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DC CHARGING SOLUTIONS

96-SERIES ALTERNATOR

MAX CHARGE MC-620
MULTI-STAGE VOLTAGE REGULATOR

INSTALLATION AND OPERATION MANUAL

INTRODUCTION

This manual covers the installation, configuration and use of the Balmar Max Charge MC-620 regulator and 96-Series alternators. These two products are designed to be used together to provide up to 4.8kW of smart, multi-stage charging for 48-volt batteries.

The MC-620 Balmar Max Charge regulator provides precise voltage control for Balmar's 96-Series high-output 48-volt alternators. The MC-620 features user selectable programs for all major battery types. In addition to the user selectable preset programs, the MC-620 features a wealth of advanced programming modes which make it possible to tailor charging to a wide variety of environments. When used in conjunction with the (required, not included) MC-TS-A alternator and (optional) MC-TS-B battery temperature sensors, the MC-620 features the ability to monitor and respond to a range of ambient temperature conditions, including reduction or discontinuation of charging voltages, should an over-temperature condition occur at the alternator or the batteries.

The 96-Series alternators charge 48V battery banks with unprecedented power in a mid-sized J-180 mount case. Both the 60A and 100A versions feature impressively low turn-on speeds and excellent performance at low rpms.

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Safety Considerations

1. *Always disconnect your battery banks and ensure that switches are "OFF" prior to installing your regulator.*
2. *Remove loose-fitting clothing or jewelry, which could become entangled in your motor or other machinery prior to installing regulator and alternator.*
3. *Wear ANSI-approved safety eye-wear and protective gear.*
4. *DO NOT attempt to modify the regulator or alternator. Modifications could result in damage to your charging system, and will void your warranty.*
5. *DO NOT attempt installation if you are tired or fatigued.*
6. *Ensure that the engine has cooled before initiating installation.*
7. *DO NOT attempt regulator installation while using alcohol or medication that could impair your judgment or reaction time.*
8. *Always use the right tool for the job. Improper tool use may damage regulator or your vessel, and could result in personal injury.*
9. *Take time to read the manual. Equipment damage and possible injuries may result from an incomplete understanding of the installation and operation of the MC-620 regulator and 96-Series alternators. If you are unfamiliar with marine electrical systems, consult with a licensed marine electrician.*

The following instructions are intended for use by experienced marine electrical installers. If you are not experienced at installing electrical system components, we recommend the use of **a qualified marine electrical technician.**

The 96-Series alternators cannot be driven (receive field voltage) from a regulator that supplies 48V field voltage. The MC-620 cannot be powered from 48V battery. Irreparable damage will occur immediately if 48V power is applied improperly. Sustained 48V power connected to the regulator's power input can result in fire.

NOTE: The engine manufacturer's instructions for alternator installation take precedence over these basic instructions.

NOTE: This manual follows best practices and standards of The American Boat and Yacht Council (ABYC). If installation is being used in another jurisdiction or application, please consult with the appropriate governing body or standards organization for any appropriate guidelines or regulations.

ALTERNATOR INSTALLATION CONSIDERATIONS

It is out of the scope of this manual to provide step-by-step alternator mounting instructions, as every installation and engine configuration is different. Below you will find information that can help ensure a complete, safe installation. If you are unsure about any aspect of the installation, please consult with a qualified installation professional.

1. Ensure the battery switch is in the OFF position. Prior to installation, ensure that the Balmar alternator mounting configuration is compatible with the mounting hardware installed on the engine. Ensure that the replacement alternator is adequately sized to meet the demands of your battery banks. As a rule of thumb, the alternator should be rated at 25-40% of your house battery capacity, depending on the battery chemistry.
2. Ensure that the belt or belts driving the alternator are capable of handling the alternator's horsepower load.
3. Only use the MC-620 regulator with 96-Series alternators, and visa-versa.
4. 96-Series alternators are NOT isolated ground (they are case ground), but provide an auxiliary ground stud on the rear cover of the alternators for convenience and best performance.
5. Cables should be sized for <3% voltage drop over the length of the cable.
6. Secure heavy battery cables to the engine within 12 inches from the alternator. The cables MUST be attached to the engine first, before transitioning to the vessel or a surface that is not part of the engine. Failure to do this may work harden the alternator posts/connections, resulting in damage.
7. Check all electrical connections for continuity and ensure no cable or wire can touch the belt or other moving parts of the engine.
8. After installation of the alternator, check for pulley alignment. Misaligned pulleys are one of the largest causes of alternator overheating and failure.
9. Belt tension is a critical aspect of alternator performance. Monitor belt tension after every charge cycle for the first several weeks of engine operation. We recommend a belt tensioning gauge for accurate deflection measurement. Make belt tension monitoring and adjustment a part of regular maintenance.

Use extreme caution when handling the alternator or other engine components during or after use. Should your alternator become so hot that it emits a burning smell, or if there is indication of discoloration at the pulley or pulley shaft, shut off the alternator immediately and (once it becomes safe to inspect the alternator) check the tension of the drive belt. Under- and over-tensioned belts are the leading cause of overheating and alternator damage. See the Troubleshooting section, later in the manual, for alternator inspection guidelines.

Alternator overheating is often a result of the one or more of the following conditions:

1. Belt mis-alignment.
2. Belt over or under tension.
3. Inadequate engine room cooling.
4. Loose or corroded battery cables or connectors.

ALTERNATOR TO BATTERY FUSING

The American Boat and Yacht Council (ABYC), in its standards for safer boating recommends that cable runs to your battery banks be fused to protect the boat and owner against damage and injury. Circuit protection, as described by ABYC standards can be accomplished by installing either a resettable circuit breaker or a fuse. The fuse or breaker you choose will depend on both the amperage rating of the alternator and the size of cable used. The following considerations can be used to determine fusing:

1. The largest available circuit protection device smaller than the amperage capacity of the cable being protected.
2. Larger than the maximum continuous current that will flow in the circuit.

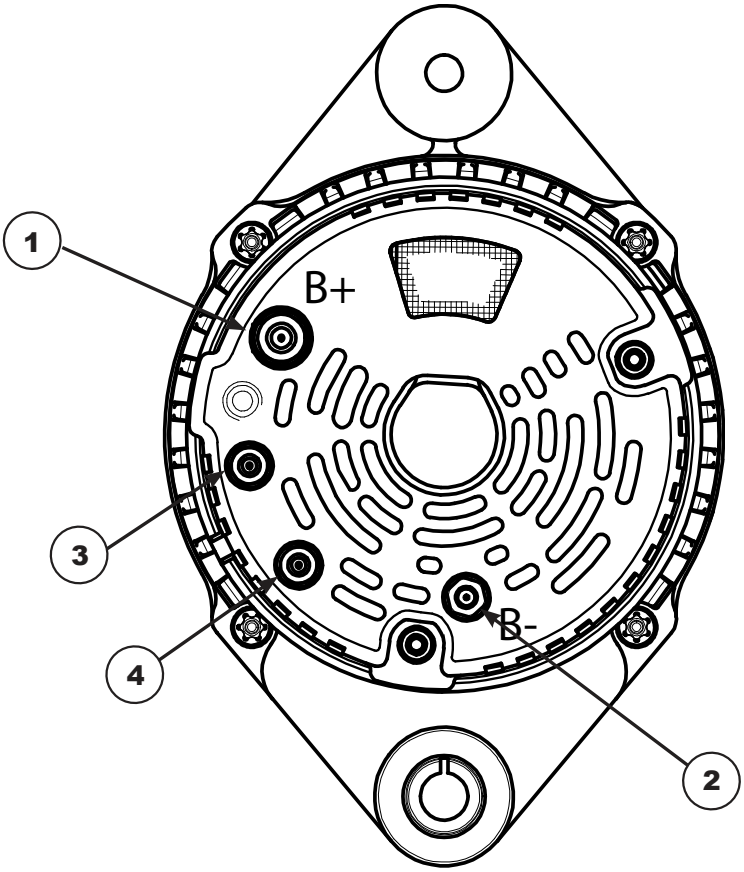
We find that a circuit protection device sized at approximately 140% of your alternator's rated amperage is typically suitable for the circuit being protected. For more info about circuit fusing, see https://tinyurl.com/r8comkd

ALTERNATOR OUTPUT-TO-BATTERY CAPACITY RATIO

In order to achieve optimal performance from your charging system, it is essential to determine the capacity your charging system is capable of supporting. In general, the size rating of the alternator should mirror the acceptance rate of the batteries being charged. Differing battery technologies will vary in terms of their acceptance rates. For example, a deep-cycle flooded battery is typically capable of accepting roughly 25 percent of its available capacity during bulk charging. As a result, we want our alternator's rated output to equal the acceptance rate of the battery being charged when it reaches its full discharge rate.

In other words, a deeply discharged 400 amp hour deep cycle flooded battery would require an alternator rated at 25 percent of 400 amps, or 100 amps to support that bank. In simpler terms, a deep-cycle flooded battery bank will require 25 amps of alternator output for every 100 amp-hours of battery rating. Some newer battery technologies, such as AGMs and spiral wound batteries can accept 40 percent or more of their available capacities.

Many $LiFePO_4$ lithium batteries can accept 100% or more of the battery capacity. Therefore, alternator output should be increased to reflect the optimal ratio between alternator and battery capacity. Failure to meet recommended alternator-to-battery ratios will commonly result in slower charge times, increased alternator heat and wear, and reduced alternator life.



96-SERIES ALTERNATOR WIRING

MID-SIZED case 96-Series alternators are designed to provide 60 or 100 amps at 48 volts. Mounting is a 4” DU-AL-FOOT J-180 mount. Alternators in the 96-Series are case ground, use external regulation and have 12-pole stator output.

1. **Positive Output Terminal** - Must be connected via properly-sized cable to the battery or batteries being charged. Cable size is determined by alternator output and length of cable run.
2. **Auxiliary Ground Post** - Even though the alternator is case ground, this stud provides a direct connection to the negative rectifier plate, and can be used for best performance with a properly sized negative cable to the battery.
3. **External Field Wire (BLUE)** - Connects to MC-620 voltage regulator via wiring harness
4. **Stator Output Wire (WHITE)** - Provides an unrectified source of AC voltage which can be used as a signal for an electric tachometer. Contact the manufacture of the tachometer before connecting, as most may not be compatible with the higher AC voltage from a 48V alternator.
5. **Temp Sensor (Not Shown)** - There is a tapped hole on the side of the rear casing for the (Optional) MC-TS-A sensor. Do not bend the heat shrink or ring terminal

Unsupported cables may damage the positive or negative terminals, resulting in damage to alternator, regulator and wiring. Ensure that cables are adequately supported to supply strain relief.

