

# DM Series

## MPPT Integrated Constant-Current Charge Controller for Solar Street Lights

Note: "-U" in this manual indicates the controller features a function of monitoring via Internet-of-Things

# User Manual

Suitable for the following models
DM120
DM120-U
DM160
DM160-U



Version: 1.04 The above information is subject to change without prior notice.

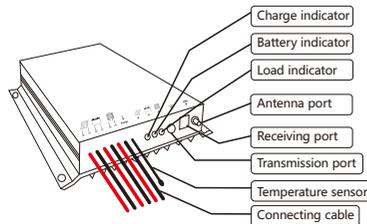
### Main features

- Features true MPPT functions, applicable to monocrystalline, polycrystalline and amorphous silicon solar panels serially connected in various numbers, significantly improving the solar panels' energy utilization ratio.
- MPPT solar charging technology, the maximum solar input voltage  $V_{oc} \leq 60V$ .
- The load is stepping up and constant current output which can support maximum 18pcs of LED beads connected in series.
- Adopts an improved charging algorithm that supports 12V and 24V lead-acid batteries and lithium batteries, and the user can set the operating modes for lead-acid batteries or lithium batteries accordingly.
- Boasts a load triple-stage brightness adjustment and morning on design, with an operating duration adjustable from 0 to 15 hours and a power settable from 0 to 100%.
- Features a system status log function, able to record a maximum of 7 days of system status, comprehensively and effectively monitoring the system's conditions.
- Data communication adopts a multi-time two-way handshake protocol and a data compression algorithm, realizing precise and fast data transmission.
- Features an intelligent power mode which can extend the battery life to its top limit by adjusting the load power automatically according to the remaining battery capacity.
- True constant current rather than current-limiting control ensures smooth and stable output current, effectively reducing LED light attenuation and extending LED service life.
- With an infrared remote control function, operations including setting parameters, reading status and viewing historical data can be conducted.
- A metal case and an IP68 waterproof level enable the device to operate in various kinds of tough conditions.
- An overheat protection function enables the device to scale down the load or shut off the load completely when its temperature exceeds a certain point.
- A range of protection measures such as battery reverse-connection protection, LED short-circuit and open-circuit protection, etc., put the system under comprehensive and constant guard.
- The following are functions of "-U" series**
- Boasts a wireless Internet communication function, able to conduct remote monitoring and real-time management on street lights via the solar power street light management system.
- Supports remote light on/off switching and dimming, as well as modification of battery and load parameters.
- Monitors solar panel voltage, current and power, battery charging and discharging current and voltage, load operating status, controller operating status and other data, and automatically triggers alarms when failures are detected.

### Exterior and Wiring

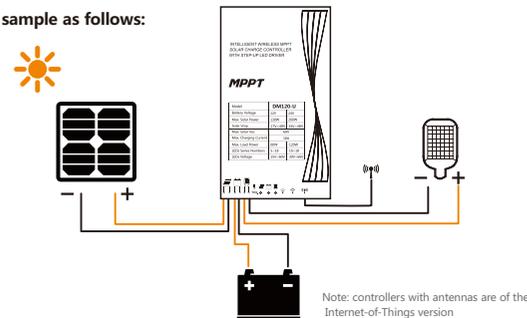
- Model name composition:** DM-120/160-U  
    - DM: Model
    - 120/160: Max. load power
    - U: Remote control via Internet-of-Things
- MPPT Integrated boost constant-current charging

#### 2. Exterior:



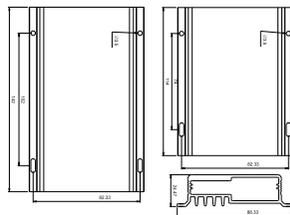
Note: controllers with antennas are of the Internet-of-Things version

#### 3. Wiring sample as follows:



#### 4. Wiring sequence: connect first the load, second the battery, and finally the solar panel.

### Installation dimensions



DM120/DM120-U 's dimensions are as follows:  
 External dimensions: 114x88.3x24.5(mm)  
 Installation dimensions: 74x82.33(mm)  
 Installation hole diameter: 3.5(mm)

DM160/DM160-U 's dimensions are as follows:  
 External dimensions: 142x88.3x24.5(mm)  
 Installation dimensions: 102x82.33(mm)  
 Installation hole diameter: 3.5(mm)

### LED Load Connection

- With a built-in boost type constant current source, DM120/160-U boasts a maximum output voltage of 60V, able to power up to 18 LED light bulbs.
- This controller is of a boost type. When LED load is connected, be sure to connect a right number of LED lights in series.

