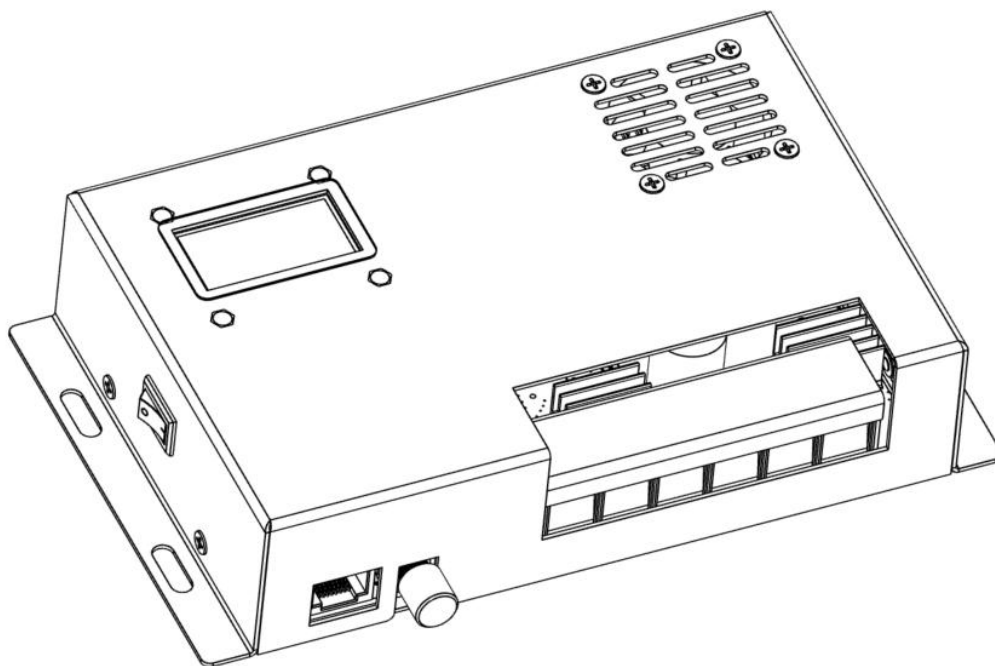


## Solar MPPT Charge Controller User Manual

### M24HC Model (30A)

Applicable for 12V/24V platform batteries (ternary, lithium iron, lead-acid, custom) buck version

Optional: 4G/wifi/ethernet/Bluetooth module available



Manual Version: V1.0 Changes may occur without prior notice; please contact sales for the latest electronic documentation

Thank you very much for choosing our products!

## Safety Instructions



1. Since the voltage of this controller exceeds the safe voltage for the human body, please read the manual carefully and complete safety operation training 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; ensure safety preparations are made before proceeding.



