



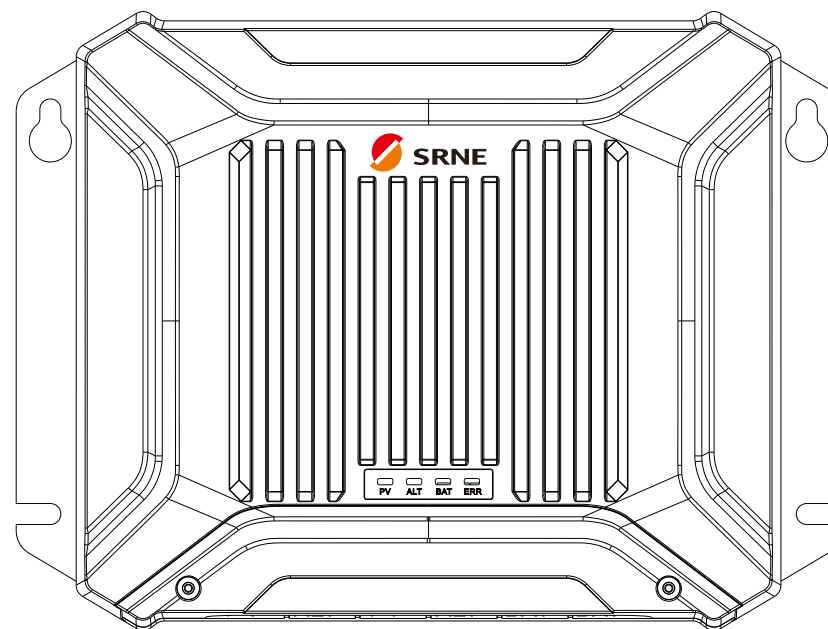
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MD12100N10

Solar Charge Controller User Manual



Dear users,

Thank you for choosing our product!

Safety Instructions

This product is designed for low-voltage high-current series of photovoltaic cells and low-voltage DC generators (starter batteries). In the PV input, DC alternator (starter battery) input and battery output are not allowed to exceed the maximum voltage access. The product has anti-reverse connection protection function, but does not mean that all reverse will not be damaged. If the PV input, the DC alternator (starter battery) input and the battery output are connected with over-voltage or reverse and connection and cause safety accident, we will not be responsible for it. To protect your rights and interests, please make sure that the wiring and connection voltage are correct before energizing the unit to avoid danger and damage. The product manufacturer is not responsible for any damage to the machine caused by using the product outside the parameters.

- ◆ As this controller deals with voltages that exceed the top limit for human safety, do not operate it before reading this manual carefully and completing safety operation training.
- ◆ The controller has no internal components that need maintenance or service, thus do not attempt to disassemble or repair the controller.
- ◆ Install the controller indoors, and avoid component exposure and water intrusion.
- ◆ During operation, the radiator may reach a very high temperature, therefore install the controller at a place with good ventilation conditions.

- ◆ It's recommended that a fuse or breaker be installed outside the controller.
- ◆ Before installing and wiring the controller, make sure to disconnect the photovoltaic array and the fuse or breaker close to the battery terminals.
- ◆ After installation, check if all connections are solid and reliable so as to avoid loose connections that may give rise to dangers caused by heat accumulation.

 **Warning:** means the operation in question is dangerous, and you should get properly prepared before proceeding.

 **Note:** means the operation in question may cause

 **Tips:** means advice or instruction for the operator.

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1. Product Profile

1.1 Product overview

MD series DC/DC&MPPT solar charging controller is based on multi-phase synchronous rectifier technology and advanced MPPT control algorithm, adopting all-digital intelligent design, which has fast response speed, high reliability and high industrialized standard. Polyphase synchronous rectifier technology can ensure high conversion efficiency under any charging power, and greatly improve the energy utilization of the system; the industry-leading Power Catcher MPPT technology realizes the maximum energy tracking of solar panels, so that it can quickly and accurately track the maximum power point of solar panels in any environment and obtain the maximum energy of solar panels in real time.

This product is a DC/DC intelligent charger for vehicle or ship system. Applied in the dual-battery system, the system integrates the respective merits of alternator (automobile) power generation and photovoltaic power generation, and a variety of charging methods are ingeniously designed and combined to effectively ensure that the power of the dual-battery system is sufficient at the time. Solar energy and alternator (automobile) can charge the house battery simultaneously, and can charge the house battery independently. In addition, solar energy can charge the starter battery under specific conditions.

