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12-Volt Alternator Manual

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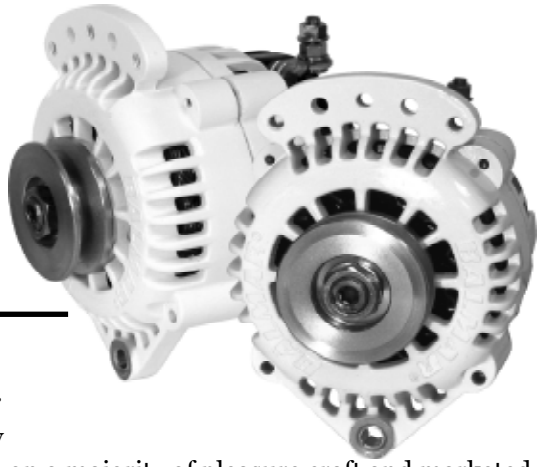


Introduction

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 a majority of pleasure craft and marketed as lower-priced marine alternatives, our marine alternators provide exceptional output at lower engine rpms typical of marine diesel engines, so you can enjoy better charging performance at idle, shorter charge cycles, longer battery life and less noise and fumes.

When used in conjunction with Balmar microprocessor controlled multi-stage voltage regulators, your Balmar alternator provides charging in league with smart, shorepower chargers — making it possible to charge deep-cycle flooded, gel and AGM batteries with superior safety and efficiency.

Safety Considerations

Before installing your new alternator, please take a moment to review 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 any charging system maintenance or repair work.
2. Remove any loose fitting clothing or jewelry which could become entangled in your engine or electrical system component.
3. Wear ANSI-approved safety glasses or eyewear.
4. Ensure that all engine parts are sufficiently cooled prior to alternator installation or maintenance work.
5. DO NOT install your high-output alternator without ensuring that POSITIVE AND NEGATIVE wiring is sufficiently scaled to support 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, as specified by USCG and ABYC electrical standards. Failure to provide proper system fusing could result in severe injury, as well as damage to your vessel.
8. DO NOT attempt electrical or mechanical work while using alcohol or medications that could impair your judgement or reaction time.
9. Use the right tool for the job. The use of improper tools could result in damage and/or personal injury.
10. Take time to read the manual. Equipment damage and possible injury could result from an incomplete understanding of the proper installation and use of the alternator.
11. If you're not experienced with marine mechanical or electrical systems, contact a qualified technician to install or maintain your engine and/or electrical system.

CONTENTS

ALTERNATOR INSTALLATION BASICS

Due to the many domestic and international configurations of engine/alternator mounts and factors such as model year, marinizer modifications and other variables, Balmar cannot guarantee drop in replacement of the standard alternator in every engine application. In some cases, adjusting the alternator mount, adding spacers or other forms of adaptation may be required. Note: Most Balmar alternators are equipped with vee belt pulleys standard. Additional pulleys are available. See www.balmar.net for a full list of available pulleys.

Choose the model that most closely matches your existing alternator and engine mount. The majority of marine engines are equipped with one of four mounting styles. In most cases, your existing alternator will be one of the styles listed below:

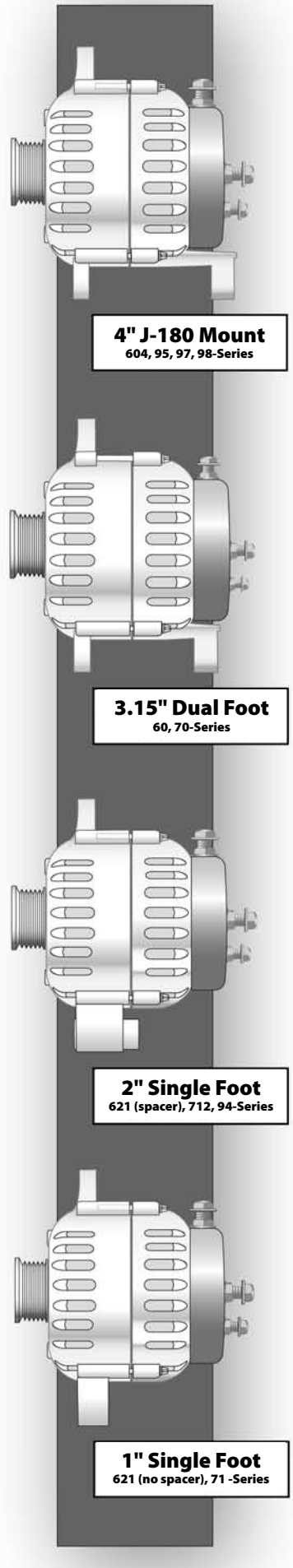
Dual Foot (Saddle Mount) With 3.15" Inside Dimension Between Feet – Replaces most small case saddle mount alternators typically found on Yanmar, Westerbeke, Mitsubishi and Lehman engines. Balmar replacement alternators include: 60-Series and 70-Series.

Single 1" Foot (Spindle Mount) – Replaces most small case single 1" foot (Motorola-style) alternators typically found on Lehman, Ford, Westerbeke, Pathfinder, Crusader and Hino engines. Balmar replacement alternators include: 621-Series (no spacer) and 71-Series alternators.

Single 2" Foot (Spindle Mount) – Replaces most small case single 2" foot (Delco-style) alternators typically found on Universal, Atomic 4, Cummins, Volvo, GM block, Perkins and Mercruiser engines. Balmar replacement alternators include: small-caxe 621-Series (with spacer) and 712-Series alternators and large-case 94-Series alternators.

Dual Foot (J180 Saddle Mount) With 4" Inside Dimension Between Feet – Replaces most small case saddle-style J180 alternators typically found on engines utilizing Bosch and Mitsubishi alternators. Balmar replacement alternators include: small-caxe 604-Series alternators, large-case 95-Series alternators and extra-large case 97-Series, 97-EHD-Series, and 98-Series alternators.

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 remote Alternator Bracket #5276, to accommodate a larger alternator.



