

Product Type

POW-M60-PRO



POWMr

SOLAR CHARGE CONTROLLER

User Manual

Important Safety Instructions

WARNING: CAREFULLY READ AND FOLLOW ALL SAFETY INSTRUCTIONS

- Carefully read the manual before the controller is installed and operated; retain the manual in a safe place for future reference.
- The controller must not be installed or operated by any of the following persons, unless they are under strict instruction and supervision:
 - a. Anyone who lacks the appropriate knowledge, experience or competence, required for safe installation and/or usage.
 - b. Anyone with compromised/reduced physical, sensory or mental capabilities, which may effect safe installation and/or usage (including children).
- **Controller installation and operation**
 - a. There are no serviceable parts for this controller. Do NOT disassemble or attempt to repair the controller.
 - b. Install the controller in a location with good natural airflow/ventilation and sufficient unobstructed space around it; refer to the “2 Installation and Connection” section for more detail.
 - c. Install the controller on a non-flammable substrate and ensure there are no heat-sensitive items in the immediate vicinity; it is normal for the controller to become hot during operation.
 - d. Install the controller in a location where it is protected from environmental conditions such as direct sunlight, water, high moisture and dust, and also located well away from any flammable liquids or gasses. Controller is for indoor use only.
 - e. Do not install or place/operate the controller on top of the battery, directly above the battery, or in a sealed compartment with the battery; batteries can emit explosive gasses.
 - f. Do not cover or place any other items on top of the controller.
- **Battery installation and charging**
 - a. Install and charge the battery in a location with good natural airflow/ventilation.
 - b. Ensure that there are no ignition sources near the battery; batteries can emit explosive gasses.
 - c. Battery acid is corrosive; if battery acid comes into contact with skin immediately rinse with water.
 - d. Do not charge non-rechargeable batteries or Li-ion batteries if the battery temperature is below 0°C. Never charge a frozen battery.
 - e. Ensure that the unit is properly set up for the type of battery intended to be charged.

- **Battery DC connections**

- a. Ensure that the DC system is fully shut down/isolated prior to disconnection of any existing cabling and/or new connections are made to the battery/DC system.
- b. Use flexible multi stranded copper cable with sufficient cross sectional area, line with an appropriate fuse or circuit breaker; refer to the "2.4 Wiring Specification and Breaker Type" section for more detail.
- c. NEVER connect the solar panel array to the controller without a battery. Battery must be connected first.

- **Controller setup**

- a. Refer to the battery manufacturers instructions and specifications to ensure the battery is suitable for use with this controller and confirm the recommended charge settings.
- b. The integrated charge modes combined with adaptive charge logic are well suited for most common battery types; such as flooded lead-acid, Gel and LiFePO4.

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1 Production Instructions

Thank you for choosing the 0 layer Series of Solar Power Controllers. The controller uses numerical control technology design, LCD display, automatic operation. Its maximum power point tracking (MPPT) type battery charging mode, as well as control technology, will greatly extend the battery life. The controller features a smart tracking algorithm that maximizes the energy from the solar PV module(s) and charge the battery.

This controller is suitable for the solar energy system (independent system), control the charging and discharging process automatically. The battery charging and discharging process of the controller is optimized, which can prolong the battery life and improve the system performance. Its self-diagnostics function and electronic protection function can avoid controller damage due to installation errors and system failures.

The 0 layer series has a humanized LCD screen display algorithm, one interface to complete all parameters display. Data can be monitored and configured in one layer of pages.

1.1 Features

- **Integrated charge presets**

Integrated charge presets combined with adaptive charge logic are well suited for most common battery types, such as LiFePO₄, Gel and flooded lead-acid.

- **Flexible Application**

Compatible with 12V/24V/36V/48V system voltage.

- **Multi-stage charge algorithm**

The multi-stage charge algorithm is specifically engineered to optimise each recharge cycle and charge maintenance over extended periods.

- **MPP Tracking Technology**

The Maximum Power Point Tracking (MPPT) technology will track the array's maximum power point voltage (V_{mp}) as it varies with weather conditions, ensuring that the maximum power is harvested from the array throughout the course of the day.

- **High efficiency**

Innovative MPPT technology with high tracking efficiency up to 99% and peak conversion efficiency of 98%; resulting in lower power usage, less heat generated and cooler operation.

