

User Manual

MPPT Solar Charge Controller



Version: 1.2

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Information on this Manual

Validity

This manual is valid for the following devices:

- ▶ MPPT solar charge controller 48V60
- ▶ MPPT solar charge controller 48V80
- ▶ MPPT solar charge controller 48V100
- ▶ MPPT solar charge controller 48V120

Scope

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

Target Group

This document is intended for qualified persons and end users. Tasks that do not require any particular qualification can also be performed by end users. Qualified persons must have the following skills:

- ▶ Knowledge of how a solar charge controller works and is operated
- ▶ Training in how to deal with the dangers and risks associated with installing and using electrical devices and installations
- ▶ Training in the installation and commissioning of electrical devices and installations
- ▶ Knowledge of the applicable standards and directives
- ▶ Knowledge of and compliance with this document and all safety information

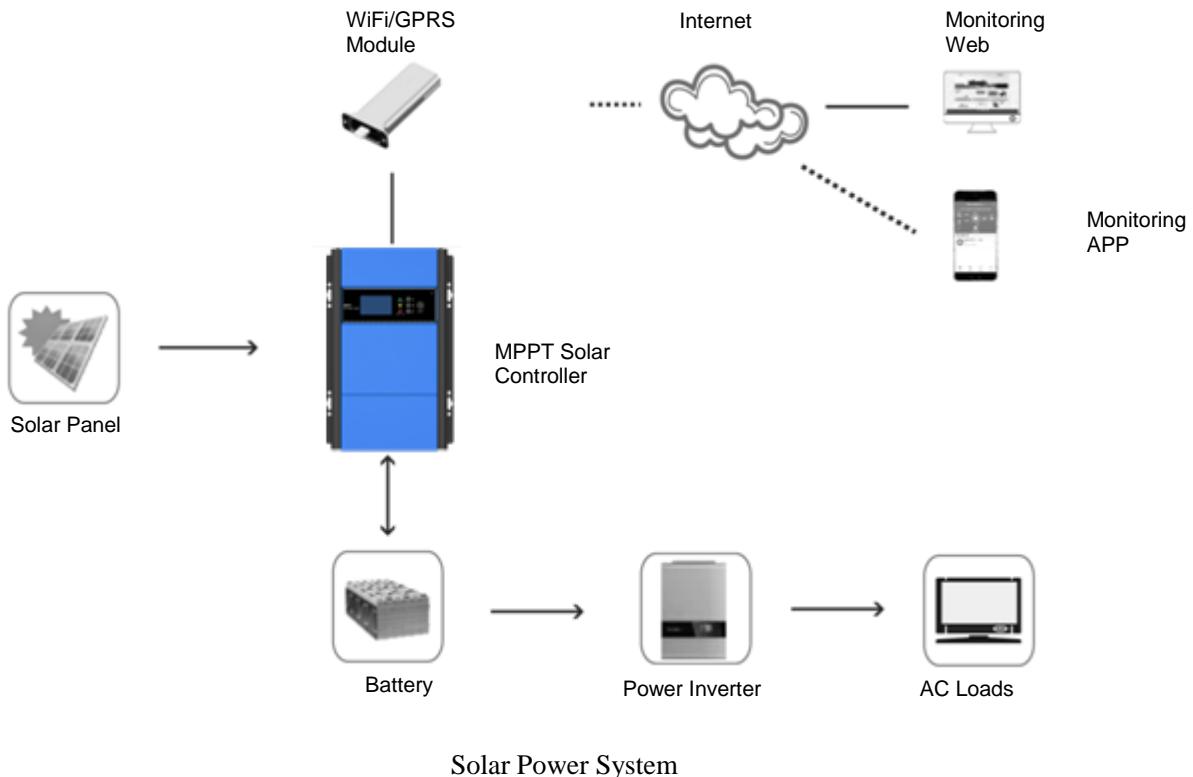
Safety Instructions



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

1. **CAUTION** – Only qualified personnel can install this device with battery.
2. Before using the unit, read all instructions and caution marks on the unit, understand the batteries and all appropriate sections of this manual.
3. **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.
4. **NEVER** charge a frozen battery.
5. 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.
6. To reduce risk of electric shock, disconnect all wiring before attempting any maintenance or cleaning. Turning off the unit will not reduce this risk.
7. Be very cautious when working with metal tools on or around batteries. A potential risk, such as dropping a tool to spark or short circuit batteries or other electrical parts, could cause an explosion.
8. Please strictly follow installation procedure when you want to disconnect terminals. Please refer to INSTALLATION section of this manual for the details.
9. **Warning!!** Only qualified service persons are able to service this device. If errors still persist after following troubleshooting table, please send this solar charge controller back to local dealer or service center for maintenance.