**Note:** Indicates that this operation is destructive.



**Tip:** Indicates suggestions and tips for the operator.

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# 1. Product Introduction

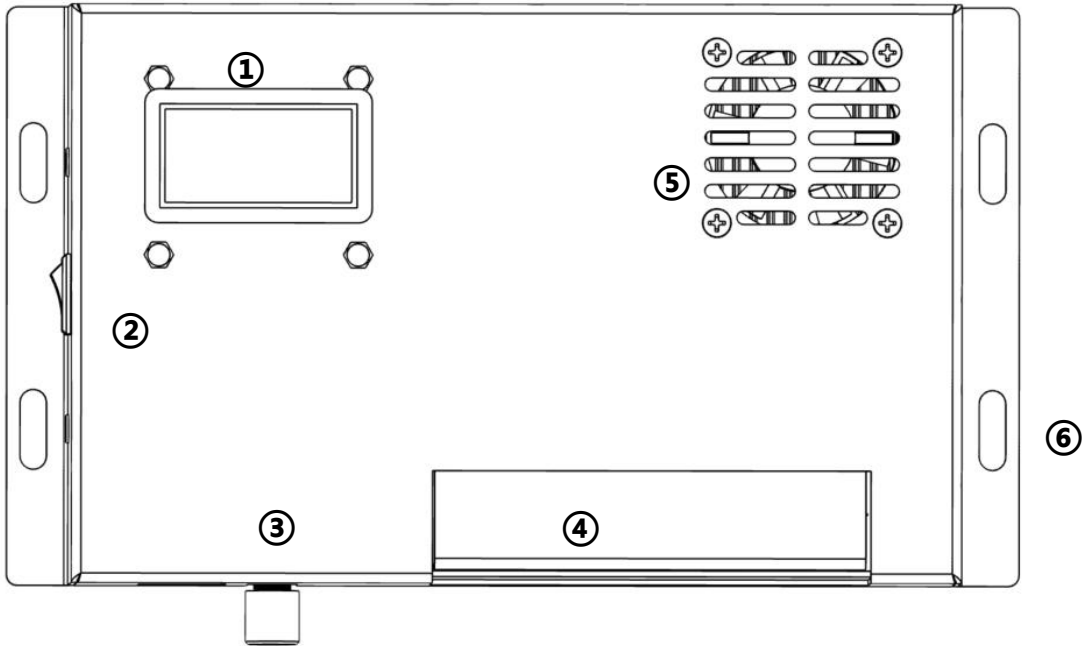
## 1.1 Product Overview

The M24HC 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 captures the maximum energy from solar panels, significantly improving the energy utilization efficiency of solar systems. It is widely used in off-grid photovoltaic systems to manage 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 damage to product components caused by installation errors and system failures.

## 1.2 Product Features

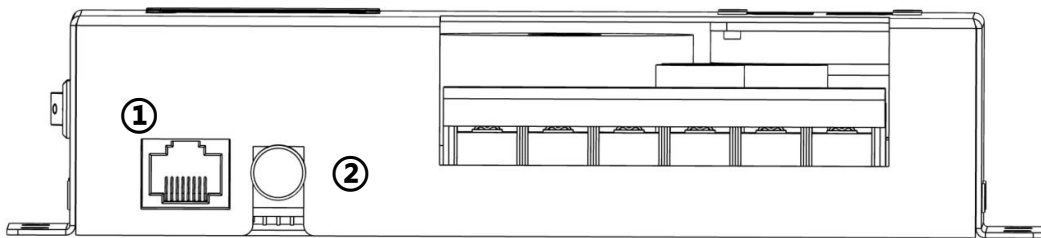
- Utilizes MPPT maximum power tracking technology, with a tracking efficiency of up to 99.9%.
- Supports simultaneous full-power charging and discharging.
- Supports various battery types including sealed, gel, open, lithium, and custom batteries.
- Supports activation of lithium and lead-acid batteries.
- 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 a fixed baud rate.
- Supports TTL communication with standard Modbus protocol, with a fixed baud rate.
- Supports Bluetooth and Ethernet communication functions (optional).
- Equipped with comprehensive protection mechanisms for over-voltage, over-current, overload, over-temperature, and short-circuit during charging and discharging.
- Uses high-quality aluminum heat sinks, air cooling, and high-temperature derating to ensure reliable and efficient operation in various working environments.

Front Interface Introduction



Serial Number	Function Description	Remarks
①	Display	See the display section for details
②	Start button	Side boat-shaped switch
③	Encoder key	Settable parameters
④	Load interface; battery interface; photovoltaic input interface	
⑤	Fan Outlet	Do Not Block
⑥	Ground Screw Hole Position	

Side Interface Introduction



Serial Number	Function Description	Remarks
①	RS485 Communication Interface	Pin Definition for the Interface is in Other Sections
②	Encoder Button	Parameter Setting

The M24HC 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.