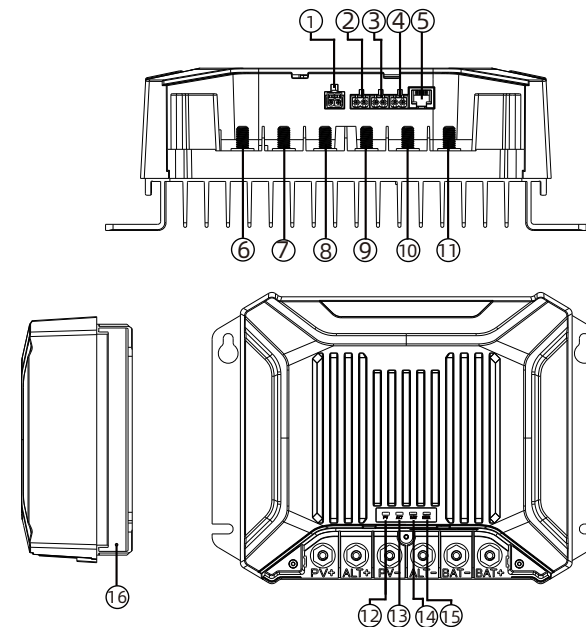
When the voltage of the starter battery is low and the vehicle cannot be started, the starter battery can be forced to be charged only by the house battery under certain conditions.

1.2 Product features

- ◆ Power Catcher MPPT technology is still available for tracking the maximum power point of solar cells in a complex environment; and compared with conventional MPPT technology, Power Catcher has faster response speed and higher tracking efficiency, which can reach 99.9%.
- ◆ The design of polyphase synchronous rectifier Buck-Boost circuit makes it have high DC/DC conversion efficiency up to 96% in both high and low power ranges.
- ◆ The house battery supports a wide variety of batteries such as sealed, colloidal, open-type, lithium battery and custom battery.
- ◆ It has various charging modes, such as photovoltaic charging the house battery alone, alternator charging the house battery alone, photovoltaic and alternator charging the house battery at the same time, photovoltaic charging the starter battery, forced charging and so on.
- ◆ With the function of line loss compensation of house battery charging voltage, which makes the battery charging voltage control more accurate.
- ◆ With house battery temperature sampling function, lead-acid battery support temperature compensation and effectively prolonging battery life.
- ◆ With automatic derating function for high-temperature charging.
- ◆ RS485 communication interface, supporting a variety of optional accessories.
- ◆ Support Bluetooth communication, and you can view the product running status/ real-time data and fault status through the mobile APP.

- ◆ High-quality aluminum radiator and high-temperature derating processing can ensure reliable and efficient operation in each work environment.

1.3 Interface description



NO.	Designation	NO.	Designation
①	Communication interface (CAN,RS485)	⑨	Negative interface of alternator (starter battery)
②	Ignition signal interface	⑩	House battery negative interface
③	House battery temperature sampling interface	⑪	House battery positive interface
④	House battery voltage compensation interface	⑫	PV indicator
⑤	RJ45 Interface	⑬	Alternator(automobile) indicator
⑥	Positive interface of solar cell	⑭	House battery indicator
⑦	Positive interface of alternator (starter battery)	⑮	Fault indicator
⑧	Negative interface of solar cell	⑯	Grounding port

1.4 Introduction to MPPT technology

Maximum Power Point Tracking (MPPT) System is an advanced charging technology which can output more energy by adjusting the work state of electrical module. Due to the nonlinear characteristic of solar array, there is a maximum energy output point (MPP) of an array on its curve, conventional controllers (switch charging technology and PWM charging technology) can not keep charging the battery at this point, so they can not obtain the maximum energy of solar array. However, solar controllers with MPPT control technology can track the MPP of the array all the time to obtain the maximum energy to charge the battery. Taking the 12V system as an example: since the peak voltage (VPP) of solar cell is about 17V and the battery voltage is about 12V, the voltage of solar cell is about 12V when an ordinary charging controller is charging, and the maximum power has not been fully exerted.

However, the MPPT controller can overcome the problem by adjusting the solar panel's input voltage and current in real time, realizing a maximum input power.

Compared with conventional PWM controllers, the MPPT controller can make the most of the solar panel's max. Power and therefore provide larger charging current. Generally speaking, the latter can raise the energy utilization ratio by 15% to 20% in contrast with the former.

