

# 12-Volt Alternator Installation & Operation Manual

**BALMAR**  
[www.balmar.net](http://www.balmar.net)



## Introduction

Thank you for choosing a Balmar high-output alternator. This alternator is uniquely engineered to provide the finest performance and durability for your vessel. Unlike most automotive-type alternators found standard on the majority of pleasure craft and marketed as lower-priced marine alternatives, our marine alternators provide exceptional output at lower engine r.p.m.'s typical of marine diesel engines, so you can enjoy shorter charge cycles, greater economy, longer battery life and less noise and fumes.

When used in conjunction with Balmar microprocessor-controlled Max Charge and ARS-Series multi-stage regulators, your Balmar alternator provides even greater efficiency when charging deep-cycle flooded, standard flooded, gel, AGM, Optima and other marine battery technologies. When preset for your battery type, the smart regulator guides your alternator through a tailored charge cycle that ensures the best care possible for your batteries. Balmar

multi-stage regulators provide the ability to monitor temperature at your alternator. When used with the optional alternator temperature sensor (MC-TS-A) installed, the regulator will automatically reduce field output to 50 and activate a warning circuit which can control a user-installed visual or audible alert, should an over-temperature condition occur. Together, the Balmar high-output alternator and multi-stage regulator work to assure the best charge possible.

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## Safety Considerations

Before installing your new alternator, please take a moment to consider the following guidelines for safe alternator installation and operation. Failure to follow these guidelines could result in injury or damage to your vessel's electrical system.

1. Always disconnect your batteries and turn your battery switch to its "OFF" position prior to installing your alternator.
2. Remove any loose fitting clothing or jewelry which could become entangled in your motor or other machinery.
3. Wear ANSI-approved safety glasses or eyewear.
4. Ensure that the engine has cooled sufficiently before beginning installation.
5. DO NOT install your high-output alternator without ensuring that the system wiring is sufficiently scaled to handle increased amperage loads.
6. Be sure that your work area is sufficiently ventilated and that no fuels or solvents are present in and around your work area.
7. DO NOT operate your charging system without proper fusing. Failure to do so could result in severe injury and/or damage or loss of your vessel. DON'T take chances with fusing.
8. DO NOT attempt installation while using alcohol or medications which could impair your judgement or reaction time.
9. Use the right tool for the job. Use of improper tools could result in damage or injury.
10. Take time to read the manual. Equipment damage and possible injury may result from an incomplete understanding of the proper installation and use of the alternator.

**CAUTION:** The following instructions are intended for use by experienced marine electrical installers. If you are not sufficiently experienced with marine electrical systems, we recommend a qualified electrician be used for installation.

### Basic Installation

#### Alternator Mounting

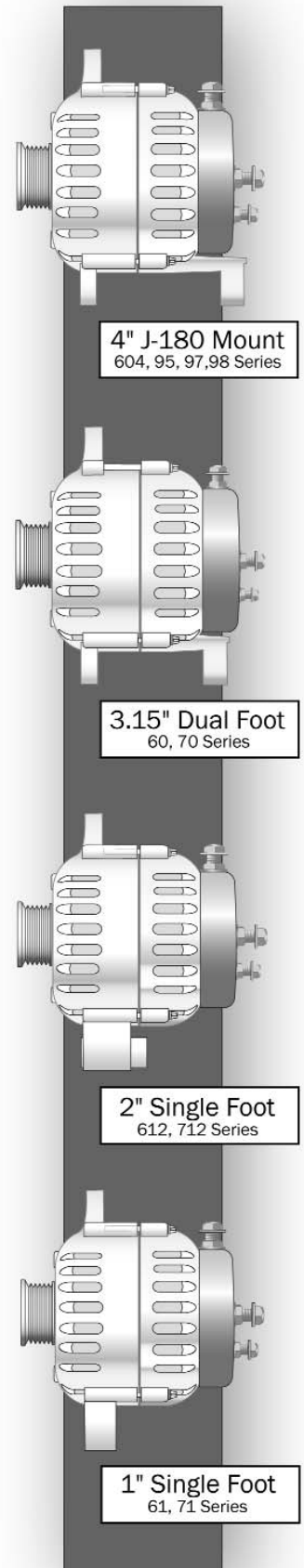
Due to the many domestic and international configurations of engine/alternator mounts, and factors such as year and location of engine manufacture and marinization, Balmar cannot guarantee a drop-in replacement in every engine application. Choose the model that most closely fits your application. Your installer may have to adapt the basic mounts to fit your needs. The majority of marine engines are equipped with one of four alternator mounting styles. The following describes which alternators represent each specific mounting style:

1. 60 & 70-Series (Dual Foot w/3.15" between legs): Small Case. Replaces most small case styles using a saddle style mount (eg., Hitachi, Lucas, Mitsubishi).
2. 621, 71 & 81-Series (1" Single Foot): Small Case. Replaces most domestic styles using a single 1" mounting foot (eg., Motorola, Prestolite). Note: 621-Series alternators provide a bushed spacer to convert from 1" to 2" single foot mount.
3. 621, 712 & 812-Series (2" Single Foot): Small Case. Replaces most domestic styles using a single 2" mounting foot (eg., Delco). See note above for 621-Series alternators.
4. 622-Series (2" Pad Mount) Series: Small case. Replaces Korean (Mando type) alternators using dual 2" static pad mounting feet. (Found on many Mercruiser and Volvo Penta gas engines.)
5. 94-Series (2" Single Foot) Series: Large case. See dimensions in our Product Guide or at our website to determine if your engine can accommodate a large case alternator.
6. 95-Series (Dual Foot w/4" between feet) Series: Large case. See dimensions in our Product Guide or at our website to verify if your engine can accommodate a large case alternator.
7. 96, 97 & 98-Series (Dual Foot w/4" between feet) Series: Extra large case. See dimensions in our Product Guide or at our website to determine if your engine can accommodate a large case alternator.

If you determine that the desired alternator will just not replace the existing alternator, one excellent option may be to leave the existing alternator in place and purchase a dual groove crank pulley for the front of the engine (in addition to the existing pulley). Have a special mount fabricated, or use the Balmar Off-Engine Alternator Bracket (Model 5276) to accommodate a larger alternator.

Once you have determined that the new alternator is the correct replacement for your existing model:

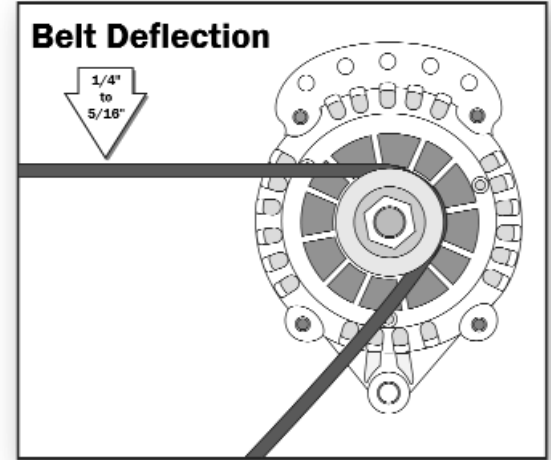
1. Disconnect the batteries and/or turn the switch to the "OFF" setting. Disconnect the wiring from the existing alternator.
2. Loosen the mounting & tensioning bolts and remove the existing alternator.
3. Once the alternator is disconnected from the engine, compare its mounting points to those on your new Balmar alternator. In most applications, the new alternator will replace the old alternator without any modification. In some cases, a simple bracket can be fabricated by a local machine shop. Balmar offers a universal mounting arm which can replace your existing tensioning arm, if needed. Others can be obtained through your local auto or marine supply.
4. Attach the mounting foot of the new alternator to its engine mount. Some shimming may be necessary to ensure that the alternator is securely mounted within the engine mount. If your alternator is a dual foot style, use care when tightening the alternator in place that the two mounting ears are not compressed. The rear bushing is designed to slide to tighten the mount.
5. Once in place, inspect to ensure that the alternator pulley is properly aligned with the engine pulley. If your belt configuration includes the pulley for the water pump, make sure that all three pulleys are properly aligned. Some shimming or modification to the alternator mount may be required to assure proper alignment.
6. Connect the output cable (see cable sizing recommendations below) ground, field wire, stator (tach) wire if needed and other necessary wiring. Connect alternator to Balmar regulator wiring harness as indicated in wiring diagram included on Page 12. The alternator's positive and ground cables should be sized according to the chart on Page 3.



- If a new regulator is being installed along with the alternator, complete its wiring installation according to the instructions included with your regulator.

