MPPT-K Solar Charge Controller User Manual

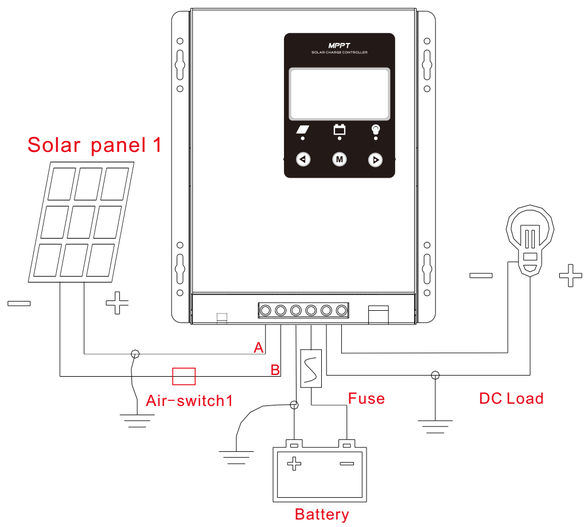
40A/60A 12V/24V/36V/48V

⚠Attentions

(1)Please confirm the polarity before wiring the solar panel, reverse connection may damage the controller.

(2)Do not disconnect the battery while the controller is charging, otherwise may damage the controller; If need disconnect the battery, please disconnect the solar panel first, and then disconnect the battery;
(3)Do not connect the solar panel to the battery terminal, may damage the controller. Please check the wiring carefully and power on;
(4)When connect the controller, be sure to tighten the terminal screws. Do not press the wire and check the wiring tightly.

Connection diagram



1 Wiring

1.1 Preparation

1.Choose the appropriate cables (fix the controller on the wall or other vertical plane).

2.Prepare pliers and hydraulic clamps (for copper crimping), copper cable connectors, screwdrivers, wrenches, multi-meter, etc.

1.2 Installation process

Note: Please switch off the breakers of battery, solar panels array before installing the controller.
Do not touch the positive and negative pole of solar panels or battery at the same time when installing, otherwise there is danger of electric shock!

(1)Mount the controller on the wall and fasten the screws.

(2)Check whether the battery voltage and solar panels array voltage is within the requested range.

(3)Switch off the over-current breaker or fuse of the battery, solar panels array and load.

(4)Connect the battery to the battery terminal on the controller by cables and fasten the screws.

(5)Connect the load to the load terminal on the controller by cables and fasten the screws.

(6)Connect the solar panel to the solar panel terminals on the controller by cables and fasten the screws.

(7)Switch on the breaker or fuse of the battery, then LCD display the system status.

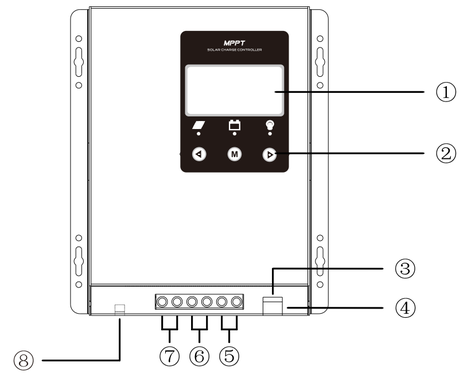
(8)Switch on the breaker or fuse of the battery, then the controller starts to charge the battery.

1. Overview

MPK solar charge controller is Multi-stage Maximum Power Point Tracking (MPPT) photovoltaic battery charge controller with our own technology. It's main topology adopts in Buck conversion circuit, and uses MCU to adjust the solar panels working point intelligently in order to make the solar panels output is maximum power. When the circumstances change, the working point of solar panels deviate from the maximum power point, MCU will adjust the solar panels working point based on MPPT calculation to make the solar panels back to the maximum power point again. Compared with PWM controller, MPPT can increase the output power of solar panels by 5%-30%. The output power increasing proportion is affected by the factors such as solar panel property, humidity and light intensity. The controller uses wall-mount installing. Connecting terminal makes the wiring area bigger and wiring loss less.

