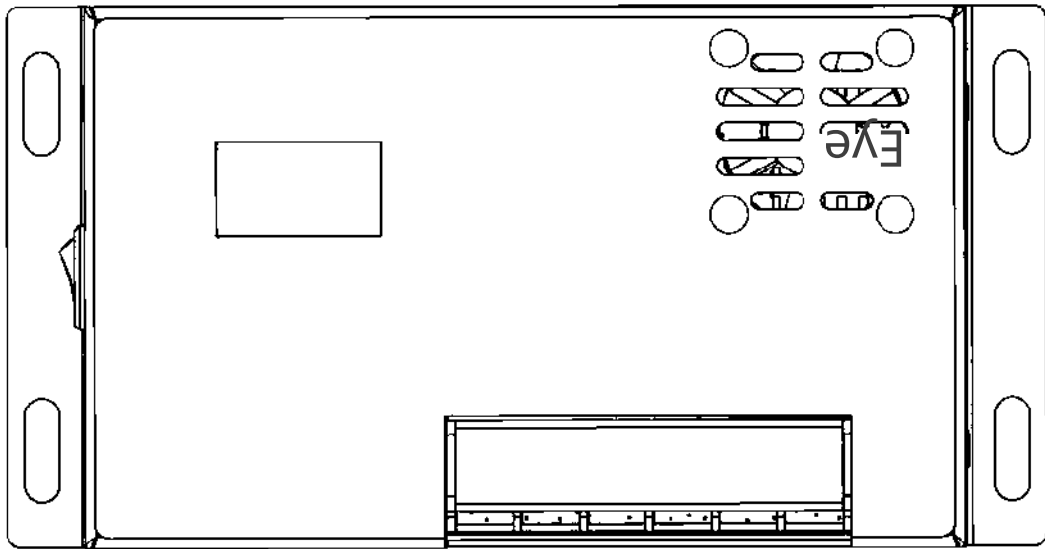


M24HA Model

Applicable **12V/24V** Platform Battery(Ternary, Lithium Iron, Lead Acid, Gel Custom)
Step-down Version



Manual Version: V1.1 Changes will not be notified separately; please contact sales for the latest electronic documentation

Thank you very much for choosing our products!

Safety Instructions



1. Since the operating voltage of this controller exceeds the safe voltage for the human body, please read the manual carefully and ensure that safety operation training is completed before operating this controller.



2. There are no parts inside the controller that require maintenance or repair; users should not disassemble or repair the controller themselves.



3. Please install the controller indoors to avoid exposure of components and prevent water from entering the interior of the controller.



4. Please install the controller in a well-ventilated area, as the temperature of the heat sink will be very high during operation.



5. It is recommended to 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 connection of the photovoltaic array and the fuse or circuit breaker near the battery terminals.



7. After installation, check that all wiring connections are secure to avoid the risk of heat buildup due to loose connections.



Warning: Indicates that this operation is dangerous; make sure to prepare for safety before proceeding.



Note: Indicates that this operation is destructive.



Tip: Indicates suggestions and prompts for the operator.

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1. Product Introduction

1.1 Product Overview

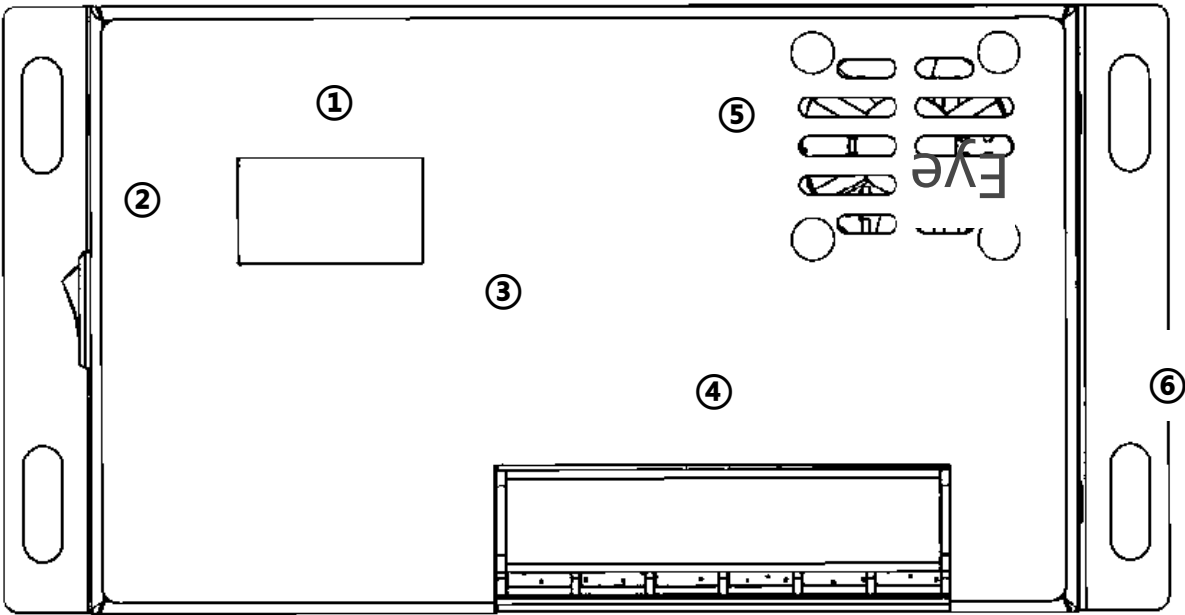
The M24HA controller adopts industry-leading MPPT (Maximum Power Point Tracking) technology to achieve maximum energy tracking of solar panels, enabling it to quickly and accurately track the maximum power point of solar cells in various environments. It real-time obtains the maximum energy from solar panels, significantly improving the energy utilization rate of solar systems. It is widely used in off-grid photovoltaic systems, managing the operation of solar panels, batteries, and loads, serving as the core control component of off-grid photovoltaic systems. The controller features comprehensive software and hardware fault detection and protection functions, minimizing the risk of damage to product components due to installation errors and system failures.

