

# C-CHARGER®

Marine Electronic Alternator Regulator

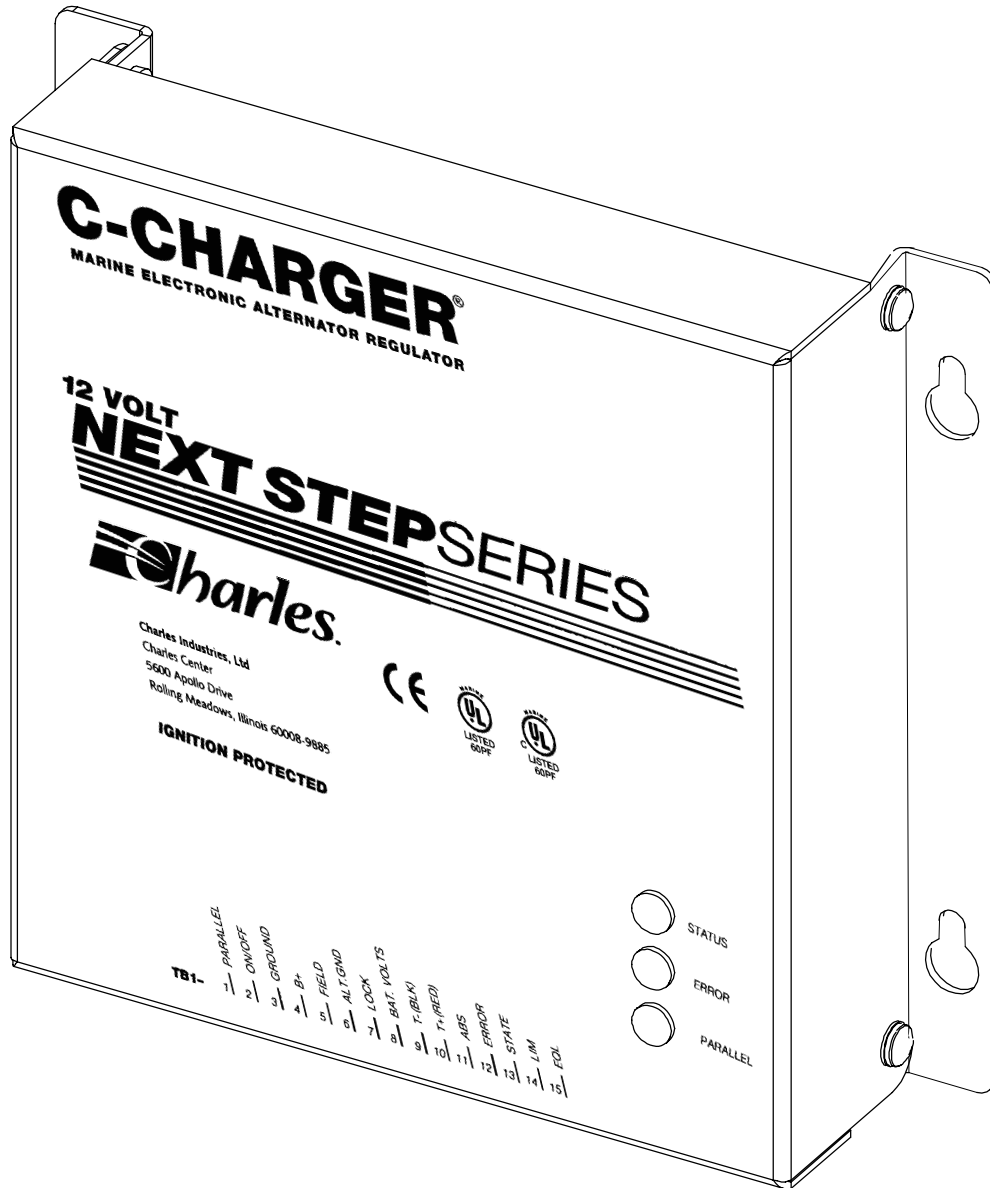
## INSTALLATION INSTRUCTIONS & OWNER'S MANUAL

Models: 93-12PREG

93-24PREG

9A-12PREG

9A-24PREG



Charles Industries, Ltd.

