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MAX CHARGE MC-624

MULTI-STAGE VOLTAGE REGULATOR



INSTALLATION AND OPERATION MANUAL

Introduction

The Balmar Max Charge MC-624 is the latest generation of smart, multi-stage Balmar Max Charge voltage regulators. Designed to provide precise voltage control for Balmar high-output 24-volt alternators and other externally regulated P-type alternators, the MC-624 features user selectable programs for the following battery types: Deep cycle flooded, standard flooded, gel, AGM, spiral wound AGM, and $LiFePO_4$ batteries. In addition, the regulator features a universal default program that's safe for most battery types, as well as a program that's designed for use in vessels utilizing voltage sensitive halogen equipment.

In addition to the user selectable preset programs, the MC-624 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 optional MC-TS-A and MC-TS-B alternator and battery temperature sensors, the MC-624 features the ability to monitor and respond to a range of ambient temperature conditions, including reduction or discontinuation of charging voltages, should a catastrophic over-temperature condition occur at the alternator or the batteries.

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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.*
3. *Wear ANSI-approved safety eye-wear and protective gear.*
4. *DO NOT attempt to modify the regulator. 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-624 regulator. If you are unfamiliar with marine electrical systems, consult with a licensed marine electrician.*

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CAUTION: 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.

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-624-H regulator kit is packaged with the following items:

- Max Charge MC-624 Regulator
- 54” Wiring Harness
- Fused (1A) Battery Sense Wire Pigtail
- Magnetic Programming Tool
- MC-624 Quick Start Guide

If any of the listed items is not included with your regulator kit, call our customer service department at 360-435-6100. Please note - If your regulator box is marked Max Charge MC-624, without the “H” designation your kit will not include the wiring harness or fused battery sense pigtail.

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). Plug is shown at right.

In addition, the harness includes a separate Stator (WHITE) wire. The proper terminal connection points for this, and additional wiring connections, are illustrated on the pin location legend shown and discussed on the following pages.

LFP LiFeP0$_4$ 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 LiFePo4 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 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 Amp Manager feature on the MC-624 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.



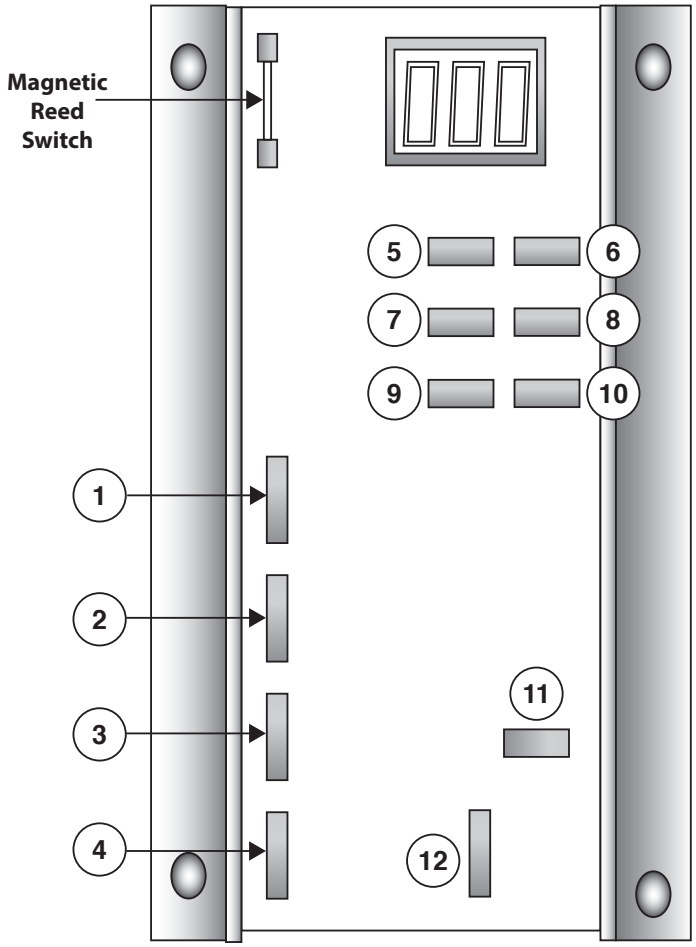
It is strongly recommended that an alternator temperature sensor (MC-TS-A) be used when charging LFP batteries. Given the extremely high charge acceptance rate of LFP batteries, the alternator will be driven to full output for almost all of the charge cycle. This can cause overheating in automotive style alternators resulting in a significantly shortened lifespan. When equipped with the MC-TS-A temperature sensor, the MC-624 will help you protect your investment by reducing the field voltage to your alternator by 50% 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 Amp Manager feature on your MC-624 to reduce maximum output until a tolerable alternator temperature is maintained under all conditions.