Removing The Existing Alternator

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

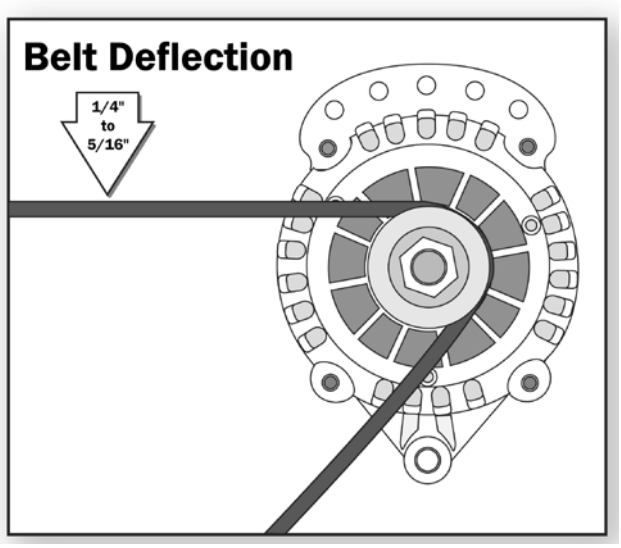
1. Disconnect the batteries and/or turn the switch to the “OFF” setting. Disconnect the wiring from the existing alternator.
2. Loosen the mounting & tensioning bolts and remove the existing alternator.
3. Once the alternator is disconnected from the engine, compare its mounting points to those on your 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. In some applications, it may be necessary to replace existing mounting bolts with longer bolts to compensate for the more substantial mounting legs of the Balmar alternator. Balmar offers a number of hardware kits for Yanmar installations. See www.balmar.net or contact Balmar Customer Service to order.

Installing The Replacement Alternator

1. 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.
2. 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.
3. 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 4.
4. 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 the pulley for proper 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:

1. Loosen the adjustment arm bolt and alternator pivot assembly bolt.
2. Fit a new, high-quality belt over the appropriate pulleys.
3. 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.
4. 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.
5. Ensure that the Mounting bolts at the alternator's pivot point are securely re-tightened.



For ease of belt installation, you may want to invest in an inexpensive belt tensioning tool like that sold by J.C. Whitney (www.jcwhitney.com). This simple tensioner provides positive support at the alternator while increasing belt tension, leaving two free hands to re-tension mounting and tensioning belts.

Your belt will 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 when needed. If you notice an accumulation of belt dust on your alternator and surrounding engine area, check belt tension. If the belt is tensioned and you still experience belt dusting, it may be necessary to reduce horsepower load on your belt with the regulator's Amp Manager function (if equipped), or you may find that a different brand of belt may work more effectively with your charging system.

Sizing Battery Cables

The addition of a high-output alternator to your charging system may make it necessary to increase the size of your battery cables to increase the system's amperage carrying capacity. To determine the proper cable size, consider BOTH cable length and alternator capacity. Both positive and negative wire runs must be included in your computation.

In other words, when determining battery cable size, we need to consider the "round trip" distance. Wire size may be calculated with the formula CM=K x I x LE (whereas 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). In most cases, it may be much simpler to use the chart as your guideline.

Alternator Drive Belts

Your new high-output Balmar alternator will increase horsepower load when compared to your standard OEM alternator. This additional load may require that you replace the standard drive belt with a heavier-duty unit. 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 and the Top Cog belt from Dayco. In addition, many auto parts suppliers, such as NAPA, carry extra heavy-duty belts designed to support larger horsepower loads.

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

As well as belt quality, belt size can have a substantial impact on alternator performance. As a rule-of-thumb, we recommend a minimum 3/8" belt (measured across the back of the belt) for our 80-amp alternators. Minimum belt width for 100 to 110-amp alternators is 1/2". Any alternator larger than 110-amps will require dual belts for optimal performance and belt life.

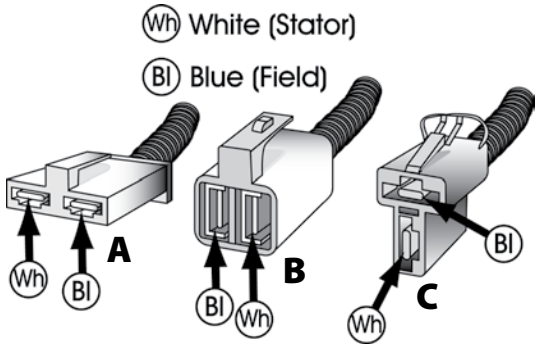
Belt Manufacturer Websites
www.gates.com
www.dayco.com
www.goodyear.com
www.fenner.com

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, although 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 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.

Voltage Regulation

With the exception of 6-Series alternators, which feature Smart Ready® internal regulation, all Balmar high-output alternators require external regulation. We recommend our multi-stage ARS-5 and Max Charge MC-612 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.



Balmar's standard 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, 96-Series, 97-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. Models in the 6-Series and 7-Series internal fan styles can typically be run in either direction without difficulty. Keep in mind that some cooling efficiency will be lost in reverse rotation applications. 94-Series, 95-Series, 96-Series, 97-Series and 98-Series feature bi-directional fans, so reverse rotation is acceptable.

Grounding

Some Balmar alternators (including 7-Series and 97-EHD-Series) are case grounded, i.e., the alternator establishes its connection to the system ground via the engine block. While the ground is "built into" its engine mount, we strongly recommend that a secondary ground cable be added to the ground terminal (if equipped) at the back of the alternator. The installed ground cable should be equal in size to the positive output cable as indicated on Page 3.

Alternator models designated as Isolated Ground (IG) feature an independent ground terminal that's isolated from the alternator case. Typically, Isolated Ground alternators are used in applications where the engine is not desired to be a part of the grounding system. This is commonplace in steel or aluminum hull boats, or with engines that depend on sophisticated electronic ignition systems. In Isolated Ground alternator installations, the ground cable should be connected to the central ground terminal. Isolated ground models include 6-Series, 94-Series, 95-Series, 97-Series and 98-Series alternators.

Pulleys

Most small case alternators rated at 110 amps or less come standard with a single groove 2.7" 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 in small, large and extra-large case series are equipped standard with 1/2" dual groove 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, 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 percent if temperatures exceed set safe working limits. 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.

Meters

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

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.

Many standard and aftermarket 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.

Fusing

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

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. Balmar offers two ratings of surface mounted circuit breakers; 125A and 150A (Models 1512 and 1515).

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. More typically, in a marine system, the alternator will be supporting a smaller starting battery and larger house battery bank -- or a starting battery, along with multiple banks for house loads, inverter loads, windlass or thruster. 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.

Switches

Available in two primary types -- ON/OFF or A/B/BOTH -- manual switches offer a simple method for charging management. 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 dis

continued as soon as the battery is disconnected. NEVER operate the alternator with switches in OFF position (doing so could cause alternator diode damage).

Combiners

Battery combiners enlist high-amperage solenoids to charge multiple battery banks. Below a specific voltage setpoint, 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.