- **Adaptive boost charge**

Adaptive boost charge monitors the battery's response during initial charging and intelligently determines the appropriate boost charge duration for each individual charge cycle. This ensures that the battery is fully recharged regardless of the discharge level or capacity and avoids excessive time at the elevated boost charging voltage (that can accelerate battery aging).

- **Durable and safe**

- i. Limit the maximum charging current. Protect battery performance and prolong battery life.
- ii. PV array short circuit protection.
- iii. PV input overcurrent protection.
- iv. Controller overload protection.
- v. Load short circuit protection.
- vi. PV reverse polarity protection. No damage to the controller will result.
- vii. Battery reverse polarity protection.
- viii. Over-temperature protection. If the temperature of the controller heat sink exceeds 65°C, the controller will automatically start reducing the charging current and shut down when temperature exceeds 80°C.

- **Silent operation**

Almost silent operation since there is no cooling fan or moving parts, cooling is via natural convection.

- **Lithium battery activation**

Compatible with Li-ion (LiFePO₄) batteries; when the battery type parameter is set to Lithium battery the charge cycle settings are altered to suit. Moreover, when the connected lithium battery is in a protected state, the controller will activate the lithium battery using the energy from the solar panel with a current that does not exceed the lithium battery's protection voltage and current range.

Warning: Do not charge Li-ion batteries if the battery temperature is below 0°C.

1.1 Production Overview



①	LCD display screen	⑤	Load terminal
②	Function keys	⑥	Mount hole
③	PV input terminal	⑦	Heat sink
④	Battery terminal		

2 Installation and Connection

2.1 Unpacking and Inspection

Before unpacking the controller, check whether the package is damaged. After unpacking, check whether the contents of the package are damaged or missing. You should have received the following items inside of package:

- Controller
- User manual
- Screws / bolts

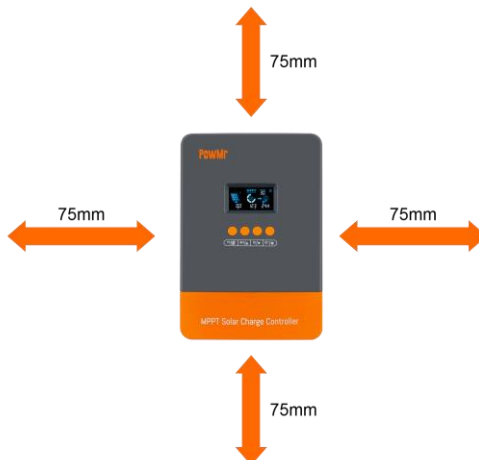
2.2 Preparing for Installation

The controller range is designed to be wall mounted using the flanges which protrude from either side of the heatsink.

Select the Mount Location:

Before mounting, the following aspects should be considered to identify/provide a suitable and safe location:

- Install the controller in a location with good natural airflow/ventilation.
- Ensure there is sufficient unobstructed space around the controller; a minimum clearance of **75mm** above and below is recommended.



- Install the controller on a non-flammable substrate and ensure there are no heat-sensitive items in the immediate vicinity; it is normal for the controller to become hot during operation.

- d. Install the controller in a location where it is protected from environmental conditions such as water, high moisture and dust, and also located well away from any flammable liquids or gasses.
- e. DO NOT install or place/operate the controller on top of the battery, directly above the battery, or in a sealed compartment with the battery; batteries can emit explosive gasses.
- f. DO NOT cover or place any other items on top of the controller.
- g. Install the unit by screwing four screws. It's recommended to use **M5** screws.

2.3 Things You Need

Make sure you have all the parts you need to install the controller:

Product	Quantity
POW-M60-PRO Controller (included)	1
DC-cable to connect the positive DC connection (+) of the controller to the positive pole of the DC-distribution	3
DC-cable to connect the negative DC connection (-) of the controller to the positive pole of the DC-distribution	3
DC breaker	3
Screws / bolts (Ø 5mm) to mount the cabinet to a surface. Use mounting materials which are suitable to carry the weight of the controller. (included)	4
PV array. See section "2.5 PV Module Selection" for the configuration of solar panels	1
Battery pack.	1

NOTICE

For all wirings and circuits specifications see section "0

- Wiring Specification and Breaker Type".