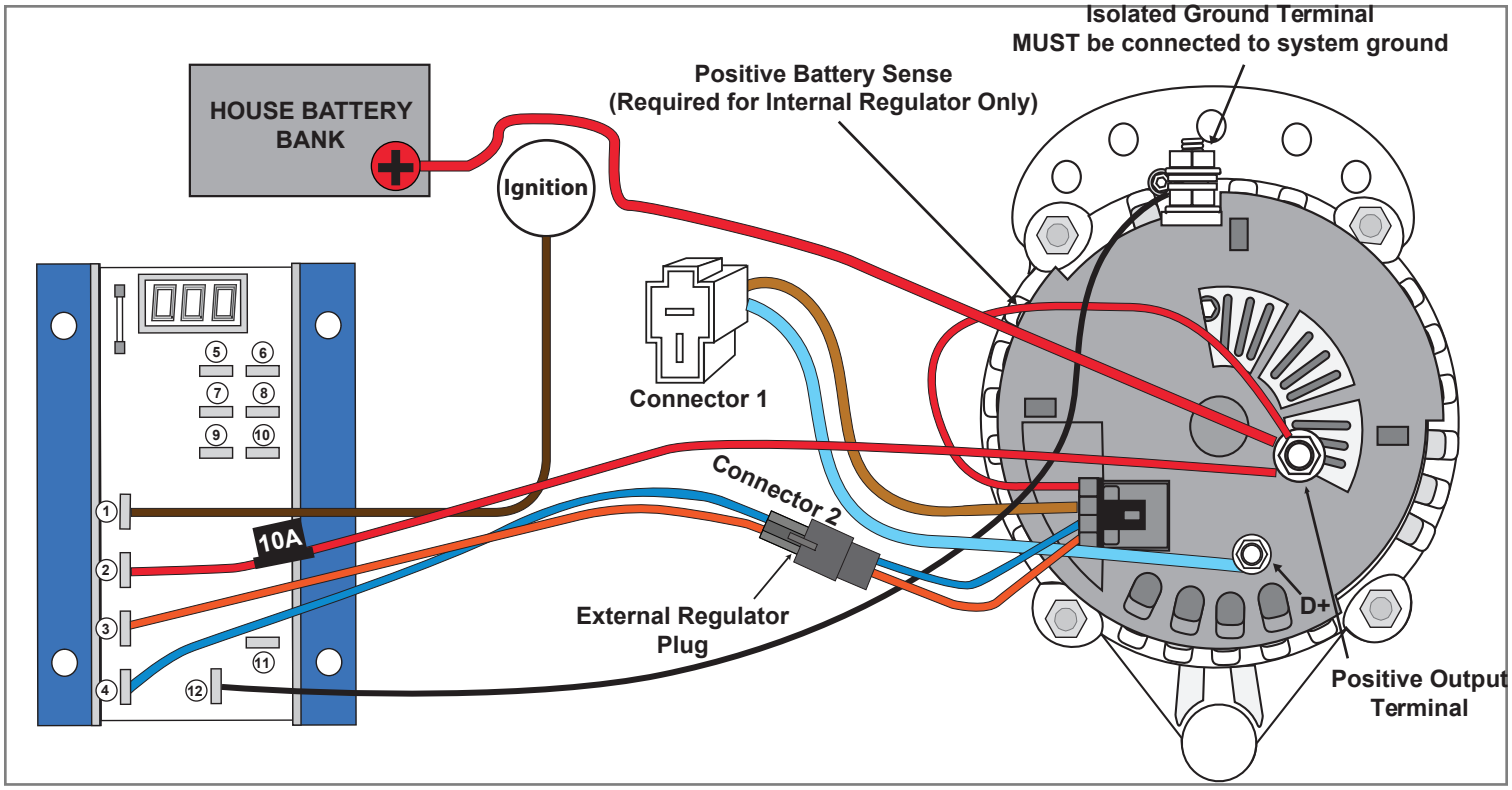


Most LFP battery manufacturers specify minimum and maximum charging temperatures to be from freezing (32°F, 0°C) to around 111°F (44°C). Again, consult with your battery manufacturer for specifics. When equipped with a MC-TS-B, the MC-624 can disable charging if the battery temperature exceeds the "B1L" temperature threshold and re-enable charging when the temperature drops below the threshold. This feature is meant to supplement, not replace, your BMS's temperature protection features. "B1L" should be adjusted to be slightly less than BMS's temperature threshold. Note that the regulator does not have the capability to prevent charging during low temperatures.

MC-624 Regulator Terminal Layout

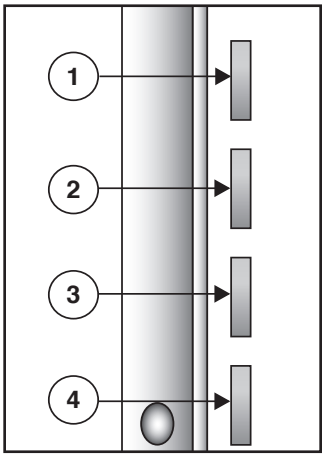
1. **IGNITION INPUT**
2. **POWER INPUT**
3. **STATOR IN**
4. **FIELD OUTPUT**
5. **ALT. TEMP. (+)**
6. **ALT. TEMP. (-)**
7. **BAT. #2 TEMP. (+)**
8. **BAT. #2 TEMP. (-)**
9. **BAT. #1 TEMP. (+)**
10. **BAT. #1 TEMP. (-)**
11. **DASH LAMP**
12. **GROUND INPUT**





Installation by Wire

Install BROWN Ignition Wire



The BROWN Ignition Wire (#1 in diagram at right) provides the ON/OFF voltage for the regulator. 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 the 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. Voltage on the ignition wire may be 12V or 24V.

Install RED Power Wire

The RED Power 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 ring terminal connector. In most applications, this wire can be connected directly to the alternator's positive output post. When a diode-type battery isolator is used, the Power (RED) 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 ORANGE Stator Wire

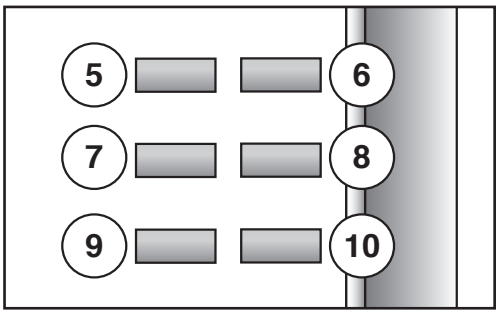
The ORANGE stator wire (#3 in diagram at right) provides a source of AC stator output voltage which is used by the regulator to assist in voltage regulation. The regulator end of the stator wire is included in the black four-wire plug, which is pre-installed on the voltage regulator.

When the tachometer is connected via the MC-624, the regulator will ensure that the tachometer will not discontinue supplying field current when the batteries are fully charged. When connecting the tachometer to the alternator stator output, it will be necessary to determine the number of poles in the alternator in order to properly adjust your tachometer. Most Balmar alternators feature 12-pole rotors and stators, though, in some cases, the pole count may be 14. See alternator manual for specifics. See your tachometer manual for adjustment instructions.

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 either a plug or a ring terminal, depending on the alternator's field terminal connection. Attach the field wire to the alternator's field terminal.