Introduction



Solar Power System

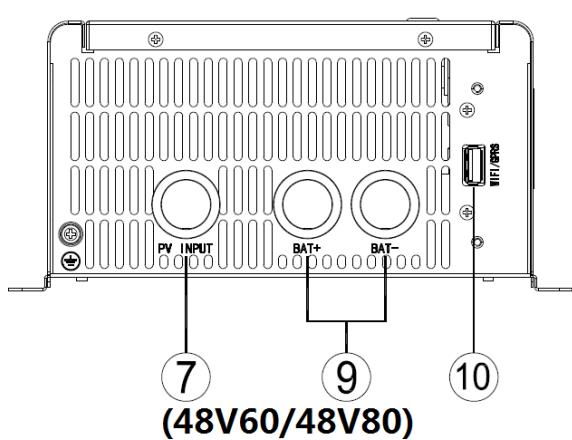
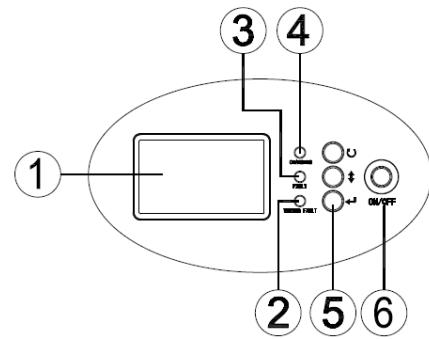
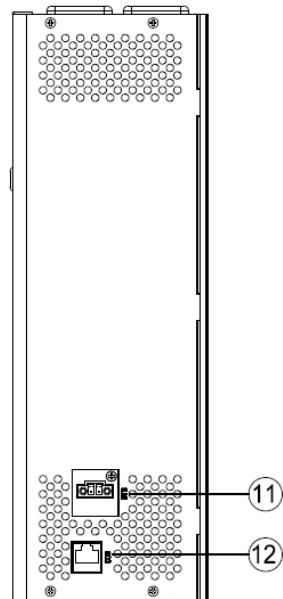
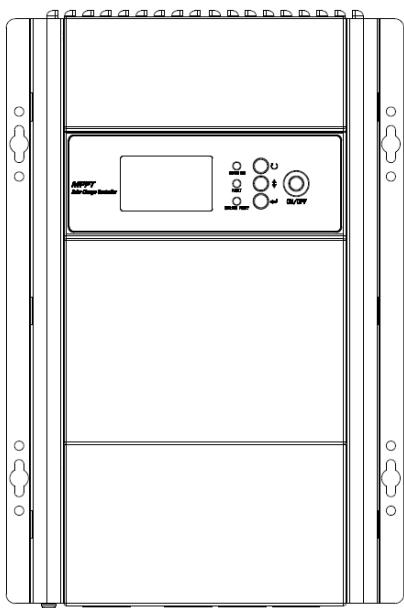
This MPPT solar controller is an advanced maximum power point tracking solar battery charger. The controller features a smart tracking algorithm that finds and maintains operation at the solar array peak power point, maximizing energy converting efficiency.

The MPPT solar controller charging process has been optimized for long battery life and improved system performance. Self-diagnostics and electronic error protections prevent damage when installation mistakes or system faults occur. The WiFi / GPRS module is a plug-and-play monitoring device to be installed on the controller. With this device, users can monitor the status of the PV system from the mobile phone or from the website anytime anywhere.

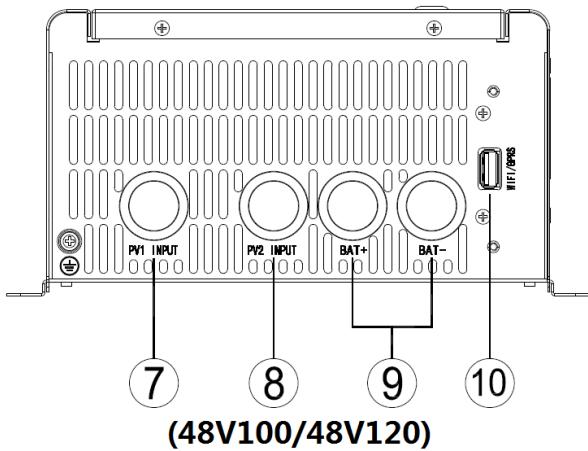
Features

- ▶ 12V/24V/48V auto work, parallel design
- ▶ Multi-stage charging optimizes battery performance
- ▶ MPPT tracking efficiency >99.5%, peak conversion efficiency 98%
- ▶ Compatible with gel, AGM flooded, sealed lead acid and lithium battery
- ▶ Comprehensive protection
- ▶ WiFi/GPRS Monitoring (optional)
- ▶ Communication Port for BMS (optional)

Product Overview



(48V60/48V80)



(48V100/48V120)

1. LCD Display
2. Warning indicator
3. Fault indicator
4. Charging indicator
5. Function buttons
6. On/Off switch
7. PV1 \pm input
8. PV2 \pm input
9. Battery input
10. WiFi/GPRS communication port
11. BTS
12. BMS communication port

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 in the package:

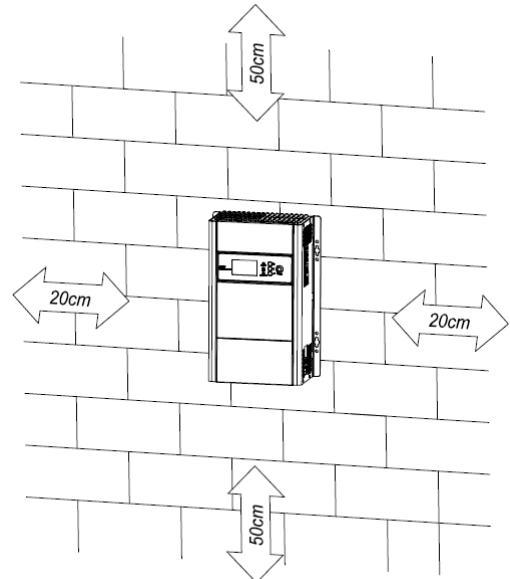
- ▶ The unit x 1
- ▶ User manual x1
- ▶ Communication wire x1
- ▶ BTS temperature control wire (optional) x1
- ▶ Cube WiFi/GPRS (optional) x1

