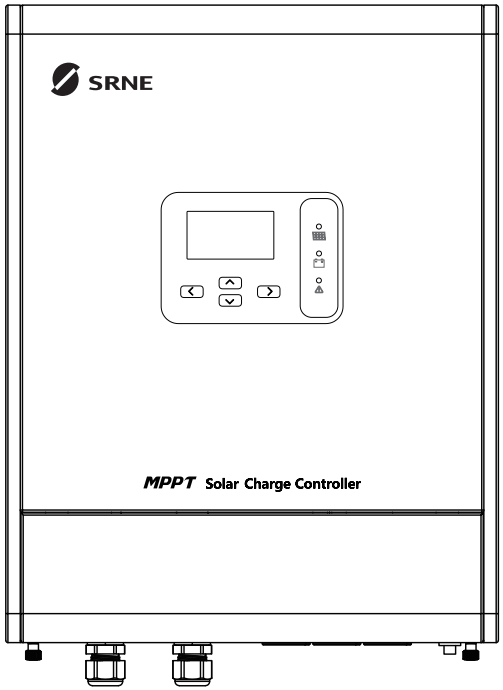
User Manual of MPPT Solar Charge Controller
500Vpv 48V100A Isolated



Code : 109850

Manual version: V1.01 Contents are subject to changes without prior notice

Dear users:

Thank you for choosing our products!

Safety Instructions

1、Since the applicable voltage of the controller exceeds the safety limit of human body, please read the manual carefully before operation and operate it only after the safety operation is trained.

2、Since no part is required to be maintained or repaired inside the controller, please do not disassemble and repair the controller.

3、Please install the controller indoors to avoid exposure of components and keep water away from the controller.

4、Since the controller will be very hot during operation, please mount it in a well-ventilated place.

5、Please install a suitable fuse or circuit breaker outside the controller.

6、Before installing and adjusting the wiring of the controller, be sure to disconnect the wiring of the solar panel battery and the fuse or circuit breaker near the accumulator battery terminals.

7、After installation, check whether all wiring is tightly connected to avoid the danger of heat accumulation due to loose connection.

Warning: Indicates that this operation is dangerous and safety preparations must be made before operation.

Attention: Indicates destructive operation.

Tips: Indicates suggestions and tips to the operator.

Contents

1. Product Introduction

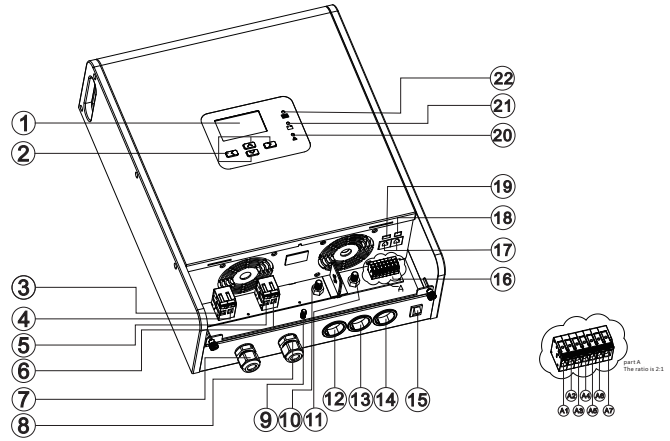
1.1 Product overview

MF series MPPT solar charge controller includes a 48V battery voltage system, with dual stand-alone PV inputs, featuring complete electrical isolation of input and output, and supports a wide voltage operating range of 80Vmp−450Vmp and dual MPPT independent tracking. The MF series controller adopts the industry-leading MPPT to achieve the maximum energy tracking for the solar panel, that is, it can quickly and accurately track the maximum power point of the solar battery on any condition, and obtain the maximum energy of the solar panel in real time, significantly improving the energy utilization rate of the solar system. It is applicable to large off-grid photovoltaic systems to control the solar panels and batteries. Besides, it has complete software and hardware fault detection and protection functions to avoid damage to product components caused by installation errors and system faults to the greatest extent. Meanwhile, the PV input and battery output are completely electrically isolated, which improves system safety.

