MPPT Solar Charge Controller

MT2410N10

User Manual

Model	MT2410N10	
Battery voltage	12V	24V
Power of maximal battery panel	130W	260W
Maximal open-circuit voltage of battery panel	100V	
Maximal charge current	10A	
Maximal discharge current	10A	

Dear users:

Thank you for selecting our products. Before using the product, please carefully read the instruction manual!

Version: V1.02 Subject to change without notice

I. Product Characteristics

- Support 100V maximal open-circuit voltage of photovoltaic panel.
- Supporting 12V/24V automatic identification of lead-acid battery.
- Supporting lithium battery application.
- Double-peak or multi-peak MPPT technology, suitable for partial shading or partial damage of photovoltaic batteries.
- Significantly improving the energy utilization rate of photovoltaic batteries, which is higher than that of the traditional PWM charge by 15% ~ 20%.
- MPPT can trace the best working point of I-V curve accurately within 1 second with as much as 99.9% tracing efficiency.
- With advanced digital power technology, the circuit energy conversion efficiency is up to 98%.
- Four-stage charge mode: MPPT - equalizing charge - boost charge - float charge.
- Limited current charge mode: in case of excessive power of photovoltaic battery, the controller automatically reduces the power to the rated value.
- With fault code indication, it is convenient for users to determine the system fault.
- It can be equipped with RM-5 LCD screen so as to view the operation data and state of the equipment and change the controller parameters.
- With multiple load control modes, it can automatically identify day/night and enhance the flexibility of load system.
- Possessing overcharge, overdischarge, overload, short circuit, reverse connection, over temperature, TVS and anti-reverse charge protection.

II. Notice for Use

1.⚠ The voltage of photovoltaic battery may exceed the safety voltage of human body. It is required to use insulating tools and keep both hands dry during operation.

2.⚠ Please connect wires carefully and correctly without incorrect, reverse or short-circuit connection. Although the controller has some reverse connection and short-circuit protection functions, the controller cannot reply various combinations of incorrect, reverse connection and short-circuit connection, which may damage the controller, wires, electrical equipment or battery!

3.⚠ Please do not connect the photovoltaic battery to the battery port and load port of the controller. Otherwise, the high voltage will damage the controller!

4.⚠ Please connect the battery at first, and then other devices after the controller indicates normally. If the battery is connected reversely, the load port will be a negative value of battery voltage, which may damage the load!

5.The controller will generate heat during operation. Therefore, it shall be installed in the ventilated and heat-removing environment.

6.Select cable with sufficient capacity for connection, so as to avoid excessive loss on the line and incorrect judgment of the controller.

7.It is very important to keep the battery fully charged at least monthly. Otherwise, the battery will be damaged permanently. Only when the energy entering the battery is more than the energy used by the load can the battery be fully charged. Users should keep it in mind when configuring the system.

8.Please do not immerse the controller in corrosive liquid, which will damage the controller and generate harmful gas.

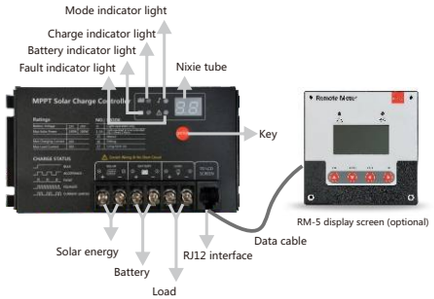
9.There is a large amount of energy stored in the battery. In any case, don't make the battery short-circuited. It is recommended to connect the fuse in series on the battery.

10.Batteries may produce combustible gas, please keep them away from sparks.

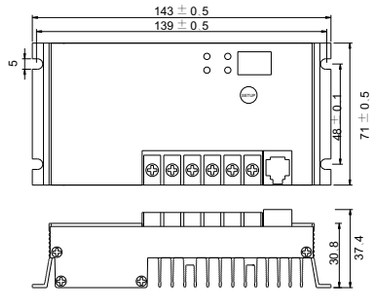
11.Please keep children away from batteries, controllers and photovoltaic batteries.

12.Please observe the safety recommendations of the battery manufacturers.