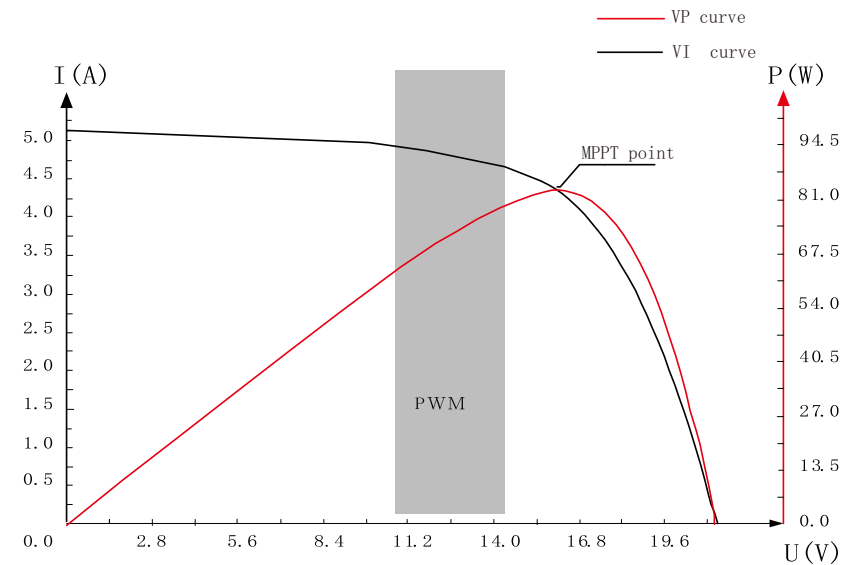


Fig. 1-2 Solar panel output characteristic curve

Due to the different ambient temperature and illumination conditions, the MPP often changes.

Our MPPT controllers can adjust the parameters from time to time according to different conditions, so that the system is always near the maximum working point. The full process is completely does not require any adjustment by the user.

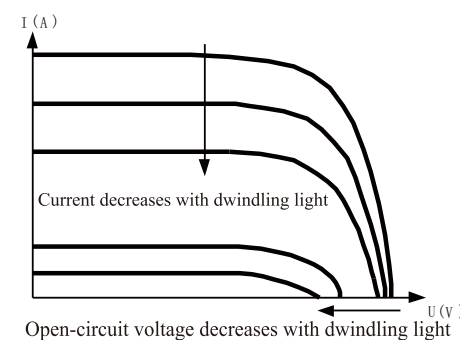


Fig. 1-3 Relation between solar panel output characteristics and illumination

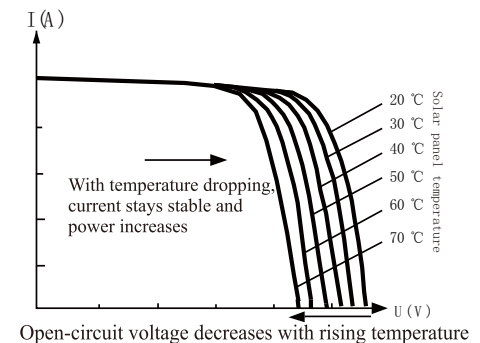


Fig. 1-4 Relation between solar panel output characteristics and illumination

1.5 Introduction to charging phase

1.5.1 Lead-acid battery charging

The controller will adopt three-stage charging for the house battery of lead-acid type, and a full charging process shall include: Bulk charge (BULK), Equalization/Absorption charge (EQUALIZE / ABSORPTION) and Floating charge (FLOAT). The charging curve is as follows:

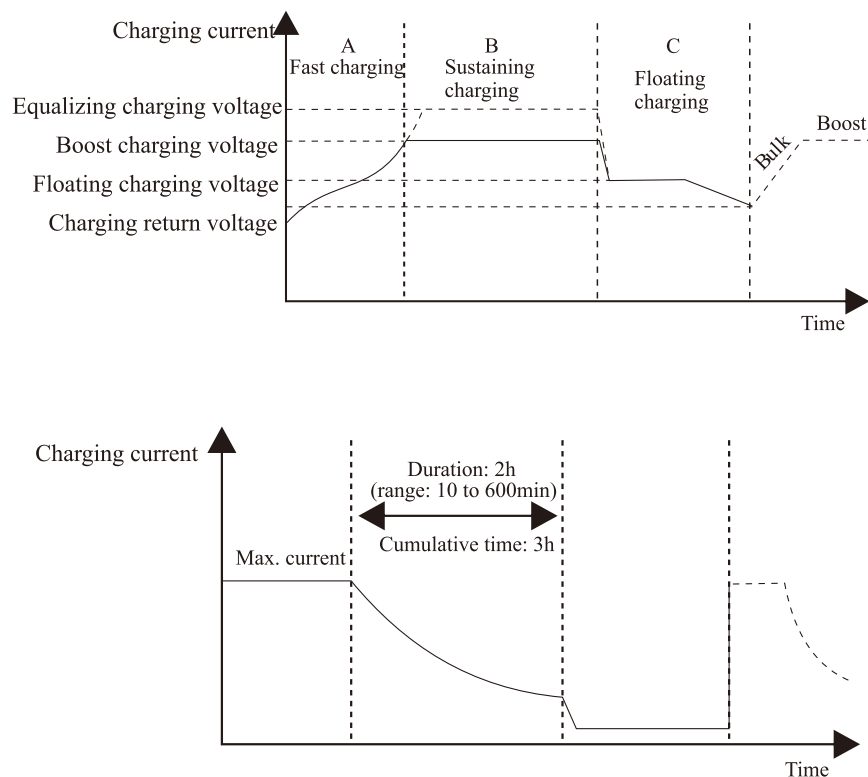


Fig. 1-5 Charging Curve of Lead-acid Battery

◆ Bulk Charge(BULK)

