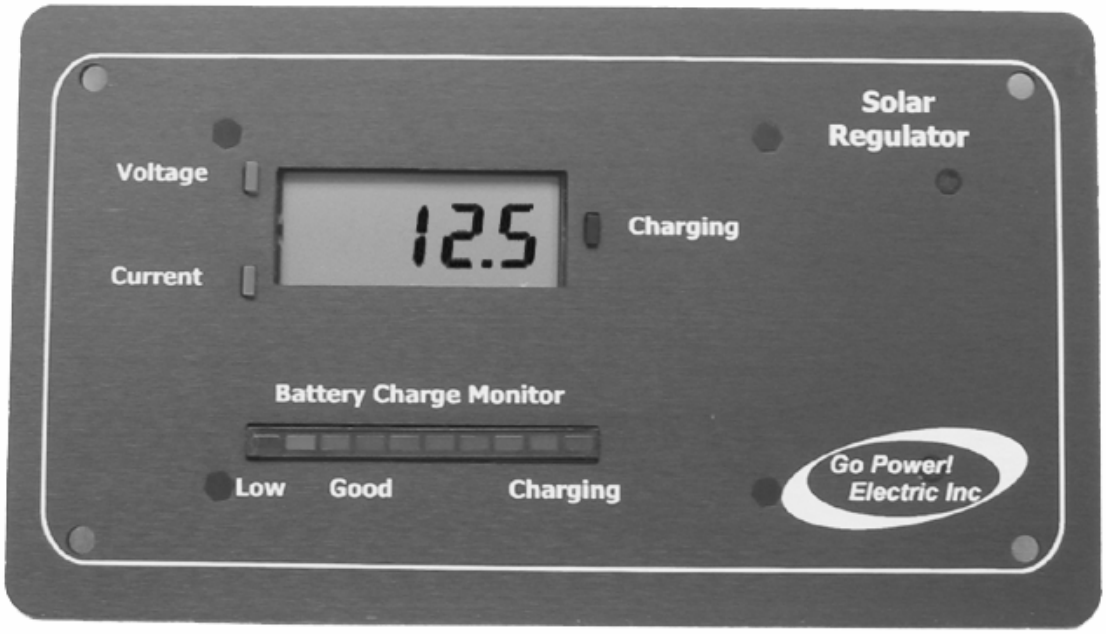
Carmanah®

OWNER'S MANUAL
GPR-25 Regulator



www.carmanah.com

Technical Support: info@gpelectric.com
In US contact: 1-866-247-6527 **In Canada contact:** 1-800-667-6527
Toll Free Fax: 1-866-607-6527

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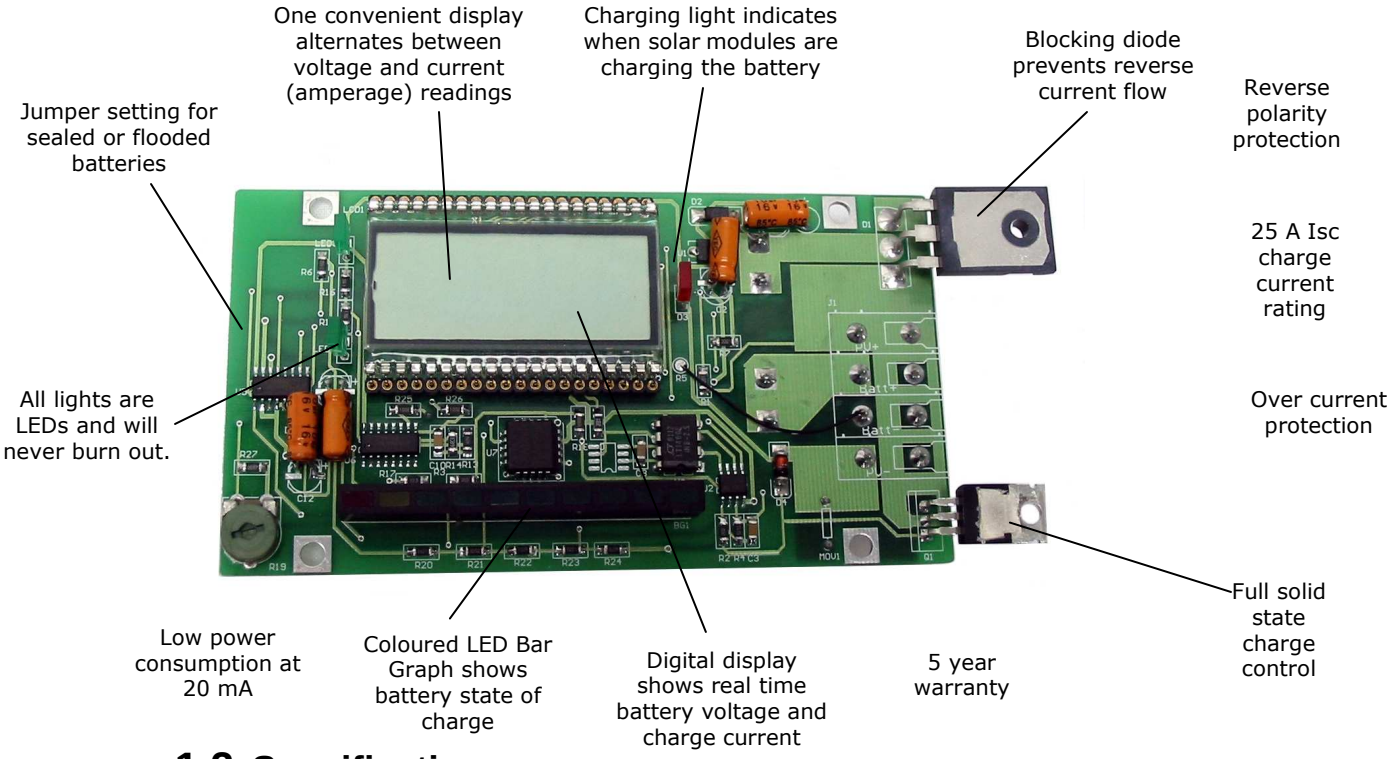
Last revised: June 21, 2007