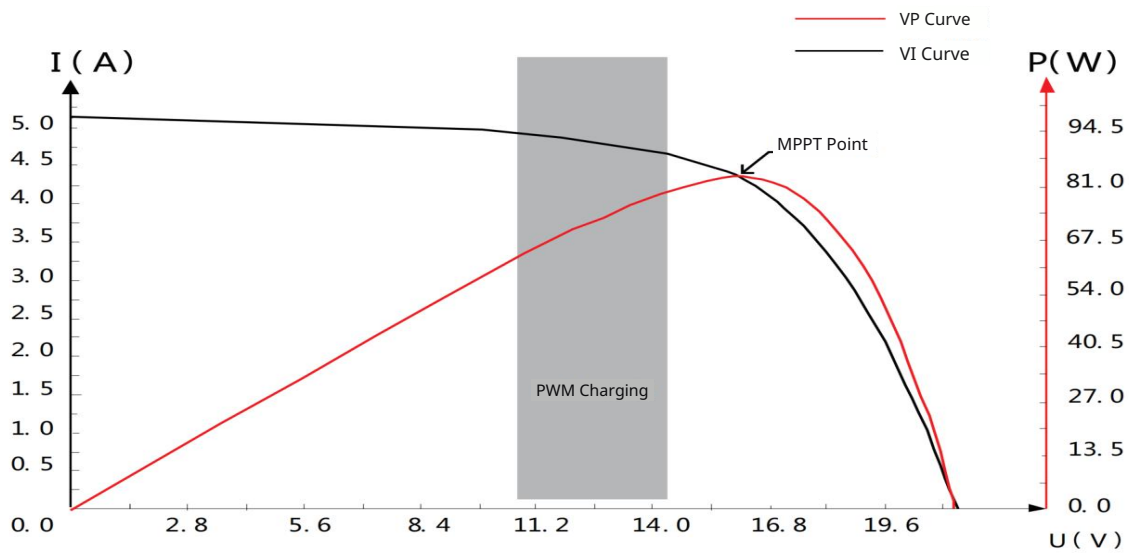


Figure 1-2 Battery Panel Output Characteristic Curve

Due to varying environmental temperatures and lighting conditions, the maximum power point frequently changes. Our company's MPPT controller can adjust parameters in real-time according to different conditions, ensuring that the system is always near the maximum operating point. The entire process is fully automatic, requiring no adjustments from the user.

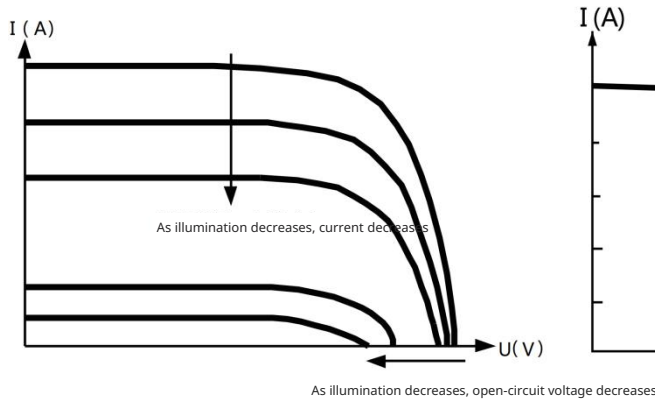


Figure 1-3 Relationship Between Battery Panel Output Characteristics and Illumination

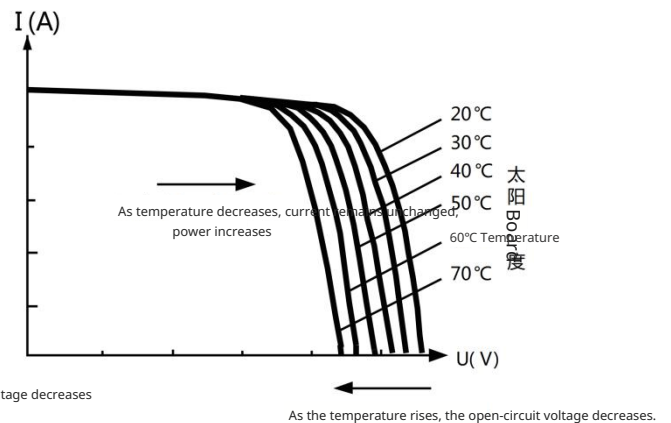
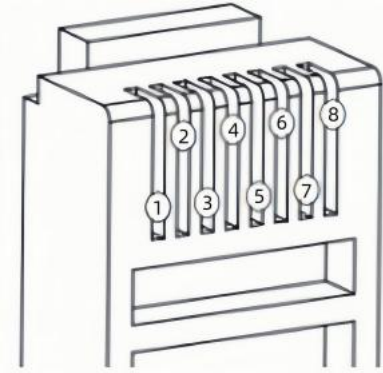


Figure 1-4 Relationship Between Battery Panel Output Characteristics and Temperature

