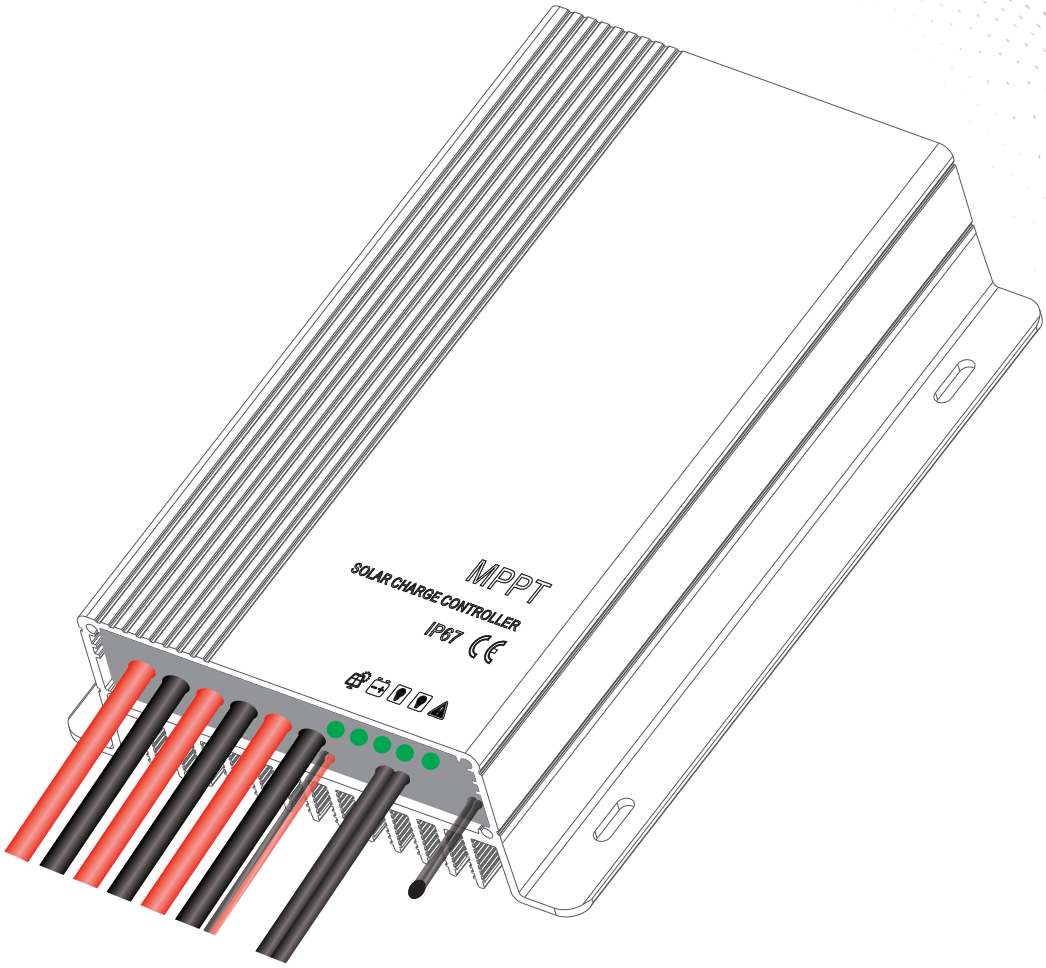
User Manual

MPPT



INTELLIGENT MPPT SOLAR CHARGE CONTROLLER

Acid Li

- Please read this user manual carefully before use and keep it properly.
- Please refer to the actual product, the picture is for reference only.

V1.1

CONTENT

1.0 Important Safety Notifications

1.1 Acknowledgments

Thank you for choosing our products and for your trust and support.
This manual is designed to enhance your understanding and effective use of our products, offering precise and clear usage guidelines along with relevant information.

1.2 Important Notice before Use

Before using this product, please carefully read this user manual to understand the correct and safe operating procedures. By using this product, you confirm that you have fully read, understood, and agreed to all contents of this manual. Do not use this product before thoroughly reviewing the manual and understanding its performance. Our company is not liable for any economic loss or personal injury resulting from improper use that does not comply with the instructions in this manual. To continuously optimize our products, we reserves the right to make adjustments to the contents of this manual. We also retain all related intellectual property and industrial rights, including copyrights, patents, trademarks, and designs. This manual will be updated from time to time without prior notice. This manual may be updated periodically without prior notice. If you find any discrepancies between your product and the manual, or have any questions regarding the product or the manual, please contact us for consultation and amendments. The company reserves the final interpretation rights of this manual.