III. Controller Panel



IV. Controller Dimension



MT2410N10's dimension：

Boundary dimension：143×71×37.4(mm)

Installation dimension：139×48(mm)

V. Installation and Use

1.Controller fixing: first fix the controller on the surface to be installed, and maintain a certain gap between the controller and the installation surface to ensure the heat dissipation needs. It should be installed in the ventilated environment.
2.Preparation of wire: use cables with current density not higher than 4A/mm² and plan the length. Peel 8mm insulated layer from the terminal connected with the controller to reduce the length of the connecting wire as far as possible. It is recommended that the battery cable be shorter than 3m to reduce the power loss.
3.Connection of battery: connect the controller and battery and pay attention to correct connection of poles + and -. The indicator light will be on in case of correct connection. Otherwise, it is required to inspect whether the connection is correct. The reversely connected controller shall not damage the controller if it doesn't work.
4.Connection of the solar panel: Note that + and - poles shall be correctly connected. In case of sufficient sunlight, the controller will display the charge mode. Otherwise, check the connection. The battery panel shall generate voltage immediately if it is exposed to the sunlight. If battery panel with 36V or greater voltage is used, the voltage generated by the battery panel can exceed the safety voltage of human body. Please prevent electric shock in use.
5.Connection of the load: connect the load connecting line to the load of the controller with the current not exceeding the rated current of the controller. Connect + and - poles correctly so as to protect the device against damage.
6.Connection of display (optional): connect the display via RJ12 interface, model: RM-5 (Do not connect other devices at will).
7.Grounding description: common negative pole design. If grounding is required, please ground the negative pole of any group of terminals.

VI. Instruction of Work State

1.Charge indication: when the output voltage of the solar panel reaches a certain value, the charge indicator light starts working. Different flashing states represent different charge stages. See table A for specific meanings.
2.Battery indication: when the battery is normal, the battery indicator light is constantly on; in case of overdischarge of the battery, the indicator light flashes slowly; in case of overvoltage of battery, the indicator light flashes quickly. (see table B)
3.Mode indicator light: when the mode indicator light is on, it means that the value displayed by the nixie tubes at the moment is the mode of the controller. If there is no key operation for 5s, the nixie tube will be off automatically.
4.Fault indicator light: when the fault indicator light is on, it means that the value displayed by the nixie tube at the moment is the fault code of controller. If there is no key operation for 5s, it will go out automatically. The indicator light will flash in case of any fault.

Table A Charge State Indication:

No.	Diagram	LED State	Charge State
①	BULK	Constant on	Charge at maximal power
②	ACCEPTANCE	Slow flashing (on for 1s, off for 1s, 2s cycle)	Boost charge
③	FLOAT	Single flashing (on for 0.1s, off for 1.9s, 2s cycle)	Float charge
④	EQUALIZE	Quick flash (on for 0.1s, off for 0.1s, 0.2s cycle)	Equalizing charge
⑤	CURRENT-LIMITED	Double flash (on for 0.1s, off for 0.1s, on again for 0.1s, off again for 1.7s, 2s cycle)	Current-limiting charge

Table B Battery Indication:

No.	LED State	Battery State
①	Constant on	Normal battery voltage
②	Slow flash (on for 1s, off for 1s, 2s cycle)	Overdischarge of battery
③	Quick flash (on for 0.1s, off for 0.1s, 0.2s cycle)	Overvoltage of battery

VII. Work Mode of Load

1. Pure optical control (0):
When there is no sunlight, the light intensity drops to the starting point. The controller confirms the starting signal after 5-minute delay, and then turns on the load for working; after dawn on the next day, the light intensity rises to the breaking point, and the controller turns off the load.
2. Optical control + time control (1~14):
When there is no sunlight, the light intensity drops to the starting point, the controller confirms the starting signal after 5-minute delay, and then turns on the load for working. The load is turned off after working time is out. See table D for specific setting time.
3. Manual mode (15) (Default):
In this mode, the user can control the breaking and making of the load by pressing the key, no matter in the daytime or at night. This mode is used in some special load situations or debugging.
4. Debugging mode (16):
It is used for system debugging. The load is broken in case of any light signal and made in case of no light signal to facilitate check of the correctness of system installation during installation and debugging.
5. Constant on mode (17):
After power on, load maintains output state all the time. The mode is suitable for the load requiring 24-hour power supply.