1.2 Product Features

- Utilizes MPPT maximum power tracking technology, with a tracking efficiency of up to 99.9%.
- Supports simultaneous full-power charging and discharging.
- Supports various battery types including sealed, gel, open, lithium, and custom batteries.
- Supports lithium battery and lead-acid activation.
- Supports charging current settings.
- Supports full charge settings.
- Supports temperature compensation function.
- Supports parallel charging.
- Supports multiple load operating modes.
- Supports starting capacitive and inductive loads.
- Supports saving historical data.
- Supports RS485 communication with standard Modbus protocol, with fixed baud rate.
- Supports TTL communication with standard Modbus protocol, with fixed baud rate.
- Supports Bluetooth and Ethernet communication functions (optional).
- It has a complete charging and discharging protection mechanism for overpressure, overcurrent, overload, overheating, and short circuit.
- It uses high-quality aluminum heat sinks, air cooling, and high-temperature derating processing to ensure reliable and efficient operation in various working environments.

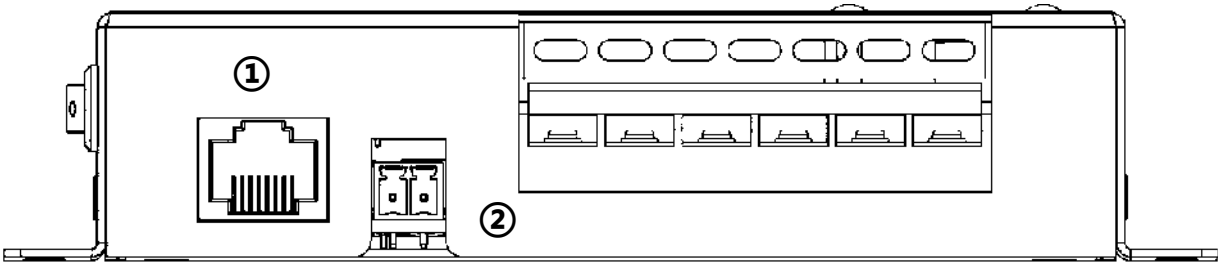
1.3 Appearance and Interface Description

Front Interface Introduction



Serial Number	Function Description	Remarks
①	Battery type selection, switch between Chinese and English, interface changes with toggle switch	For details, see the toggle switch section
②	Start button	Side boat-shaped switch
③	Display screen interface	
④	Load interface; battery interface; photovoltaic input interface	Interface KF2EDGR
⑤	Fan outlet	Do not block
⑥	Ground screw hole position	

Side interface introduction



Serial Number	Function Description	Remarks
①	RS485 communication interface	Pin definitions for the interface are in other sections
②	Battery temperature monitoring interface, external NTC B3950 10K temperature sensor	Battery-free temperature monitoring for missed calls

The M24HA series Maximum Power Point Tracking (MPPT) system is an advanced charging technology that adjusts the operating state of the electrical module to enable solar panels to output more electrical energy. Due to the nonlinear characteristics of solar panel arrays, there exists a maximum power point on their curve. Traditional PWM charging technology cannot maintain charging at this point, thus failing to capture the maximum energy from the solar panels. However, solar controllers with MPPT technology can continuously track the maximum power point of the array to obtain the maximum energy for charging the batteries. For example, in a 12V system, the peak voltage (V_{pp}) of the solar panel is around 18V, while the battery voltage is about 12V. General charging controllers operate at around 12V during charging, which does not fully utilize the maximum power.

MPPT controllers can overcome this issue by real-time adjusting the input voltage and current of the solar panels to achieve maximum input power. Compared to traditional PWM controllers, MPPT controllers can harness the maximum power of solar panels, thus providing a larger charging current. Generally, MPPT can improve energy utilization by 20% to 30% compared to PWM controllers.