Mounting the Unit

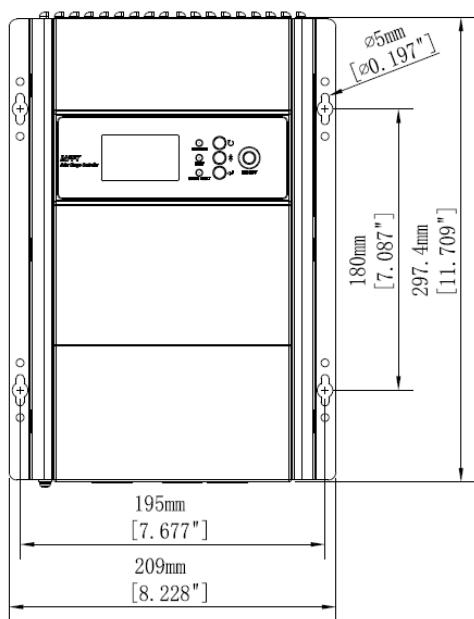
Consider the following points before selecting where to install:

- ▶ Do not mount the controller on flammable construction materials.
- ▶ Mount on a solid surface
- ▶ Install this controller 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.

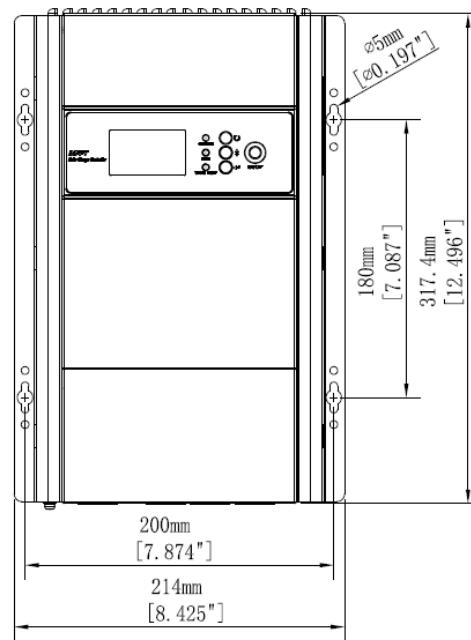
⚠ SUITABLE FOR MOUNTING ON CONCRETE OR OTHER NON-COMBUSTIBLE SURFACE ONLY.



Dimension & Structure



(48V60/48V80)



(48V100/48V120)

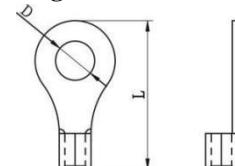
Battery Connection

CAUTION: For safety operation and regulation compliance, it's requested to install a separate DC over-current protector or disconnect device between battery and controller. 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.

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

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.

Ring terminal:

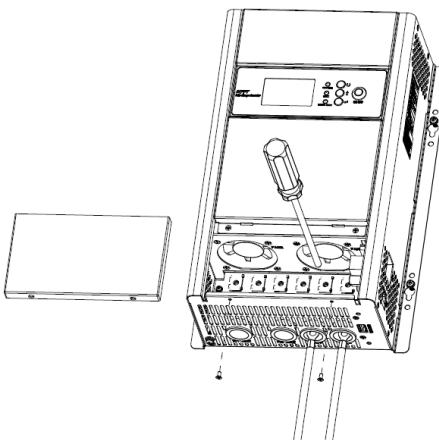


Note: For the lead acid battery, the recommended charge current is 0.2C(C=battery capacity). Please follow below steps to implement lead-acid battery connection:

1. Assemble battery right terminal based on recommended battery cable and terminal size.
2. Connect all battery packs as units requires. It's suggested to connect at least 550Ah capacity battery for 48V/120A model.

Model	48V60	48V80	48V100	48V120
Capacity of battery	250Ah	350Ah	450Ah	550Ah

Insert the ring terminal of battery cable flatly into battery connector of controller and make sure the bolts are tightened with torque of 2-3Nm. Make sure polarity at both the battery and the controller 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 controller 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, be sure positive (+) must be connected to positive (+) and negative (-) must be connected to negative (-).

Recommended cable size:

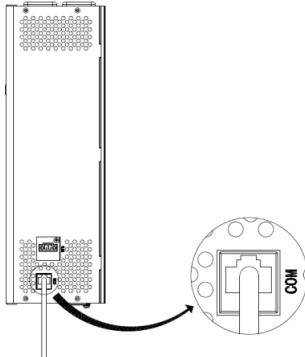
Model	Copper Wire Type	Recommended Size	Minimum Size
60A	Copper	5AWG	6AWG
80A	Copper	4AWG	5AWG
100A	Copper	2AWG	3AWG
120A	Copper	2AWG	2AWG

Lithium Battery Connection

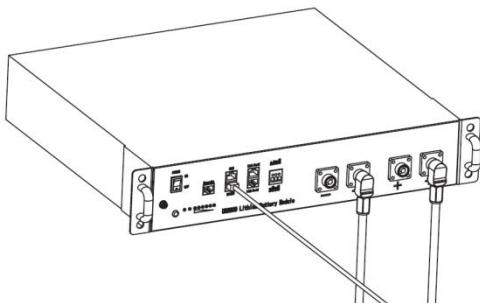
If choosing lithium battery for the controller, you are allowed to use the lithium battery only which have configured. There're two connectors on the lithium battery, RJ45 port of BMS and power cable.

