



# User Manual

Solar Controller / Battery Charger



MODEL: RS-PWM20WP

## Congratulations

You have made an excellent choice by purchasing this high-quality RICH SOLAR PWM solar controller, which has been manufactured to the highest standards of performance, quality and safety.

We want you to be completely satisfied with your purchase, so this solar controller is backed by our own 2-year warranty.

If you require technical support regarding this product, please call **1-800-831-9889** or email **support@richsolar.com**.

Faulty product claims made within the 2-year time frame will be repaired or replaced free of charge provided you have satisfactory proof of purchase (keep your receipt).

# VERSION AND RATINGS

There are two standard versions of RICH SOLAR PWM controllers

## **12V 10A**

Rated for 12V solar panel (Max. 25V)

Rated maximum output current of 10Amp

## **12V 20A**

Rated for 12V solar panel (Max. 25V)

Rated for maximum output current of 20Amp

# WARNING

**RISK OF EXPLOSIVE GASES: WORKING IN VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. EXPLOSIVE GASES DEVELOP DURING NORMAL BATTERY OPERATION. BE CERTAIN THERE IS ENOUGH VENTILATION TO RELEASE THE GASSES.**

**IT IS IMPORTANT THAT EACH TIME BEFORE USING OR CONNECTING YOUR SOLAR CONTROLLER, YOU READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EXACTLY.**

- Make sure you connect the red to the positive on the battery and the black to the negative on battery.
- Please double check before you connect, connecting to wrong terminals may burn out the controller.
- Confirm that the power wires are tightened to the correct torque to avoid excessive heating from a loose connection.
- Refer to battery specification, be very careful not to short circuit to the battery connections.
- Accidental 'shorting' of the terminals or wiring can result in sparks causing personal injury or a fire hazard. We recommend that you cover up the panel(s) with some sort of soft cloth so you can block all incoming light during the installation. This will ensure that no damage is caused to the Solar Panel or Battery if the wires are accidentally short circuited.
- Always install a battery fuse on each circuit including the solar controller.

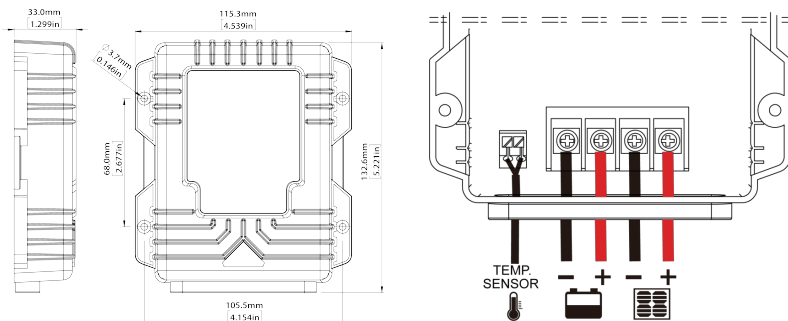
# FEATURES AND ADVANTAGES

- PWM technology, switching control by MOSFET
- Common Positive Grounding connection
- High efficiency and low power consumption
- Battery type setting and battery condition indication
- Smart charging control
- Charging time management
- LED indication for the battery condition and charging status
- Digital display charging parameters and battery settings
- Automatically active to Lithium battery against BMS protection
- Thermal protection
- Over voltage protection, Short circuit protection, Reverse polarity protection
- No sparks
- Waterproof
- Solid-duty cables
- Corrosion-resistant terminals and connectors.
- Conformal coating supplied to the inside board against moisture
- Includes a port for external battery temperature sensor (BTS - optional).
- Suitable for most of the rechargeable Lead acid battery, including Flooded (WET), AGM, GEL, Calcium battery and Lithium batteries.
- Designed according to CE standard, EMC, FCC compliance.

# INSTALLATION

The Solar Controller can be mounted as shown below.

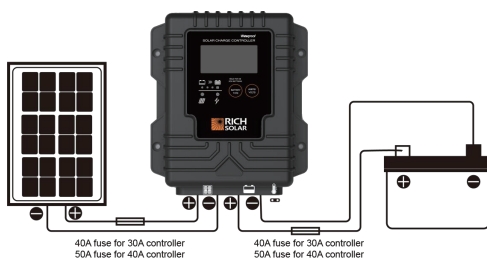
The quickest and easiest way to mount the unit is to use the four plastic spacers and self-tapping screws supplied and mount the unit to a flat surface.



# WIRING CONNECTIONS

The Solar Controller has 4 terminals which are clearly marked 'Solar' and 'Battery'. There is a (12V) and earth (GND) terminal for each circuit.