After the alternator is installed and the wiring connections are attached, inspect for proper belt tension. When changing pulleys or when using the factory-installed pulley, torque the shaft nut to 50-60 foot-pounds. The shaft nut measures 15/16". To install the belt:

- Loosen the adjustment arm bolt and alternator pivot assembly bolt.
- Fit a new, high-quality belt over the appropriate pulleys.
- Tension the alternator until the belt is securely tightened in place. Re-tighten the pivot assembly and tension arm bolts. To test tension, place a 15/16" wrench on the alternator shaft nut and apply pressure. If the pulley rotates without moving the belt, re-loosen the bolts, apply additional pressure and re-tighten. Repeat until the belt is properly tensioned.
- Verify proper tension by pushing on the outside surface of the belt. The belt should deflect approximately 1/4" to 5/16" under moderate pressure. Your local auto parts store may carry a measuring tool designed to gauge belt deflection.
- Ensure that the mounting bolts at the alternator's tensioning arm and pivot point are securely re-tightened.



For ease of belt installation, invest in an inexpensive belt tensioning tool like that sold by J.C. Whitney. This simple tensioner (Model #ZX156161X) provides positive support at the alternator while increasing belt tension, leaving two free hands to re-tension mounting and tensioning belts. DO NOT use a bar or other device to pry the alternator case into place, as damage to the alternator may occur.

New belts tend to stretch during the first several times you run your engine. Make it a part of your normal pre-flight check to test belt deflection and re-adjust belt tension as needed. If you notice significant black dust on your alternator and surrounding engine area, check belt tension. If the belt is properly tensioned and you still experience belt dusting, it may be necessary to reduce horsepower load with the Max Charge regulator's Amp Manager, or ARS-5 regulator's Belt Load Manager. See your regulator manual for programming instructions.

## Additional Installation Information

### Sizing Battery Cables

It may be necessary to increase the size of your battery cables to support the added amperage output of the Balmar alternator. The chart to the right indicates cable gauge required to handle current loads. When determining wire length, the "round-trip distance" both positive and negative wire runs between the alternator and the batteries being charged must be considered.

Should greater accuracy be desired in determining the optimal wire gauge, the following formula can be used:  $CM = K \times I \times LE$  (whereas CM represents the circular mil area of the conductor, K represents the mil-foot resistance of copper, I represents current, and L represents the length, in feet, of the round-trip cable run and E represents voltage drop in volts). When using this equation, a K constant of 10.75 indicates copper's mil-foot resistance and voltage drop should be calculated at 3% (the standard for critical functions affecting the safety of vessel passengers).

| Length (feet) | 5 | 10  | 15  | 20  | 25  | 30  | 40  | 50  | 75  |
|---------------|---|-----|-----|-----|-----|-----|-----|-----|-----|
| <b>Amps</b>   |   |     |     |     |     |     |     |     |     |
| <b>75</b>     | 8 | 6   | 4   | 2   | 2   | 1   | 1/0 | 2/0 | 4/0 |
| <b>100</b>    | 8 | 4   | 2   | 2   | 1   | 3/0 | 4/0 |     |     |
| <b>125</b>    | 6 | 4   | 2   | 1   | 1/0 | 3/0 | 4/0 |     |     |
| <b>150</b>    | 6 | 2   | 1   | 1/0 | 2/0 | 3/0 | 4/0 |     |     |
| <b>175</b>    | 6 | 2   | 1   | 1/0 | 2/0 | 3/0 | 4/0 |     |     |
| <b>200</b>    | 4 | 2   | 1/0 | 2/0 | 3/0 | 4/0 |     |     |     |
| <b>225</b>    | 4 | 1   | 1/0 | 2/0 | 3/0 | 4/0 |     |     |     |
| <b>250</b>    | 4 | 1   | 2/0 | 3/0 | 4/0 |     |     |     |     |
| <b>275</b>    | 4 | 1   | 2/0 | 3/0 | 4/0 |     |     |     |     |
| <b>300</b>    | 2 | 1/0 | 3/0 | 4/0 |     |     |     |     |     |
| <b>350</b>    | 2 | 1/0 | 3/0 | 4/0 |     |     |     |     |     |

In addition wire gauge and quality, the quality of wiring connectors and terminations can have a direct effect on charging efficiency and safety. Be sure that all cable connections are secure and in excellent condition prior to operation of the charging system. Failure to do so could result in decreased performance, damage to the charging system or batteries, or in overheating and potential electrical fire. **NEVER operate your charging system if you have any concerns about the capacity or condition of your electrical wiring.**

### Selecting Drive Belts

The added horsepower load of your Balmar alternator will increase stress on your engine's drive belt. This additional load may require that you replace the standard drive belt with a heavier-duty belt. Many aftermarket belt manufacturers supply premium-quality belts, designed specifically for heavy-duty marine and industrial applications. Among these are the Green Stripe belt by Gates, Gator Belts by Goodyear, and the Top Cog belt from Dayco. Many auto parts suppliers, such as NAPA, carry extra heavy-duty belts designed to support larger horsepower loads.

In addition to belt quality, belt size can have a substantial impact on alternator performance. We recommend a minimum 3/8" belt (measured across the back of the belt) for alternators up to 80-amp output. Minimum belt width for alternators up to 110 rated amps is 1/2". Any alternator larger than 110-amps will require dual belts, or multi-groove serpentine belts for optimal performance, as well as acceptable belt life.

The addition of a larger diameter alternator pulley can often improve belt wear, as it will increase belt wrap and surface contact with the belt -- though the increased pulley diameter will lessen the ratio between the alternator and flywheel pulley and reduce low end amperage output.

Should you find that your belt is undersized for your alternator, the Amp Manager mode, available in the Max Charge MC-612 (12-volt) and MC-624 (24-volt) multi-stage regulators, enables you to limit the maximum field potential of the regulator and limit the horsepower load of the alternator. This feature, accessible through the Max Charge's advanced programming mode, can be adjusted in precise 2% increments -- so output can be adjusted to suit the system without losing more charging current than necessary. For more information, see the manual included with your Max Charge MC-612 or MC-624 regulator. Many engine manufacturers can provide replacement pulleys to convert your drive system to support dual belts.

### Belt Manufacturer Websites

Gates - [www.gates.com](http://www.gates.com)

Dayco - [www.dayco.com](http://www.dayco.com)

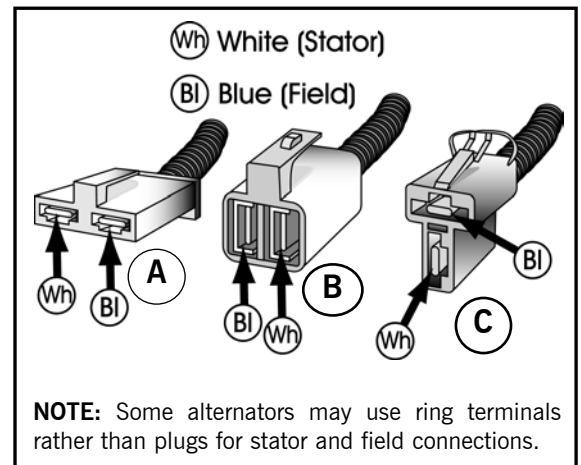
Goodyear - [www.goodyear.com](http://www.goodyear.com)

Fenner - [www.fennerindustrial.com](http://www.fennerindustrial.com)

### Voltage Regulation

With the exception of our 6-Series alternators, which feature patented "Smart Ready<sup>®</sup>" internal regulators, Balmar high-output alternators require external regulation in order to operate. We recommend our multi-stage ARS-4 and Max Charge regulators to provide optimal, balanced charging for most marine battery technologies. When ordered with supplied wiring harness, the voltage regulator can be mounted on a stringer or bulkhead up to four feet from the alternator. Excessive heat and exposure to coolant or saltwater can damage the regulator. Consider that when determining regulator placement.

Balmar's standard regulator wiring harness measures 54", and features ring terminal connectors at the alternator, or plugs (as seen at right) depending on which alternator is being used. The flat plug, indicated by the letter "A" is used with our 95-Series alternators, the grey rectangular plug, indicated by the letter "B" is used with our 6-Series and 9-Series alternator models. The black, T-shaped plug, indicated by the letter "C", is designed for use with our 94-Series alternators. All 7-Series, 8-Series, 97-Series, 97EHD-Series and 98-Series alternators use ring terminal connectors.