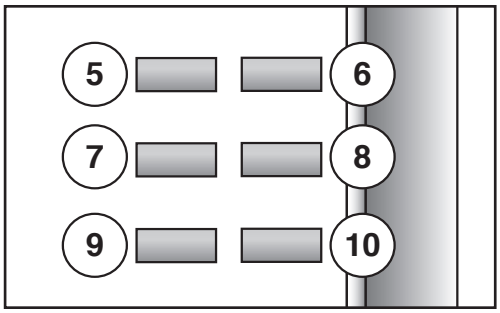
Install Alternator Temperature Sensor



To optional Alternator Temperature Sensor (MC-TS-A) allows your MC-624 voltage regulator to monitor your alternator temperatures and limit output if safe operating levels are exceeded. 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 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 match the polarity of the regulator connection pins. Connect the red wire to the positive terminal (#5) and the black wire to the negative terminal (#6)

Install Battery #2 Temperature Sensor



Your Max Charge MC-624 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:

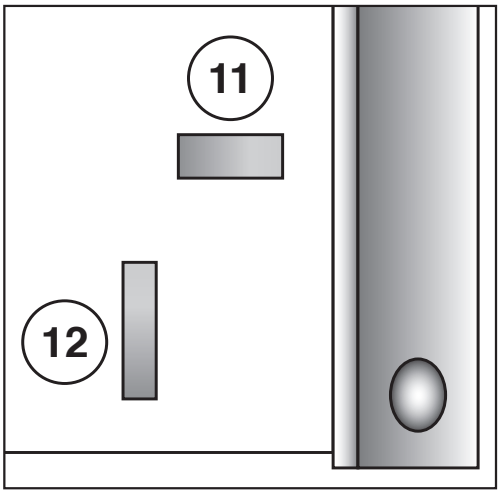
1. Connect the temperature sensor to the secondary battery bank following the directions provided for the primary battery temperature sensor.
2. Plug the positive and negative sensor to the appropriate positive connector; The RED positive sensor wire should be connected to the #7 terminal pin.
3. The BLACK negative sensor wire should be connected to terminal pin #8. Reconnect the spade to the (#9) pin.

Install Battery #1 Temperature Sensor

The Optional Battery Temperature Sensor (MC-TS-B) allows your Max Charge MC-624 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 discontinuing charging. The MC-TS-B sensor includes a 20-foot cable, a sensing attachment lug and positive and negative regulator plug-in connectors.

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 match the polarity of the regulator connection pins. Connect the red wire to the positive terminal (#9) and the black wire to the negative terminal (#10).

Install Dash Lamp



The Max Charge Dash Lamp (#11) 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.

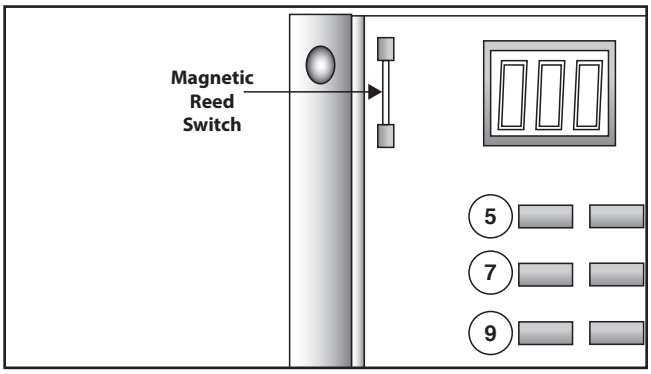
Install BLACK Ground Wire

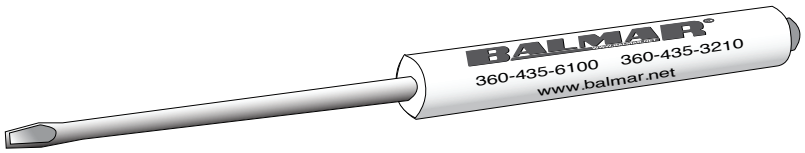
The BLACK Ground Wire (#12 in diagram at right) are included in the four-wire Ford-style plug on the wiring harness and are factory installed on regulator packages designated with “H” at the end of the model number. The other end of the Ground Wire is fitted with a ring terminal connector. In most applications, this wire can be connected directly to the alternator’s ground terminal post. Both alternators and regulators must be connected to system ground.

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.

Magnetic Reed Switch

Looking much like a small thermometer atop the regulator's circuit board, the magnetic reed switch provides a durable, sealed interface that enables the user to set basic and advanced regulator programming features. Included with the regulator is a small screwdriver that doubles as the regulator's programming tool. A small magnet embedded in the tip of the screwdriver's handle allows the user to activate the magnetic reed switch. By holding the magnet to the RED dot located at the end of the reed switch, the user allows the user to scroll through the regulator's various program modes and individual program selections.





Initial Pre-Flight Test And Start-Up

When the regulator is properly mounted and the regulator wiring is installed, the MC-624 is ready for pre-flight testing. Before turning on the engine, it is 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 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 #3) >24V
- BROWN Ignition Wire (Terminal #2) 0V
- Primary BLUE Field Wire (Terminal #1) 0V