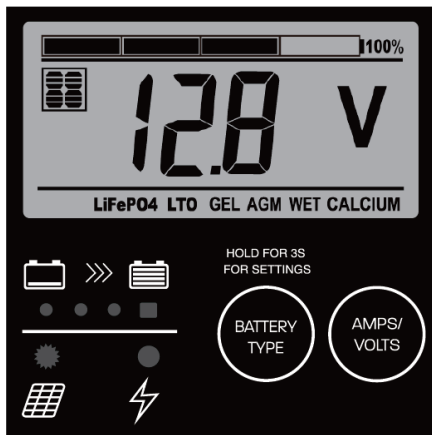
Refer to the wiring diagram as shown below, please cover the solar panel before connecting cables.



When the connections are completed, the Solar Controller will start working automatically.

## OPERATION - LCD DISPLAY

Please check your battery manufacturer's specifications to select correct battery type. The unit provides 7 battery types for selections: Lithium-ion, LiFePO<sub>4</sub>, LTO, Gel, AGM, WET (conventional lead acid), and Calcium battery.



Press **BATTERY TYPE button** and hold for 3 seconds to go into your battery type selection mode, the battery type you select will be shown on the LCD meter, the default setting is AGM Battery; the controller will automatically memorize your battery type setting.

LiFePO<sub>4</sub> battery shown in LCD indicates Lithium Iron Phosphate battery, LFP battery. LTO battery shown in LCD indicates Lithium Titanate Oxide, Li<sub>4</sub>Ti<sub>5</sub>O<sub>12</sub> battery.

**Caution: Prolonged connection with incorrect battery type setting may damage your battery.**

When the controller powers on, the unit will run self-qualify mode and automatically show below items on LCD before going into charging process

Self-test starts, digital meter segments test

Software version test

V

A

Rated voltage and current test

°C

External battery temperature sensor test (if connected)

After going into charging process, the LCD displays the charging statuses as below: Press **VOLT / AMP button** in sequence, the LCD will display in turn with Battery Voltage, Charging Current, Charged capacity (Amp-hour) and Battery Temperature (if external temperature sensor connected)

#### Display in the day-time -

A sequence of four digital displays: 8.8.8 V, 8.8.8 A, 8.8.8 AH, and 8.8.8 °C. Each display is connected to the next by a right-pointing arrow. Curved arrows at the beginning and end of the sequence indicate a continuous cycle.

#### Display during the night-

A sequence of two digital displays: 8.8.8 V and 8.8.8 °C. They are connected by a right-pointing arrow. Curved arrows at the beginning and end of the sequence indicate a continuous cycle.

#### Display when battery fully charged

Press **VOLT / AMP button** in sequence, the LCD will display in turn with Battery Voltage, Charging Current, if you do not press the button, the LCD will alternatively display the FUL and VOLT or FUL and AMP every 2 seconds

Two alternative sequences of LCD displays. The first sequence shows 8.8.8 V followed by 8.8.8 °C. The second sequence shows 8.8.8 A followed by 8.8.8 °C. The two sequences are separated by the word 'or'. Curved arrows at the beginning and end of each sequence indicate a continuous cycle.

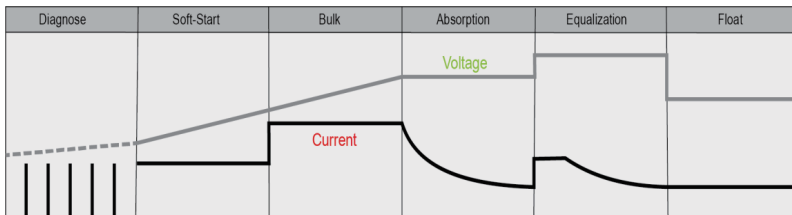
The **VOLT / AMP button** can be changed at any time during charging process.

The LCD also can be treated as an independent voltage meter or thermometer. A voltage less than 11.5V Volts indicates that the battery is discharged and needs re-charging.

# CHARGING STAGES

The unit has a 6-stage charging algorithm.

**Diagnose\* - Soft Charge - Bulk Charge - Absorption charge - Equalizing Charge\* - Float Mode**



## Diagnose \* -

Only for Lithium battery type, subjected to the Lithium battery initial voltage then determine if going to Soft start or Bulk charge; if the Lithium battery is protected by BMS, the controller will automatically send the signal periodically to the battery terminals to activate the BMS against protection.

## Soft start -

When batteries suffer an over-discharge, the controller will softly ramp the battery voltage up to 10V.

## Bulk Charge -

Maximum current charging until batteries rise to Absorption level.

## Absorption -

Constant voltage charging and battery is over 85% for lead acid battery, LiFePO<sub>4</sub> battery and LTO battery will close fully charging after absorption stage, the absorption voltage level will reach 14.4V for LiFePO<sub>4</sub> battery; 14.0V for LTO battery.



## Equalization \* -




Only for WET battery or Calcium battery type, when the battery is deeply drained below 10V or every 28 days cycle, it will automatically run this stage to bring the internal cells as an equal state and fully complement the loss of capacity. (LiFePO<sub>4</sub>, LTO, Gel and AGM battery do not run Equalization charge).

## Float Charge or Re-Bulk charge -

Battery is fully charged and maintained at a safe level.

