# 40A PWM
# SOLAR CHARGE CONTROLLER
## USER MANUAL

**MODEL: RS-PWM40PF** 12VOLT 40AMP

THIS MANUAL CONTAINS IMPORTANT SAFETY AND OPERATING INSTRUCTIONS FOR THE SOLAR CHARGE CONTROLLER. PLEASE READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EXACTLY.

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## 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 comes with a 2-year warranty.

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

Claims to faulty product within the 2-year warranty period will be repaired or replaced free of charge, provided you present valid proof of purchase (keep your receipt).

## Version And Ratings

This is a standard version of RICH SOLAR 12V 40A PWM controller
Rated for 12V solar panel (Max. 25V)
Rated maximum output current of 40A.

## ⚠ 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 gases.
It is important that each time before using or connecting your solar controller, always read this manual and follow the instruction exactly.

- Make sure to connect the red to the positive on the battery and the black to the negative.
- Please double check before connecting. Connecting to the wrong terminals may burn out the controller.
- Confirm that the power wires are tightened to the correct torque to avoid excessive heating from loose connections.
- Refer to the battery specifications and exercise caution to avoid short-circuiting the battery connections.
- Accidental 'shorting' of the terminals or wiring can result in sparks, causing personal injury or a fire hazard. We recommend covering the panel(s) with a soft cloth to 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.

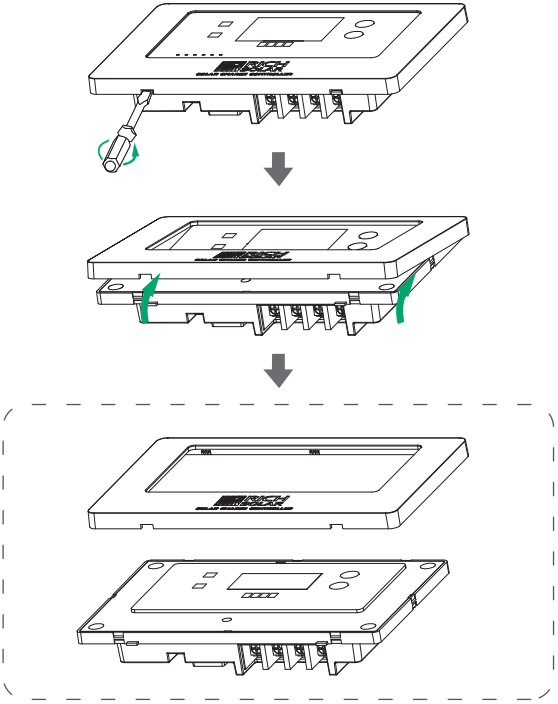
# Features And Advantages

- 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 activates Lithium battery against BMS protection
- Thermal protection
- Over-voltage protection, short-circuit protection, reverse polarity protection
- No sparks
- The thinnest and compact design
- Corrosion-resistant terminals and connectors
- Conformal coating supplied to the inside board against moisture
- Includes a port for external battery temperature sensor (BTS - optional)
- Compatible with most rechargeable lead-acid batteries, including Flooded (WET), AGM, GEL, Calcium and Lithium batteries
- Designed to meet UL1741, CE standards and comply with EMC and FCC regulations

# Installation

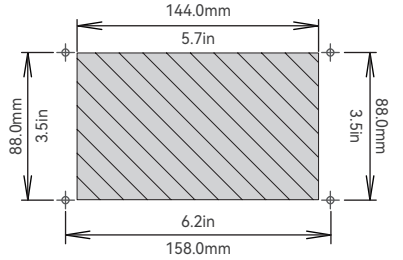
## Surface Mount

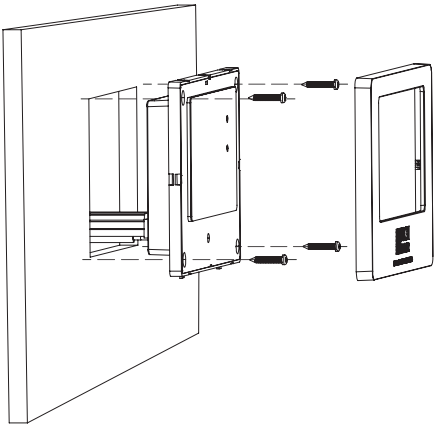
The quickest and easiest way to mount the unit is to remove the front cover and tap screws supplied to secure it to a flat surface.



## Flush Mount

Before using this mounting method, make sure there is sufficient depth behind the controller or in the cavity (refer to diagram below).