In the fast charging stage, the battery voltage has not reached the set value of full voltage (i.e., equalization/absorption voltage). When the energy does not meet the maximum charging current, the solar battery will perform MPPT charging to provide the maximum solar energy for charging the battery, and the generator will input constant voltage for charging, and the maximum input power will charge the battery. When the battery voltage reaches the preset value, it will be charged at constant voltage.

◆ Equalization/Absoption Charge (EQUALIZE/ABSORPTION)

When the battery voltage reaches the set value of the maintenance voltage, the controller will perform constant voltage charging. This process will no longer be in the "BULK" charging stage, and the charging current will gradually decrease over time. Maintenance charging has two stages, namely equalization charging (EQUILIZE) and absorption charging (ABSORPTION). These two charging processes are not repeated, among which equalization charging is initiated once every 30 days.

◆ Equalization Charge(EQUALIZE)

Some types of batteries are regularly charged equally, and this can stir electrolyte, balance battery voltage and complete chemical reaction. Equalization charging will increase the charging voltage to be higher than the standard complementary voltage and gasify the battery electrolyte. Equalization charging time is 120 min (by default). Equalization charging and absorption charging will not be repeated in one process of fully charging so as to avoid excessive overflow gas or overheating of the battery.

◆ Equalization Charge

Warning: Explosion Risk!
Gas can be generated during equalization charging and the battery cartridge must be well ventilated without foreign matters.

Notice: Equipment Breakdown!

Over-charging and too much gas evolution may damage the battery plate, which may cause the active substances on the battery plate to fall off. If the balanced charging voltage is too high or lasts too long, it will damage the battery. Please strictly follow the technical specifications of the battery.

◆ Absorption Charge (ABSORPTION)

Generally, the default duration of the absorption charging stage is 2h. Customers can also adjust the holding time and the preset value of the absorption voltage point as actually needed. When the duration has reached the set value, the system will switch to floating charge.

◆ Floating Charge (FLOAT)

Floating charge can keep the battery voltage near the floating charging voltage. In the floating charge stage, the battery will be charged with very weak current to ensure that the battery is kept in the full-charged state.

In the stages of equalization charge, absorption charge and floating charge, when the battery voltage is as low as "the absorption recovery voltage", the System will exit the current charging stage and re-enter the BULK charging stage. As the charging proceeds, the battery voltage will slowly rise and the current will drop and then re-enter the constant voltage stage.

1.5.2 Lithium Battery Charging

The controller will adopt two-stage charging for the house battery of lithium type: the first is the bulk charging (BULK) stage, i.e. Under the condition of limiting the maximum charging current, solar energy and alternator (automobile) energy are maximized, and the battery voltage is rapidly increased to the set charging voltage; then the charging will enter the constant voltage stage till the battery is fully charged, and the charging current will gradually decrease in the constant voltage charging stage.