2.4 Wiring Specification and Breaker Type

- **PV input cable specifications and circuit breaker type:** Determine the maximum PV input current based on the configured system voltage and by referring to “6 Technical Specification”.
Note: The voltage in series shall not exceed maximum PV input open-circuit voltage.
- **Recommended input wire diameter and switch type for DC output (DC load):**

Model	Max. DC output Current	Wire Diameter	Circuit Breaker Spec
POW-M60-PRO	8A	14AWG	2P-8A

- **The cables and circuit breakers of the battery** should be selected based on the maximum charging current of the battery you connected.

2.5 PV Module Selection

When selecting proper PV modules, please be sure to consider below parameters:

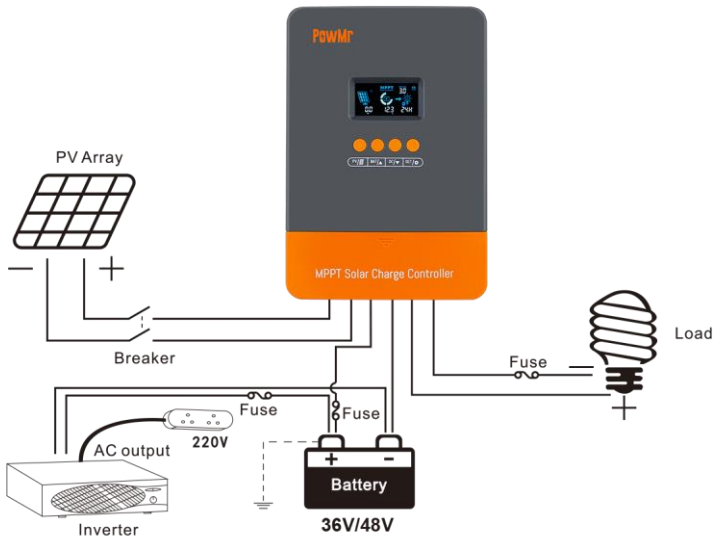
1. Open circuit Voltage (Voc) of PV modules not exceeds max. PV array open circuit voltage of controller.

Controller mode	POW-M60-PRO
Max. PV array open circuit voltage of controller	160V

2. Open circuit Voltage (Voc) of PV modules should be higher than Min. battery voltage.

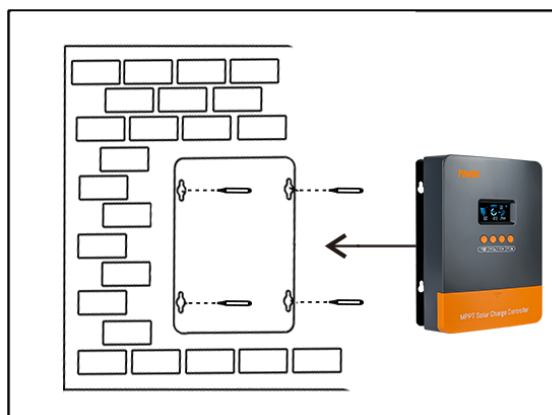
2.6 Wiring Precautions

- a. Let installation and connection work be done by a licensed electrician.
- b. To avoid short circuit and reverse polarity connection, ensure that the positive cable is connected to the positive polarity port (+) of the device, and the negative cable is connected to the negative polarity port (-) of the device.
- c. Too-thin cables and/or loose connections can cause dangerous overheating of the cables and/or terminals. Therefore, tighten all connections well, in order to limit transition resistance as far as possible. Use cables of the correct size. Please refer “2.4 Wiring Specification and Breaker Type” section for details.
- d. Do not connect the inverter to the load side of the controller. Otherwise, irreversible damage may be caused to the device. If you need to install an inverter, see the following system application diagram of the controller.



2.7 Installation and Connection Step-By-Step

1. Mark the position of the mounting spots on the wall based on the mount holes of the controller.
Then make 4 mounting holes in the wall with an electric drill according to the spots. Refer to the " 2.2 Preparing for Installation" section for installation locations.
2. Insert the expansion rubber screw plug into the mounting holes.
3. Mount the controller vertically to the ground with terminals facing down; secure using the 4 mounting holes/slots on the base. To aid installation, it is recommended to 'hang' the unit using the 2 upper screws and then add the 2 lower screws, before fully securing all 4 screws.
Recommend screws size is M5.



4. **Battery Connection:** Connect the battery to the controller with the cables.

