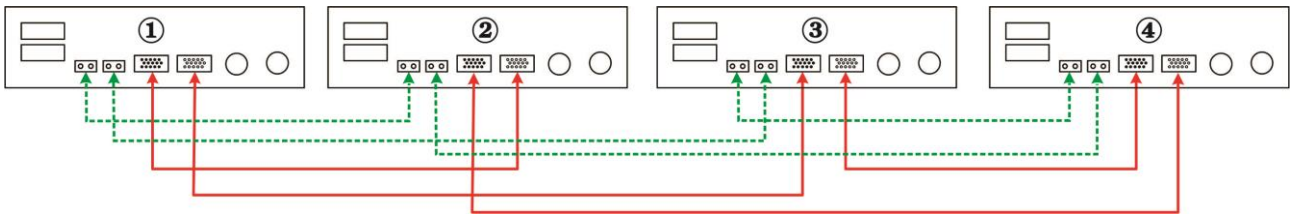
Five inverters in parallel:
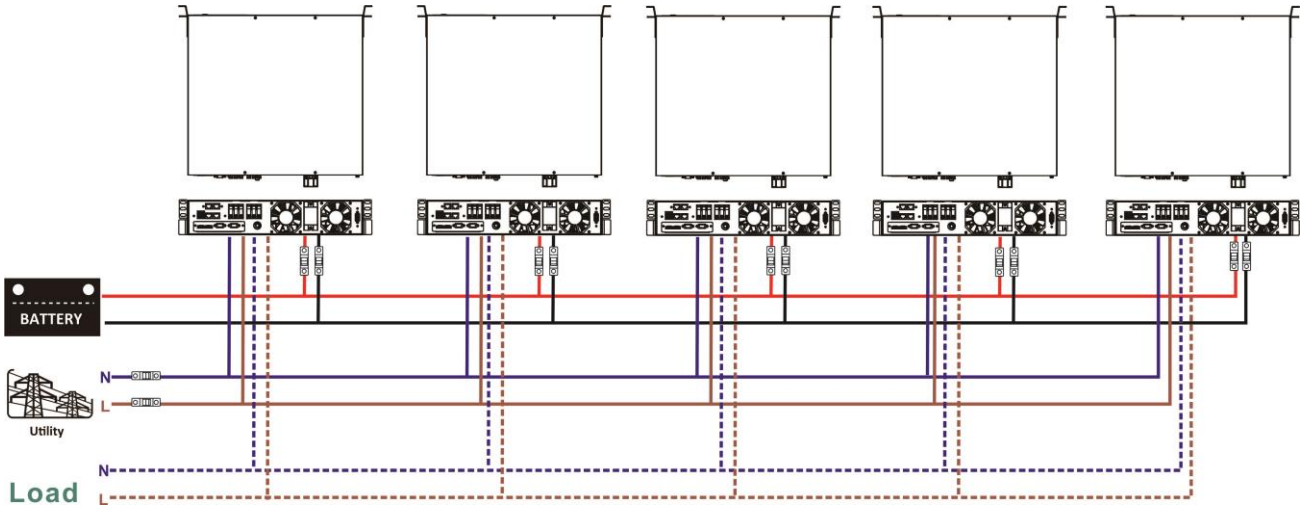
Power Connection

Communication Connection
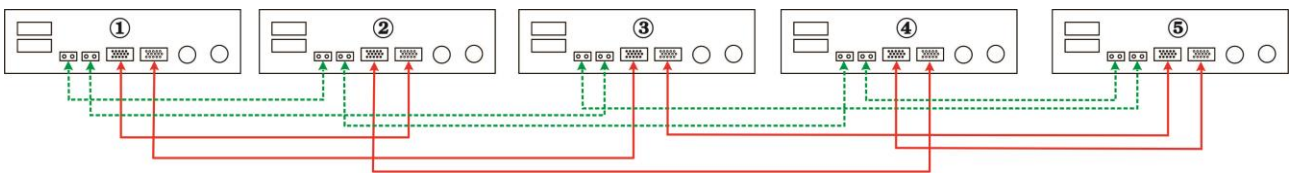
Six inverters in parallel:
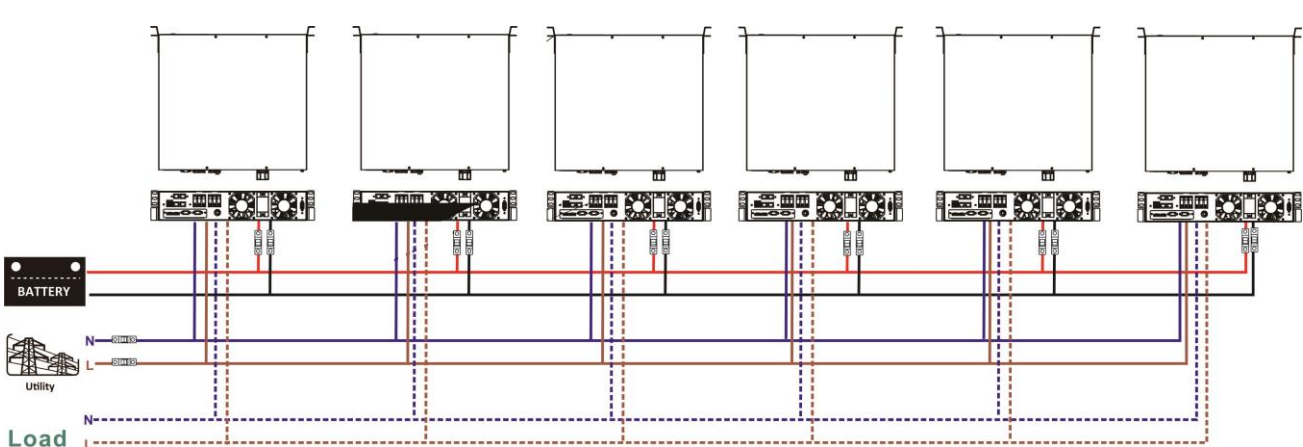
Power Connection