Please follow below steps to implement lithium battery connection:

1. Assemble battery ring terminal based on recommended battery cable and terminal size (same as Lead acid, see section Lead-acid Battery connection for details) .
2. Insert the ring terminal of battery cable flatly into battery connector of inverter and make sure the bolts are tightened with torque of 2-3Nm. Make sure polarity at both the battery and the inverter/charge is correctly connected and ring terminals are tightly screwed to the battery terminals.
3. Connect the end of RJ45 of battery to the communication port of the controller.



4. The other end of RJ45 insert to battery comm port.



Note: If choosing lithium battery, make sure to connect the BMS communication cable between the battery and the controller. You need to choose battery type as "lithium battery"

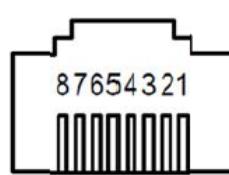
Lithium battery communication and setting

In order to communicate with battery BMS, you should set the battery type to "LI" in Program 2. Then the LCD will switch to Program 21, which is to set the protocol type. There are several RS485 protocols in the controller which can match some customized battery. Please consult with supplier first before you choosing the battery model.

1. Connecting the communication port between the controller and battery

Make sure the lithium battery BMS port connects to the controller is Pin to Pin, the controller communication port pin assignment shown as below ("COM" port on the controller, support RS485 or CAN protocol).

Pin number	RS485	CAN
1	RS485B	--
2	RS485A	--
3	--	--
4	--	CANH
5	--	CANL
6	--	--
7	--	--
8	--	--



2. LCD setting

To connect battery BMS, need to set the battery type as "LI" in Program 02. After set "LI" in Program 02, it will switch to Program 21 to choose battery type. There will be some options under Program 21.

02	Battery type	AGM (default) AGM 02	
		Flooded FLD 02	
		User-Defined USE 02	
		If "User-Defined" is selected, battery charge voltage and low DC cut-off voltage can be set up in program 05,06 and 07.	
		User-Defined 2 US2 02	
Suitable for lithium battery when inverter not communicated with BMS. If "US2" is selected, battery charge voltage and low DC cut-off voltage can be set up in program 05,06 and 07.			
Lithium Li 02		Only suitable for lithium battery when inverter communicated with BMS. The lithium battery BMS communication protocol options: L01 21 L99 21	

When the battery type set to Li, the setting option 07 will change to display percent.

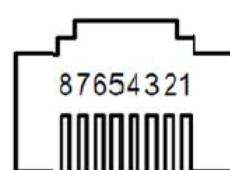
Note: When the battery type set as "Li", the Maximum charge current can't be modified by the user. When the communication fail , the inverter will cut off output.

07	Low DC cut-off SOC. If "Li" is selected in program 2, this program can be set up.	20 % 07
Default 20%, 5%~50% Settable.		

Inverter Connection

Some specific off grid inverters and this controller can communicate to summarize data. Make sure the inverter connect to the controller Pin to Pin as below by communication port ("COM" port on the controller).

Pin number	RS485	CAN
1	RS485B	--
2	RS485A	--
3	--	--
4	--	CANH
5	--	CANL
6	--	--
7	--	--
8	--	--

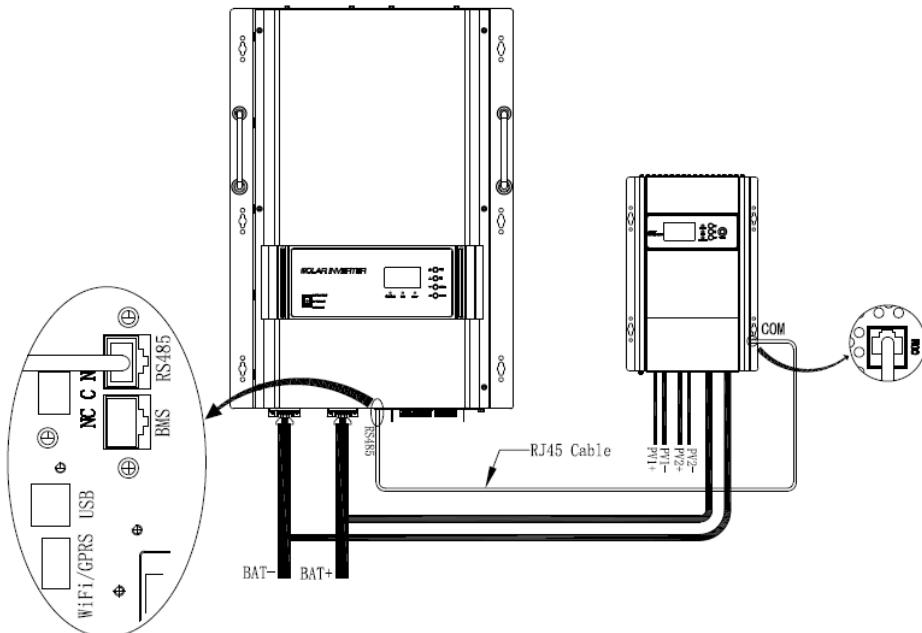


There will be 2 options to connect with inverter in Program 08. Set to mode CL1 if you select RS485 communication, set to CL2 if you select CAN communication. Details as below:

		SIG 08
08	Communication model	SIG (default), used to communicate with upper computer
		CL1 08
		CL1, used to communicate through RS485
		CL2 08
		CL2, used to communicate through CAN.
09	RS485 Communication Address	I 09 Address 1 (default) Used to communicate with controller in CL1 or CL2, or used to communicate with upper computer in SIG

Communication operation between one inverter and one controller

Set parameters on the controller: Program 08 as CL1, Program 09 as Protocol 2.



