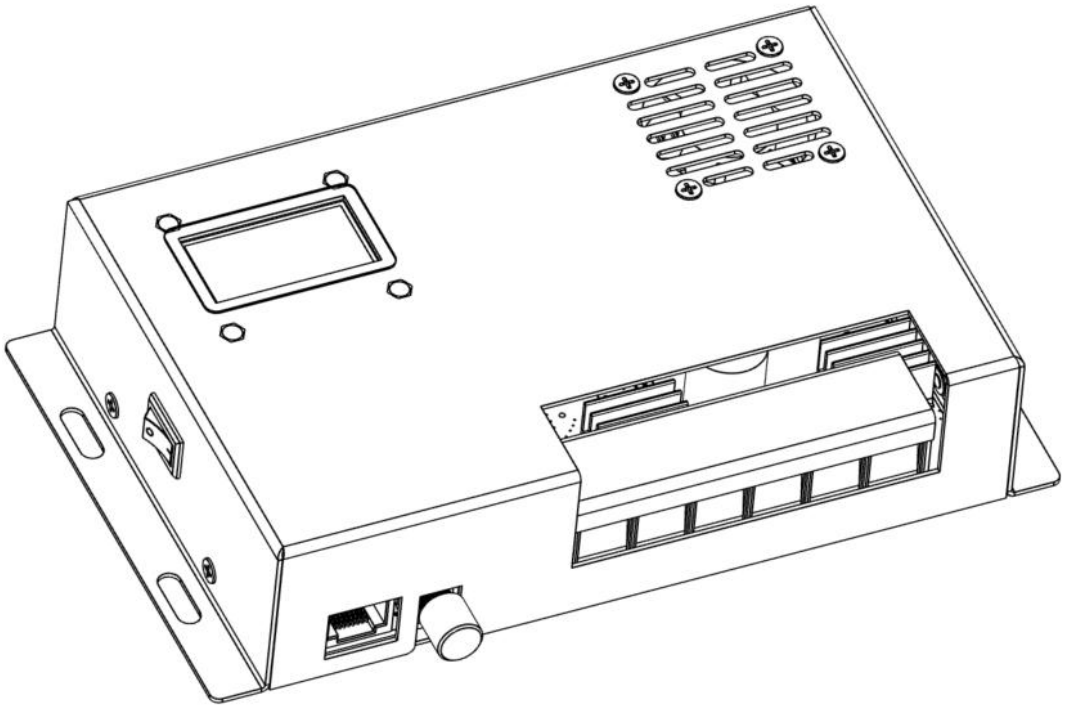
MPPT Solar Charging Controller User Manual

M48HC Model (30A)

Applicable to 24V/36V/48V platform batteries (ternary, lithium iron, lead-acid, custom) step-down 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 this controller operates at a voltage exceeding the safe voltage for humans, 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 exposing components and to 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 can 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 photovoltaic array and the fuse or circuit breaker near the battery terminals.

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

Warning: Indicates that this operation is dangerous; safety preparations must be 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

