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## Owner's Manual



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# 1.0 Installation Overview

## 1.1 Introduction

A Solar Controller (or Charge Controller / Regulator) maintains the life of the battery by protecting it from overcharging. When your battery has reached a 100% state of charge, the controller prevents overcharging by limiting the current flowing into the batteries from your solar array. The GP-PWM-10-SQ is rated for a continuous solar current input of 10 amps, uses Pulse Width Modulation (PWM) technology and a unique four stage charging system that includes an optional equalize setting to charge and protect your battery bank.

## 1.2 Specifications







Description	Value			Dimensions (H x W x D):
Rated solar panel amps for 10A/10AW	10	Max	AMP	102 x 130 x 27 mm 4.02 x 5.12 x 1.06 in <b>Weight:</b> 151 grams / 5.34 oz <b>Maximum Wire Gauge:</b> #6 AWG <b>Warranty:</b> 1 year
Nominal input solar cell array voltage	15-22		VDC	
Max. solar cell array voltage (output has no load)	25	Max	VDC	
Lowest operating voltage (solar or battery side)	8V	Min	VDC	
Max voltage drop-solar panel to battery	0.25		2	
<b>CHARGING CHARACTERISTICS</b>				
Min battery start charging voltage	3	Min	VDC	
Soft start charging voltage	3-10	+/-2	VDC	
Soft start charging current (50% PWM duty)	Up to 15		AMP	
Bulk charge voltage	10-14.6	+/-0.2	VDC	
Absorption charging voltage at 25°C				
LTO type battery	14.0	+/-0.2	VDC	
Gel type battery	14.1	+/-0.2	VDC	
AGM type battery (DEFAULT setting)	14.4	+/-0.2	VDC	
LiFePO4 type battery	14.4	+/-0.2	VDC	
WET type battery	14.7	+/-0.2	VDC	
Calcium type battery	14.9	+/-0.2	VDC	
Absorption transits to Equalizing or Float condition:				
Charging current drops to	14.9	+/-0.1	AMP	
Or Absorption charging timer timed out	4		Hour	
Equalizing charging active				
Only for WET or Calcium battery	10	+/-0.2	VDC	
Automatic equalizing charging periodical	28		Day	
Equalizing charging voltage at 25°C	15.5	+/-0.2	VDC	
Equalizing charging timer timed out	2		Hour	
Float charging voltage at 25°C				
For LTO and LiFePO4 battery	13.4/14.0	+/-0.2	VDC	
For Gel, AGM, WET and Calcium	13.6	+/-0.2	VDC	
Voltage control accuracy	+/-1%			
Battery temperature compensation coefficient	-24		mV/°C	
Temperature compensation range	-20--+50		°C	
<b>PROTECTION</b>				
Reverse polarity & short circuit				
No reverse current from battery to solar at night				
Over temperature protection during charging	65		°C	
Transient over voltage protection with TVS or varistor				
Power terminal max stranded wire size	#12 AWG stranded -3mm <sup>2</sup>			
Mounting	Vertical wall mounting			
Net Weight	Approx. 0.25kg / 0.55lb			

- PWM charging
- 4 Battery charging profiles
- 4 Stage charging
- Monthly equalize option
- Displays charging current, Battery voltage and battery state of charge
- Reverse polarity protected
- Temperature compensated
- RoHS compliant
- Accepts up to 10 Amps DC Input Current

The total rated Maximum Power Current (Imp) of the PV input should not exceed 10 Amps

ENVIRONMENTAL CHARACTERISTICS	
Operating temperature	-20 ~ 50°C / -13 ~ 122°F
Storage temperature	-40 ~ 85°C / -40 ~ 185°F
Operating humidity range	100% no condensation

## 2.0 Warnings

	Disconnect all power sources	Electricity can be very dangerous. Installation should be performed only by a licensed electrician or qualified personnel.
	Battery and wiring safety	Observe all safety precautions of the battery manufacturer when handling or working around batteries. When charging, batteries produce hydrogen gas, which is highly explosive.
	Wiring connections	Ensure all connections are tight and secure. Loose connections may generate sparks and heat. Be sure to check connections one week after installation to ensure they are still tight.
	Work safely	Wear protective eyewear and appropriate clothing during installation. Use extreme caution when working with electricity and when handling and working around batteries.
	Observe correct polarity	Reverse polarity of the battery terminals will cause the controller to give a warning tone. Reverse connection of the array will not cause an alarm but the controller will not function. Failure to correct this fault could damage the controller.
	Do not exceed the GP-PWM-10-SQ Amp current and max voltage ratings	The current rating of the solar system is the sum of the Maximum Power Current (Imp) of the solar PV strings in parallel. The resulting system Imp current is not to exceed 10A. The voltage of the array is the rated open circuit voltage (Voc) of the PV array and is not to exceed 28V. If your solar system exceeds these ratings, contact your dealer for a suitable controller alternative.

