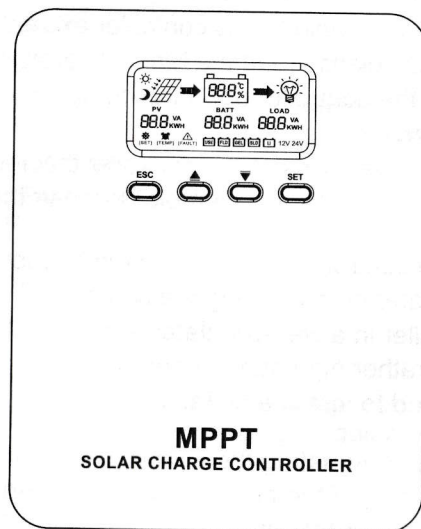


Maximum Power Point Tracking (MPPT) Series

1024/2024/3024/4024/5024/6024

User Manual



Model	1024	2024	3024	4024	5024	6024
Battery voltage	12V/24V/Auto					
Max. solar panel voltage	50Vdc		100Vdc			
Charging current	10A	20A	30A	40A	50A	60A
Discharging current	20A					
USB output	5V*3A					

Manual Version: 2.1


Product information is subject to change without further notice. This User Manual will be frequently updated; please contact customer service personnel for the latest version information.

Dear User:

Thank you for choosing our company's products!

Safety Instructions

1. Since the voltage applicable to this controller exceeds the safe voltage for the human body, please read the Manual carefully before operation and only operate the controller upon the completion of the training on **safety operation**.
2. There are no components 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 to prevent water from entering the controller.
4. Install the controller in a well-ventilated area; the temperature of the heat sink will be rather high during operation.
5. It is recommended to install a suitable fuse or circuit breaker on the outside of the controller.
6. Before installing or adjusting the wiring of the controller, be sure to disconnect the wiring 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 any danger owing to loose connections causing heat to build up.

 **Safety Warning:** indicating that this operation is dangerous and safety precautions must be taken before proceeding.

 **Caution:** indicating that this operation is destructive.

 **Note:** indicating suggestions and tips for the operator.

1. Product Introduction

1.1 Product Overview

This product is capable of real-time detection of the generated power of solar panels and tracks the highest voltage and current values (VI), enabling the system to charge the batteries with maximum power output. It is applied in off-grid photovoltaic systems, coordinating the work of solar panels, batteries, and loads, and is the core control component of the off-grid photovoltaic system.

The product features an LCD display for operating status, operating parameters, and control parameters, etc. Users can conveniently view various parameters via the buttons and modify control parameters as needed to adapt to different system requirements.

The controller is provided with comprehensive electronic fault self-testing functions and robust electronic protection functions, which can maximize the prevention of any damage to product components owing to installation errors and system failures.

1.2 Product Features

- Advanced dual-peak or multi-peak tracking technology is employed. When the solar panel is partially shaded or some panels are damaged, the I-V curve will show multiple peaks, during which the controller can still accurately track the maximum power point.
- The built-in maximum power tracking algorithm significantly boosts the efficiency of energy utilization of the photovoltaic system, with charging efficiency about 25% higher than traditional PWM charging.
- The combination of multiple tracking algorithms allows for accurate tracking of the best working point on the I-V curve in an extremely short time.
- The efficiency of MPPT can reach up to 99.9%.
- Advanced digital power technology, with a circuit energy conversion efficiency of up to 98%.
- Charging programs for different types of batteries, e.g., gel batteries, sealed batteries, opened batteries, and lithium batteries.
- The product features a limited current charging mode. When the power of the solar panel is too high and the charging current exceeds the rated current, the controller automatically reduces the charging power to work within the rated charging current.
- Capacitive loads with instantaneous high current startup supported.

- Automatic battery voltage recognition supported.
- The product is provided with an LCD display for faults, making it easy for users to determine system failures.
- There is an over-temperature protection mechanism built in. When the temperature exceeds the set value of the equipment, the charging current decreases linearly with temperature, thereby reducing the controller's temperature rise and avoiding high-temperature damage.
- It is equipped with a temperature compensation function, automatically adjusting charging and discharging parameters to extend the service life of the batteries.
- Comprehensive electronic protection functions.
- A metal casing for better heat dissipation.
- OV charging function for lithium batteries.
- High input voltage tolerance for solar panels, which can reduce the specification of solar wiring and lower system costs.