Communication Connection
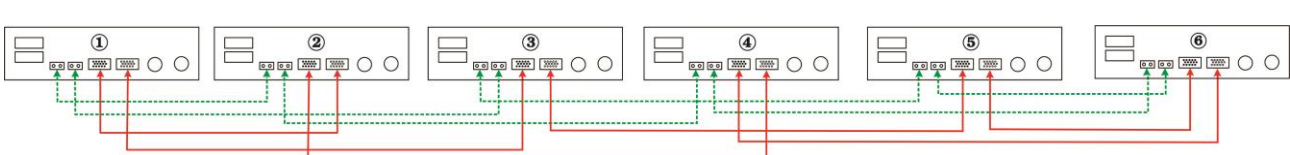
Seven to nine inverters in parallel:
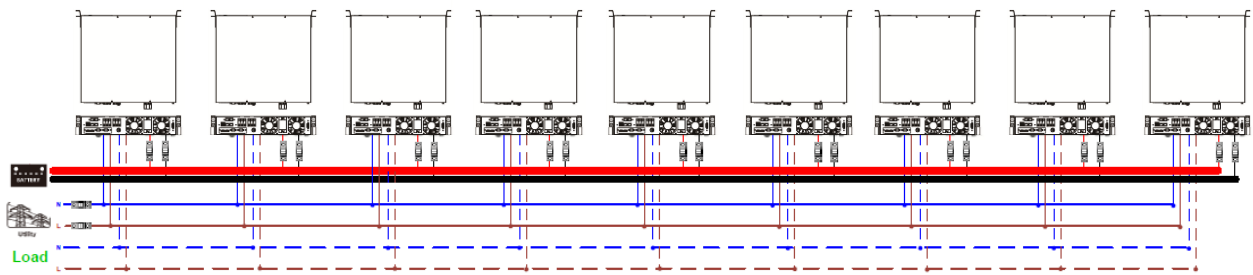
Power Connection

Communication Connection

➢ Seven inverters in parallel
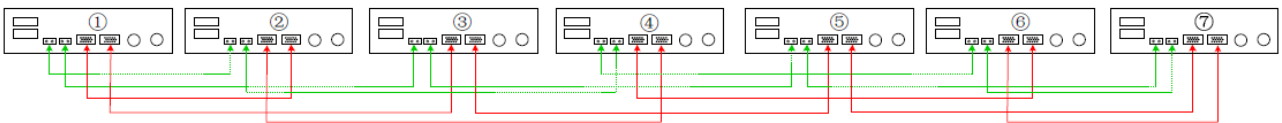
➢ Eight inverters in parallel
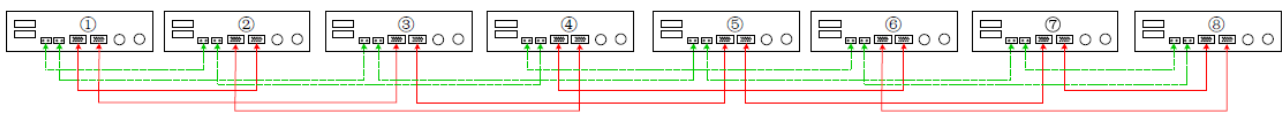
➢ Nine inverters in parallel