## 3.0 Choosing a Location

The GP-PWM-10-SQ is designed to be mounted against a wall, out of the way but easily visible. The GP-PWM-10-SQ should be:

- Mounted as close to the battery as possible
- Mounted on a vertical surface to optimize cooling of the unit
- Indoors, protected from the weather

Solar should connect directly to the controller. Positive and negative battery connections must connect directly from the controller to the batteries. Use of a positive or negative distribution bus is allowed between the controller and battery as long as it is properly sized, electrically safe and an adequate wire size is maintained. **Note:** In a RV, the most common controller location is above the refrigerator. The wire from the solar array most commonly enters the RV through the fridge vent on the roof.

## 4.0 Installation Instructions

- 1. Select wire type and gauge.** If this GP-PWM-10-SQ was purchased as part of a Go Power! Solar Power Kit, appropriate wire type, gauge and length is provided. Please continue to **Section 5**, “Operating Instructions.” If the GP-PWM-10-SQ was purchased separately, follow the instructions included here. Wire type is recommended to be a stranded aluminum UV resistant wire. Wire fatigue and the likelihood of a loose connection are greatly reduced in stranded wire compared to solid wire. Wire gauge should be able to sustain rated current as well as minimizing voltage drop.

**Suggested Min. Wire Gauge** (Cable 25 ft. max. from solar array to battery bank)

80 Watt	#12 Wire Gauge	For other applications, please refer to standard wire guide.
95 Watt	#10 Wire Gauge	
160 Watt	#10 Wire Gauge	



Identify the polarity (pos. and neg.) on the cable used for the battery and solar module. Use colored wires or mark the wire ends with tags. Although the GP-PWM-10-SQ is protected, a reverse polarity contact may damage the unit

**2. Wiring the GP-PWM-10-SQ.** Wire the GP-PWM-10-SQ according to the wiring schematic in **Section 9**. Run wires from the solar array and the batteries to the location of the GP-PWM-10-SQ. Keep the solar array covered with an opaque material until all wiring is completed. Torque all terminal screws to 16 inch pounds (1.8N.m). Connect the battery wiring to the controller first and then connect the battery wiring to the battery.



Use appropriate circuit protection on any conductor attached to a battery.

With battery power attached, the controller should power up and display information. Connect the solar wiring to the controller and remove the opaque material from the solar array. The negative solar array and battery wiring must be connected directly to the controller for proper operation. Do not connect the negative solar array or negative battery controller wiring to the chassis of the vehicle.

**3. Mounting the GP-PWM-10-SQ.** Mount the GP-PWM-10-SQ to the wall using the included two mounting screws. After 30 days of operation, re-torque all terminal screws to ensure the wires are properly secured to the controller. Congratulations, your GP-PWM-10-SQ should now be operational. If the battery power is low and the solar array is producing power, your battery should begin to charge.



You must set the battery type on the GP-PWM-10-SQ before you begin to use the controller. See section 5.2

## 5.0 Operating Instructions

### 5.1 Power Up

Please check your battery manufacturer's specifications to select correct battery type. The unit provides 4 battery types for selections: Gel, AGM, WET (conventional lead acid), and Calcium.


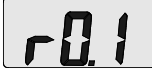


### 5.2 Setting the Battery Type / Charging Profile

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









Incorrect battery type setting may damage your battery.

When the controller powers on, the unit will run self-test mode and automatically show below items on LCD before going into charging process. Refer to the Battery Charge Profile Chart on for details on each profile.

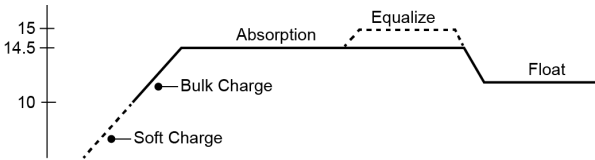
	Self-test starts, digital meter segments test		Software version test
	Rated voltage		Current test

After going into charging process, the LCD displays the charging states 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).