1.2 Product features

- MPPT maximum power tracking technology with a tracking efficiency of 99.9%.
- Dual stand-alone MPPT, with complete electrical isolation of input and output.
- MPPT voltage range of 80Vmp−450Vmp, with max. open circuit voltage of 500Voc.
- Various types of backup batteries are supported such as sealed, gel, flooded, lithium, and custom batteries.
- Activation by lithium battery and lead-acid battery.
- Charging current setting.
- Full-charging setting.
- Temperature compensation.
- Parallel charging, which can break the power limit of a single device and meet the demand for greater charging power with multiple parallel devices.
- Cable drop compensation for charging voltage, so that the controller controls the charging voltage in a more accurate way.
- RS485 communication of standard Modbus protocol with adjustable baud rate.
- TTL communication of standard Modbus protocol with fixed baud rate.
- CAN communication (optional).
- Remote charging switch, which can be remotely controlled by external mechanical switch or relay.
- Programmable relay output.
- Standard display and Bluetooth for inspecting product operating status, real-time data, and fault status.
- Perfect protection functions against overvoltage, overcurrent, over-temperature, and fan failure.
- High-quality aluminum radiator and high-temperature derating treatment to ensure reliable and efficient operation in various operating conditions.

1.3 Appearance and interface description



S/N	Name	S/N	Name
①	LCD(backlit)	⑫	Battery positive outlet
②	Key	⑬	Battery negative outlet
③	First PV panel positive interface	⑭	Functional line outlet
④	First PV panel negative interface	⑮	Power switch
⑤	Second PV panel positive interface	⑯	Terminal A (interface defined as follows)
⑥	Second PV panel negative interface	⑰	RS485/CAN isolated communication interface
⑦	First PV panel outlet	⑱	Temperature sensor interface
⑧	Second PV panel outlet	⑲	TTL communication interface
⑨	Grounding screw	⑳	Fault indicator
⑩	Battery positive interface	㉑	Battery indicator
⑪	Battery negative interface	㉒	Charge indicator

Terminal A interface description:

S/N	Name	S/N	Name
A1	Positive electrode of BVS+ charging cable loss compensation	A5	Programmable relay NC
A2	Negative electrode of BVS− charging cable loss compensation	A6	Programmable relay C
A3	Positive electrode of charging remote switch	A7	Programmable relay NO
A4	Negative electrode of charging remote switch		

2. Technical Parameters

Product model	MF48100N50
Static power consumption	≤60mA
Battery type	USE/FLD/GEL/LI/SLD(default)
System voltage	48V
Battery operating voltage range	36V~64V
Rated charging current	100A
Single charging current	50A
Max. PV input current	20A+20A
Max. PV panel power	3000W+3000W
Max. PV open circuit voltage	500V+500V
PV starting voltage	120V
MPPT operating voltage range	80~450V
MPPT tracker number	2
MPPT tracking efficiency	>99%
Max. charging conversion efficiency	96%
Parallel charging	1~16sets
Charging cable loss compensation	√
Full-charging setting	√
Constant voltage output setting	√
Temperature compensation	√
Temperature protection	√
Programmable relay	NO, C, NC -current limit: DC: 10A,30VDC/ AC: 10A,250VAC
Charging remote switch control	√
TTL communication	9600bps, 8, 1, None
RS485 communication	9600bps, 8, 1, None 2 isolated RS485 communication interfaces for parallel operation Power output of 5 V and 200 mA, and baud rate (default) of 9,600 bps (adjustable)
Bluetooth communication	9600bps, 8, 1, None Built-in Bluetooth, supporting APP data interaction and OTA upgrading
CAN communication	Optional (RV-C protocol)
Historical data	Saving the last 200 days of historical data
Backlit function	Automatically lighting up when there is keys operation and lighting off after 20s without keys operation
Protection function	PV overvoltage protection and overcurrent protection, input/output power-limiting protection, over-temperature protection, busbar overvoltage protection, battery overvoltage/over-discharge protection
Operating ambient temperature range	-20~+65℃
Protection level	IP21
Cooling mode	Air cooling
Dimensions	440*340*124mm
Weight	11kg

3. Charging

3.1 Charging of lead-acid battery

The battery type shall be SLD/FLD/GEL/USE.

As shown in Figure 8, the charging stages of the lead-acid battery are MPPT charging, constant voltage charging (equalizing/absorption/floating charging), and current-limiting charging.

The constant voltage charging is divided into three stages—equalizing charging, absorption charging, and floating charging:

[MPPT charging] When the battery voltage does not reach the target constant voltage value, the controller conducts MPPT charging, and when reaches, it automatically exits MPPT charging and switches to constant voltage charging (equalizing/boosting/floating charging).

[Equalizing charging] Equalizing charging is mainly to elevate the charging voltage of batteries higher than the standard voltage, which vaporizes the battery electrolyte to balance the battery voltage and complete relevant chemical reactions. Equalizing charging and absorption charging are not repeated during one charge cycle to avoid excessive gas evolution or overheating of the battery.