The number of connected LED lights is recommended as follows:

System voltage	Recommended minimum No. of serially connected LEDs (n)	Load output voltage $V_{out}$
12V	$n \geq 5$	$V_{out} \geq 15V$
24V	$n \geq 10$	$V_{out} \geq 30V$

- In practical use, make sure you correctly connect the LED lights before switching on the load.

**Warning: if a wrong number of LED lights are connected in series, the LED load or the controller may get damaged. Always bear this in mind!**

### State Indicators

LED indicator	Indicated item	Status	Meaning
	Charging	Steady on	Solar panel voltage higher than light control voltage
		Off	Solar panel voltage lower than light control voltage
		Slow flashing	Charging in process
		Quick flashing	System over-voltage
	Battery	Steady on	Normal battery function
		Off	Battery not connected
		Quick flashing	Battery over discharged
	Load	Steady on	Load turned on
		Slow flashing	Open-circuit LED load
		Quick flashing	Short-circuit LED load
		Off	Load switched off

### Load Working Modes

Controlled by the DM120/160-U controller, the load's working time can be divided into 3 stages plus a 4th—morning on. The operating duration and power of each stage can be freely adjusted, with different combinations bringing about different control modes.



- Normal working mode:** operates according to time and power settings in sequence.
- Delay on mode:** e.g. set the 1st-stage operating duration to 4 hours and power to 0%, and the system will delay switching on the lights by 4 hours.
- Morning on mode:** the controller will automatically calculate the length of the night and intelligently adjust the time point for switching on the light in the morning, thereby making the morning on time more precise.
- Test mode:** in daily use, the controller works in the light control + time control mode, but when test is needed during installation, you can use the remote control to switch on the load, and then the LED load will change its power according to the remote control settings. The test mode lasts for 1 minute, and after that, the system will automatically restore the normal working mode.

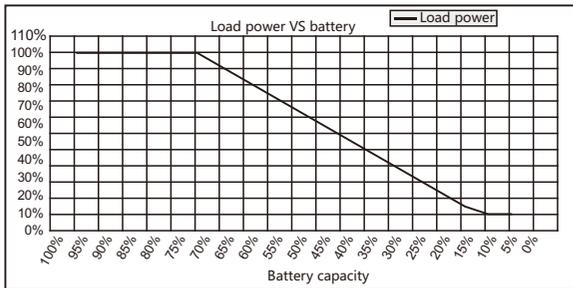
Adjustment item	Value	Default
1st-stage operating duration	0 to 15 hours	4
1st-stage operating power	0 to 100%	100%
2nd-stage operating duration	0 to 15 hours	0
2nd-stage operating power	0 to 100%	70%
3rd-stage operating duration	0 to 15 hours	4
3rd-stage operating power	0 to 100%	50%
Morning on operating duration	0 to 15 hours	0
Morning on operating power	0 to 100%	30%

## Intelligent LED Power Control

When the controller's "intelligent power" mode is activated by the user, the LED load's power can be automatically adjusted according to the battery capacity. While the operating duration and load power set by the user are still valid, the system will choose the smaller one from between the automatically adjusted power and the power set by the user as the load output power.

For example: when the remaining battery capacity is 50% and the load power calculated in the intelligent power mode is 60%, and if the load power set by the user is 100%, then the final load power is 60%; however, if the load power set by the user is 20% instead, the final load power will also become 20% accordingly.