1.3 Safety Warning Note

We prioritize safety and strongly advise that all individuals involved in the installation, operation, maintenance, or servicing of our products exercise caution and adhere to common sense. It is essential to follow the safety guidelines provided in this manual and on the device's installation labels to safeguard both personnel and property, and to minimize potential risks.
The following informational symbols appear in the instruction manual or on the product labeling sticker: DANGER or WARNING symbols indicate a potential hazard or a high risk situation that, if not avoided, could result in death or serious personal injury. Extreme caution and attention should be paid, as it regards the safety of both personnel and the product.

	**Reminder:** Indicates advice and tips for the operator.
	**Note:** Indicates that this operation is destructive.
	**Warning:** Indicates that this operation is dangerous and that safety preparations must be made before operation.

2.0 Product Introduction

2.1 Product Overview

The SMF series detects the real-time power generation of solar panels and tracks the maximum voltage and current (VI) values, enabling the system to charge the battery with maximum power output. It is designed for off-grid photovoltaic systems, coordinating the operation of solar panels, batteries, and loads, and is the core control component of off-grid photovoltaic systems.

This product can be connected to a PC, Bluetooth, 4G module, or other devices via RS485, allowing users to view operating parameters, controller logs, historical data, control settings, remote control, etc. Additionally, controller parameters can be modified as needed to accommodate different system requirements.

The controller utilizes the standard Modbus communication protocol, enabling users to easily perform secondary development based on their specific application requirements. Free monitoring software is available for viewing and modifying various system parameters.

The controller is equipped with comprehensive electronic error self-test capabilities and powerful electronic protection functions, which effectively minimize the risk of component damage caused by installation errors or system failures.

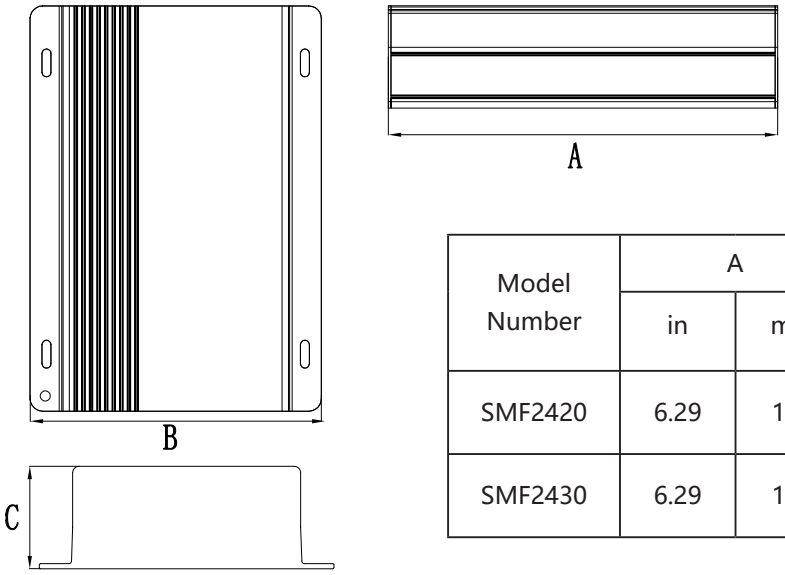
2.2 Product Features

- The SMF series employs advanced dual-peak or multi-peak tracking technology. When the panel is shaded or partially damaged, multiple peaks will appear on the I-V curve, yet the controller can still accurately track the maximum power point;
- The built-in maximum power point tracking algorithm significantly improves the energy utilization rate of the photovoltaic system, increasing charging efficiency by approximately 15% to 20% compared to traditional PWM charging methods;
- The combination of multiple tracking algorithms accurately tracks the best working point of I-V curve in a very short time;
- MPPT tracking efficiency reaches up to 99.9%;
- By employing advanced digital power technology, the circuit energy conversion efficiency is as high as 98%;
- Supports colloidal battery, sealed battery, open-cell battery, user-defined and other different types of battery charging;
- With current-limiting charging mode, when the power of the panel is too large and the charging current is greater than the rated current, the controller automatically reduces the charging power to make it work at the rated charging current;
- Supports instantaneous high current startup of capactive loads;
- Supports battery voltage automatic identification;
- With fault LED indicator, easy to determine the system fault;
- Supports standard modbus protocol, to meet the communication needs of different occasions;
- Built-in overtemperature protection mechanism, when the temperature exceeds the device set value, the charging current decreases linearly to avoid high temperature damage to the controller;
- Equipped with a temperature compensation function, the controller automatically adjusts charge and discharge parameters, improving the battery's lifespan.