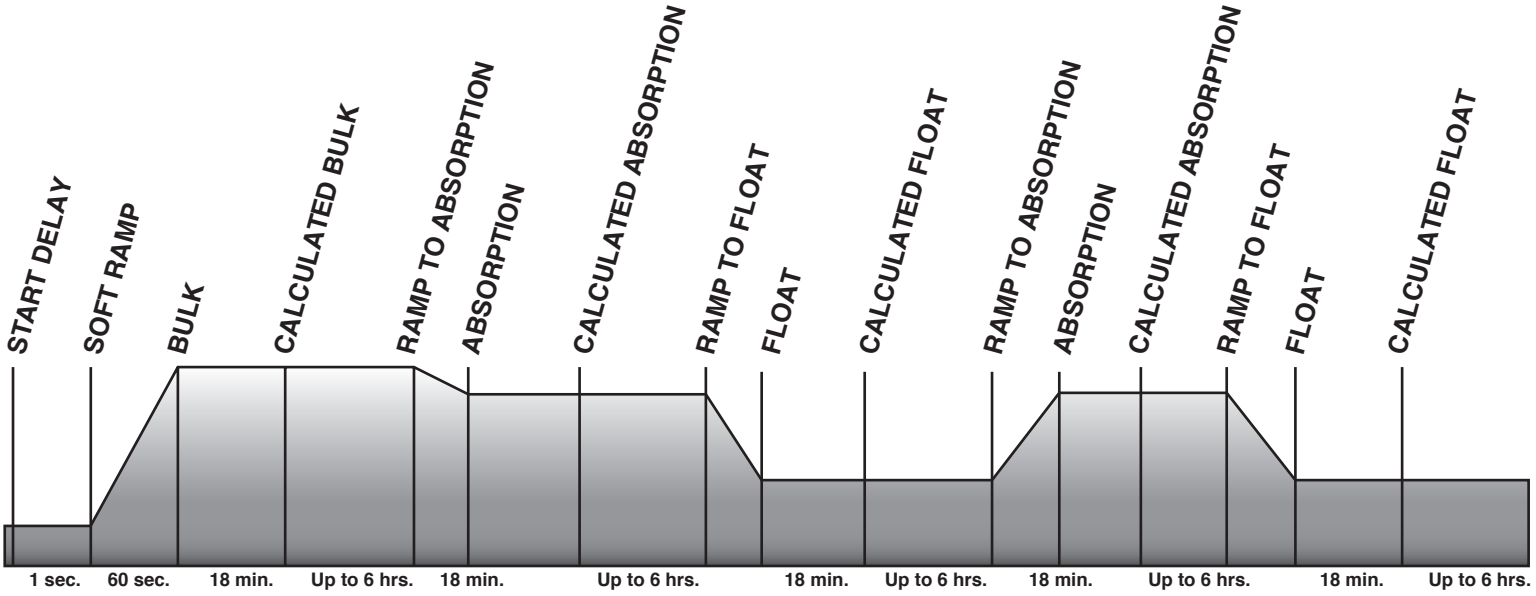
TEST #2: Engine/Ignition ON

- Primary RED Power Wire (Terminal #3) >24V
- BROWN Ignition Wire (Terminal #2) 12V or 24V
- Primary BLUE Field Wire (Terminal #1) 4-22V