1.0 Installation Overview

1.1 Introduction

A Charge Regulator is an essential component of your photovoltaic system. The Regulator maintains the life of the battery by protecting it from overcharging. When your battery has reached a 100% state of charge, the Regulator prevents overcharging by limiting the current flowing into the batteries.

The GPR-25 is a 12 volt flush mounted photovoltaic charge regulator rated for a maximum current of 25 amps. The GPR-25 features an LCD digital display that shows solar array charge current and system battery voltage. An LED bar graph shows the battery state of charge.



1.2 Specifications

Description	Value
Nominal Voltage	12 V
Rated Current, Continuous Array Isc	25 A
Array Voltage, Max Voc	26 V
Quiescent Current	20 mA
Current Consumption, Charging Typ.	20 mA
Voltage Drop, Array to Battery, Typ.	0.8 V
Charge Termination Selectable	14.1 / 14.4 ± 0.2 V
Charge Resumption	13.0 ± 0.3 V
Operating Temperature Range	-40 to 85 ° C
	-40 to 185 ° F
LCD Operating Temperature	-10 to 55 ° C
	14 to 131 ° F
Display Accuracy	2 Points

Dimensions (H x W x D):
107.95 x 190.5 x 19 mm
4.25 x 7.5 x 1.6 in

Hardware: #8/32

Weight: 172 grams
6 ounces

Fuse: 25 Amp AGC

Max Wire Gauge: #8 AWG

Warranty: 5 Years

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2. Warnings

Disconnect all power sources before attempting installation. 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 may produce hydrogen gas, which is highly explosive. Work only in a well ventilated area and use caution when making or removing electrical connections. Ensure wires are disconnected from their power sources when wiring. Do not expose battery to open flame, cigarettes, or sparks. Shield skin and eyes from battery acid.

Wiring connections. Ensure all connections are tight and secure. Loose connections may generate sparks.

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 at all times. Any contact in reverse polarity, however brief, will cause the regulator fuse to blow and may damage the unit.

Do not exceed the GPR-25 and Voltage The current rating of the solar system is the sum of the short circuit currents (Isc) of the solar modules in parallel. The resulting system Isc current is not to exceed 25 A. The voltage of the array is the rated open circuit voltage (Voc) of the solar module and is not to exceed 26 V. If your solar system exceeds these ratings, contact your dealer for a suitable regulator alternative. **ratings**

3. Tools and Materials Needed

Drill with 3/32" and 3/8 bits	UV Wire (Module(s) to GPR-25)*
Keyhole or Jigsaw	Battery Wire (GPR-25 to Battery)*
Phillips Screwdriver	Wire Cutters
#8 Flat Washers	Wire Strippers
Pencil or Marking Implement	Electrical Tape

* If the GPR-25 Charger Controller was purchased with a Go Power! Electric RV Solar Kit then UV resistant wire is included. For instructions regarding RV Charger Kit installation, please refer to the RV Charger Kit Installation Guide provided with the Kit.

4. Choosing a Location

The GPR-25 is designed to be mounted flush against a wall, out of the way and easily visible.
The GPR-25 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.

In an RV, the most common regulator location is above the refrigerator. The wire from the solar modules most commonly enters the RV through the fridge vent on the roof. Solar connections should connect directly to the regulator. Battery connections should connect directly from the regulator to the batteries. **Do not tie the regulator wiring in with the refrigerator wiring or any other DC wiring**.

If the flush mount option is not used, ensure that the optional knockout box (Model: GPR-25-KBox) is securely mounted to the wall before proceeding with the installation of the GPR-25 Regulator.

5. Installation Instructions

1. **Prepare for mounting.** Use the template provided at the end of the manual to mark the four mounting holes and the *"cutting line for flush mounting".*

2. **Complete the installation of the solar modules.** If this GPR-25 was purchased as part of a Go Power! Electric Solar Kit, follow the RV Installation Guide provided. Otherwise follow manufacturer's instructions for module mounting and wiring.

3. **Select wire type and gauge.** If this GPR-25 was purchased as part of a Go Power! Electric Solar Kit, appropriate wire type, gauge, and length is provided. Please continue to Section 6, "Operating Instructions". If the GPR-25 was purchased separately, follow the instructions included here.