Notes:

1) Since the equalizing charging of floored lead-acid batteries produces explosive gas, the battery compartment must be well-ventilated.

2) Excess charging and gas evolution may damage the battery panel and result in falling off of the active substances on the battery panel. Besides, excessive high equalizing charging voltage or excessive long equalizing charging duration may damage the battery. It is necessary to set relevant parameters according to the specifications of the battery used in the system.

[Absorption charging] The duration of absorption charging is 2h (default). When the duration reaches the set value, the system will switch to floating charging.

[Floating charging] Floating charging is the last constant voltage charging stage in the charging cycle of lead-acid batteries. The controller keeps the charging voltage constant at the floating charging voltage.

In this stage, the battery is charged with a very weak current to maintain the battery in a fully-charged state.

When the battery voltage drops to the reconnect voltage of the absorption charging, the system will exit the float charging stage and re-enter the fast next charging stage.

3.2 Charging of lithium battery

The battery type shall be LI/USE LI. As shown in Figure 9, the charging stages of the lead-acid battery are MPPT charging, absorption charging, and current-limiting charging.

[MPPT charging] When the battery voltage does not reach the target constant voltage value, the controller conducts MPPT charging to charge the battery with maximum solar power, and when reaches, it automatically switches to absorption charging.

[Absorption charging] In the absorption charging stage of lithium battery, when the battery voltage is lower than the absorption charging voltage, the system conducts MPPT charging or current-limiting charging, when reaches, it switches to absorption charging.

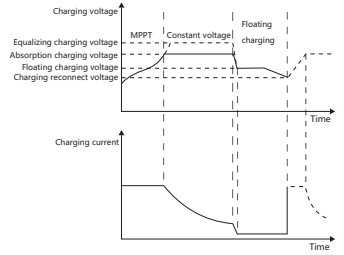


Figure 8 Lead-acid battery charging curve

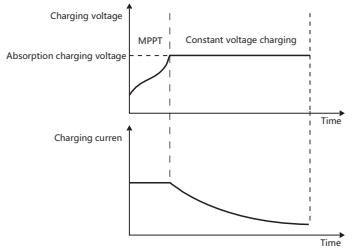


Figure 9 Lithium battery charging curve

3.3 Current-limited charging

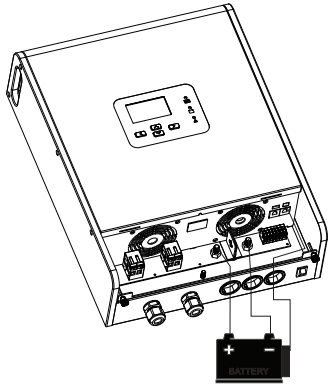
1) When the charging current exceeds the set value, the system immediately limits the charging current within the set value range.

2) When the device is over-temperature, the system automatically conducts the over-temperature current-limiting charging.

4. Battery Temperature Sampling and Control

1) Connecting the temperature sensor to the corresponding temperature interface can achieve over- and under-temperature protection for the battery and the temperature compensation for the charging voltage of the lead-acid battery (no temperature compensation for the lithium battery). If the temperature sensor is not connected, the default temperature is 25°C;

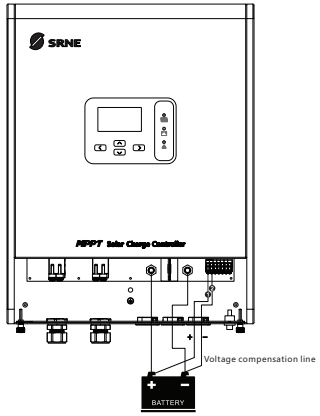
2). See the description in "13. System alarm" for the battery-related temperature protection/recovery value. The wiring method is shown in the figure below:



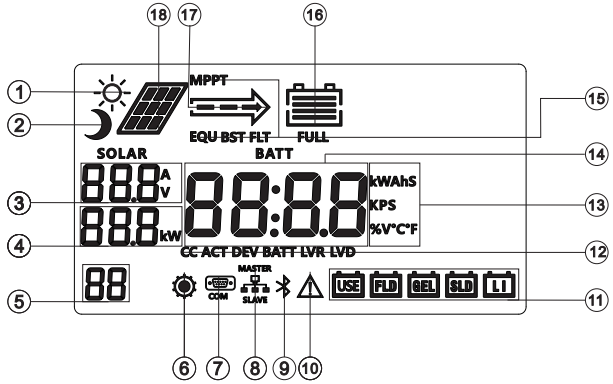
5. Charging Cable Loss Compensation

If the line diameter from the battery to the controller is too small, the voltage collected by the controller terminal will be higher than the actual voltage of the battery terminal when the charging power is high, resulting in the battery being not fully charged. Connecting the voltage compensation line can more accurately collect the battery terminal voltage and timely output the voltage difference compensation, so that the charging voltage input of the battery terminal is more appropriate.