## 2. Technical Parameters

Product Model	<b>M24HC</b>	
Static Power Consumption	≤50mA	≤50mA
Battery Type	Ternary/Lithium Iron/Lead Acid/Colloidal/Other Batteries (Users can configure independently via the upper computer)	Ternary/Lithium Iron/Lead Acid/Colloidal/Other Batteries (Users can configure independently via the upper computer)
Battery Voltage	12V Platform	24V platform
System Mode	Step-down	Step-down
Rated Battery Charging Current (MAX)	30A	30A
Max PV Input Current	28A	28A
Max Solar Panel Power	420W	820W
Max: PV Open Circuit Voltage (Voc)	90V	90V
Recommended PV Power Point Voltage (Vmp)	16V~36V	36V~72V
Maximum System Voltage	100V (±2%) Overvoltage Will Damage the System	100V (±2%) Overvoltage Will Damage the System
MPPT Tracking Efficiency	>99%	>99%
MPPT Tracking Speed	<1ms	<1ms
Charging conversion efficiency	93%~98%	93%~98%
Rated load current	30A	30A
Load operating mode	Manual mode, automatic mode (users can configure independently based on the upper computer)	
Charging operating mode	Activation/trickle/constant current/constant voltage/full charge stop	Activation/trickle/constant current/constant voltage/full charge stop
Activate battery	√	√
Load overload/short circuit protection	√	√
TTL communication	√	√
RS485 Communication	√	√
<b>External 12V Power Supply (&lt;300mA)</b>	√	√
<b>Display</b>	√	√
Supports SOC Display	√	√
Charging Power Can Be Set	√	√
Battery Model Series Can Be Configured	√	√
Supports Bluetooth (External Optional)	√	√
Supports Ethernet (External Optional)	√	√
Set Automatic Save	√	√
Supported Baud Rate Types	4800/9600/14400/19200/38400/56000/57600 Default 9600 (Change Requires Host Configuration)	
Backlight function	Default backlight always on (backlight time adjustable, set to 0 for constant backlight)	
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 <small>(Start activation function prohibits reverse connection)</small>	
Operating temperature range	-35°C~65°C (within 45°C under good ventilation without derating)	
Protection level	IP32	IP32
Cooling method	Natural cooling, air cooling (speed-adjustable fan)	
Size	Length x Width x Height 109x190x40mm	
Weight	0.82kg	
Lithium Iron Phosphate Battery Support	4-8 Series	
Ternary Lithium Battery Support	3-8 Series	
Lead Acid Battery Support	1-2 Series	
Colloidal battery support	1-2 Series	
Other Batteries	User-defined undervoltage and overvoltage points (set via the upper computer 9V~33.6V)	

### 3. TTL Communication, RS485 Communication, External 12V Output Interface Pin Definition



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

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

### 4. Fan Temperature Control

Serial Number	Fan Startup Logic Diagram
During PV charging	<p>The graph shows Fan Voltage on the y-axis and Temperature on the x-axis. The voltage starts at 45°C and increases linearly to 12V at 60°C, then remains constant.</p>
When PV is not charged, discharge load current starts	<p>The graph shows Fan Voltage on the y-axis and Discharge Load Current on the x-axis. The voltage starts at 20A and increases linearly to 12V at 30A, then remains constant. A hysteresis point is marked at 20A.</p>
Six-stage current charging	<p>The graph shows Current on the y-axis and Battery Voltage on the x-axis. It illustrates six stages: Pulse Activation, Current Soft-Start Stage, Constant current stage, Constant Voltage Stage, Float Charge Stage, and Full Charge Cut-off Stage. Key voltage points include Ultra-low voltage, Under-voltage point, and Over-voltage point.</p>
Custom settings	<p>Repeatedly switching on and off the load during undervoltage conditions solving the self-discharge voltage drop of a fully charged battery, repeatedly charging</p> <p>The graph shows Battery Voltage on the x-axis with several key points: Under Voltage Point, Recovery Hysteresis Voltage Point, Float Charge, Full Charge, Hysteresis Voltage Point, and Over Voltage Point.</p> <p>Users can reasonably set this parameter according to the characteristics of their batteries to better protect the reliability of the battery and the system</p>

## 5. Common problems and solutions

Phenomenon	Handling method
Indicator light and LCD screen not lit	Check if the connections of the battery and solar panel are correct
Solar panel has voltage, but no voltage output at the battery terminal	Disconnect the battery to check if there is voltage; if there is no voltage, activate the battery in the system settings. (The battery is in an activated state, and the system does not support reverse connection protection for the battery)
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;
The load cannot start some loads	The short circuit load time can be set 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. Please be cautious!
No response when the battery is connected	1. Check if the fuse is damaged; it may need to be replaced, or contact the manufacturer for repair
The fan does not rotate	1. Check if there are foreign objects blocking the fan; clean the air duct regularly. 2. If the fan still does not rotate after cleaning, contact after-sales service for fan replacement.