2.3 Packing List

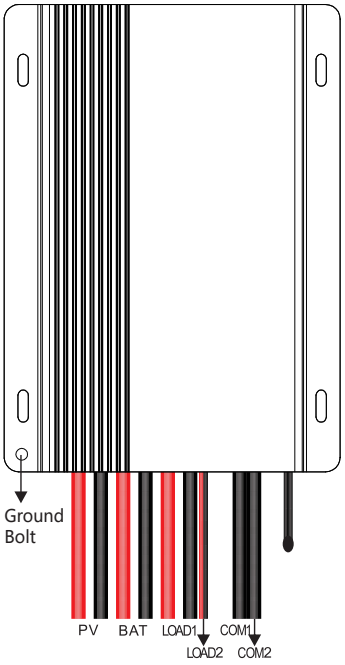
1	Communication cable *2	4	Certificate of conformity*1
2	Expansion Pipe *4	5	User manual*1
3	M4 Screw *4		

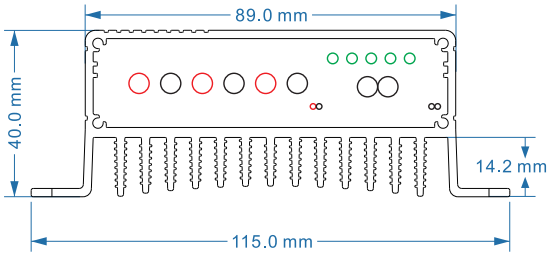
2.4 Product Dimensions



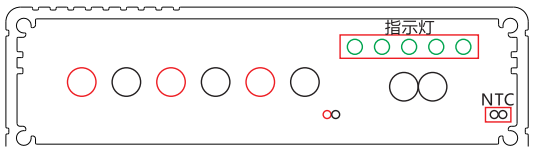
Model Number	A		B		C	
	in	mm	in	mm	in	mm
SMF2420	6.29	160	4.53	115	1.57	40
SMF2430	6.29	160	4.53	115	1.57	40

2.5 Structure Description



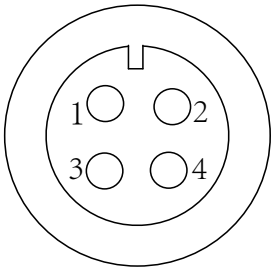


Note: Indicator light from left to right are: PV, BAT, Load 1, Load 2, Communication



Pin definition:

Pin	COM1	COM2	Colour
1	GND	GND	black
2	5V	10.7V	red
3	RS485-B	RS485-B	white
4	RS485-A	RS485-A	green



Note: Pin definition applies to this product only.

2.6 Specifications

SMF24 Series		SMF2420	SMF2430
Controller Type		MPPT Controller	
MPPT Efficiency		≥99%	
Peak Conversion Efficiency		≥98%	
Standby Consumption		Around 1W	
Heat-Dissipation Method		Self-Cooling	
Input Parameters			
Maximum PV Open Circuit Voltage		60VDC	
Start Charging Vstart-pv		Vbat+3V	
Low Voltage Protection Vlow-pv		Vbat+2V	
Maximum PV Open Circuit Voltage		60Vdc	
Input Protection Recovery Voltage		55Vdc	
Rated Input Power	12V System	260W	390W
	24V System	520W	780W
Charging Parameters			
Output DC Voltage Range		Output Range:9V ~ 30VDC	
Battery Type		Lead-Acid Battery / Li-ion Battery	
Battery Management		Variable Output Charging Parameters and Protection Parameters	
Lithium Battery Activation		Equipped	
Output DC Current		0~20A (Variable)	0~30A (Variable)
Charging Mode		Lead-Acid Battery: Fast, Equalized, Float; Lithium Battery: Fast,Equalized	
Fault Parameters		Lead-Acid Battery (GEL/AUTO)	
Load Parameters			
Load Voltage		Load 1: Same as Battery Voltage Load 2: 12V	
Rated Load Current		Load 1: 20A; Load 2: 2.0A (Continuous), 2.5A (3S)	
Load Control Mode		Allows to operate in 5 timed periods (the main switch can be enabled via instructions), with time range variable as needed. Unused time slots are set to 0:00-0:00 by default, meaning no operation.	
Load Protection		Over Current Protection	
Display&Communication			
Communication		RS485 Bus/ Standard Modbus Protocol	
Monitoring		PC, Wi-Fi Module, 4G Module, Ethernet	
Protection			
PV Input Protection		PV Input Overvoltage Protection, Reverse Polarity Protection, Surge Protection, Lightning Protection	
Output Protection		Voltage Stabilization/ Reverse Polarity Protection/ Battery Detachment Protection/ Overcharge Protection	
Normal Protection		Heat Dissipation Over-temperature Protection/ Load Reduction Operation under Over-Temperature / Ambient Over-Temperature Protection	
Other Parameters			
Installation		Wall-Mounted Type	
Product Dimensions		160*115*40mm	
Product Weight(kg)		0.99	
Operating Ambient Temp.		-20℃ ~+50℃	
IP Rating		IP67	
Operating Altitude		≤3000m	