## Battery Charge Profile Chart

The 6 LED's indicate the charging status and the battery condition						
	RED	BLUE	GREEN	GREEN	YELLOW	RED
Solar Power Present- No battery connected	ON	OFF	OFF	OFF	OFF	Flash
Soft charging	ON	Flash	OFF	OFF	OFF	ON
Bulk charging ( $V_b < 11.5V$ )	ON	ON	OFF	OFF	OFF	ON
Bulk charging ( $11.5V < V_b < 12.5V$ )	ON	ON	OFF	OFF	ON	OFF
Bulk charging ( $V_b > 12.5V$ )	ON	ON	OFF	ON	OFF	OFF
Absorption charging	ON	ON	OFF	ON	OFF	OFF
Float charging	ON	OFF	ON	OFF	OFF	OFF
Solar panel weak	Flash	OFF	OFF	Subject to battery voltage		
At night no charge	OFF	OFF	OFF	Subject to battery voltage		

## Wet Cell Battery Charging Algorithm



**Auto Equalize:** The GP-PWM-10-SQ has an automatic equalize feature that will charge and recondition your batteries once a month at a higher voltage to ensure that any excess sulfation is

removed. This feature is recommended for Flooded batteries only. Check with your battery manufacturer. This feature is only available for wet cell or flooded batteries.

**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 and battery is over 85%

**Equalization Charge\*-** Only for WET battery (Flooded lead acid) or Calcium battery type, when the battery is deeply drained below 10V, it will automatically run this stage to bring the internal cells as an equal states and fully complement the loss of capacity. (Gel and AGM battery do not run Equalization charge)

**Float Charge-** Battery is fully charged and maintained at a safe level. A fully charged battery has a voltage of more than 13.6 Volts.

## Viewing the Controller display information

Solar Panel Abnormal Mode	LCD display	LED indication	LCD backlight
Solar panel weak		 Flash	ON
Solar panel reverse connection	<b>PO1</b>	 Flash	Flash
Solar panel over voltage (> 26.5V)	<b>PO2</b>	 Flash	Flash

Battery Abnormal Mode	LCD display	LED indication			LCD backlight
Battery disconnected or less than 3.0V	<b>b01</b>	 Flash			Flash
Battery reverse connection	<b>b02</b>	 Flash			Flash
Battery over voltage than > 17.5V	<b>b03</b>	 Flash	 Flash	 Flash	Flash
Battery temperature over 65C	<b>b04</b>	 Flash	 Flash	 Flash	Flash

Solar Controller Abnormal Mode	LCD Display	LED indication	LCD backlight
The controller over temp. protection	<b>otP</b>		Flash

## 6.0 Frequently Asked Questions (FAQs)

Visit [gpelectric.com](http://gpelectric.com) to read the Frequently Asked Questions section on our website.

## 7.0 Troubleshooting

### 7.1 Problems with the Display

**Display Reading:** Blank

**Time of Day:** Day / Night

**Possible Cause:**

- (1) Battery or fuse connection and/or solar array connection (Daytime only).
- (2) Battery or fuse connection (Night only).

**How to tell:**

- (1) & (2) Check the voltage at the controller battery terminals with a voltmeter and compare with a voltage reading at the battery terminals. If there is no voltage reading at the controller battery terminals, the problem is in the wiring between the battery and controller. If the battery voltage is lower than 6 volts the controller will not function. For the solar array, repeat steps 1 and 2 substituting all battery terminals with solar array terminals.

**Remedy:**

- (1) & (2) Check all connections from the controller to the battery including checking for correct wire polarity. Check that all connections are clean, tight, and secure. Ensure the battery voltage is above 6 volts. Check the condition of the fuse.

### 7.2 Problems with Voltage

**Voltage Reading:** Inaccurate

**Time of Day:** Day / Night

**Possible Cause:**

- (1) Excessive voltage drop from batteries to controller due to loose connections, small wire gauge or both.

**How to tell:**

- (1) Check the voltage at the controller battery terminals with a voltmeter and compare with the voltage reading at the battery terminals. If there is a voltage discrepancy of more than 0.5 V, there is an excessive voltage drop.

**Remedy:**

- (1) Check all connections from the controller to the battery including checking for correct wire polarity. Check that all connections are clean, tight, and secure. Shorten the distance from the

controller to battery or obtain larger gauge wire. It is also possible to double up the existing gauge wire (i.e. two wire runs) to simulate a larger gauge wire.