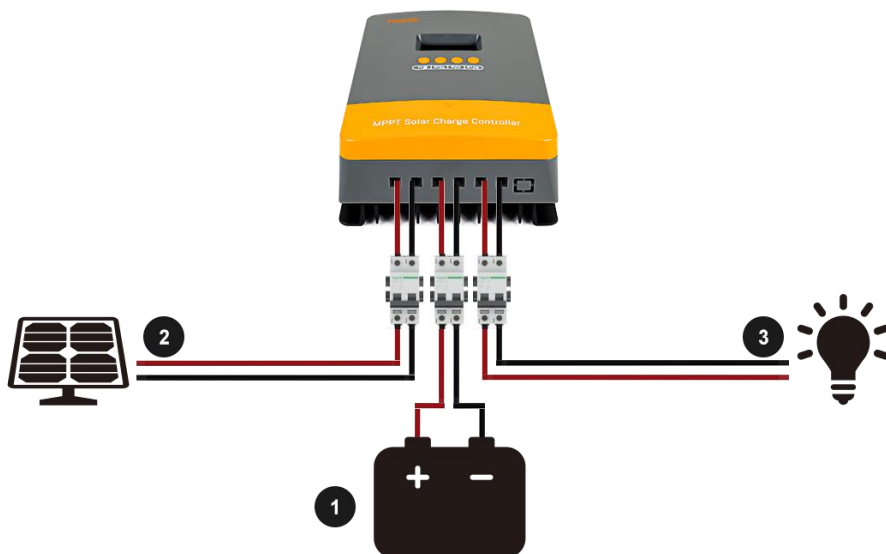
NOTICE

- All wiring must be performed by a qualified personnel.

For safe operation and standard application, a circuit breaker of the corresponding specifications must be installed on the cable connecting to the controller. And confirm that the wire used is thick enough. Please refer “0

- Wiring Specification and Breaker Type” section for selection of wiring and circuit breaker specifications.
- Ensure that all circuit breakers are open until all cables are connected.
- The positive end of the cable shall be connected to the positive port (+), and the negative end shall be connected to the negative port (-).
- The above precautions also apply to the wiring of the PV side and the load side.

5. **PV Connection:** Connect the PV array to the controller with the cables.
6. **DC Output Connection:** Connect the load to the controller with the cables.
7. **Check before starting up:** See figure as shown below for wiring details. If everything is all right, and all the wires are firmly connected, close the circuit breakers at the battery side, PV module side, and load side in sequence to startup controller.

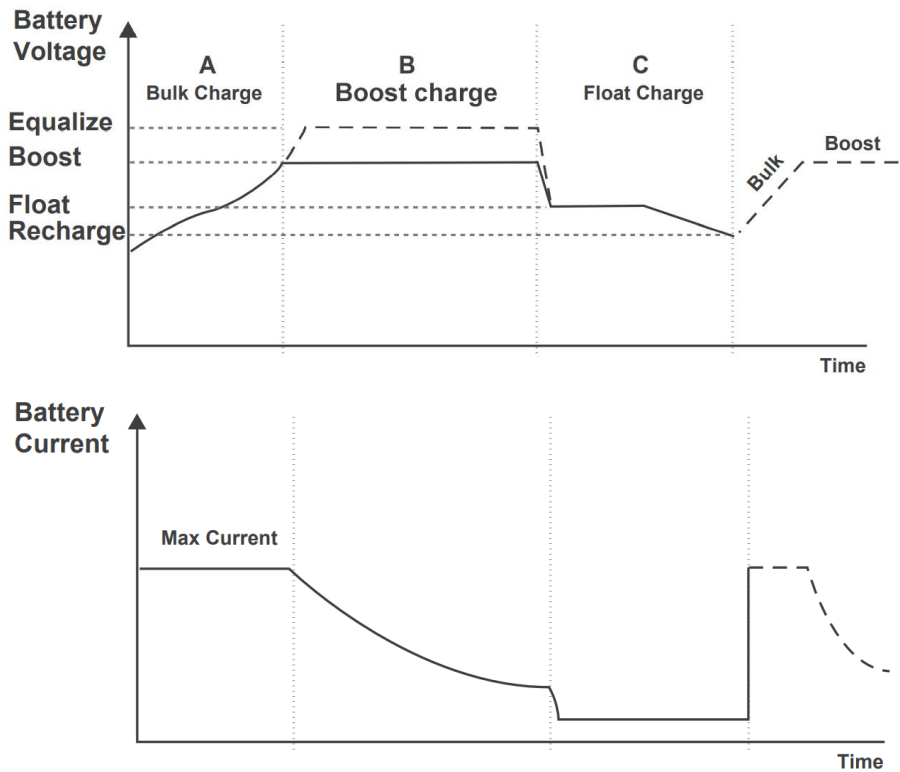


WARNING: Risk of electric shock!