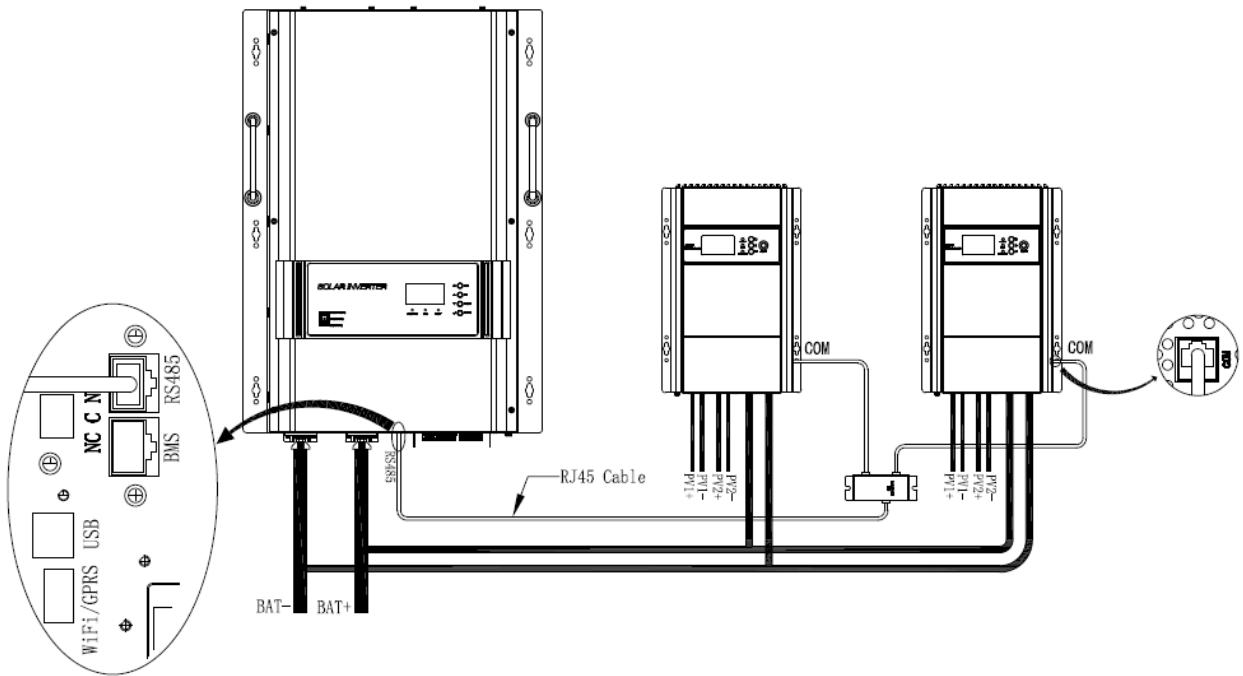
Communication operation between one inverter and two controllers

Set parameters on the first controller: Program 08 as CL1, Program 09 as Protocol 2.

Set parameters on the second controller: Program 08 as CL1, Program 09 as Protocol 3.

There will be a RS485/CAN Hub needed to converge the communication cables from the controllers to the inverter.
RS485/CAN Hub:





Note: The battery type should be set as the same for the inverter and controllers.

PV Connection

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

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 PV module connection. To reduce risk of injury, please use the proper recommended cable size as below.

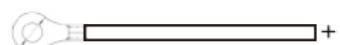
PV Module Selection:

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

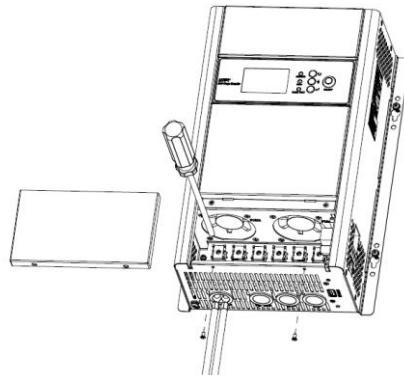
1. Open circuit Voltage (Voc) of PV modules not exceeds max. PV array open circuit voltage of controller.
2. Open circuit Voltage (Voc) of PV modules should be higher than min. battery voltage.

MPPT CONTROLLER MODEL	60A / 80A / 100A / 120A
Max. PV Array Open Circuit Voltage	150Vdc max
PV Array MPPT Voltage Range	60~145Vdc

Please follow below steps to implement PV module connection:



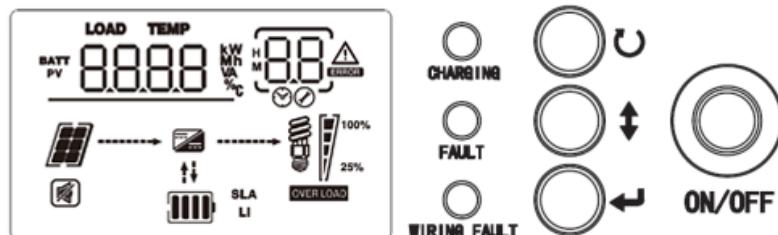
1. Remove insulation sleeve 10 mm for positive and negative conductors.
2. Check correct polarity of connection cable from PV modules and PV input connectors. Peel the plastic tube 10mm from the positive polarity end of the wire. Insert the wire into the ring terminal and crimp the edges by tools. Then connect the wire to the PV Input port "PV+" of the controller. Also use the same method to connect the PV Input port "PV-".
3. Make sure the wires are securely connected.



Operation

Operation and Display Panel

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



Power ON/OFF

Press the “ON/OFF” button to turn on or turn off the system.