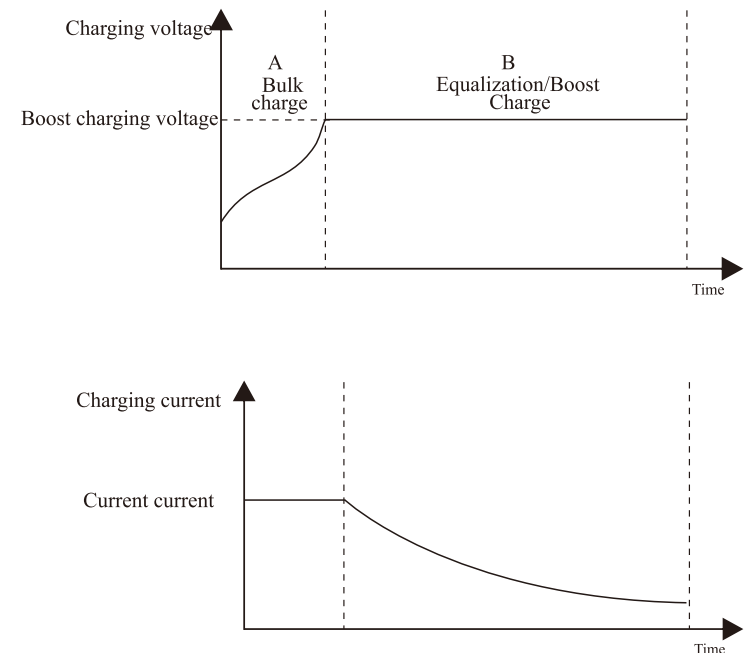


Fig. 1-6 Schematic Diagram of Lithium Battery Charging Stage

2. Product Application

2.1 Spec chart

Parameter		Value
Model		MD12100N10
House Battery System Voltage		12V/24V Automatic recognition
House battery voltage range		9~32VDC
House battery type		Sealed Battery, Gel Battery, Flood Battery, Lithium Iron Phosphate Battery, User-defined Battery
Rated charging current		100A
Maximum PV input voltage		95VDC
Max. power point voltage range		15×N~72V
Maximum PV input current		80A
Solar panel charging mode		Buck MPPT
MPPT efficiency		>99%
Maximum PV input power		House battery 12V 1400W House battery 24V 2800W
Alternator (starter battery) system voltage		12V/24V Automatic recognition
Starter battery type		Lead-acid Battery
Maximum alternator input voltage		32VDC
Maximum alternator input current		120A
Alternator voltage range	Conventional alternator	12V 13.2~16VDC 24V 26.4~32VDC
	Intelligent (Euro 6 standard)	12V 12~16VDC 24V 24~32VDC
	User-defined battery	11~14VDC Adjustable(×2 24V alternator system)
Alternator charging mode		Buck , Boost

Parameter		Value
Alternator rated charging current		Alternator/starting battery 12V, House battery 12V 100A Alternator/starting battery 12V, House battery 24V 50A Alternator/starting battery 24V, House battery 12V/24V 100A
Maximum alternator input current		House battery 12V 1400W House battery 24V 2800W
PV charges the starter battery	Charging voltage	Alternator start charging voltage-0.2V
	Charging current	≤10A(12V); ≤5A(24V)
No-load loss		≤55mA
Maximum charging conversion efficiency		96%
Temperature compensation factor		-3mV/ °C/2V can be set No temperature compensant of lithium battery
Communication method		RS485,CAN,BLE
Protection function		Over-charging protection, Over-current protection, Over-temperature protection, Alternator reverse Connection protection, Solar panel reverse connection protection, Anti-reverse charging protection at night
Operating temperature		-35°C~65°C
Altitude		≤3000m
Waterproof level		IP32
Net weight		8kg
Product dimensions		314*234*106mm

2.2 Battery type default parameters

Battery type Parameters	Sealed lead acid battery (SLD) (default)	Colloid al lead - acid battery (GEL)	Flood lead-acid battery (FLD)	Lithium iron phosphate battery (LFP)	Custom battery (USER)
Over-voltage break voltage	16.0V	16.0V	16.0V	16.0V	9.0~17.0V
Over-voltage recovery voltage	15.5V	15.5V	15.5V	15.5V	--
Equalization voltage	14.6V	--	14.8V	--	9.0~17.0V
Absorption voltage	14.4V	14.2V	14.6V	14.4V	9.0~17.0V
Float voltage	13.8V	13.8V	13.8V	--	9.0~17.0V
Absorption recover voltage	13.2V	13.2V	13.2V	13.2V	9.0~17.0V
Over-discharge recovery voltage	12.6V	12.6V	12.6V	12.6V	9.0~17.0V
Under-voltage alarm voltage	12.0V	12.0V	12.0V	12.0V	9.0~17.0V
Over-discharge voltage	11.1V	11.1V	11.1V	11.1V	9.0~17.0V
Absorption duration	120min	120min	120min	--	10~600min
Equilibrium duration	120min	--	120min	--	0~600min
Equalization charging interval	30d	--	30d	--	0~255d
Temperature compensation (mV/°C/2V)	-3	-3	-3	0	-5~0

Note: Please strictly follow the technical specifications and safety recommendations provided by the battery manufacturer to set relevant parameters.

3. Indicator Definitions And Description

3.1 Indicator definitions

	NO.	Indicator definitions
	PV	PV Charge indicator
	ALT	Alternator (automobile) indicator
	BAT	House battery indicator
	ERR	Fault indicator

3.2 PV charge indicator

Indicator Color	Indication Mode	Description
White	Normally on	MPPT charging
	Slow flashing	Absorption charging
	Single flashing	Floating charging
	Flashing	Equalization charging
	Double flashing	Current-limit charging
	Three flashing	Fully charged
	Extinction	Not charging

3.3 Alternator (automobile) indicator

Indicator color	Indication mode	Description
White	Normally on	The alternator (automobile) will charge the house battery
	Slow flashing	The solar energy will charge the starting battery
	Flashing	Alternator over-voltage
	Extinction	Not charging

3.4 House battery indicator

Indicator color	Indication mode	Description
White	Normally on	The battery voltage is normal.
	Slow flashing	Battery over-discharge
	Flashing	Battery over-voltage

3.5 Fault indicator

Indicator color	Indication mode	Description
White	Extinction	The system is normal.
	Normally on	System Fault

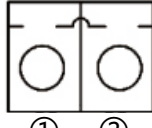
4. House Battery Temperature Sampling Interface

By connecting the temperature probe to Interface ③, the real-time temperature of the battery can be sampled, and the default is 25°C if the temperature probe is not connected; If the temperature probe is connected, the battery temperature will be sampled for high and low temperature protection of the battery or temperature compensation of charging voltage of lead-acid battery. Connection method: connect the temperature sensor terminal to Interface ③, and fix the temperature sensor on the battery surface.