- Make sure that all the power is turned off before above operations, and then follow the corresponding inspections and operations.

3 Charging Mode

The charging controller is equipped with an intelligent 3-stage charge characteristic which takes care of an optimal charge of your batteries. When switched on, the controller always starts at Bulk stage.



There are 3 integrated charge modes (Bulk, constant, float). Through the three stages of fast, efficient and safe battery charging mode, the system can effectively extend the battery life. The integrated charge modes combined with adaptive charge logic are well suited for most common battery types; such as flooded lead-acid, Gel and LiFePO4.

The charging mode parameters can be set as required via LCD screen. Please refer to the “4.3 Browse and Configuration Step-By-Step” section for more information.

Any setting made are stored and will not be lost when the controller is disconnected from battery or PV module.

The multi-stage charge algorithm includes the individual charge stages described below:

➤ **Bulk charge:**

The battery is charged at maximum charge current until the voltage increases to the configured boost charge voltage. The bulk stage duration is dependent on the battery's level of discharge, the battery capacity and the charge current. When the battery voltage reaches the preset value of the Boost charging voltage, it starts to boost charging.

➤ **Boost charge:**

The battery is charged at the configured boost charging voltage, with the charge current slowly decreasing as the battery approaches full charge.

The default boost stage duration is adaptive and intelligently varied depending on the battery's level of discharge – this is determined from the duration of the bulk charge stage.

When the photovoltaic module is reconnected, a new round of charging cycle will be started. If the battery is in full state, the charging stage will directly enter stage B, which is the boost charging voltage stage, and the battery voltage in this stage will not be higher than the set voltage of stage B. Currently, the duration of stage B is 30 minutes.

➤ **Float charge:**

At the end of the boost charging stage, the controller will reduce the battery voltage by reducing the charging current and keep the battery continuously at the floating charging voltage set value to maintain the full charge state of the battery.

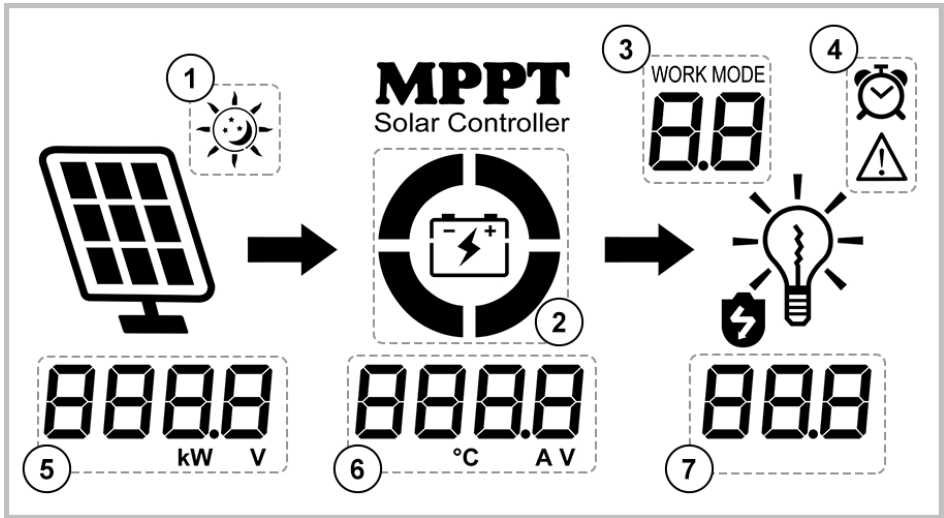
In Float charging stage, loads are able to obtain almost all power from solar panel. If loads exceed the power, the controller will no longer be able to maintain battery voltage in Float charging stage. If the battery voltage remains below the Recharge Voltage, the system will leave Float charging stage and return to Bulk charging stage.

3.1 Alarm Function

The battery controller is equipped with an integrated alarm function. For details about protection and fault alarm, see "5.2 Troubleshooting" section.