MC-620 REGULATOR INSTALLATION

The following information is intended to provide the installer with the basic information required to complete installation. This section of the installation manual will deal with mounting, wiring connections and basic programming for battery type. Additional information regarding advanced programming adjustments and troubleshooting are addressed later in the manual.

UNPACKING THE BOX

Your Max Charge MC-620-H regulator kit is packaged with the following items:

- Max Charge MC-620 Regulator
- 54” Wiring Harness for the 96-Series Alternator
- Magnetic Programming Tool
- MC-620 Quick Start Guide
- Spade Terminal for Voltage Sense wire.

If any of the listed items is not included with your regulator kit, call our customer service department at +1-360-435-6100. Please note - If your regulator box is marked Max Charge MC-620, without the “H” designation your kit will not include the wiring harness.

LOCATE AND MOUNT THE REGULATOR

Choosing a mounting location for your voltage regulator should be determined based on the following factors; distance from alternator, distance from inverters, transmitters and other sources of RF noise, convenient access and readability of the display. The regulator wiring harness is 54 inches long, providing a three to four foot radius for mounting. Ample airflow is essential for the regulator’s proper operation. Ensure that the regulator is free from obstructions that restrict air movement around or below the regulator’s aluminum heat sink. While the regulator is designed to operate safely in conditions typical of a marine engine compartment, the regulator may be better protected, and easier to use and monitor if mounted outside of the engine compartment. The max operating temperature is 90°C.

Should it be necessary to install the regulator further than 54” from the alternator, ensure that any wire extensions are properly connected, as resistance in the harness wiring can affect charging efficiency. If harness length must reach beyond approximately 8’, replace the RED power and BLUE field wires with larger gauge wire that’s sized to ensure voltage drop < 3%.

BASIC WIRING INSTALLATION

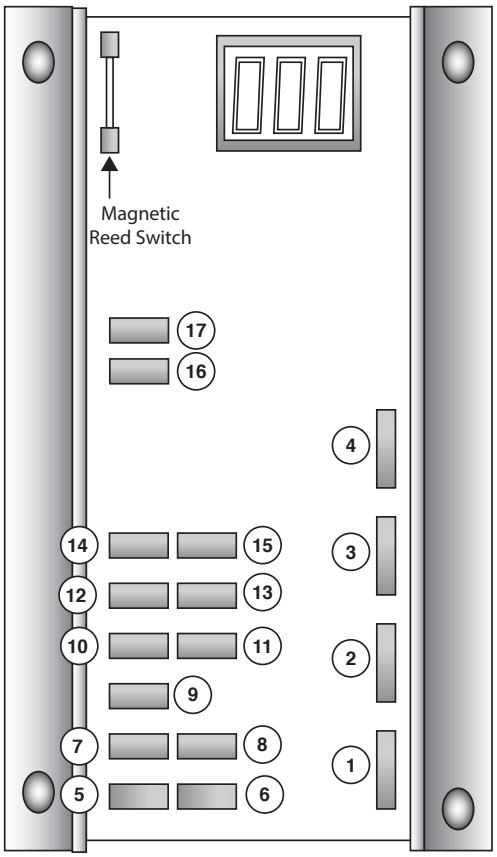
The regulator’s wiring harness includes six wires required for standard installation. Four of those wires are connected to the regulator via a Ford-style plug connector that’s pre-installed on the regulator. These wires include the Ground (BLACK), Power (RED), Ignition (BROWN), and Field (BLUE). The other two wires are 48V Voltage Sense (RED) and Stator (WHITE).

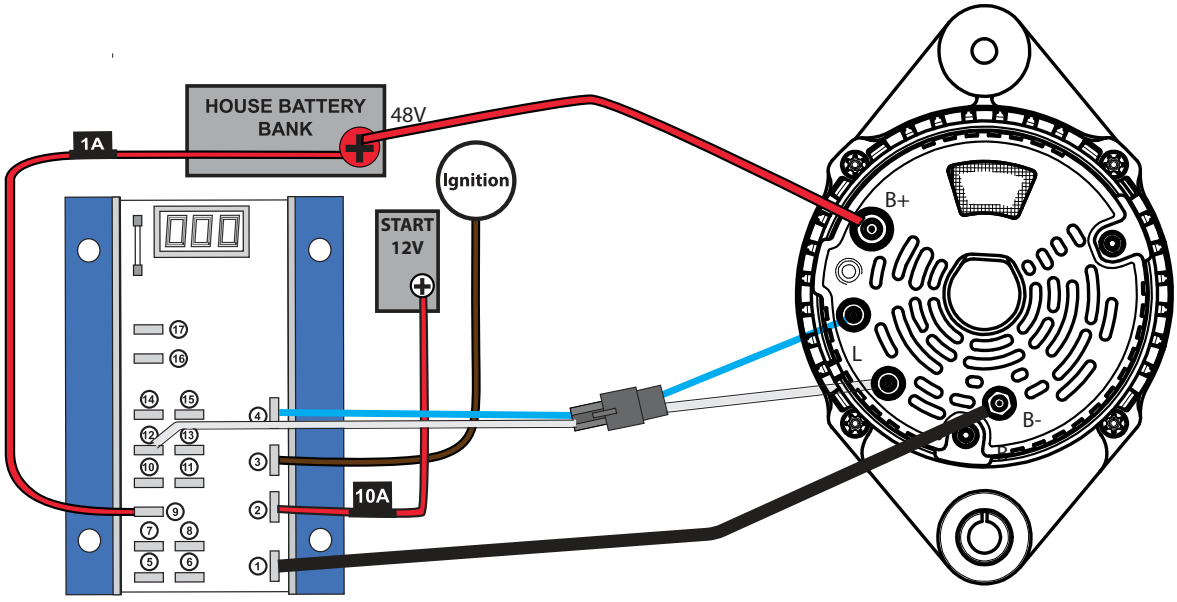
The sense wire in the harness is designed to connect to the positive post on the alternator. For most accurate sensing and the best charging performance, consider sensing the battery voltage directly at the battery. This wire is not included. Ensure that appropriate fusing for the wire run is used, and tape or cap of the unused sense wire in the harness.

Connecting the 12V Power lead from the regulator to a 48V battery bank or the B+ Terminal of the alternator will destroy the regulator. This is not covered under warranty. Only connect the 12V power lead to a 12V battery, typically the engine starting battery.

MC-620 Regulator Terminal Layout

1. GROUND INPUT
2. POWER INPUT - 12V ONLY!!!!
3. IGNITION INPUT - 12V ONLY!!!
4. FIELD OUTPUT
5. ALT. TEMP. (-)
6. ALT. TEMP. (+)
7. BAT. TEMP. #1 (-)
8. BAT. TEMP. #1 (+)
9. 48V BATTERY VOLTAGE SENSE
10. DATA TX
11. DATA RX
12. STATOR IN
13. TACHOMETER OUT
14. BAT. #2 TEMP. (-)
15. BAT. #2 TEMP. (+)
16. AUX. #1 LAMP
17. DASH LAMP

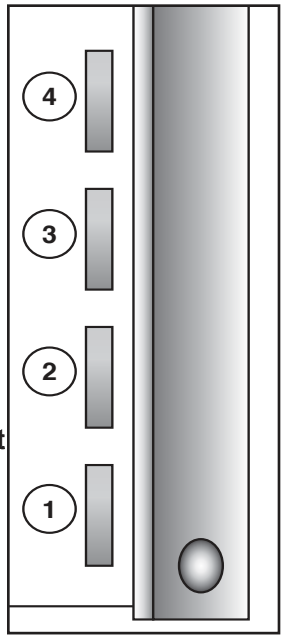




WARNING: **DO NOT** connect terminal #2, 12V Power input, to the alternator. The regulator will be damaged beyond repair and **MAY RESULT IN FIRE** in addition to alternator damage. This is not covered under warranty.

INSTALLATION BY WIRE

NOTE: Must install wires listed on this page for regulator to operate.



INSTALL BLACK GROUND WIRE

The BLACK Ground Wire #1 in diagram at right is included in the four-wire Ford-style plug on the wiring harness and is factory installed on regulator packages designated with “H” at the end of the model number. The other end of the Ground Wire is fitted with a ring terminal connector. In most applications, this wire can be connected directly to the alternator’s ground terminal post. For best accuracy ground as close to the battery as possible. Both the alternator and regulator must be connected to system ground.

INSTALL RED POWER WIRE

The RED Field Wire #2 in diagram at right is included in the four-wire Ford style plug and is factory installed on regulator packages designated with “H” at the end of the model number. The other end of the Power Wire is fitted with a butt connector. **This MUST be installed to a 12V battery. DO NOT connect to a 48V battery.** When a diode-type battery isolator is used, the power and wire must be connected to the battery side of the battery isolator. Power Wire is equipped with 10-amp ATC type fuse. The Power Wire must be fused to ensure against damage to the voltage regulator.

INSTALL BROWN IGNITION WIRE

The BROWN Ignition Wire #3 in diagram at right provides ON/OFF voltage for the regulator. This MUST BE a 12V power source. This wire is included in the Ford-style plug at the regulator end of the wiring harness. The other end of the wire is fitted with a butt connector. Typically, the ignition wire is connected to the ON side of the ignition switch. This may be at the actual switch, or to a wire in the existing engine wiring loom that delivers switched voltage from the ignition switch. In some cases, an oil pressure switch may be used to activate the regulator. In either case, the regulator’s ignition wire must see zero volts when the engine ignition is switched off. This must be an isolated switch functioning as a relay. Switches with a positive and negative connection will not work.