Wire type is recommended to be a stranded copper 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 Minimum Wire Gauge
(Cable length 25 ft max. from solar array to battery bank)

50 Watt	#14 Wire Gauge
80 Watt	#12 Wire Gauge
115 Watt	#10 Wire Gauge
160 Watt	#10 Wire Gauge
240 Watt	#10 Wire Gauge

IMPORTANT: Identify the polarity (positive and negative) on the cable used for the battery and solar module. Use colored wires or mark the wire ends with tags. A reverse polarity contact, however brief, will blow the regulator fuse and may damage the unit.

4. **Jumper setting for sealed or flooded batteries.** Refer to the wiring schematic.

5. **Wiring the GPR-25.** Wire the GPR-25 according to the wiring schematic. Run wires from the solar modules and the batteries to the location of the GPR-25. Keep the solar module(s) covered with an opaque material until all wiring is completed.
   Connect the battery wiring to the regulator first and then connect the battery wiring to the battery.
   The regulator should now be showing the battery voltage. Connect the solar wiring to the regulator and remove the opaque material from the solar module(s). The negative solar array and battery wiring must be connected directly to the regulator for proper operation.
   Do not connect the negative solar array or negative battery regulator wiring to the chassis of the vehicle.

6. **Mounting the GPR-25.** Mount the GPR-25 to the wall using the included four mounting screws. Place washers between the wall and the back of the faceplate to create a gap that provides airflow to the back of the unit.

Congratulations, your controller should now be operational. If the battery power is low and the solar modules are producing power, your battery should begin to charge.

6. Operating Instructions

When connected to solar modules and batteries, the GPR-25 will automatically begin to function. It will regulate and monitor the battery state of charge. No further user intervention is necessary. The LCD monitor will cycle between array current and battery voltage.

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7. Monitoring

Charging LED (red): When the battery is charging, the charging light will be lit. When the state of charge for the battery is close to full, the light will be off for short periods of time and on for short periods of time - the pulse-charging feature of the GPR-25. In situations where outside ambient light is shining on the solar module, it may be possible for the charging light to be on after the sun has set.

LCD Display: The LCD display will cycle between solar array charge current and battery voltage readings, as indicated by the green LED on the left of the display. The meter is accurate to within ± 2 points.
Note: Charge Termination: The charge termination of the regulator is accurate to less than 1/10 (0.1) of a volt most of the time. Due to varying reasons the regulator may briefly overshoot the termination point by a maximum of 2/10 (0.2) of a volt. The on/off charging nature of the regulator means that even if the charge voltage is terminated slightly higher than the termination point, sealed batteries will not sustain enough current to cause any overcharging or damage.

Battery Charge Monitor LEDs (green, yellow, red): These are a graphical representation of a battery's state of charge during the charging cycle. When the far right green LED is blinking, the batteries are almost full. Yellow indicates that the batteries are below 12.0 V, and that the loads should be turned off. Red indicates the voltage has fallen below 10 V and the battery is dead. Disregard the bar graph reading if the battery is disconnected.

8. Normal Status Scenarios

These are all normal operating conditions. For abnormal conditions, consult the *"Troubleshooting Problems"* portion of the Troubleshooting section.

Voltage Reading: 9.5 V - 11.5 V **Charge Light:** ON
Current Reading: 1 A – 25 A **Time of Day:** Daytime

Status: Battery is low. Regulator is charging the battery.
Remedy: Minimize loads on the battery. If available, charge the battery with alternate sources such as the RV alternator or a generator.

Voltage Reading: 9.5 V - 11.5 V **Charge Light:** OFF
Current Reading: 0 A **Time of Day:** Nighttime

Status: Battery is low. Regulator is NOT charging the battery.
Remedy: Minimize loads on the battery. If available, charge the battery with alternate sources such as the RV alternator or a generator.

Voltage Reading: 12 V – 14 V **Charge Light:** ON
Current Reading: 1 A – 25 A **Time of Day:** Daytime

Status: Battery is charging.
Remedy: None required. Battery is fine and charging.

Voltage Reading: 13 V – 14 V **Charge Light:** OFF
Current Reading: 0 A **Time of Day:** Daytime

Status: Battery is full or almost full.
Remedy: None required.

Voltage Reading: 11.5 V – 14 V **Charge Light:** OFF
Current Reading: 0 A **Time of Day:** Nighttime

Status: Battery is fine
Remedy: None required.

9. Before You Read Troubleshooting

Before a problem is suspected with the system, read this section. There are numerous events that may appear as problems but are in fact perfectly normal.

My regulator has been charging/not charging for quite a while now.
The regulator is designed to keep the batteries state of charge at full while protecting them from overcharging. This means that when the voltage of the battery falls under approximately 13.0 V, the regulator starts charging and doesn't stop until the voltage exceeds approximately 14.1V / 14.4 V. When the regulator stops charging at 14.1/14.4 volts, the unit will wait until the voltage drops to approximately 13 volts before it starts charging again. If the unit is not charging but shows a voltage between 12.7 and 14.4 volts, the unit is operating normally.