3.0 Installation

3.1 Precautions before Installation

➢ Installation Position

- Before proceeding with the installation, please review the entire installation section thoroughly.
- Be cautious while using the battery. Wear goggles. Use fresh water to rinse and clean any area that comes into contact with battery acid.
- Use insulated tools and avoid placing metal objects near the battery.

	**Warning:** Never install the MPPT an enclosure with open or flooded batteries. Battery fumes are flammable and can corrode and damage the MPPT circuitry.

	**Reminder:** When installing the MPPT in an enclosure, ensure adequate ventilation. Installing it in a sealed enclosure can lead to overheating, reduced power output, and a shortened product lifespan.

➢ Safety Information

- Do not install the controller in areas prone to water ingress or excessive humidity.
- Loose power connections or corroded wires can increase contact resistance or line impedance, potentially melting the wire insulation, burning surrounding materials, and even causing a fire. Ensure all connections are secure and reliable, and use cable clamps to fix the cables in place to prevent movement in mobile applications.
- The default charging mode is typically designed for common battery types. Custom settings are available for different charging requirements (see Section 4.2 for details).
- This MPPT controller can connect one battery or battery pack.
- This MPPT controller prevents reverse current leakage during the night, eliminating the need for a series-connected diode in the system.
- This MPPT controller is only used for solar power generation. Connecting to any other type of power source (such as a wind turbine or generator) may void the warranty.

3.2 Wiring Specification

2% Voltage Drop Charts for 75°C Stranded Copper Wire

1-Way Wire Distance (feet), 12 Volt System									
Wire Size(AWG)	60A	55A	50A	45A	40A	35A	30A	25A	20A
2/0*	22.4	24.4	26.9	29.9	33.6	38.4	44.8	53.8	67.2
1/0*	17.7	19.3	21.3	23.6	26.6	30.4	35.5	42.6	53.2
2	11.2	12.2	13.4	14.9	16.8	19.2	22.4	26.9	33.6
4	7.1	7.7	8.5	9.4	10.6	12.1	14.1	17.0	21.2
6	4.4	4.8	5.3	5.9	6.6	7.5	8.8	10.6	13.2
8	2.8	3.1	3.4	3.7	4.2	4.8	5.6	6.7	8.4
10	1.7	1.9	2.1	2.3	2.6	3.0	3.5	4.2	5.2
1-Way Wire Distance (meters), 12 Volt System									
Wire Size(AWG)	60A	55A	50A	45A	40A	35A	30A	25A	20A
70*	6.8	7.4	8.2	9.1	10.2	11.7	13.7	16.4	20.5
50*	5.4	5.9	6.5	7.2	8.1	9.3	10.8	13.0	16.2
35*	3.4	3.7	4.1	4.5	5.1	5.8	6.8	8.2	10.2
25	2.1	2.3	2.6	2.9	3.2	3.7	4.3	5.2	6.4
16	1.3	1.5	1.6	1.8	2.0	2.3	2.7	3.2	4.0
10	0.8	1.0	1.1	1.1	1.3	1.5	1.7	2.0	2.5
6	0.5	0.6	0.6	0.8	0.8	0.9	1.1	1.3	1.6

Maximum 1-way wire distance for 12 Volt systems, stranded copper, 2% voltage drop

2% Voltage Drop Charts for 75°C Solid Copper Wire

1-Way Wire Distance (feet), 12 Volt System									
Wire Size(AWG)	60A	55A	50A	45A	40A	35A	30A	25A	20A
2/0*	27.8	30.3	33.4	37.1	41.7	47.7	55.6	66.7	83.4
1/0*	22.1	24.1	26.5	29.4	33.1	37.8	44.1	53.0	66.2
2	13.9	15.1	16.6	18.5	20.8	23.8	27.7	33.3	41.6
4	8.7	9.5	10.5	11.6	13.1	15.0	17.5	21.0	26.2
6	5.5	6.0	6.6	7.3	8.2	9.4	10.9	13.1	16.4
8	3.5	3.8	4.2	4.6	5.2	5.9	6.9	8.3	10.4
10	2.2	2.4	2.6	2.9	3.3	3.8	4.4	5.3	6.6
1-Way Wire Distance (meters), 12 Volt System									
Wire Size(AWG)	60A	55A	50A	45A	40A	35A	30A	25A	20A
70*	8.5	9.2	10.2	11.3	12.7	14.5	16.9	20.3	25.4
50*	6.7	7.3	8.1	9.0	10.1	11.5	13.4	16.1	20.2
35*	4.2	4.6	5.1	5.6	6.3	7.2	8.5	10.1	12.7
25	2.7	2.9	3.2	3.5	4.0	4.6	5.3	6.4	8.0
16	1.7	1.8	2.0	2.2	2.5	2.9	3.3	4.0	5.0
10	1.1	1.1	1.3	1.4	1.6	1.8	2.1	2.5	3.2
6	0.7	0.7	0.8	0.9	1.0	1.1	1.3	1.6	2.0