4-2. Support 3-phase equipment

Three inverters in each phase:
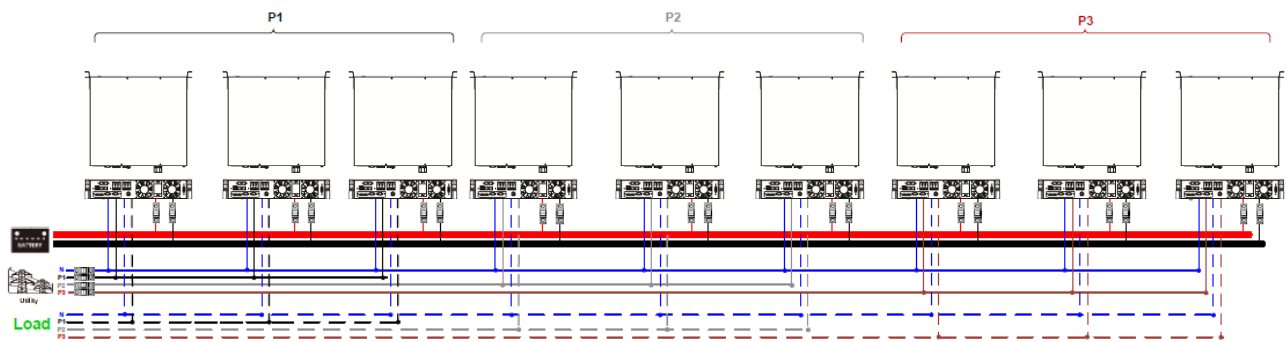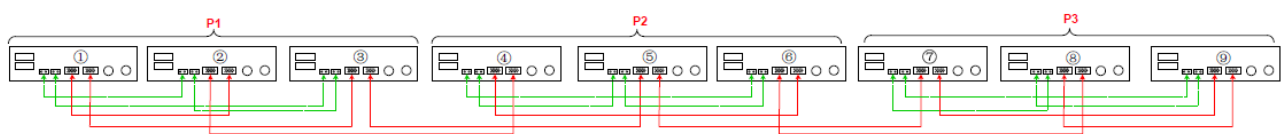
Power Connection

Communication Connection

Seven inverters in one phase and one inverter for the other two phases:

Power Connection
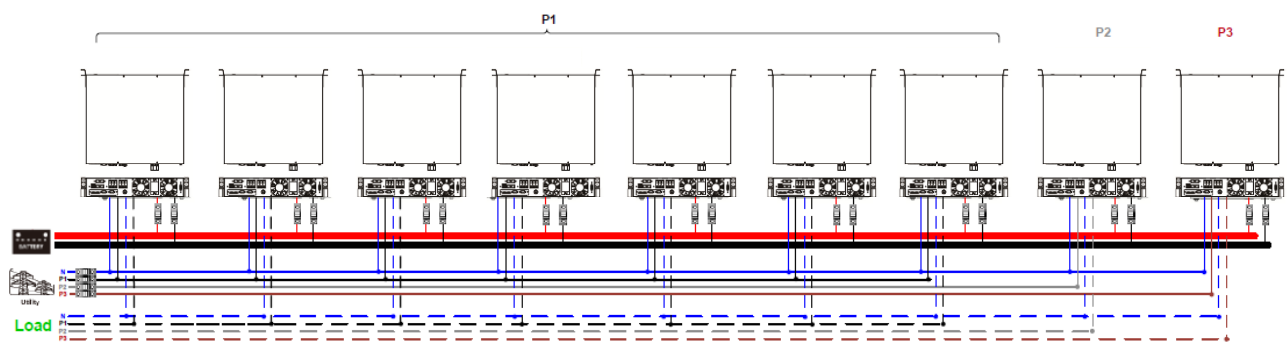
**Note**: It's up to customer's demand to pick 7 inverters on any phase. P1: L1-phase, P2: L2-phase, P3: L3-phase.
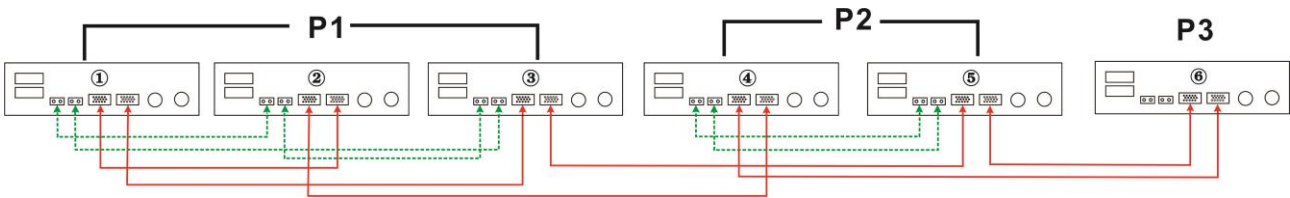
Communication Connection
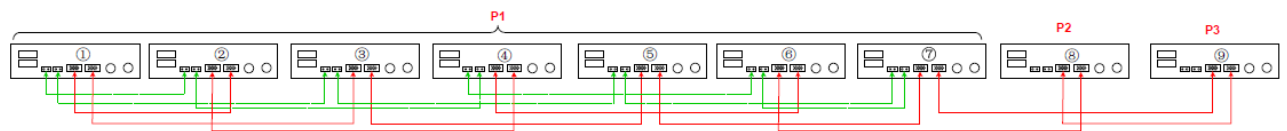
Note: If there is only one unit in one phase, this unit doesn't need to connect the current sharing cable.