It seems like my flooded batteries are losing water over time.
Flooded batteries may need to have distilled water added periodically to replace fluid loss during charging. Excessive water loss during a short period of time indicates the possibility of overcharging or aging batteries.

When charging, my flooded batteries are emitting gas.
During charging, hydrogen gas is generated within the battery. The gas bubbles stir the battery acid allowing it to receive a more full state of charge.

My voltmeter shows a different reading than the LCD display
The meter value on the LCD display is an approximate reading intended for indication purposes only. There is an approximate two digit or 0.2 volt inherent error present that may be accentuated when compared with readings from another voltmeter.
There may be a slight difference between the battery voltage displayed on the LCD screen and the battery voltage measured at the battery terminals. When troubleshooting using a voltmeter, check both the battery voltage at the regulator battery terminals and battery voltage at the battery terminals. If a difference of more than 0.5 Volts is noted, this indicates a large voltage drop possibly caused by long wiring runs, small wire gauge, faulty wiring, a faulty voltmeter or all the above. Consult the Suggested Minimum Wire Gauge chart in section five for wiring suggestions and check all connections.

10. Troubleshooting Problems

How to read this section

Troubleshooting Problems is split into six sub-sections, grouped by symptoms involving key components. Components considered irrelevant in a diagnosis are denoted 'Not Applicable' (N/A). A multimeter may be required for some procedures listed.

It is imperative all electrical precautions stated in the Warning Section and outlined in the Installation Section are followed. Even if it appears the system is not functioning, it should be treated as a fully functioning system generating live power.

10.1 Problems with both Voltage & Current

Voltage Reading: Blank
Current Reading: Blank
Charge Light: N/A
Time of Day: Daytime/Nighttime

Possible Cause:
(1) Battery or fuse connection and/or solar array connection (Daytime only).
(2) Battery or fuse connection (Nighttime only).
(3) Defective GPR-25.

How to tell:
(1) & (2) Check the voltage at the regulator terminals labeled 'Battery' with a multimeter and compare with a reading at the battery terminals.

If there is no reading at the regulator terminals, the problem is in the wiring between the battery and the regulator. For array, repeat step substituting all battery terminals with array terminals.

Remedy:
(1) & (2) Check the fuse. Check all connections from the regulator to the battery including checking for correct wire polarity. Check that all connections are clean, tight, and secure.

Voltage Reading: 9 V – 12 V
Current Reading: 0 A
Charge Light: Off
Time of Day: Daytime

Possible Cause:
(1) Battery or fuse connection
(2) Defective GPR-25.
How to tell:
(1) Check the voltage at the regulator terminals labeled 'Battery' with a multimeter and compare with a reading at the battery terminals. If there is no reading at the regulator terminals, the problem is somewhere in the wiring from the battery to the regulator.

Remedy:
(1) Check the fuse. Check all connections from the regulator to the battery including checking for correct wire polarity. Check that all connections are clean, tight, and secure.

10.2 Problems with Voltage

Voltage Reading: Inaccurate
Current Reading: N/A
Charge Light: N/A
Time of Day: Daytime/Nighttime

Possible Cause:
(1) Battery or fuse connection
(2) Excessive voltage drop from batteries to regulator.
(3) Incorrect calibration of the voltage meter.

How to tell:
(1) Check the voltage at the regulator terminals labeled 'Battery' with a multimeter and compare with a 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 the fuse. Check all connections from the regulator to the battery including checking for correct wire polarity. Check that all connections are clean, tight, and secure. Shorten the distance from the regulator 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.

Voltage Reading: Erratic
Current Reading: N/A
Charge Light: N/A
Time of Day: Daytime/Nighttime

Possible Cause:
(1) Battery or fuse connection
(2) Electric noise.

Remedy:
(1) Check fuse. Check all connections from the regulator to the battery including checking for correct wire polarity. Check that all connections are clean, tight, and secure.
(2) Electric noise from other electronics such as inverters or fluorescent lights may affect the current reading. Attempt to trace the problematic appliance and fix the problem by relocation.

10.3 Problems with Current

Voltage Reading: N/A
Current Reading: Less than expected
Charge Light: N/A
Time of Day: Daytime

Possible Cause:
(1) Wrong series/parallel configuration and/or wiring connections and/or wire gauge.
(2) Dirty or shaded module or lack of sun.
(3) Blown diode in solar module when two or more modules are connected in parallel.

How to tell:
(1) Check that the modules and batteries are configured correctly. Check all wiring connections.
(2) 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.
(3) Disconnect one or both array wires from the regulator. Take a voltage reading between the positive and negative array wire. A single 12 volt module should have an open circuit voltage between 18 and 22 volts. If you have more than one 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:
(1) Reconnect in correct configuration. Tighten all connections. Check wire gauge and length of wire run. Refer to Suggested Minimum Wire Gauge in section 5.
(2) Clean modules, clear obstruction or wait for conditions to clear.
(3) If the voltage of a non-connected module (open circuit) is lower than 15 volts, contact the manufacturer.

Voltage Reading: N/A
Current Reading: Zero
Charge Light: N/A
Time of Day: Daytime

Possible Cause:
(1) Wrong series/parallel configuration and/or wiring connections.
(2) Shaded module or overcast conditions.
(3) Blown diode in module.