1.3 Product characteristics

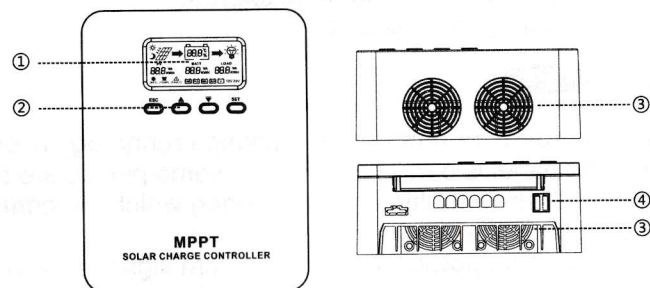


Figure-1 Controller Appearance and Interfaces

No.	Name
①	LCD Display Screen
②	Operation Buttons
③	Fan Heat Sink
④	USB Output

1.4 Introduction to Maximum Power Point Tracking (MPPT) Technology

The Maximum Power Point Tracking (MPPT) system is an advanced charging technology that adjusts the working state of the electrical module to allow the solar panel to output more electrical energy. Due to the nonlinear characteristics of the solar array, there is a point on its curve where the

array outputs the maximum energy (maximum power point). Traditional controllers (switching charging technology and PWM charging technology) cannot maintain charging at this point for the batteries, and therefore cannot obtain the maximum energy from the panel. However, a solar controller with MPPT control technology can constantly track the maximum power point of the array to obtain the maximum energy for charging the batteries.

Taking a 12V system as an example, the peak voltage (V_{pp}) of the solar panel is about 17V, while the battery voltage is around 12V. Generally, when a general controller is charging, the voltage of the solar panel is around 12V, which does not fully utilize its maximum power. The MPPT controller can overcome this issue by adjusting the input voltage and current of the panel in real-time to achieve the goal of maximizing the input power.

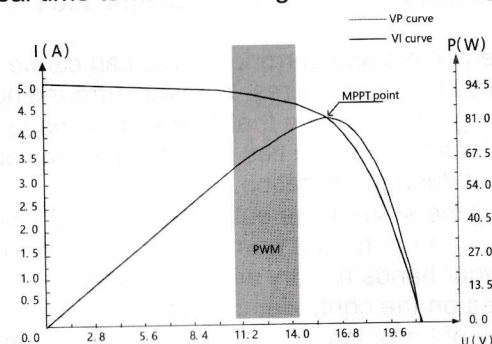


Figure 1-2 Output Characteristic Curve of the Solar Panel

Meanwhile, the maximum power point often changes along with varying environmental temperatures and lighting conditions. Our company's MPPT controller can adjust parameters in real-time based on different conditions to keep the system close to the maximum working point at all times. The entire process is fully automatic and does not require any adjustment by the user.

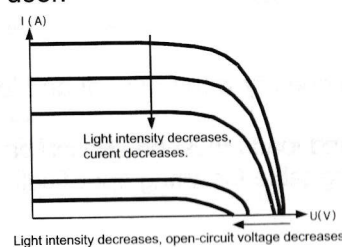


Figure 1-3 Relationship between Solar Panel Output Characteristics and Light Intensity

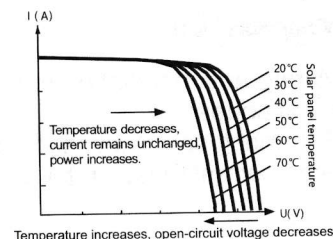


Figure 1-3 Relationship between Solar Panel Output Characteristics and Temperature

2. Product Installation

2.1 Installation Precautions

- Exercise extreme caution when installing batteries. For the installation of opened lead-acid batteries, wear protective glasses. If you come into contact with battery acid, rinse immediately with clear water.
- Avoid placing metal objects near the batteries to prevent a short circuit.
- When charging, batteries may produce acidic gases; guarantee that the surrounding environment is well-ventilated.
- Batteries may produce flammable gases; keep away from sparks.
- For outdoor installations, avoid direct sunlight and prevent water from seeping in.
- Virtual connected points and corroded wires can cause significant heat, melting the insulating layer of wires, burning surrounding materials, and potentially causing a fire. Ensure that all connections are tight and wires are securely fastened with cable ties to prevent loose connections owing to wire movement during application.
- When connecting the system, the output voltage of the components may exceed the safe voltage for the human body. Use insulated tools and guarantee that your hands are dry when handling.
- The battery poles on the controller can be connected to either a single battery or a bank of batteries. The following instructions in the Manual are for single battery use, but they also apply to systems with a bank of batteries.
- Please follow the safety recommendations provided by the battery manufacturer.
- Choose system connection wires based on a current density not exceeding $4A/mm^2$.
- Connect the controller's ground terminal to earth ground.