2. Instruction

2.1 Structure



①LCD Display Screen ②Button ③Communication port ④Grounding terminal

⑤Load terminal ⑥Battery terminal ⑦Solar panel terminal 1 ⑧Temperature sensor

2.2 Functions

(1) Maximum Power Point tracking technology
The controller uses Buck conversion circuit and MCU technology to track the maximum power point to implement the maximum output power of solar panels in different illumination intensity and temperature. The MPPT algorithm increases efficiency of your PV system and decreases the quantity of solar panels.

(2) Multi-stage
The starting charging voltage of battery is different; the controller will use different charging strategies to finalize the charging process. When starting charging voltage is lower than 12.6v (for 12V battery), the battery will go through three stages as Bulk, Absorption and Float charging, when starting charging voltage of battery is higher than 12.6V (for 12V battery), battery will go through two stages as Bulk and Float charging.

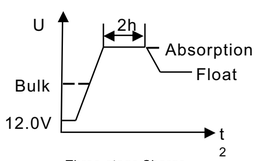
Bulk Charge:
The controller charges the battery at the maximum output current. At this stage, it is in the maximum power point tracking state.

Absorption Charge:
The controller begins to limit the charging current to make the battery voltage at a settled absorption voltage (this voltage has temperature compensation) for two hours. It increases the charging saturation level of battery and prevents battery from leaking gas, and can increase the lifetime of battery.

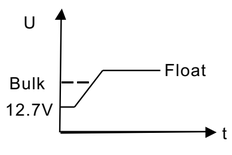
Float Charge:
The battery is at saturation state, and the controller charges the battery at a trickle current to make the battery voltage fixed at the settled float charging voltage (this voltage has temperature compensation)

(3) Charge Voltage Temperature-compensated
The controller will compensate the Float charging voltage and Absorption charging voltage by -4Mv/Cell/℃according to the current battery temperature.
For 12V battery, the compensated voltage U= (t-25)*6*(-0.004) V
For 24V battery, the compensated voltage U= (t-25)*12*(-0.004) V
For 48V battery, the compensated voltage U= (t-25)*24*(-0.004) V

(4) Discharge control
The controller records the battery voltage all the time. The load will be switched off when the voltage lower than the Low Voltage Disconnect (LVD) point, and it won't be switched on until the voltage higher than the Low Voltage Reconnect (LVR) point.



Three-stage Charge



Two-stage Charge

(5) Battery Reverse Connection Protection
Connecting the battery to the controller by reversed polarity (with the solar panel disconnected) will not damage the controller. The controller will work normally when it is correct connected.

(6) Solar Panel Reverse Connection Protection
Connecting the solar panel to the controller by reversed connection will not damage controller (with the battery disconnected). The controller will work normally when it is correct connected.

(7) Reverse Current Protection
The controller prevents reverse current from flowing into the solar panel at night.

(8) Overheating Protection
When the controller detects that the temperature of the internal power module is higher than a certain value, the controller stops charging the battery. When the temperature drops to a certain value, the controller will restart charging the battery.

(9) Solar panel Over voltage Protection
If the input voltage of the solar panel exceeds the maximum voltage allowed by the controller, it will enter into protection state automatically and stops charging. When the input voltage returns to the normal range, the controller will restart charging the battery.

(10) Solar panel input power limit
When the solar panels are too powerful, the controller will deviate from the maximum power point to limit the output current to prevent the controller being damaged.

(11) Lithium battery awaken
MPK series MPPT charge controller has a reactivation feature to awaken a sleeping lithium battery. The protection circuit of Li-ion battery will typically turn the battery off and make it unusable if over-discharged. This can happen when storing a Li-ion pack in a discharged state for any length of time as self-discharge would gradually deplete the remaining charge. Without the wake-up feature to reactivate and recharge batteries, these batteries would become unserviceable and the packs would be discarded. The MPK series MPPT solar charge controller will apply a small charge current to activate the protection circuit and if a correct cell voltage can be reached, it starts a normal charge.

2.3 MPPT Technology Instructions

Solar panels are nonlinear materials, and output power is primarily affected by illumination intensity, solar panel temperature, and load impedance. When the illumination intensity and solar panel temperature are fixed, the output power of the solar panel is only affected by load impedance. Different load impedances will make the solar panels to work at different points, producing different powers.