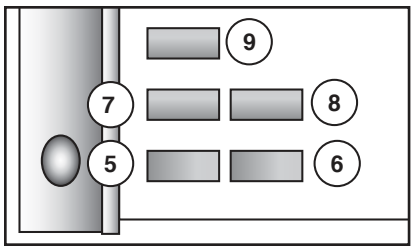
INSTALL BLUE FIELD WIRE

The BLUE Field Wire #4 in diagram at right provides regulated current to control alternator output. The wire is included in the wiring harness Ford-style plug and is pre-connected at the regulator. At the other end of the wire, you’ll find a ring terminal. Attach the field wire to the alternator’s field terminal.

INSTALL ALTERNATOR TEMPERATURE SENSOR

Because of the high-power output of the 96-Series alternators, the use of the Alternator Temperature Sensor (MC-TS-A) is required. It is NOT included in the harness and must be purchased separately. It allows your MC-620 voltage regulator to monitor your alternator temperatures and limit output if safe operating levels are exceeded. The MC-620 uses active temperature regulation to maximize high-temperature output. The MC-TS-A sensor includes a 54” cable, a sensing attachment lug, and positive and negative regulator plug-in connectors. To install the MC-TS-A:

1. Connect the sensor lug to one of the four bolts that hold the alternator’s front and rear cases together. Extend the sensor cable to the regulator. The cable can be included within the regulator’s wiring harness, or can be run alongside the harness and attached with cable ties.
2. Connect the temperature sensor to the Alt. Temp. terminals on the regulator. It is essential that the terminals are connected to the correct pin. Connect the red wire to the positive terminal #6 and the black wire to the negative terminal #5.



INSTALL POSITIVE BATTERY SENSE WIRE (48V)

The included voltage sense wire length is designed to sense at the B+ terminal of the alternator. For the most accurate voltage sensing and better charging performance, consider extending the voltage sense wire to run directly between the regulator and the 48V battery bank. This method is also used if using a battery isolator, or sensing at another location such as a battery switch (Anywhere other than the alternator.)

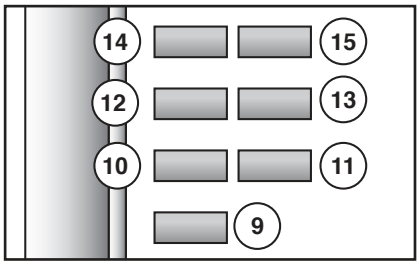
1. Attach the included wiring pigtail with 1-amp fuse to a length of wire of sufficient length to reach the desired sensing location. If the length of the wire between the regulator and the sensing location is 8’ or less, a 16-gauge wire is satisfactory. If the wire exceeds 8’, increase the wire size to 14 gauge.
2. If the batteries are connected to a battery isolator, the positive sense wire must be connected to the battery side of the isolator, preferably at the larger of the battery banks. If you do not sense at the battery, use the included sense wire to read at the B+ stud at the back of the alternator. It features a ring terminal at the alternator end and a female quick connect terminal at the regulator end. This wire is fused at the alternator end with a 1-Amp ATC-type fuse and fuse holder. The wire MUST be connected at the (#9) Positive Battery Sense Terminal. To complete installation of the sense circuit Crimp the included spade terminal to the sense wire and reconnect the spade to the (#9) pin.

CAUTION: Reversing the polarity of the terminal connections on any of the alternator or battery temperature sensors can result in invalid sensing and potential damage to alternators, regulator and/or batteries.

INSTALL BATTERY #1 TEMPERATURE SENSOR

The optional Battery Temperature Sensor (MC-TS-B) allows your Max Charge MC-620 voltage regulator to monitor your battery bank for changes in battery temperature, adjust charging voltages to compensate for battery temperature, and respond to a battery over-temperature condition by stopping charging. For the $LiFePO_4$ profile only, the regulator will also disable charging if the sensor temp drops to or below 32°F, 0°C. The MC-TS-B sensor includes a 20' cable, a sensing attachment, lug and positive and negative regulator plug-in connectors. To install the MC-TS-B:

1. Connect the sensor lug to the battery negative post closest to the center of the battery bank. Extend sensor cable to the regulator.
2. Connect the temperature sensor to the Bat. #1 Temp. terminals on the regulator. It is essential that the terminals are connected to the correct pin. Connect the RED wire to the positive terminal (#8) and the BLACK wire to the negative terminal (#7).



INSTALL WHITE STATOR-IN AND TACH-OUT WIRES

NOTE: Do not attempt to use the White Stator Out to drive a tachometer unless you have verified that it can be safely driven from a 48V alternator output. Consult the Tachometer Manufacturer if you are unsure.

When an electric tachometer is used, the alternator's stator output will provide the electrical pulse needed to drive the tachometer. The MC-620 has been designed to provide regulated tach output when the WHITE stator wire is connected to the regulator's Stator In (#12) terminal and the out feed wire to the electric tachometer is connected to the Tach Out terminal (#13) terminal. *Not required for magnetic pick-up Tachs.

Stator output can also be used to detect alternator failure. See Page 10 for details.
When the tachometer is connected via the MC-620, the regulator will ensure that the tachometer will continue to operate by supplying just enough field current to keep the tachometer operating. See your tachometer manual for adjustment instructions.

INSTALL BATTERY #2 TEMPERATURE SENSOR

Your Max Charge MC-620 voltage regulator can accommodate a secondary battery temperature sensor. Used in conjunction with an optional MC-TS- B battery temperature sensor, the regulator can monitor temperature at a secondary battery bank and respond to a battery over-temperature condition by discontinuing charging.
To install a secondary battery temperature sensor:

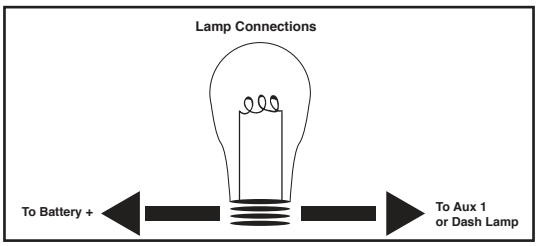
1. Connect the temperature sensor to the secondary battery bank following the directions provided for the primary battery temperature sensor.
2. Connect the temperature sensor to the Bat. #2 Temp. terminals on the regulator. It is essential that the terminals are connected to the correct pin. Connect the RED wire to the positive terminal (#15) and the BLACK wire to the negative terminal (#14).

DATA TX AND DATA RX

Data TX((#10) and RX(#11) circuits provide a connection point with outside monitoring equipment. At this time, the Data TX and RX circuits are only for factory use.

INSTALL AUX. 1 LAMP

The Max Charge MC-620 regulator's Aux. #1 (#16) terminal provides the ability to use a visual indicator when the regulator is operating under the following conditions: Full field (the alternator is working at full power) and Small Engine Mode (the regulator is being controlled at 50% field output). When a described condition is detected, the regulator sends the Aux. #1 terminal from neutral to ground. To utilize the Aux. #1 Lamp function:



1. Connect a small LED or incandescent lamp (maximum current flow is 500 mA) to a positive voltage source.
2. Connect the negative terminal on the lamp to the Aux. #1 terminal on the regulator.

INSTALL DASH LAMP

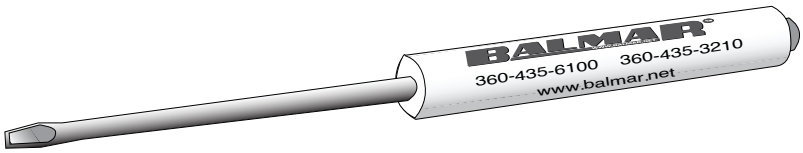
The Max Charge Dash Lamp (#17) terminal provides the ability to activate a visual or audible indicator when the regulator monitors the following conditions: Low system voltage, high system voltage, high alternator temperature, high battery temperature (temperature conditions are only indicated when appropriate temperature sensors are connected) and no voltage on stator, indicating that the alternator has failed. When a described condition is detected, the regulator sends the Dash Lamp terminal from neutral to ground. To utilize the Dash Lamp function:

1. Connect a small LED or incandescent lamp, or an audible (piezo) alert (maximum current flow is 500 mA) to a positive voltage source.
2. Connect the negative terminal on the lamp or audible alert to the Dash Lamp terminal on the regulator.
3. When connected, the lamp should flash at regulator start-up to indicate active status.

INITIAL PRE-FLIGHT TEST AND START-UP

When the regulator is properly mounted and the regulator wiring is installed, the MC-620 is ready for pre-flight testing. Before turning on the engine, it's advisable to check voltages at the following terminal connections to ensure that the wiring is correct. Test #1 verifies proper voltage values with the regulator turned off. Test #2 verifies the expected voltages with the regulator turned on.

Note: If the regulator's BROWN ignition wire is receiving it's switched source of voltage from an oil pressure switch, it may be necessary to start the engine before applying test #2. If the engine must be run to accomplish test #2, be sure that the alternator is properly cabled on both positive and negative sides to the battery being charged. Failure to do so could result in damage to the regulator and alternator.