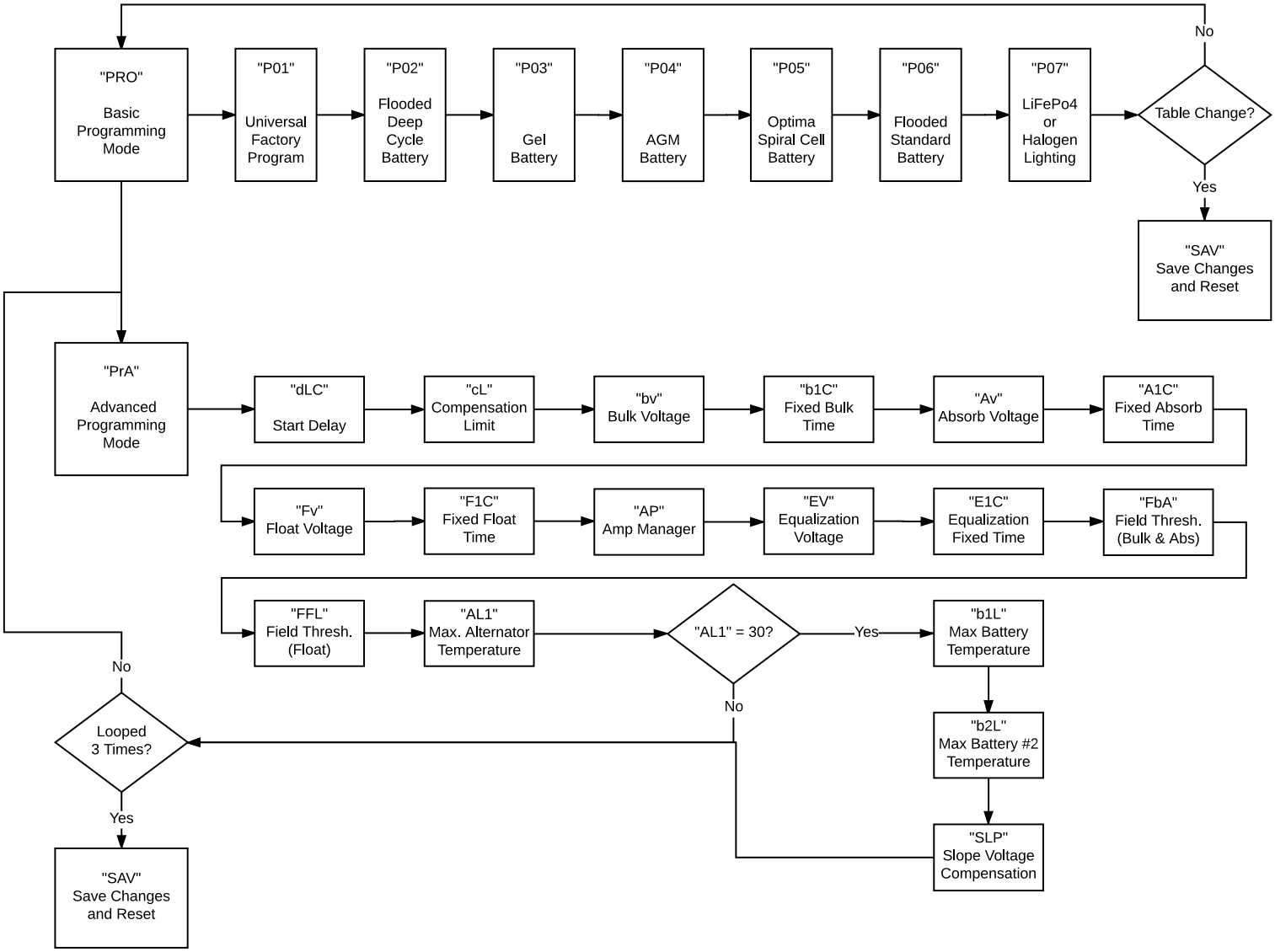
Regulator Operation

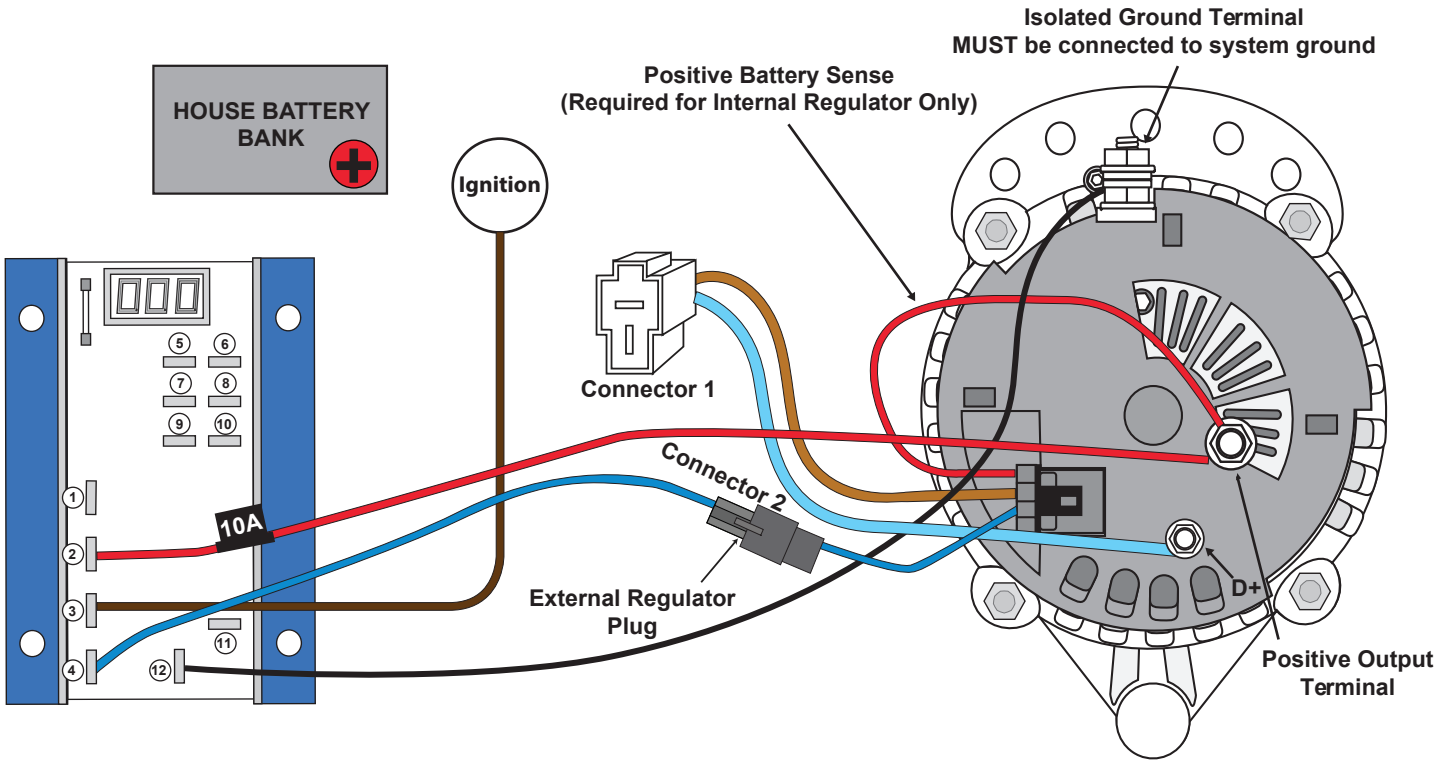
The MC-624 regulator's microprocessor controlled charging system uses a sophisticated, multi-stage profile to deliver maximum charging output, while protecting the batteries from overcharging damage. When the regulator is first turned on, the processor performs a quick one-second self diagnostic assessment. Following that diagnostic, the MC-624 initiates a charge program as follows:

1. **Start Delay** - Factory set at one second. Can be user-adjusted to a maximum of 999 seconds in the regulator's advanced programming mode. See Advanced Programming section for adjustment instructions.
2. **Soft Ramp** - Gently increases voltage to bulk preset levels based on battery program selected.
3. **Bulk Charge** - The most aggressive of the charging stages. Voltage is held at a pre-set level, specified by battery program selected, for a set time period. Factory-set bulk time is 18 minutes. Adjustable in 6-minute increments.
4. **Calculated Bulk Charge** - Holds voltage at bulk level for six minutes, then calculates battery condition by comparing existing voltage, time at voltage, and field percentage to target values. If values are met, the regulator advances to the next stage. If values are not met, the regulator continues to bulk charge and compares real-time to target values. This will re-occur until all values are met.
5. **Ramps down** to Absorption voltage.
6. **Absorption Charge** - Regulator continues to control the alternator's output voltage for an additional 18 minutes at approximately 2/10's of a volt below bulk charging voltage. Adjustable in 6-minute increments.
7. **Calculated Absorption Charge** - Holds voltage at absorption level for six minutes, then calculates battery condition bycomparing existing voltage, time at voltage, and field percentage to target values. If values are met, the regulator advances to the next stage. If values are not met, the regulator extends the absorption charge and compares real-time to target values. This will re-occur until all values are met.
8. **Ramp down** to Float.
9. **Float Charge** - Regulator continues to control the alternator's output voltage for an additional 18 minutes, typically at a volt less than bulk voltage (based on battery program presets). After that initial fixed time period, the regulator can respond to increased charging demand by cycling to absorption voltage. After 12 hours of continuous operation, the regulator will automatically revert to absorption voltage through calculated absorption and back to float charging stage.