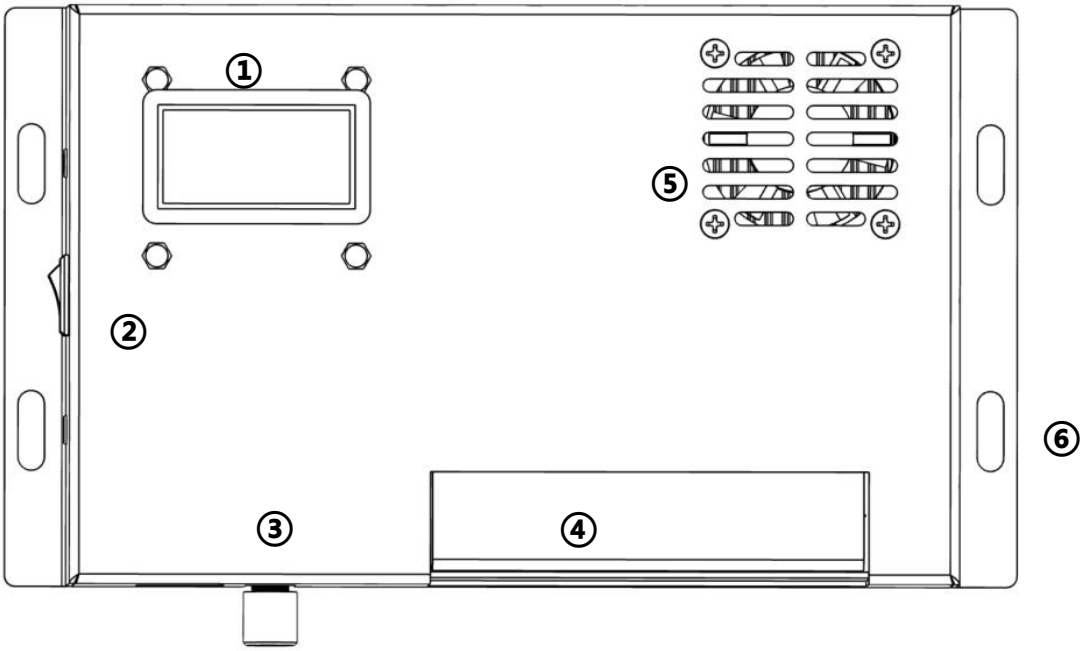
The M24HC controller adopts industry-leading MPPT (Maximum Power Point Tracking) technology to achieve maximum energy tracking of solar panels, enabling it to quickly and accurately track the maximum power point of solar cells in various environments. It real-time obtains the maximum energy from solar 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

- Adopts MPPT (Maximum Power Point Tracking) technology, with a tracking efficiency of up to 99.9%.
- Supports simultaneous full-power charging and discharging.
- Supports various types of batteries including sealed, gel, open, lithium, and custom types.
- 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 the startup of capacitive loads 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 overpressure, overcurrent, overload, overheating, and short circuit during charging and discharging.
- Uses high-quality aluminum heat sinks, air cooling, and high-temperature derating processing to ensure reliable and efficient operation in various working environments.

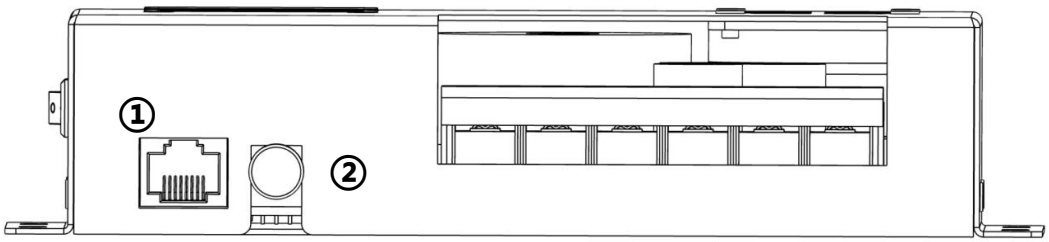
1.3 Appearance and interface description

Front Interface Introduction



Serial Number	Function Description	Remarks
①	Display Screen	For details, see the display section.
②	Start Button	Side Boat-Type Switch
③	Encoder Key	Configurable Parameters
④	Load Interface; Battery Interface; Photovoltaic Input Interface	
⑤	Fan Outlet	Prohibition of blockage
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	Encoder button	Parameter setting

The M48HC 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 charge the batteries with the maximum energy. For example, in a 12V system, the peak voltage (Vpp) of the solar panel is around 18V, while the battery voltage is about 12V. Generally, during charging, the voltage of the solar panel hovers around 12V, failing to fully utilize its 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.