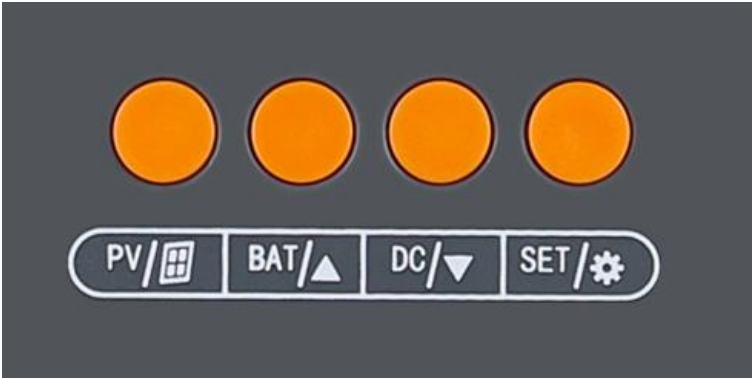
4 Operation Instruction

4.1 Icon Display on LCD Screen



No.	Function
①	Day or night indicating icon
②	Indicates the remaining battery capacity
③	Working mode (See “4.4 Working Mode” section for details.)
④	Periodic running status of the load and warning state (See “5.2 Troubleshooting” section for details.)
⑤	Indicate PV input voltage/power
⑥	Indicate Current battery voltage/Charging current/Equipment temperature/Battery calibration voltage/Battery type/Boost charging voltage/Float charging voltage/Low DC cut-off recovery voltage/ Low DC cut-off voltage.
⑦	Indicate working mode of load.

4.2 Function Keys



Icon	Description
PV / 	To switch the PV input parameters information
BAT / 	To switch the charging information/ Return the previous option.
DC / 	To adjust DC output mode and DC output operation duration/ Enter the next option.
SET / 	Confirm and reserve the settings.

4.3 Browse and Configuration Step-By-Step

After cables are connected and the device is started, perform the initial configuration according to the following steps based on the actual situation.

NOTICE

- The screen will automatically turn off the backlight after about 25 seconds without pressing a button to save power consumption. The backlight display can be activated by operating the key again.

4.3.1 PV side

Step 1. Checking PV input Information

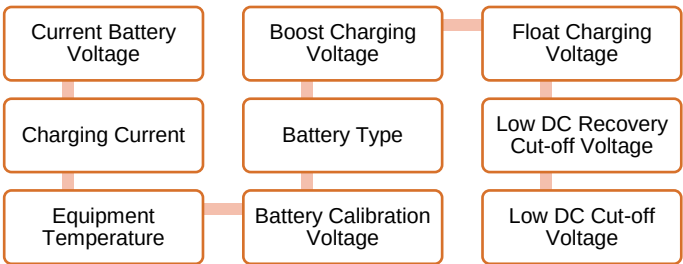
Press “PV /  ” key to switch PV information, which is PV input voltage and PV input power in sequence.



4.3.2 Battery side

Step 1. Checking Battery Information

Press “BAT /  ” key to switch battery information, which is current battery voltage, charging current, equipment temperature, battery calibration voltage, battery type, boost charging voltage, float charging voltage, low DC recovery cut-off voltage, low DC cut-off voltage in sequence.



Step 2. Calibrate battery voltage

The battery calibration voltage parameter is used to correct the current battery voltage measured by the controller. The specific operations are as follows:

- a. Once the parameter switches to “battery calibration voltage” item, press and hold “**BAT / ▲**” key to enter the battery voltage calibration setting.



- b. Then press the “**BAT / ▲**” or “**DC / ▼**” keys to calibrate the battery voltage parameters of the controller according to the battery voltage measured by the multimeter. Finally press “**SET / ***” to confirm.

Step 3. Select the Battery Type

Adjust battery type parameters based on the battery you connected:

- a. Once the parameter switches to the battery type item, press and hold “**BAT / ▲**” key to enter the battery type adjustment setting.
- b. Then press “**BAT / ▲**” or “**DC / ▼**” adjust battery type, finally press “**SET / ***” to confirm. The operating voltage varies according to battery types.
- c. For details, please refer “4.5.2 Battery parameters of different types” section.