### Fan Rotation

Balmar alternators are designed to turn in a clockwise rotation. Face the front of the engine with the engine running to determine direction of rotation. Internally fanned 6-Series alternators are designed for clockwise rotation only. 7-Series model styles can typically be run in either direction (15% to 20% cooling loss may occur). 94-Series, 95-Series, 97-Series, 97EHD-Series and 98-Series feature bi-directional fans and keyed pulleys, so reverse rotation is acceptable.

8-Series and out-of-production 90, 91, and 912-Series alternators may require a reverse-rotation kit for counter-clockwise rotation applications. Keep in mind, alternators with non-keyed shafts will require pinning to ensure proper performance. A long twist drill bit and a roll pin are included in the reverse rotation kit.

## Grounding

Most Balmar models are designated as Isolated Ground (IG), and feature an independent ground terminal that's isolated from the alternator case. It is essential that a dedicated ground cable, equal in gauge to the alternator's positive output cable, is installed between the alternator's ground terminal and the electrical system ground. This can be to a primary ground bus, battery ground terminal, or the engine block if it is connected directly to system ground. Failure to connect the alternator to system ground could result in damage to the ship's electrical system, alternator and voltage regulator. Case ground alternators may access ground through the engine block, although it is recommended that a dedicated cable be connected between the alternator's ground terminal and system ground to ensure optimal continuity.

## Pulleys

Most small case alternators rated at 110 amps or less come standard with a single groove deep vee pulley. The deep vee pulley is designed to provide optimal power transfer for belts measuring 3/8" (10mm) to 1/2" (13mm), as measured across the back of the belt. Keep in mind, 3/8" and 7/16" belts may sit low in the pulley sheave. This will not adversely affect the belt's performance. Higher output alternators (120+ amps) in small, large and extra-large case series are equipped standard with 1/2" dual groove pulleys. Some models, including 622-Series alternators may be equipped with multi-groove serpentine type pulleys. Should your application require a different pulley than that provided as standard, Balmar may carry an optional pulley more suited to your needs. For a list of optional pulleys, visit <http://www.balmar.net/pulleymatrix.htm>, or call Balmar Customer Service at 360-435-6100.



## Alternator Heat

During operation, your alternator will become hot as a result of friction and the generation of inductive current. In some instances, particularly during extended periods of heavy load, alternator case temperature can exceed 200 degrees (F). If your system is operating with an ARS-5 or Max Charge MC-612 voltage regulator with optional Alternator Temperature Sensor (MC-TS-A), the regulator will automatically reduce the alternator output by approximately 50% if temperatures exceed set safe working limits (approximately 225°F. While this is an extremely effective protection for the alternator, it should not be depended upon as a part of normal operation. Correction of conditions causing overheating are strongly advised.

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. In applications where airflow to the alternator is limited, consider providing ducted air from a cool source (such as the bilge, or from an external vent) to the rear of the alternator. This will provide a pronounced improvement in cooling efficiency.

## Meters

Replacing your standard alternator with a high-output Balmar alternator may require that your standard amp meter be replaced with a high amperage, shunt-type meter. We strongly recommend replacing your amp meter with a more fully functioning charging system monitor, such as the Link Meter from Xantrex/Heart Interface. In addition to metering system current, these system monitors will indicate battery condition and estimate battery time remaining before charging is needed.

## Charge Lamps

Depending on your application, your dash-mounted charge indicator lamp may be controlled by a diode trio (D+) circuit provided by the alternator. 6-Series alternators provide a D+ terminal to activate the lamp circuit. If your Balmar alternator does not include a D+ terminal, your Max Charge or ARS-5 voltage regulator provides a Dash Lamp circuit which may be capable of activating the charge lamp. See your regulator manual for more information.

## Tachometers

All Balmar alternators provide a source of un-rectified AC voltage directly from the stator output. This stator output provides the pulse required to drive most electric tachometers. Most current Balmar alternators feature 12-pole stator outputs (meaning 12 pulses of AC voltage during each alternator revolution). Extra-large case 98-Series and older 9-Series alternators feature 14-pole stator outputs.

Most electrical tachometers feature some level of adjustment to calibrate the tachometer to your alternator's pole settings and pulley ratios. If your existing tachometer does not provide any adjustability, it may be necessary to replace the existing tachometer with an adjustable model.

### Tach Manufacturer Websites

Teleflex - [www.teleflexmarine.com](http://www.teleflexmarine.com)

VDO - [www.vdo.com](http://www.vdo.com)

Stewart Warner - [www.stewartwarner.com](http://www.stewartwarner.com)

ISSPRO - [www.isspro.com](http://www.isspro.com)

## 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 length and the size of cable used. Blue Sea Systems, a respected manufacturer of high-quality fuses and circuit breaker devices, recommends the following when sizing the proper circuit protection for your system. Fusing should be:

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.

**Note: Fusing is designed to protect the boat and its wiring from the constant potential energy stored in the battery, rather than output from the alternator. Fusing should always be installed at the end of a wire or cable run closest to the battery. DO NOT place fusing for the alternator's output cable at the alternator end of the cable run!**

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 <http://www.blueseasystems.com/circuit.htm>.

## Alternator-to-Battery Ratios

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 at any given time. 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 up to 40 percent of their available capacities, as such, 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.**

## Multiple Bank Charging Options

When charging a single starting battery, the alternator can be connected to the battery directly, or via an ON/OFF switch. In marine charging systems, the alternator typically supports a smaller starting battery and larger house battery bank -- or multiple banks dedicated house loads, inverter loads, as well as windlass or thruster batteries. Many methods of multi-bank charge control are available, ranging from manual switches to products like Balmar's Digital Duo Charge, which automatically provides charging current to the starting battery whenever charging voltage is present at the house battery.

The following section outlines many of the most commonly used options for multiple-bank battery management:

## Switches

Available in two primary types -- ON/OFF or A/B/BOTH -- manual switches offer a simple method for managing battery charging. Possible installations include separate cables to each battery bank with ON/OFF switches in line for each bank, or, a common output cable to the common post of the A/B/BOTH switch with an output cable to each battery bank. Field disconnect switches feature terminals where the field output from the regulator to the alternator can be interrupted when the battery switch is turned to the OFF position. This feature ensures that alternator output is discontinued as soon as the battery is disconnected. NOTE: NEVER operate the alternator with all switches in the OFF position (doing so will damage the alternator).

|                         |  |
|-------------------------|--|
| <b>Advantages:</b>      | Inexpensive. No substantial voltage drop.  |
| <b>Disadvantages:</b>   | Require user interaction and heightened system understanding. Can be accidentally shut down, causing potential alternator damage. Does not allow for mixed battery technologies. |
| <b>Voltage Sensing:</b> | Battery voltage sensed must always be that of battery being charged. Sense voltage at common side of battery switch or at alternator positive output.                            |

## Battery Combiner

Battery combiners enlist high-amperage solenoids to charge multiple battery banks. Below a specific voltage set-point, the combiner's solenoids remain open, isolating the individual battery banks. Once the baseline voltage is reached, the solenoid(s) open, combining all of the batteries into one big bank.

|                         |   |
|-------------------------|---|
| <b>Advantages:</b>      | No user interface required. No substantial voltage drop. Available in 2 or 3-bank models. |
| <b>Disadvantages:</b>   | Moderately expensive. Does not allow for mixed battery technologies.                      |
| <b>Voltage Sensing:</b> | Sense voltage at common side of combiner or at alternator positive output.                |

## Diode Isolator

Isolating diodes direct charging current to the battery bank with the greatest demand. Best suited for battery banks that are comparable in size and degree of discharge. Isolators are not necessarily the best choice when charging house and start battery banks. Only one battery bank can be sensed by the regulator, so under- or over-charging can be a substantial issue if batteries are dissimilar in capacity or degree of charge. Diodes can drop voltage at the battery side of the isolator by nearly a volt, which means that the alternator is forced to increase voltage far in excess of that needed by the batteries.

|                         |   |
|-------------------------|---|
| <b>Advantages:</b>      | No user interface required. Reasonably priced. Available in 2 or 3-bank models.   |
| <b>Disadvantages:</b>   | Substantial voltage drop. Can only sense voltage at one battery bank. May drive voltage at secondary battery bank to dangerously high levels. May hold high voltage for too long at smaller bank. Tendency to under- or over-charge secondary (non-sensed) battery bank. Greater chance of early battery failure. |
| <b>Voltage Sensing:</b> | Voltage must be sensed at most commonly used battery bank (typically house). Connect sense wire to battery side of isolator or positive post of battery being sensed.   |