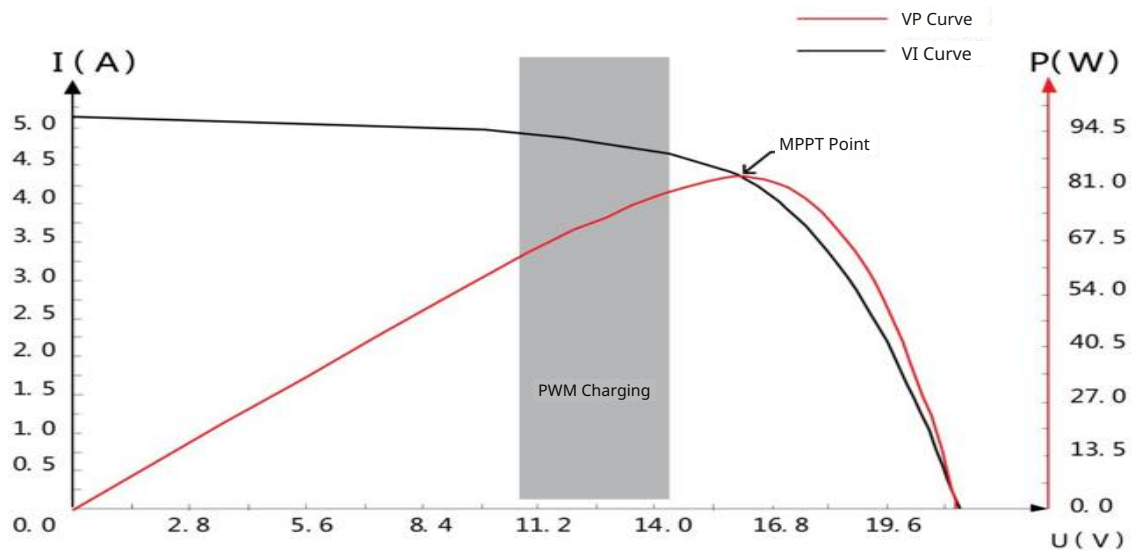


Figure 1-2 Battery Panel Output Characteristic Curve

Due to varying environmental temperatures and lighting conditions, the maximum power point frequently changes. Our MPPT controllers can adjust parameters in real-time according to different conditions, ensuring that the system remains close to the maximum operating point at all times. The entire process is fully automatic, requiring no adjustments from the user.

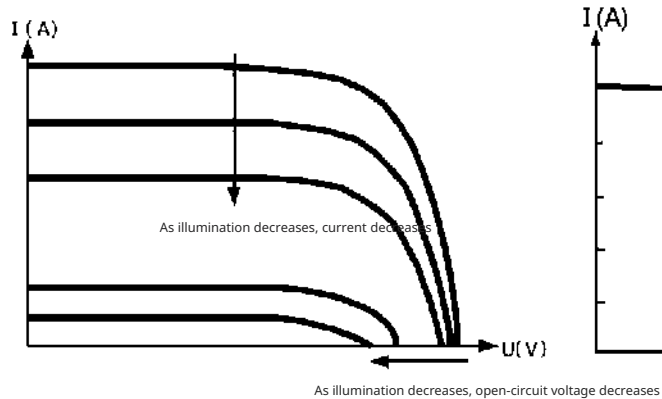


Figure 1-3 Relationship Between Battery Panel Output Characteristics and Illumination

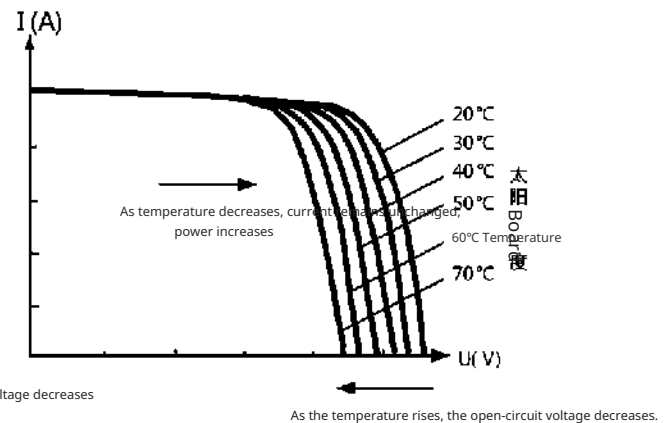


Figure 1-4 Relationship between Battery Panel Output Characteristics and Temperature