Maximum 1-way wire distance for 12 Volt systems, solid copper, 2% voltage drop

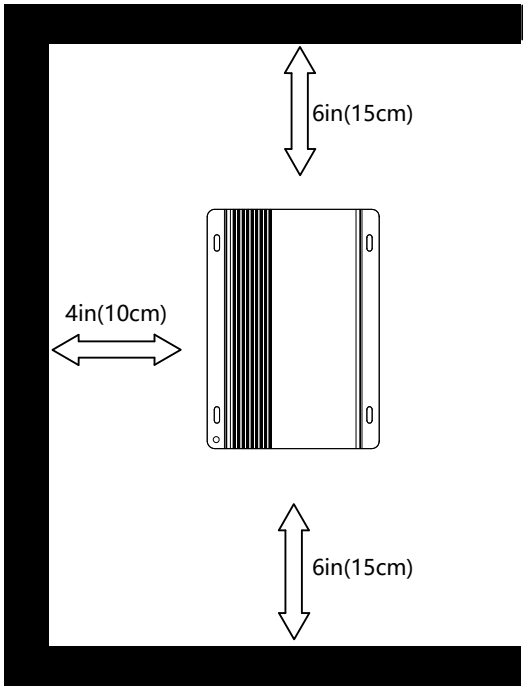
Note: The wires over 4 AWG (25mm^2) must be terminated at the external combine box outside the MPPT controller. Connect the MPPT controller to the combiner box with 4 AMG (25mm^2) or smaller wires.

Note: The specified wire length applies to a pair of wires (one way distance) from the solar or battery power supply to the controller. For a 24V system, multiply the length in the table by 2.

3.3 Installation Procedure

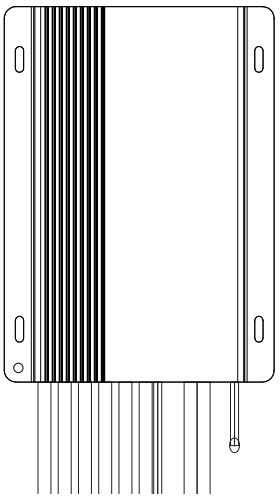
Inspect the controller for any shipping damage before installation. Do not install it directly on combustible surfaces, as the heat sink may become hot under certain operating conditions.

For proper air circulation, ensure there is at least 15 cm (6 inches) of clearance above and below the controller, and at least 50 mm (2 inches) on each side. Avoid installing the controller in an enclosure where battery gases may accumulate. Please refer to the image on the right.



➢ **Step 1: Verify controller parameter limits**

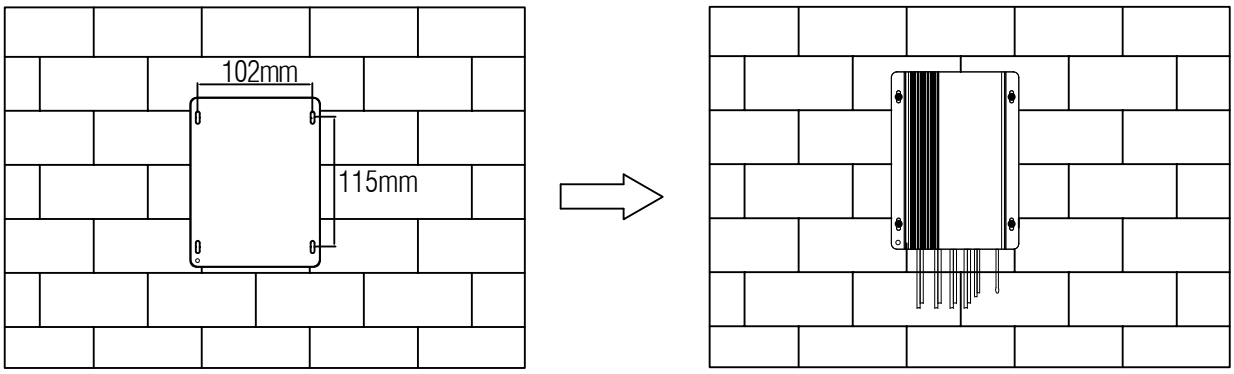
Ensure that the solar array open circuit voltage (Voc) under the maximum temperature compensation state does not exceed the MPPT rated voltage value of the model. Multiple controllers can be mounted in parallel on the same battery pack for greater charging current. Each MPPT in parallel must be connected to an independent solar panel.