5. Ignition Signal Interface

The starting charging voltage of intelligent alternator (automobile) is different from that of conventional alternator. If it is an intelligent generator, it is necessary to connect the ignition signal line to IGN ②. The starting charging voltage of conventional alternator is 13.2V. The starting charging voltage of intelligent generator is 12.0V. It is also allowed to connect only one positive wire here.

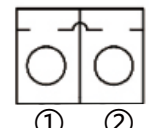
The interface is defined as follows:

 ① ② IGN	No.	Definition
	①	+
	②	-

6. House Battery Voltage Compensation Interface

For the reason of configuration, the charging power is high and the diameter of wire from the battery to the controller is slightly smaller, causing the battery voltage collected by the controller to be higher than the actual voltage at the battery end, which prevents the battery from being fully charged; To a certain extent, through the battery voltage sampling wire, the battery terminal voltage can be collected more accurately and the differential voltage compensation can be output in time, so that the battery terminal can get a more reasonable charging voltage. Connect the positive and negative poles of the battery to the interface ④. Pay attention to the voltage compensation port of the house battery. Pay attention to connect positive with the left and negative with the right.

The interface is defined as follows:

 ① ② VBAT	No.	Definition
	①	+
	②	-

7. Communication Functions Installtion

7.1 RS485 & CAN communication

◆ RS485 communication:

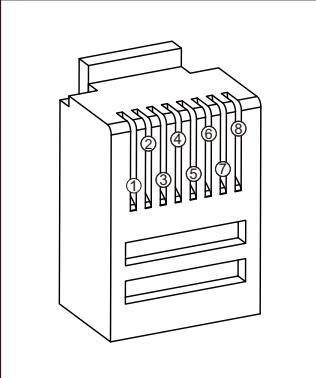
The default baud rate is 9600bps; Parity: None; Data bit: 8bit; Stop bit: 1bit

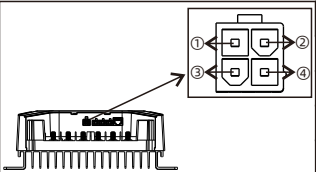
Interface type: RJ45, and matching resistance is 120R.

◆ CAN communication

CAN 2.0B mode, extend frame, baud rate of 250kbps, support RV-C protocol, and there is no terminal resistance.

◆ Interface communication line sequence definition:

	No.	Definition
	①	CAN_L
	②	CAN_H
	③	NC
	④	NC
	⑤	Ground/signal ground
	⑥	B/D-
	⑦	A/D+
	⑧	Power supply positive

	No.	Definition
	①	B/D-
	②	A/D+
	③	CAN_L
	④	CAN_H

7.2 Bluetooth communication

Bluetooth 4.0 BLE module is integrated in the controller, and users can use the mobile APP developed by our company to monitor and set the data of the controller.

APP download:



8. Common Problems And Solutions

Phenomenon	Possible problems	Solution
After the house battery is connected for energizing, there is no response and the indicator lamp is not ON.	A. Wrong or loose connection of house battery B. Lithium battery protection	A1. Please check whether the connection of house battery wires is correct and reliable; B1. Connect a solar panel or a alternator (automobile) to charge and activate the lithium battery.
The controller cannot charge the house battery through the solar panel during the daytime.	A. Wrong or loose wiring with the: solar panel B. The solar panel being blocked voltage C. Error in house battery system level setting	A1. Please check whether the connection of solar panel wires is correct and reliable; B1. Ensure that the solar panel is not blocked; C1. The system voltage level set by the controller is identical with the actual battery voltage level used.

Phenomenon	Possible problems	Solution
The house battery cannot be charged by the alternator (automobile) while the vehicle is running.	A. Wrong or loose wiring of alternator (automobile)	A1. Please check whether the connection of alternator (automobile) wires is correct and reliable;
	B. Error in house battery system voltage level setting	B1. The system voltage level set by the controller is identical with the actual battery voltage level used.