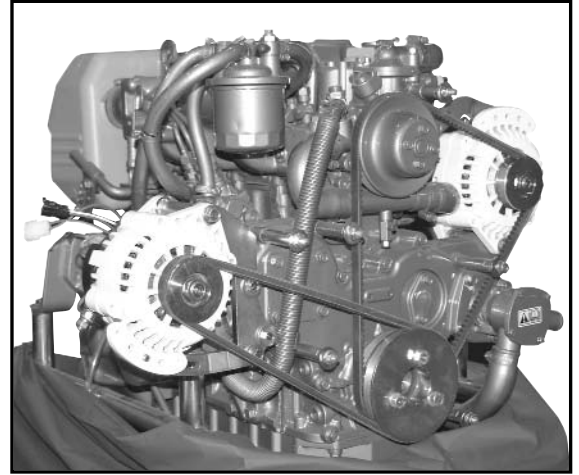
## Digital Duo Charge

Balmar's Digital Duo Charge connects between the house and start (secondary) batteries -- keeping the two banks separate until the unit senses 13 volts (26@24V) at the house battery. Once voltage is reached, the Duo Charge supplies up to 30A to the secondary bank. Voltage is regulated at the secondary bank based on a preset program chosen by the user to reflect the secondary battery type. Standard and deep cycle flooded, gel and AGM battery types are supported. Optional battery temperature sensing and solenoid drive are included. 12 or 24-volt settings.

|                         |  |
|-------------------------|--|
| <b>Advantages:</b>      | No user interface required. Selectable programs ensure proper voltage control -- even with varied battery bank capacities and mixed battery constructions. Amperage limits require smaller wire gauge. Works with DC or shorepower charge sources. Simplifies charging control for alternator and regulator. Can be used to control an optional solenoid to support battery banks with demands greater than 30 amps. |
| <b>Disadvantages:</b>   | 30-amp maximum output may not support larger secondary banks (bowthruuster, windlass, etc.) without use of manual solenoid control.  |
| <b>Voltage Sensing:</b> | Duo Charge senses source battery voltage at positive input terminal. Secondary (starting) battery voltage is sensed at the Duo Charge's positive output terminal. ON/OFF voltage can be monitored at the house battery bank, or at the ignition switch. Visit the Manuals Page at the Balmar website for detailed Digital Duo Charge installation and operational information  |

### Two Alternators/Single Engine

Should more charging power be required than is conveniently available from the engine's primary alternator, many boaters choose to install a second alternator. In these applications, alternators can be used separately as dedicated charge sources for the various battery banks, or the outputs from both alternators can be combined to provide a single source of charging. This requires that the field wire from a single regulator be split to supply both alternators. This system is commonly used to supply a large house bank, with a Duo Charge unit providing charging current to the starting battery. Balmar's Max Charge regulator is designed specifically to supply sufficient field output to control dual alternators, and is required for installations where dual alternators are used to supply a single battery bank. See the Max Charge manual for additional installation information.



|                  |   |
|------------------|---|
| Advantages       | Provides substantial increase in available charging amperage. Builds in system redundancy.  |
| Disadvantages:   | Requires addition of new bracketry and upgraded crankshaft pulleys. Potentially expensive   |
| Voltage Sensing: | Depends on whether alternators are dedicated to specific banks, or if they are combined to support a single bank. Voltage must be sensed at the battery(ies) being charged. |

### Twin Engine Issues

Twin engine applications pose some unique challenges in addressing battery needs. Some primary charging configurations are as follows:

1. Dedicate Alternator #1 to charge engine starting batteries. (May be done with a switch, or by connecting the alternator output to one engine battery and a Digital Duo Charge from the primary to the secondary engine battery). Dedicate Alternator #2 to the house battery bank.
2. Combine outputs from Alternator #1 and Alternator #2 to provide increased charging amperage for the main (house) battery bank, and supply the engine (and other secondary) batteries via Digital Duo Charges or combiners. Combining the output from two alternators on two engines will require the use of Balmar's Centerfielder (described below). This configuration will require that both alternators are equipped with Max Charge regulators, which are designed to provide sufficient field current to drive two alternators. For additional information, download the Centerfielder instructional manual from the Balmar website; [www.balmar.net](http://www.balmar.net).

### Centerfielder

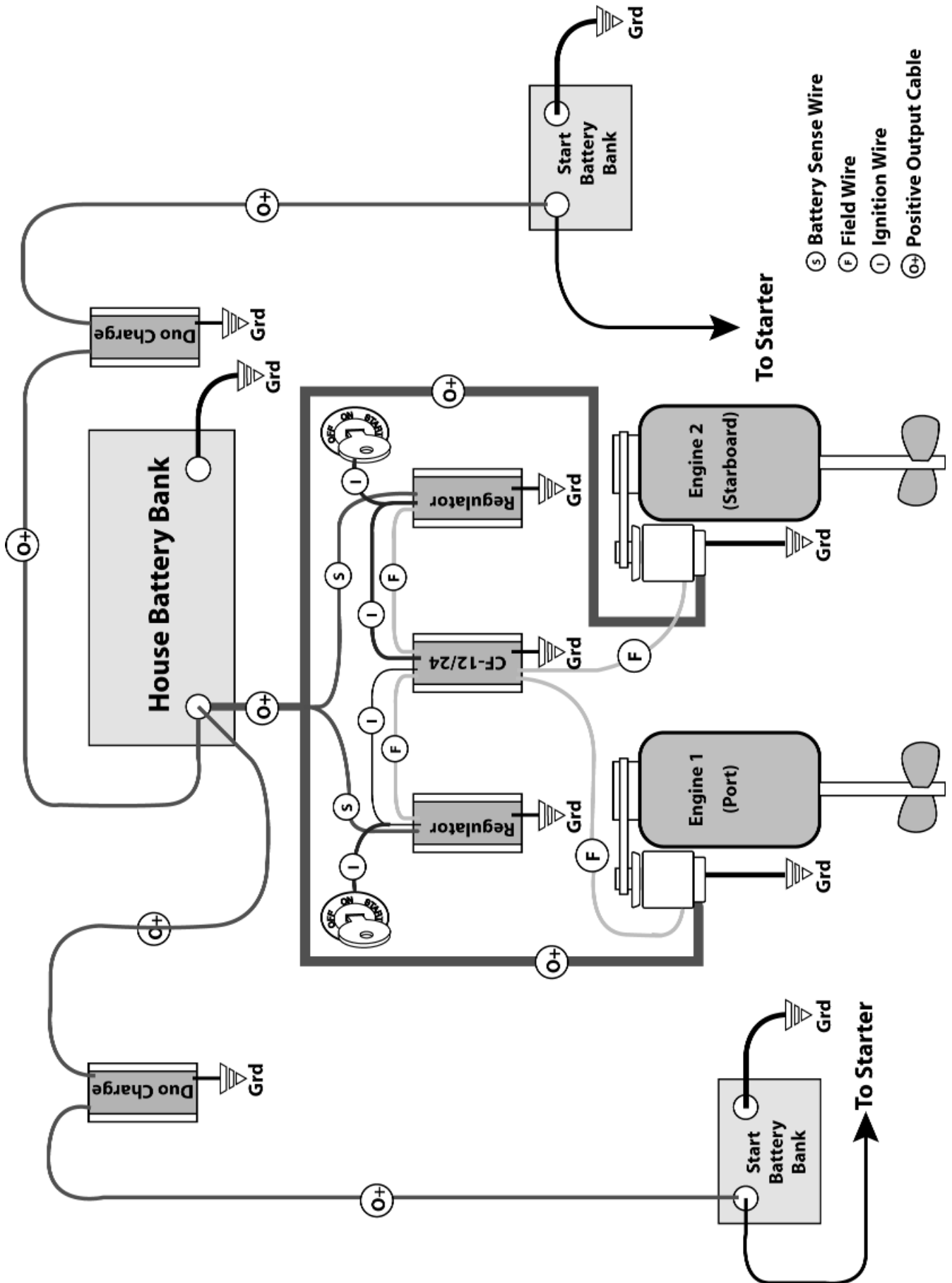
Balmar's Centerfielder works as a "smart switch" that enables twin engine systems to combine or isolate port and starboard alternators by controlling field output from their respective regulators.

The Centerfielder monitors field and ignition wires on port and starboard voltage regulators (Max Charge MC-612 or MC-624 regulators strongly recommended, depending on system voltage). When both regulators are up and running, the Centerfielder identifies the dominant regulator and splits its field to supply both alternators with the same excitation voltage. This allows the user to supply output from both alternators to the same battery bank.