Using your hand-held multi-meter, test the following wiring terminals for voltage:

TEST #1: Engine/Ignition OFF

- Primary RED Power Wire (Terminal #2) >12V
- Positive Voltage Sense Wire (Terminal #9) >48V
- BROWN Ignition Wire (Terminal #3) 0V
- Primary BLUE Field Wire (Terminal #4) 0V

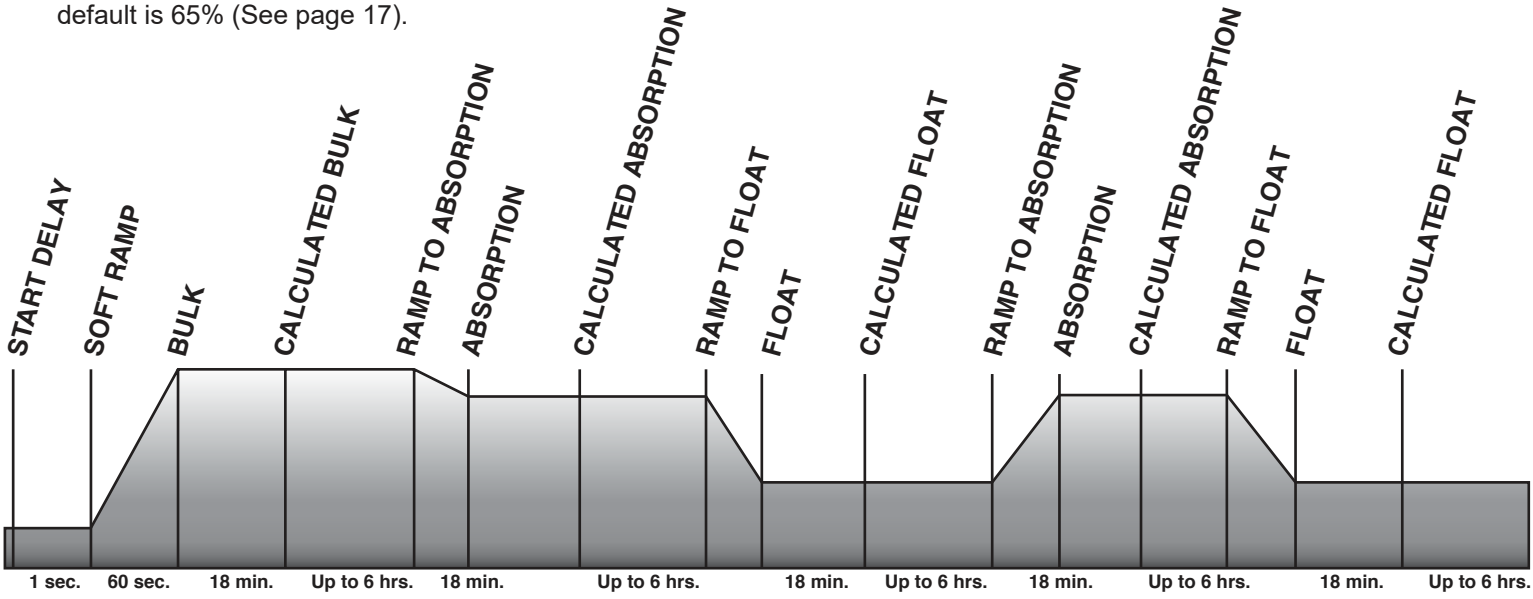
TEST #2: Engine not Running/Ignition ON (Wait 2 minutes)

- Primary RED Power Wire (Terminal #2) >12V
- Positive Voltage Sense Wire (Terminal #9) >48V
- BROWN Ignition Wire (Terminal #3) >12V
- Primary BLUE Field Wire (Terminal #4) within 2V of 12V starter battery's voltage

REGULATOR OPERATION

The MC-620 regulator's microprocessor controlled charging system uses a sophisticated, multi-stage profile to deliver maximum charging output, while protecting the batteries from overcharging damage. When the regulator is first turned on, the processor performs a quick one-second self diagnostic assessment. Following that diagnostic, the MC-620 initiates the selected battery charge program. Note that the Factory-set default values mentioned below correspond to the UFP battery program which is enabled by default. The battery program is as follows.

1. **Start Delay.** Controls time between regulator activation and the start of charging. Factory set at one second. User adjustable with dLc (See page 16)
2. **Soft Ramp.** Gently increases target voltage from current battery resting voltage to the Bulk Charge stage target at a fixed rate of 0.16 volts per second. This stage typically takes 1-2 minutes to complete.
3. **Bulk Charge.** The most aggressive of the charging stages. Target voltage is held to a preset level for a set time period, both of which are specified by the battery program selected. Factory-set values are 56.4 Volts for 0.3 hours (18 minutes), and are adjustable with bv and b1c, respectively (See page 16).
4. **Calculated Bulk Charge.** Target voltage is maintained at Bulk level. The regulator calculates battery condition by constantly monitoring field duty cycle, battery sense voltage, and an internal timer. Depending on these conditions, the regulator will stay in Calculated Bulk stage between 2 seconds and a fixed 6 hour time limit. If the 6 hour limit is exceeded it will automatically transition to the following stage. The field duty cycle target (FBA) is user adjustable. Factory set default is 65% (See page 17).
5. **Ramp to Absorption.** Gradually changes the target voltage from the current battery sense voltage to the Absorption Charge stage target at a fixed rate of 0.08 volts per 7 seconds. This stage typically takes 1 minute to complete.
6. **Absorption Charge.** The alternator output is held at a set voltage for a set time period, specified by the battery program selected. Factory-set values are 55.6 volts for 0.3 hours (18 minutes) and are adjustable with Av and A1c, respectively (See page 16).
7. **Calculated Absorption Charge.** Target voltage is maintained at the Absorption Charge level. The regulator calculates battery condition by constantly monitoring field duty cycle, battery sense voltage, and an internal timer. Once all conditions are met, the regulator will transition to the next stage. The time duration of this stage is between 2 seconds and 6 hours, depending upon battery condition. If the 6 hour limit is exceeded the regulator will automatically transition to the following stage. The field duty cycle target (FBA) is user adjustable. Factory set default is 65% (See page 17).
8. **Ramp to Float.** Gradually changes the target voltage from the current battery sense voltage to the Float Charge stage target at a fixed rate of 0.08 volts per 3 seconds. This stage typically takes about 1 minute to complete.
9. **Float Charge.** The alternator output is held at a preset voltage for a set time period, again, specified by the battery program selected. Factory-set defaults are 55.6 volts for 0.3 hours (18 minutes), adjustable with Fv and F1c, respectively (See page 16 & 17).
10. **Calculated Float Charge.** Target voltage is maintained at the Float level. The regulator can respond to an increased charge demand by reverting to the Absorption Charge stage if the conditions warrant. The battery condition is judged by constantly monitoring field duty cycle, battery sense voltage, and an internal timer. The regulator will stay in the Calculated Float charge stage a minimum of 2 seconds and up to 6 hours. If the 6 hour limit is exceeded the regulator will automatically revert to the absorption charge stage. The field duty cycle threshold (FFL) is user adjustable. Factory set default is 65% (See page 17).



REGULATOR DISPLAY MODES - SHORT DISPLAY / LONG DISPLAY

The regulator's three digit alphanumeric LED display provides a scrolling view of charging status. Under normal operation, the display will indicate the following:


BAL Indicates Balmar


620 Indicates Model MC-620


UFP Indicates regulator's default Universal Factory Program. Display will vary based on program selected.


b-0 Indicates the regulator's Belt Load Manager setting. Ranges from b-0 to b-9


-b- Indicates stage of charge. "-b-" indicates bulk. "-A-" indicates absorption. "-F-" indicates float. "-r-" indicates ramp.


bv Indicates system Battery Voltage. Followed by actual voltage reading.


Cv Indicates Calculated Voltage (Target voltage based on preset program levels). Followed by voltage reading.


b1 Indicates Battery #1 Temperature. Followed by NC (not connected), or temperature in Celsius.


AL Indicates Alternator #1 Temperature. Followed by NC (not connected), or temperature in Celsius.


b2 Indicates Battery #2 Temperature. Followed by NC (not connected), or temperature in Celsius.

In addition to the information provided in the basic display shown above, the MC-620 long display provides the following data. The long display is accessed during basic programming, which will be discussed in the next section of the manual.


FE Indicates the percentage of field output to the alternator. The higher the percentage, the greater the output.


r4.1 Indicates regulator's software revision code.


SP Indicates internal regulator temperature. Followed by degrees Celsius.


SLP Indicates, in millivolts, the value used to control voltage compensation for battery temperature.


Hr. Indicates overall regulator hours. Followed by hours and hours in hundreds of hours.


FbA Indicated field threshold from bulk to absorption. Factory set at 65%. Adjust in advanced programming mode.


FFL Indicates field threshold from float to absorption.


E Indicates System advisory codes. Individually numbered codes are defined below.

The following advisory codes can be used to determine possible system errors or to identify specific operational modes. Note that E codes are cumulative and will be held in memory until cleared. Codes can be cleared by entering dSP and letting it save. Display settings DO NOT need to be changed. See basic programming for more info.


E10 *BATTERY #1 SENSOR CABLE SHORTED*


E11 *BATTERY #1 TEMP. SENSOR CABLE OPEN OR NOT FOUND*


E12 *BATTERY #2 TEMP. SENSOR CABLE SHORTED*


E13 *BATTERY #2 TEMP. SENSOR CABLE OPEN OR NOT FOUND*


E14 *ALTERNATOR #1 TEMP. SENSOR CABLE SHORTED*


E15 *ALTERNATOR #1 TEMP. SENSOR CABLE OPEN OR NOT FOUND*


E20 *BATTERY #1 TOO HOT OVER 55°C. FACTORY DEFAULT*


E21 *BATTERY #2 TOO HOT. OVER 55°C. FACTORY DEFAULT*


E22 *ALTERNATOR TOO HOT. OVER 107°C*


E24 *VOLTAGE REGULATOR TOO HOT. OVER 90°C*


E25 BATTERY #1 TOO COLD

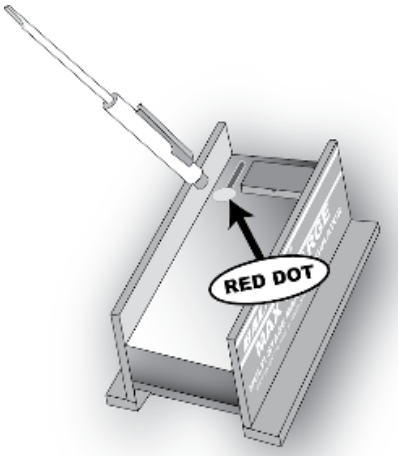

E33 *BATTERY SENSE DIS-CONECTED*


E41 *FIELD VOLTAGE TOO HIGH*


E42 *STATOR VOLTAGE TOO HIGH*


E51 *SMALL ENGINE MODE IS IN OPERATION*

REGULATOR PROGRAMMING MODES



USING THE MAGNETIC REED SWITCH

Control of the MC-620 regulator's basic and advanced programming modes is provided by a magnetic reed switch located in the upper left corner of the regulator's circuit board. The reed switch provides selectable control of the regulator's programming without creating an intrusion point as is common on many other adjustable voltage regulators currently on the market.

A small screwdriver with a magnet embedded in the tip of the handle is included to activate the magnetic reed switch. While any magnetic tip tool can be used, the Balmar programming screwdriver does an excellent job as an interfacing tool.

Programming is accomplished by contacting and removing the magnet from the RED dot affixed to the regulator's epoxy potting. If the magnet has difficulty activating the reed switch at that position, try moving it up and down along the length of the reed switch until the RED light is illuminated at the top of the LED display, between the second and third display digits. The RED light indicated activation of the reed switch.