A fully charged Lead acid battery (GEL, AGM, WET and Calcium battery) has a voltage of more than 13.8Volts; if the lead acid battery voltage drops to 12.8V at float mode, it will return to Bulk charge; LiFePO<sub>4</sub> and LTO battery have no float mode; if a LiFePO<sub>4</sub> battery voltage drops to 13.4V, or LTO battery voltage drops to 13.2V after Absorption stage, they will return to Bulk charge.

## LED INDICATION

LED indications							LCD Display	LCD Backlight
LED Color	RED	BLUE	RED	ORG	GREEN	GREEN		White
Soft start charging	ON	FLASH	FLASH	OFF	OFF	OFF	Normal Display	ON
Bulk charge (charged capacity <25%)	ON	ON	ON	OFF	OFF	OFF		
Bulk charge (charged capacity <50%)	ON	ON	OFF	ON	OFF	OFF		
Bulk charge (charged capacity <75%)	ON	ON	OFF	OFF	ON	OFF		

Absorption charging	ON	ON	OFF	OFF	ON	OFF	Normal Display	ON
Float charging	ON	OFF	OFF	ON	ON	ON		
Solar weak (at dawn or dusk)	FLASH	OFF	Subject to battery voltage					OFF
In the night	OFF	OFF						
Solar good, VB < 3V	ON	OFF	FLASH	OFF	OFF	OFF	b01	FLASH
Solar good, Battery reversed	ON	OFF	FLASH	OFF	OFF	OFF	b02	FLASH
Solar good, Battery over-voltage	ON	OFF	FLASH	FLASH	FLASH	OFF	b03	FLASH
Solar off, Battery over-voltage	OFF	OFF	FLASH	FLASH	FLASH	OFF	b03	FLASH
Solar good, Battery over 65°C	ON	OFF	Subject to battery voltage				b04	FLASH
Battery good, Solar reverse	FLASH	OFF					P01	FLASH
Battery good, Solar over-voltage	FLASH	OFF					P02	FLASH
Over Temperature Protection							OTP	FLASH

# SPECIFICATIONS

## Electrical Parameters

Rated solar panel amps	Max. 10/20A
Normal input solar cell array voltage	15-22 VDC
Max. solar cell array voltage (output has no load)	Max. 25 VDC
The controller lowest operating voltage at solar or battery side	8 VDC
Standby current consumption at night	5 mA
Maximum voltage drop-solar panel to battery	0.25 VDC

## Charging characteristics

Minimum battery starts charging voltage	3 VDC
Soft start charging voltage	3-10 $\pm$ 0.2 VDC
Soft start charging current (50% PWM duty)	Up to 5/10 AMP
Bulk charge	By the max. rated current

### Absorption charging voltage at 25°C

--Gel type battery	14.1 $\pm$ 0.2 VDC
--AGM type battery (default setting)	14.4 $\pm$ 0.2 VDC
--WET type battery	14.7 $\pm$ 0.2 VDC
--Calcium type battery	14.9 $\pm$ 0.2 VDC
--LTO battery	14.0 $\pm$ 0.2 VDC
--LFP battery	14.4 $\pm$ 0.2 VDC

### Absorption transits to equalizing or float condition:

--Charging current drops to	1.5 $\pm$ 0.1 AMP
-- or absorption charging timer timed out	4h

### Equalization charging active (only for WET or calcium battery)

--Battery voltage discharged to less than	10 $\pm$ 0.2
--Automatic equalizing charging periodical	28 Day
Equalization charging voltage at 25°C	15.5 $\pm$ 0.2 VDC
Equalization charging timer timed out	2h
Float voltage (GEL, WET, Calcium, AGM battery) at 25°C	13.6 $\pm$ 0.2 VDC
Restart voltage for LTO battery	13.2 $\pm$ 0.2 VDC
Restart voltage for LFP battery	13.4 $\pm$ 0.2 VDC
Voltage control accuracy	$\pm$ 0.1 %

Battery temperature compensation coefficient	-24 mV/°C
Temperature compensation range	-20~+50°C
<b>Protection</b>	
Transient overvoltage protection	65°C
<b>Electrical parts</b>	
Input output terminal	M5 terminals
<b>Physical Parameters</b>	
Controller material	Plastic, Standard ABS
Power terminal maximum stranded wire size	#10 AWG stranded- 5 mm <sup>2</sup>
Power terminal torque	Up to 17 in-lb (0.2n-m)
Mounting	Vertical wall mounting
IP grade	IP65
Net weight	Approx. 300g
<b>Environmental characteristics</b>	
Operating temperature	-25 ~ 50°C / -13 ~ 122 °F
Storage temperature	-40 ~ 85°C / -40 ~ 185 °F
Operating humidity range	100% no condensation

## MAINTENANCE

Occasionally, clean the case using a damp cloth and mild cleaning agent. Check with terminals without loosen, rusty; If connecting cable is damaged, replace the cable by qualified person.