In multi-bank battery systems, the output can be directed to additional banks via Digital Duo Charge. A typical system wiring design is shown on the following page:







## System Troubleshooting

Determining the causes of failures in an electrical system is a “step by step” process. Before you begin your search to determine if the failure can be attributed to the alternator or the voltage regulator, we recommend you inspect and clean all system electrical connections.

*Most charging system problems will be corrected by performing the steps on Pages 10 & 11.*

1. Remove and clean all charging system electrical connections from the alternator, the batteries and wire runs (this includes the ground side). Also, check the voltage regulator's harness for resistance. Wires and terminals can and will become corroded and may need to be cleaned or replaced. Check **ALL FUSING** in the regulator harness and alternator output cables.
2. 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 state of charge.
3. Check and tighten alternator belt. If the belt shows signs of wear or damage, now is an ideal time for replacement. Always replace existing belts with the finest quality replacements available.

After determining that your 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. The following tests provide an opportunity to isolate the alternator, regulator and wiring harness in order to determine which component may be malfunctioning. In order to perform these tests, you will need a simple test lamp (available at most auto parts or marine hardware stores. West Marine sells Ancor continuity testers for just a few dollars). A digital handheld multimeter can also be helpful in checking for voltage drop and resistance in wiring and terminal connections. A clamp-type DC Amp meter may be useful in diagnosing amperage issues. A 10' long, 14-gauge wire with insulated alligator clips at each end provides the ability to take measurements with your test lamp or multi-meter with a centralized ground point.

## Voltage Regulator Diagnosis

The failure of the voltage regulator to provide field current to the alternator will cause the charging system to fail. To begin the voltage regulator tests, check to see that the regulator display is lit when the engine is running. If the regulator display fails to light after the engine is started:

1. Connect your ground extension wire (as described above) to your second ground terminal at the regulator. Connect the other end of the extension to the ground probe of the test light. Turn your ignition switch to the ON position – if the regulator's brown (ignition) wire is connected to an oil pressure switch, connect a jump wire across the oil pressure switch.
2. Apply the test light's positive probe to the red (power) wire in regulator's black 4-wire plug. If the test light does not illuminate, follow the red (power) wire to its source (at the battery, alternator output or common side of the battery switch) and test for power there.
3. If the red (power) wire has power at that location, replace the 10-amp fuse in the red (power) wire and re-check for power at the regulator wiring plug. If the wire has no power at the regulator end, inspect for damage along the length of the wire and repair/replace as needed.
4. If the red (power) wire lights the test lamp, but the regulator display remains unlit, apply the positive probe of the tester to the brown (ignition) wire. If the test lamp remains unlit, follow the brown (ignition) wire to its source and test the source with your test lamp. If the source illuminates the test lamp, repair or replace any damaged wire or connectors needed until the test lamp indicates current at the regulator end of the brown (ignition) wire.
5. If the regulator is a Max Charge MC-612, follow the same testing guidelines for the Positive Battery Sense wire. Repair/replace damaged wire, connectors or fusing, as needed.

If the regulator display is illuminated, yet charging is not occurring (be sure to wait beyond the 45-second delay before taking test readings:

1. Apply the test lamp's positive probe to the blue wire in the regulator's black 4-wire plug (with negative probe connected to the regulator ground). If the test lamp does not illuminate, the regulator may be damaged. If the regulator is within the warranty period (see Warranty Info on Page 12) call our Customer Service Department at 360-435-6100.
2. If the test lamp is illuminated, the regulator is providing field current, and the charging problem is likely elsewhere in the charging system.
3. Follow the field wire to its connection at the alternator. Disconnect from the alternator and apply the test lamp to the wire. If the lamp illuminates, the regulator and wiring harness are likely to be good.

## Alternator Diagnosis

Once the regulator and harness are tested and proven good, disconnect the negative probe of the test lamp from the regulator ground and connect the negative probe to the field terminal of the alternator. Connect the positive probe to the blue (field) wire coming from the regulator.

1. Monitor the test lamp. If the lamp doesn't light when the regulator reaches Stage 3, as indicated on the regulator display, the alternator may not be completing the connection to ground. Check the ground connections at the alternator to system ground. Some test lamps may not be sensitive to low field current levels. If your test lamp does not illuminate, go to the next step.
2. If the meter indicates substantial amount of resistance between the alternator and the system ground, a wiring or terminal connection issue is indicated. Re-check system ground cabling and wiring.
3. If an internal fault is indicated as a result of testing, remove the alternator and contact Balmar Customer Service or your local alternator shop for recommendations.
4. If the test lamp is illuminated when connected inline between the the regulator field wire and the alternator field terminal, place a metallic object (a screwdriver blade works well) near the front of the alternator pulley shaft or the rear bearing cover of the alternator. If the screwdriver blade is magnetically drawn to the alternator, the alternator's internal components appear to be functioning correctly.
5. If the test lamp is lit and magnetism is detected, you can remove the test lamp, re-connect the blue (field) wire and start the engine. Once the engine is started and the regulator's start delay is complete, voltage should climb to set charging levels..

## Alternator Diagnosis - Independent of Regulator

The alternator can be tested independently of the regulator and wiring harness by connecting the alternator's field terminal directly to battery voltage. Once connected to battery voltage, the alternator's pulley shaft and rear bearing cover should generate a substantial magnetic pull. If no pull is present, an internal wire or positive/negative brush connection may be at fault. To test the alternator only:

1. Connect one side of the test wire to a source of positive battery voltage. Connect the other to the alternator's field terminal. If the alternator's rotor, stator and brushes are in working order, the alternator will have substantial magnetic current at the front and rear of the rotor shaft. This can be verified by placing a screwdriver, wrench or other metallic object near the pulley nut or at the center of the alternator's rear cover.
2. If there is magnetic current found at the front or rear of the alternator, you can test alternator operation by starting the engine. If charging voltage immediately begins to climb, the alternator is unlikely to be the cause of charging issues. If voltage remains at resting battery voltage (<12.8 volts) the alternator may require repair or replacement. NOTE: When testing the alternator by applying battery voltage to the alternator's field terminal, voltage may climb above safe levels for the batteries and any electronics onboard. If voltage exceeds 14+ volts, shut off the engine.

## Overview

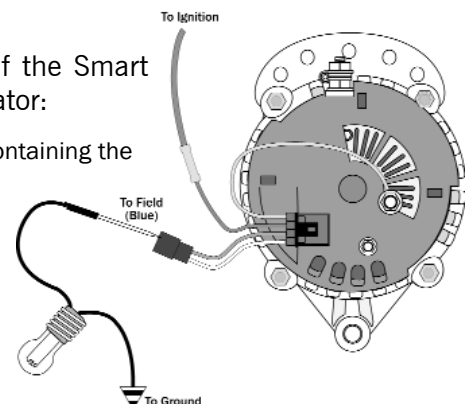
If alternator and regulator tests indicate proper operation, further investigation into battery damage or wiring failure is recommended. If charging system performance continues to be compromised, we strongly advise that you seek the assistance of a certified marine electrical diagnostician. For additional assistance or recommendations, contact our Customer Service department at 360-435-6100.

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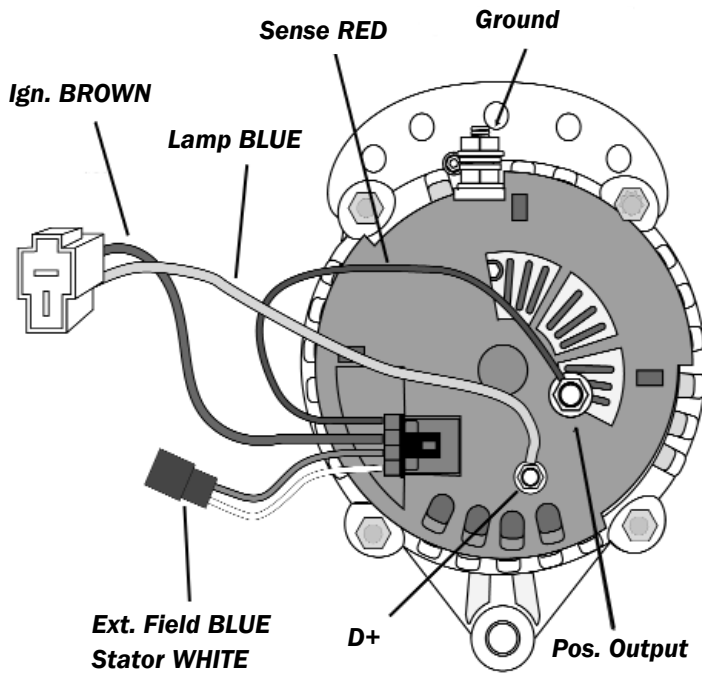
## Testing Smart Ready® Internally Regulated Alternators

