MPPT Solar Controller

Characteristics

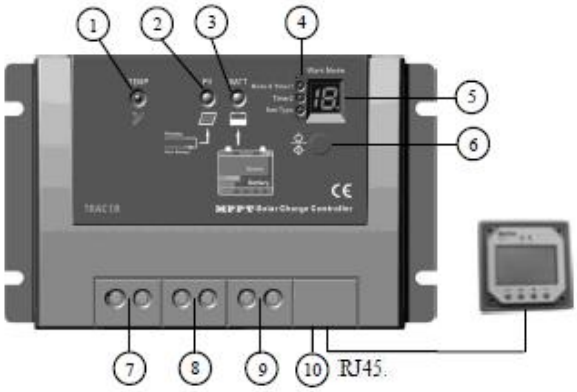
- MPPT series controller is suitable for the street light system. The controller features a smart tracking algorithm inside that maximizes the energy from the solar PV module(s) and charge the battery. At the same time, the low voltage disconnect function (LVD) will prevent the battery from over discharging.
- The controller charging process has been optimized for long battery life and improved system performance. The comprehensive self-diagnostics and electronic protection functions can prevent damage from installation mistakes or system faults.
- Peak conversion efficiency of 97 %, high Tracking efficiency of 99%.
- Very fast sweeping of the entire I-V curve, several seconds tracking speed.
- Widely used, automatic recognize day/night.
- Timer function with 1-15 hours option for street light.
- Unique dual timer function, enhance the flexibility of street light system.
- Sealed, Gel and Flooded battery option.
- Adopting temperature compensation and correcting the charging and discharging parameters automatically, improving the battery lifetime.
- Electronic protection: over charging, over discharging, overload, short circuit.
- Reverse protection: any combination of solar module and battery, without causing damage to any component.
- RJ45 interface with remote meter MT-5, convenient to check operating parameters of controllers. (MT-5 is optional)

CE

1. Technical Specifications

Model	10 A	20 A	30 A	45 A
Rated Battery Current	10 A	20 A	30 A	45 A
Nominal System Voltage	12V / 24V Auto Work			
Max. Solar Input Voltage	100 V		150 V	
Maximum Battery Voltage	32 V			
Low voltage disconnect	11,1V / 22,2V			
Under voltage warning	12,0V / 24,0V			
Under voltage recover	12,2V / 24,4V			
Low voltage reconnect	12,6V / 25,2 V			
Boost return voltage	13,2V / 26,4 V			
Float voltage	13,8V / 27,6V			
Boost voltage	14,2V / 28,4V			
Over Voltage Reconnect	15,0V / 30,0 V			
Charging limit voltage	15,5V / 31,0 V			
High Volt Disconnect	16,0V / 32,0 V			
Self-consumption	≤ 30 mA			
Discharge Circuit Voltage Drop	≤ 170 mV			
Charging Mode	Modo MPPT			
Temperature Compensation Coefficient	-30mV/°C/12V（25°C）			
NTTV (Night Time Threshold Voltage)	5V / 10V			
DTTV (Day Time Threshold Voltage)	6V / 12V			
Terminal	≤ 4 mm²	≤ 10 mm²	≤ 25 mm²	≤ 25 mm²
Ambient temperature range	-35ºC ~ +55ºC			
Humidity range	10%-90%(NC)			
Communication	TTL232 / 8 pin RJ45			
Dimension (mm)	156x97x68	169x118x83	242x169x91	242x169x91
Mounting holes (mm)	147x60	160x80	180x160	180x160
Weight (g)	550	950	2000	2050
Price	-			

1. Technical Specifications



1 – Temperature Sensor Measure ambient temperature and make temperature compensation for charging and discharging.

2 – Charging Status LED Indicator An LED indicator that shows charging status and overvoltage of battery.

3 – Battery Status LED Indicator An LED indicator that shows battery status or system errors.

4 – Setting Indicator Corresponding indicator will be on when set timer1, timer2 and battery type.

5 – LED Digital Display Display the load work mode and status.

6 – Setting Button (in manual mode used for load ON/OFF) Set load work mode and select battery type.