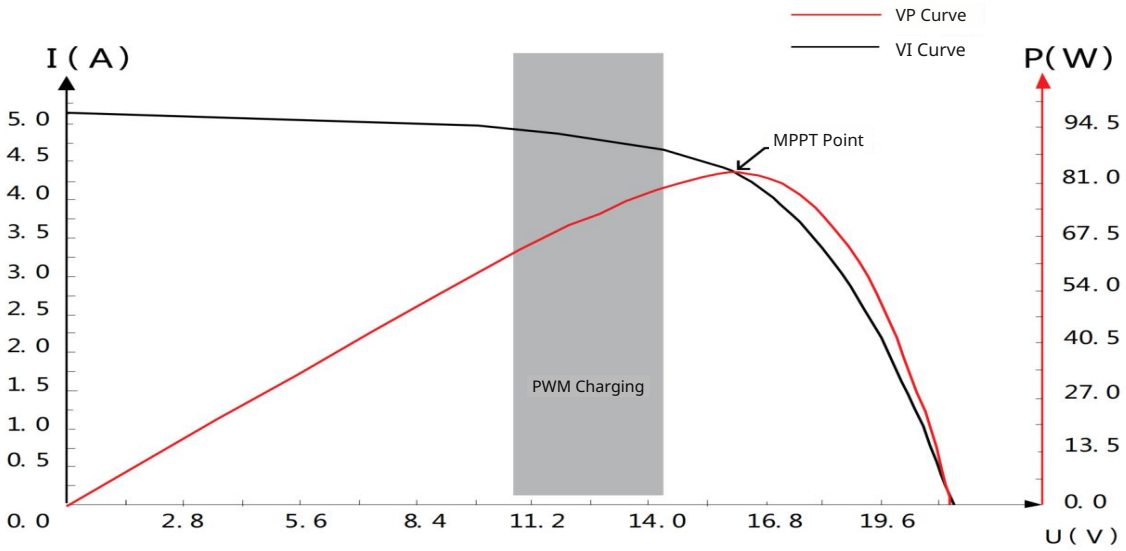


Figure 1-2 Battery panel output characteristic curve

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 remains close to the maximum operating point at all times. The entire process is fully automatic, requiring no adjustments from the user.

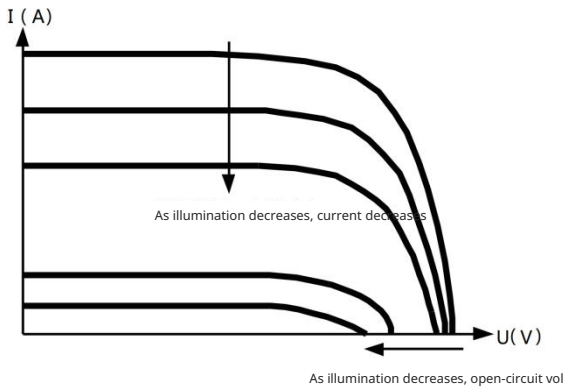


Figure 1-3 Relationship between battery panel output characteristics and illumination

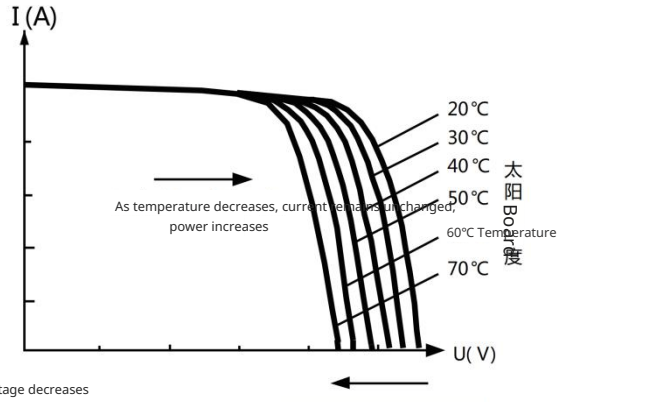
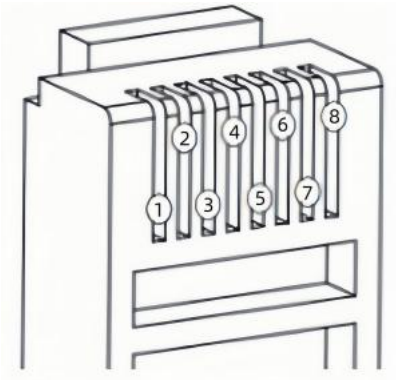