Isolators

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 overcharging 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 full volt, which means that the alternator is forced to increase voltage far in excess of that needed by the batteries.

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.

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 will require 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. Max Charge regulator is recommended for dual alternator operation.

Twin Engine Issues

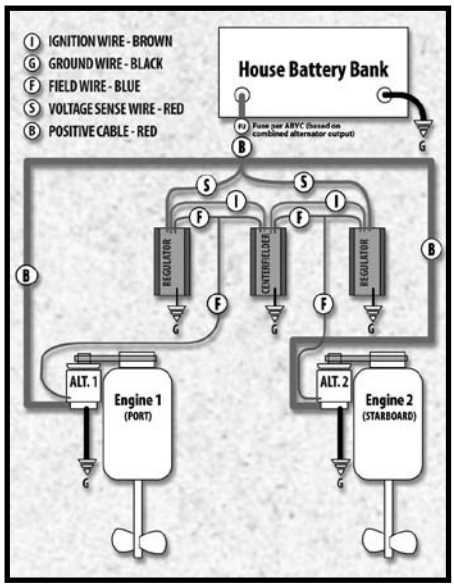
1. Twin engine applications pose some unique challenges in addressing battery needs. Some primary charging configurations are as follows:
2. Dedicate Alternator #1 to charge engine starting batteries. (May be done with a switch, or by connecting the alternator output to one engine battery and a Digital Duo Charge from the primary to the secondary engine battery). Dedicate Alternator #2 to the house battery bank.

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.

Centerfielder

Balmar's Centerfielder enables twin engine systems to balance alternator output, so available amperage from both alternators can be combined to support larger battery banks. 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 exitation voltage.

A diagram of a typical dual engine system using a Centerfielder to control port and starboard alternators is shown at right. 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 or other control devices.



INSTALLATION/OPERATION BY ALTERNATOR SERIES

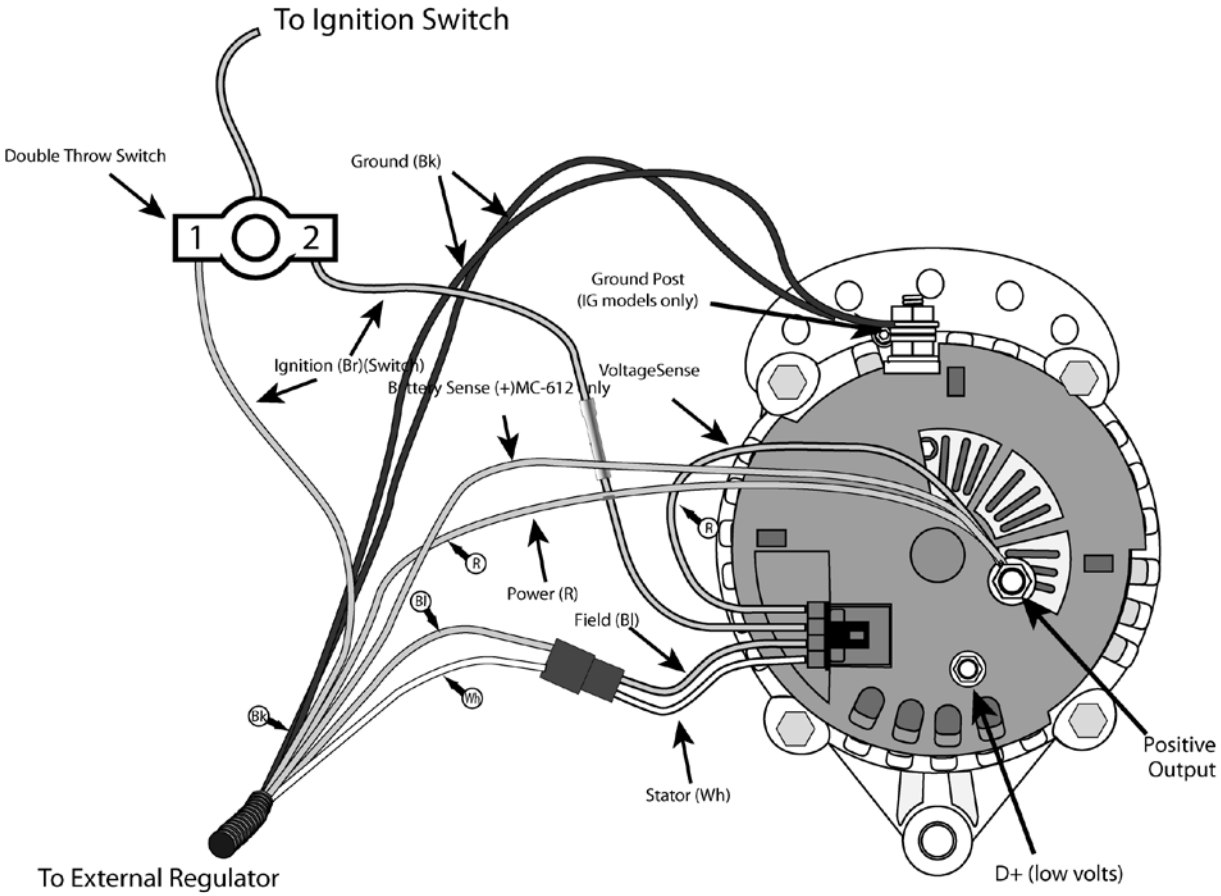
Each series of Balmar's high-output alternators has features and considerations rgarding its installation and operation. The following pages break down instructions by alternator type — highlighting terminal connections, wiring issues and other unique aspects.

6-Series Alternators – Smart Ready™ Internal Regulator

Small-case 6-Series alternators are equipped with a patented Smart Ready™ internal voltage regulator that's designed to provide "stand alone" control in applications where a smart, multi-stage regulator is not required. This type of installation would typically include a smaller trailer boat with limited electrical demands and a small, standard flooded battery bank.

In systems where a multi-stage voltage regulator is used, the Smart Ready internal regulator provides a built in back up in the unlikely event that the external regulator fails. In this type of application, we recommend the addition of a three position toggle switch which enables the user to select either the internal or external voltage regulator. The 6-Series alternator should NEVER be wired in a manner that would allow the internal and external regulators to be excited at the same time. A typical wiring method is as illustrated below.