2. Technical Parameters

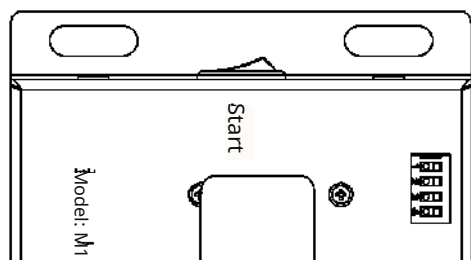
Product Model	M24HA	
Battery Platform	12V Platform	24V Platform
Static Power Consumption	$\leq 30\text{mA}$	
Battery Type	Ternary/Lithium Iron/Lead Acid/Colloidal/Other Batteries (Users can configure independently based on the upper computer)	
Battery Voltage	12V Platform (Ternary, Lithium Iron, Lead Acid, Colloidal, etc.)	24V Platform (Ternary, Lithium Iron, Lead Acid, Colloidal, etc.)
System Mode	Step-down	
Rated Battery Charging Current	12.5A (Exceeds automatic current limiting)	
Maximum PV Input Current	10A (Exceeds automatic current limiting)	
Maximum Solar Panel Power	180W (exceeds automatic power limit)	300W (exceeds automatic power limit)
Max: PV Open Circuit Voltage (Voc)	16V~56V	30V~56V
Recommended PV Power Point Voltage (Vmp)	16V~36V (recommended)	30V~48V (recommended)
System Maximum Voltage Rating	60V($\pm 2\%$) overvoltage will damage the system	
MPPT Tracking Efficiency	>99.9%	
MPPT Tracking Speed	<1ms	
Charging Conversion Efficiency	>96%	
Rated Load Current	10A	
Load Operating Mode	Manual Mode, Automatic Mode (Users can configure independently via the upper computer)	
Charging Work Mode	Activation/Trickle/Constant Current/Constant Voltage	
Battery Charging Temperature Control Adjustable	√	
Temperature Protection	√	
Activate Battery	√	
Load Overload/Short Circuit Protection	√	
TTL Communication	√	
RS485 Communication	√	
External 12V Power Supply (<300mA)	√	
Display	√	
Support SOC display	√	
Charging power can be set	√	
Battery model series can be configured	√	
Supports Bluetooth (optional expansion)	√	
Supports Ethernet (optional expansion)	√	
Set automatic save	√	
Supported baud rate types	4800/9600/14400/19200/38400/56000/57600 default 9600 (replacement requires configuration via upper computer)	
Backlight function	Default backlight always on (M24HA model is not adjustable)	
Protection Functions	PV over-voltage protection, PV reverse connection protection, PV short-circuit protection, night reverse charging protection, input power limit protection, over-temperature protection, load short-circuit protection, load overload protection, battery over-voltage/over-discharge protection, battery reverse connection protection(fuse)	
Operating Environment Temperature Range	-35°C~65°C (within 45°C under well-ventilated conditions without derating)	
Protection Level	IP32	
Cooling Method	Natural cooling, air cooling	
Dimensions	Length x Width x Height 78x150x29mm	
Weight	0.36kg	
Lithium Iron Phosphate Battery Supported	4 Series	8 Series
Nickel Cobalt Manganese Lithium Battery Supported	3 Series	6 Series
Lead Acid/Colloidal Battery Supported	1 Series	2 Series
Other Batteries	User-defined undervoltage and overvoltage points (9.0V~30.0V)	

3. DIP Switch and Power On/Off Instructions

3.1 Dip Switch Usage Instructions (Please select the battery type carefully from the front)

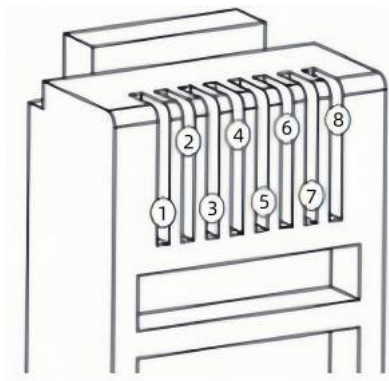
Dip Selection (ON:1) (Switch up is 1, down is 0)				Type	Over Voltage Protection	Under Voltage Protection	Full Charge Recovery	Load Recovery
1	2	3	4					
0	1	0	1	Trinary	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				3 Series	12.6V	9.0V	12.3V	9.6V
		1	0	Lithium Iron	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				4 Series	14.4	11.2V	13.6V	12.4V
		1	1	Lead-acid	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				1 Series	14.4	10.5V	13.4V	11.5V
		0	0	Colloidal	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				1 Series	13.8	10.5V	13.2V	11.5V
1	0	0	1	Trinary	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				6 Series	25.2V	18.0V	24.6V	19.2V
		1	0	Lithium Iron	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				8 Series	28.8	22.4V	27.2V	24.8V
		1	1	Lead-acid	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				2 Series	28.8V	21.0V	26.8V	23.0V
		0	0	Colloidal	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				2 Series	27.6	21.0V	26.4V	23.0V
0	0	0	0	Custom	Overvoltage	Undervoltage	Full Charge Recovery	Load Recovery
				Custom	User Settings	User Settings	User Settings	User Settings

3.2 Device Startup Switch Instructions



① To start the device, switch left to turn off and right to turn on

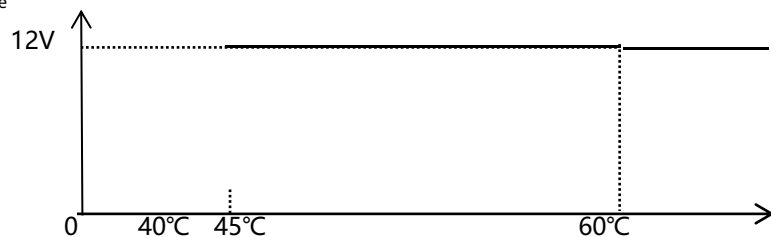
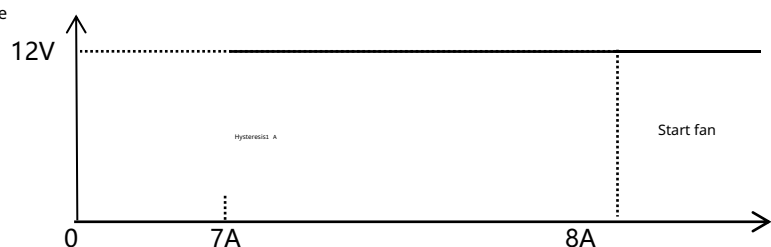
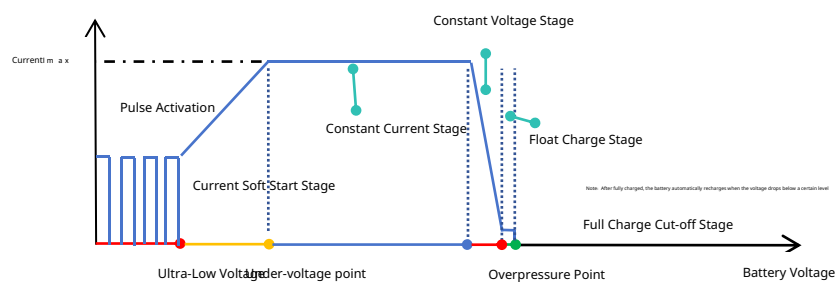
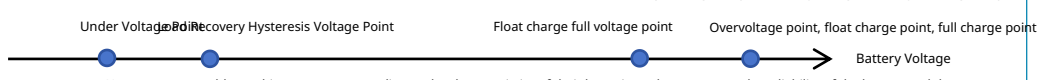
4. TTL Communication, RS485 Communication, External 12V Output Interface Pin Definitions