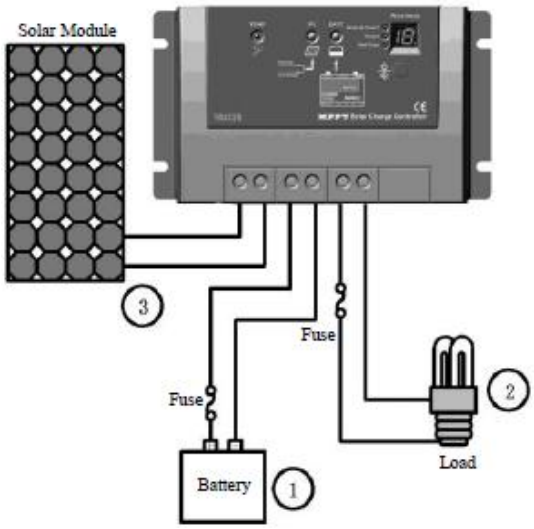
7 – Solar Module Terminals Connect solar modules.

8 – Battery Terminals Connect batteries.

9 – Load Terminals Connect loads.

10 – RJ45 Communication Interface Communicate with remote meter MT-5.

2. Installation Instructions



- Read through the entire installation section first before beginning installation.
- Be very careful when working with batteries. Wear eye protection. Have fresh water available to wash and clean any contact with battery acid.
- Uses insulated tools and avoid placing metal objects near the batteries.
- Explosive battery gasses may be present during charging. Be certain there is sufficient ventilation to release the gasses.
- Avoid direct sunlight and do not install in locations where water can enter the controller.
- Loose power connections and/or corroded wires may result in resistive connections that melt wire insulation, burn surrounding materials, or even cause fire. Ensure tight connections and use cable clamps to secure cables and prevent them from swaying in mobile applications.
- Use with Gel, Sealed or Flooded batteries only.
- Battery connection may be wired to one battery or a bank of batteries. The following instructions refer to a singular battery, but it is implied that the battery connection can be made to either one battery or a group of batteries in a battery bank. Select the system cables according to 3A/mm2 current density.

2.1. MOUNTING

- Step 1: Choose Mounting Location
  Locate The Controller on a vertical surface protected from direct sun, high temperature, and water.

- Step 2: Check for Clearance
  Place The Controller in the location where it will be mounted. Verify that there is sufficient room to run wires and that there is sufficient room above and below the controller for air flow.

- Step 3: Mark Holes
  Use a pencil or pen to mark the four (4) mounting hole locations on the mounting surface.

- Step 4: Drill Holes
  Remove the controller and drill four sizeable holes in the marked locations.

- Step 5: Secure Controller
  Place the controller on the surface and align the mounting holes with the drilled holes in step 4. Secure the controller in place using the mounting screws.

2. Installation Instructions

2.2. WIRING

NOTE: A recommended connection order has been provided for maximum safety during installation. The Controller is a negative ground controller. Any negative connection of solar module, battery or load can be earth grounded as required. Grounding is recommended.

CAUTION: Don't connect the loads with surge power exceeding the ratings of the controller. For mobile applications, be sure to secure all wiring. Use cable clamps to prevent cables from swaying when the vehicle is in motion. Unsecured cables create loose and resistive connections which may lead to excessive heating and/or fire.

Step 1: Battery Wiring

- WARNING: Risk of explosion or fire! Never short circuit battery positive (+) and negative (-) or cables
- Before connecting the battery, measure the battery voltage. It must be over 9V to power the controller. For 24V, the voltage must be greater than 18V to properly detect a 24V battery. The 12/24V battery detection is automatic and the check is only performed at start-up.
- Wire an in-line fuse holder no more than 150mm from the battery positive terminal. Do not insert a fuse at this time. Confirm the connection correct and then turn on the power.

Step 2: Load Wiring

- The Controller load output can connect DC electronic devices of which rated voltage is same as battery's. Controller will provide battery voltage to the loads. See Section 4.4 Setting Operation for more details about the load control.
- Connect load positive (+) and negative (-) to the Controller load output as shown in figure 3-3. The load terminals may exist voltage, connect carefully to avoid short circuit. An in-line fuse holder should be wired in series in the load positive (+) or negative (-) wire as shown. Do not insert a fuse at this time. Confirm the connection correct and then turn on the power. If wiring the load connection to a load distribution panel, each load circuit should be fused separately. The total load draw should not exceed the 10A load rating.

Step 3 ： Solar Module Wiring

- WARNING: Risk of electric shock! Exercise caution when handling solar wiring. The solar module(s) high voltage output can cause severe shock or injury. Cover the solar module(s) from the sun before installing solar wiring.
- The Controller can accept 12V, 24V nominal off-grid solar module arrays. Grid –tie solar module(s) may be used if the open circuit voltage does not exceed the maximum solar input rating. The solar module(s) nominal voltage must be equal to or greater than the nominal battery voltage.