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## INTRODUCING... THE ALTERNATOR REGULATOR

*Thank you* for purchasing the Alternator Regulator! The Alternator Regulator controls the field current of an alternator so that the output DC voltage will regulate and charge batteries.

### Manual Purpose

With your personal safety in mind, this manual lists important safety precautions first, then covers installation, operation, maintenance, troubleshooting, warranty, and customer service information.

## APPLICATION

### Alternator Requirements

The alternator must be an externally regulated model with one brush connected to ground and the other brush fitted with a connection to make the field connection (P-type).

*Note:* Alternators not rated for continuous operation at high current and temperature may fail when driven by the regulator unless current is limited to a safe value.

## IMPORTANT SAFETY INSTRUCTIONS

**SAVE THESE INSTRUCTIONS.** This manual contains important safety and operating instructions for the Alternator Regulator. Read the entire manual before using this unit. Also read all instructions and cautions for and on the Alternator Regulator.

### Installation Precaution

Boat wiring is a complex task that can cause shock, corrosion and other hazards if not done properly by trained, experienced personnel. For more information on this subject contact the **American Boat and Yacht Council (ABYC)** or see the standards and regulations below:

#### American Boat and Yacht Council E-11 "AC and DC Electrical Systems on Boats"

3069 Solomon's Island Road  
Edgewater, MD 21037  
Telephone: 410.956.1050  
FAX: 410.456.2737

#### NFPA Standard 302. "Pleasure and Commercial Motor Craft"

National Fire Protection Association  
1 Batterymarch Park  
P.O. Box 9101  
Quincy, MA 02269-9401  
Telephone: 800.344.3555

#### Rules and Regulations for Recreational Boats

Excerpts from the United States Code (USC) and the Code of Federal Regulations (CFR) (U.S. Coast Guard Regulations) are available from the **American Boat and Yacht Council** listed above.

*Note:* Installation of the Alternator Regulator must be made in accordance with all applicable standards and regulations.

### Environmental Precaution

The Alternator Regulator is intended for installation inside an engine room or elsewhere inside the boat. Make sure that the location will not subject the unit to rain, snow, excessive moisture, excessive heat, or corrosive elements.

### Application Precaution

These units are intended for hard-wired, permanent, on-board applications. Use of attachments not recommended or sold by Charles Marine Products may result in risk of fire, electrical shock or personal injury.

### Damaged Unit Precaution

Do not operate the Alternator Regulator if it has received a sharp blow, been dropped, immersed in water or otherwise damaged. See the section in this manual on *Warranty & Customer Service* for repair information.

### Disassembly Precaution

Do not disassemble the Alternator Regulator. See the sections in this manual on *Maintaining the Alternator Regulator*, *Troubleshooting the Alternator Regulator* and *Warranty & Customer Service*.

## MOUNTING

### Choosing Mounting Hardware

As with any marine equipment, secure mounting is of utmost importance. You will need to provide four #8 bolts or screws to secure the unit. The screws or bolts you choose should be backed with a flat washer and kept vibration-free with a split-ring lock washer. If using bolts, they must be secured on both sides of the bulkhead and also backed with a washer or washer plate. If using screws, they should be at least 1" long. All hardware must be corrosion-resistant stainless steel or cadmium-plated steel.

### Mounting the Alternator Regulator

The regulator is protected against ambient humidity, but must be mounted in a dry location free of moisture, dust, and other environmental insults. The regulator will operate in temperatures to 140° F (60° C).