Regulator Programming Flow Chart (More details can be found on pages 10-14)





Preset, Multi-Stage Battery Programs	Balmar Regulators				Digital Duo Charge	Dual Engine Centerfielder
	12 Volt			24 Volt		
Part Number:	**ARS-5**	**MC-614**	**MC-612-DUAL**	**MC-624**	**DDC-12/24**	**CFII-12/24**
Universal Factory Program, Deep Cycle Flooded, Gel Cell, Absorbed Glass Mat (AGM) and Spiral Wound Flooded (Optima)	Yes	Yes	Yes	Yes	Yes	Yes
Standard Flooded, Halogen Systems, Lithium	-	Yes	Yes	Yes	Yes	Yes
Balmar Alternator Models						
6-Series Alternators (70A-150A)	Yes	Yes	Yes	Yes	Yes	Yes
AT-Series Alternator (165A-200A)	-	Yes	Yes	-	Yes	Yes
9-Series Large Case Alternators (140A-310A)	-	Yes	Yes	Yes	Yes	Yes
Multiple Alternator/Engine Configurations						
Dual Engine, One Alternator Each	-	Yes (qty 2)	-	Yes (qty 2)	Yes	Yes
Single Engine, Two Alternators	-	-	Yes	Yes (qty 2)	Yes	Yes

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


624 Indicates Model MC-624


P01 Indicates Program Number (P01=UFP, P02=FdC, P03=gEL, P04=AGL, P05=OPS, P06=FsB, P07=LFP)


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


S01 Indicates stage of charge; S01=Delay, S02=Ramp, S03=Bulk, S04=Calc. Bulk, S05=Ramp-to-Absorption, S06=Absorption, S07=Calc. Absorption, S08=Ramp-to-Float, S09=Float, S10=Calc. Float


Bv Indicates system Battery Voltage. Followed by actual voltage reading as measured by regulator.


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

In addition to the information provided in the basic display shown above, the MC-624 long display provides the following data. The long display can be accessed at any time during operation by tapping the RED dot with your magnet.


r2.4 Indicates regulator's software revision


b1 Indicates Battery #1 temperature. Followed by degrees Celsius.


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


b2 Indicates Battery #2 temperature. Followed by degrees Celsius.


AL1 Indicates Alternator Temperature. Followed by degrees Celsius.


SP Indicates internal regulator temperature. Followed by degrees Celsius.


AP Indicates Amp Manager setting. Followed by maximum allowed field output percentage.


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


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


FbA Indicates Field threshold from bulk to absorption. Factory set at 77%.


FFL Indicates field threshold from float to absorption. Factory set at 77%. Adjust in advanced programming mode.


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*


E41 *FIELD VOLTAGE TOO HIGH*

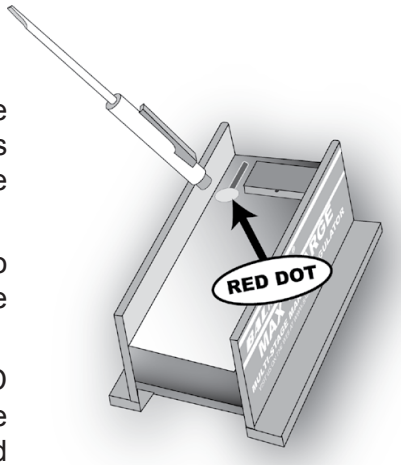

E42 *STATOR VOLTAGE TOO HIGH*


E51 *SMALL ENGINE MODE IS IN OPERATION*


E52 *BELT LOAD MANAGER IS IN OPERATION*

Regulator Programming Modes

Using The Magnetic Reed Switch



Control of the MC-624 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 tipped 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 the up and down along the length of the reed switch until the light is illuminated at the top of the LED display, between the second and third display digits. The light indicates activation of the 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***
- ***TOUCH / HOLD / RELEASE - Indicates the action of contacting and holding the magnet to the reed switch, then releasing the reed switch be removing the magnet from the RED dot on the epoxy potting***

Basic Programming

Programming For Battery Type

The MC-624 features selectable programs for SEVEN battery technologies. Programming can be done whenever the regulator is active. **System voltage must be greater than 25.0V for programming changes to be saved.**

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. 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 display will scroll through the seven available preset battery programs. The battery programs are signified by one of the program numbers shown below.
5. When the desired battery code is displayed, RELEASE the magnet from the RED dot.
6. The regulator will indicate the Pro code once the reed switch is released, followed by the SAV code to indicate that the program change has been saved.

REVERSING DIRECTION OF SCROLL: The regulator display from P01 to P07 and will then stop. To reverse the direction of scroll, remove the magnet from the dot until the PRO code is displayed, then re-activate and hold. The display will then scroll downward until the desired code is shown.

Pro *INDICATES ENTRY INTO BASIC PROGRAMMING MODE*

P01 *INDICATES UNIVERSAL FACTORY PROGRAM (FACTORY DEFAULT)*

P02 *INDICATES DEEP CYCLE FLOODED BATTERY PROGRAM (FDC)*

P03 *INDICATES PROGRAM FOR SEALED GEL BATTERIES (GEL)*

P04 *INDICATES ABSORBED GLASS MAT BATTERIES (AGL)*

P05 *INDICATES PROGRAM FOR OPTIMA BATTERIES (OPS)*

P06 *INDICATES STANDARD FLOODED PROGRAM (FSB)*

P07 *INDICATES PROGRAM FOR LiFePO$_4$*

SAV *INDICATES PROGRAM CHANGE IS SAVED*

NOTE: A CHART DESCRIBING VOLTAGE, TIME AND ALARM SETTINGS FOR EACH SELECTABLE BATTERY PROGRAM IS AVAILABLE ON PAGE 14 IN THIS MANUAL.

Advanced Programming

Accessing The Advanced Programming Mode

The MC-624 provides a broad range of advanced user adjustments in its Advanced Programming mode. The Advanced Programming mode can be accessed at any time via the following steps:

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.
3. Remove the magnet from the switch when the PRO code is displayed.
4. The PrA code will be displayed, indicating entry into the Advanced Programming mode, followed by codes for the individual Advanced Programming adjustment codes as described below.
5. Re-activate and hold when the desired Advanced Programming adjustment mode is indicated.