### 7.3 Problems with Current

**Current Reading:** 0 A

**Time of Day:** Day, clear sunny skies

**Possible Cause:**

- (1) Current is being limited below 1 Amp as per normal operation.
- (2) Poor connection between solar array and controller.

**How to tell:**

- (1) The State of Charge (SOC) screen is close to 100% and the Sun and Battery icon are present with an arrow between.
- (2) With the solar array in sunlight, check the voltage at the controller solar array terminals with a voltmeter. If there is no reading at the controller solar array terminals, the problem is somewhere in the wiring from the solar array to the controller.

**Remedy:**

- (1) Check all connections from the controller to the array including checking for correct wire polarity. Check that all connections are clean, tight, and secure. Continue with the solutions below for additional help on low current readings.

### 7.4 Problems with Current 2

**Current Reading:** Less than expected

**Time of Day:** Day, clear sunny skies

**Possible Cause:**

- (1) Current is being limited below 1 Amp as per normal operation.
- (2) Incorrect series/parallel configuration and/or wiring connections and/or wire gauge.
- (3) Dirty or shaded module or lack of sun.
- (4) Blown diode in solar module when two or more modules are connected in parallel.

**How to tell:**

- (1) Battery State of Charge screen is close to 100% and the Sun and Battery icon are present with an arrow in between.
- (2) Check that the modules and batteries are configured correctly and check wiring connections.
- (3) Modules look dirty, overhead object is shading modules or it is an overcast day in which a shadow cannot be cast. **Note:** Avoid any shading no matter how small. An object as small as a broomstick held across the solar module may cause the power output to be cut to almost nil. Overcast days may also cut the power output of the module to almost nil.
- (4) Disconnect one or both array wires from the controller. Take a voltage reading between the positive and negative array wire. A single 12 volt module should have an open circuit voltage between 17 and 22 volts. If you have more than one solar module, you will need to conduct this test between the positive and negative terminals of each module junction box with either the positive or negative wires disconnected from the terminal.

**Remedy:**

- (2) Reconnect in correct configuration. Tighten all connections. Check wire gauge and length of wire run. Refer to Suggested Minimum Wire Gauge in Section 4.
- (3) Clean modules, clear obstruction or wait for conditions to clear.
- (4) If the open circuit voltage of a non-connected 12 volt module is lower than the manufacturer's specifications, the module may be faulty. Check for blown diodes in the solar module junction box, which may be shorting the power output of module.

## 8.0 General Warranty

Go Power! warrants the GP-PWM-10-SQ for a period of one (1) year from the date of purchase. This warranty is valid against defects in materials and workmanship for the one (1) year

warranty period. **Proof of purchase is required** for any warranty replacements. Visit [gpelectric.com](http://gpelectric.com) for warranty details.

## 8.1 Return Information

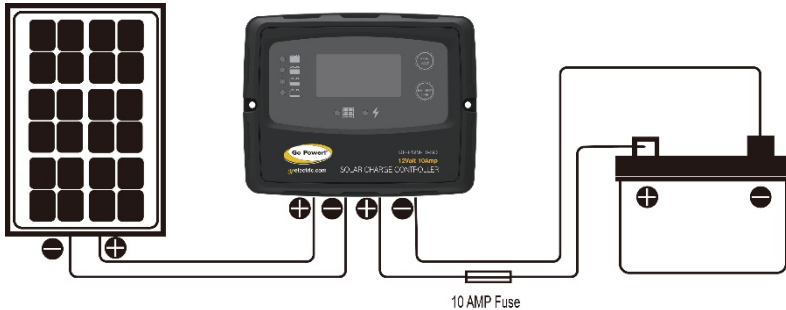
Visit [gpelectric.com](http://gpelectric.com) to read the “frequently asked questions” section of our website to troubleshoot the problem. If trouble persists:

1. Call your Go Power!® Technical Support team (1-866-247-6527).
2. Return defective product to place of purchase

## 9.0 Wiring Diagram

The GP-PWM-10-SQ is based on a 10 amp max input from the solar modules. Use the wiring diagram to connect your battery to the battery terminals on the solar controller. First, connect the battery to the controller and then connect the solar panel to the controller.

**The controller will not work unless there is a battery connected to the battery terminals.**



Solar Panel +

Solar Panel -

Battery +

Battery -

Note: The fuse or breaker used should be no larger than 10 amps.



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GP\_MAN\_GP-PWM-10-SQ\_RevF

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