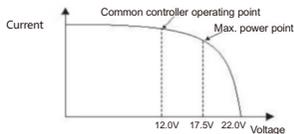
The typical curve of intelligent power is shown below:



## Parameter Access and Modification

The DM120/160-U controller can be used to set parameters including load operating duration, load operating power, light control delay, charging voltage, etc. When finishing settings through the remote control, aim it at the controller and press the "send" key to save the settings. Besides, current parameter settings in the controller can also be accessed to make sure the settings are correct.

## MPPT Charging Introduction



Standing for "Maximum Power Point Tracking", MPPT is an advanced charging method. The MPPT controller can keep monitoring the solar panel's generating power and tracking the highest voltage and current values (V), enabling the system to charge the battery in optimum efficiency. Compared with conventional PWM controllers, the MPPT controller can make the most of the solar panel's max. power and

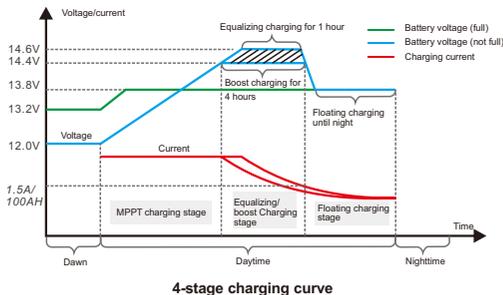
therefore provide larger charging current. Generally speaking the latter can raise the energy utilization ratio by 15% to 20% in contrast with the former.

As the solar panel's peak voltage (Vpp) is approximately 17V while the battery's voltage is around 12V, when charging with a conventional charge controller, the solar panel's voltage will stay at around 12V, failing to deliver the maximum power. However, the MPPT controller can overcome the problem by adjusting the solar panel's input voltage and current in real time, realizing a maximum input power.

Meanwhile, due to changing ambient temperature and illumination conditions, the max. power point varies frequently, and the MPPT controller adjusts parameter settings according to the environmental conditions in real time, so as to always keep the system close to the max. operating point.

As one of the charging stages, MPPT can not be used alone, but has to be used together with boost charging, floating charging, equalizing charging, etc. to complete charging the battery. When the controller starts operation, it first conducts an assessment of the battery voltage. If the battery voltage is higher than 13.2 V ( $\times 2/24$  V), the controller will decide that the battery is in full capacity, then skips equalizing charging and boost charging and directly performs floating charging instead. If the battery voltage is lower than 13.2 V ( $\times 2/24$  V), the charging process is going as follows:

MPPT (equalizing charging for 1 hour), boost charging for 4hours, and then floating charging. Equalizing charging interval is 30 days.

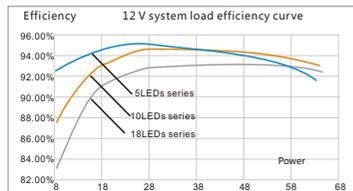


## System Status Log

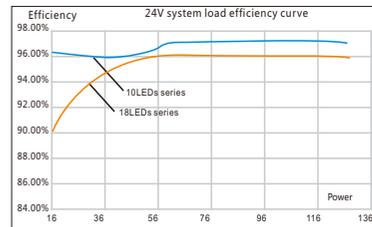
The DM120/160-U controller can record the operating status of the whole system, including operating days, over-dischargings, full-chargings, etc. And besides, it can also keep a record of battery voltage changes in a week, enabling the user to have a clear understanding of the system and conduct better analysis on it. The user needs to use the remote control (CU-ALL) to read the system's operating status, and when the reading is successfully done, the parameters will be recorded in the remote control.