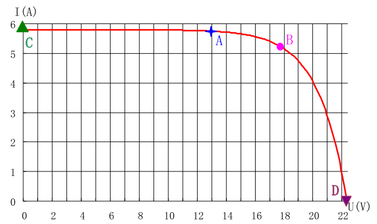
The following figure will mark four work points A, B, C, D, and the following work point features:
Working point D: Output voltage is 22.3V, output power is 0W. This is the open circuit point of solar panel.

Working point C: Output voltage is 0V, output power is 0w.This is the short circuit working point of solar panel.

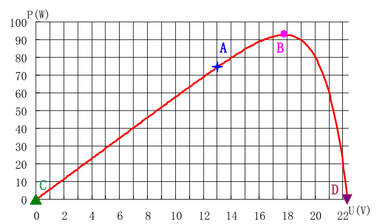
Working point A: Output voltage is 13V, output power is 74W. This working point is the state when using normal controller and the solar panel voltage is clamped to 13V by battery.

Working point B: Output voltage is 17.6V, Output power is 92W. This point the state when using MPPT controller. Due to the power conversion technology, the solar panel voltage is not clamped by battery and still works at maximum power point.

By comparing the working points of A and b, it is easy to find using MPPT controller can improve the efficiency of solar panels. The MPK controller can generate more power than normal controller.



Voltage-Current Curve



Voltage-Power Curve

3. PV System Planning Reference

3.1 System Voltage

In reality application, user should consider the load power, and the voltage range allowed by load, then confirms which system voltage you should use. The power range for each system voltage is as follows:

System Voltage	Recommend Power Range
12V	<800W
24V	<2000W
48V	<6000W

3.2 Solar Panels configuration

MPK series controller can be connected with mono crystalline silicon solar panels and Thin-film solar panels. When configuring the system, make sure the open circuit voltage of solar panels array is not higher than the maximum voltage allowed by the controller. Table 3-2 describes the panels and their parameters for mono crystalline silicon and Thin-film solar panels. Table 3-3 shows the configuration solution for 1 2 V, 24 V, 4 8 V system for solar panels.

Model	Category	Pmax	Voltage	ISC	Vpmax	Ipmax
STP140D-12/TEA	Mono crystalline silicon Module	140W	22.4V	8.33A	17.6V	7.95A
MS140GG-02	Thin-film Module	140W	29.0V	7.12A	23.0V	6.52A
STP190S-24/Ad+	Mono crystalline silicon Module	190W	45.2V	5.65A	36.6V	5.2A
NS-F130G5	Thin-film Module	130W	60.4V	3.41A	46.1V	2.82A
The above parameters are for condition of 25℃,AM1.5 spectrum,1000W/㎡illumination intensity.						

Table 3-2

Model	12V System	24V System	48V System
STP140D-12/TEA	N in parallel	Two in series N in parallel	Four in series N in parallel
MS140GG-02	N in parallel	Two in series N in parallel	Four in series N in parallel
STP190S-24/Ad+	N in parallel	N in parallel	Two in series N in parallel
NS-F130G5	N in parallel	N in parallel	Two in series N in parallel

Table 3-3

3.3 Wiring Size

To ensure the cable temperature does not exceed the safe range, the copper cable's size must be less than 4A/ mm².In reality application, user can choose the appropriate cables according to the system voltage, allowed cable temperature, cable voltage drop and also cable material. We suggest customer to control the maximum battery voltage loss under 1.5%, and control the maximum voltage loss of solar panels under 2.5%.

The following is the cable length between controller and battery, and the suggested copper cables:

Cable Length	Cable Size in	Cable Size in AWG	Voltage Loss (a pair)	Battery Voltage Loss		
				12V	24V	48V
1m	2. 5mm²	#13 AWG	0.14V	1.20%	0. 60%	0. 30%
2m	4mm²	#11 AWG	0.18V	1.50%	0. 75%	0. 38%
4m	6mm²	#9 AWG	0.24V	2.00%	1. 00%	0. 50%

The following is the cable length between solar panels and controller, and also the suggested copper cables:

Cable Length	Cable Size in	Cable Size in AWG	Voltage Loss (a pair)	Battery Voltage Loss		
				17V	34V	68V
2m	4mm²	#11 AWG	0.18V	1.10%	0. 53%	0. 26%
4m	6mm²	#9 AWG	0.24V	1.40%	0. 71%	0. 35%
8m	10mm²	#7 AWG	0.29V	1.70%	0. 86%	0. 43%

3.4 Over Current Protection

The electrical equipment used in power circuits must be equipped with over current and short circuit protection devices, and there is no exception for MPK Series controller. The controller adopts in the design of common positive pole inside. We suggest user to install over-current breaker or fuse on the negative loop of solar panels input, and also the negative loop of battery output. The capacity of the over-current breaker or fuse is 1.25 times of the rated current.