Note that the switched voltage from the ignition switch is directed to the common post on the double-throw toggle switch. The #1 position provides switched voltage to the external regulator's ignition wire, while the #2 position provides switched voltage to the alternator's internal excite wire. The switch can be mounted in a location that can be conveniently accessed should it be necessary to change from external to internal regulation. The Smart Ready internal regulator is non-adjustable and provides a fixed 14.1 volt output.

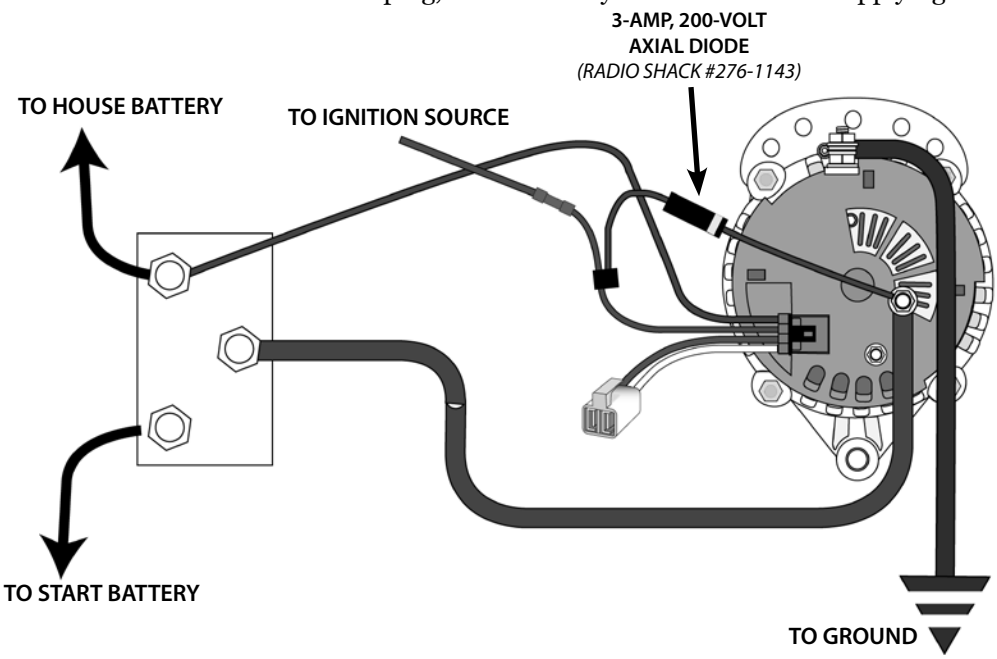


6-Series Alternators – Smart Ready™ Internal Regulator (Continued)

When using the 6-Series alternator's internal regulator in conjunction with a diode-based battery isolator, it's necessary to ensure that the internal regulator is able to sense voltage at the battery side of the isolator. Like most internally regulated alternators, it's also necessary that the alternator's positive output must be exposed to battery voltage directly to operate properly. The following illustration provides the wiring requirements for proper operation:

When using the 6-Series alternator in conjunction with a multi-bank, diode battery isolator:

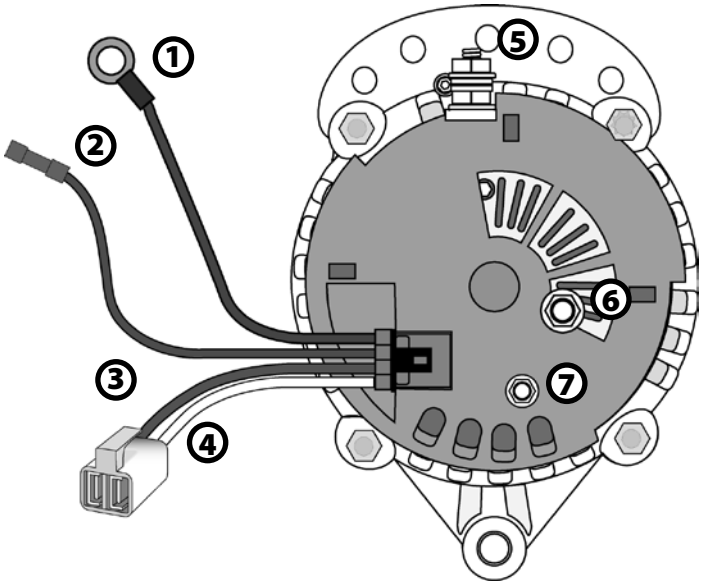
1. Connect the RED wire, included in the alternator's four-wire plug, to the battery isolator terminal supplying the house battery bank.
2. Connect a wire equipped with a 3-amp, 200-volt axial diode between the alternator's positive output terminal and the brown wire connected to a switched voltage source.
3. The banded end of the diode goes toward the alternator positive output terminal. Use heat shrink to cover and protect the diode leads.



6-Series Alternators – Wiring Connections

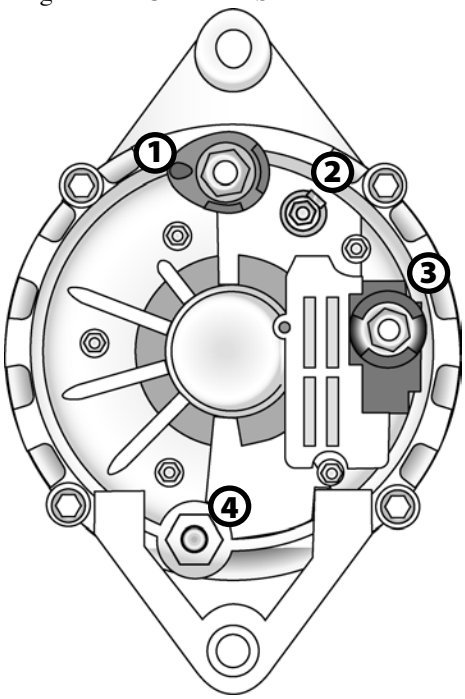
When used with the Smart Ready™ internal regulator only, the 6-Series alternator will require connection at terminals 1, 2, 5 and 6. When used with an external regulator only, the 6-Series alternator will require connection at terminals 3, 4, 5 and 6. For applications where both internal and external regulator connections are required, see the diagram on the facing page. Note: operating the 6-Series alternator with internal and external voltage regulators active will result in a potential over-voltage condition, which could damage batteries and electronic components. Terminal connection locations and functions are as follows:

1. **Internal Regulator Voltage Sense Wire (RED)** – acts as the sense source for battery voltage for the internal regulator. Connect to Positive Output Post (6) when internal regulator is used. See diagram above for use with isolator
2. **Internal Regulation Ignition Wire (BROWN)** – connects to ignition switch or oil pressure switch when internal regulator is used.
3. **Field Wire (BLUE)** – delivers positive field current from external voltage regulator to alternator's positive brush.
4. **Stator Output (WHITE)** – provides unrectified AC output to supply tachometer signal. AC output is 12-pole.
5. **Isolated Ground Terminal** – must be connected to system ground for proper alternator operation. See information about cable size.
6. **Positive Output Post** – connects alternator to the batteries being charged. DO NOT operate alternator if the Positive Output Post is not connected to system batteries.
7. **D+ Circuit** – provides a low current/low voltage signal from the alternator's diode which can be used to support panel charge indicator light.