#### **WARNING – ELECTRICAL SHOCK HAZARD**

**Use care when drilling to avoid contact with any wires or live components.**

Step	Action
1.	Carefully lower and position the Alternator Regulator in the exact location the unit will be installed. <i>Note: The wiring enclosure should be visible and accessible.</i>
2.	Mark the location of the mounting holes.
3.	Remove the regulator and drill the four marked holes with the proper-sized drill bit.
4.	Realign the regulator's mounting holes with the drilled holes and fasten the unit to the mounting surface with the appropriate mounting hardware.
5.	Firmly secure all mounting hardware.

## WIRING

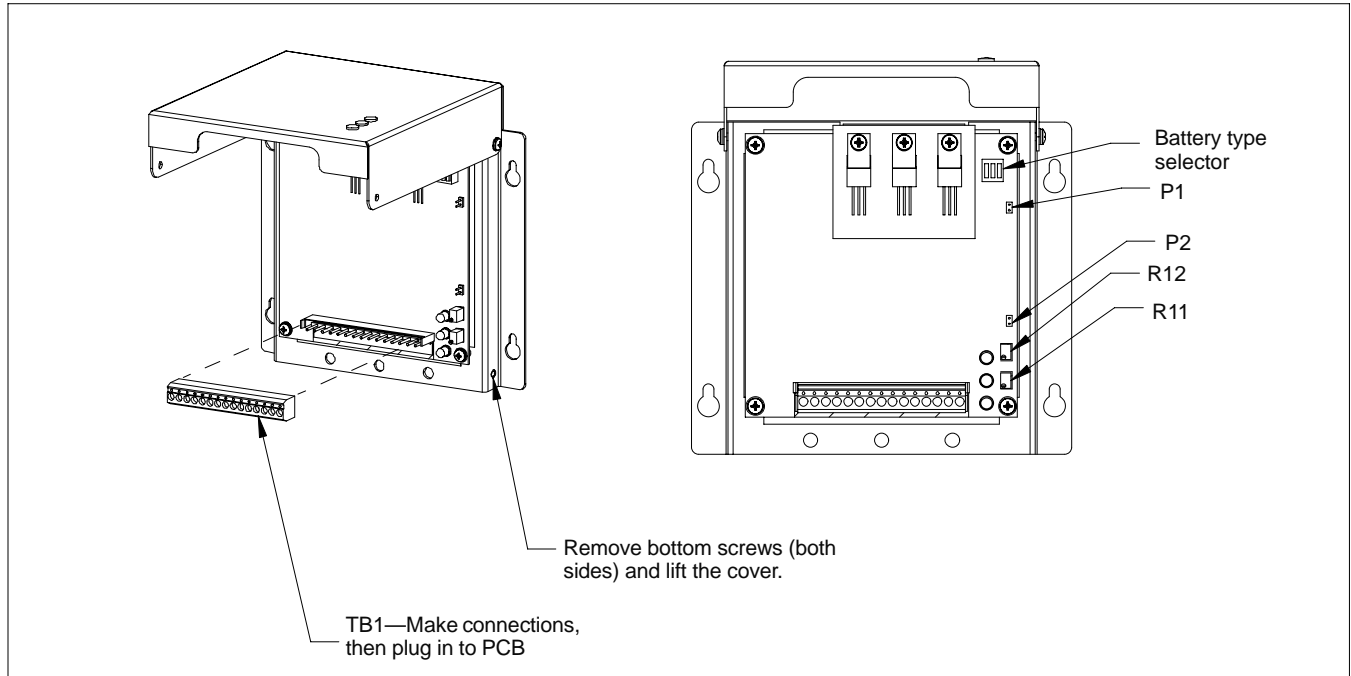
The wiring diagram shown in Figure 2 is the only way to wire the regulator. Do not wire in any other way (such as combining ground wires or battery positive wires).