New 6-Series alternators require slightly different diagnosis to determine if the Smart Ready® internal regulator is functioning correctly. To test the internal regulator:

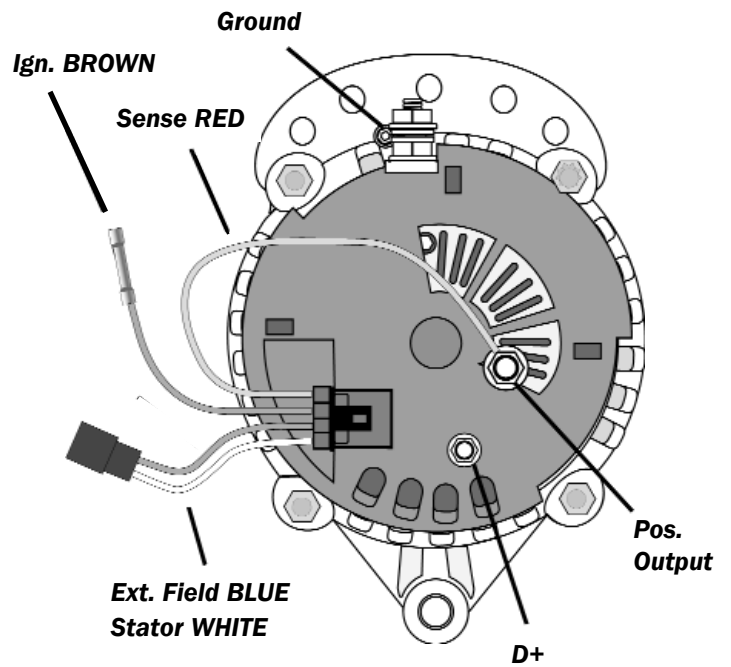
1. Disconnect the external regulator wiring harness from the alternator wiring plug containing the field and stator wires. Turn the ignition switch to the ON position.
2. Contact the positive probe of your test lamp on the FIELD terminal of the wiring plug. Connect the tester's negative probe to ground. If the internal regulator is functioning properly, the test light will illuminate.
3. If testing the operation of the internal regulator with a multi-meter, adjust the meter to read 12V DC before placing probes at the field terminal and ground. If the regulator is working correctly, the meter will show approximately 3V DC.