## 6. Display interface introduction

	Shut down	In shutdown state
	98%	Battery level 98%
	Photovoltaic	60.8V Current Photovoltaic Voltage
	Battery	25.1V Current Battery Voltage
	Daily Power Generation	Today's Power Generation 615WH
	Total Power Generation	Historical Total Power Generation 615WH
	25. 2V	Current Battery Overvoltage Protection Threshold
	22. 0V	Current battery undervoltage protection threshold

### 6 . 2 Set battery interface

	Battery Type	Nickel-cobalt-manganese/Lithium iron phosphate/Lead-acid/Colloidal/Sodium batteries, etc.
	Number of series	6S represents 6 series
	25. 2V	Battery overvoltage setting threshold
	21. 2V	Battery undervoltage setting threshold
	24. 2V	Full charge return voltage setting threshold
	22. 2V	Under-voltage load recovery voltage setting threshold

6 . 3 Custom Battery Interface Users can set their own over-voltage and under-voltage protection for the battery, adjusting it more reasonably according to their own battery

	25. 2V	Custom battery over-voltage threshold
	21. 2V	Custom battery under-voltage threshold
	24. 2V	Custom full charge recharge voltage threshold
	22. 2V	Custom under-voltage load recovery voltage threshold
	No	Enable custom mode: Yes/No

6 . 4 System temperature interface

	60S	Backlight time setting 60S, 0: means always on
	786W	Charging power set to 786W charging
	No	Enable battery activation mode

6 . 5 Other parameter setting interface

	500 Microsecond	Load short circuit protection time setting
	100H	Device communication address 100 (1-255)
	9600/B	Device 485 communication baud rate setting

6 . 6 Power-on status display interface

	Charging	Charging/Full/Constant voltage/Constant current/Activate/Stop
	98%	Battery level 98%
	60. 8V	Current photovoltaic voltage: 60.8V
	12. 0A	Current input current of photovoltaic: 12.0A
	729W	Current charging power of photovoltaic: 729W
	Start	Load start status, Start/Stop
	9. 5A	Load output current: 9.5A
	237W	Load output power: 237W
	25. 0V	Current battery voltage: 25.0V
	Normal	Normal/Overvoltage/Overcurrent/Overload/Undervoltage, etc.

## 7. Product Installation

### 7.1 Installation precautions

- Be very careful when installing the battery. When installing an open lead-acid battery, wear protective goggles. If battery acid comes into contact, rinse immediately with clean water.
- Avoid placing metal objects near the battery to prevent short circuits.
- When charging the battery, acidic gases may be generated, so ensure that the surrounding environment is well-ventilated.
- The battery may produce flammable gases; please keep away from sparks.
- When installed outdoors, avoid direct sunlight and rainwater infiltration.
- Loose connection points and corroded wires can cause significant heating, melting the wire insulation, burning surrounding materials, and even causing fires. Therefore, ensure that all connections are tight, and it is best to secure the wires with cable ties to prevent them from moving and causing loose 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 terminals on the controller can be connected to 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 a system of multiple batteries.
- Please follow 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.