Or you connect it like as below:

Two inverters in each phase:
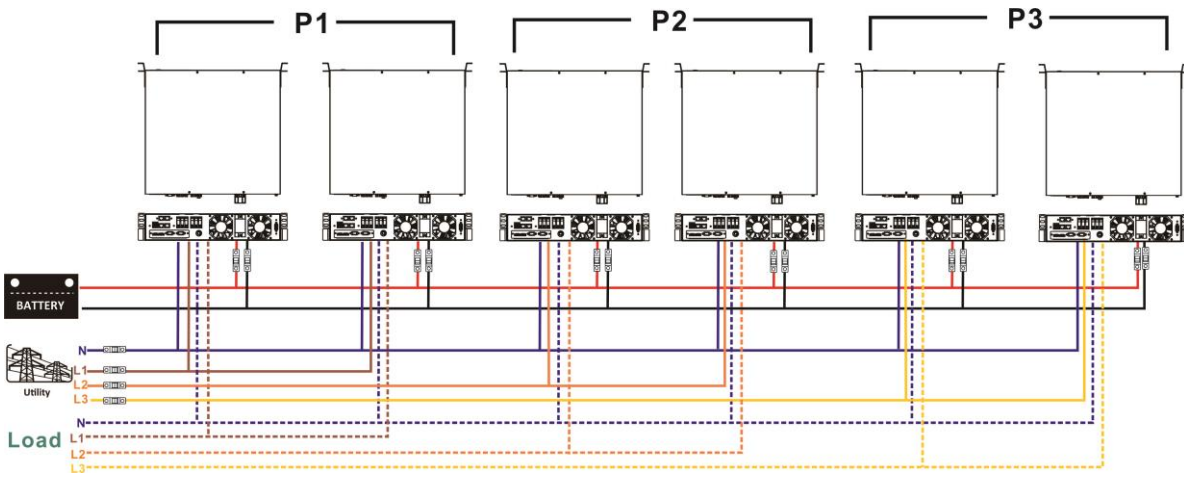
Power Connection

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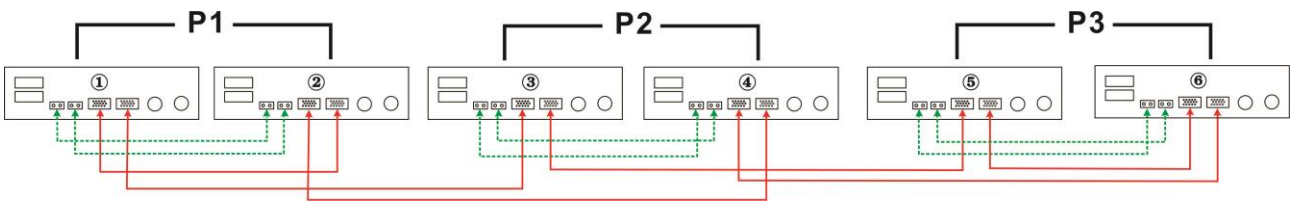
Four inverters in one phase and one inverter for the other two phases:
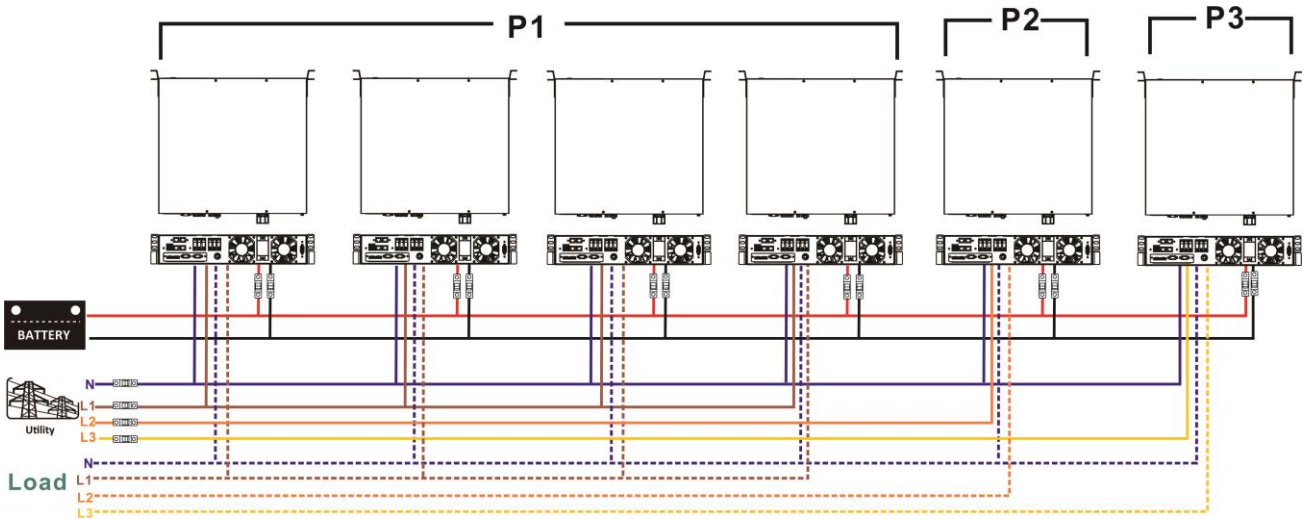
Power Connection

Note: It's up to customer's demand to pick 4 inverters in any phase.