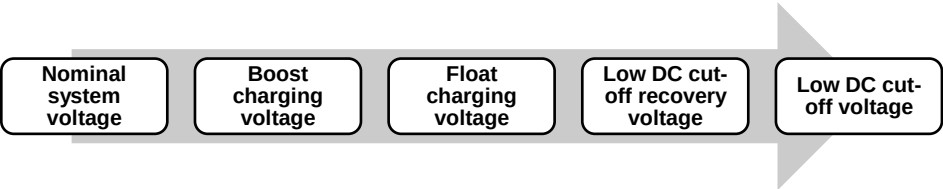
Sequence	Display	Battery Type
1	SEL	Sealed lead acid battery
2	USE	User-defined
3	N14	Ternary lithium battery
4	N13	Ternary lithium battery
5	N07	Ternary lithium battery
6	N06	Ternary lithium battery
7	N03	Ternary lithium battery
8	L16	Lithium iron phosphate battery
10	L15	Lithium iron phosphate battery
11	L08	Lithium iron phosphate battery
12	L04	Lithium iron phosphate battery
13	FLd	Vented lead acid battery
14	GEL	Colloidal lead acid battery

Step 4. Customize configured voltage parameters

NOTICE

- This step is required only when the battery type is set to “USE”.

a. Once the battery type is set to “USE”, the configurable parameters are presented in the following order. Increment of each click is 0.1V.



Item	Setting Range
Nominal system voltage	12V/24V/36V/48V (optional)
Boost charging voltage	10.0~17.0V
Float charging voltage	10.0~17.0V
Low DC cut-off recovery voltage	10.0~15.0V
Low DC cut-off voltage	10.0~15.0V

- b. Press “**BAT / ▲**” key to select parameter item which you need to adjust.
- c. Then press and hold “**BAT / ▲**” key to enter related parameter, then press “**BAT / ▲**” or “**DC / ▼**” adjust voltage value.
- d. Finally press “**SET / ***” to confirm. Refer “4.5 Key Points Battery Parameter Settings” section for the logic for setting battery voltage parameters.

NOTICE

- The 5 parameters as shown above can be set only when the battery type is “USE”. If “USE” is selected, you need to manually set the system voltage.

CAUTION

- The preceding parameter ranges apply to the 12V battery. When the connected battery voltage is 24V/36V/48V, the range values are 2/3/4 times of this range, respectively. And the LCD only display the voltage of the 12V battery.

WARNING

- The above Settings must follow the following logic: Boost charging voltage > Float charging voltage > Low DC cut-off recovery voltage > Low DC cut-off voltage.

4.3.3 Load side

Step 1. Configure load enable duration

- a. Press and hold “**DC / ▼**” key to enter the load mode setting.
- b. Then press “**BAT / ▲**” or “**DC / ▼**” adjust load state or load enable duration
- c. Finally press “**SET / ***” to confirm.
 - 00H: The solar light control mode. (When the solar energy is sufficient, enable the DC output.)
 - 24H (Default): Turn on load immediately.
 - 01H~23H: Adjust the load enable duration.

Setting range is from 0 hour to 24 hours. Increment of each click is 1 hour.

4.4 Working Mode

Code	Description
3.0	Night mode, no charging
4.0	Bulk charging mode (MPPT mode)
7.0	Boost charging mode
8.0	Float charging mode

4.5 Key Points Battery Parameter Settings

4.5.1 The logic for setting battery voltage parameters

- 1) Before you customize battery parameters, confirm the following parameters of the connected battery:

- **Max charging voltage**
- **Discharging protection voltage**

- 2) After confirming the battery information, you can set the 4 key parameters according to the following logic:

Max. charging voltage > Boost charging voltage > Float charging voltage > Low DC cut-off recovery voltage > Low DC cut-off voltage > Discharge protection voltage

4.5.2 Battery parameters of different types

For lead-acid battery & User define:

Battery type Parameter	FLd	GEL	SEL	USE
Boost charging voltage	14.6V	14.2V	14.4V	10.0~17.0V
Float charging voltage	13.8V	13.8V	13.8V	10.0~17.0V
Low DC cut-off voltage	11.0V	11.0V	11.0V	10.0~15.0V
Low DC cut-off recovery voltage	12.6V	12.6V	12.6V	10.0~15.0V

For Ternary lithium battery:

Battery type Parameter	N03	N06	N07	N13	N14
Boost charging voltage	12.5V	25.0V	29.2V	54.2V	58.3V
Float charging voltage	12.2V	24.4V	28.5V	52.9V	56.9V
Low DC cut-off voltage	8.4V	16.8V	19.6V	36.4V	39.2V
Low DC cut-off recovery voltage	9.0V	18.0V	21.0V	39.0V	42.0V