2.2 Wiring Specifications

Wiring and installation methods must comply with national and local electrical codes.

The wiring specifications for batteries and loads must be chosen based on the rated current. Please refer to the following table for wiring specifications:

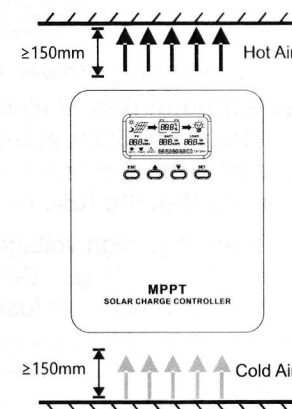
Model	Rated Charging Current	Rated Discharging Current	Battery Wire Diameter	Load Wire Diameter
1024	10A	20A	3mm ²	5mm ²
2024	20A	20A	5mm ²	5mm ²
3024	30A	20A	6mm ²	5mm ²
4024	40A	20A	8mm ²	5mm ²
5024	50A	20A	10mm ²	5mm ²
6024	60A	20A	12mm ²	5mm ²

2.3 Installation and Wiring

⚠ Warning: Risk of explosion! Never install the controller and opened batteries in the same enclosed space! Nor should they be installed in an enclosed area where battery gases may accumulate.

⚠ Warning: High voltage danger! The photovoltaic array may produce high open-circuit voltage. Disconnect the circuit breaker or fuse before wiring and be careful during the process.

⚠ Note: When installing the controller, guarantee that there is sufficient air flow through the controller's heat sink. Leave at least 150mm of space above and below the controller to guarantee natural convection cooling. If installed in a closed box, guarantee reliable heat dissipation through the box.



Step 1: Choose the Installation Location

Avoid installing the controller in areas of direct sunlight, high temperatures, and where water can easily enter. Also, guarantee good ventilation around the controller.

Step 2: Fix Screws

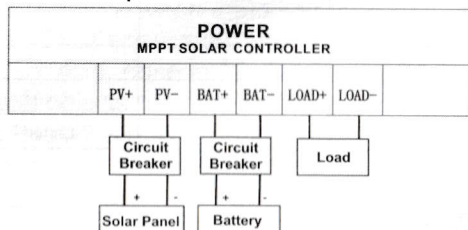
Place the controller in the appropriate position and mark the installation location with a pen. Drill 4 appropriately sized holes at the marked locations.

Step 3: Fix the Controller

Align the controller with the four pre-drilled holes and install the screws. and where water can easily enter. Also, guarantee good ventilation around the controller.

Step 4: Wiring

For safety during installation, connect the batteries first, then the solar panel, and finally the load. Please guarantee that the positive and negative poles of each wire are not reversed. When wiring, follow the sequence of connecting the "+" pole first, then the "-" pole.



① Connecting Power Lines

⚠ Warning: Risk of electric shock! We strongly recommend installing fuses or circuit breakers at the photovoltaic array terminal, load terminal, and battery terminal to prevent electric shock during wiring or owing to misoperation. Ensure that the fuse or circuit breaker is disconnected before wiring.

⚠ Warning: High voltage danger! The photovoltaic array may produce high open-circuit voltage. Be careful during wiring and make sure to disconnect the circuit breaker or fuse first.

⚠ Warning: Risk of explosion! A short circuit at the battery's positive and negative poles or the wires connected to them can cause a fire or explosion. Please handle with care.

② Powering On

After all power lines are connected securely and reliably, check again to guarantee that the wiring is correct and that the poles are not reversed. Once confirmed, connect the battery's fuse or circuit breaker first to see if the LCD screen displays anything. If there is no display, immediately cut off the fuse or circuit breaker and check if the wiring is connected correctly.

If the batteries are powered on normally, then connect the solar panel. If there is sufficient sunlight, the controller's display screen will show the charging indicator flashing and will start charging the batteries.

After the batteries and photovoltaic are connected, finally connect the fuse or circuit breaker for the load. At this point, you can use the manual mode to test whether the load turns on and off normally. Refer to the load operating mode and instructions for details.

⚠ Warning: Disconnecting the batteries while the controller is in normal charging mode will influence the DC load of the controller and can damage the load in severe cases.