Figure 1-4 Relationship between battery panel output characteristics and temperature

2. Technical Parameters

Product Model	M48HC		
Static Power Consumption	≤50mA	≤50mA	≤50mA
Battery Type	Tri-element/Lithium Iron/Lead Acid/Colloidal/Other Batteries (Users can configure independently based on the upper computer)		
Battery Voltage	24V Platform	36V	48V
System Mode	Step-down	Step-down	Step-down
Rated Battery Charging Current (MAX)	30A		
Maximum PV Input Current	28A		
Maximum Solar Panel Power	820W	1080W	1440W
Max: PV Open Circuit Voltage (Voc)	90V	90V	90V
Recommended PV Power Point Voltage (Vmp)	36V~72V	48V~80V	60V~80V
Maximum System Voltage	100V (±2%) Overvoltage will damage the system		
MPPT Tracking Efficiency	>99%		
MPPT tracking rate	<1ms		
Charging conversion efficiency	93%~98%		
Rated load current	25A		
Load operating mode	Manual mode, automatic mode (users can configure independently via the upper computer)		
Charging working mode	Activation/trickle/constant current/constant voltage/full charge stop		
Activate battery	√	√	√
Load Overload/Short Circuit Protection	√	√	√
TTL Communication	√	√	√
RS485 Communication	√	√	√
External 12V Power Supply (<300mA)	√	√	√
Display Screen	√	√	√
Supports SOC Display	√	√	√
Charging Power Adjustable	√	√	√
Battery Model Series Configurable	√	√	√
Supports Bluetooth (Optional Expansion)	√	√	√
Supports Ethernet (Optional Expansion)	√	√	√
Set Auto Save	√	√	√
Supported baud rate types	4800/9600/14400/19200/38400/56000/57600 Default 9600 (change requires upper computer configuration)		
Backlight function	Default backlight always on (backlight time adjustable, set to 0 for always on)		
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 (Start activation function prohibits reverse connection)		
Operating environment temperature range	– 35℃~65℃ (within 45℃ under good ventilation, no derating)		
Protection level	IP32		
Cooling Method	Natural Cooling, Air Cooling (Variable Speed Fan)		
Dimensions	Length x Width x Height 109x190x40mm		
Weight	0.82kg		
Lithium Iron Phosphate Battery Support	7~16 in Series		
Nickel Manganese Cobalt Lithium Battery Support	6~14 strings		
Lead-acid battery support	2~4 in series		
Gel battery support	2~4 in series		
Other batteries	User-defined undervoltage and overvoltage points (set via the upper computer 18V~60V)		