Serial Number	Definition
①	485-A
②	485-B
③	12V
④	GND
⑤	Unused
⑥	Unused
⑦	TTL-TXD
⑧	TTL-RXD

Note: The 12V maximum provides a current of 300mA; exceeding this may damage the interface.

5. Fan Temperature Control

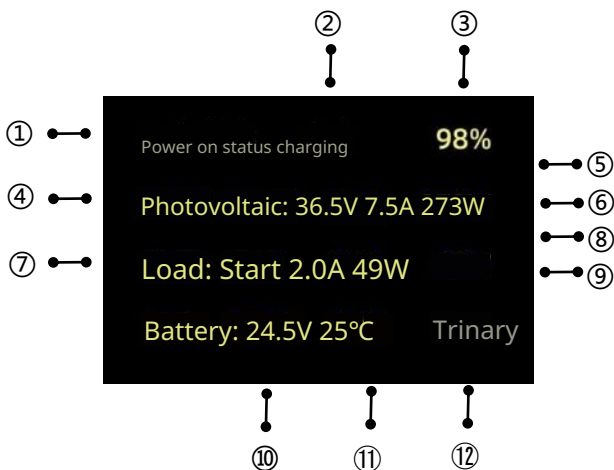
Serial Number	Fan Start Logic Diagram
When PV is charging	
When PV is not charging, the load current starts with discharge	
Six-Stage Current Charging	
Custom Settings	Resolve the issue of load repeatedly turning on and off during undervoltage, reduce the self-discharge voltage drop of the fully charged battery, leading to repeated charging  Users can reasonably set this parameter according to the characteristics of their batteries to better protect the reliability of the battery and the system.

6. Common problems and solutions

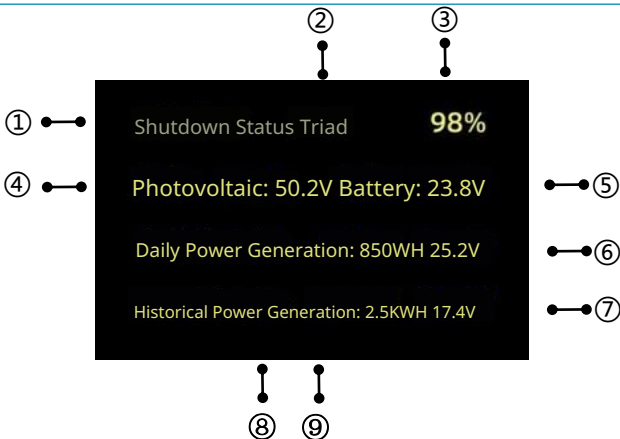
Phenomenon	Treatment method
Indicator light, LCD screen not lit	Check if the connections of the battery and solar panel are correct
The solar panel has voltage, but there is no voltage output at the battery terminal	Disconnect the battery to check if it has voltage. If there is no voltage, activate the battery in the system settings. (The battery is in activation status, and the system does not support battery reverse connection protection)
Battery type and series cannot be modified while MPPT is in operation	Changing the battery type will alter the over-voltage and under-voltage protection points!
Charging power does not reach the rated value	The system uses current limiting and constant temperature control; check if the system has reset the charging power; check if the voltage difference between the PV model and the battery model is too large.
The load cannot start some loads	You can set the short-circuit load time through the upper computer to accommodate different external loads
Other issues or difficult-to-solve anomalies	Go to the settings interface to initiate a factory reset. After setting the factory settings, reconfigure the relevant parameters according to the system configuration
Battery connection unresponsive	1. Check if the last reverse connection caused the fuse to blow; if so, replace the fuse or contact the manufacturer for repair.
Fan not spinning	1. Check if there are any foreign objects blocking the fan; clean the air duct regularly. 2. If the fan still does not spin after cleaning, contact customer service for fan replacement.