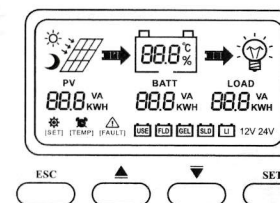
⚠ Warning: Reversing the connection polarity of batteries can damage the internal components of the controller.

Note:

- 1) The installation location of the battery fuse should be as close to the battery terminal as possible, preferably not more than 150mm away.
- 2) The controller assumes a fixed battery temperature of 25°C if a remote temperature sensor is not connected.
- 3) If an inverter is connected in the system, connect the inverter directly to the batteries and do not connect it to the load terminal of the controller.

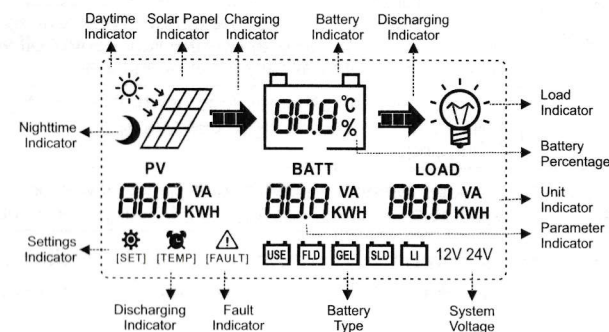
3. Product operation and display

3.1 Button Operations

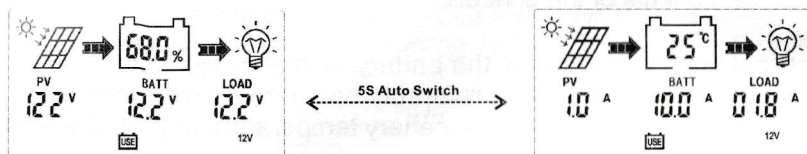


ESC	Switch load (manually switch load); interface exit setting;
▲	Scroll up on the main interface to view parameters; increase parameters in setting mode;
▼	Scroll down on the main interface to view parameters; decrease parameters in setting mode;
SET	Scroll down on the main interface to view parameters; decrease parameters in setting mode.

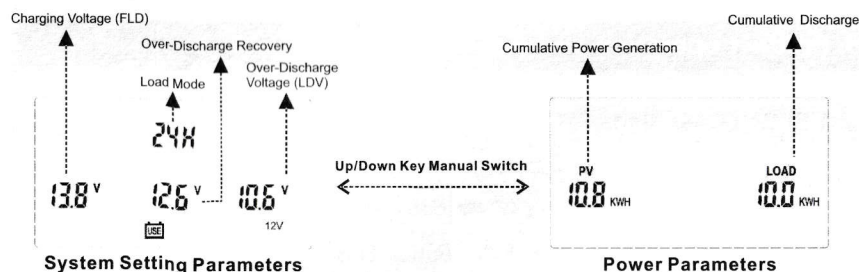
3.2 LCD Boot and Main Interface Display



3.3 Main Interface Display Introduction



Note: On the main interface, detecting parameters are displayed in a loop every 5S.



Note: On the main interface, you can manually switch between system setting parameters and power parameters using the up and down keys. The main interface will automatically switch if there is no button operation within 5S.

3.4 Load Mode Introduction

This controller is designed in three load operating modes, as referenced below!

Mode	Description
Light Time Control Mode (1H-23H)	When there is no sunlight and the panel voltage is below the light control on voltage, the controller automatically turns on the load based on the set time period. When sunlight appears and the panel voltage is above the light control off voltage, the controller automatically turns off the load.
Always Off Mode (0H)	The load remains off regardless of whether it is day or night after power-on. This mode is used for special loads or during debugging.
Always Off Mode (24H)	The load remains on continuously after power-on. This mode is suitable for loads that require 24-hour power supply.

Note: All three modes can be overridden by using the switch button to turn the load on or off, and the controller will automatically resume the set mode the next day.

3.5 System Parameter Settings

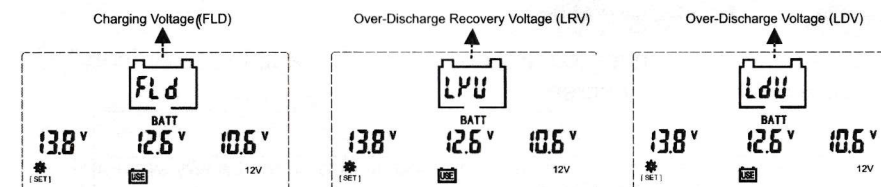
Restore Factory Defaults: On the main interface, press and hold the SET and ESC buttons simultaneously for 5S to restore the charging settings and load settings to the factory defaults.