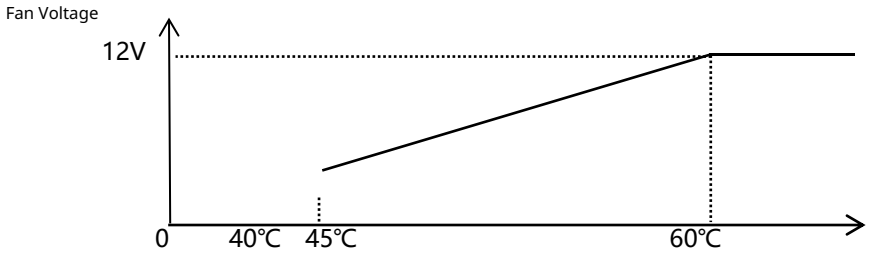
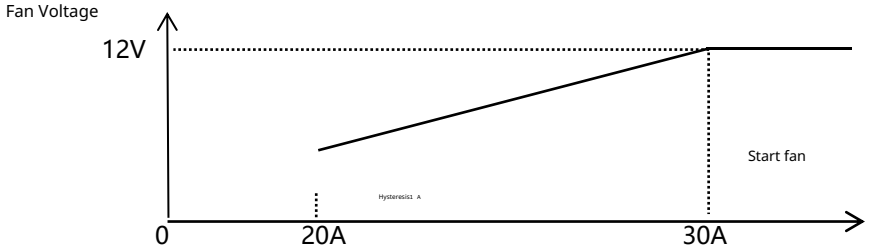
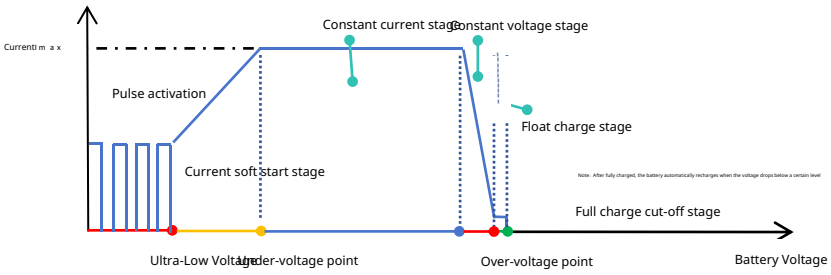
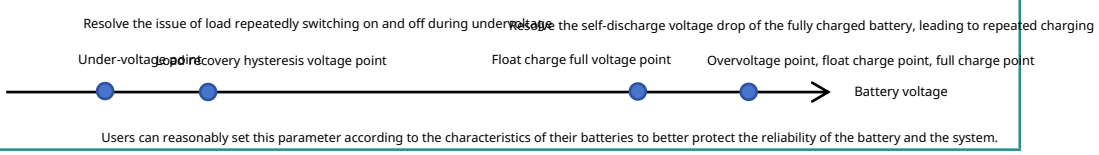
3. TTL communication, RS485 communication, external 12V output interface pin definition



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

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

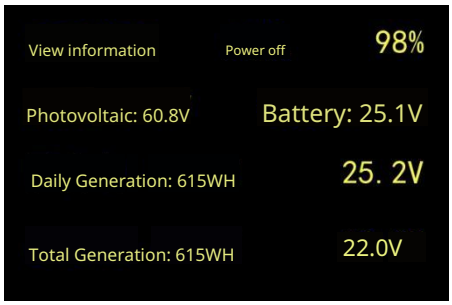
4. Fan temperature control

Serial Number	Fan Startup Logic Diagram
When PV is charging	
When PV is not charging, the load current starts with discharge	
Six-Stage Current Charging	
Custom Settings	 Users can reasonably set this parameter according to the characteristics of their batteries to better protect the reliability of the battery and the system.

5. Common problems and solutions

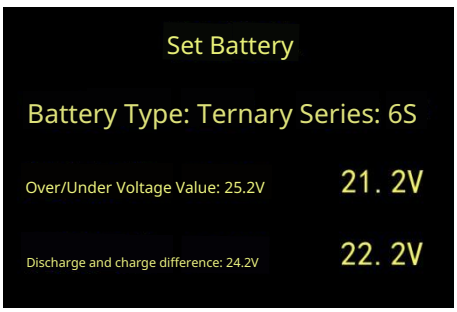
Phenomenon	Handling method
Indicator light and LCD screen not lit	Check if the connections of the battery and solar panel are correct
Solar panel has voltage, but no voltage output at the battery terminal	Disconnect the battery and check if there is voltage. If there is no voltage, activate the battery 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. Proceed with caution!
No response when the battery is connected.	1. Check if the fuse is damaged; if so, replace the fuse or contact the manufacturer for repair.
The fan does not turn	1. Check if there are any foreign objects blocking the fan, and clean the air duct regularly. 2. If the fan still does not turn after cleaning, please contact customer service for fan replacement.