*Note: The parallel solenoid, the error lamp, and the status lamp are wired to their respective outputs with their other connection returned to ground. All inputs at the terminal block are activated when they are connected to battery voltage. Leave terminals open if they are unused.*



**DANGER**

**Use fuses where shown. Failure to do so may result in fire.**



**Figure 1. Connecting the Terminal Block to the Alternator Regulator**

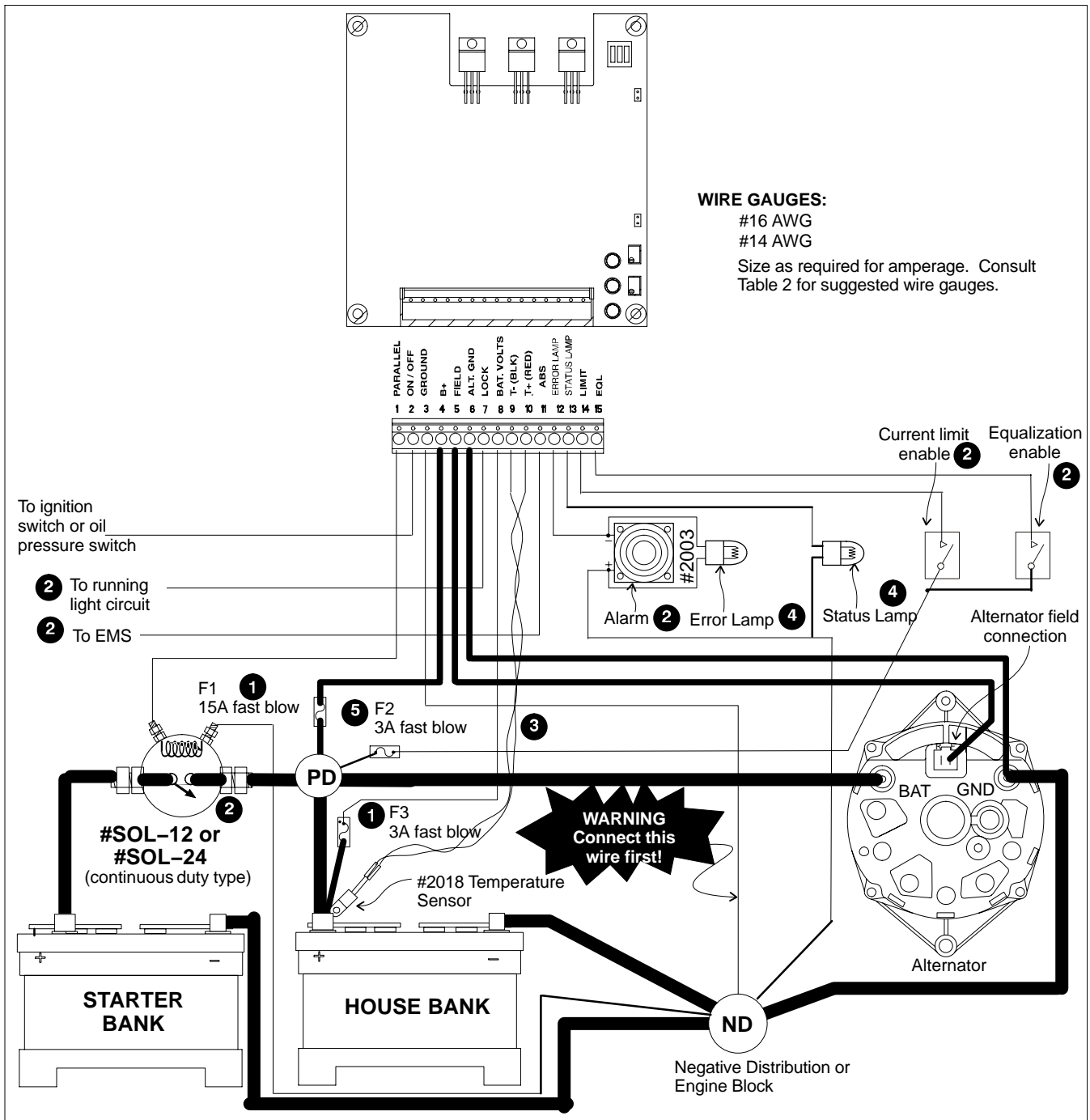


Figure 2. Alternator Regulator Wiring Diagram

Table 1. Notes for Figure 2

1	Required in-line fuse and holder or equivalent.
2	Optional
3	The temperature sensor wires should be a twisted pair at a minimum. For extremely noisy environments, use shielded pair wiring.
4	Optional lamps may be up to 0.5 watt (0.05 amps maximum).
5	In-line fuse and holder or equivalent should be used when optional switches are installed.

**Table 2. Suggested Wire Gauges**

Wire Length (feet)	< 140 Amps	< 200 Amps
10	#6	#6
20	#4	#2
30	#2	#1
40	#1	#0
50	#0	#00

Table 3 shows all the signals available, whether or not they are required, and their function.

**Table 3. Alternator Regulator Signals**

Pin #	Signal Name	Required	Function
1	PARALLEL	NO	An output that has a positive voltage when the regulator detects that the house battery is being charged. The maximum load is 1.5 amps.
2	ON/OFF	YES	A positive voltage that turns the alternator field circuits of the regulator on. Typically connected to the ignition switch or oil pressure switch. Typical draw is 0.003 amps  <i>Note: On gasoline engines, do NOT connect to the ignition coil circuit. Connect at the ignition switch.</i>
3	GROUND	YES	The reference ground for the regulator. All battery voltages are referenced to this wire. <b>Connect this wire first.</b>
4	B+	YES	The source of power for the alternator field current, PARALLEL, ERROR lamp, and STATUS lamp. Amperage draw on this wire is the same as the alternator field current: 15 amps maximum.
5	FIELD	YES	The wire driven positive by the regulator to make the alternator charge. Voltage at this point depends on how much current is being produced by the alternator, and varies from zero to battery voltage.