3.5 Lightning Protection

It is same as other electrical devices that MPK Series controller will be damaged by lightning. The controller has limited surge absorption capacity. We suggest users to install lightning surge absorption devices to increase the reliability of the system.

3.6 Grounding

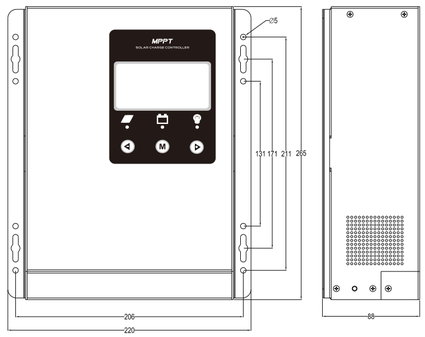
Use 4MM2 yellow and green cable to connect any of the positive terminal of the controller to the ground bus of the system. This can decrease the electromagnetic interference in a certain value.

3.7 System Expansion

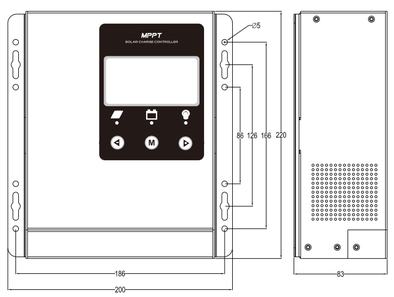
If you want to deploy a bigger system, you can expand the system by paralleling several sets of the same controller. More controllers can share with one battery group, but each controller must be connected with the independent solar panels array and the independent load. (Please contact the local distributor for further information)

4. Installation

4.1 Dimensions



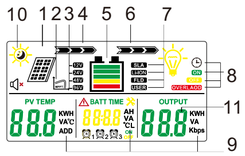
60A dimensions:
Mounting hole pitch:
131mm*206mm
Mounting hole pitch:
171mm*206mm
Mounting hole pitch:
211mm*206mm
Mounting hole diameter:
Φ5mm
Length*Width*Thickness:
265mm*220mm*88mm
Connecting terminals:
Maximum 25mm²



40A dimensions:
Mounting hole pitch:
86mm*186mm
Mounting hole pitch:
126mm*186mm
Mounting hole pitch:
166mm*186mm
Mounting hole diameter:
Φ5mm
Length*Width*Thickness:
220mm*200mm*83mm
Connecting terminals:
Maximum 25mm²

5. Operation Instruction

5.1 Symbols



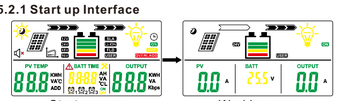
1.Data display area
2.Working status
3.System voltage level
4.Charging
5.Battery capacity
6.Discharging
7.Battery type
8.Load working mode&status
9.Unit
10.Day and night
11.Characters

Explanation of characters in the page

AbS for Absorption charge
Flt for Floating charge,
EqU for Equalization charge,
cv for Constant pressure,
Rcv for Lithium battery charge recovery,
Lvd for Low voltage disconnection,
Lvr for Low voltage recovery,
dt for Night time,
dn for Morning hours,
Ld for Load working mode,
SyS for System voltage,
tyP for Battery type,
tCC for Temperature compensation coefficient
bAt for Battery capacity,
Ldt for Timing control

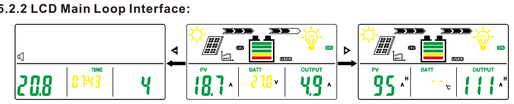
5.2 LCD Interface

5.2.1 Start up Interface

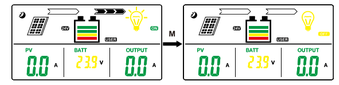


(1)Startup page: the interface when system is powered on by which you check whether the LCD is in good condition.
(2)Working page: The battery is properly connected to the controller, rated charging and discharging current, battery voltage, system voltage, battery type etc. can be checked in this page.