The positive/negative electrodes of the battery shall be connected to the positive electrode①and negative electrode②of the battery voltage sampling port through voltage compensation lines, as shown in the figure below:



6. Menu

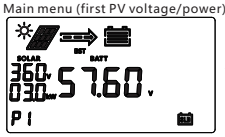


No.	Description	No.	Description
①	Daytime indicator icon	⑩	System alarm
②	Night indicator icon	⑪	Battery type
③	Solar panel current or voltage	⑫	Function character
④	Solar panel power	⑬	Unit symbol
⑤	PV connection indication	⑭	Battery voltage/current, etc.
⑥	Parameter setting	⑮	Charging stage
⑦	Communication indication	⑯	Battery
⑧	Parallel communication	⑰	Charging state
⑨	Bluetooth prompt	⑱	Solar panel

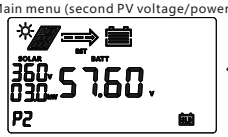
6.1 Menu browsing

6.1.1 Main menu display

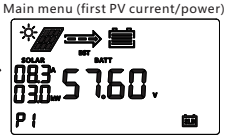
Main menu (first PV voltage/power)



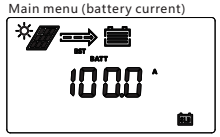
Main menu (second PV voltage/power)



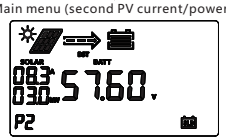
Main menu (first PV current/power)



Main menu (battery current)

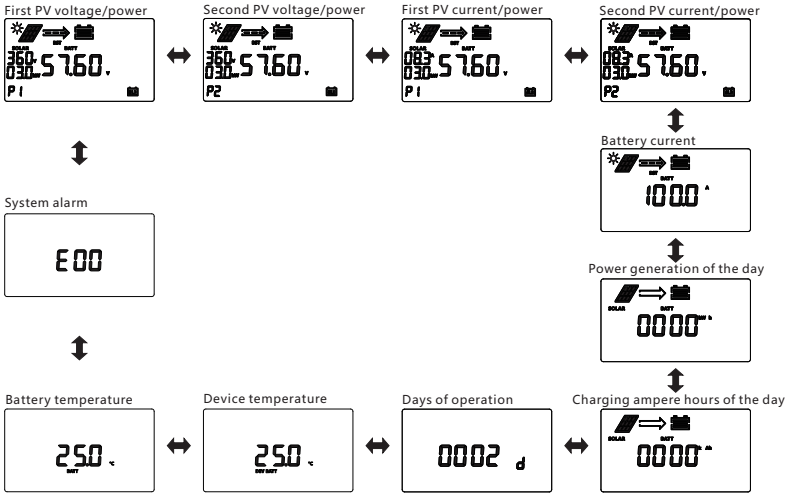


Main menu (second PV current/power)



In the main menu, the display of PV (voltage/power), PV (current/power), and charging current switches every 10 seconds.

6.1.2 Browsing interface display



1) Short press [∧] [∨] to browse the menu

2) Long press [>] on any interface to enter the parameter setting page

7. Parameter Setting

7.1 Battery parameter list

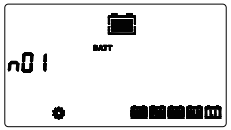
Battery parameters						
Battery type / Voltage setting	Sealed lead-acid battery (SLD)	Gel lead-acid battery (GEL)	Flooded lead-acid battery (FLD)	Lithium battery (LI)	Customized lead-acid battery (USE)	Customized lithium battery (USE LI)
Overvoltage disconnection voltage	64.0V	64.0V	64.0V	absorption voltage +8V	absorption voltage +8V	absorption voltage +8V
Equalizing voltage	58.4V	--	59.2V	--	40~60V	--
absorption voltage	57.6V	57.6V	58.4V	57.6V	40~60V	40~60V
Floating voltage	55.2V	55.2V	55.2V	--	40~60V	--
absorption restoring voltage	52.8V	52.8V	52.8V	52.8V	40~60V	40~60V
Over-discharge restoring voltage	50.4V	50.4V	50.4V	50.4V	40~60V	40~60V
Under-voltage alarming voltage	48.0V	48.0V	48.0V	48.0V	40~60V	40~60V
Over-discharge voltage	44.4V	44.4V	44.4V	44.4V	40~60V	40~60V
Over-discharge cutoff voltage	42.4V	42.4V	42.4V	42.4V	40~60V	40~60V
Equalizing charging interval	30days	--	30days	--	30days	--
Equalizing charging duration	120min	--	120min	--	120min	--
absorption charging duration	120min	120min	120min	--	120min	--
Temperature compensation factor (mV/°C/2V)	-3	-3	-3	--	-3	--