Step 4: Accessories (option)

- Install Remote Meter (purchased separately) if required. Refer to the instructions provided for detailed installation procedures.

Step 5: Confirm Wiring

- Double-check the wiring in step1 through 4. Confirm correct polarity at each connection. Verify that all six power terminals are tightened.

Step 6: Confirm Power-up

- When battery power is applied and The Controller powers up, the battery led indicator will be green. If Controller does not power up or battery status LEDs error exists, refer to Section 5 Troubleshooting

3. Operation

3.1. MPPT Technology

3.1.1. MPPT

The Controller utilizes Maximum Power Point Tracking technology to extract maximum power from the solar module (s). The tracking algorithm is fully automatic and does not require user adjustment, Controller technology will track the array maximum power point voltage (Vmp) as it varies with weather conditions, ensuring that maximum power is harvested from the array through the course of the day.

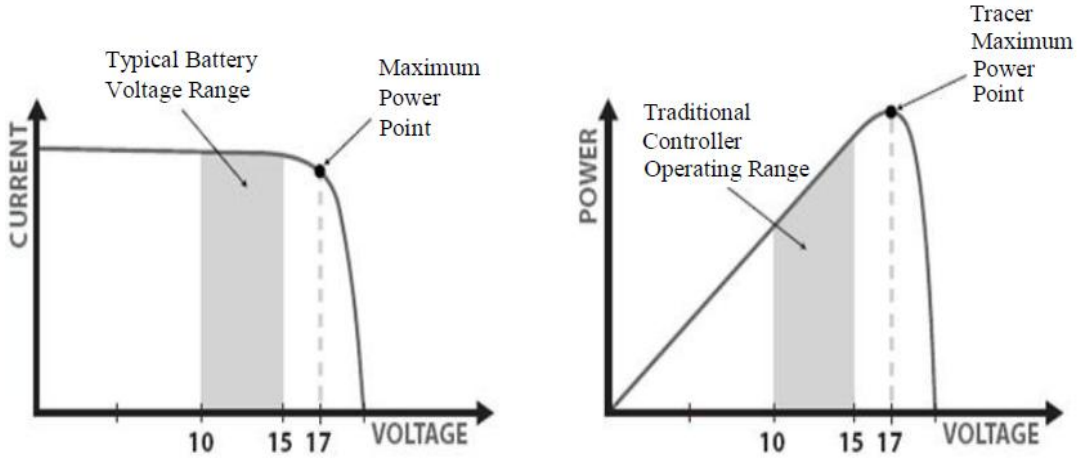
Current Boost
In many cases, Controller MPPT technology will —boost the solar charge current. For example, a system may have 8 Amps of solar current flowing into The Controller and 10 Amps of charge current flowing out to the battery. The Controller does not create current! Rest assured that the power into The Controller is the same as the power out of the Tracer. Since power is the product of voltage and current (Volts × Amps), the following is true*:

(1) Power Into The Controller=Power Out of the Tracer

(2) Volts In × Amps In=Volts Out × Amps Out

Assuming 100% efficiency. Actually, the losses in wiring and conversion exist.
If the solar module's Vmp is greater than the battery voltage, it follows that the battery current must be proportionally greater than the solar input current so that input and output power are balanced. The greater the difference between the maximum power voltage and battery voltage, the greater the current boost. Current boost can be substantial in systems where the solar array is of a higher nominal voltage than the battery.

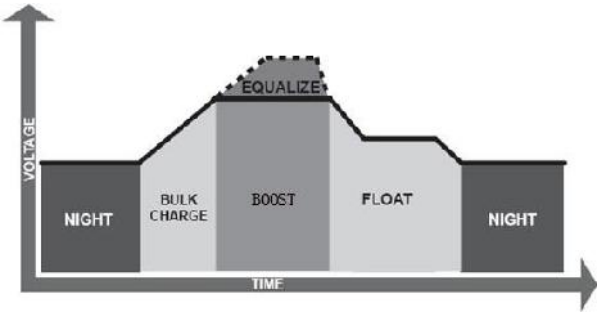
An Advantage Over Traditional Controllers
Traditional controllers connect the solar module directly to the battery when recharging. This requires that the solar module operate in a voltage range that is below the module's Vmp. In a 12V system for example, the battery voltage may range from 11-15Vdc but the module's Vmp is typically around 16 or 17V.