     P1: L1-phase, **P2**: L2-phase, **P3**: L3-phase.

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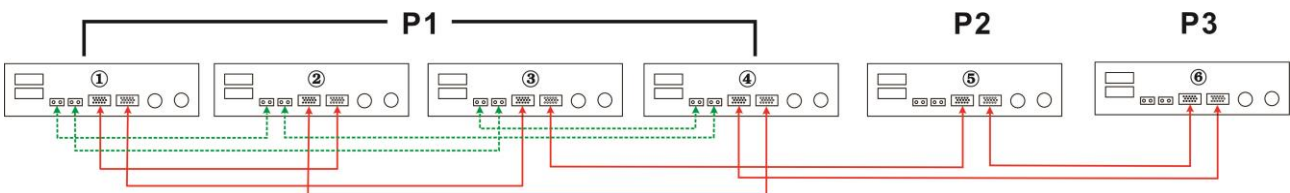
Three inverters in one phase, two inverters in second phase and one inverter for the third phase:
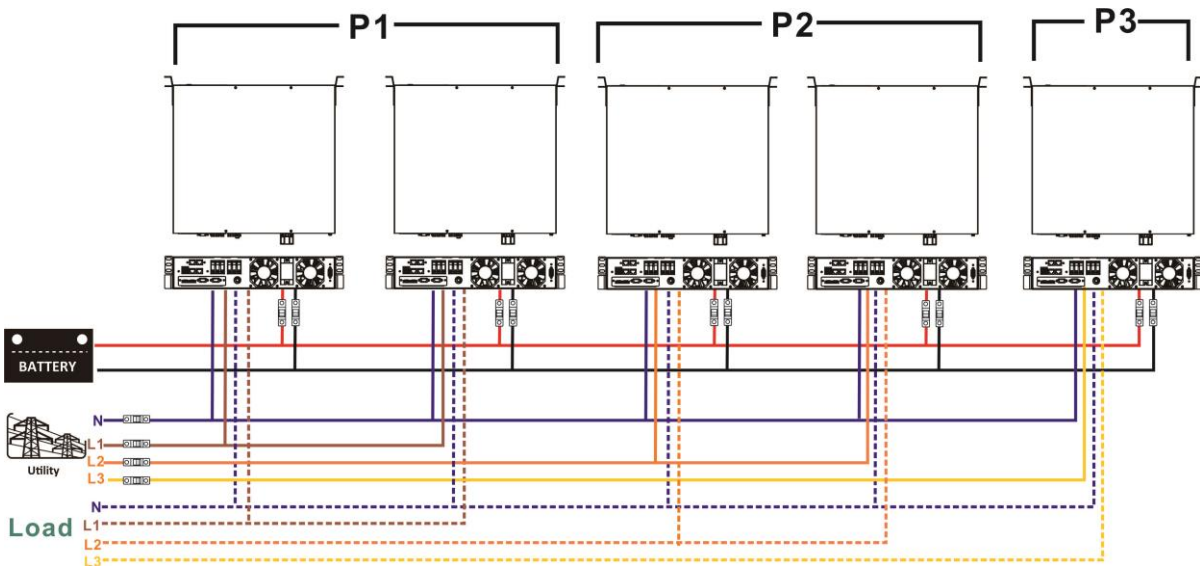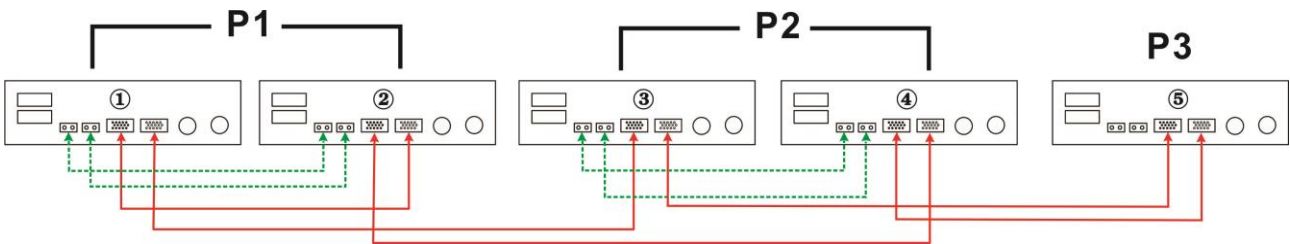
Power Connection
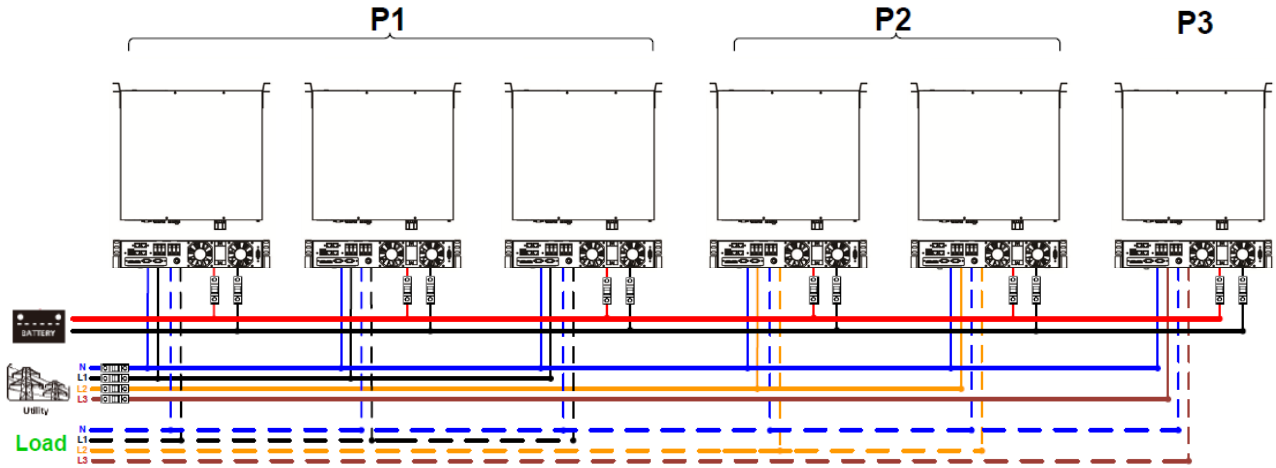
Communication Connection