Pro *INDICATES ACTIVATION OF MAGNETIC REED SWITCH / ENTRY INTO PROGRAMMING MODE. RELEASE MAGNET FROM SWITCH AS SOON AS PRO CODE IS INDICATED.*

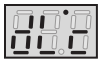


PrA *INDICATES ENTRY INTO ADVANCED PROGRAMMING MODE. PRA CODE WILL BE FOLLOWED BY INDIVIDUAL PROGRAMMING MODES AS INDICATED BY CODES BELOW.*

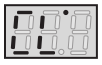
Making Advanced Programming Adjustments

Once accessed, the Advanced Program mode allows the user to adjust time, voltage and temperature settings for most operational modes. When the desired mode is indicated, TOUCH / HOLD the magnet to the RED dot on the epoxy potting. When the reed switch is engaged, the values for the various modes will scroll upward or downward. To reverse the direction of scroll:

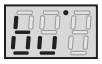
1. REMOVE the magnet from the reed switch.
2. Wait for the mode indicator to be displayed.
3. TOUCH / HOLD when the mode indicator is displayed. The values for that mode will begin to scroll in the opposite direction. Continue to HOLD until the desired value is displayed.
4. REMOVE the magnet from the 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:



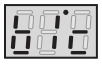
(dLc) Start Delay. Controls time from regulator activation to start of charging. Factory preset at one second. Adjustable to a maximum of 999 seconds. To reverse direction of scroll, release magnet and wait for LED to display dLc code. Re-activate switch with magnet and release when desired value is indicated.



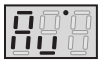
(CL) Compensation Limit. Controls maximum allowable temperature compensated system voltage. Adjustment spans from 28.2 to 31.8 volts. Default is 29.6V. To reverse direction of scroll, release magnet and wait for LED to display Cl code. Re-activate switch and release when desired value is indicated.



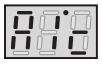
(bv) Bulk Voltage. Controls the target voltage for bulk charge mode. Starts at value set by battery program in use. Adjustment spans from 28.2 to 29.6 volts. To reverse direction of scroll, release magnet and wait for LED to display bv code. Re-activate switch and release when desired value is indicated.



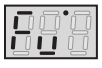
(b1c) Bulk Time. Controls time setting for bulk charge mode. Standard value set is 30 minutes. Settings are from 6 minutes to 6 hours. To reverse direction of scroll, release magnet and wait for LED to display b1c code. Re-activate switch with magnet and release when desired value is indicated.



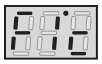
(Av) Absorption Voltage. Controls the target voltage for absorption charge mode. Starts at value set by battery program in use. Adjustment spans from 27.8 to 29.4 volts. To reverse direction of scroll, release magnet and wait for LED to display bv code. Re-activate and release when desired value is indicated.



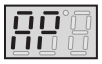
(A1c) Absorption Time. Controls time setting for absorption mode. Standard value set is 18 minutes. Settings are from 6 minutes to 6 hours. To reverse direction of scroll, release magnet and wait for LED to display a1c code. Re-activate switch with magnet and release when desired value is indicated.



(Fv) Float Voltage. Controls the target voltage for float stage. Adjustment spans from 26.0 to 27.6 volts. Default is based on battery program selected. To reverse direction of scroll, release magnet and wait for LED to display Fv code. Re-activate switch and release when desired value is indicated.



(F1c) Float Time. Controls time setting for float mode. Standard value set is 18 minutes. Settings are from 6 minutes to 6 hours. To reverse direction of scroll, release magnet and wait for LED to display F1c code. Re-activate switch with magnet and release when desired value is indicated.

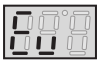


(AP) Amp Manager. The Amp Manager function allows for precise reductions in the maximum allowable field percentage, making it possible to reduce alternator horsepower load on belts, or to provide governance to protect the alternator from abnormally large battery or system electrical loads. When activated, the display will indicate OFF, meaning that no field reduction is occurring. To adjust, remove the magnet until the AP code is indicated. Re-activate and hold the magnet to the RED dot. The display will scroll downward until the desired value is indicated

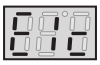
BATTERY EQUALIZATION FUNCTION - (Use Extreme Caution While Equalizing!)

Depending on battery technology and battery manufacturer recommendations, it may be necessary to periodically apply equalization/conditioning voltage to your batteries to reduce sulfation and equalize the specific gravity of the electrolyte solution. While it is FAR preferable to equalize your batteries with your shorepower charger at the safety of your slip, the MC-624 does provide the ability to equalize with the alternator and regulator. NOTE: Equalization voltage and duration should be in accordance with battery manufacturer guidelines. Equalization programming must be done with the engine running, as the equalization mode will occur as soon as the program adjustments are made.

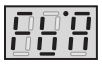
WARNING: EQUALIZATION IS A MANUAL PROCESS WITH POTENTIAL DANGERS.
DO NOT LEAVE SYSTEM UNATTENDED.



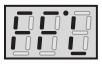
(Ev) Equalization Voltage. Sets the target voltage applied to the batteries during the equalization period. Contact your battery manufacturer for voltage guidelines.



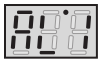
(E1c) Equalization Duration. Controls the length of time the batteries will be held at equalization voltage. Maximum time adjustment is three hours. If manufacturer guidelines require longer equalization times, allow for maximum time, and reset for additional periods as required.



(FbA) Field Threshold - Bulk To Absorption. Controls the criteria used to determine field output required to maintain calculated bulk charging mode. Factory set at 65% field output. Raising “fba” shortens calculated bulk charge time. Lowering “fba” increases calculated bulk charge time. Span of adjustment is 16% to 96%. To reverse direction of scroll, release magnet and wait for LED to display “fba” code. Re-activate switch and release when desired value is indicated.



(FFL) Field Threshold - Float To Absorption. Controls the criteria used to determine the field current threshold required to cycle between absorption and float charging modes. Factory set at 65%. Raising “ffl” increases calculated float charge time. Adjusted in 1% increments. Span of adjustment is 16% to 96%. To reverse direction of scroll, release “ffl” code. Reactivate switch with magnet and release when desired value is indicated.