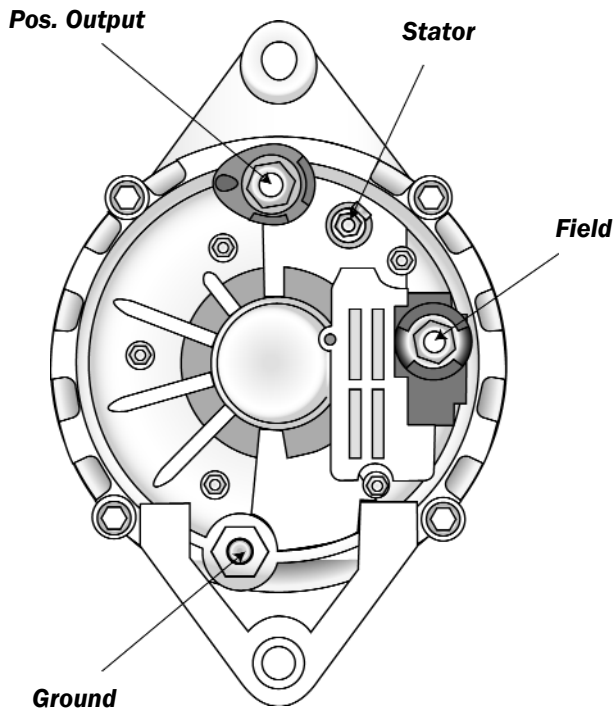
## 60-Series Terminal Connections



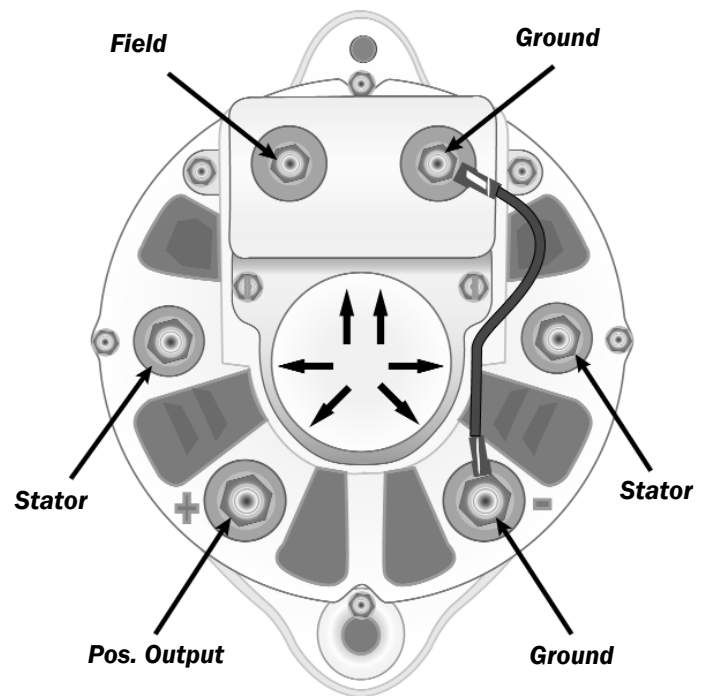
## 60-Series Terminal Connections



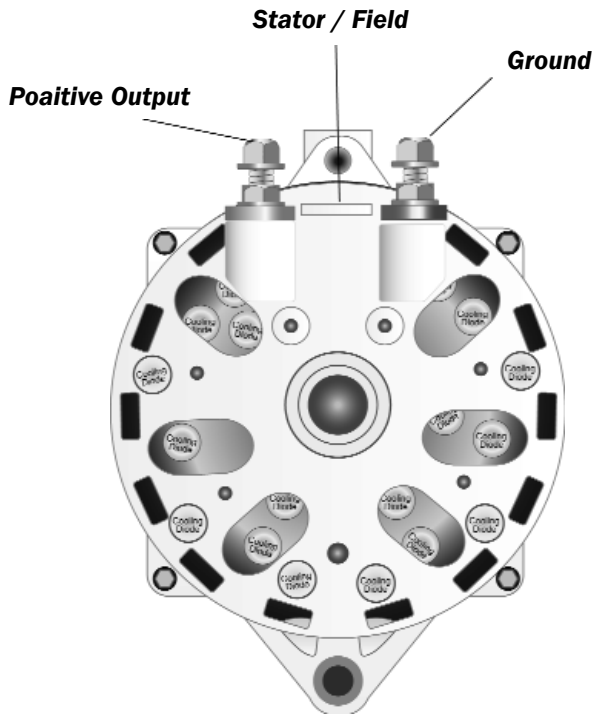
## 7-Series Terminal Connections



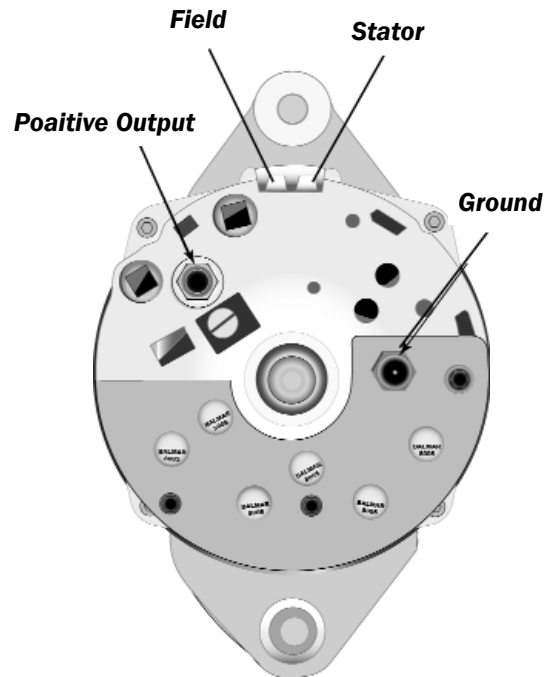
## 8-Series Terminal Connections



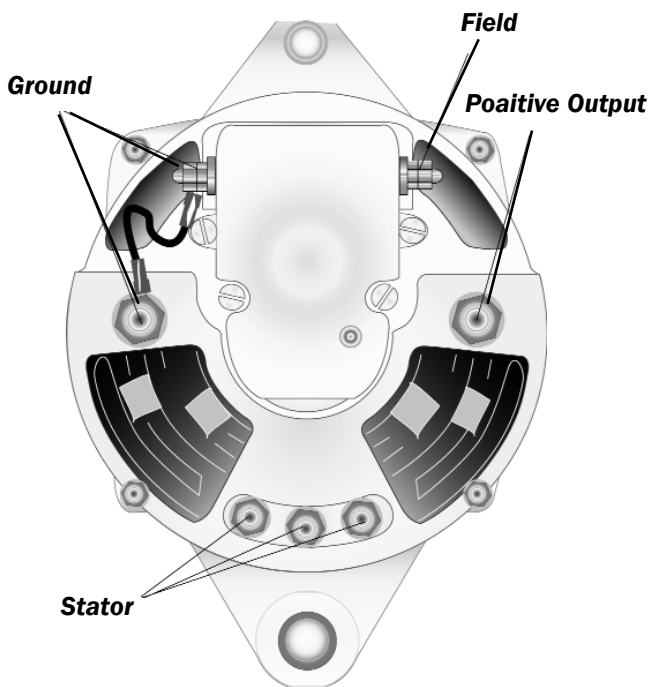
### 94-Series Terminal Connections



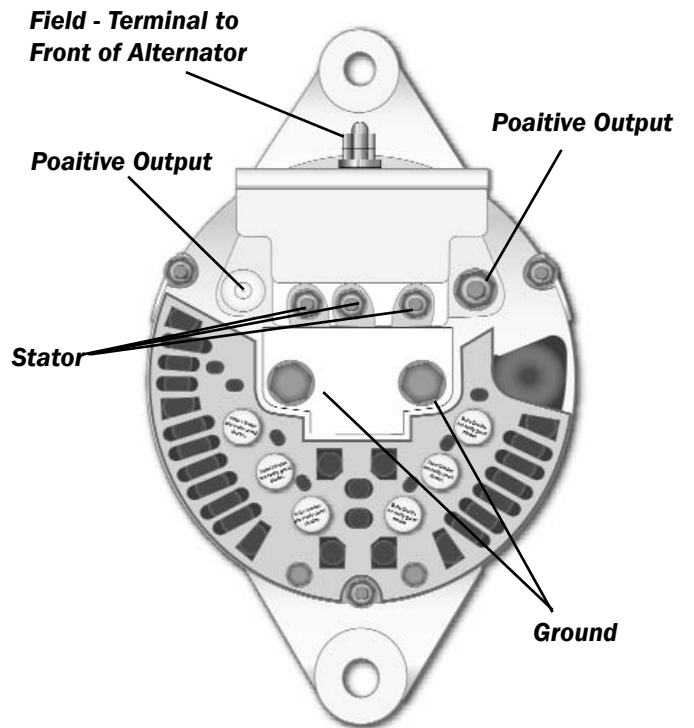
### 95-Series Terminal Connections



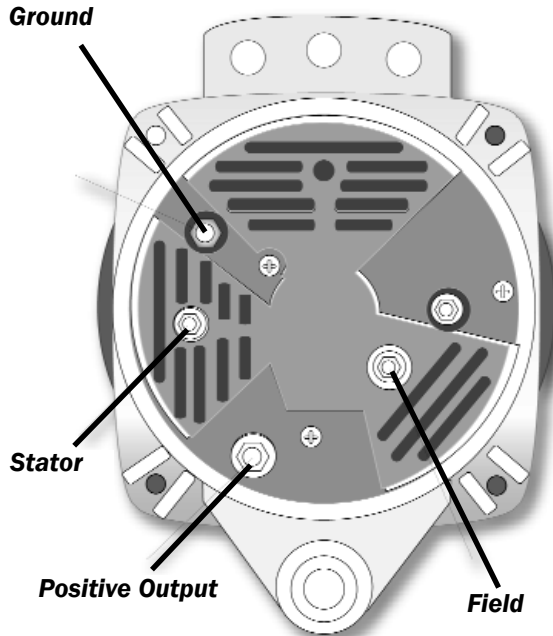
### 97-Series Terminal Connections



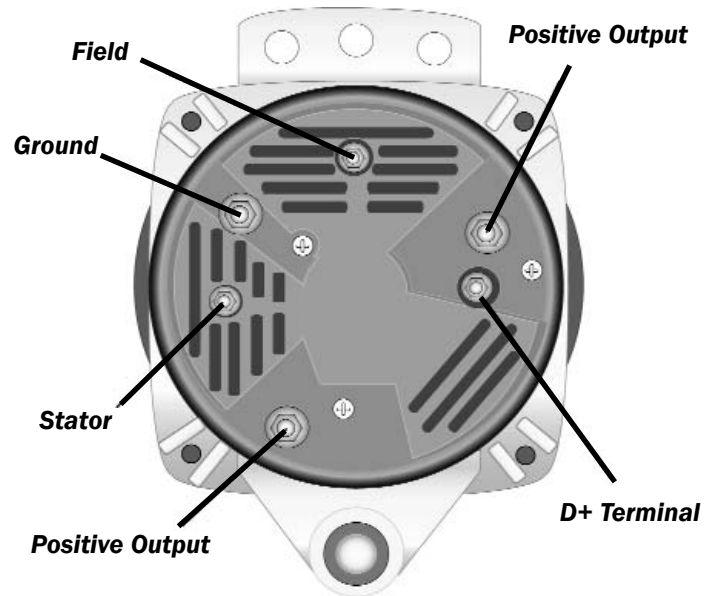
### 97-EHD Terminal Connections



## 98-Series Terminal Connections (Early Models)



## 98-Series Terminal Connections (Current Models)



### LIMITED PRODUCT WARRANTY

BALMAR warrants to the original consumer/purchaser the product is free from any defects in material or workmanship for a period of one year from the date of purchase. If any such defect is discovered within the warranty period, BALMAR will replace the regulator free of charge, subject to verification of the defect or malfunction upon delivery or shipping prepaid to BALMAR.

This warranty DOES NOT apply to defects or physical damage resulting from abuse, neglect, accident, improper repair, alteration, modification, or unreasonable use of the products resulting in breakdown, cracked or broken cases nor are parts damaged by fire, water, freezing, collision, theft, explosion, rust, corrosion or items damaged in shipment in route to BALMAR for repair. BALMAR assumes no responsibility for consequential damage or loss or expense arising from these products or any labor required for service or repair.

BALMAR WILL NOT repair or be held responsible for any product sent without proper identification and return address or RA number clearly marked on the package. You must include proof of date and place of purchase (photocopy of purchase invoice) or we cannot be responsible for repairs or replacement. In order to expedite warranty claims more efficiently, BALMAR asks that prior to returning a defective product for repair, you call their customer service department for a warranty return authorization number .

If factory service is required, you can contact our BALMAR Customer Service Department Monday through Thursday, 7:30 AM to 5:30 PM, (PST)1-360 435-6100 ext "3".

Material required for the repair or replacement for the defective part or product is to be supplied free of charge upon delivery of the defective regulator to BALMAR, 18930 59th Ave. NE, Arlington, WA 98223. Customer is responsible for all return transportation charges and any air or rush delivery expense. BALMAR reserves the right to determine whether to repair or replace defective components.