How to tell:
(1) Check that modules and batteries are configured correctly and the negative solar and battery wires are connected directly to the regulator. Check all wiring connections
(2) An object is shading modules or it is an overcast day in which a shadow cannot be cast.
(3) Disconnect one or both array wires from the regulator. Take a voltage reading between the positive and negative array wire. A 12 volt module should have an open circuit voltage between 18 and 22 volts. If you have more than one module, you may 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:
(1) Reconnect in correct configuration. Tighten all connections.
(2) Clear obstruction or wait for conditions to clear.
(3) If the voltage of a non-connected module (open circuit) is lower than 15 volts, contact the manufacturer

Voltage Reading: N/A
Current Reading: Erratic
Charge Light: N/A
Time of Day: N/A

Possible Cause:
(1) Battery or fuse connection.
(2) Electric noise.

Remedy:
(1) Check fuse. Check all connections from the regulator to the battery.
(2) Electric noise from other electronics such as inverters or florescent lights may affect the current reading. Attempt to trace the problematic appliance and fix the problem by relocation.

Voltage Reading: N/A
Current Reading: Rapidly changing

Possible Cause:
(1) Battery is full, array is producing full current, and there are functioning loads connected. This is normal.
(2) The battery is too old or going bad and is unable to hold a charge.
(3) Poor battery or array connection.

How to tell:
(1) & (2) & (3) Check the voltage at the terminals with a multimeter.
(3) Check all wiring connections.

Remedy:
(1) & (2) If the voltage on the multimeter is rapidly increasing and decreasing, the battery is going bad, the battery bank is too small, or this is a normal condition. Unfortunately, there is no way to differentiate. Possible solutions are to test, individually, the physical battery status using a hydrometer. Consult your battery manufacturer's manual for more information.

(3) If the voltage on the multimeter is stable while the current reading is behaving erratically, it is the battery connection between the battery and regulator. Check connections.

(3) Reconnect wiring correctly.

10.4 Miscellaneous Problems

Status: Charge light blinking when fuse is touched

Possible Cause:
(1) Fuse is loose.

Remedy:
(1) Securely attach fuse.

Status: GPR-25 buzzing

Possible Cause:
(1) Bad battery, array or fuse connection.

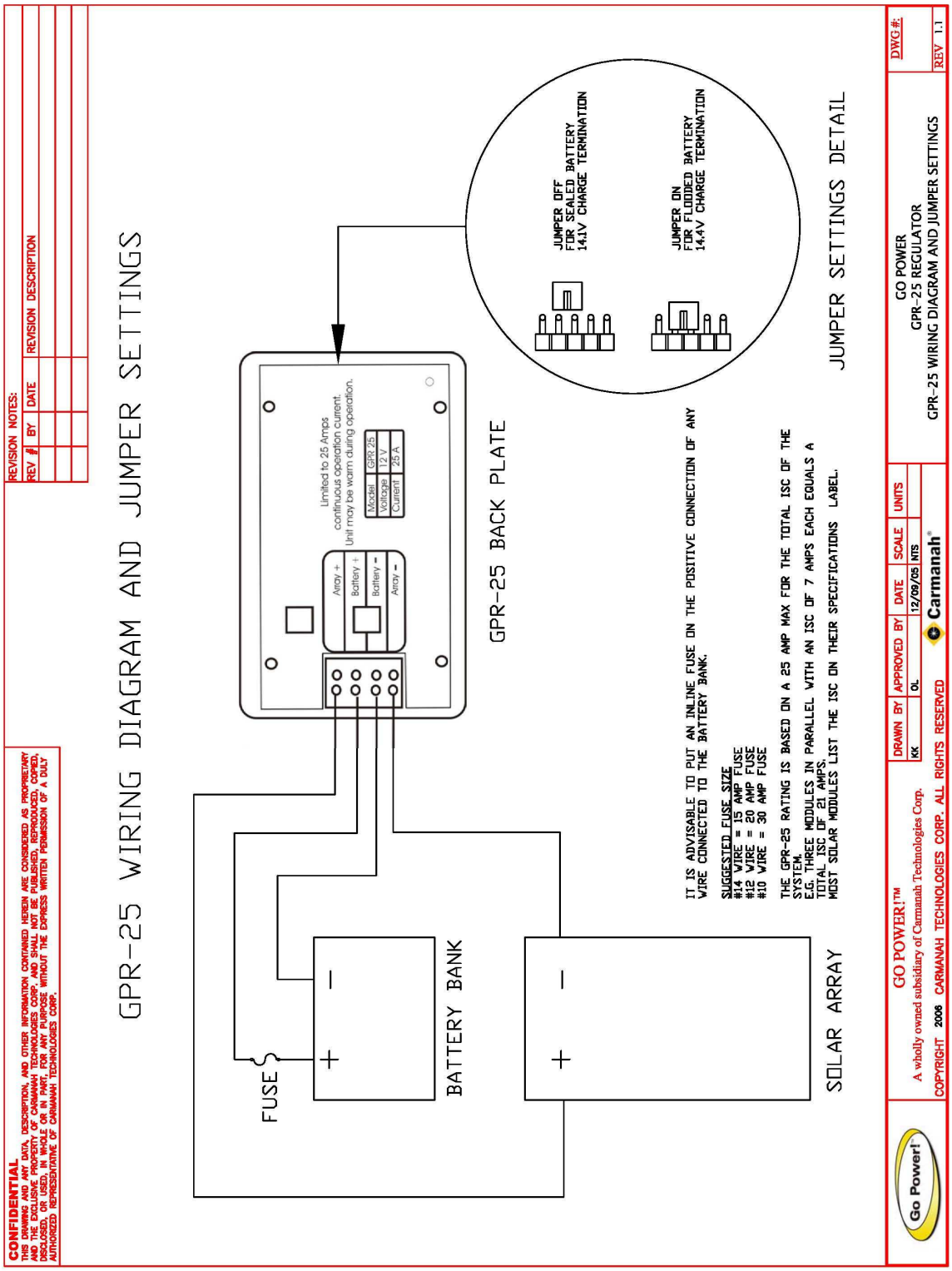
Remedy:
Check all connections and reconnect correctly.