7.2 Parameter setting list

Setting No.	Function	Setting Range	Default
n01	Battery type	FLD/SLD/GEL/LI/USE/USE LI	SLD
n02	Equalizing charging voltage	40V~60V	Available for USE only
n03	Absorption charging voltage	40V~60V	Available for USE and USE LI only
n04	Floating charging voltage	40V~60V	Available for USE only
n05	Charging reconnect voltage	40V~60V	Available for USE and USE LI only
n06	Over-discharge reconnect voltage	40V~60V	Available for USE and USE LI only
n07	Over-discharge voltage	40V~60V	Available for USE and USE LI only
n09	Charging current setting	0-rated current (0: charging prohibited)	Rated charging current
n10	Full-charging setting	0A~10A (0: indicates off)	0
n11	Constant voltage output of lead-acid battery	No other battery connected to the battery terminal (on: normal charging, oF: charging prohibited)	oF
n18	Temperature unit	°C: Celsius/°F: Fahrenheit	℃
n19	RS485 communication baud rate	1200~115200bps	9600bps
n20	Device address	1-247	1
n21	Function selection of Rs485 communication interface	485C: communication/ 485P: parallel operation	485C
n22	System restart	F01	Function key
n23	Factory reset	F02	Function key
n24	Clear historical data	F03	Function key

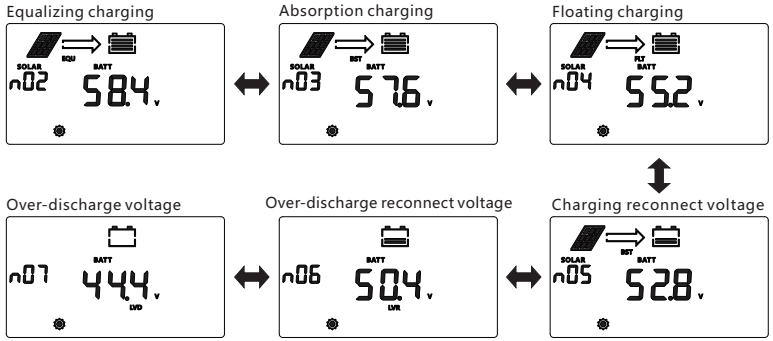
7.3 Battery type (n01)

Please refer to "7.1 and 7.2" for setting.



7.4 Equalizing charging\absorption charging\floating charging\charging reconnect voltage\over-discharge reconnect voltage\over-discharge voltage (n02–n07)

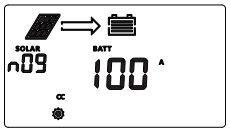
n02-n07 battery type settings are only displayed for "USE" or "USE LI" options, and other battery types are not displayed.



7.5 Charging current (n09)

1) [Charging prohibited] Set to 0

2) [Charging current limit] Set an arbitrary value from 1 to rated charging current.

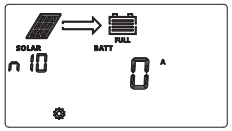


7.6 Full-charging setting (n10)

1) [Off] Set to 0
2) [On] Select the appropriate current value between 1A–10A

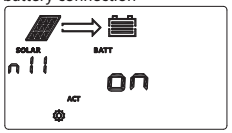
Full-charging condition: When the constant voltage charging duration of the lithium battery reaches the set duration or the lead-acid battery is in float charging after the equalizing charging or the absorption charging is finished, and the charging current is less than the set current value, the system will stop charging after 1 minute, and the "FULL" icon will light up on the screen.

Charging recovery condition: The battery voltage is less than the absorption charging reconnect voltage, the system will recover charging, and the "FULL" icon will light off on the screen.

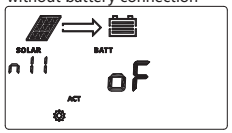


7.7 Constant voltage output of lead-acid battery (n11)

Constant voltage output without battery connection

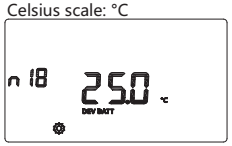


No constant voltage output without battery connection

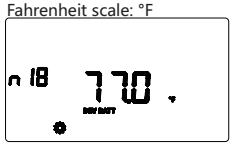


7.8 Temperature unit (n18)

Celsius scale: °C



Fahrenheit scale: °F



7.9 RS485 communication baud rate (n19)

The RS485 communication baud rate can be modified according to actual needs.