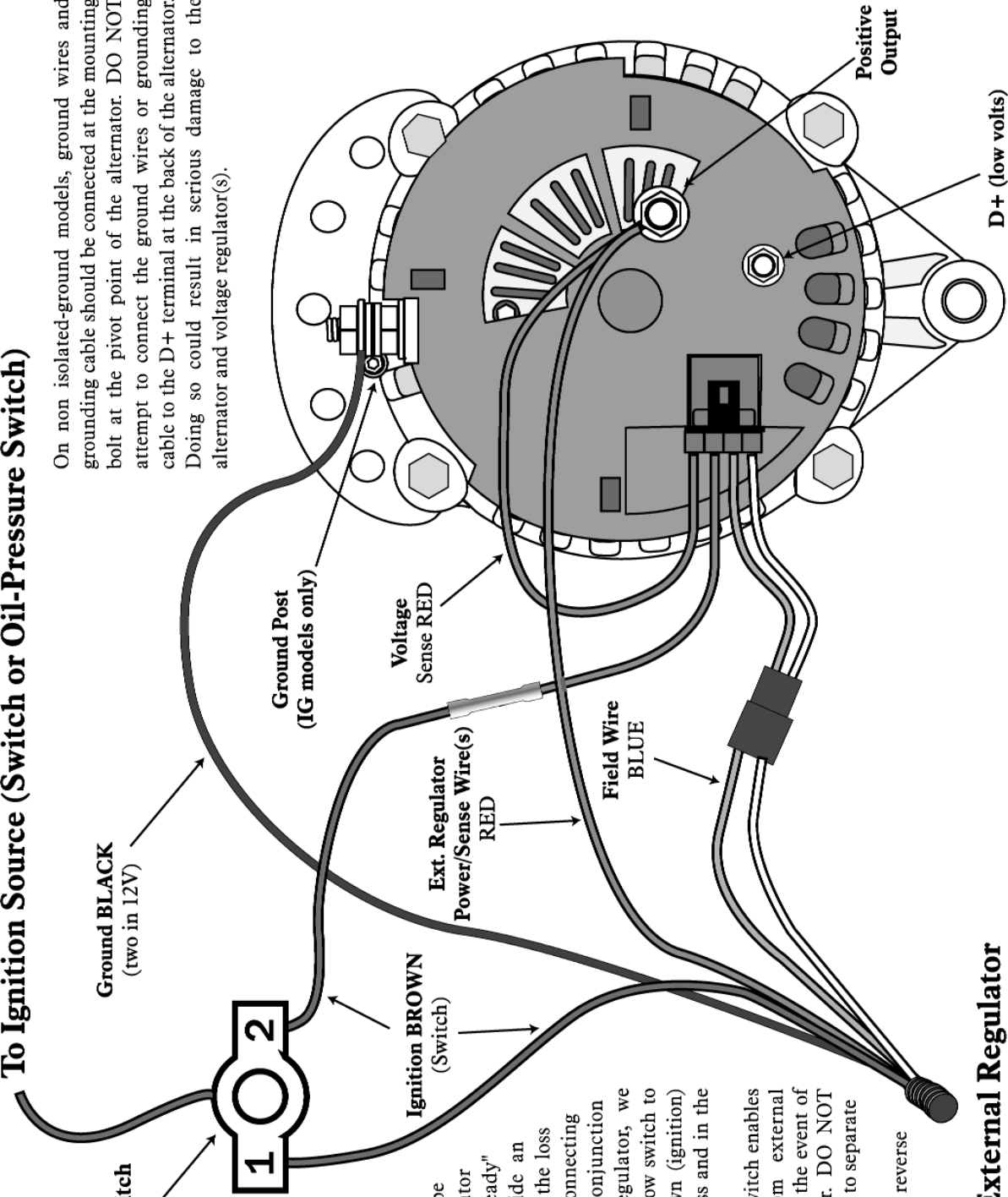
THE ABOVE LIMITATIONS MAY NOT APPLY TO YOU. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS. NO PERSON, AGENT, DEALER IS AUTHORIZED TO GIVE ANY WARRANTY

# 6-Series Alternator Wiring Addendum

## Suggested Smart Ready Back Up Regulator Wiring

### To Ignition Source (Switch or Oil-Pressure Switch)

On non isolated-ground models, ground wires and grounding cable should be connected at the mounting bolt at the pivot point of the alternator. DO NOT attempt to connect the ground wires or grounding cable to the D+ terminal at the back of the alternator. Doing so could result in serious damage to the alternator and voltage regulator(s).



**Double Throw Switch**

The 6-Series alternator is designed for use with Balmar's Max Charge MC-612 (12-volt)MC-624 voltage regulator. The diagram below provides a guideline for wiring connections between the MC-624 and the 6-Series alternator.

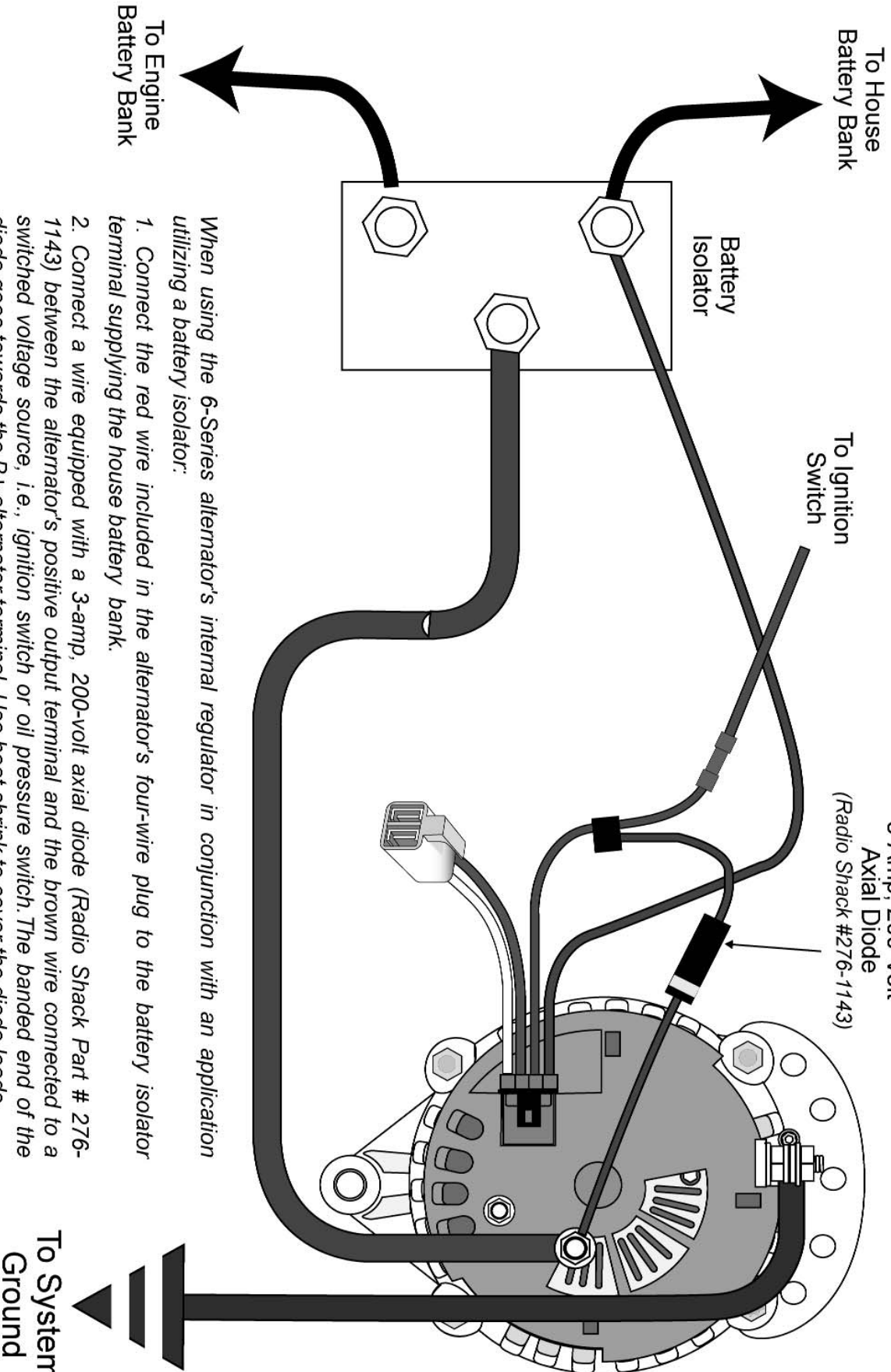
In addition to its ability to be externally regulated, this alternator features an internal "Smart Ready" regulator that's intended to provide an immediate back-up in the event of the loss of the external regulator. When connecting the "Smart Ready" regulator in conjunction with the external multi-stage regulator, we recommend the use of a double throw switch to direct switched voltage to the brown (ignition) wires in the regulator wiring harness and in the alternator wiring plug.

The addition of the double throw switch enables the user to quickly switch from external regulation to internal regulation in the event of a failure of the external regulator. DO NOT connect both Ignition (switch) wires to separate sources of switched voltage.

For additional wiring details, see reverse side of this addendum.

### To External Regulator

### Using internal regulator in conjunction with an isolator.



*When using the 6-Series alternator's internal regulator in conjunction with an application utilizing a battery isolator:*

1. Connect the red wire included in the alternator's four-wire plug to the battery isolator terminal supplying the house battery bank.
2. Connect a wire equipped with a 3-amp, 200-volt axial diode (Radio Shack Part # 276-1143) between the alternator's positive output terminal and the brown wire connected to a switched voltage source, i.e., ignition switch or oil pressure switch. The banded end of the diode goes towards the B+ alternator terminal. Use heat shrink to cover the diode leads