## Typical Constant-Current Source Efficiency Curve

### 1. 12V system

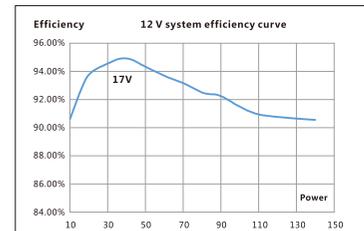


### 2. 24V system

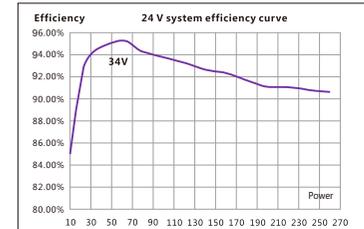


## Charging conversion efficiency curve

### 1. 12V system



### 2. 24V system



## Frequently Met Abnormalities and Solutions

Symptoms	Causes and solutions
No output after reconnecting the open-circuit load.	Check whether connection is correct and reliable. A maximum of 10 s is needed for the load to get started again when reconnection is rightly done.
No output after solving a short-circuit load problem.	The load will restart following a time delay of 1 s after a short-circuit event.
The battery indicator is flashing quickly and no output.	The battery is over-discharged, and will recover automatically when getting recharged to the over-discharge recovery point.
While sunlight is present, the solar panel indicator doesn't light up.	Check whether the solar panel is correctly connected and whether it's blocked.
The load current doesn't reach the set value.	Check whether the current value exceeds the max. current allowed by the controller.

Note: for detailed parameter and status information, refer to the CU-ALL Instruction Manual.

## Parameter Settings

Parameter	Value				Adjustable or not	Default
Model	DM120	DM120-U	DM160	DM160-U		
No-load loss	26mA/12V; 15mA/24V	40mA/12V; 21mA/24V	28mA/12V; 17mA/24V	42mA/12V; 23mA/24V		
System voltage	12V/24V					
Charging current	10A		15A			
Max. solar panel power	130W/12V;260W/24V		200W/12V;400W/24V			
Solar panel input voltage	< 60V					
MPPT tracking efficiency	> 99%					
Charging conversion efficiency	90% ~ 96%					
Lead conversion efficiency	90% ~ 96%					
Output current	70mA ~ 4200mA		70mA ~ 5600mA		✓	900mA
Load current accuracy	±3% (load current > 300 mA)					
Max. load power	60W/12V;120W/24V		80W/12V;160W/24V			
Load output voltage	< 60V					
Over-voltage protection	17.0V ; $\times 2/24V$					
Charging voltage limit	15.5V ; $\times 2/24V$					
Equalizing charging voltage	(Boost charging voltage+0.2V; $\times 2/24$ V (25 °C)				✓	14.6V
Equalizing charging time	1 hour					
Equalizing charging interval	30 days					
Boost charging voltage	7.5V ~ 15.5V ; $\times 2/24V(25^{\circ}C)$				✓	14.4V
Boost charging time	4 hours					
Floating charging voltage	7.5V ~ 15.5V ; $\times 2/24V(25^{\circ}C)$				✓	13.8V
Temperature compensation factor	-3.0mV/°C/2V					
Over-voltage protection (prohibited below 0 °C)	(over charge voltage+2V) ; $\times 2/24V(25^{\circ}C)$				✓	16.6V
Whether charging is prohibited below 0 °C	Yes, No				✓	No
Overcharge voltage	7.5V ~ 15.5V ; $\times 2/24V(25^{\circ}C)$				✓	14.6V
Overcharge recovery voltage	7.5V ~ 15.5V ; $\times 2/24V(25^{\circ}C)$				✓	13.6V
Over-discharge voltage	7.5V ~ 15.5V ; $\times 2/24V(25^{\circ}C)$				✓	11.0V
Over-discharge recovery voltage	7.5V ~ 15.5V ; $\times 2/24V(25^{\circ}C)$				✓	12.6V
Light control voltage	5V ~ 15V ; $\times 2/24V$				✓	10V
Light control delay	1 ~ 50min				✓	1min
Operating temperature	-35°C ~ +65°C					
Protection degree	IP68					
Weight(g)	380		480			
Dimensions (mm)	114x88.3x24.5		142x88.3x24.5			

Note: parameter settings shall comply with the following rule, i.e. Boost charging voltage > floating charging voltage > over-discharge recovery voltage > over-discharge voltage.