6. Display interface introduction



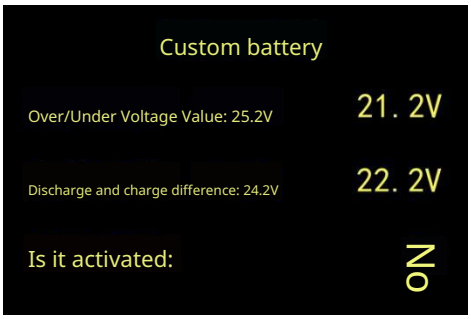
Power off	In shutdown state
98%	Battery level 98%
Photovoltaic	60.8V current photovoltaic voltage
Battery	25.1V current battery voltage
Daily power generation	Today's generation 615WH
Total Power Generation	Historical Total Power Generation 615WH
25. 2V	Current Battery Overvoltage Protection Threshold
22. 0V	Current Battery Undervoltage Protection Threshold

6 . 2 Set Battery Interface

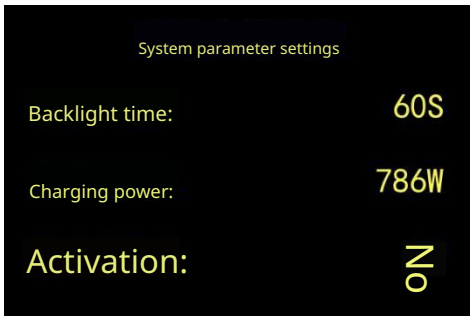


Battery Type	NCM/LFP/Lead Acid/Colloidal/Sodium Batteries, etc.
Number of Series	6S represents 6 series
25. 2V	Battery over-voltage setting threshold
21. 2V	Battery undervoltage setting threshold
24. 2V	Full charge return voltage setting threshold
22. 2V	Undervoltage load recovery voltage setting threshold

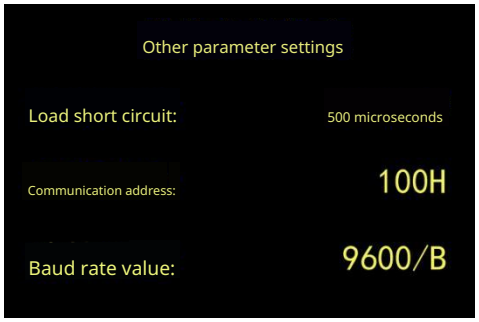
6 . 3 Custom Battery Interface Users can set their own over-voltage and under-voltage protection for the battery, adjusting it more reasonably based on their own battery

	25. 2V	Custom Over-Voltage Threshold
	21. 2V	Custom 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

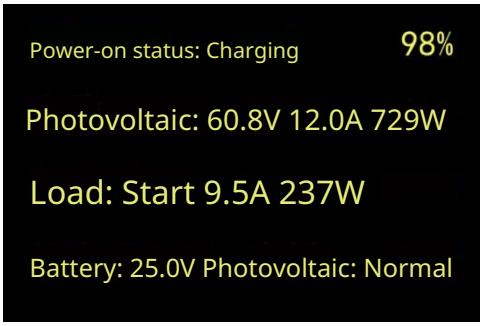
6 . 4 System Temperature Interface

	60S	Backlight Time Setting 60S, 0: represents always on
	786W	Charging Power Set to 786W Charging
	No	Whether to activate battery activation mode

6 . 5 Other parameter setting interface

	500 Microseconds	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

- When installing a lead-acid battery, it is very important to be cautious. Protective goggles should be worn during the installation of open lead-acid batteries. If contact is made with the battery acid, please rinse it off with clean water immediate
- 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; please keep away from sparks.
- When installed outdoors, avoid direct sunlight and rainwater infiltration.
- Loose connections and corroded wires can cause excessive heat, melting the wire insulation, burning surrounding materials, and even starting a fire. Therefore, ensure all connections are tight, and it is best to secure the wires with ties to prevent them from moving and loosening 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 connect to either a single battery or a group of batteries. The subsequent instructions in the manual are for single battery use but are also applicable to a system of batteries.
- Please follow the safety recommendations of the battery manufacturer.
- Ground the controller's grounding terminal.
- During installation, do not reverse the battery connections, as this can cause irreversible damage.