3. Operation

3.1.2 Battery Charging Information

The Controller has a 4-stage battery charging algorithm for rapid, efficient, and safe battery charging.



Bulk Charge
In this stage, the battery voltage has not yet reached boost voltage and 100% of available solar power is used to recharge the battery.

Boost Charge
When the battery has recharged to the Boost voltage set point, constant-voltage regulation is used to prevent heating and excessive battery gassing. The Boost stage remains 120 minutes and then goes to Float Charge. Every time when the controller is powered on, if it detects neither over discharged nor overvoltage, the charging will enter into boost charging stage.

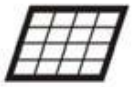
Float Charge
After the Boost voltage stage, Controller will reduce the battery voltage to Float voltage set point. When the battery is fully recharged, there will be no more chemical reactions and all the charge current transmits into heat and gas at this time. Then The Controller reduces the voltage to the floating stage, charging with a smaller voltage and current. It will reduce the temperature of battery and prevent the gassing, also charging the battery slightly at the same time. The purpose of Float stage is to offset the power consumption caused by self consumption and small loads in the whole system, while maintaining full battery storage capacity.
In Float stage, loads can continue to draw power from the battery. In the event that the system load(s) exceed the solar charge current, the controller will no longer be able to maintain the battery at the Float set point. Should the battery voltage remains below the boost reconnect charging voltage, the controller will exit Float stage and return to Bulk charging.

Equalize
WARNING: Risk of explosion! Equalizing flooded battery can produce explosive gases, so well ventilation of battery box is necessary.
NOTE: Equipment damage! Equalization may increase battery voltage to the level damaging to sensitive DC loads. Ensure that all load allowable input voltages are greater than the equalizing charging set point voltage.

Over-charging and excessive gas precipitation may damage the battery plates and activate material shedding on them. Too high an equalizing charge or for too long may cause damage. Please carefully review the specific requirements of the battery used in the system.
Certain types of batteries benefit from periodic equalizing charge, which can stir the electrolyte, balance battery voltage and complete chemical reaction. Equalizing charge increases the battery voltage, higher than the standard complement voltage, which gasifies the battery electrolyte. If it detects that the battery is being over discharged, the solar controller will automatically turn the battery to equalization charging stage, and the equalization charging will be 120mins. Equalizing charge and boost charge are not carried out constantly in a full charge process to avoid too much gas precipitation or overheating of battery.

3. Operation

3.2. LED Indications

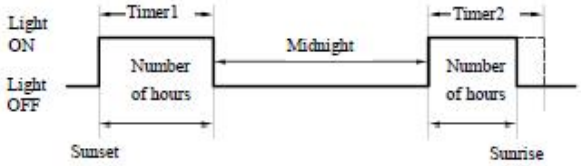


GREEN ON: charging
GREEN BLINK: Battery over-voltage
RED: LED digital tube displays ”P” => PV Overvoltage
RED: LED digital tube displays ”CP” => PV Overcurrent

GREEN ON when battery voltage in normal range
GREEN FLASHING when battery full
ORANGE ON when battery under voltage
RED ON when battery over discharged Please refer to Chapter 5 for troubleshooting.

Setting Operation

The default night length is 10 hours. The controller can learn the night length referring to the previous night so as to adapt to the different seasons. However, it will take some time to learn it.



Notes: when the “OFF” time set at timer 2 is later than local sunrise time, the controller will turn off the load output at the sunrise time, which shows light control first!.

3.2.1 Dusk to Dawn (Light ON + Light OFF)

When solar module voltage goes below the point of NTTV (Night Time Threshold Voltage) at sunset, the solar controller will recognize the starting voltage and turn on the load after 10 minutes delay; When solar module voltage goes above point of DTTV (Day Time Threshold Voltage), the solar controller will recognize the starting voltage and turn off the load after 10 minutes delay.

3.2.2. Light ON + Timer (1-15h on)

When solar module voltage goes below the point of NTTV (Night Time Threshold Voltage) at sunset; the solar controller will recognize the starting voltage and turn on the load after 10 minutes delay for several hours which users set on the timer. The timer setting operation is referred to as —Load Work Mode Settin

3.2.3. Test Mode

It is used to test the system and the same as Dusk to Dawn. But there is no 10 minutes delay when controller recognizes the starting voltage. When below the starting voltage, the controller will turn on the load, if higher, it will turn off load. The test mode makes it easy to check the system installation.