VIII. Operation Instruction

1. Load mode and fault code browsing
During normal operation, the nixie tube will be off; when the key is pressed, the nixie tube will be on, and the mode indicator light or fault indicator light will be on. If the mode indicator light is on, the value displayed by the nixie tube is the load working mode of controller; if the fault indicator is on, the value displayed by the nixie tube is the fault code. See table C for controller fault codes.
2. Load mode setting
Through the mode and fault code browsing operation, when the mode indicator light is on, press and hold the key for 3s, and the nixie tube will flash at this moment. Release the key and then press the key briefly. Each time you press the key, the nixie tube will change a number. After selection, press and hold the key for 3s or when there is no operation for 8s, the setting is completed when the nixie tube doesn't flash any more. See table D for controller load mode.
3. Battery type setting
Through the mode and fault code browsing operation, when the mode indicator light is on, press and hold the key for 8s (the current load mode starts to flash at the moment of 3s), the nixie tube flashes (the nixie tube displays current battery type), and release the key. Press the key again briefly, each time you press the key, the nixie tube will change a battery type. After selection, press and hold the key for 3s or when there is no operation for 8s, the setting is completed when the nixie tube doesn't flash any more. See table E for controller battery mode.
After the battery type is changed, current charge may be broken. The charge is started again just a moment.
After changing the battery type, it is required to power on the controller again. Otherwise, it shall operate based on previous battery type.

Table C Fault Code

Display of Nixie Tube	Significance of Fault Code	Control Strategy
E0	No fault	
E1	Overdischarge of battery	No discharge
E2	Overvoltage of battery	No charge or discharge
E3	Undervoltage warning of battery	The battery indicator light indicates that the battery can be charged and discharged normally.
E4	Short circuit of load	Turn off the load immediately
E5	Overload	Break the load after delay in accordance with multiples of rated current
E6	Overheated device	Derating charge according to overtemperature strategy
E8	Excessive input power of solar panel	Limitary-current charge
E0.	Overvoltage of solar panel	No charge
E5.	Battery not connected or lithium battery in feed protection	
E8.	BMS overcharge protection	No charge

Note: If the key is pressed for 5s, the nixie tube may be turned off. However, if there is fault, the fault indicator light shall flash all the time until the fault is cleared.

Table D Work Mode of Load

Nixie Tube	Description of Mode
0	Pure optical control, the load is turned on and off through optical control.
1	The load is turned on and then turned off through optical control after 1-hour delay.
2	The load is turned on and then turned off through optical control after 2-hour delay.
3	The load is turned on and then turned off through optical control after 3-hour delay.
4	The load is turned on and then turned off through optical control after 4-hour delay.
5	The load is turned on and then turned off through optical control after 5-hour delay.
6	The load is turned on and then turned off through optical control after 6-hour delay.
7	The load is turned on and then turned off through optical control after 7-hour delay.
8	The load is turned on and then turned off through optical control after 8-hour delay.
9	The load is turned on and then turned off through optical control after 9-hour delay.
10	The load is turned on and then turned off through optical control after 10-hour delay.
11	The load is turned on and then turned off through optical control after 11-hour delay.
12	The load is turned on and then turned off through optical control after 12-hour delay.
13	The load is turned on and then turned off through optical control after 13-hour delay.
14	The load is turned on and then turned off through optical control after 14-hour delay.
15	Manual mode (by default)
16	Debugging mode
17	Constant on mode

Table E Comparison of Battery Type

Nixie Tube	Type of battery	Remark
b.1	Sealed lead acid battery (SLD)	Factory default
b.2	Gel lead acid battery (GEL)	
b.3	Vented lead acid battery (FLD)	
b.4	Three strings of ternary lithium batteries(11.1V)	
b.5	Four strings of ternary lithium batteries(14.8V)	
b.6	Seven strings of ternary lithium batteries(25.9V)	
b.7	Four strings of lithium iron phosphate battery(12.8V)	
b.8	Eight strings of lithium iron phosphate battery(25.6V)	
b.9	Six strings of ternary lithium batteries(22.2V)	
b.0	User-defined (USER)	