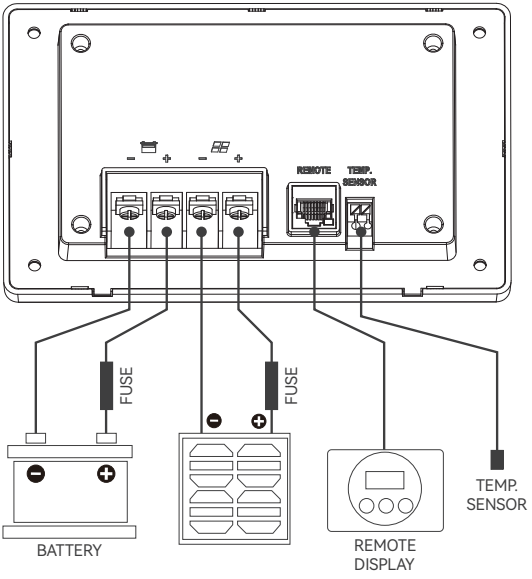


# Wiring Connections

The Solar Controller has 4 terminals which are clearly marked ‘Solar’ and ‘Battery’.
There is a (12V) and ground (GND) terminal for each circuit.
Refer to the wiring diagram 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 8+1 battery types for selections: LCO, LTO, LFP, Crystal (Lead crystal), GEL, AGM, WET (Conventional flooded lead-acid) and Calcium (Calcium-Alloy Grid) battery plus Custom setting via App.

Press and hold the **BATT. TYPE button** for 3 seconds to enter battery type selection mode. The selected battery type will be shown on the LCD meter. The default setting is LFP Battery, and the controller will automatically memorize your selection.

$LiFePO_4$ battery shown on the LCD indicates Lithium Iron Phosphate (LFP) battery.
LTO battery shown on the LCD indicates Lithium Titanate Oxide ($Li_4Ti_5O_{12}$) battery.
The LCO battery type setting is only recommended when working with 3-series Lithium Cobalt Oxide ($LiCoO_2$) battery.

**Caution: Incorrect battery type setting may damage your battery.**

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

Self-test starts, digital meter segments test

Software version test

Rated voltage and current test

Press **BATT. TYPE button** to navigate your desired battery type as below:

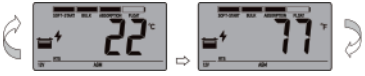
Press the **AMP/VOLT button** again to confirm the selected battery type (it will stay solid). Alternatively, the selection will be automatically confirmed after 3 seconds.

## Parameter display for battery or solar side

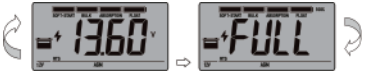
Once the settings are completed, the solar controller will automatically go into charging process, the LCD displays the parameters of solar input or battery charging acceptance as below:

Press **AMP/VOLT button** in sequence, the LCD will display in turn with solar input voltage, current, power, kWh, battery voltage, charging current, charged capacity (Amp-hour) and battery temperature (if external temperature sensor connected).

The users can also read the battery voltage as degree Celsius or degree Fahrenheit by pressing **BATT. TYPE button** for converting.



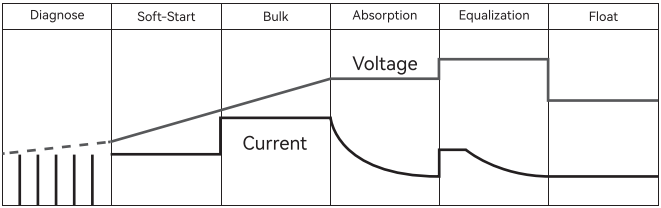

Alternatively display voltage and FULL when battery is fully charged.




You can also visually monitor your battery charging condition for each battery; there is an LCD bar to show the percentage of charge, you can easily see the battery is charged to 25%, 50%, 75% or 100%, and also roughly match each charging stage of Soft-start, Bulk, Absorption and Float.

The LCD can also be treated as an independent voltage meter or thermometer at night.

# Charging Stages




**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 Charge-** 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 Charge-** Constant voltage charging occurs when the battery reaches over 85% capacity. For lead-acid batteries, $LiFePO_4$ batteries, and LTO batteries, full charging will complete after the absorption stage. The absorption voltage levels are 14.2V for $LiFePO_4$ batteries, 14.0V for LTO batteries, and 12.6V for LCO batteries.

**Equalization Charge*-** Only for WET 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. (LCO, Crystal, $LiFePO_4$, LTO, GEL and AGM battery do not run Equalization charge).

**Float Charge or Restart Charge*** - Battery is fully charged and maintained at a safe level. A fully charged Lead-acid battery (Crystal, GEL, AGM, WET or Calcium battery) has a voltage of more than 13.6 Volts; if the lead-acid battery voltage drops to 12.7V at float mode, it will return to Bulk charge. Lithium battery will stop charge after Absorption stage, it will restart to bulk charge if the voltage discharge less than 12.0V for LCO battery, 13.0V for LTO battery, and 13.3V for LFP battery.