Within the basic and advanced programming instructions, activation of the reed switch will be described by the following actions:

TOUCH/RELEASE - Indicates the action of contacting and immediately removing the magnet from the reed switch

TOUCH/HOLD - Indicates the action of contacting and holding the magnet to the reed switch

BASIC PROGRAMMING

PROGRAMMING FOR BATTERY TYPE

The MC-620 features selectable programs for the following battery technologies; Standard Flooded (FSb), Deep Cycle Flooded (FdC), Gel (gEL), AGM (AgL), Optima (OPS), a factory default program (UFP), a program for systems with voltage sensitive halogen equipment (HAL), and $LiFePO_4$ (LFP).

When activating the programming mode, keep in mind that the regulator will scroll through the basic programming mode three times before saving and returning to the operational mode. To adjust the regulator for your battery type:

1. Turn on the regulator. This may be accomplished by turning the ignition switch at the panel to the ON position. If the regulator's BROWN ignition wire is connected to an oil pressure switch, it may be necessary to start the engine to activate the regulator.
2. Once the regulator is on and the display is scrolling, TOUCH/HOLD the magnetic end of the programming screwdriver to the RED dot on the regulator as described above.
3. Continue to hold the magnet to the RED dot. The letters PRO will appear on the LED.
4. Continue to hold the magnet to the RED dot. The letters BA will appear on the LED.
5. Continue to hold the magnet to the RED dot. The LED display will begin to scroll through the various battery codes.
6. When the desired battery code is displayed, RELEASE the magnet from the RED dot.
7. The Display will indicate BA once again. At this point, you have the option to re-enter the battery type mode by re-applying


Pro *INDICATES ENTRY INTO BASIC PROGRAMMING MODE*


gEL *INDICATES PROGRAM FOR DEEP CYCLE GEL BATTERIES*


HAL *INDICATES PROGRAM FOR HALOGEN SYSTEMS*


bA *INDICATES ENTRY INTO BATTERY TYPE PROGRAM MODE*


AgL *INDICATES PROGRAM FOR ABSORBED GLASS MAT BATTERIES*


LFP *INDICATES PROGRAM FOR* $LiFePO_4$


UFP *INDICATES FACTORY DEFAULT UNIVERSAL FACTORY MODE*


OPS *INDICATES PROGRAM FOR SPIRAL WOUND (OPTIMA)*


Fdc *INDICATES PROGRAM FOR DEEP CYCLE FLOODED BATTERIES*


FSb *INDICATES PROGRAM FOR STD. FLOODED BATTERIES*

LFP/LiFePO$_4$ RECOMMENDATIONS

Our LFP program is a generalized version of the recommendations provided by the top LFP battery manufacturers. For best performance and compatibility, please consult your battery manufacturer and use the regulator's advanced programming features to adjust the LFP program as needed. LFP batteries are more sensitive to abuse than a traditional chemistry battery and can fail catastrophically. It is HIGHLY recommended that the charging system as a whole be installed or inspected by a qualified marine electrical installer that has experience with Balmar charging system products and LFP batteries. The LFP profile is intended to work with the battery manufacturer's battery management systems (BMS). The LFP profile IS NOT a replacement for a BMS.

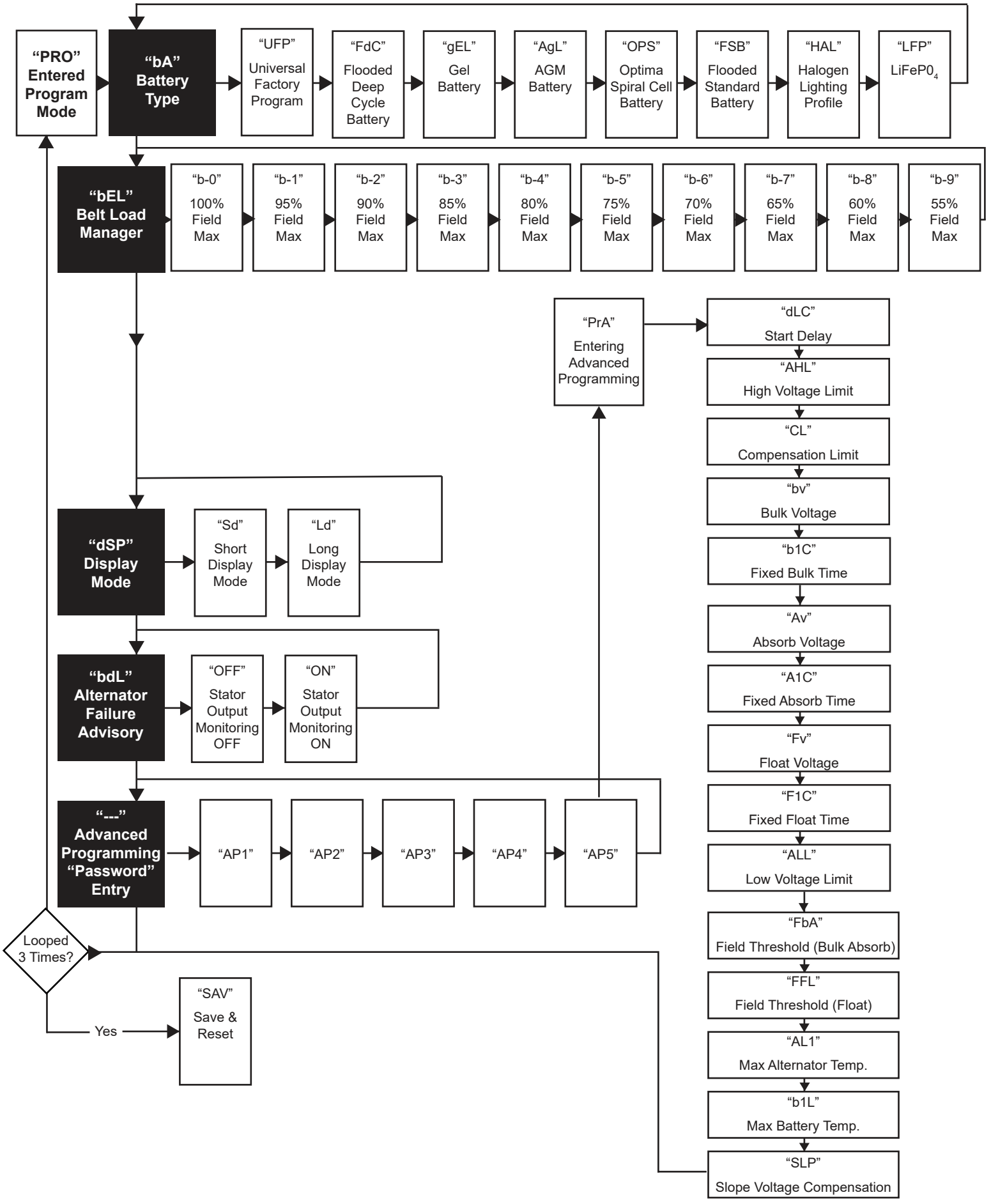
Many LiFePO$_4$ batteries have a Battery Management System (BMS) that may disconnect the battery from the alternator as a protective action or when charging is complete. The regulator must be shut down before the battery is disconnected. Running an alternator without a battery will damage the alternator and may damage any attached system. This is doubly true if the battery can be disconnected during high current charging, causing a load dump. The load dump can easily cause a high voltage spike which will destroy the alternator's rectifier, at minimum. This is not a warrantable failure. To reiterate: THE ALTERNATOR MUST BE SHUT DOWN BEFORE DISCONNECTING THE BATTERY. THE ONLY SAFE WAY TO SHUT DOWN THE ALTERNATOR IS TO TURN OFF THE REGULATOR. The preferred method of turning off the regulator is disconnecting the regulator's ignition (brown) wire, but if used as an EMERGENCY ONLY shutdown, disconnecting the regulator's power input (red) wire in addition to the ignition wire has a very low chance of damaging the regulator.

LFP batteries will readily accept a potentially damaging amount of current. Applying too much charge current to a LFP battery will, at the very least, permanently damage the battery's capacity. It is CRITICAL to ensure that the alternator is not capable of exceeding the maximum continuous charge current rating of your battery (or batteries). As always, check with your battery manufacturer for specifics. Your battery manufacturer may supply you with a "C-rate" for charging and discharging. The maximum amount of charging current your battery can safely handle is determined by multiplying the "C-Rate" by the capacity of the bank. i.e. 4x 100Ah 12V batteries rated at 0.5C charge = 400 Ah * 0.5C = 200amps MAX. If your alternator is capable of outputting more current, at any time or condition, than the battery (or batteries) can handle, you may use the Belt Manager feature on the MC-620 to lower the maximum field drive output, and thereby lower the maximum alternator output current. See page 10 of your regulator manual for details and instructions. Be aware that it is not an exact 1:1 correlation between field output and alternator output, so start with more reduction (lower output) than you think you need and adjust accordingly.

It is required that an alternator temperature sensor (MC-TS-A) be used when charging LFP batteries. Given the extremely high charge acceptance rate of LFP batteries, the alternator will be driven to full output for almost all of the charge cycle. This can cause overheating in automotive style alternators resulting in a significantly shortened lifespan. When equipped with the MC-TS-A temperature sensor, the MC-620 will help you protect your investment by performing active alternator temperature control. This is accomplished by scaling back the field voltage to the alternator when over the "AL1" temperature threshold. If you cannot use an MC-TS-A in your application, you should monitor the alternator's temperature (measure as close to the loop ends of the stator as possible) and discontinue charging if the alternator temperature rises above the maximum recommended level. You may also use the Belt Manager feature on your MC-614 to reduce maximum output until a tolerable alternator temperature is maintained under all conditions.

Most LFP battery manufacturers specify minimum and maximum charging temperatures to be from freezing (32°F, 0°C) to around 111°F (44°C). Again, consult with your battery manufacturer for specifics. When equipped with a MC-TS-B, the MC-614 can disable charging if the battery temperature exceeds the "B1L" temperature threshold and re-enable charging when the temperature drops below the threshold. This feature is meant to supplement, not replace, your BMS' temperature protection features. "B1L" should be adjusted to be slightly less than BMS' temperature threshold. The regulator will also disable charging if the sensor temp drops to or below 32°F, 0°C, only while using LiFePO$_4$ profile.