6	ALT. GND	YES	The return line for field current.  <i>Note: Absence or loss of this connection will prevent charging. Do NOT jumper this wire to the ground tab.</i>
7	LOCK	NO	If connected to battery voltage, the regulator is locked at battery gassing voltage, typically 13.8 volts. Used to prevent higher voltages when halogen lights are being used. Removal of the lock signal causes the regulator to go to the float setpoint.
8	BAT. VOLTS	YES	The sense wire for battery voltage. Any voltage drop in this wire from the battery can cause overcharge.
9	T- (BLK)	NO	Ground side of the temperature sensor which is supplied with the regulator.
10	T+ (RED)	NO	Positive side of the temperature sensor. Voltage at T+ is 2.98 volts at 25° C, and varies plus and minus with temperature at the rate of 0.01 volts per degree C. Some battery manufacturers require temperature sensing of the battery for warranty purposes. In all cases (except for temporary troubleshooting) we recommend using the temperature sensor at all times.
11	ABS	NO	A positive voltage at ABS will lock the regulator at the absorption setpoint. Typically used with the Charles Industries Energy Management System.
12	ERR	NO	A positive going signal that provides troubleshooting information identical to the red Error LED (see Table 6). Maximum current permitted from the ERR output is 0.05 Amps.

Pin #	Signal Name	Required	Function
13	STATE	NO	A positive going signal that provides troubleshooting information identical to the green Status LED (see Table 5). Maximum current permitted from the STATE output is 0.05 Amps.
14	LIM	NO	If connected to battery voltage, the regulator is duty-cycle-current limited at the setting of potentiometer R11 (see Figure 1).
15	EQL	NO	This input is used to select either the regulator's equalization mode or a second duty cycle current limit, depending on internal jumper P1. This input is activated when battery voltage is applied to EQL. The duty-cycle current limit is adjusted with potentiometer R12 (see Figure 1).