3.2.4. Manual Mode

This mode is to turn on/off the load by Setting Switch. Press the setting button once and setting indicators will be changed once among timer 1, timer2 and battery type. When timer 1 setting indicator is on, press the setting button for more than 5 seconds till the LED digital tube flashes. Then press the setting button till the desired number appears according to the following table. The setting is finished when the digital tube stop flashing. Timer 2 setting is the same as timer 1 when the setting indicator is on timer2.

3. Operation

LED Nº	TIMER 1
0	Dusk to Dawn, Load will be on all night
1	Load will be on for 1h after 10 min delay since sunset.
2	Load will be on for 2h after 10 min delay since sunset.
3	Load will be on for 3h after 10 min delay since sunset.
4	Load will be on for 4h after 10 min delay since sunset.
5	Load will be on for 5h after 10 min delay since sunset
6	Load will be on for 6h after 10 min delay since sunset
7	Load will be on for 7h after 10 min delay since sunset
8	Load will be on for 8h after 10 min delay since sunset
9	Load will be on for 9h after 10 min delay since sunset
0.	Load will be on for 10h after 10 min delay since sunset
1.	Load will be on for 11h after 10 min delay since sunset
2.	Load will be on for 12h after 10 min delay since sunset
3.	Load will be on for 13h after 10 min delay since sunset
4.	Load will be on for 14h after 10 min delay since sunset
5.	Load will be on for 15h after 10 min delay since sunset
6.	Test Mode
7.	ON/OFF Mode

LED Nº	TIMER 2
0	Sem atraso, a carga é ligada após anoitecer
1	Load will be on for 1 hour before sunrise
2	Load will be on for 2 hour before sunrise
3	Load will be on for 3 hour before sunrise
4	Load will be on for 4 hour before sunrise
5	Load will be on for 5 hour before sunrise
6	Load will be on for 6 hour before sunrise
7	Load will be on for 7 hour before sunrise
8	Load will be on for 8 hour before sunrise
9	Load will be on for 9 hour before sunrise
10	Load will be on for 10 hour before sunrise
11	Load will be on for 11 hour before sunrise
12	Load will be on for 12 hour before sunrise
13	Load will be on for 13 hour before sunrise
14	Load will be on for 14 hour before sunrise
15	Load will be on for 15 hour before sunrise

LED Nº	BATTERY TYPE
1	Seal lead acid battery
2	Flooded battery
3	Gel battery

4. TROUBLESHOOTING / MAINTENANCE

Indicador	Razões Possivéis	Troubleshooting
Charging LED indicator off during daytime when sunshine falls on PV modules properly.	PV array disconnection	Check that PV and battery wire connections are correct and tight.
Green charging LED indicator flashing	Battery voltage higher than over voltage disconnect voltage(OVD)	Check if battery voltage over high. Disconnect the solar module
Battery LED indicator are orange	Battery under voltage	Load output is normal,, charging LED indicator will return to green automatically when fully charged.
Battery LED indicator RED color	Battery over discharged	The controller cut off the output automatically, LED indicator will return to green automatically when fully charged.
LED digital tube displays —P	PV Overvoltage	Check whether the PV parameters match with the controller's; It will be reconnected automatically until the voltage falls safely below the maximum rating.
LED digital tube displays —C	PV Overcurrent	Check whether the PV parameters match with the controller's, please according to the controller parameters for photovoltaic parameters selection.
Battery Indicator red flashing	Over load or short circuit	Overload: Please reduce the load and press the button once, the controller will resume to work after 3s; Short circuit: when the first short-circuit occurs, the controller will automatically resume to work after 10s; when a second short-circuit occurs, press the button, the controller will resume to work after 3s.

Maintenance

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

- Check that the controller is securely mounted in a clean and dry environment.
- Check that the air flow and ventilation around the controller is not blocked. Clear all dirt or fragments on the heat sink.
- Check all the naked wires to make sure insulation is not damaged for serious solarization , frictional wear, dryness, insects or rats etc. Maintain or replace the wires if necessary.
- Tighten all the terminals. Inspect for loose, broken, or burnt wire connections.
- Check and confirm that LED digital tube is consistent with required. Pay attention to any troubleshooting or error indication .Take necessary corrective action. 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.
- Inspect for dirt, insects and corrosion, and clear up.
- Check and confirm that lightning arrester is in good condition. Replace a new one in time to avoid damaging of the controller and even other equipments.