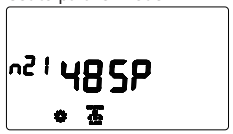
7.10 Device address (n20)

The device communication address can be modified according to actual needs.

7.11 RS485 function selection (n21)

Set to communication mode

Set to parallel mode



7.12 System restart (n22)

Single press [>], 'F01' flashes, and single press [>] again, the controller will restart.

7.13 Factory reset (n23)

The controller restores factory default settings in accordance with "7.12".

7.14 Historical data clearing (n24)

The controller clears the historical data in accordance with "7.12".

8. Parallel Application

The parallel function means that multiple controllers charge a battery pack collectively. Each controller has an independent solar panel and connects to each other through RS485 communication lines, whose parameters, such as the charging state/stage/target constant voltage value, are managed by the master in a unified manner. Parallel charging can break the power limit of a single device, and multiple parallel devices can meet the demand for greater charging power. After setting to the parallel mode, the master regularly sends management packets to the slaves (automatically assigned by the master) through RS485 bus.

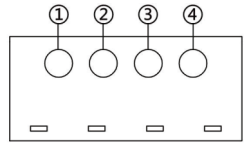
1) Set non-repeating device addresses from 1 to 16 for each device in accordance with "7.9";
2) Set to "parallel mode" in accordance with "7.10";
3) Connect wires of the parallel system in accordance with "19.2".

9. Communication

9.1 TTL communication

1) 9600bps, 8, 1, None

2) Output specification of communication power supply: (12V±3V)/100mA

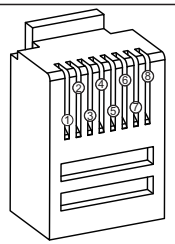


TTL-COM

S/N	Definition
①	VCC communication power supply output
②	RX controller data receiving terminal
③	TX controller data transmitting terminal
④	GND

9.2 RS485 and CAN communication

9.2.1 RJ45 interface definition



S/N	Definition
①	CAN_L
②	CAN_H
③	NC
④	NC
⑤	Power ground/signal ground
⑥	D-
⑦	D+
⑧	Positive terminal

9.2.2 RS485 communication

1) 9600bps, 8, 1, None

2) Interface type: RJ45; output specification of communication power supply: 5V/200mA

3) Isolated RS485 communication interface, which can be set to communication mode or parallel mode.

9.2.3 CAN communication

1) 250kbps

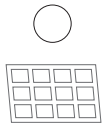
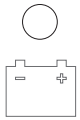
2) RV-C Protocol

3) Optional

9.3 Bluetooth communication

Bluetooth is integrated into the controller, therefore, users can download the APP in the following ways for data monitoring, settings, etc.

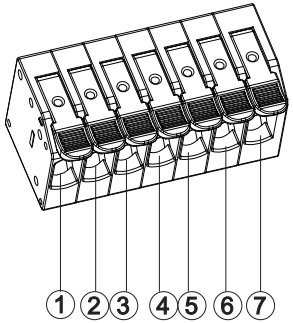
10. Indicator and Buzzer

Indicator		Light state	Meaning
	Charge indicator	Normally on	MPPT charging
		Slow flash	Absorption charging
		Single flash	Floating charging
		Fast flash	Equalizing charging
		Double flash	Current-limited charging
		OFF	No charging
	Battery indicator	Normally on	Normal battery
		Slow flash	Battery over-discharge
		Fast flash	Battery overvoltage
	System alarm indicator	OFF	Normal system
		Normally on	System alarm
	Buzzer	Buzz at 1Hz in case of error	

11. Key

Key	Function
<	[Short press] this key to return to the previous menu/undo the modification of the current item [Long press] this key to jump to "System alarm" page
∧	[Short press/Long press] this key to page up/set data increment
∨	[Short press/Long press] this key to page down/set data decrement
>	[Long press] to enter/exit parameter setting [Short press] this key to modify and confirm parameters

12. Programmable Relay and Charging Remote Switch



12.1 Programmable relay

Single pole double throw DPST relay

⑤: NC, normally closed contact

⑥: C, common contact

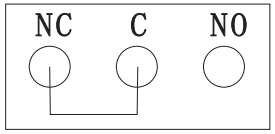
⑦: NO, normally open contact

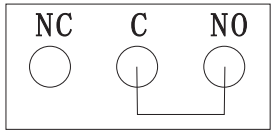
1. Relay contact specification DC: 10A, 30VDC/AC: 10A, 250VAC

2. Relay trigger conditions:

① When the battery voltage is normal, the relay coil does not work and is normally closed (C and NC are conducting)

② When the battery is over-voltage or over-discharged, the relay coil operates and is normally open (C and NO are conducting)





12.2 Charging remote switch

③: Positive electrode of remote switch

④: Negative electrode of remote switch

The device is not charged in case of short circuit of interfaces ③ and ④, and it operates normally when interfaces ③ and ④ are open.