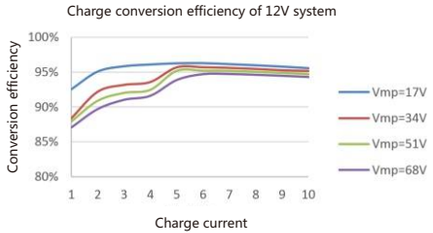
IX. Detailed Parameter

Name of Parameter	Value of Parameter					
Type of battery	Sealed lead acid battery	Gel lead acid battery	Vented lead acid battery	Ternary lithium battery	Lithium iron phosphate battery	User -defined
System voltage	12V/24V AUTO			3/4 string: 12V system 6/7 string: 24V system	4 strings: 12V system 8 strings: 24V system	12V/24V AUTO
Overvoltage protection voltage (V)	16.0*n	16.0*n	16.0*n	4.2*N+2.0*n	3.6*N+2.0*n	9~17
Overvoltage restoration voltage (V)	15.0*n	15.0*n	15.0*n	4.2*N+1.0*n	3.6*N+1.0*n	/
Charging limit voltage (V)	15.5*n	15.5*n	15.5*n	4.2*N	3.6*N	9~17
Equalizing charge voltage (V)	14.6*n	-	14.8*n	-	-	9~17
Boost charge voltage (V)	14.4*n	14.2*n	14.6*n	4.2*N	3.6*N	9~17
Float charge voltage (V)	13.8*n	13.8*n	13.8*n	-	-	9~17
Boost return voltage (V)	13.2*n	13.2*n	13.2*n	3.9*N	3.3*N	9~17
Overdischarge return voltage (V)	12.6*n	12.6*n	12.6*n	3.3*N	3.0*N	9~17
Undervoltage alarm restoration voltage (V)	12.2*n	12.2*n	12.2*n	(3.2*N+0.2)*n	(2.7*N+0.2)*n	/
Undervoltage alarm voltage (V)	12.0*n	12.0*n	12.0*n	3.2*N	2.7*N	9~17
Overdischarge protection voltage (V)	11.1*n	11.1*n	11.1*n	3.0*N	2.5*N	9~17
Discharge cut-off voltage (V)	10.6*n	10.6*n	10.6*n	2.8*N	2.3*N	9~17
Operating voltage range of battery	8V~32V					
Charge mode	Trace MPPT at maximal power					
Maximum PV open-circuit voltage	100V (95V protection, stop charging. Restore in case of less than 90V)					
Voltage range of MPPT working point	(Vbat+2)~72V					
MPPT tracking efficiency	> 99%					
Charge conversion efficiency	85%~98% (10%~100% of rated power)					
Rated charge current	10A					
Maximum solar panel power	130W/12V ; 260W/24V					
No-load loss	≤10mA					
Rated load current	10A (breaking type)					
Overload protection	1.25 times of 10s protection; 1.5 times of 5s protection; double 1s protection					
Load working mode	Pure optical control, light and time control, manual mode (default), debugging mode, constant on mode					
Optical control vol	Optical control on 5V; optical control off 6V; *2/24V					
Optical control delay	Optical control on: 5min; Optical control off: 1min					
Equalizing charge interval	30 days					
Equalizing charge duration	120min					
Boost charge time	120min					
Internal overtemperature protection	When the internal temperature of the controller is higher than 60 ℃, the controller will run with power declining linearly until the charge stops; when the temperature is reduced, the charge can be restored.					
Working temperature	-35℃ ~ +65℃ ;					
Protection level	IP64					
Weight	430g					
Altitude	≤3000m					
Product dimension	143×71×37.4(mm)					
Installation size	139×48 (mm)					
Grounding mode	Common negative design, negative grounding.					
Protection function	PV overvoltage protection, PV reverse connection protection, reverse charge protection at night, input overpower protection, charge PV short circuit protection, internal overtemperature protection of controller, load short circuit protection, overload protection, battery overvoltage protection, battery overdischarge protection, battery reverse connection protection, TVS lightning protection.					