➢ **Step 2: Connect input and output cables**

➢ **Step 3: Drill the mounting hole on the wall**

Measure and mark the distances on the wall, then drill 4 holes with a 6mm diameter. Fill the 4 holes with plastic expansion plugs.



➢ **Step 4: Mount the controller onto the wall**

Align the mounting holes of the controller with the installation holes made in Step 4. Use M4 self-tapping screws to secure the controller to the mounting surface and tighten the screws.

➢ **Step 5: Power on to operate**

Check and make sure the solar panels and batteries are in normal condition, check again that the input and output cables are connected correctly, and then power on the batteries first and then the solar panels, and the controller will run automatically.

	**Note:** Before connecting the battery, measure the battery open circuit voltage. It must be over 10 volts to start the controller. If the system voltage is set to auto-detect, a battery voltage over 18V will be detected as a 24V nominal battery and the unit will charge the 24V battery. 12/24V auto selection is only performed at power-on start.

	**Warning: Potential damage!** Whenever possible, disconnect the battery from the MPPT after the solar input is disconnected. If the battery is removed during MPPT charging, there is a low chance that the controller will be damaged. To prevent damage, the power supply must be disconnected in the reverse order to when the power is turned on.

3.4 Power off

Reverse the power-on sequence, disconnect the solar panel first and then the battery.

	**Warning:** 1. If the system needs to be connected to an inverter, please connect the inverter directly to the battery, and never connect it to the load end of the controller; 2. When the controller is in normal charging state, do not disconnect the battery, otherwise the DC load may be damaged, and the controller damage caused by this will not be covered by the warranty.

	**Note:** Please strictly follow the above instructions to power on and off. If the device is abnormal or damaged due to failure to follow this operation sequence, you will not be able to enjoy the warranty service.

4.0 Display and Operation

4.1 Reference Table of the Quantity of Solar Modules Connected in Series

Voc * N = PV Input < 60dc												
System Voltage	Voc<23V		Voc<31V		Voc<34V		Voc<38V		Voc<46V		Voc<60V	
	Max.	Opt.	Max.	Opt.	Max.	Opt.	Max.	Opt.	Max.	Opt.	Max.	Opt.
12V	2	1	2	1	2	1	1	1	1	1	1	1
24V	2	1	2	1	2	1	1	1	1	1	1	1

"Max." stands for "Maximum" ; "Opt." stands for "Optimal" .

	**Note:** N in the table represents the number of series, the data is for reference only.

4.2 Status Indicator Light

PV Indicator Light :

-When the PV voltage exceeds the battery voltage and is not in the charging status, the light is on and off at a 0.5 second cycle;

-When the PV voltage exceeds the battery voltage and charging conditions are met, if the battery is full, the indicator light will remain on. Otherwise, the light will blink on and off in a 1-second cycle;

-When the PV voltage is not greater than the battery voltage, the indicator light will turn off.

BAT Indicator Light :

- When the battery voltage is activated, the light is on and off at a 0.5 second cycle.
- When the battery is overvoltage, the light will turn on and off at a 1-second cycle;
- When the battery undervoltage, the light goes out;
- Indicator When the battery voltage is within the normal range, the indicator is steady on.

Load1 Indicator Light :

- When the Load1 voltage is greater than 9V, the light is steady on, otherwise the light is off;

Load2 Indicator Light :

- When the Load2 voltage is greater than 9V, the light is steady on, otherwise the light is off;

Communication Indicator Light :

- The light is steady on when the communication is established and it will be turned off after 3 seconds if there is no communication.

4.3 Maximum Power Point Tracking Technology

Power is equal to the product of voltage and current. The following equations hold true:

(1) MPPT Input Power = MPPT Output Power

(2) Input Voltage × Input Current = Output Voltage × Output Current

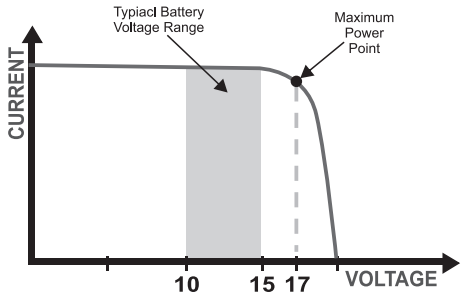
- Under the assumption of 100% conversion efficiency, ignoring line losses and energy conversion losses.