13. System Alarm

System alarm	Meaning	Description
E0	Normal system	No action
E1	Battery over-discharge	The battery voltage rises to the over-discharge reconnect voltage to relieve the over-discharge state
E2	Battery overvoltage	Battery voltage drops and automatically recovers if turned off charging
E3	Battery under-voltage warning	When battery voltage is lower than the under-voltage warning threshold, warning only
E6	Device over-temperature protection	Thermostat control will be turned on when the internal temperature is above 75°C, and resumed when it is below 73°C. Charging will be stopped when the internal temperature is above 90°C, and resumed when it is below 85°C
E7	Battery over-temperature protection	Charging will be stopped when the battery temperature is above 65°C, and automatically resumed when it is below 60°C
E10	Solar panel overvoltage	Charging is stopped, and then automatically resumed when the solar panel voltage is below the safety limit
E15	Battery not connected or lithium battery feed	As long as the voltage of the solar panel meets charging conditions, the lithium battery has a constant voltage output , and the lead-acid battery has no voltage output. Only when the battery is connected can it return to normal (when the lead-acid activation switch is closed)
E19	Battery low temperature charging protection	Charging will be stopped when the battery temperature is below −20°C and resumed when it is above −15°C
E24	Fan fault	After the fan blockage is troubleshot, it will automatically recover
E30	Charging prohibited during remote communication	Default off (communication command)
E31	Charging overvoltage, overcurrent, reverse current protection, etc.	The device will be automatically resumed after the exception is released
E32	Busbar overvoltage	Check the cause of high bus voltage to automatically resume the device after voltage reduction
E33	Charging prohibited after remote charging switch connection	The device will automatically recover after unplugging the short-connected control cable

14. Common Problems and Solutions

Phenomenon	Troubleshooting
Indicator and LCD screen do not light up	Check whether the battery and solar panel are properly connected and whether the LCD connection cable has a poor connection
There is voltage in the solar panel, there is no voltage output from the battery side, and code E1/E15 is displayed	If the lead-acid battery terminal cannot detect the battery, there is no voltage output at both ends of the battery, and it will return to normal after turning on the lead-acid activation switch or connecting the battery
The controller fails to charge	Check whether there is wrong wiring, whether the solar panel voltage exceeds the rated value, whether the battery is overvoltage, whether the LCD screen displays any error code of internal over-temperature, external over-temperature, external low temperature of lithium battery, or lead-acid battery open-circuit, and whether it displays E7/E10, etc. ,
Charging power does not reach the rated value	Perform system current limiting and thermostatic control; Check whether the system has reset the charging current
Other problems or exceptions difficult to resolve	Try F01 reset Restore factory settings (F02), and reset relevant parameters again as per system configurations. This operation requires careful consideration!
The screen displays "FULL", and charging stops	Charging stops as current conditions of full charging are met. When the voltage is below the absorption charging reconnect voltage, the charging will be automatically resumed
There is a system alarm code	See "13. System alarm" for details

15. Product Installation

15.1 Installation precautions

- Be careful when installing battery. Wear protective goggles when installing a flooded lead-acid battery. Once in contact with the battery acid, rinse with water immediately.
- Stay away from metal objects to prevent battery short-circuit.
- Ensure the ambient environment is well ventilated, because the battery may produce acid gas when charging.
- Stay away from sparks since the battery may produce combustible gases.
- During outdoor installation, avoid direct sunlight and rainwater infiltration.
- Since false connection and corroded cables may produce extreme heat to melt the cable insulation and burn surrounding materials, even causing a fire, make sure that the connections are tightened, and the cables are fixed with ties to avoid loose connections due to wobbling in transportation.
- Use insulated tools and keep hands dry for the reason that the output voltage of the components may exceed the human body safety voltage when connecting the system.

- The battery terminals on the controller can be connected either to a single battery or a battery pack. The subsequent instructions are for a single battery in this Manual, but they are also applicable to systems with a battery pack.
- Follow the safety recommendations of the battery manufacturer.
- Select the system connection wire with a current density of no less than 5A/mm2.
- Ground the ground terminal of the controller.
- When installing the battery, do not reverse the battery connection, which may cause irreversible damage.