Status: GPR-25 face plate hot to touch

Possible Cause:
(1) Defective GPR-25.

Note: It is normal for the faceplate to get warm during operation. The symptom of a defective GPR-25 is only when then unit gets too hot to touch.

11. Wiring Diagram



12. Limited Warranty

1. Carmanah warrants the GPR-25 for a period of five (5) years from the date of shipment from its factory. This warranty is valid against defects in materials and workmanship for the five (5) year warranty period. It is not valid against defects resulting from, but not limited to:
   - Misuse and/or abuse, neglect or accident.
   - Exceeding the unit's design limits
   - Improper installation, including, but not limited to, improper environmental protection and improper hook-up
   - Acts of God, including lightning, floods, earthquakes, fire, and high winds
   - Damage in handling, including damage encountered during shipment

2. This warranty shall be considered void if the warranted product is in any way opened or altered. The warranty will be void if any eyelet, rivets, or other fasteners used to seal the unit are removed or altered, or if the unit's serial number is in any way removed, altered, replaced, defaced, or rendered illegible

12.1 General Warranty Issues

Please refer to the manufacturers' warranty sheet(s)

1. Carmanah cannot assume responsibility for any damages to any system components used in conjunction with Carmanah products nor for claims for personal injury or property damage resulting from the use of Carmanah products or the improper operation thereof or consequential damages arising from the products or use of the products.
2. Carmanah cannot guarantee compatibility of its products with other components used in conjunction with Carmanah products, including, but not limited to, solar modules, batteries, and system interconnects, and such loads as inverters, transmitters, and other loads which produce "noise" or electromagnetic interference, in excess of the levels to which Carmanah products are compatible.
3. Warranty repair and/or evaluation will be provided only at the Victoria, British Columbia facility of Carmanah. Units for such repair and/or evaluation must be returned freight prepaid to Carmanah with a written description of any apparent defects. Carmanah will not be required at any time to visit the installation site wherein Carmanah products are subject to warranty repair and/or evaluation.
4. Only Carmanah is authorized to repair any of its products, and they reserve the right to repair or replace any unit returned for warranty repair. The party returning a unit for repair is responsible for proper packaging and for shipping and insurance charges, as well as any other charges encountered, in shipping to and from Carmanah.
5. The purchaser's exclusive remedy for any and all losses or damages resulting from the date of sale of this product including, but not limited to, any allegations of breach of warranty, breach of contract, negligence or strict liability, shall be limited, at Carmanah option, to either the return of the purchase price or the replacement of the particular product for which claim is made and proved. In no event shall Carmanah be liable to purchaser or purchaser's customers or to anyone else for any punitive, special, consequential, incidental or indirect losses or damages resulting from the sale of the product, whether based upon loss of goodwill, lost profits, work stoppages, impairments of other goods, breach of contract, or otherwise.
6. This warranty supersedes all other warranties and may only be modified by statement in writing, signed by Carmanah.
7. Warranty terms effective as of January 2, 2004.

12.2 Repair and Return Information

To return items:

1. Call your Carmanah dealer or Carmanah's technical SUPPORT (1-800-667-6527) to try and troubleshoot the problem.
2. Obtain an RMA # by calling your Carmanah sales representative or the RMA department
3. Ensure the RMA # is clearly visible on the outside of the package, or **THE PACKAGE WILL BE REFUSED**.

4. Ship to Carmanah Victoria PREPAID at the following address:
   Carmanah Technologies

Building 4, 203 Harbour Road
Victoria, British Columbia
Canada V9A 3S2

5. Ensure the product is not shipped collect, unless approved by management prior to Carmanah receiving said product, or **THE PACKAGE WILL BE REFUSED**.
6. Test items or items that are not under warranty, or units that are not defective, will be charged a minimum bench charge of ($50.00 US) plus taxes and shipping.
7. A 15% restocking charge will be applied on goods returned and accepted as "new" stock.

13. PHOTOVOLTAIC SYSTEM GLOSSARY

Ampere: A unit of electrical current. Designates the number of electrons flowing per second through a conductive material.