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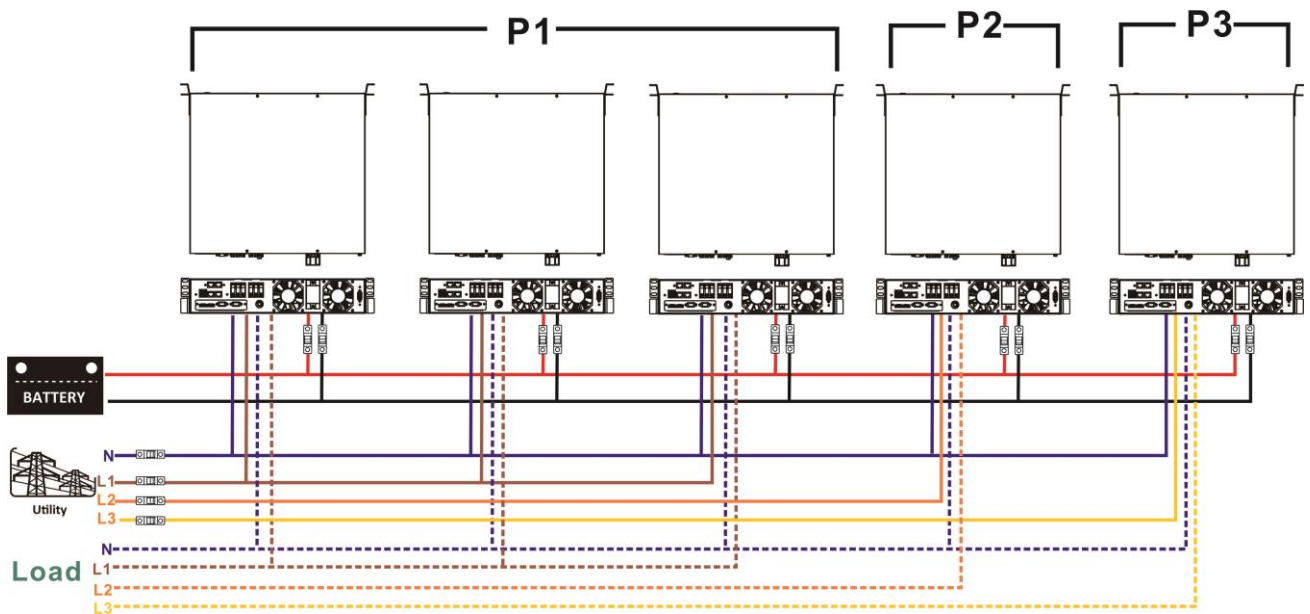
Power Connection
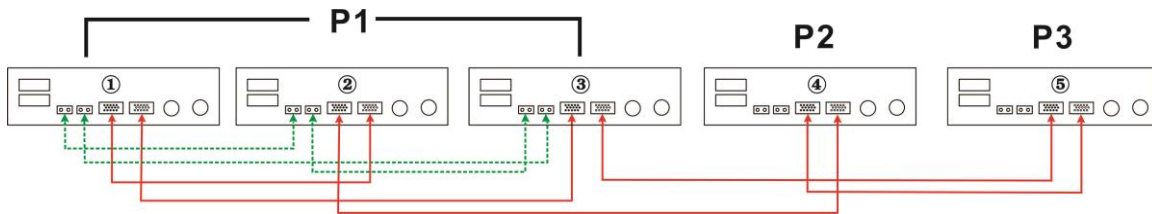