If the Vmp of the solar panel array is greater than the battery voltage, then the current of battery must be proportionally greater than the PV input current in order to balance the input and output power. The larger the difference between the maximum PV input voltage and the battery voltage, the greater the difference between the input and output currents.

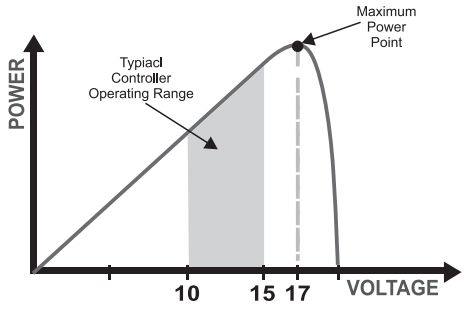
For a given input power, a higher input voltage from the solar panel array will result in a lower solar input current. High-voltage solar input arrays allow for smaller gauge wiring for the solar connections. This is particularly advantageous for systems with long wiring requirements between the solar panel array and the MPPT controller.

Comparably, the principle of traditional controllers during charging is to directly connect the solar modules to the battery. This requires the solar modules to operate within a voltage range below the Vmp of the modules. For example, in a 12V system, the battery voltage may range between 10-15VDC, but the module's Vmp is typically around 17V. The following diagram shows a typical current and voltage output curve for a nominal 12V charging system.

12 Volt Module Current vs. Voltage



12 Volt Module Output Power



4.4 Charging Status and Parameters

4.4.1 Controller Charging the Lead-Acid Battery

The MPPT controller features a 4-stage battery charging algorithm designed to charge lead-acid batteries quickly,efficiently, and safely.

1 - CC status (Constant Current Charging): Stage of fast charging - FAST

2 - CV status (Constant Voltage charging): Stage of charging with stable voltage - KEEP

3 - CF status (Float Charging): Prevents the battery from being overcharged for a long time and make up for the loss of self-discharge. -FULL

4 – Boost charging: Activate the battery's chemical reaction; desulphurization effect.

4.4.2 Controller Charging the Lithium-Ion Battery

The MPPT controller will charge according to the specifications of the lithium-ion battery, mainly in two stages.

Stage 1: When the battery voltage is below the saturation voltage, it will charge quickly according to the maximum power point it tracks.

Stage 2: When the battery voltage reaches the saturation voltage, it will be in constant voltage charging mode, and the charging current will gradually decrease to 0.

4.4.3 Charging Parameter Settings

Below are the parameters of commonly used lead-acid battery. All the voltage settings listed are all applied to nominal 12V battery. (For example, for 24V battery, mutiply the voltage by 2)

Battery Type	Constant Voltage	Float Charging	Equalized Voltage	Equalization charging time	Undervoltage Protection	Undervoltage Recovery Voltage
Gel (GEL)	14.2V	13.8V	14.2V	30 mins (user-defined)	11.1V	12.6V
Sealed (SEL)	14.4V	13.8V	14.6V	30 mins (user-defined)	11.1V	12.6V
Flooded (FLD)	14.6V	13.8V	14.8V	30 mins (user-defined)	11.1V	12.6V
Custom(CUS)	user-defined	user-defined	user-defined	30 mins (user-defined)	user-defined	user-defined

Commonly used lithium-ion battery charging parameters:

Battery Type	Nominal Voltage	Saturation Voltage	Discharge Cut-off Voltage	Cut-off Recovery Voltage
LiFePO4-12V (4 strings of lithium iron phosphate)	12.8V	14.4V	10.8V	12.4V
LiFePO4-24V (8 strings of lithium iron phosphate)	25.6V	28.8V	21.6V	24.8V
Ternary-12V (3 strings of ternary lithium)	11.1V	12.6V	9.6V	10.5V
Ternary-24V (6 strings of ternary lithium)	22.2V	25.2V	19.2V	21.0V
user-defined	user-defined	user-defined	user-defined	user-defined

Reminder: These settings are general guidelines for users to operate. The MPPT can be set to meet a variety of charging parameters. Consult the battery manufacturer for optimal battery charging settings.

4.5 Load Control

The main purpose of the load control function is to disconnect the system load when the battery is discharged to a low voltage state, and reconnect the system load when the battery is charged to a certain level. The system load can be a light, a DC appliance, or other electronic equipment. The total current of all loads must not exceed the MPPT rated load current.