Ampere-Hour (**Ahr**): A unit of energy, typically referring to battery capacity. One ampere of current flowing for one hour.

Azimuth of the Sun: The angular measure between due south and the point on the horizon directly below the sun.

Array: A number of photovoltaic modules electrically connected to produce a single electrical output.

Angle of Incidence: The angle between a ray of sunlight striking a surface and a line perpendicular to that surface. Rays perpendicular to a surface have a zero angle of incidence.

Battery: Two or more electrochemical cells connected to provide energy storage.
May be used to designate one cell. PV system batteries may be "sealed" or "wet acid".

Blocking Diode: A diode application that prevents a battery from discharging through the array at night or if the array becomes shaded. Most charge controllers are equipped with a blocking diode.

Charge Controller: The PV system component that controls the battery's state of charge. It may also provide other system control functions.

Charge Rate: The current applied to a battery to restore its energy capacity. The battery manufacturer will usually have a recommended charge rate for their product. The rate is typically 10 –20 percent of the amp hour capacity at the 20-hour rate.

Current: DC or Direct Current is the type of electron flow provided by a battery or solar cell, which flows in one direction. The unit for current is ampere or amp for short and designated by the letter *I*.

Cycle One battery cycle equals one discharge and one charge.

Deep Cycle Battery: Batteries that are designed to discharge as much as 80% of their capacity as opposed to engine-starting or "shallow cycle" batteries which are designed for heavy cranking but will not stand up to repeated deep discharges.

Depth of Discharge: A measure of how much energy has been withdrawn from a battery, expressed as a percentage of full capacity. A 100 Ahr battery from which 30 Ahr has been withdrawn has undergone a 30% depth of discharge (DOD). This term is the inverse of state of charge (SC); the example battery would be at 70% SC.

Diode: A semi-conductor device that allows current to flow in one direction only.

Equalization: The process that equalizes the specific gravity of all the cells in a battery by means of a controlled overcharge that breaks down sulfation on the battery plates. Most inverter/chargers and some charge controllers are equipped with this feature.

Grid-Connected: A power system interconnected with the grid (or *mains*) of the local electric utility. Also referred to as *utility-interactive.*

Hybrid System: A power system consisting of two or more energy sources (e.g., a PV array and a wind generator.)

Hydrometer: A device used to measure the specific gravity (SG) of the electrolyte in a wet acid battery. A hydrometer provides a very accurate way to see the true charge of a battery.

Insolation: The solar energy received at a place over a given period. May be expressed as sunhours per day, watts per square meter per hour, or any number of other units.

Inverter: A device that converts DC electricity to AC.

Isolation Diode: A diode application that prevents one segment of a PV array from interacting with another array segment. Usually used in situations where two parts of an array are facing in different directions therefore one part of an array may experience shading while the other does not. Prevents array energy from flowing backwards through a low voltage string of the array. May also serve the function of *blocking diode*.

Maximum Power: Also referred to as *peak power.* The point of a solar array, panel or module output where the product of "Imp" and "Vmp" ("Pmax", measured in watts) is maximized. The points used to calculate Pmax are Imp (current @ max power) and Vmp (voltage @ max power.)

Module: A number of solar cells electrically connected, and protected from the environment usually by an aluminum frame covered with a pane of glass. A module is self-contained and not sub dividable, therefore providing a single electrical output.

Nominal Operating Cell Temperature (**NOCT**): The temperature at which cells in a module operate under *Standard Operating Conditions* (**SOC**), which are: irradiance of 0.8 kW/m2, 20ºC ambient temperature, and average wind speed of 1 m/s, with the wind oriented parallel to the plane of the array, and all sides of the array fully exposed to the wind.

Open-Circuit Voltage (**Voc**): Refers to a photovoltaic device's voltage potential when it is disconnected from the rest of the PV system.

Parallel Connection: Electrical connection where the positive terminals of a number of devices are connected together, as are their negative terminals. The output voltage is usually limited to the device with the lowest voltage, and the total current is the sum of the current of all the devices.

Photovoltaic (**PV**): Capable of producing a voltage when exposed to radiant energy, especially light.

Sealed Batteries: Electrolyte will not spill out and gassing is kept to a minimum**.** A sealed battery is maintenance free and may be installed in several orientations.

Series Connection: Electrical connection where the positive terminal of one device is attached to the negative terminal of the next in a series string; in this connection, the string voltage is the sum of the device voltages and the string current is limited to the current of the least productive device in the string.

Short-Circuit Current (**Isc**): Refers to a photovoltaic device's current output when the positive terminal is directly connected to the negative terminal.

Solar Panel: A group of photovoltaic modules mechanically mounted on a single frame. A single module on a frame may be referred to as a solar panel.

Specific Gravity: In relation to a wet acid battery, it is the density of the electrolyte (battery acid) compared with the density of water thereby measuring the battery state of charge.

Standard Operating Conditions (**SOC**): A set of reference PV device measurement conditions consisting of irradiance of 0.8 kW/m2, 20ºC ambient temperature, and average wind speed of 1m./s, with the wind oriented parallel to the plane of the array, and all sides of the array fully exposed to the wind.