### 7.2 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/mm<sup>2</sup>.

#### Step 1: Choose the installation location.

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

#### Step 2: Secure the hanging screws

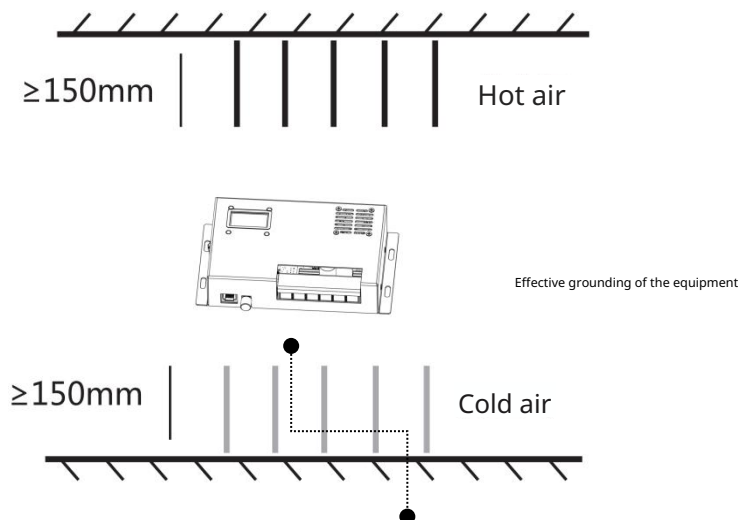
Mark the installation position according to the controller's installation dimensions, drill two appropriately sized mounting holes at the two marked points, and secure the screws in the two mounting holes.

#### Step 3: Secure the controller

Align the controller's mounting holes with the two pre-secured 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 screw of the controller, and connect the other end effectively to the ground (it can be tied to a metal block for burial) to allow leakage, static electricity, and lightning current to be directed into the ground.



## 8. Protection Function

- **Overtemperature Protection**  
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 internal temperature.
- **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.
- **Excessive Voltage at Photovoltaic Input**  
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 Charge Protection**  
Prevents the battery from discharging through the solar panel at night. Special note: There is no reverse connection protection for the battery.

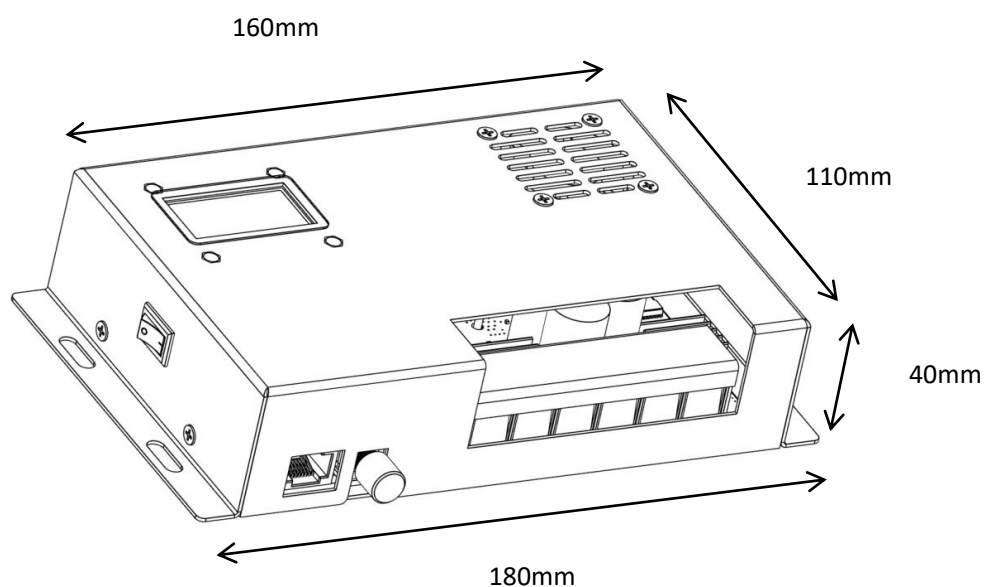
## 9. System Maintenance

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

- If any abnormal faults or error messages are found, corrective measures should be taken promptly.
- Check for corrosion, insulation damage, high temperature, or signs of burning/discoloration on the terminal connections, as well as any deformation of the casing, and repair or replace as necessary.
- If any exposed, damaged, or deteriorating wires are found, they should be repaired or replaced promptly.
- If dirt, nesting insects, or corrosion are found, 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 checks! Non-professionals should not operate without authorization.**

## 10. Product Size Diagram



## 11. Communication Protocol

### 11.1 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 <standard> MODBUS protocol>, the master cyclically requests data from the slave, the slave receives the request command and responds with data.	0x03 Read Holding Register	Read as 16-bit word
Parity Bit	No Parity		0x04 Read a Register	Read as 16-bit word
Data Bit	8bit		0x05 Write a Coil Status	Bit Write
Stop Bit	1bit		0x06 Write a holding register	Write in 16-bit words
Frame interval	Not less than 3.5 byte times		0x10 Write multiple holding registers	Write in 16-bit words
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 ac	
Maximum response time from the slave	350 Byte time		03 Illegal data value 04 service failure	
Minimum polling interval for the master	400 Byte time			