REGULATOR PROGRAMMING FLOW CHART



PROGRAMMING THE BELT LOAD MANAGER

The MC-620 provides the ability to manage regulator field potential, making it possible to govern the horsepower loads placed on the drive belt(s) by the alternator. The Belt Load Manager can also be used to protect the alternator from extraordinary load created by a battery load that's too large for the alternator's capacity. The Belt Load Manager is accessed in the basic programming mode, directly after the battery type programming mode. The Belt Load Manager can be accessed at the same time the battery program is set, or by itself.

When activating the programming mode, keep in mind that the regulator will scroll through the basic programming mode three times before saving and returning to the operational mode. To adjust the regulator for your battery type:

1. Turn on the regulator. If the regulator's BROWN ignition wire is connected to an oil pressure switch, it may be necessary to start the engine to activate the regulator.
2. If the battery type program has been adjusted, TOUCH/HOLD when entry into the Belt Load Manager is indicated by the bEL display on the regulator's LED.
3. If you don't wish to adjust the battery programming, TOUCH/HOLD the RED dot when the regulator is activated. RELEASE when the Pro display is indicated. The regulator will indicate bA, for battery type, and will cycle to bEL.
4. TOUCH/HOLD. The regulator display will indicate b-0 (indicating that the Belt Load Manager is off). Continue to HOLD the regulator display to scroll through seven settings. Each setting decreases the field potential by approximately seven percent.
5. RELEASE when the display indicates your desired level of field reduction. The display will cycle to bEL. You can re-activate to change your selection, or wait until the regulator cycles to the next programming mode.
6. If no other changes are made to the Belt Load Manager program, the regulator will cycle to the next programming mode.


bEL *INDICATES ENTRY INTO BELT LOAD MANAGER MODE*


b-0 *INDICATES BLM OFF.*


b-1 *INDICATES BLM SETTING #1. FIELD REDUCTION 5%.*


b-2 *INDICATES BLM SETTING #2. FIELD REDUCTION 10%.*


b-3 *INDICATES BLM SETTING #3. FIELD REDUCTION 15%.*


b-4 *INDICATES BLM SETTING #4. FIELD REDUCTION 20%.*


b-5 *INDICATES BLM SETTING #5. FIELD REDUCTION 25%.*


b-6 *INDICATES BLM SETTING #6. FIELD REDUCTION 30%*


b-7 *INDICATES BLM SETTING #7. FIELD REDUCTION 35%.*


b-8 *INDICATES BLM SETTING #8. FIELD REDUCTION 40%*


b-9 *INDICATES BLM SETTING #9. FIELD REDUCTION 45%*

PROGRAMMING FOR SHORT OR LONG DISPLAY MODE

You can choose the amount of information displayed on the regulator. The information displayed on the short or long display is detailed on Page 8 of the manual. To adjust the regulator for short or long display:

1. TOUCH/HOLD when entry into the short/long display selector is indicated by dSP on the regulator's LED.
2. The regulator display will indicate codes Sd (for short display) or Ld (for long display).
3. RELEASE when the display indicates your desired display mode. The display will cycle to dSP. You can re-activate to change your selection, or wait until the regulator cycles to the next programming mode.


dSP *INDICATES ENTRY INTO SHORT OR LONG DISPLAY MODE*


Sd *INDICATES SHORT DISPLAY MODE*


Ld *INDICATES LONG DISPLAY MODE*

PROGRAMMING FOR ALTERNATOR FAILURE ADVISORY MODE (BDL)

The regulator provides a ground signal on the dash lamp terminal when the following conditions occur: low battery voltage (<50.8V), high battery voltage (>62V), high battery temperature (<52°C), or high alternator temperature (105°C). In addition, the user has the option to send the dash lamp ground in the event that the stator output drops to zero volts. The Regulator's Default bdL setting is ON. Monitoring stator output is an optional function which can be turned on or off in the basic programming mode. The regulator's default setting for the bdL mode is ON, meaning that the stator output is being monitored. This function can be used in conjunction with a relay to control a charge indicator lamp.

1. To enable or disable the stator monitoring function, activate and hold when the bdL mode is indicated.
2. Release when the desired setting is shown. NOTE: Stator wire must be connected to the regulator's Stator-In terminal to use this function.


bdL *INDICATES ENTRY INTO ALTERNATOR FAILURE ADVISORY MODE*


OFF *STATOR OUTPUT MONITORING OFF*


ON *STATOR OUTPUT MONITORING ON*

ADVANCED PROGRAMMING MODES
ACCESSING THE ADVANCED PROGRAMMING MODE

The MC-620 provides a broad range of advanced user adjustments in it's password-protected Advanced Program Mode. The Advanced Program mode is accessed via the Basic Program mode. To access the Advanced Program mode:

1. With the regulator activated, TOUCH/HOLD the magnet to the RED dot on the regulator's epoxy potting.
2. The regulator will cycle to PRO. RELEASE the magnet from the switch.
3. The regulator will cycle through all of the Basic Program modes; bA, bEL, dSP, and bdL followed by three dashes.
4. TOUCH/HOLD when the three dashes are displayed. The dashes will be replaced by AP0 followed by AP1, and so on.
5. When the display indicates AP5, RELEASE.
6. The display will cycle to PrA, indicating entry into the Advanced Programming mode.


Pro *INDICATES ENTRY INTO PROGRAM MODE*


dSP *INDICATES SELECTION MODE FOR SHORT/LONG DISPLAY*


AP1 *INDICATES ENTRY INTO PASSWORD MODE FOR AP MODE*


bA *INDICATES SELECTION MODE FOR BATTERY TYPE*


bdL *INDICATES ALTERNATOR FAILURE ADVISORY (BDL)*


AP5 *INDICATES PASSWORD FOR ADVANCED PROGRAM MODE*


bEL *INDICATES SELECTION MODE FOR BELT LOAD MANAGER*


--- *INDICATES ENTRY INTO PASSWORD MODE FOR AP MODE*

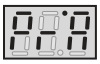

PrA *INDICATES ENTRY INTO THE ADVANCED PROGRAM MODE*

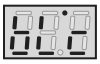
MAKING ADVANCED PROGRAMMING ADJUSTMENTS

Once accessed, the Advanced Program mode allows the user to adjust time, voltage and temperature setting for the active battery program. Adjustments made are semi-permanent meaning they will be saved until the battery program is changed. All defaults shown below are for the UFP program and will vary depending on which program you have selected. To change the settings TOUCH/HOLD the magnet to the RED dot on the epoxy potting when the desired mode is indicated. When the reed switch is engaged, the values for the various modes will scroll upward or downward. To reverse the direction of scroll:

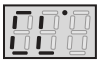
1. REMOVE the magnet from the reed switch.
2. Wait for the mode indicator to be displayed.
3. TOUCH/HOLD when the mode indicator is displayed. The values for that mode will begin to scroll in the opposite direction. Continue to HOLD until the desired value is displayed.
4. REMOVE the magnet from the RED dot. The mode indicator will be displayed again, followed by the indicator for the next Advanced Programming mode.

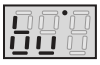
The Advanced Programming Modes are as follows:

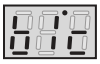

(PrA) Advanced Program Mode. Once the correct password is used to unlock the Advanced Program mode, the PrA display will be immediately followed by Advanced Programming modes. The Advanced Programming modes include:

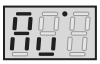

(dLc) Start Delay. Controls time from regulator activation to start of charging. Factory preset at one second. Adjustable to a maximum of 200 seconds.

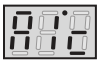

(AHL) High Voltage Limit. Controls high voltage alarm threshold. Adjustment spans from cl to 16 volts. Default is 60.8 volts adjustable in .1 volt increments. See information for Battery Equalization for more details on AHL adjustment.

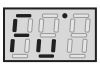

(CL) Compensation Limit. Controls maximum allowable temperature compensated system voltage. Adjustment spans from bv to AHL. Default is 59.2 volts. Adjustable in .1 volt increments.

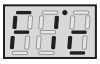

(bv) Bulk Voltage. Controls the target voltage for bulk charge mode. Adjustment spans from Av to cL. Default is 56.4 volts adjustable in .1 volt increments.


(b1c) Bulk Time. Controls minimum time in Bulk Mode before entering Calculated Bulk. Standard value set is .3 hours (18 minutes). Settings are from 6 minutes to 6 hours. Adjustable in .1 hrs (6 minute) increments.

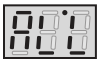

(Av) Absorption Voltage. Controls the target voltage for absorption charge mode. Adjustment spans from Fv to bv. 55.6V default, adjustable in .1 volt increments


(A1c) Absorption Time. Controls minimum time in Absorption Mode before entering Calculated Absorption. Standard value set is .3 hours (18 minutes). Settings are from 6 minutes to 6 hrs. Adjustable in .1 hrs (6 minute) increments.

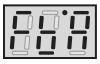

(Fv) Float Voltage. Controls the target voltage for float stage. Adjustment spans from ALL to Av. Default is 53.6 volts, adjustable in .1 volt increments.



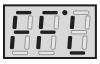
(F1c) Float Time. Controls minimum time in Float Mode before entering Calculated Float. Standard value set is .3 hours (18 minutes). Settings are from 6 minutes to 6 hrs. Adjustable in .1 hrs (6 minute) increments.



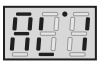
(ALL) Low Voltage Limit. Allows user control of regulator's low voltage limit. Spans between 10 volts and Fv. Dropping below ALL causes Dash Lamp to turn on. Default is 50.8 volts in .1 volt increments.



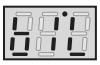
(FbA) Field Threshold - Bulk and Absorption. Controls the field output threshold required to cycle from Bulk to Absorb and Absorb to Float. Factory set at 65% of field output. Raising "FbA" shortens calculated bulk and absorption charge time. Adjusted in 1% increments. Span of adjustment is 16% to 96%.



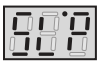
(FFL) Field Threshold - Float to Absorption. Controls the field output threshold required to cycle from float to absorption charging modes. Factory set at 65%. Raising "FFL" increases calculated float charge time. Adjusted in 1% increments. Span of adjustment is 16% to 96%.