Standard Test Conditions (**STC**): A set of reference PV device measurement conditions consisting of irradiance of 1 kW/m2, AM 1.5, and 25ºC cell temperature.

Standalone System: A power system not connected to the utility grid (*mains*.) Sometimes referred to as an autonomous system.

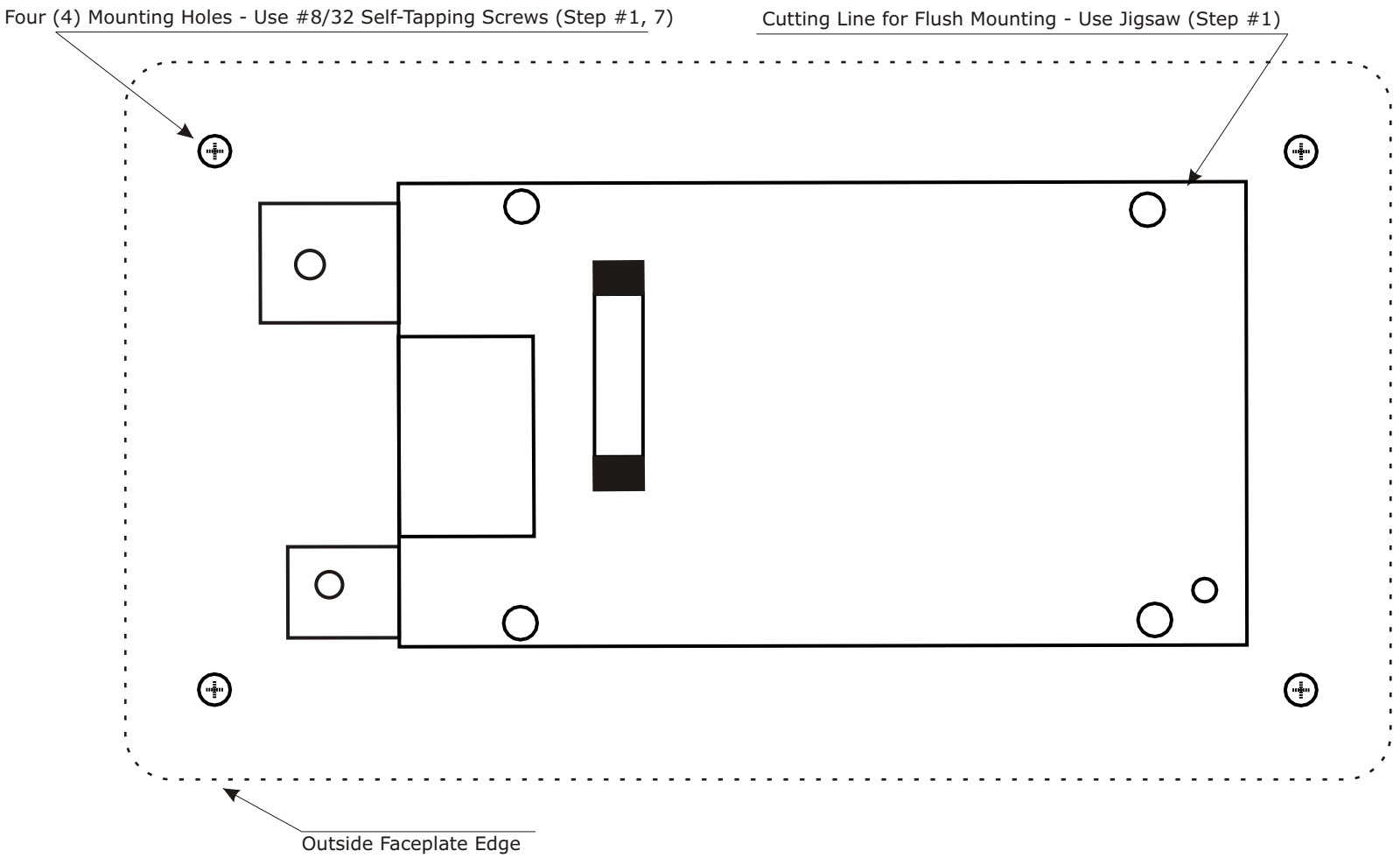
State of Charge (**SC**): The percentage of energy in a battery referenced to its nominal full capacity.

Sulfation: The formation of lead sulfate crystals on the plates of a lead-acid battery. Normally used to refer to large sulfate crystals, rather than small crystals formed in normal battery operation. The plates of a battery will sulfate if left in a partially charged state, causing reduced battery capacity and shortening the life of the battery. If caught in time, *equalization* will remove the buildup of sulfation.

Voltage: The electrical potential between two points. Voltage is analogous to water pressure in that it pushes the electrons or current through a conductor. The unit for voltage is volt and designated by the letter *V*.

Wet Acid or Flooded Batteries: The most common type of PV battery. Battery caps may be removed to expose the electrolyte liquid inside the battery. Need proper ventilation due to gassing and may need to be topped up with distilled water at regular intervals.

Faceplate Mounting Template



IMPORTANT: Use this template insert to mount your faceplate.