5.2.2 LCD Main Loop Interface:



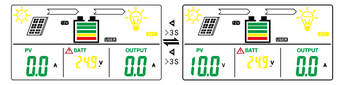
In main loop interface, by short pressing + or - you can circulate interfaces. Interface will remain if the machine works well. Interface will switch automatically to fault interface after 15s if something is out of work. (Check chapter 6 for fault information)
By short pressing + or - to close "error code" interface. *Below situation valid only for products with loading control function.



(3)In Working page, switch loading on/off by Short pressing "M" button to switch

Working page

5.2.3 Panel voltage display

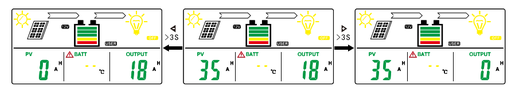


Long press - for over 3s to switch PV voltage

5.2.4 Time setting

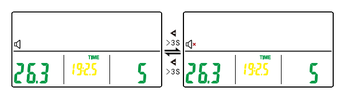
Set the RTC time and date, long press the middle button to enter the setting page. Then, from left to right, it is day, month, hour, minute,Year and week.Short press the left and right button to modify, short press the middle key to switch, long press the middle button for saves.
Month:
o stands for October; n stands for November; d stands for December

5.2.5 Total ampere count



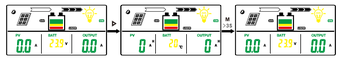
(1)Total charging discharging ampere, maximum is 65KAH. Over 65KAH, the count starts again from 0 Ah.
(2)Long pressing ▲ over 3S to restore ampere count.

5.2.6 Sound setting

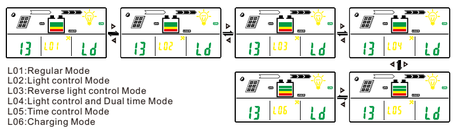


Set the sound switch, long press the left button on the time page to switch the sound

5.2.7 Restore factory settings

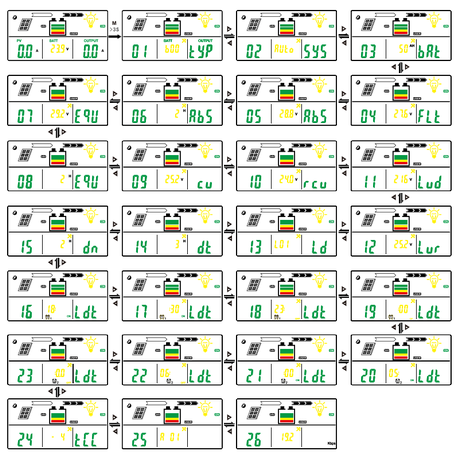


5.2.8 Load working mode

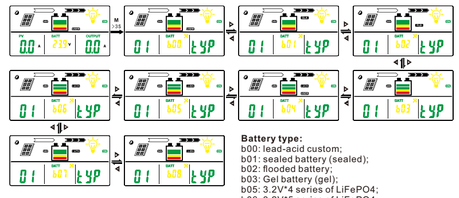


L01:Regular Mode
L02:Light control Mode
L03:Reverse light control Mode
L04:Light control and Dual time Mode
L05:Time control Mode
L06:Charging Mode

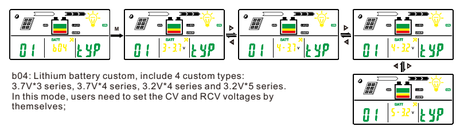
5.2.9 Parameters setting



5.2.10 Battery Type

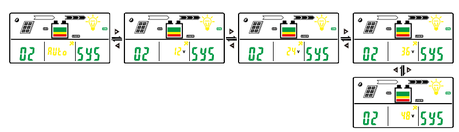


Battery type:
b00: lead-acid custom;
b01: sealed battery (sealed);
b02: flooded battery;
b03: Gel battery (gel);
b05: 3.2V*4 series of LiFePO4;
b06: 3.2V*5 series of LiFePO4;
b07: 3.7V*3 series polymer lithium battery;
b08: 3.7V*4 series polymer lithium battery.
Charging parameters cannot be set from b05 to b08;