Enter Setting Interface: On the main page, press and hold the SET button enter the setting interface. The display screen " [SET] " will show a constant indicator, and the controller will enter the setting state.


Battery Type Setting: In the setting interface, press the SET button briefly to select the batteriestype bar " [USE] [FLD] [GEL] [SLD] [LI] ". The chosen battery type will flash. Use the up and down keys to select the desired battery type. If there is no button operation within 10S, the settings will be saved and exited automatically.

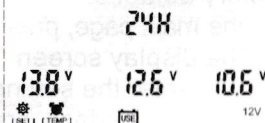


Charging Parameter Setting: In the setting interface, press the SET button briefly to select the parameter setting bar. After the cursor for the chosen parameter starts flashing, use the up and down keys to adjust the parameter. If there is no button operation within 10S, the settings will be saved and exited automatically. Note: Charging parameters cannot be set under this type " [FLD] [GEL] [SLD] " of battery setting.



System Voltage Setting: In the setting interface, press the SET button briefly to select the system voltage type bar "12V 24V". The corresponding system voltage will flash. Use the up and down keys to select the desired battery system voltage level. If there is no button operation within 10s, the settings will be saved and exited automatically. Note: For a 24V system, the charging parameters are 2 times those of a 12V system. For a 36V system, the charging parameters are 3 times those of a 12V system. For a 48V system, the charging parameters are 4 times those of a 12V system.


Load Setting: In the setting interface, press the SET button briefly to select the load timing typebar "  ". After the cursor for the chosen parameter starts flashing, use the up and down keys to adjust the parameter. If there is no button operation within 10S, the settings will be saved and exited automatically.






⚠ Attention: After setting the system voltage, the system must be rebooted; otherwise, it may operate under an abnormal system voltage. The controller allows users to customize parameters based on actual conditions. Parameter settings must be completed under the guidance of a professional, as incorrect parameters may prevent the system from functioning normally. The content of the parameter settings is shown in Table 3.

Setting Parameters Comparison Table			
NO.	Description	Parameter Range	Default Parameter
1	Battery Type	Sealed Battery / Opened Battery / Gel Battery / Lithium Battery	Sealed Battery
2	Voltage Level	12V/24V	AUTO
3	Charging Voltage	10.0-20.0V	13.8V
4	Over-Discharge Recovery Voltage	9.0 ~20.0V	12.6V
5	Over-Discharge Voltage	9.0 ~20.0V	10.6V

3.6 Abnormal Display and Alarm

When a fault occurs in the controller system, the fault indicator icon "  " is shown on the display screen.

	Solar panel flashing, indicating overvoltage of the solar panel.
	Battery frame flashing, indicating an error in the battery system parameter settings.
	LED flashing, indicating overcurrent or short circuit protection for the load.

4. Product Protection Function and System Maintenance

4.1 Introduction to Protection Functions

• Waterproof Protection

Waterproof Rating: IP21

• Input Power Limitation Protection

When the power of the solar panel exceeds the rated power, the controller will limit the power of the solar panel within the rated power range to prevent any damage to the controller owing to excessive current. The controller enters into a limited current charging mode.

• Too High Voltage Protection of PV Input Terminal

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

• Short-Circuit Protection of PV Input Terminal

After a short circuit occurs at the input terminal of the photovoltaic array, the controller will cut off the charging. Once the short circuit is cleared, charging will automatically resume.

• Reverse Connection Protection of PV Input

If the polarity of the photovoltaic array is reversed, the controller will not be damaged. It will continue to work normally after correcting the wiring error.

• Overpower Protection of Load

If the load exceeds the rated power, the load will be protected with a delay.

• Short-Circuit Protection of Load

The load will be protected immediately and quickly from short circuits, and the load will be automatically attempted to be turned on after a certain delay. Load short circuits can be manually released if any.

• Nighttime Anti-Reverse Charge Protection

Prevent the batteries from discharging through the solar panel at night.

• TVS Lightning Protection

• Overheat Protection

When the temperature of the controller exceeds the set temperature, the controller will reduce the charging power or stop charging, as shown below.