7-Series Alternators – Wiring Connections

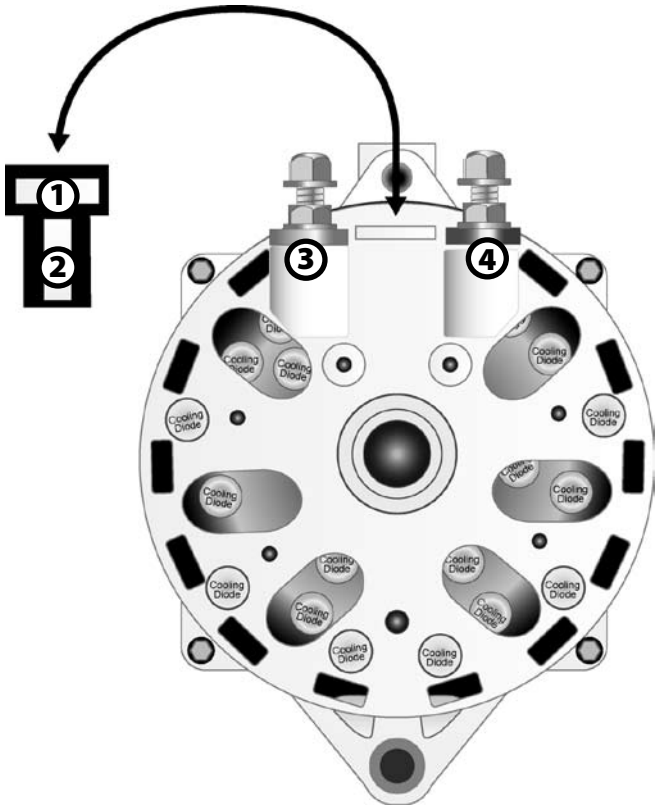
The small-case 7-series alternator features a case-ground construction, dual internal fans and sealed brushes, making it an excellent choice for gas or diesel installations. Output ratings are 80 amps and 110 amps. Saddle mount 70-series alternator models feature 10mm standard bushings, as well as smaller, 8mm bushings, which can be ordered by contacting Balmar Customer Service at 360-435-6100. The 1" single-foot 71-Series alternator features a 1/2" bore in the mounting foot. The 2" single foot 712-Series alternator features a 3/8" bore in the mounting foot. Wiring connection locations are as follows:



1. **Positive Output Terminal – Connects to battery bank(s) via the positive output cable**. When used in application where output is connected directly to batteries (no diode battery isolator installed), the positive output cable can be used as a connection point for the external regulator's power and voltage sense wires. The positive output cable must be supported to minimize stress on the alternator's positive output terminal.
2. **Stator Output** – Provides unrectified AC output to supply tachometer signal. AC voltage output at the stator output terminal is generally about 50% of system output voltage. I.E., if charging voltage is 14 volts, stator output should measure about 7VAC. Terminal connects to the WHITE stator wire in the regulator wiring harness. AC stator output is 12 pole.
3. **Field Input Terminal** – Delivers external field current to alternator's positive brush to provide excitation. The terminal connects to the BLUE field wire in the regulator wiring harness.
4. **Ground Terminal** – While the 7-Series alternator is case ground, we strongly recommend connecting the Ground Terminal to system ground via ground cabling of equal current carrying capacity as the positive output cable. Regulator BLACK ground wires can be connected to the Ground Terminal to provide the regulator with a connection to system ground.

94-Series Alternators – Wiring Connections

The large-case 94-series, 12-volt alternator provides output ratings of 165 amps and 210 amps. Its Delco-style 2" single foot mount is commonly found on larger American-made diesel engines. The 94-Series alternator features a 1/2" bore in the mounting foot. The 94-Series alternator requires single-stage or multi-stage external P-type regulation. AC/stator output provides 14 pulses per rotation (14 pole). Wiring connection locations are as follows:

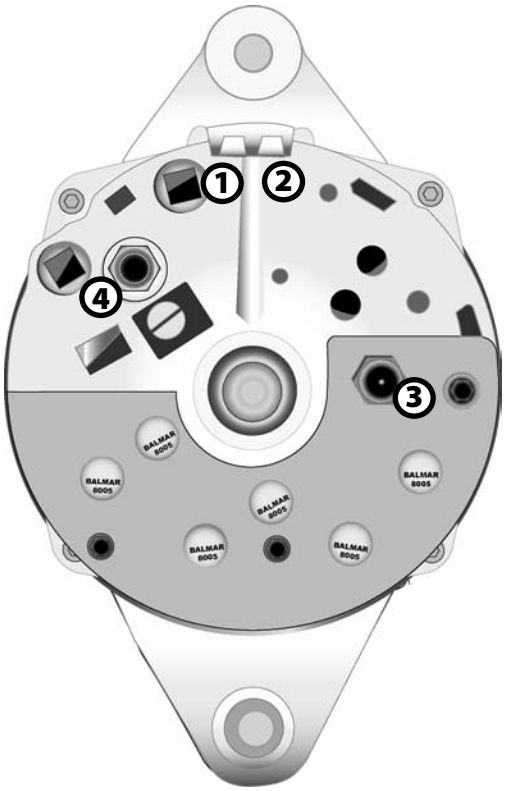


1. **Field Input Terminal** – Delivers external field current to alternator's positive brush to provide excitation. The terminal connects to the BLUE field wire in the regulator wiring harness.
2. **Stator Output** – Provides unrectified AC output to supply tachometer signal. AC voltage output at the stator output terminal is generally about 50% of system output voltage. I.E., if charging voltage is 14 volts, stator output should measure about 7VAC. Terminal connects to the WHITE stator wire in the regulator wiring harness.
3. **Isolated Ground Terminal** – Ground Terminal connects to system ground via ground cabling of equal current carrying capacity as the positive output cable. Regulator BLACK ground wires can be connected to the Ground Terminal to provide the regulator with a connection to system ground. The 94-Series alternator MUST be connected to system ground via the Isolated Ground Terminal. Failure to do so could result in damage to the alternator and other electrical components.
4. **Positive Output Terminal – Connects to battery bank(s) via the positive output cable**. When used in application where output is connected directly to batteries (no diode battery isolator installed), the positive output cable can be used as a connection point for the external regulator's power and voltage sense wires. The positive output cable must be supported to minimize stress on the alternator's positive output terminal.