# LED Indication

## Normal Charge

| LED indications | | | | | | |
|---|---|---|---|---|---|---|
| LED Color | GREEN | BLUE | WHITE | WHITE | WHITE | WHITE |
| Soft-Start | ON | FLASH | FLASH | OFF | OFF | OFF |
| Bulk charge | ON | ON | ON | FLASH | OFF | OFF |
| Absorption / Equalization charge | ON | ON | ON | ON | ON | FLASH |
| Float charge | ON | OFF | ON | ON | ON | ON |

## Abnormal Charge

| Solar panel abnormal mode | LCD display | LED indication | LCD backlight |
|---|---|---|---|
| Solar panel weak (<15V) | | Flash<br>ON | ON |
| Solar panel reverse connection | | Flash Flash | Flash |
| Solar panel over voltage (> 25V) | | Flash Flash | Flash |

| Battery abnormal mode | LCD display | LED indication | LCD backlight |
|---|---|---|---|
| Solar panel connected, battery disconnected | | Flash | Flash |
| Battery reverse connection | | Flash | Flash |
| Battery over voltage (> 17V) | | Flash Flash Flash Flash | Flash |
| Battery temperature over 65℃/149°F | | Flash Flash Flash Flash | Flash |
| Controller over-temperature protection fault | | ON | Flash |

# Specifications

| **Electrical Parameters** | |
|---|---|
| Rated solar panel current | Max. 40 AMP |
| Normal PV input voltage | Max. 15–22 VDC |
| Max. PV input voltage (Output has no load) | Max. 25 VDC |
| Min. Operating Voltage (Solar or Battery Side) | Min. 8 VDC |
| Rated charging current | Max. 40 AMP |
| Max. voltage drop from panel to battery | Max. 0.25 VDC |
| Standard current consumption at night | Max. 10 mA |
| **Charging Characteristics** | |
| Min. battery start charging voltage | Min. 3 VDC |
| Soft-start charging voltage range | 3–10 ±0.2 VDC |
| Soft-start charging current | Max. 20 AMP |
| Bulk charge | Max. 40 AMP |
| Absorption charging voltage at 25℃/77°F | |
| --LCO battery | 12.6 ±0.2 VDC |
| --LTO battery | 14.0 ±0.2 VDC |
| --LFP battery (default setting) | 14.2 ±0.2 VDC |
| --GEL type battery | 14.1 ±0.2 VDC |
| --AGM type battery | 14.4 ±0.2 VDC |
| --WET type battery | 14.7 ±0.2 VDC |
| --Crystal battery | 14.7 ±0.2 VDC |

| | |
|---|---|
| --Calcium battery | 14.9 ±0.2 VDC |
| --Custom setting range for absorption charge | 13.2-15.5 ±0.2 VDC |
| Absorption transits to Equalization or Float/Stop condition: | |
| --Charging current drops to | 2.0 ±0.1 AMP |
| --or Absorption charging timer timed out for Lead-acid battery | 4 Hour |
| --or Absorption charging timer timed out for Lithium battery | 0.5 Hour |
| Equalization charging activation (Only for WET or Calcium battery) | |
| --Battery voltage discharged less than | 10 ±0.2 VDC |
| --Automatic equalization charging periodical | 28 Day |
| --Custom setting for automatic equalization charging period | 0-100 Day |
| Equalization charging voltage at 25℃/77°F | 15.5 ±0.2 VDC |
| Equalization charging timer timed out | 2 Hour |
| Equalization charging voltage range for CUSTOM setting | 13.2-16.2 ±0.2 VDC |
| Custom setting for Equalization time range | 5-500min |
| Float voltage (for Crystal, GEL, WET, AGM and Calcium battery) at 25℃/77°F | 13.6 ±0.2 VDC |
| -- Custom setting range for Float charge | 13.0-14.0 ±0.2 VDC |

| | |
|---|---|
| Restart voltage | |
| -- for Crystal, GEL, WET, AGM and Calcium battery | 12.7 ±0.2 VDC |
| -- for LCO battery | 12.0 ±0.2 VDC |
| -- for LTO battery | 13.0 ±0.2 VDC |
| -- for LFP battery | 13.3 ±0.2 VDC |
| -- CUSTOM setting range for restart voltage | 12.5-13.5 ±0.2 VDC |
| Voltage control accuracy | ± 1 % |
| Battery temperature compensation coefficient | -24 mv/°C |
| Temperature compensation range | -20~50°C/-4~122°F |
| **Electrical Parts** | |
| Input output terminal | M4 terminals |
| **Physical Parameters** | |
| Controller material | Plastic (PC) |
| Mounting | Surface or Flush mounting |
| IP grade | IP22 |
| Net weight | Approx. 300 g / 0.66 lb |
| **Environmental Characteristics** | |
| Operating temperature | -25~50°C / -13~122°F |
| Storage temperature | -40~85°C / -40~185°F |
| Operating Humidity range | 0-85% RH |

Remarks: The custom settings are realized by RICH SOLAR App.

## Download The App

Option 1: Scan the QR code below to be taken directly to the “**RICH SOLAR**” download page (ios and Android).
(This QR code can also be found on the front of your device.)

iOS

Android

Option 2: Search for “**RICH SOLAR**” on the Google Play Store (Android) or App Store (iOS).

1-800-831-9889
support@richsolar.com
www.richsolar.com
1900 Mountain Ave, Norco, CA 92860

FCC Warnning:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection againstharmful interference in a residential installation. This equipment generates, uses and can radiateradio frequency energy and, if not installed and used in accordance with the instructions, maycause harmful interference to radio communications. However, there is no guarantee thatinterference will not occur in a particular installation. If this equipment does cause harmfulinterference to radio or television reception, which can be determined by turning the equipmentoff and on, the user is encouraged to try to correct the interference by one or more of thefollowing measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1)This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.