7. Display interface introduction

7.1 Start System Display Interface

	① Power On Status Display
	② System is in Charging State (Charging, Discharging, Protection)
	③ Battery Level SOC Display
	④ Display Photovoltaic Voltage Value
	⑤ Display the size of the photovoltaic charging current
	⑥ Display the size of the photovoltaic charging power
	⑦ Load startup status display
	⑧ Display the size of the load output current
	⑨ Display the size of the load output power
	⑩ Display the size of the battery voltage
	⑪ Battery temperature display (not displayed if NTC is not connected)
	⑫ Display battery selection type (ternary, lithium iron, lead-acid, other)

7.2 Close system display interface

	① Represents the current shutdown status
	② Represents that the current battery selection is of the ternary type
	③ Display battery level SOC
	④ Display photovoltaic voltage value
	⑤ Display battery voltage value
	⑥ Current battery over-voltage protection set point
	⑦ Current battery under-voltage protection set point
	⑧ Display today's power generation
	⑨ Display historical power generation

8. Product Installation

8.1 Installation Precautions

- Be very careful when installing batteries. When installing open lead-acid batteries, wear protective goggles. If battery acid comes into contact with skin, rinse immediately with clean water.
- Avoid placing metal objects near the battery to prevent short circuits.
- Charging the battery may produce acidic gases; ensure the surrounding environment is well-ventilated.
- The battery may produce flammable gases; keep away from sparks.
- When installing outdoors, avoid direct sunlight and rain infiltration.
- Loose connections and corroded wires can cause significant heat, melting the wire insulation, burning surrounding materials, and even causing fires. Therefore, ensure all connections are tight, and it is best to secure the wires with zip ties to prevent movement that could loosen the connections during use.
- When connecting the system, the output voltage of the components may exceed the safe voltage for the human body. When operating, be sure to use insulated tools and keep your hands dry.
- The battery terminal on the controller can be connected to either a single battery or a group of batteries. The subsequent instructions in the manual are for use with a single battery, but they also apply to systems with a group of batteries.
- Please adhere to the safety recommendations of the battery manufacturer.
- Ground the controller's grounding terminal.
- During installation, reverse connection of the battery is prohibited, as it can cause irreversible damage.

8.2 Installation Steps

Wiring and installation methods must comply with national and local electrical code requirements. Wiring specifications must be selected according to the rated current, generally at 5A/mm².

Step 1: Choose the installation location.

Avoid installing the controller in direct sunlight, high temperatures, or areas prone to water ingress, and ensure good ventilation around the controller.

Step 2: Secure the mounting screws.

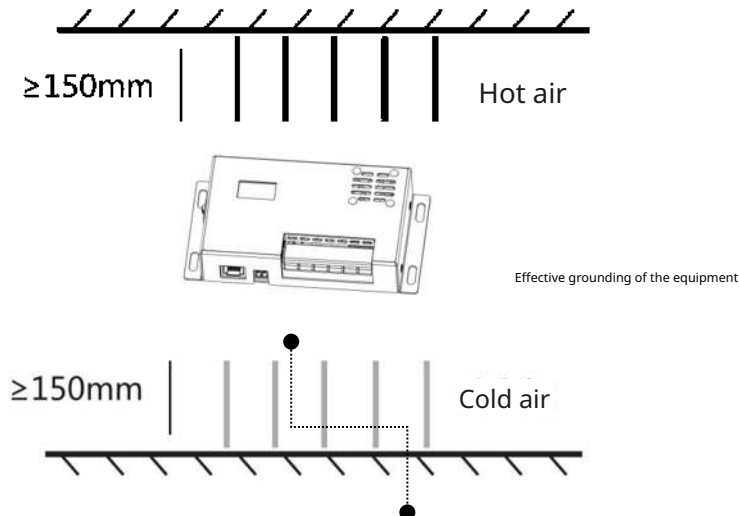
Mark the installation position according to the controller's installation dimensions, drill two appropriately sized mounting holes at the two marks, and secure the screws in the two mounting holes.

Step 3: Secure the controller.

Align the controller mounting holes with the two pre-fixed screws and hang it up, then secure the two screws at the bottom.

Step 4: Secure the grounding wire

Lock one wire to the side screws of the controller, and connect the other end effectively to the ground (it can be buried with a metal block) to allow leakage, static electricity, and lightning current to be directed into the ground.



9. Protection Functions

- **Overtemperature protection of the equipment**
When the internal temperature of the controller exceeds the set value, it will automatically reduce the charging power or even shut down during charging, thereby further slowing the rise in the internal temperature of the controller.
- **Battery Overtemperature Protection**
The battery overtemperature protection requires an external battery temperature sampling sensor. When the battery temperature is detected to be too high, charging will stop. When the battery temperature drops to 5 degrees below the set value and remains there for 2 seconds, charging will automatically resume.
- **Input Overpower Protection**
When the power of the solar panel exceeds 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-limiting charging.
- **Photovoltaic Input Voltage Over High**
If the input voltage of the photovoltaic array is too high, the controller will automatically disconnect the photovoltaic input.
- **Photovoltaic Input Reverse Polarity Protection**
When the polarity of the photovoltaic array is reversed, the controller will not be damaged and will continue to operate normally after correcting the wiring error.
- **Nighttime Anti-Reverse Charging Protection**
Prevents the battery from discharging through the solar panel at night.