### 11.2 Information address

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

Address ( Decimal)	Meaning	Byte	Read/Write	Example	Explanation
40000	Device Model	2	R	52483	M24HC Model
40001	Software Version	2	R	10	V1.0
40002	Hardware Version	2	R	10	V1.0
40003	Maximum Power Support	2	R	820	820W
40004	Maximum Input and Output Current	2	R	2830	PV: 28A, BAT: 30A
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: Drip, 3: Constant current, 4: Constant pressure
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 OHeatSink 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	No (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 Charging <sup>WH</sup> High Number	2	R	H+L (unit WH)	Historical total power generation WH
40034	Historical system charging <sup>WH</sup> Value is low	2	R		
40035	Current <sup>S</sup> O <sup>2</sup> Value	2	R	982	98. 2%
40036	Reserved	2	R	Unused	Reserved
40037	Today's power generation	2	R	855	855WH
40038	M P P Operating Mode	2	R	0	See Function Table 2
40039	Remote Load Switch	2	R/W	0	1: Load On; 0: Load Off
40040	Setting of Maximum Voltage for Photovoltaic Access	2	R	560	56. 0V
40041	Minimum voltage setting for photovoltaic access	2	R	20	20. 0V
40042	User-defined maximum charging power	2	R/W	200	200W (limit maximum photovoltaic power)
40043	Current battery full charge recovery difference	2	R	2380	23.8V (recharge back-off 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	Battery Charging Maximum Voltage Setting	2	R	2520	25. 2V
40048	Battery Discharging Minimum Voltage Setting	2	R	1740	17. 4V
40049	Current battery undervoltage hysteresis value	2	R	2170	21.7V (load recovery hysteresis value)
40050	Reserved	2	R/W	Unused	Reserved
40051	Reserved	2	R/W	Unused	Reserved
40052	Reserved	2	R/W	Unused	Reserved
40053	Reserved	2	R/W	Unused	Reserved
40054	Reserved	2	R/W	Unused	Reserved
40055	Set battery type	2	R	0	0: Ternary Lithium See Function Table 1
40056	Set Battery String Count	2	R	7	Ternary Lithium 7 Strings
40057	Power On	2	R	1	0: Disable Generation, 1: Start Generation
40058	Battery Activation Setting	2	R	0	0: Disable Activation (Default), 1: Activate
40059	Baud Rate	2	R/W	0	1:9600 (default) 0~8
40060	Backlight Time	2	R/W	60	60S (default) (some models M24PB do not support)
40061	Lock Screen	2	R/W	0	0: Unlock, 1: Lock (some models M24PC do not support)
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 cutoff hysteresis voltage setting	2	R/W	1000	1000mV (setback start voltage after load shutdown)
40069	Full charge return pressure difference setting	2	R/W	1000	1000mV (voltage drop after floating charge full voltage, recharging voltage difference setting)
40070	Reserved	2	R/W	Unused	Reserved

## 12. Detailed attachment table

### 12.1 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 Battery	4
OTH Battery	Other Batteries	5
ERR	Error Configuration	8

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

### 12.2 Fault Table

Fault Table 1 (Decimal)			
OV	Solar Panel Over Voltage	SC	Solar Panel Short Circuit
UV	Solar panel undervoltage		
OT	System overtemperature		
TF	Temperature sensor failure		
OC	Solar panel overcurrent		
OP	Solar panel overpower		
SF	Current Sensor Fault		

Fault Table II (Decimal)					
OV	Battery Over Voltage	1	SF	Battery Current Sensor Fault	28
UV	Battery Under Voltage	2	SC	Battery Short Circuit	256
OT	Battery Over Temperature	4	LOC1	Load Level 1 Overcurrent	512
UT	Battery Low Temperature	8	LOC2	Load Level 2 Overcurrent	1024
TF	Temperature sensor failure	16	LSC	Load Short Circuit	2048
OC	Battery Overcurrent	32	LSF	Load Current Sensor Fault	5096
OP	Battery Overload	64	PF	Battery Configuration Abnormal	10192
DPF	Charging Switch Fault	20384			

## 13. Application wiring diagram