Communication Connection

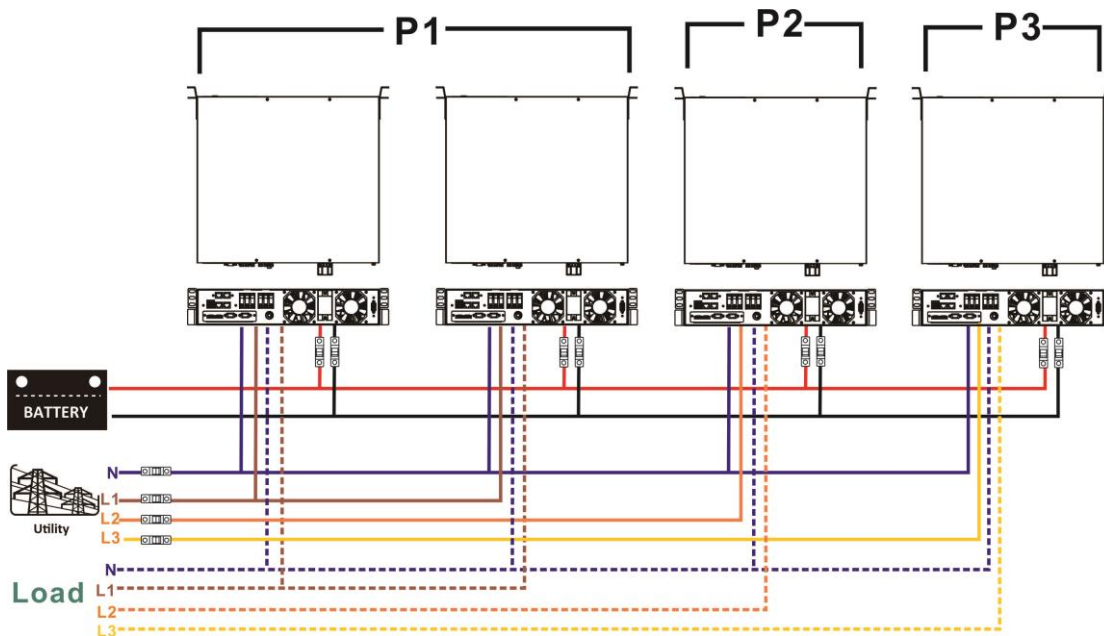Three inverters in one phase and only one inverter for the remaining phases:

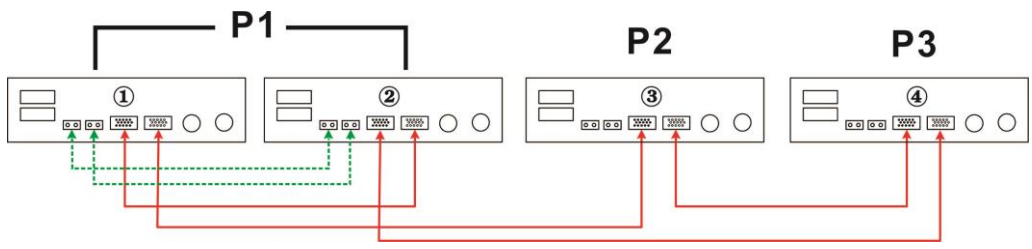**Power Connection**

Communication Connection

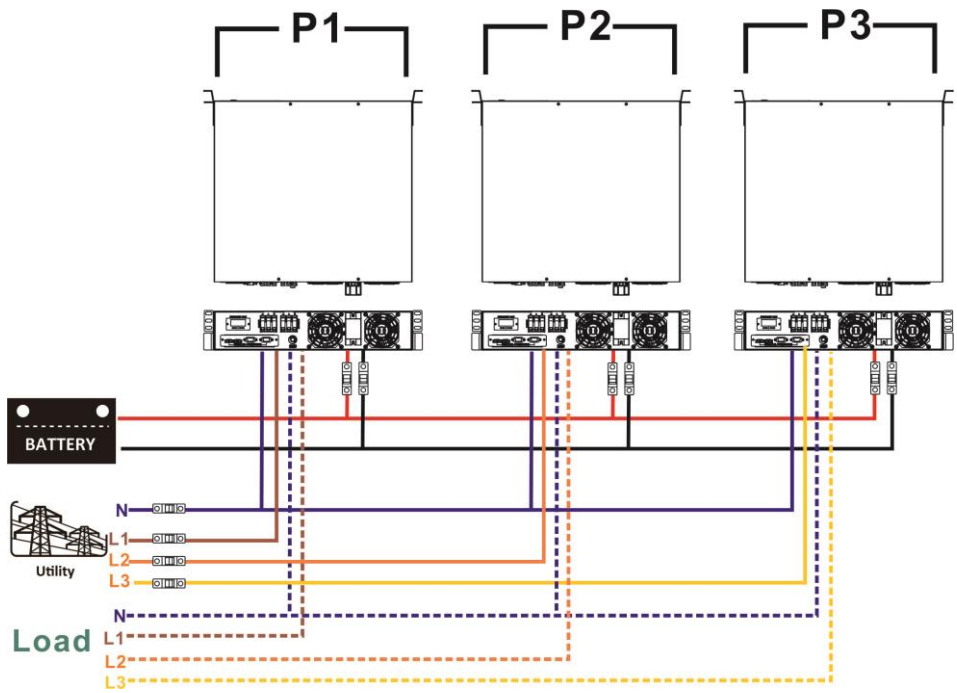Two inverters in one phase, and only one inverter for the remaining phases:

Power Connection
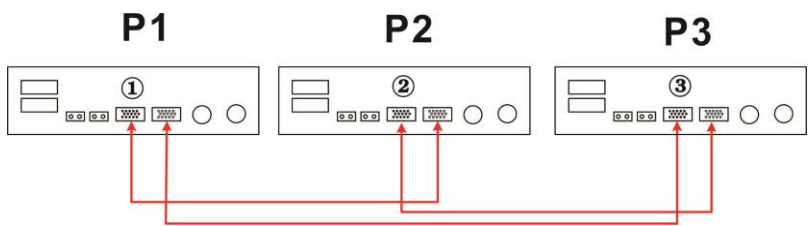
Communication Connection

One inverter in each phase:

Power Connection

Communication Connection

WARNING: Do not connect the sharing cable between the inverters in different phases. Otherwise, it may damage the inverters.

5. LCD Setting and Display

Setting Program:

Program	Description	Selectable option	
28	AC output mode *This setting is only available when the inverter is in standby mode (Switch off).	Single: 5I 5 528	When the units are used in parallel with single phase, please select "PAL" in program 28.
		Parallel: PAL 528	It is required to have at least 3 inverters or maximum 9 inverters to support three-phase equipment. It's required to have at least one inverter in each phase or it's up to seven inverters in one phase. Please refers to 5-2 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. Besides, power saving function will be automatically disabled.
		L1 phase: 3P I 528	
		L2 phase: 3P2 528	
		L3 phase: 3P3 528	
30	PV judge condition (Only apply for setting "Solar first" in program 1: Output source priority)	One Inverter (Default): OnE 530	When "ONE" is selected, as long as one of inverters has been connected to PV modules and PV input is normal, parallel or 3-phase system will continue working according to rule of "solar first" setting. For example, two units are connected in parallel and set "SOL" in output source priority. If one of two units has connected to PV modules and PV input is normal, the parallel system will provide power to loads from solar or battery power. If both of them are not sufficient, the system will provide power to loads from utility.
		All of Inverters: ALL 530	When "ALL" is selected, parallel or 3-phase system will continue working according to rule of "solar first" setting only when all of inverters are connected to PV modules. For example, two units are connected in parallel and set "SOL" in output source priority. When selecting "ALL" in program 30, it's necessary to have all inverters connected to PV modules and PV input is normal to allow the system to provide power to loads from solar and battery power. Otherwise, the system will provide power to loads from utility.

Fault code display:

Fault Code	Fault Event	Icon on
60	Power feedback protection	F60
71	Firmware version inconsistent	F11
72	Current sharing fault	F12
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

6. 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, so 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 at load side are open and each neutral wires of each unit are connected.

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 matched with the setting in the unit, they will work normally. If the sequences do not match, it won't work in Line mode. You must exchange the wires of P2 & P3 or exchange the setting of P2 & P3.

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 at 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.

7. 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 current cables are connected in all inverters. For supporting three-phase system, make sure the sharing current cables connected the inverters in the same phase, and disconnected 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 the firmware of all inverter to the same version. 2. Check the version of each inverter via LCD setting and make sure the CPU versions are the same. If not, please contact your instraller to update the firmware. 3. If the problem still remains after the firmwzre is updated, please contact your installer.
72	The output current of each inverter is different.	1. Check if shared cables are well connected 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.
81	Host data loss	
82	Synchronization data loss	2. If the problem remains, please contact your installer.
83	The battery voltage of each inverter is not the same.	1. Make sure all inverters share the same groups of batteries. 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 different, please check if all battery cables are in the same length and same type of material. Otherwise, please contact your installer for an SOP to calibrate the 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 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. 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 supporting three-phase system, make sure no "PAL" is set on #28. 3. If the problem remains, please contact your installer.

Appendix II: Approximate Back-up Time Table

Model	Load (W)	Backup Time @ 48Vdc 100Ah (min)	Backup Time @ 48Vdc 200Ah (min)
5KW	400	613	1288
	800	268	613
	1200	158	402
	1600	111	271
	2000	90	215
	2400	76	182
	2800	65	141
	3200	50	112
	3600	44	100
	4000	40	90
	5000	30	70

Note: Backup time depends on the quality of the battery, age of battery and type of battery.
Specifications of batteries may vary depending on different manufacturers.