9. Product Installation

9.1 Precautions for installation

- ◆ Be very careful when installing the battery. Wear protective glasses when installing the open type lead-acid battery. Once contacting the acid solution of battery, please rinse with clear water in time.
- ◆ Avoid placing any metal object near the battery against short-circuiting.
- ◆ Acid gas may be generated when the battery is charged so as to ensure good ventilation of surroundings.
- ◆ The battery may produce combustible gas, please stay away from sparking.
- ◆ Direct sunlight and rainwater infiltration should be avoided during the outdoor installation.
- ◆ Virtual: junctions and corroded wires; May cause great heat, melt the insulation of wire, burn; The surrounding material, and even cause fire. Therefore, it is necessary to ensure that all connectors are tightened, and wires are preferably fixed with ties to avoid loose connectors caused by shaking of wires during mobile applications.

- ◆ Once the system is connected, the output voltage of the component may exceed the safe voltage of human body. In the process of operation, attention shall be focused on using insulating tools and ensure that hands are dry.
- ◆ The battery terminals on the controller can be connected with either a single battery or of batteries. Subsequent instructions in the manual are for use: With a single battery, but also, group applicable to systems with a group of batteries.
- ◆ Please follow the safety recommendations of battery manufacturers.
- ◆ The system's connection wire shall be selected according to the current density no more than: $4A/mm^2$.
- ◆ Ground the controller earth terminal.
- ◆ It is forbidden to connect the battery in reverse, which will cause irreversible damage in the process of installation.

9.2 Reference for wire and fuse type selection

The wiring and installation methods must comply with national and local electrical specifications PV, alternator (automobile) and battery wiring specifications must be selected according to rated current. Please refer to the following table for wire and fuse specifications.

Type	Maximum input current of PV terminal/A	PV-terminal wire gauge(mm ² /AWG)	PV Fuse Spec/A
MD12100N10	80	21mm ² /4AWG	100

Type	Alternator-terminal fuse spec/A	Alternator-terminal wire gauge(mm /AWG)	House battery-terminal current/A
MD12100N10	150	33mm ² /2AWG	100

Type	Maximum input current of alternator terminal /A	House battery-terminal wire gauge mm ² /AWG	House battery-terminal fuse spec/A
MD12100N10	120	26mm ² /3AWG	125

9.3 Installation and wiring

Warning: Danger of Explosion! Never install the controller and open the battery in the same closed space! Do not install it in a closed place where battery gas may accumulate.

Warning: Danger of high voltage! The PV array may generate high open-circuit voltage. Before wiring, please carefully check the series and parallel connection of the components to ensure that the open-circuit voltage of the components is less than 50V. Disconnect the circuit breaker or fuse before wiring, and be careful during wiring.

Warning: Danger of electric shock! We strongly recommend fuses or open circuits on the PV array side, alternator (automobile) side and battery side.

Notice: When installing the controller ensure enough air flowing through the heat sink of the controller and reserve at least 150mm space above and below the controller for natural convection. If installed in a closed box, ensure reliable heat dissipation through the case.

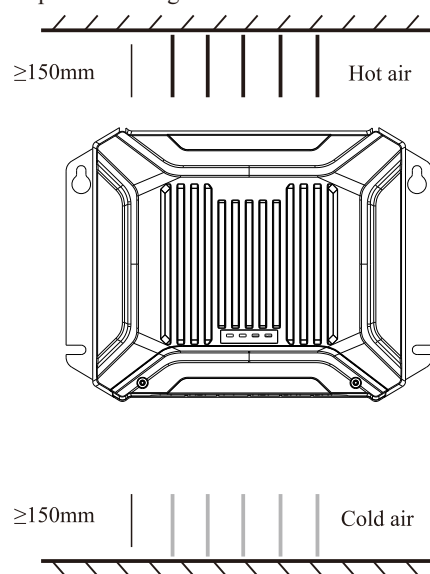


Fig. 9-1 Installation and Heat Dissipation

Step 1: Select the installation position

Water flooding, and ensure good ventilation around the controller.

Step 2: Fix the suspension screws

With appropriate size for mounting at the 2 marks, and fix the screws on such 2 holes.

Step 3: Fix the Controller

screws below.

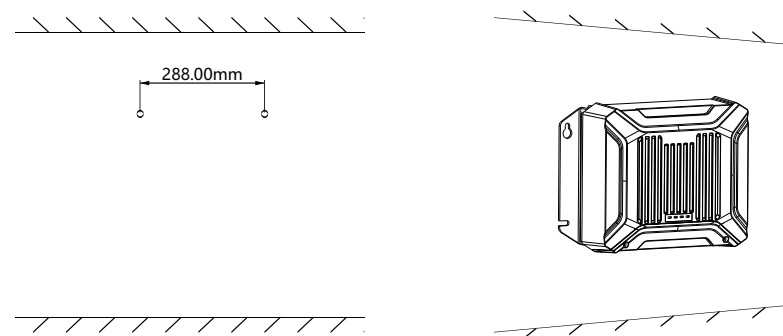


Fig. 9-2 Fixing the Controller

Step 4: connect the Wire

4.1 Crimping: select wire with appropriate specification according to the system configuration, and press one end of the wire to the standard copper terminal;