### Voltage and Absorption Time Setpoints

Voltage and the time of the absorption cycle are controlled by internal dipswitch S1. Select a charge profile by setting the battery type switches on S1 according to Table 4.

#### IMPORTANT

**Voltages and absorption time should be measured with the temperature sensor disconnected.**

**Table 4. Voltage and Absorption Time Dipswitch Settings**

Battery Type	S1-1	S1-2	S1-3	Absorption (v)	Float (v)	Eq. (v)
Thick Plate Liquid	OFF	OFF	OFF	14.4	13.6	16.2
Medium Plate Liquid	ON	OFF	OFF	14.4	13.6	16.2
East Penn Gel	OFF	ON	OFF	14.1	13.4	—
Concorde AGM	ON	ON	OFF	14.3	13.3	15.5
Optima	OFF	OFF	ON	14.3	13.4	15.5
Exide Gel	ON	OFF	ON	14.2	13.4	—
Johnson Control Gel	OFF	ON	ON	14.2	13.4	—
Ample Power Gel	ON	ON	ON	14.4	13.5	—

## OPERATING THE ALTERNATOR/REGULATOR

The regulator is on whenever power is present at TB1-4 (B+). Without the ON/OFF output on TB1-2, the regulator is simply controlling the parallel solenoid, and will close the solenoid whenever the voltage on TB1-8 indicates that the main battery is being charged.

### At Power-Up

When the regulator is first turned on, the red ERROR LED will glow for 5-8 seconds before extinguishing. Then the green STATUS LED will start to flash status information, typically 2 seconds off, 1 second on (bulk charge). If there is a positive voltage on TB1-2, ON/OFF, the alternator should start to charge after the ERROR LED goes off. Charging can be controlled using the ON/OFF input.

### Input Priority

The input signals are recognized in the following priority (the earlier listed input overrides all the inputs below it).

1. EQL
2. LIM
3. ABS
4. LOCK



Each input is described in detail in the following paragraphs.

### **ABS Input**

When this input is connected, the alternator regulator is held at the absorption setpoint. Removal of the input signal causes the alternator regulator to begin stepping towards the float voltage. Step-to-float is an intermediate mode where the float setpoint is approached in small steps over time. This is done in an attempt to maintain some alternator output and keep the tachometer alive.

### **LOCK Input**

This input locks the alternator regulator at the gassing setpoint, which is halfway between the absorption and the float setpoint. Removal of the signal toggles between stepping to float or going to the absorption setpoint. The first time the signal is removed, the alternator regulator steps to float. The next time the signal is asserted, the regulator will go to the absorption setpoint. The LOCK input can be used to completely control the setpoint.

### **Current Limiting (LIM & EQL)**

Two potentiometers with two input signals permit duty cycle current limiting at two specific setpoints. Duty cycle current limiting is a mode in which the maximum amount of time that the alternator is driving the field is set by the potentiometer. Current limiting is useful to reduce alternator output, reducing horsepower requirements from the engine.

Two settings are available (LIM and EQL). EQL overrides the LIM input. For normal limiting on a small engine, use the LIM input. The EQL input can be connected to the same switch that enables another load on the engine. For instance, a clutch-driven pump may require a further reduction in current; in that case, wire the EQL input to the switch that activates the clutch for the water pump. The potentiometer for LIM is R11. R12 sets the current limit for the EQL input.

### **Equalization**

Equalization is a process in which the voltage on the battery is allowed to rise to a higher voltage, typically 16.2/32.4 volts for most batteries; applied current is limited to 3–7% of the Ah capacity of the battery. The applied current must be set using R12.

The EQL input is used for a second current limit whenever the input signal is activated. To enter actual equalization mode, the two pins of P1 must first be shorted with a jumper terminal or a switch connected to the two pins (refer to Figure 1). This changes the mode of the EQL input signal to regulate at the equalization voltage setpoints, as well as current limit. Then the EQL limit should be activated for at least 2 seconds, then released. To terminate the equalization process, activate the limit a second time. Equalization terminates automatically whenever the ending voltage or time is achieved.