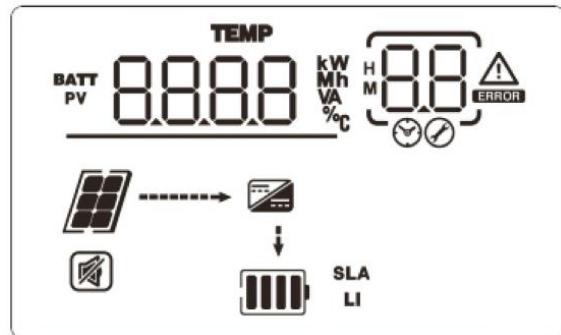
LED Indicator

LED Indicator		Messages	
CHARGING	Green	Solid On	System is running fine, but not charging now
		Flashing	During charging now
FAULT	Red	Solid On	An error occurs
		Flashing	A warning occurs
WIRING FAULT	Red	Solid On	Battery wiring reversed

Function Buttons

Button	Description
ESC	To exit setting mode
UP/DOWN	To change selection
ENTER	To confirm the selection in setting mode or enter setting mode

LCD Display Icons



Icon	Function Description
System Parameters Information	
BATT	Indicates the battery
PV	Indicates the PV input
LOAD TEMP 8.888 <small>kW MWh VA %C</small>	Indicate PV voltage, battery voltage, charging current etc.
Configuration Program and Fault Information	
	Indicates the setting programs.
	Warning: flashing with warning code.
	Fault: lighting with fault code
System Status Information	
	Indicates battery level by 0-24%, 25-49%, 50-74% and 75-100% in battery mode and charging status in line mode.
SLA	Indicates SLA battery
LI	Indicates Lithium battery
	Indicates unit connects to the PV panel.
	Indicates the DC/DC circuit is working.
	Indicates unit alarm is disabled.

LCD Setting

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

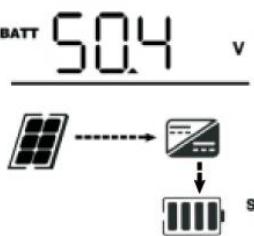
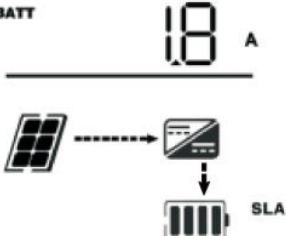
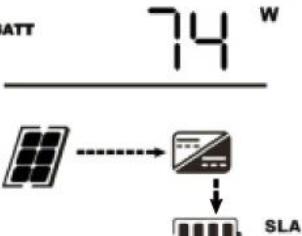
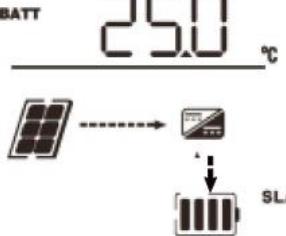
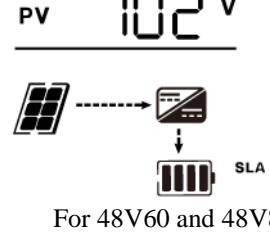
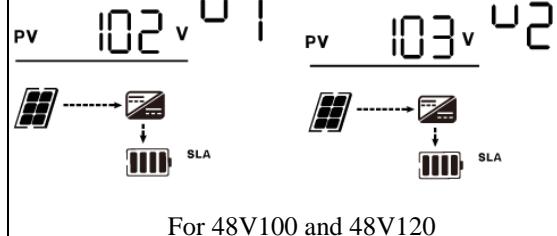
Program	Description	Setting Option	
01	Maximum charging current	PV 80 A 0 !	120A model: Default 60A, 10A~120A Settable 100A model: Default 60A, 10A~100A Settable 80A model: Default 60A, 10A~80A Settable 60A model: Default 60A, 10A~60A Settable (If Li is selected in program 2, this program can't be set up)
02	Battery type	AGM (default) AGM 02 Flooded FLd 02 User-Defined USE 02 User-Defined 2 US2 02 Lithium LI 02	If “User-Defined” is selected, battery charge voltage and low DC cut-off voltage can be set up in program 05,06 and 07. Suitable for lithium battery when inverter not communicated with BMS. If “US2” is selected, battery charge voltage and low DC cut-off voltage can be set up in program 05,06 and 07. Only suitable for lithium battery when inverter communicated with BMS. The lithium battery BMS communication protocol options: L01 21 L99 21
03	Buzzer	Buzzer on (default) b0n 03	Buzzer off b0f 03
04	Backlight Control	Backlight on (default) L0n 04	Backlight off L0f 04