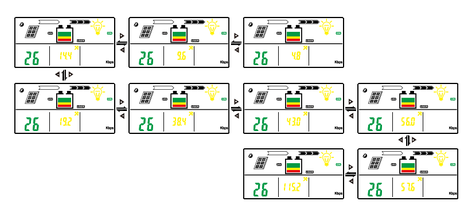


b04: Lithium battery custom, include 4 custom types:
3.7V*3 series, 3.7V*4 series, 3.2V*4 series and 3.2V*5 series.
In this mode, users need to set the CV and RCV voltages by themselves;

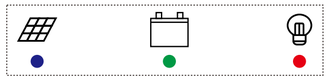
5.2.11 Battery voltage identification



5.2.12 Serial port communication baud rate setting



Description of 3 LED indicators:



Blue indicator(left): on -> bulk charge (MPPT charge), flashing -> equalization ,absorption or floating charge, off -> stop charging;

Green indicator(middle): on -> battery is normal, flashing quickly -> battery is over voltage, flashing slowly -> battery low voltage, off -> battery voltage is too low or not connected;

Red indicator(right): on -> load is on, flashing -> load is overloaded, off -> The load is off.

6. Faults and Remedies

6.1 Error Code and Correction

Error code	Cause	Correction
Ex1	Low voltage of battery and load switch off	Manually recharge the battery
Ex3	Excessive load current and load switch off	Reduce load current at load output, and switch on load manually or wait 6 minutes for auto switch-on by controller
Ex5	Battery charging switch off due to over-temperature of controller	The controller automatically resumes charging after the temperature is lowered
Ex6	High-voltage of solar panel	Make sure voltage of open circuit is not too high and reduce the number of solar panels in series.

6.2 Common Faults and Remedies

Phenomenon	Cause	Remedy
LCD no display	The battery is connected to the controller with the wrong polarity, the fuse burns out	Check the fuse, Disconnect the battery and reconnect it to the controller with correct polarity
Battery overvoltage protection when startup	The controller adjusts to the wrong system voltage	Disconnect the load, solar panel and battery. Waiting for about 10 seconds and then re-install the controller
Stay in direct charging mode	PV maximum power voltage is too low	It's normal. If possible you can re-configure the PV system to enlarge the PV open circuit voltage

7. Technical Data

Model	MPPT4840K	MPPT4860K
Input		
Maximum PV open circuit voltage	150V (at the lowest temperature) 138V (at a standard temperature of 25°)	
Minimum PV voltage	20V/40V/60V/80V	
Rated Charge Current	40A	60A
Output		
System voltage	12V/24V/36V/48V Auto	
Rated Discharge Current	20A	30A
Own consumption	≤35mA(48V)	
MPPT highest accuracy	99%	
Maximum charging efficiency	97%	
Charging control mode	Multi-stage(MPPT, Absorption, Float,Equalization,CV)	
Float charge	13. 8V/27. 6V/41. 4V/55. 2V	
Absorption charge	14. 4V/28. 8V/43. 2V/57. 6V	
Equalization charge	14. 6V/29.2V/43. 8V/58.4V	
Load disconnection(LVD)	10. 8V/21. 6V/32. 4V/43. 2V	
Load reconnection(LVR)	12. 6V/25. 2V/37. 8V/50. 4V	
Load control mode	Normal, light control, light and timing control, timing control, reverse light control	
Light control point voltage	5V/10V/15V/20V	
Battery Type	GEL, SLD,FLD and USR(default),Lithium batteries customization 3series 3.7V,4 series 3.7V,4series 3.2V,5series 3.2V	
Other		
Human interface	Color LCD with backlight, 3 buttons	
Cooling mode	AL alloy heat sink and cooling fan	
Wiring	High current copper terminal≤25 mm² (3AWG)	
Temperature probe	10K, line length 3 meters	
Communication mode	RS485,RJ45 port	
Working temperature range	-20~+55° C	
Storage temperature range	-30~+80° C	
Humidity	10%~90% No condendation	
Size	220mm*200mm*83mm	265mm*220mm*88mm
Weight	2. 8KG	3. 5KG
Note: Please operate at the ambient temperature allowed by the controller. If the ambient temperature exceeds the allowable range of the controller, please derate it		

***36V is not automatically recognized and can be set as a fixed system voltage;**
****There is no equalizing charging method for colloidal batteries.**