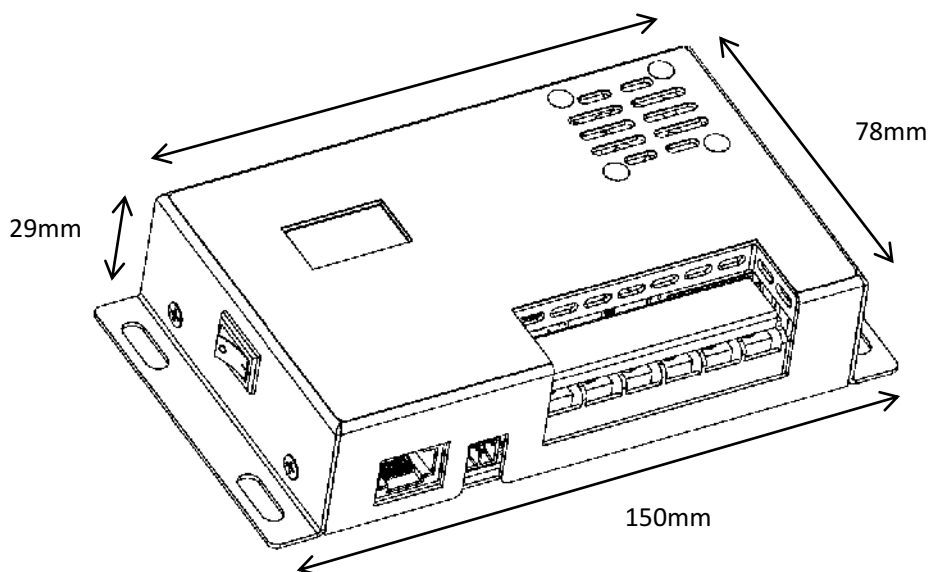
10. System Maintenance

To ensure that the controller maintains optimal performance over time, it is recommended to regularly check the following items.

- When abnormal faults or error messages are detected, corrective measures should be taken promptly.
- Check for signs of corrosion, insulation damage, high temperature, burning/discoloration, and deformation of the casing at the terminal connections, and repair or replace as necessary.
- If exposed, damaged, or deteriorating wires are found during inspection, they should be repaired or replaced promptly.
- If dirt, nesting insects, or corrosion are found during inspection, they should be cleaned up promptly.

Warning: Risk of electric shock! Ensure that all power to the controller is disconnected before performing the above operations or inspections! Non-professionals should not operate without authorization.

11. Product Dimension Diagram



12. Communication Protocol

12.1 Basic communication configuration

Transmission mode	RTU	Protocol Standard/Function Code	0x02 Read one or more input statuses	Bitwise Read
Baud Rate	Default is 9600bps	This communication protocol is based on <Sunopen Modbus RTU V1.0>, where the host cyclically requests data from the slave, and the slave receives the request command and responds with data.	0x03 Read Holding Registers	Read by 16-bit words
Parity Bit	No Parity		0x04 Read a Register	Read as 16-bit word (function code prohibited)
Data Bit	8bit		0x05 Write a Coil Status	Write by Bit (function code prohibited)
Stop Bit	1bit		0x06 Write a Holding Register	Write as 16-bit word
Frame Interval	Not less than 3.5 bytes time		0x07 Write multiple hold registers	Write by 16-bit word (function code prohibited)
Frame length	200 bytes		When the communication module detects errors other than CRC code errors, it must send back information to the host, with the highest bit of the function code set to 1; 01 illegal function code, 02 illegal data address, 03 illegal data value 04 service fault	
Maximum response time of the slave	350 Byte time			
Minimum host polling interval	400 Byte time			

12.2 Information address

Register address table, read corresponding function code 0x03, set corresponding function code 0x06. The addresses in the table below are the same as those in the actual information frame, and no offset or other conversion is needed.

Address (Decimal)	Meaning	Byte	Read/Write	Example	Explanation
40000	Device Model	2	R	52481	M24HA model
40001	Software version	2	R	10	V1. 2
40002	Hardware version	2	R	10	V1. 0
40003	Maximum power support	2	R	300	300W
40004	Maximum input and output current	2	R	1012	PV: 10A, BAT: 12A
40005	Photovoltaic step-down heat sink temperature	2	R	25	Current system temperature 25 degrees Celsius
40006	P V N T Status	2	R	0	0~7
40007	B A T N T Status	2	R	0	0~7
40008	Reserved	2	R	Unused	Reserved
40009	Reserved	2	R	Unused	Reserved
40010	Charging Stage	2	R	3	1: Activation, 2: Trickle, 3: Constant Current, 4: Constant Voltage
40011	Charging Status	2	R	1	0: Not Charging, 1: Charging
40012	Full Charge Status	2	R	1	0: Not Full, 1: Full
40013	Current Load Status	2	R	1	1: Starting, 0: Shutting Down
40014	B U C Heat Sink Temperature	2	R	50	50°C
40015	Reserved	2	R	Unused	Reserved
40016	Reserved	2	R	Unused	Reserved
40017	Reserved	2	R	Unused	Reserved
40018	Reserved	2	R	Unused	Reserved
40019	Reserved	2	R	Unused	Reserved
40020	Photovoltaic input voltage	2	R	4550	45.5V (accuracy 0.01V)
40021	Photovoltaic input current	2	R	111	1.11A (accuracy 0.01A)
40022	Photovoltaic input power	2	R	256	256W (accuracy 1W)
40023	Photovoltaic radiator temperature	2	R	20	20°C(accuracy 1°C)
40024	Photovoltaic fault code	2	R	0	See fault table 1
40025	Battery output voltage	2	R	2412	24.12V(accuracy 0.01V)