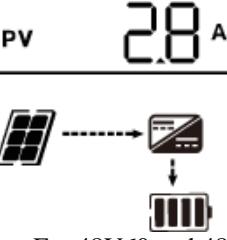
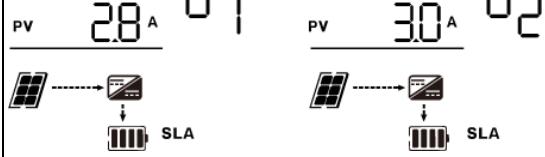
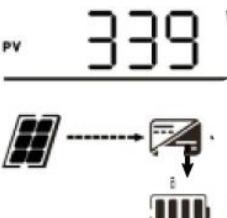
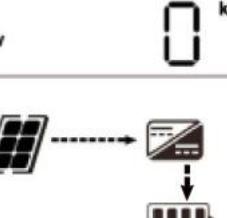
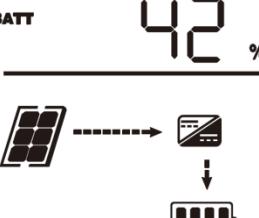
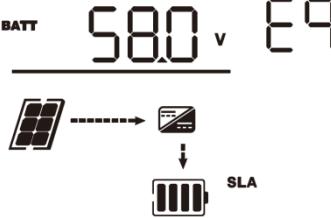
05	Bulk charging voltage (C.V voltage)	BATT 56.4 v 05 48V mode: default 56.4V, 48.0V~58.4V Settable 24V mode: default 28.2V, 24.0V~29.2V Settable 12V mode: default 14.1V, 12.0V~14.6V Settable If "Li" is selected ,it can't be set up
06	Floating charging voltage	BATT 54.0 v 06 48V mode: default 54.0V, 48.0V~58.4V Settable 24V mode: default 27.0V, 24.0V~29.2V Settable 12V mode: default 13.5V, 12.0V~14.6V Settable If "Li" is selected ,it can't be set up
07	Low DC cut-off voltage	BATT 39.6 v 07 48V mode: default 42.0V, 40.0V~48.0V Settable 24V mode: default 21.0V, 20.0V~24.0V Settable 12V mode: default 10.5V, 10.0V~12.0V Settable 20 % 07 48V Li model: default 20%,5%~50% Settable
08	Communication mode	SIG 08 SIG (default), used to communicate with upper computer CL1 08 CL1, used to communicate through RS485 CL2 08 CL2, used to communicate through CAN.
09	RS485 Communication Address	1 09 Protocol 1 (default) Used to communicate with controller in CL1 or CL2, or used to communicate with upper computer in SIG
10	Battery equalization	ENR 10 dis 10 If "Flooded" or "User-Defined" is selected in program this program can be set up.

11	Battery equalization voltage	58.0 v	48.0V model: default 58.0V,48~60V Settable
12	Battery equalization time	030 12	Setting range is from 5 min to 900 min. Increment of each click is 1 min.
13	Battery equalization timeout	060 13	Setting range is from 5 min to 900 min. Increment of each click is 1 min.
14	Equalization interval	00 1 14	Setting range is from 1 to 30 days. Increment of each click is 1 day.
15	Equalization activated immediately	ENR 15	dis 15 If equalization function is enabled in program 10, 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 "Eq". If "Disable" is selected, it will cancel equalization function until next activated equalization time arrives based on program 14 setting. At this time, "Eq" will not be shown in LCD main page.

LCD Display Information

The LCD display information will be switched in turns by pressing “UP/DOWN” key. The selectable information is switched as below order.

Setting Information	LCD display
Charging voltage	
Battery charging/discharging current	
Battery charging/discharging power	
Battery temperature sensor (BTS)	
PV input voltage	 

PV generated current	 <p>PV 28 A</p> <p>For 48V60 and 48V80</p>  <p>PV 28 A 2 PV 30 A 2</p> <p>For 48V100 and 48V120</p>
PV generated power	 <p>PV 339 W</p>
Total PV generated energy	 <p>PV 0 kWh</p>
PV controller temperature	 <p>PV 294 °C</p>
Battery SOC	 <p>BATT 42 %</p>
Battery Equalization	 <p>BATT 58.0 V E9</p>

Fault Code

Fault Code	Fault Event	Icon On
01	Fan is locked when controller is off.	
02	Over temperature	
03	Battery voltage is too high	
20	BMS communication loss	
63	Can't communicate with the inverter	

Warning Code

Warning Code	Warning Event	Icon Flashing
04	Battery voltage is too low	
06	PV input voltage is too high	
07	Overload	

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.

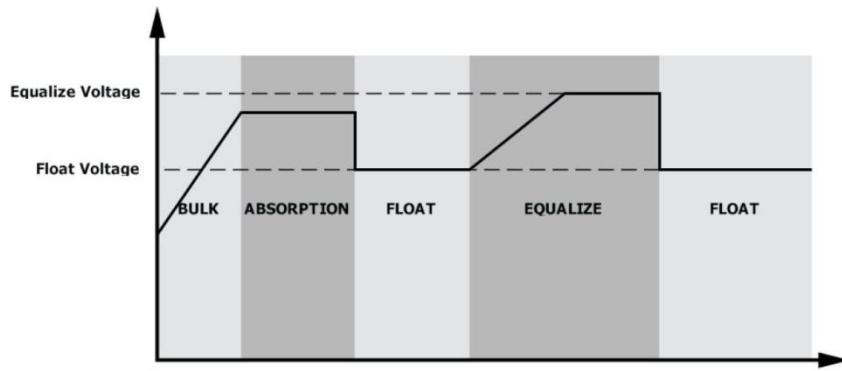
How to Apply Equalization Function

You must enable battery equalization function in monitoring LCD setting program 10 first. Then, you may apply this function in device by either one of following methods:

1. Setting equalization interval in program 14.
2. Active equalization immediately in program 15.

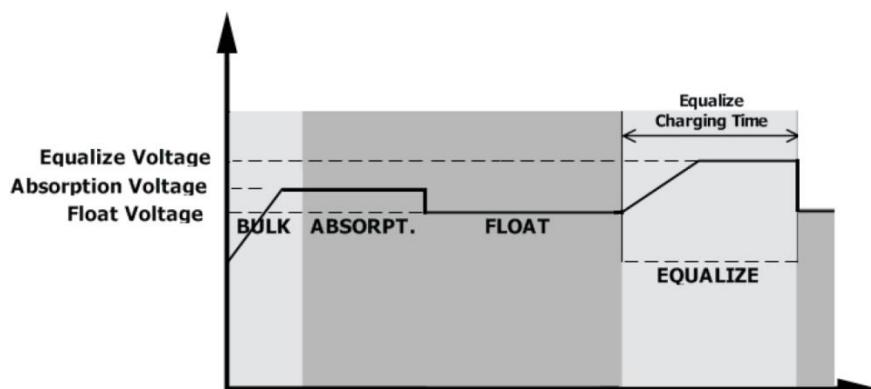
When to Equalize

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.