95-Series Alternators – Wiring Connections

The large-case 95-series, 12-volt alternator provides output ratings of 165 amps and 210 amps. Its J-180 style saddle mount is commonly found on larger American-made diesel engines, and is preferred for custom mounting as a second alternator. The 94-Series alternator features a 1/2" bore in the mounting foot. The 94-Series alternator requires single-stage or multi-stage external P-type regulation. AC/stator output provides 14 pulses per rotation (14 pole). Wiring connection locations are as follows:

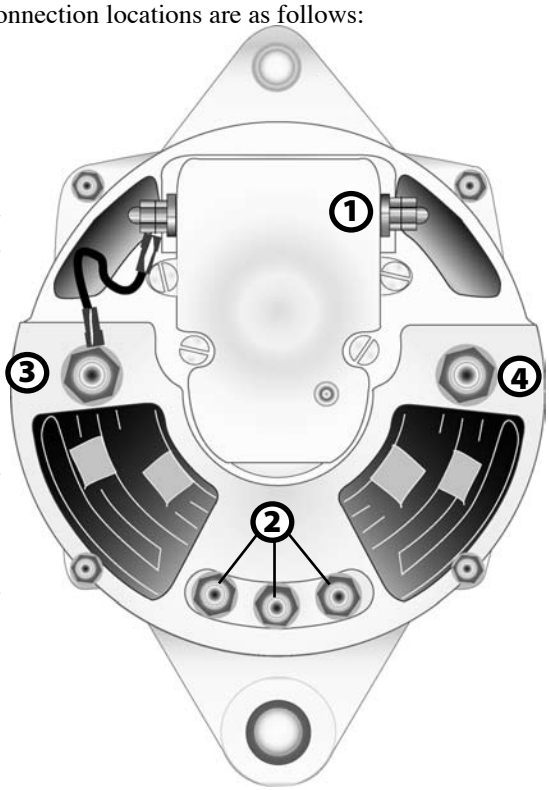
1. **Field Input Terminal** – Delivers external field current to alternator's positive brush to provide excitation. The terminal connects to the BLUE field wire in the regulator wiring harness.
2. **Stator Output** – Provides unrectified AC output to supply tachometer signal. AC voltage output at the stator output terminal is generally about 50% of system output voltage. I.E., if charging voltage is 14 volts, stator output should measure about 7VAC. Terminal connects to the WHITE stator wire in the regulator wiring harness.
3. **Isolated Ground Terminal** – Ground Terminal connects to system ground via ground cabling of equal current carrying capacity as the positive output cable. Regulator BLACK ground wires can be connected to the Ground Terminal to provide the regulator with a connection to system ground. The 94-Series alternator MUST be connected to system ground via the Isolated Ground Terminal. Failure to do so could result in damage to the alternator and other electrical components.
4. **Positive Output Terminal – Connects to battery bank(s) via the positive output cable**. When used in application where output is connected directly to batteries (no diode battery isolator installed), the positive output cable can be used as a connection point for the external regulator's power and voltage sense wires. The positive output cable must be supported to minimize stress on the alternator's positive output terminal.



97-Series Alternators – Wiring Connections

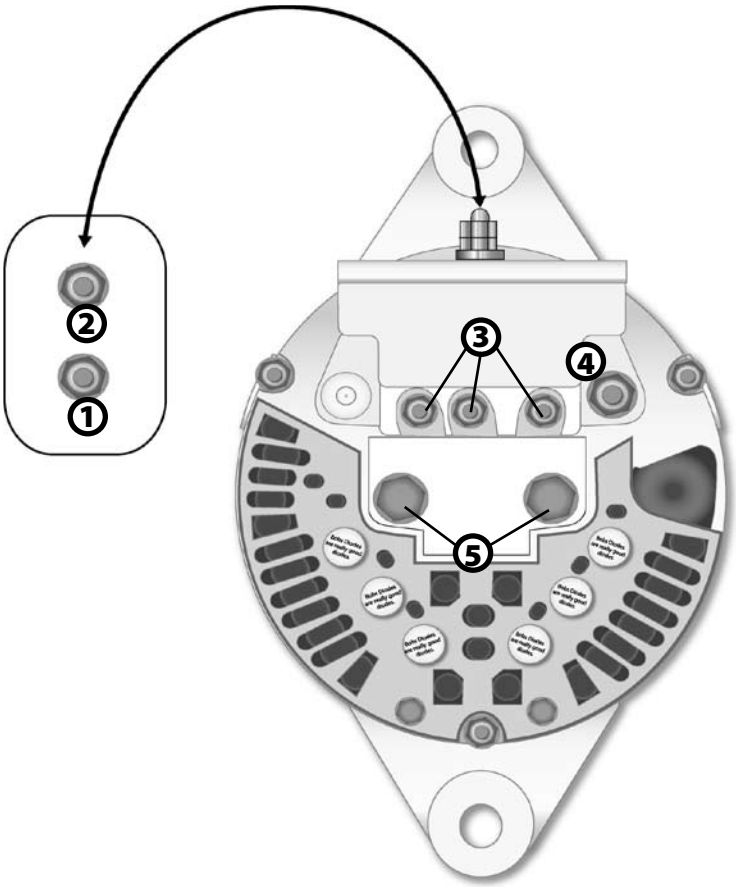
The large-case 97-series, 12-volt alternator provides output ratings of 140 amps and 160 amps. Its J-180 style saddle mount is commonly found on larger American-made diesel engines, and is preferred for custom mounting as a second alternator. The 97-Series alternator features a 1/2" bore in the mounting foot. The 97-Series alternator requires single-stage or multi-stage external P-type regulation. AC/stator output provides 16 pulses per rotation (16 pole). Wiring connection locations are as follows:

1. **Field Input Terminal** – Delivers external field current to alternator's positive brush to provide excitation. The terminal connects to the BLUE field wire in the regulator wiring harness.
2. **Stator Outputs** – Three terminals provide unrectified AC output to supply tachometer signal. AC voltage output at the stator output terminal is generally about 50% of system output voltage. I.E., if charging voltage is 14 volts, stator output should measure about 7VAC. Terminal connects to the WHITE stator wire in the regulator wiring harness. Any of the three terminals can be used.
3. **Isolated Ground Terminal** – Ground Terminal connects to system ground via ground cabling of equal current carrying capacity as the positive output cable. Regulator BLACK ground wires can be connected to the Ground Terminal to provide the regulator with a connection to system ground. The 94-Series alternator MUST be connected to system ground via the Isolated Ground Terminal. Failure to do so could result in damage to alternator and other electrical components.
4. **Positive Output Terminal – Connects to battery bank(s) via the positive output cable**. When used in application where output is connected directly to batteries (no diode battery isolator installed), the positive output cable can be used as a connection point for the external regulator's power and voltage sense wires. The positive output cable must be supported to minimize stress on the alternator's positive output terminal.



97EHD-Series Alternators – Wiring Connections

The large-case 97EHD-series, 12-volt alternator provides output ratings of 180 amps and 265 amps. Its J-180 style saddle mount is commonly found on larger American-made diesel engines, and is preferred for custom mounting as a second alternator. The 97-Series alternator features a 1/2" bore in the mounting foot. The 97EHD-Series alternator requires single-stage or multi-stage external P-type regulation. AC/stator output provides 16 pulses per rotation (16 pole). Wiring connection locations are as follows:



1. **Field Input (+) Terminal** – Delivers external field current to alternator's positive brush to provide excitation. The terminal connects to the BLUE field wire in the regulator wiring harness.
2. **Field Input (-) Terminal** – Connects alternator's negative brush to ground terminal.
3. **Stator Outputs** – Three terminals provide unrectified AC output to supply tachometer signal. AC voltage output at the stator output terminal is generally about 50% of system output voltage. I.E., if charging voltage is 14 volts, stator output should measure about 7VAC. Terminal connects to the WHITE stator wire in the regulator wiring harness. Any of the three terminals can be used.
4. **Positive Output Terminal – Connects to battery bank(s) via the positive output cable**. When used in application where output is connected directly to batteries (no diode battery isolator installed), the positive output cable can be used as a connection point for the external regulator's power and voltage sense wires. The positive output cable must be supported to minimize stress on the alternator's positive output terminal.
5. **Ground Terminals** – Ground Terminals connect to system ground via ground cabling of equal current carrying capacity as the positive output cable. Regulator BLACK ground wires can be connected to either Ground Terminal to provide the regulator with a connection to system ground. The 97EHD-Series alternator MUST be connected to system ground via the ground terminals. Failure to do so could compromise alternator performance.

BALMAR LIMITED PRODUCT WARRANTY

BALMAR warrants its products against defects in material or workmanship for a period of one year from the date of purchase. If any such defect is discovered by the original purchaser within the warranty period, BALMAR will repair or replace the product free of charge, subject to verification of defect or malfunction by BALMAR Customer Service. BALMAR is not responsible for costs incurred for shipping to or from its headquarters. This warranty DOES NOT apply to defects or physical damage resulting from abuse, neglect, accident, mis-application, unauthorized or improper installation or repair, alteration, modification, or unreasonable use of the products. Cracked or broken cases, or parts damaged by fire, water, freezing, collision, theft, explosion, rust, corrosion or items damaged in shipment while in route to BALMAR for repair are not warrantable conditions. BALMAR assumes no responsibility for consequential damage, injury, loss or expense arising from use of these products or any labor required for repair or replacement. BALMAR holds no responsibility for costs incurred as a result of repairs initiated by facilities other than BALMAR's warranty repair department. The customer must ensure that any product returned to BALMAR is properly packed to provide protection against damage in shipment. Claims against shippers for damage in transit to or from BALMAR are the responsibility of the customer. BALMAR cannot be held liable for damage due to improper packaging and/or shipping processes.

BALMAR WILL NOT repair or be held responsible for any product returned to BALMAR without proper identification, return address and a BALMAR-issued Return Authorization (RA) number clearly marked on the package. Proof of date and place of purchase (photocopy of purchase invoice) must be included with products returned for warranty evaluation. Authorization for warranty evaluation and repair must be received from BALMAR Customer Service and issuance of an authorization number must occur prior to product return.

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 item 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 product repair or replacement is required. Returned warranty or non-warranty items deemed non-repairable will be disposed of after 30 days, unless claimed by owner. Balmar is not liable for damage to or loss of returned items. Warranty limitations may vary by state. Contact your state's consumer affairs agency for special warranty protections and policies.

NO PERSON, AGENT, DEALER IS AUTHORIZED TO GIVE ANY WARRANTY.

98-Series Alternators – Wiring Connections

The large-case 98-series, 12-volt alternator provides output rating of 310 amps. Its J-180 style saddle mount is commonly found on larger American-made diesel engines, and is preferred for custom mounting as a second alternator. The 98-Series alternator features a 1/2" bore in the mounting foot. The 98-Series alternator requires single-stage or multi-stage external P-type regulation. AC/stator output provides 12 pulses per rotation (12 pole). Wiring connection locations are as follows:

1. **Field Input (+) Terminal** – Delivers external field current to alternator's positive brush to provide excitation. The terminal connects to the BLUE field wire in the regulator wiring harness.

2. **Stator Outputs** – Three terminals provide unrectified AC output to supply tachometer signal. AC voltage output at the stator output terminal is generally about 50% of system output voltage. I.E., if charging voltage is 14 volts, stator output should measure about 7VAC. Terminal connects to the WHITE stator wire in the regulator wiring harness. Any of the three terminals can be used.

3. **Isolated Ground Terminal –** Ground Terminal must connect to system ground via ground cabling of equal current carrying capacity as the positive output cable. Regulator BLACK ground wires can be connected to either Ground Terminal to provide the regulator with a connection to system ground. The 98-Series alternator MUST be connected to system ground via the ground terminals. Failure to do so could damage the alternator or other electrical system components.

4. **D+ Circuit –** provides a low current/low voltage signal from the alternator's diode which can be used to support panel charge indicator light.

5. **Positive Output Terminal – Connects to battery bank(s) via the positive output cable**. When used in application where output is connected directly to batteries (no diode battery isolator installed), the positive output cable can be used as a connection point for the external regulator's power and voltage sense wires. The positive output cable must be supported to minimize stress on the alternator's positive output terminal.