40026	Battery output current	2	R	0	None (see load current)
40027	Battery output power	2	R	0	None (see load power)
40028	Battery radiator temperature	2	R	25	25°C (accuracy 1°C)
40029	Battery fault code	2	R	See fault table 2	See fault table 2
40030	Load output current	2	R	18	1. 8A
40031	Load Output Power	2	R	125	125W
40032	Fan Startup Status	2	R	0	0: Off 1: On
40033	Historical system chargingW High number	2	R	H+L (unit WH)	Historical total power generation WH
40034	Historical system chargingW value is low	2	R		
40035	CurrentS O value	2	R	982	98. 2%
40036	Reserved	2	R	Unused	Reserved
40037	Today's power generation	2	R	855	855WH
40038	M P POOperating mode	2	R	0	See Function Table 2
40039	Remote load switch	2	R/W	0	1: Load on; 0: Load off
40040	Photovoltaic Access Maximum Voltage Setting	2	R	560	56. 0V
40041	Photovoltaic Access Minimum Voltage Setting	2	R	20	20. 0V
40042	User Set Maximum Charging Power	2	R/W	200	200W (Limit Maximum Photovoltaic Power)
40043	Current battery full charge recovery difference	2	R	2380	23.8V (recovery difference voltage)
40044	Photovoltaic stop working temperature setting	2	R/W	70	70°C
40045	Current photovoltaic fan start temperature	2	R	40	40°C Fan Start
40046	Device Address	2	R/W	01	Communication Address: 01H
40047	Maximum Charging Voltage Setting	2	R	2520	25. 2V
40048	Minimum Discharging Voltage Setting	2	R	1960	19. 6V
40049	Current battery undervoltage hysteresis value	2	R	2170	21.7V (load recovery hysteresis value)
40050	Current battery discharge high temperature setting	2	R/W	60	>60°C stop load output
40051	Current battery discharge low temperature setting	2	R/W	-10	<-10°C stop load output
40052	Current battery charging high temperature setting	2	R/W	45	>45°C stop charging the battery
40053	Current battery charging low temperature setting	2	R/W	0	<0 stop charging the battery
40054	Reserved	2	R/W	Unused	Reserved
40055	Set battery type	2	R	0	0: Ternary lithium, see Function Table 1
40056	Set battery series number	2	R	7	Ternary lithium 7 series
40057	Power on	2	R	1	0: Disable power generation, 1: Start power generation
40058	Battery Activation Settings	2	R	0	0: Disabled (default), 1: Enabled
40059	Baud Rate	2	R/W	0	1: 9600 (default) 0~8
40060	Backlight time	2	R/W	60	M24HA not supported
40061	Lock screen	2	R/W	0	M24HA not supported
40062	Reserved	2	R/W	Unused	Reserved
40063	User set battery overvoltage value	2	R/W	2520	25. 2V
40064	User set battery undervoltage value	2	R/W	1740	17. 4V
40065	User set load short-circuit time	2	R/W	500	500*20 (us)
40066	Reserved	2	R/W	Unused	Reserved
40067	Reserved	2	R/W	Unused	Reserved
40068	Load Shutdown Hysteresis Voltage Setting	2	R/W	1000	1000mV (Shutdown voltage setting after load disconnection)
40069	Full Charge Recharging Voltage Difference Setting	2	R/W	1000	1000mV (Voltage difference setting for recharging after full charge voltage drops during float charge)
40070	Reserved	2	R/W	Unused	Reserved

13. Detailed Attachment Table

13.1 Function Table

Function Table I (Decimal)		
NMC Battery	Nickel Manganese Cobalt Battery	0
LFP Battery	Lithium Iron Phosphate Battery	1
PAB Battery	Lead-acid battery	2
GEL Battery	Colloidal	3
OTH Battery	Other batteries	5
ERR	Error configuration	8

Function Table II (Decimal)		
MPPT->BAT	Solar panel charging battery	0

13.2 Fault Table

Fault Table 1 (Decimal)				
OV	Solar Panel Over Voltage	4	SC	Solar Panel Short Circuit
UV	Under Voltage of Solar Panel	2		
OT	System Over Temperature	4		
TF	Temperature Sensor Fault	8		
OC	Over Current of Solar Panel	4		
OP	Solar Panel Overload	32		
SF	Current Sensor Fault	64		

Fault Table II (Decimal)				
OV	Battery Overvoltage	1	SF	Battery Current Sensor Fault
UV	Battery Undervoltage	2	SC	Battery Short Circuit
OT	Battery Over Temperature	4	LOC1	Load Level 1 Overcurrent
UT	Battery Low Temperature	8	LOC2	Load Level 2 Overcurrent
TF	Temperature Sensor Fault	16	LSC	Load Short Circuit
OC	Battery Overcurrent	32	LSF	Load Current Sensor Fault
OP	Battery Overload	64	PF	Battery Configuration Abnormal
DPF	Charging Dial Fault	2048		

14. Application Wiring Diagram