4.1 System Maintenance

- To maintain optimal long-term working performance, it is recommended to check the following items more than twice a year.
- Confirm that the airflow around the controller is not obstructed, and clear any dirt or debris from the heat sink.
- Check all exposed wires for damage owing to sunlight exposure, friction with surrounding objects, dry rot, insect or rodent damage, and guarantee necessary repairs or wire replacements if needed.
- ☐ Verify that the display matches the device's operation. Note any faults or error displays and take corrective measures as necessary.
- Check all connection terminals for corrosion, insulation damage, high

- temperature or burning/discoloration signs, and tighten terminal screws.
- Check for dirt, nesting insects, and corrosion, and clean as required.
 - If the lightning arrester has failed, replace the failed lightning arrester promptly to prevent lightning damage to the controller or other user equipment.

⚠ Warning: Electric Shock Hazard! Make sure that all powers to the controller are disconnected before performing any checks or operations as mentioned above!

4. Product Specifications and Parameters

5.1 Electrical Parameters

Parameter Name	Parameter Value					
Model	1024	2024	3024	4024	5024	6024
System Voltage	12V / 24V Adaptive					
No-Load Voltage	≤0.4W					
Maximum Input Voltage of Solar Panel	50Vdc		100Vdc			
Battery Voltage	9-32V					
Voltage Range of Maximum Power Point	Battery Voltage +2V-50V		Battery Voltage +2V-100V			
Rated Charging Current	10A	20A	30A	40A	50A	60A
Rated Load Current	20A					
USB Output	5V*3A					
Maximum Input Power of Solar Panel	120W/12V 240W/24V	240W/12V 480W/24V	360W/12V 720W/24V	480W/12V 960W/24V	600W/12V 1200W/24V	720W/12V 1440W/24V
Conversion Efficiency	≤98%					
MPPT Efficiency	> 99%					
Temperature Compensation Coefficient	-2mv/°C/2V (Default Value)					
Operating Temperature	-10°C-+65°C					
Protection Level	IP21					
Net Weight	0.4kg		1.08kg		1.43kg	
Gros Weight	0.4kg		1.3kg		1.65kg	
Electromagnetic Compatibility	Comply with EN61000, EN55022, EN55024					
Communication Method	Rs485 (Optional)					
Altitude	≤3000M					
Product Dimensions	135x135x55mm		196x186x76mm		230x186x76mm	

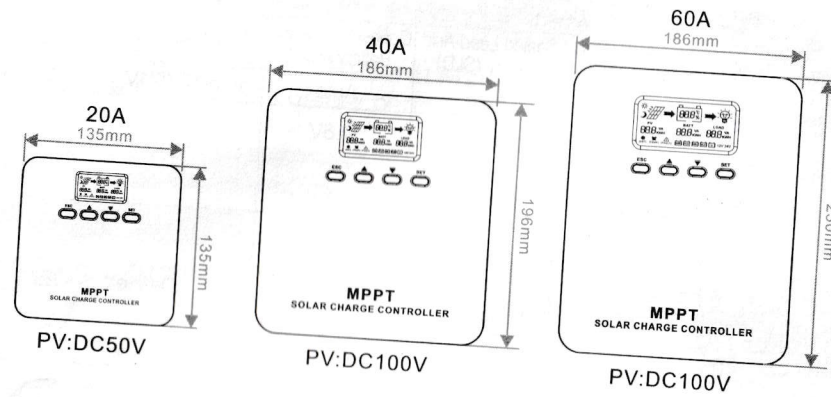
5.2 Battery Charging Voltage Parameters

Battery Charging Voltage Parameters Comparison					
Battery Type	Gel Lead-Acid Battery (GEL)	Sealed Lead-Acid Battery (SLD)	Opened Lead-Acid Battery (FLD)	User (Custom)	Lithium Battery (LI)
System Voltage	Auto	Auto	Auto	Auto/12V/24V	12V/24V
Equalization Voltage(EQU)	14.2V	14.6V	14.8V	---	
Boost Voltage(BST)	14.2V	14.4V	14.6V		
Charging Voltage(FLD)	13.8V	13.8V	13.8V	Defined by GEL	
Recovery Voltage (LRV)	12.6V	12.6V	12.6V		
Over-discharge Voltage(LDV)	11.1V	11.1V	11.1V		

For User (Custom) batteries, the system default voltage parameters are consistent with the gel lead-acid battery parameters. The following logic must be observed when modifying the charging and discharging parameters of the batteries: Over-Discharge Voltage; Charging Voltage > Recovery Voltage > Over-Discharge Voltage;



MPPT Controller Series



Product Installation Hole Position Diagram