(AL1) Alternator Temperature Threshold. Controls the Alternator over temperature set point. Requires MC-TS-A temperature sensor to be connected to the Alt. Temp. #1 and/or Alt. #2 temperature sensor terminals. Preset at 100°C. Spans from 60-128°C. Adjustable in 1°C increments.



(b1L) Battery Temperature Threshold. Controls the Battery over temperature set point. Requires MC-TS-B temperature sensor to be connected to the Bat. Temp. #1 and or Bat. #2 temperature sensor terminals. Preset at 52°C. Spans from 42-56°C. Adjustable in 1°C increments.



(SLP) Slope Voltage Correction. Adjusts the voltage (in millivolts) the regulator uses when monitoring battery temperature sensing. Can be custom adjusted to meet the needs of unique battery technologies. Consult with battery manufacturer for specific slope voltage recommendations. Spans from 0 to 8.3 millivolts per degree Celsius. Default is 6.0 mV/°C. Adjustable in 0.1mV/°C increments.

BATTERY EQUALIZATION

Due to the hazardous nature of equalization (the intentional overcharging of batteries to remove sulfation from the battery plates) we strongly recommend that the process be done at the dock with a voltage-adjustable shorepower charger. If it is absolutely impossible to do so, equalization can be done with the alternator and regulator by doing the following:

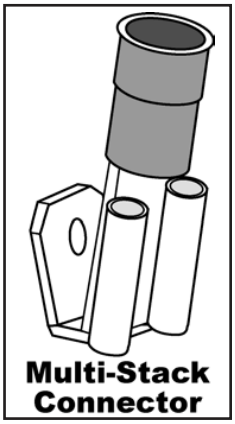
1. In Advanced programming, Pra, change the following values.
2. Cl to a voltage above the desired equalize voltage.
3. AHL to a voltage above the desired equalize voltage.
4. Bv to the desired equalize voltage.
5. Blc to the desired equalize time.
6. Disconnect ALL battery temperature sensors.
7. YOU MUST MONITOR THE BATTERIES DURING EQUALIZE PROCESS!
8. Once the equalization is complete, activate the regulator's basic programming and reset the battery program mode to UFP, and allow the program to save. Once saved, access the basic programming mode again and reset for the desired battery program.

WARNING: EQUALIZATION IS A MANUAL PROCESS WITH POTENTIAL DANGERS.
DO NOT LEAVE SYSTEM UNATTENDED.

Default Program Settings By Battery Type								
	UFP	**Fdc**	**gEL**	**AgL**	**OPS**	**FsB**	**HAL**	**LFP**
START DELAY (SECS.)	1	1	1	1	1	1	1	1
HIGH VOLTAGE LIMIT (VOLTS)	60.8	62.4	60.4	61.6	62.4	61.6	60	59.2
COMPENSATION LIMIT (VOLTS)	59.2	59.2	59.2	59.2	59.2	59.2	59.2	59.2
BULK VOLTAGE	56.4	58.4	57.6	57.6	58.4	58.4	56	57.2
BULK TIME (MINIMUM)	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	6 MIN
ABSORPTION VOLTS	55.6	57.6	55.6	56.8	57.6	56.8	55.2	54.4
ABSORPTION TIME (MINIMUM)	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN
FLOAT VOLTS	54.8	53.6	54.8	53.6	53.6	53.6	54	53.6
FLOAT TIME (MINIMUM)	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN	18 MIN
FLOAT TIME (MAX FIXED)	6 HRS	6 HRS	6 HRS	6 HRS	6 HRS	6 HRS	6 HRS	6 HRS
LOW VOLTAGE LIMIT (VOLTS)	50.8	50.8	50.8	50.8	50.8	50.8	50.8	50.8
MAX BAT. TEMP.	125°F/52°C	125°F/52°C	125°F/52°C	125°F/52°C	125°F/52°C	125°F/52°C	125°F/52°C	111°F/44°C
MAX ALT. TEMP.	212°F/100°C	212°F/100°C	212°F/100°C	212°F/100°C	212°F/100°C	212°F/100°C	212°F/100°C	194°F/90°C
BAT. TEMP. COMPENSATION	6.0mV/°C	6.0mV/°C	5.0mV/°C	3.8mV/°C	5.0mV/°C	6.0mV/°C	5.0mV/°C	0.0mV/°C

ADDITIONAL REGULATOR FEATURES

SMALL ENGINE MODE



In situations where additional power is needed for propulsion, the MC-620 provides the option to manually reduce regulator field output by approximately one half. This option, called Small Engine Mode, can be accessed by shorting the positive and negative Alternator #1 Temperature Sensor terminals. This can be done by splicing into the positive and negative wires of the Alternator Temperature Sensor cable (MC-TS-A) with a switched wire. With the switch in the OFF position, the Alternator #1 Temperature Sensor will work normally. With the switch in the ON position, the regulator will reduce field output by approximately 50%. To enable the Small Engine Mode:

1. If the Alternator Temperature Sensor cable is being used, replace the female terminal connectors on the cable with Multi-Stack Connectors (Ancor Part # 230612).
2. Install a standard ON/OFF switch in a location that's easily reached from the helm.
3. Run wires from the switch back to the positive and negative terminals of the Alternator #1 Temperature Sensor terminals (#5 and #6).
4. Add appropriate connectors to the switched wires and connect to the positive and negative terminal connections.

DASH LAMP

The MC-620 provides a Dash Lamp circuit that's capable of providing a signal to a user supplied and installed audible or visual alert if the following issues were to occur while the regulator is in operation:

- Low Battery Voltage <51.2V Adjustable with "ALL." (See Page 12)
- High Battery Voltage >62V Adjustable with "AHL." (See Page 11)
- High Alternator Temperature 225°F Adjustable with "AL1." (See Page 12 Requires installation of MC-TS-A sensor)
- High Battery Temperature >125°F Adjustable with "B1L." (See Page 12 Requires installation of MC-TS-B sensor)
- Low Battery Temperature <32° F ($LiFePO_4$ only) not adjustable.
- Alternator Failure (No voltage on stator if bdL is enabled)
- Regulator Overtemp Fixed 194°F

AUX #1 LAMP

The MC-620 provides an Auxiliary Lamp circuit that's capable of providing a signal to a user supplied and installed audible or visual alert to indicate the following while the regulator is in operation:

- Small Engine Mode is activated
- Regulator is at full field

SYSTEM TROUBLESHOOTING
REGULATOR TROUBLESHOOTING

The majority of charging difficulties can be attributed to damage, corrosion or wear at wiring, fusing or wiring connections. Before attempting to troubleshoot alternator or regulator issues, be sure to address the following:

1. Remove and clean all charging system electrical connections (positive and negative). Check the voltage regulator's harness for continuity. Wires and terminals can and will become corroded, and need to be cleaned or replaced. Ensure that the regulator's ground wires are provided with a clean connection to system ground.
2. Inspect and replace 10A and 1A ATC type fuses in the regulator wiring harness if fuse appear to be damaged or corroded. Ensure that the fuse holder is also free of corrosion.
3. Charge all batteries to their proper fully charged state, and determine if they are serviceable. If your batteries are flooded-type, use your hydrometer to determine their condition.
4. Check and tighten alternator belt. If the belt show signs of wear or damage, replace it. Always replace existing belts with the finest quality replacements available.

If batteries and wiring are in suitable condition, use the following tests to determine if charging problems are a result of a faulty alternator or regulator. These tests provide an opportunity to isolate the alternator, regulator and wiring harness in order to determine the problem source. In order to perform these tests, you will need an independent DC meter (preferably a digital type). In an emergency, a 12V light bulb or test light can be used to help determine if power or working grounds exist. An amp meter and a battery hydrometer with a thermometer are also helpful diagnostic tools.

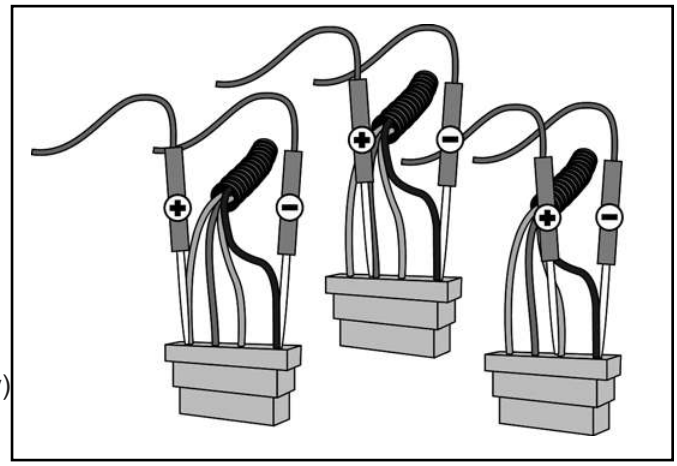
VOLTAGE REGULATOR TESTING

Set your voltmeter to VDC and connect the negative lead to the BLACK ground wire at the regulator as shown in diagram.

1. With the ignition turned OFF, check voltage on the RED (power), Voltage Sense (Terminal #9), BLUE (field) and BROWN (Ignition) wires in the regulator plug.

Voltages should be as follows:

- RED wire equal to start battery voltage (for 12V battery)
- Terminal #9 RED wire equal to battery voltage (48V)
- BLUE wire zero volts
- BROWN wire zero volts



2. With the ignition in the ON position (engine not running) for at least two minutes, check voltage on the RED (power), Secondary RED on Terminal #9 (voltage sense) BLUE (field) and BROWN (ignition) wires in the regulator plug:

- RED wire equal to start battery voltage (12V)
- Terminal #9 RED wire equal to battery voltage (for 48V battery)
- BLUE wire within 2V of 12V start battery's voltage
- BROWN wire equal to battery voltage

PLEASE NOTE: In systems where the ignition (BROWN) wire is supplied power via an oil pressure switch, jump directly from test #1 to test #3.