15.2 Installation steps

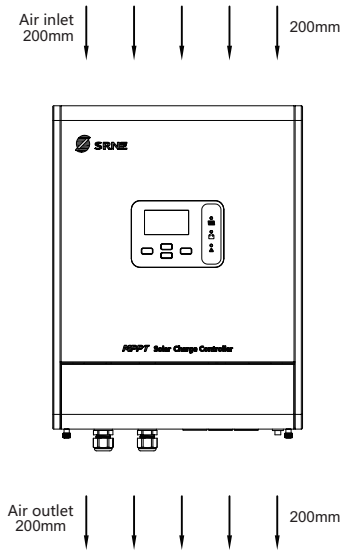
Wiring and installation must meet the requirements of national and local electrical codes. Wiring specifications shall be selected according to the rated current, generally, 5A/mm2.

Step 1: Avoid installing the controller in a place with direct sunlight, high temperature, or where water can easily enter, and make sure the controller is well-ventilated.

Step 2: Select a suitable position to fix the wall mount, keep the wall mount parallel, and lock the screws at the 3 corresponding screw holes.

Step 3: Place the hanging piece on the back of the product on the wall mount.

Step 4: Open the front cover of the controller, connect the wires, and then close the front cover.



16. Protection Function

- **Device over-temperature protection**
  When the internal temperature of the controller exceeds the set value, the charging power will be automatically lowered or the charging will even be stopped, further slowing the rise in the internal temperature of the controller.。
- **Battery over-temperature protection**
  Battery over-temperature protection requires an external battery temperature sampling sensor. Charging will be stopped when the battery temperature is detected to be too high, and will be automatically resumed when the battery temperature drops to 5°C below the set value for 2s.
- **Input over-power protection**
  When the battery panel power is greater than the rated power, the controller will limit the charging power within the rated power range to prevent excessive current from damaging the controller, and the controller will enter current-limited charging.
- **Too high voltage protection at PV input side**
  When the voltage at the input side of the PV array is too high, the controller will automatically cut off PV input.

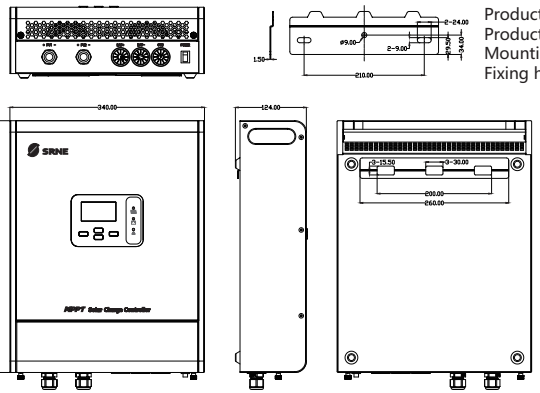
17. System Maintenance

In order to maintain the optimal operating performance of the controller for a long time, it is recommended that the following items are regularly checked.

- Make sure that the airflow around the controller is not blocked, and remove any dirt or debris from the air inlet and outlet of the fan.
- Take corrective actions timely after any fault or error is found.
- Check whether there is corrosion, insulation damage, high temperature or burning/discoloring at terminals, case distortion, etc., and repair or replace timely if any.
- Check whether there is any exposed or broken wire or wire with poor insulation, and repair or replace timely if any.
- Check whether there is dirt, nesting insects, or corrosion, and clean timely if any.

Warning: Danger of electric shock! Before carrying out checks or operations above, make sure that all power supplies for the controller are disconnected!
Any non-professional personnel is prohibited from carrying out such operations.

18. Product Dimensions

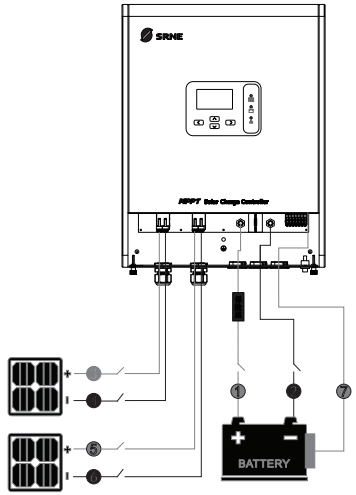


Product model：MF48100N50
Product dimensions：440*340*124mm
Mounting hole spacing：210mm
Fixing hole position：φ9mm

19. System Wiring Diagram

19.1 Single application wiring diagram

It is recommended to connect wires in numerical order as shown in the diagram.



19.2 Parallel application wiring diagram