Note: RISK OF EQUIPMENT DAMAGE!
Do not connect any AC inverter to the load terminals of the MPPT, which may result in damage to the load control circuit. The inverter should be connected to the battery. If any other load may sometimes exceed the maximum voltage or current limits, the device should be connected directly to the battery or battery bank.

➢ **Brief Description of Load Control:**

1. Do not connect multiple MPPT load outputs in parallel to a power DC load with a current consumption greater than 20A, depending on the MPPT model used.
2. Be careful when connecting loads with specific polarity to the controller load terminals. Reverse polarity connection may damage the load. Always check the load connection carefully before powering on.
3. The controller load output voltage is the same as the voltage of the battery pack. For example, when the battery voltage is 25.2V, the load output voltage is also 25.2V.
4. When the load output current is less than the rated load current, the output load can be continuously stably powered.
5. When the load output current exceeds the rated load current and lasts for 5 minutes within the range of 100%~120%, the load output will turn off and switch to the normally off mode.
6. When the load output current is detected to exceed 120% of the rated load current, the load output will immediately turn off and switch to the normally off mode.

Reminder: When the load switches to the normally off mode, in order to turn the load back on, the user needs to reset the load mode through the mobile phone APP, PC, or meter.

➢ **Load Control Mode:**

Working Mode of Load 1:

The rated maximum value of Load 1 is 20A, and it operates in 5 fixed time periods (the master switch can be enabled through instructions). The time intervals can be set as needed, with unused time periods defaulting to 00:00~00:00, meaning no operation during that time.

(1) When Load 1 is turned on — No Overcurrent:
- If set to charge priority, when a battery under-voltage or over-voltage warning occurs, Load 1 will turn off (it will turn back on once the warning is cleared); otherwise, Load 1 remains on.
- If set to load priority, when a battery over-voltage warning occurs, Load 1 will turn off (it will turn back on once the warning is cleared); otherwise, Load 1 remains on.

(2) When Load 1 is turned on — Overcurrent Occurs:
- Load 1 will turn off and on every 20ms, and the event will be recorded. If the overcurrent condition persists for 10 consecutive times, the enablement of Load 1 will be turned off, preventing it from turning on again. After checking and resolving any short-circuit faults, Load 1 can be re-enabled via instructions.

Working Mode of Load 2:

Load 2 has a rated maximum value of 2A and operates in 5 time periods (which can be enabled via a control switch). The time intervals can be set as needed, with unused time periods defaulting to 00:00–00:00 (i.e., no operation).

(1) When Load 2 is activated:
- If set to charge priority, Load 2 will turn off if there is a battery under-voltage or over-voltage warning, or if the output voltage of Load 2 is less than 10V (Load 2 will restart when the under-voltage/over-voltage warning is cleared). Otherwise, the load will remain on.
- If set to load priority, Load 2 will turn off if there is a battery over-voltage warning, or if the output voltage of Load 2 exceeds 14V (Load 2 will restart when the warning is cleared). Otherwise, the load will remain on.
- The output is generated by an independent Buck module circuit, and the output voltage and protection functions are controlled by hardware circuitry.

5.0 Common Faults and Solutions

5.1 Common Faults

LED indicator light is off, the controller seems to be powered off:

- Use a multimeter to check the voltage at the battery terminals on the MPPT controller. The battery voltage must be 10 VDC or higher. If the voltage at the controller’s battery terminals is between 10 and 25 VDC and no indicator light is on, please contact an authorized dealer for servicing.
- If the voltage is not measured, check the wiring, fuses, and circuit breakers.

Controller is not charging:

- Check the fuses, circuit breakers, and wiring connections in the power supply circuit. Use a multimeter to directly measure the array voltage at the MPPT solar input terminals. The input voltage must be higher than the battery voltage before charging begins.
- Connect additional accessories like a display meter or a PC to verify that the battery voltage shown is within the controller's system recognition range.

Battery is continuously in a low charge or discharged state:

- Potential causes:

1.There are too few solar panels to generate enough energy to meet the system's requirements. Consider adding more solar panels to the array.

2.The battery capacity is too small to store enough energy to meet the system's requirements. Consider increasing the battery bank capacity.

	**Warning: Risk of Electric Shock!** There is no electrical isolation between input and output, and dangerous solar voltage may be present. Under certain fault conditions, the battery could be overcharged. Before making contact, test the impedance between all wiring terminals and ground.

	**Warning: Risk of Electric Shock!** A method to disconnect all power electrodes must be provided. These disconnecting devices must be included in the fixed wiring. Before removing the controller wiring cover or servicing the wiring, ensure that all power sources are disconnected.