4.2 Wiring: connect the wiring hole of copper terminal into the wiring port corresponding to the controller;

Step 1: Push open the black terminal cover in the direction of [push] arrow in the following left picture;

Step 2: Access the corresponding interface according to the screen mark of each terminal, and pay attention not to connect the positive and negative in reverse;

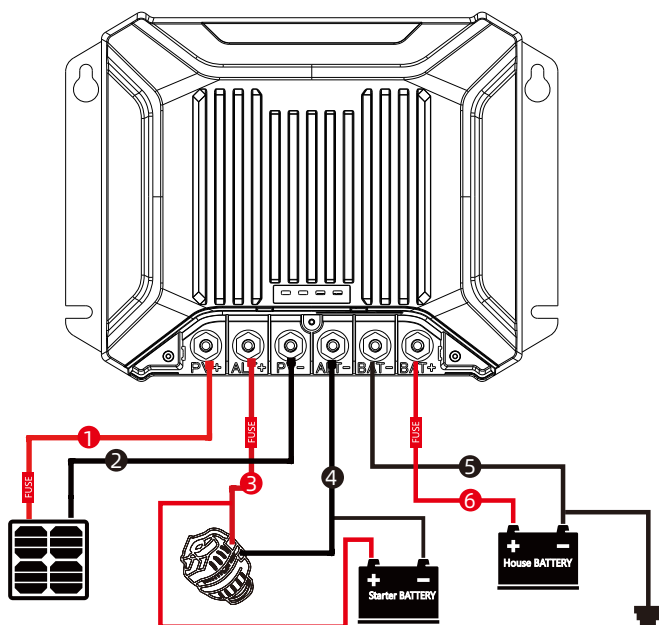


Fig. 9-3 Wiring Sequence

Warning: Danger of electric shock! We strongly recommend connecting fuses or circuit breakers at the photovoltaic array end, load end and battery end to prevent electric shock hazard in the process of wiring or mis-operation, and ensure that the fuses or circuit breakers are disconnected before wiring.

Warning: Danger of High Voltage! Photovoltaic arrays may produce high open-circuit voltage, so please be sure to disconnect the circuit breaker or fuse before wiring and be careful in the process of wiring.

Warning: This product does not support reverse connection protection for house batteries. Please confirm the correct polarity of the positive and negative terminals during the wiring process.

Please connect the battery first, then the battery panel, and finally the load and connect "+" first and then "-" in the process of wiring.

When all power wires are connected firmly and reliably, check whether the wiring is correct and whether the positive and negative are wrongly connected once again.

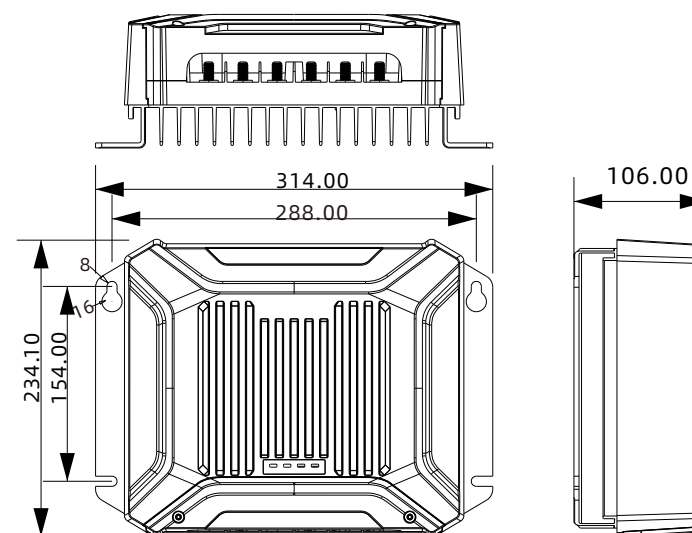
Once confirmed and found no error, connect the battery fuse or circuit breaker first, and observe whether the LED indicator light is lit. If not lit, please cut off the fuse or circuit breaker immediately and then check whether the wire is connected correctly.

If the battery is energized normally, connect the battery panel again. If the sunshine is sufficient, the charging indicator of the controller will be normally on or flashing and start charging the battery.

Note: That the installation position of battery fuse should be as close to the Controller as possible, and the recommended installation distance should not exceed 150mm.

10. Product Size

10.1 MD12100N10



Product Size: 314*234*106mm
Installation Size: 288*154mm
Mounting Hole Position: $\phi 8$ mm