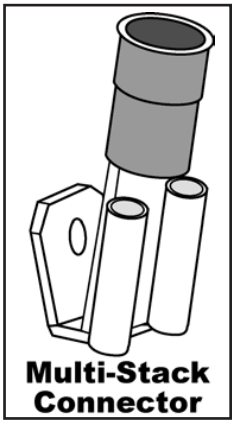
(AL1) Alternator Temperature Threshold. Controls the setpoint at which point field current is reduced when the the alternator temperature sensor indicates an over-temp condition at the alternator. Requires temperature sensor installation. Preset at 108˚.

Default Program Settings By Battery Type							
	UFP	**FdC**	**gEL**	**AGL**	**OPS**	**FsB**	**LFP**
START DELAY (SECS.)	1	1	1	1	1	1	1
HIGH VOLTAGE LIMIT (VOLTS)	31.8	31.8	31.8	31.8	31.8	31.8	29.6
BULK VOLTAGE	28.2	29.1	28.0	28.6	29.2	28.8	28.6
BULK TIME (MINIMUM)	30 MIN	30 MIN	30 MIN	30 MIN	30 MIN	30 MIN	6 MIN
ABSORPTION VOLTS	27.6	28.8	27.5	28.3	28.8	28.5	27.2
ABSORPTION TIME (MINIMUM)	30 MIN	30 MIN	30 MIN	30 MIN	30 MIN	30 MIN	18 MIN
FLOAT VOLTS	27.0	26.6	27.2	26.3	26.7	26.6	26.6
FLOAT TIME (MINIMUM)	2 HRS	2 HRS	2 HRS	2 HRS	2 HRS	2 HRS	18 MIN
FLOAT TIME (MAXIMUM)	12 HRS	12 HRS	12 HRS	12 HRS	12 HRS	12 HRS	12 HRS
LOW VOLTAGE LIMIT (VOLTS)	25.0	25.0	24.2	24.8	25.0	25.0	25.4
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	111°F/44°C
MAX ALT. TEMP.	225°F/107°C	225°F/107°C	225°F/107°C	225°F/107°C	225°F/107°C	225°F/107°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	0.0mV/°C

Additional Regulator Features

Small Engine Mode

In situations where additional power is needed for propulsion, the MC-624 provides the option to manually reduce regulator field output by approximately one half. This option, called Small Engine Mode, can be accessed by creating a direct pathway between the positive and negative Alternator 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 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 (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-624 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 <25.6V
- High Battery Voltage >31.0V
- High Alternator Temperature >225˚F (Requires installation of MC-TS-A sensor cable.) Temperature adjustable.
- High Battery Temperature >125˚F (Requires installation of MC-TS-B sensor cable.)

System Troubleshooting

Regulator Troubleshooting

The majority of charging difficulties can be attributed to damage, corrosion or wear at wiring, fusing or wiring connections. Please note: the regulator will not produce field output if the system voltage is below 22V. **Please ensure that voltage is above 22V when testing the system for proper operation.** 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 fuse in the regulator wiring harness if fuses 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 tests on the following page 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 or 24V 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 24VDC and connect the negative lead to SYSTEM GROUND.

With the ignition turned OFF, check voltage on the RED (power), BLUE (field) and BROWN (ignition) wires BY INSERTING YOUR POSITIVE PROBE INTO THE TOP OF THE FOUR-WIRE PLUG AT THE REGULATOR. The probe will slip in alongside the wire in the top of the plug. DO NOT disconnect the plug from the regulator while testing.

Voltages should be as follow:

- RED wire equal to battery voltage
- BLUE wire zero volts
- BROWN wire zero volts

With the ignition in the ON position (engine not running), check voltage on the RED (power), BLUE (field) and BROWN (ignition) wires in the regulator plug:

- RED wire equal to battery voltage
- BLUE wire between 4V and 22V
- 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.

With the ignition in the ON position (with engine running at 1,400 rpm fast idle), check voltage on the RED (power), BLUE (field) and BROWN (ignition) wires in the regulator plug. Voltages should be as follow:

- RED wire equal to battery voltage
- BLUE wire between 4V and 22V
- BROWN wire equal to battery voltage

PLEASE NOTE: SYSTEM VOLTAGE MUST BE ABOVE 22V FOR FIELD OUTPUT TO OCCUR. ENSURE THAT VOLTAGE IS ABOVE 22V WHEN TESTING SYSTEM.

If voltage is not present on the RED or BROWN wires, the regulator will not work. If voltage is as expected at the RED and BROWN wires, and there is zero, or an unexpected voltage reading at the BLUE wire, contact our technical support staff at (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:

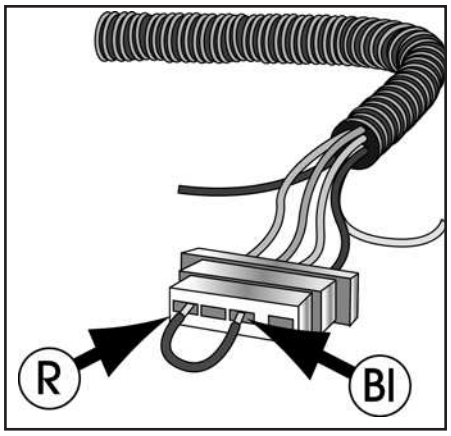
1. With the ignition in the OFF position, place the tip of a non-magnetic steel screwdriver near the nut on the pulley shaft or near the rear bearing of the alternator. There should be no evidence of a magnetic field pulling the screwdriver toward the alternator. (A slight amount of magnetism may be 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.

Alternator Testing Continued

3. After allowing time for the regulator's start-up delay, place the head of a steel screwdriver near the nut on the pulleyshaft 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 24VDC 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 is grounded and severe damage could occur.
3. 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.
4. 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 (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 1400 rpm.

NOTES:

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 © Copyright 2017.

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DC CHARGING SOLUTIONS

Balmar Knows How To Charge Your Batteries

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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.

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