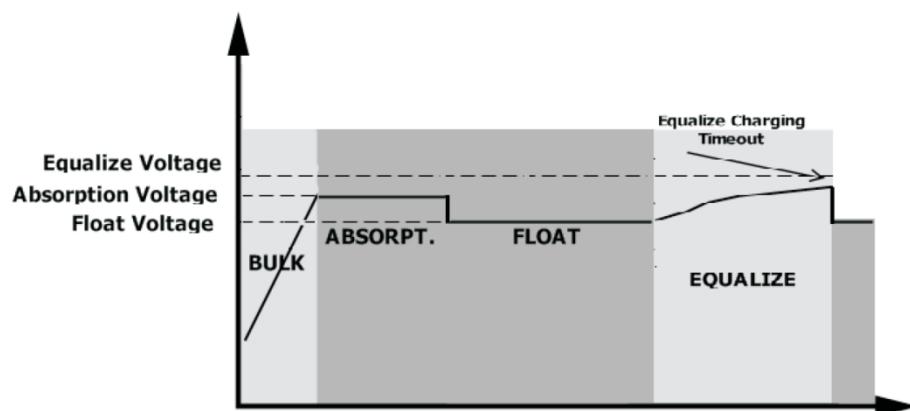


Equalize charging time and timeout

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.



Trouble Shooting

Use the table below to solve minor problems.

Problem	LCD/ LED/ Buzzer	Explanation	What to do
When power fails, the backup time is shorten.	Battery low alarm issue quickly.	Battery voltage is too low.	Charge the unit at least 8 hours.
		Battery capacity is not full even after charge the unit for at least 8 hours.	Check the date code of the battery. If the batteries are too old, replace the batteries.
No LED display on the front panel when PV/battery is working	No LED display.	Battery/PV is not connected well.	Return to repair center.
Buzzer beeps continuously and red LED is on.	Fault code 01	Fan fault	Replace the fan.
	Fault code 02	Internal temperature of controller component is over 90 °C.	Check whether the air flow of the unit is blocked or whether the ambient temperature is too high.
	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.
	Warning code 04	The battery voltage is too low.	Connect with PV to charge, the problem will be solved.
	Warning code 06	PV input voltage is too high	Return to repair center.
	Fault code 20	BMS Communication failed	Check the BMS communication wire to see if it's well connected Check the transceiver signal
	Fault code 63	Inverter Communication failed	Check the communication wire to see if it's well connected Check the transceiver signal

If any unlisted abnormal situations occur, please call the service people for professional examination.

Specifications

MODEL	48V60	48V80	48V100	48V120
Solar System Voltage	12V/24V/48V			
Electrical				
PV operating voltage	15 ~50Vdc@12V 30~100Vdc@24V 60~145Vdc@48V	15 ~50Vdc@12V 30~100Vdc@24V 60~145Vdc@48V	15 ~50Vdc@12V 30~100Vdc@24V 60~145Vdc@48V	15 ~50Vdc@12V 30~100Vdc@24V 60~145Vdc@48V
Max. PV open circuit voltage	150Vdc	150Vdc	150Vdc	150Vdc
Max. PV input power	1000W@12V	1250W@12V	1500W@12V	1750W@12V
	2000W@24V	2500W@24V	3000W@24V	3500W@24V
	4000W@48V	5000W@48V	6000W@48V	7000W@48V
Number of MPPT trackers	1	1	2	2
Max. charging current	60A	80A	100A	120A
Self Consumption	3W	3W	5W	5W
MPPT Efficiency	99.5%	99.5%	99.5%	99.5%
Conversion Efficiency	97.5%	97.5%	97.5%	97.5%
Protection	High voltage, high temperature protection			
Battery Charging				
Battery Type	Sealed, AGM, Gel, Flooded, Lithium, User define			
Charging Algorithm	Bulk, Absorption, Float, Equalize			
Bulk charge voltage	Sealed:14.4V AGM Gel:14.1V Flooded:14.6V User define:12-14.6V (For 24V system, total voltage*2; for 48V system, total voltage*4)			
Float charge voltage	Sealed/Gel/AGM:13.7V Flooded:13.6V User define :12-14.6V (For 24V system, total voltage*2; for 48V system, total voltage*4)			
Low DC Warning SOC (Only Li)	Low DC Cut-off SOC+5%			
Low DC Warning Return SOC (Only Li)	Low DC Cut-off SOC+15%			
Temperature compensation	-5mV/°Cwith BTS(Optional)			
Communication				
Communication Port	USB			
Mechanical				
Net weight	3KG	3.2KG	4KG	4.2KG
Dimensions	295*180*100	295*180*100	320*200*105	320*200*105
Cooling	Fan cooling			
Enclosure	IP20			
Environment				
Ambient Temperature	-20~55°C (Derating from 45°C)			
Storage Temperature	-40°C~+60°C			
Humidity	100% non-condensing			