7.2 Installation Steps

The wiring and installation methods must comply with national and local electrical code requirements. The wiring specifications must be selected according to the rated current, generally chosen 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

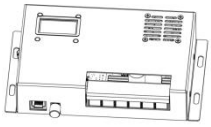
Mark the installation position according to the controller's installation dimensions, drill two appropriately sized mounting holes at the two marked points, and secure the screws in the two mounting holes.

Step 3: Secure the controller

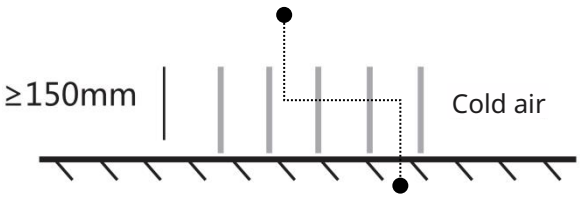
Align the controller's mounting holes with the two pre-secured screws and hang it up, then secure the two screws at the bottom.

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 buried with a metal block) to direct leakage, static electricity, and lightning currents into the ground.



Effective grounding of the equipment



8. 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 internal temperature.

- Input over-power 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 the photovoltaic input terminal

  If the voltage at the photovoltaic array input terminal is too high, the controller will automatically disconnect the photovoltaic input.

- Photovoltaic Input Reverse Connection Protection

  When the photovoltaic array is connected with reversed polarity, the controller will not be damaged and will continue to operate normally after correcting the wiring error.

- Nighttime Reverse Discharge Protection

  Prevents the battery from discharging through the solar cells at night. Special note: There is no reverse connection protection function for the battery.

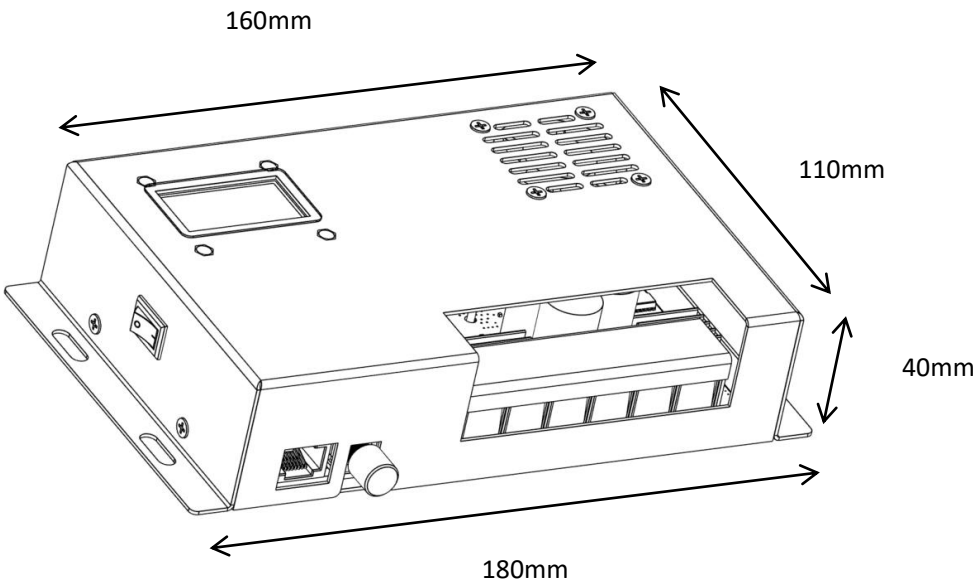
9. System maintenance

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.
- Check for any exposed, damaged, or deteriorating insulation on wires and repair or replace them promptly.
- Check for dirt, nesting insects, and corrosion, and clean them up in a timely manner.