*Note: Equalization produces a higher voltage than some normal equipment can tolerate. Turn off equipment that will not tolerate an input of 17 volts or more.*

The alternator regulator does not permit equalization for the gel batteries selected by S1.

## The STATUS LED

This green LED shows at which setpoint the regulator is presently operating. Status is shown by flashing the LED ON and OFF—times in seconds as shown in Table 5. The same information is available at the STATE output.

**Table 5. Status LED**

Status	ON	OFF
Bulk Charge	2	1
Gas Charge	6	1
Absorption Charge	1	1
Step to Float	1	6
Float Charge	2	2
Gas Lock	3	1
ABS Hold	1	3
Equalization Charge	6	6

## The ERROR LED

Abnormal conditions are reported by the red ERROR LED (and the external lamp/alarm, if wired). Errors are indicated by flashing the LED ON and OFF—times in seconds as shown in Table 6.

**Table 6. Error LED**

Error	ON	OFF
Can't turn field off	1	1
Can't turn field on	1	3
Battery volts disconnected	3	1
Over temperature	3	3
Voltage runaway	6	3
Bad temperature sensor	6	6
Field short circuit	3	6

## ALTERNATOR REQUIREMENTS

The alternator must be an externally-regulated model with one brush connected to ground and the other brush fitted with a connection to make the field connection (P-type).

*Note: Alternators not rated for continuous operation at high current and temperature may fail when driven by the regulator unless the current is limited to a safe value.*

## TROUBLESHOOTING

Most problems with new installations are due to wiring faults. Look at the signal list (Table 3) and make sure that all required wires are in place and properly connected.

Remove the T+ connection to prevent a faulty temperature sensor from affecting the system.

If all required wires are proper, as verified by a multimeter on the regulator connections, call your dealer or local installer with voltage readings on all the regular connections. Measure the ON/OFF signal with the ignition switch off, and again with it on.

## WARRANTY & CUSTOMER SERVICE

### Warranty

The CHARLES Marine & Industrial Group warrants the unit will be free from defects in materials and workmanship that cause mechanical failure for two (2) years, as set forth in the Limited Warranty. Notice of any alleged defect in material or workmanship must be provided within thirty (30) days of discovering the problem, and within the warranty period. Follow the procedure outlined below to obtain warranty service.

### Service Center and Repair Correspondence

*Note: Do not attempt to service the unit. Contact the Service Center.*

To contact the Service Center via telephone directly:

800-830-6523 (Toll Free)

217-932-2317 (Voice)

217-932-2473 (FAX)

Call to obtain a Returned Materials Authorization (RMA) number prior to returning any unit to Charles Industries.

Return the unit for repairs to the Service & Repair Center address below:

Charles Industries, Ltd.  
Marine & Industrial Group  
503 NE 15th Street  
Casey, IL 62420-2054  
USA

Correspondence can be sent to Corporate Headquarters via the address below:

*Note: Do not return the unit to this address.*

Charles Industries, Ltd.  
Marine & Industrial Group  
5600 Apollo Drive  
Rolling Meadows, IL 60008-4049  
USA  
847-806-6300  
www.charlesindustries.com

## SPECIFICATIONS

The specifications for the Alternator Regulator are listed in Table 7.

**Table 7. Alternator Regulator Specifications**

Feature	U.S.	Metric
Input Voltage	12/24 VDC (nominal)	
Input Current	15 Amps	
Output Current	15 Amps	
Operating Temperature	32° to 140° F	0° to 60° C
Approximate Weight	1 pound	0.4356 kilograms
Height	5.85 inches	14.86 centimeters

Width	6.70 inches	17.02 centimeters
Depth	1.65 inches	4.2 centimeters