3. With the ignition in the ON position (with engine running at 1,400 rpm fast idle for at least two minutes), check voltage on the RED (12V Start battery voltage), Secondary RED on Terminal #9 (voltage sense - 48V battery) BLUE (field) and BROWN (ignition) wires in the regulator plug. Voltages should be as follows:

- RED wire equal to start battery voltage (12V)
- Terminal #9 RED wire equal to 48V battery voltage
- BLUE wire is a variable voltage based on the state of charge of the batteries. It will range between .5V and slightly less than the 12V start battery's voltage. The lower the state of charge of the 48V battery, the higher the voltage.
- BROWN wire equal to battery voltage

If voltage is not present on the RED, the BROWN and the Positive Battery Sense Wire, the regulator will not work. If voltage is as expected at the RED the BROWN and Positive Battery Sense wire, and there is zero, or an unexpected voltage reading at the BLUE wire, contact our technical support staff at +1(360) 435-6100, or e-mail us at balmar@balmar.net.

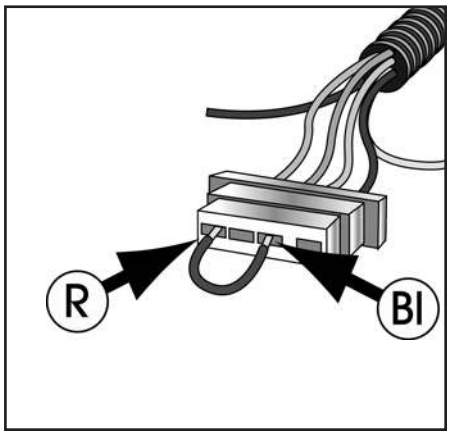
If all voltages at the regulator meet expectations, yet the alternator is not producing charging current, test the alternator. The following tests are recommended for determining alternator functionality.

ALTERNATOR TESTING

TEST #1 - The following test is used to isolate the alternator and determine if the failure is a result of the alternator. Once again, testing at either the alternator or regulator is only effective if the wiring, fusing and batteries have been determined to be in correct working order. The alternator and regulator can be tested for function by determining if a magnetic field exists at the alternator's pulley shaft or rear bearing. To test:

1. With the ignition in the OFF position, place the tip of a non-magnetic steel screwdriver near the nut on the pulley shaft or near the rear bearing of the alternator. There should be no evidence of a magnetic field pulling the screwdriver toward the alternator. (A slight amount of magnetism may be present, due to residual voltage in the alternator).
2. Engage the ignition, without starting the engine, to activate the voltage regulator. If an oil pressure switch is used, a jumper between the RED and BROWN wires in the Ford-style plug will activate the regulator.
3. After allowing time for the regulator's start-up delay, place the head of a steel screwdriver near the nut on the pulley shaft or near the rear bearing of the alternator. There should be substantial magnetic pull. If a magnetic field is present, the voltage regulator, alternator brushes and rotor are likely to be working properly.

If there is little or no magnetic pull at the pulley shaft or at the rear bearing, initiate the following test:
With the key off and the engine off, remove the large harness plug from the regulator.



1. Insert the end of a short length of electrical wire to the RED connector slot of the regulator harness and the other end of the wire to the BLUE connector slot. This bypasses the regulator and tests the alternator and the harness.
2. Using your steel screwdriver, inspect for a magnetic field as described above.
3. With your voltmeter, check for voltage on the blue wire at the alternator. If voltage does not exist, the harness may be at fault. If voltage does exist at the harness, but no magnetism is present, the alternator is likely to be malfunctioning.
4. If a magnetic field is present. Both harness and alternator brushes and rotor appear to be working properly. If no magnetic field is present, proceed with the next test.

Testing the actual output of the alternator is known as "Full Field Testing". This can be accomplished by jumping a positive 12VDC current to the field terminal at the rear of the alternator. This test eliminates both the regulator and the harness, making it easier to isolate your investigation to the alternator.

CAUTION: Ensure that all voltage sensitive equipment is turned off prior to starting the engine. Voltage is unregulated during this test and could damage sensitive electronics. DO NOT let the engine run any longer than necessary to detect charging. If the system is not charging, remove the alternator and have it inspected by a qualified alternator shop, or call Balmar for warranty evaluation. To test the alternator:

1. Clip a jumper wire to the positive post of the alternator, or on the battery side of the isolator (if an isolator is in use). Use a SHIELDED alligator clip for post attachment. Unintentional contact between the alligator clip and the alternator case could result in damage to your electrical system.
2. Disconnect the field wire from the rear of the alternator and attach the other end of the jumper wire to the alternator's Field terminal (F). CAUTION: Do not allow the wire to contact the case while it is attached to the positive post. The case may be grounded and severe damage could occur.
2. The regulator is now bypassed. When the ignition is engaged and the motor is started, the voltage should rise and charging current should be present.
3. The motor should be run long enough to determine that charging voltage is present. Unregulated voltage can rise quickly. Do not allow extended unregulated charging to occur without carefully monitoring voltage levels. If the alternator fails to generate voltage during field testing, a malfunction of the alternator is likely. Contact your local alternator repair shop or Balmar's technical service staff for recommendations.

CONCLUSION

If your readings differ substantially from the "expected Readings" listed in the troubleshooting charts, the regulator may be malfunctioning, or there may be a continuity problem. Contact our technical support staff at +1(360) 435-6100. If you determine that repair service is necessary for either your alternator or regulator, please gather the following information before contacting our service technicians: Make and model of alternator. Model of voltage regulator and date of mfg. (date punched on rear side label of regulator). Voltage readings on RED, BROWN and BLUE wire at regulator with engine off, key on. Voltage readings on RED, BROWN and BLUE wire at regulator with engine running at a fast ideal 1400rpm.

BALMAR WARRANTY

Balmar Limited Warranty

Balmar's Limited Warranty covers defects in material or workmanship on new Balmar products generally for a period of one (1) year from the purchase date. Only consumers or dealers purchasing Balmar products from authorized Balmar retailers or resellers and installed by a qualified installer may obtain coverage under Balmar's Limited Warranty. Components with a manufacturing date greater than ten (10) years old are not covered under the Balmar Warranty, even if the purchase date has been within the past two (2) years. Purchase from unauthorized resellers, which may include some online entities, may not guarantee the purchaser will receive a newly manufactured component, and therefore does not guarantee Warranty coverage.

Warranty Resolution

If Balmar authorizes a product to be returned to Balmar or an authorized service provider, Balmar will repair the product or replace it without charge with a functionally equivalent replacement product. Balmar may replace the product with a product that was previously in service or repaired, but re-tested to meet Balmar specifications. Balmar will pay to ship the replacement product to the purchaser. By sending the product for replacement, ownership of the original product will be transferred to Balmar. Labor charges at the consumer's site are not covered under this Warranty. Balmar warrants that repaired or replaced products shall be covered under the Balmar Warranty for the remainder of the original product warranty, or 90 days, whichever is greater.

Not Covered Under Warranty

Balmar's Warranty does not cover any problem that is caused by (a) an accident, abuse, neglect, exposure to shock, electrostatic discharge, heat or humidity beyond the product's specifications, improper installation, inappropriate operation/misapplication, maintenance or modification, or (b) any misuse contrary to the instructions provided with the product, or (c) loss, or (d) malfunctions caused by other equipment, or (e) acts of God. Examples of conditions not warranted: cracked or broken cases, parts damaged by fire, water, freezing, lightning, collision, theft, explosion, rust, corrosion, or items damaged in route to Balmar for repair. Balmar's Warranty is void if a product is returned with removed, damaged or tampered labels or any other alterations (including removal of any component or external cover) to the product. Balmar's Warranty does not cover labor charges or any direct, consequential, or incidental damages. Costs related to recovery removal or installation are not recoverable under the Balmar Limited Warranty.

Applicable Laws

Balmar's Warranty is governed by the laws of the State of Alabama, USA. The Balmar Warranty provides the purchaser specific legal rights, and you may also have other rights that vary from state to state. Balmar's Warranty does not affect any additional rights consumers have under laws in their jurisdictions governing the sale of consumer goods, including, without limitation, national laws implementing EC Directive 44/99/EC. Some states do not allow the exclusion of limitation of incidental or consequential damages, so the limitation or exclusions of Balmar's Warranty may not apply in certain jurisdictions.

Warranty Return Material Process

1. Contact Balmar Technical Support at +1 (360) 435-6100. Tech Support will review the troubleshooting steps with you to help determine if Balmar's product is defective.
2. Go to www.balmar.net and download the RMA request.
3. Once complete, you will receive an RMA number, at which point you should complete the forms and send them with the product and the original receipt showing the date of purchase to Balmar at the address listed below. Please include the RMA number on the outside of the package.
4. Please send the product postage prepaid via a carrier that can track the package. Note: If you have a 9-Series Alternator to return, please ship it to our Marysville, WA location.

Balmar LLC
353 James Record Road SW
Huntsville, AL 35824
Attention: Warranty Returns RMA# _____

Balmar LLC
15201 39th Ave. NE
Marysville, WA 98271
Attention: Warranty Returns RMA# _____

Once Balmar receives the product, we will test the product to determine if the problem is due to a defect in the product. If, at the sole discretion of Balmar, the problem is determined to be a manufacturer defect, Balmar will repair the product or send a new product to replace the defective product.

Balmar will not provide Warranty coverage unless Warranty claims are made in compliance with all the terms listed here, and the specified return procedures are followed.

For more information, contact Balmar Customer Service or Technical Support at +1(360) 435-6100 or visit the Balmar website at www.balmar.net. Balmar LLC believes all information herein to be factual and accurate, yet maintains no liability for factual or typographic error. In addition, Balmar retains the right to revise or update products without notification. Visit the Balmar website for product updates or bulletins and may apply to your alternator or voltage regulator. No part of this document may be reproduced without express written permission of Balmar LLC

NOTES

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ISO 9001 CERTIFIED

CDI Electronics designs and manufactures ignition components for outboard motors and diagnostic software for most Marine Engines. CDI enjoys relationships with 70 distribution partners around the world. To Find a CDI distribution partner, visit **www.cdielectronics.com.**

Both Balmar and CDI Products are manufactured in our ISO 9000-Certified Factory in Huntsville, Alabama.

Please read carefully. All policies, procedures and instructions are subject to change. This guide was prepared to provide information and does not constitute a contract. Balmar reserves the right, without prior notice, to change, delete, supplement, or otherwise amend at any time the information and policies contained in this guide.

For the most recent information about Balmar's products, policies and instructions please visit, **www.balmar.net.**

SUP-0276