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

10. Product dimension diagram



11. Communication Protocol

11.1 Basic communication configuration

Transmission mode	RTU	Protocol standard/function code	0x02 Read one or more input states	Bitwise read
Baud rate	Default is 9600bps	This communication protocol is based on <Standard MODBUS protocol>, where the master continuously requests data from the slave, and the slave receives the request command and responds with data.	0x03 Read Holding Registers	Read as 16-bit words
Parity Bit	No Parity		0x04 Read One Register	Read as 16-bit words
Data Bit	8bit		0x05 Write One Coil Status	Bitwise Write
Stop Position	1bit		0x06 Write a holding register	Write by 16-bit word
Frame Interval	Not less than 3.5 byte times		0x10 Write multiple holding registers	Write by 16-bit word
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 of the slave	350 Byte time			
Minimum polling interval of the host	400 Byte time	03 Illegal data value 04 service fault		

11.2 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, so no offset or other conversion is needed.

Address (Decimal)	Meaning	Bytes	Read/Write	Example	Explanation
40000	Device Model	2	R	54883	M48HC Model
40001	Software Version	2	R	10	V1.0
40002	Hardware Version	2	R	10	V1.0
40003	Maximum Power Support	2	R	1440	1440W
40004	Maximum Input and Output Current	2	R	2830	PV:28A, BAT:30A
40005	Photovoltaic Step-Down Heat Sink Temperature	2	R	25	The current system temperature is 25 degrees Celsius
40006	PV NTC Status	2	R	0	0~7
40007	BAT NTC 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 Charged, 1: Charging
40012	Full Charge Status	2	R	1	0: Not Full, 1: Full
40013	Current Load Status	2	R	1	1 Starting, 0 Stopping
40014	BUCK Heatsink Temperature	2	R	50	50℃
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℃ (accuracy 1℃)
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℃ (accuracy 1℃)
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	2	R	H+L (unit WH)	Total historical generation WH
40034	Historical system chargingW 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 Operating 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℃
40045	Current photovoltaic fan start temperature	2	R	40	40℃ 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 series	2	R	7	Ternary lithium 7 series
40057	Power on	2	R	1	0: Disable power generation, 1: Start power 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 shutdown hysteresis voltage setting	2	R/W	1000	1000mV (Hysteresis start voltage setting after load shutdown)
40069	Full charge return voltage difference setting	2	R/W	1000	1000mV (Voltage difference setting for recharging after full charge voltage drops during float char
40070	Reserved	2	R/W	Unused	Reserved

12. Detailed table of attachments

12.1 Function Table

Function Table I (Decimal)		
NMC Battery	Nickel Manganese Cobalt Lithium Battery	0
LFP Battery	Lithium Iron Phosphate Battery	1
PAB Battery	Lead-acid battery	2
GEL Battery	Gel battery	4
OTH Battery	Other batteries	5
ERR	Error configuration	8

Function Table II (Decimal)		
MPPT->BAT	Solar Panel to Battery Charging	0

12.2 Fault Table

Fault Table 1 (Decimal)					
OV	Solar Panel Over Voltage	1	SC	Solar Panel Short Circuit	128
UV	Under Voltage of Solar Panel	2			
OT	System Over Temperature	4			
TF	Temperature Sensor Fault	8			
OC	Over Current of Solar Panel	16			
OP	Solar Panel Overload	32			
SF	Current Sensor Fault	64			

Fault Table II (Decimal)					
OV	Battery Overvoltage	1	SF	Battery Current Sensor Fault	128
UV	Battery Undervoltage	2	SC	Battery Short Circuit	256
OT	Battery Over Temperature	4	LOC1	Load Level 1 Over Current	512
UT	Battery Low Temperature	8	LOC2	Load Level 2 Over Current	1024
TF	Temperature Sensor Fault	16	LSC	Load short circuit	2048
OC	Battery Overcurrent	32	LSF	Load Current Sensor Fault	5096
OP	Battery Overload	64	PF	Battery Configuration Abnormality	10192
DPF	Charging Dial Fault Code	20384			

13. Application wiring diagram