Lithium iron phosphate battery:

Battery type Parameter	L04	L08	L15	L16
Boost charging voltage	14.5V	29.0V	54.4V	58.0V
Float charging voltage	13.8V	27.6V	51.8V	55.2V
Low DC cut-off voltage	11.2V	22.4V	42.0V	44.8V
Low DC cut-off recovery voltage	12.0V	24.0V	45.0V	48.0V

5 Protection

5.1 Protection Provided

Protection	Behavior
PV Array Short Circuit	When PV short circuit occurs, the controller will stop charging. Clear it to resume normal operation
PV Input Overcurrent	The controller will limit the battery charging current to the maximum battery current rating. Therefore, an overcurrent solar array will not operate at peak power.
Controller Overload	If the current exceeds the maximum load current rating of 21A, the controller will disconnect the load. Overloading must be cleared up by reducing the load and restarting the controller.
Load Short Circuit	Fully protected against the load wiring short-circuit. Once the load short circuit (more than quadruple rated current), the load short circuit protection will start automatically. After 5 automatic load reconnect attempts, the faults must be cleared by restarting the controller.
PV Reverse Polarity	The controller will not operate if the PV wires reverse polarity. Wire them correctly to resume normal controller operation.
Battery Reverse Polarity	The controller will not operate if the battery wires reverse polarity. Wire them correctly to resume normal controller operation.
Over-Temperature	If the temperature of the controller heat sink exceeds 65°C, the controller will automatically start reducing the charging current and shut down when temperature exceeds 80°C.

5.2 Troubleshooting

In case of a failure, the controller display shows an error signal to help you find its source.

Fault code	Possible Cause	What to do
18	Input PV voltage is low	Increase the number of photovoltaic panels; or increase the photovoltaic input voltage value in series.
60	Over-temperature protection	When the temperature of the device is cooled below the recovery temperature, normal charge and discharge control is resumed.
63	Battery voltage is high	Measure whether the battery voltage exceeds the rated voltage and turn off the photovoltaic array air switch.
65	Battery voltage is low	Charge the battery and wait until the battery voltage is higher than the low voltage cut-off voltage recovery point, refer to “4.5.2 Battery parameters of different types” section for detail.
71	Input PV voltage is high	Reduce the number of PV panels connected to the controller to reduce the PV input; or reduce the voltage or current value by changing the series or parallel mode
73	Over-charging current	

5.3 Maintenance

The following inspections and maintenance tasks are recommended at least two times per year for best performance.

- Make sure controller firmly installed in a clean and dry ambient.
- Make sure no block on air-flow around the controller. Clear up any dirt and fragments on radiator.
- Check all the naked wires to make sure insulation is not damaged for serious solarization, frictional wear, dryness, insects or rats etc. Repair or replace some wires if necessary.
- Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.
- Confirm that all the system components are ground connected tightly and correctly.
- Confirm that all the terminals have no corrosion, insulation damaged, high temperature or burnt/discolored sign, tighten terminal screws to the suggested torque.
- Check for dirt, nesting insects and corrosion. If so, clear up in time.

WARNING: Risk of electric shock!

- Make sure that all the power is turned off before above operations, and then follow the corresponding inspections and operations.

6 Technical Specification

Model	POW-M60-PRO
PV Input	
Max Open Voltage of PV Module	160Vdc
Max. Input Power: For 12V system For 24V system For 36V system For 48V system	720W 20-80Vdc; 1440W 37-105Vdc; 2100W 50-160Vdc; 2800W 72-160Vdc.
Charge Mode	
Charging Technology	MPPT
Charge Algorithm	3-Stage
Nominal System Voltage	12V/24V/36V/48V
Battery Voltage Range	9~70V
Rated Charging Current	60A
Conversion Efficiency	≤98%
MPP Tracking Efficiency	>99%
Self-consumption	0.7W-1.2W
DC output	
Rated Output Current	6A
Max. DC Output Current	8A
Max. Capacitive Load Capacity	10000μF
Environment	
Operating Temperature Range	-35℃~+45℃
Humidity Range	≤95%, Non-condensing
Altitude	<3000m
General Specification	
Protection Class	IP32
Dimension	230*165*72mm (9.1*6.5*2.8in)
Net Weight	1.33kg (2.9lbs)



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