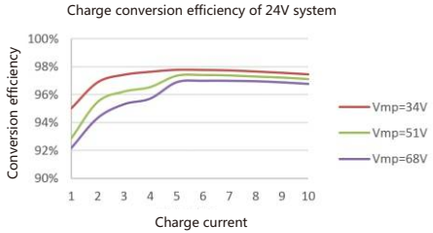
Note:
1. In case of inverse connection of PV or battery, the sum of PV voltage and battery voltage shall not exceed 100V. Otherwise, the controller will be damaged;
2. At the lithium battery mode, in case of voltage output from the battery terminal, the controller may be damaged in case of inverse connection of battery;
3. In case of 25℃/12V parameter for above lead-add batteries, n=1/2 respectively indicates 12/24 system. N indicates number of battery strings in the lithium battery parameter.

X. Typical efficiency chart

1. Energy conversion efficiency of controller (condition: 12V battery, voltage of battery panel 17V, 34V, 51V and 68V)

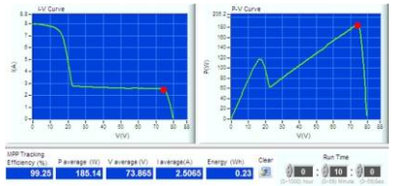


1. Energy conversion efficiency of controller
(condition: 24V battery, voltage of battery panel 34V, 51V and 68V)

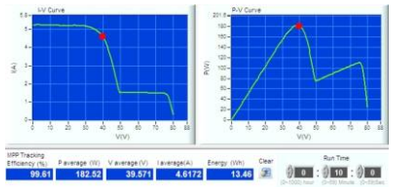


XI. MPPT Tracking Efficiency Test of Photovoltaic Module in case of any Shade

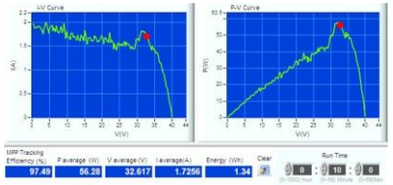
1.99.25% tracking efficiency in case of any shade in middle part.



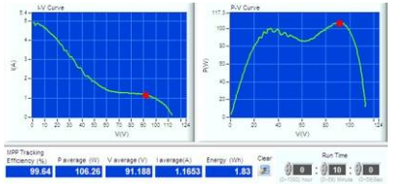
2.99.61% tracking efficiency in case of any shade in corners.



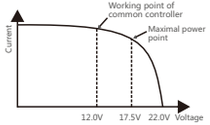
3. 97.49% tracking efficiency in case of any tree shade.



4. 99.64% tracking efficiency in case of large area of shade.



XII. Introduction to MPPT Charge

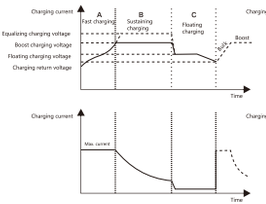


(Take 12V battery system as an example)
MPPT referring to Maximum Power Point Tracking, is an advanced charge mode. MPPT controller can detect the power generation power of the solar panel instantly, and also the maximum voltage and current value (VI), so that the system can charge the battery at maximal efficiency. Compared with the traditional PWM controller, MPPT controller can exert maximal power of battery panel, so as to supply greater charge current. Generally speaking, MPPT controller can improve the energy utilization rate by 15%～20% compared with PWM controller.

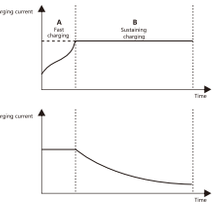
Because the peak voltage (VPP) of the solar panel is about 17V, but the battery voltage is about 12V, when the charge controller is charging, the voltage of the solar panel is about 12V, and the maximum power is not fully exerted. The MPPT controller can overcome this problem and adjust the input voltage and current of the battery panel from time to time, and achieve maximal input power value.

At the same time, due to different ambient temperatures and light conditions, the maximum power point often changes. The MPPT controller adjusts parameters constantly according to different conditions so that the system shall be close to the maximum working point at all times.

As a charge stage, MPPT can not be used alone. Usually, it needs to be combined with boost charge, float charge, equalizing charge and other charge methods to jointly complete battery charge. A complete charge process includes fast charge, maintenance charge and float charge. The charging curve is as follows:



SLD Battery charging stages diagram



LI Battery charging stages diagram

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