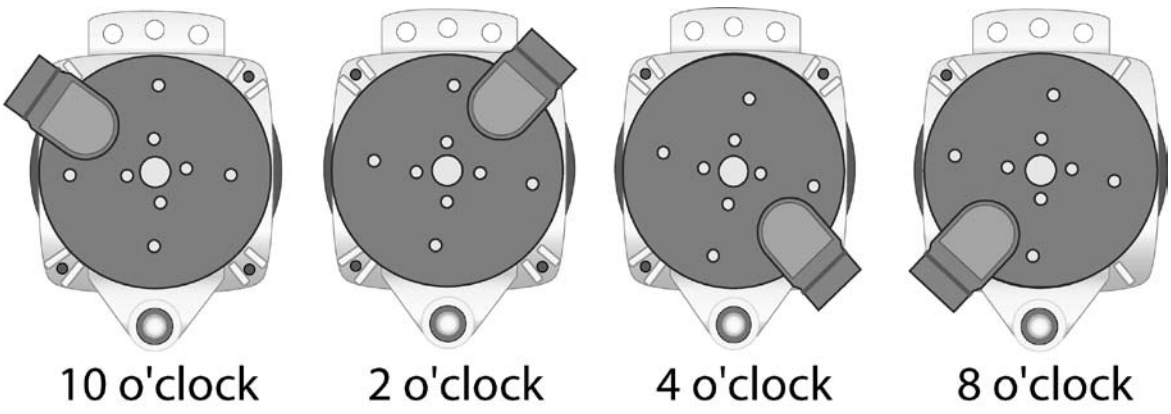
Air Inlet Installation Kit - Balmar Model #12-98-AIR

When charging large battery banks, the 98-Series alternator's cooling characteristics can be improved by installing the Air Inlet back on the rear of alternator. The Air Inlet back enables a fan to be used to force air across the diode plates and through the rest of the alternator to ensure cooler operation. Call Balmar Customer Service at 360-435-6100 to order.

The air inlet back for your Model 98-Series alternator must be aligned in one of the four configurations shown below in order to ensure proper alignment with mounting standoffs included with the inlet assembly.

Once the proper mounting angle is determined, holes must be cut at the side of the Air Inlet back to allow cables to be connected to their respective terminal posts. For maximum cooling efficiency, high temperature sealant should be used in gaps surrounding the cables where they enter the air inlet back.

A 150 c.f.m. fan is typically sufficient to promote optimal cooling.



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 volltage regulator, we recommend you inspect and clean all system electrical connections. Most charging system problems will be corrected by performing the following steps:

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 condition.
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 batteries and wiring are in suitable condition, use the following tests to determine if charging problems are a result of a faulty alternator or regulator. These tests isolate the alternator, regulator and wiring harness to determine which component is malfunctioning. You will need a simple test lamp (available at most auto parts or marine hardware stores). 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 helps diagnose amperage issues. A 20' 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 its warranty period (see Warranty Info at www.balmar.net) 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 elswhere in the charging system.

1. 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 does not illuminate, the alternator may not be completing the connection to ground. Check the ground connections at the alternator to system ground If you know how, you can use your multimeter to check for resistance between the alternator and ground.
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 initial start delay is complete, voltage should climb to levels set by the regulator.

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:

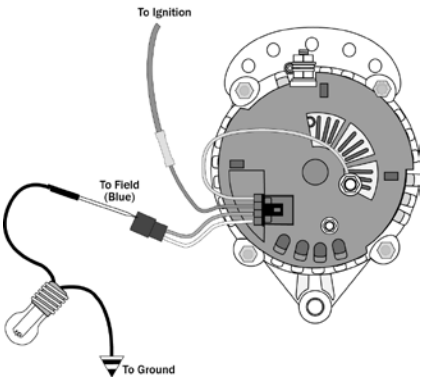
1. Connect one side of the test lamp to a source of positive battery voltage. Connect the other to the alternator's field terminal. If the test lamp illuminates and the alternator indicates magnetic current, start the engine. This is known as full fielding the alternator.
2. With the lamp connected and the engine on, voltage at the alternator's positive output terminal should steadily climb. The Lamp will act as an in-line resistor, so voltage rise should be moderately controlled. Once charging voltage is indicated (check output voltage with your multi-meter), the engine can be shut down. A steadily climbing voltage at the alternator output indicates good alternator functionality.

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.

Testing Smart Ready® Internally Regulated Alternators

Smart Ready™ 6-Series alternators require slightly different diagnosis to determine 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.



Scheduled Alternator Maintenance

The following should be included as part of pre-flight with each operation:

1. Drive belt tension must be closely monitored after installation of a new Balmar alternator or replacement belts. Belts should be monitored and re-tightened, as needed, after every three hours of operation for the first four weeks of use, and should be inspected and re-tensioned prior to each subsequent engine operation. NOTE: DO NOT use a pry bar on the side of the alternator case to tension the alternator belt!
2. Inspect belt condition prior to every period of engine operation. Belts should be replaced if evidence of cracking, delamination, pitting or excessive stretching is observed. Failure to replace damaged belts may result in damage to the alternator and/or engine, and voids warranty protection. Only high quality belts should be used with high-output alternators. Failure to use premium quality belts may result in damage to the engine and alternator.
3. Inspect alternator and regulator wiring. Damaged or abraded wires should be replaced when identified. Loose or corroded wires and/or terminal connections must be corrected or replaced. Periodic applicaction of dielectric grease can greatly reduce poor connections due to corrosion and moisture.

The following should be included as part of monthly scheduled maintenance:

1. Inspect alternator mounting and tensioning bolts. Engine torque and vibration can result in loosening of alternator tensioning and mounting bolts which can affect belt alignment and stress on alternator bearings and other internal components. Ensure that bolts are tightened to the following values: Bolts up to ¼" to 10 ft-lbs.; 5/16" to 19 ft-lbs.; 3/8" to 33 ft-lbs.; 7/16" to 54 ft-lbs.; ½" to 78 ft-lbs.; 9/16" to 114 ft-lbs.
2. Inspect alternator electrical terminal connectors and terminal bolts to ensure they are secure. Positive and negative output terminals should be tightened to recommended torque values shown above. NOTE: When tightening double-nutted terminals, a wrench must be used to support the bottom nut while the top nut is tensioned. Failure to do so could result in damage to the alternator. Wires and cables connected to the alternator must be supported by strain relief sufficient to remove any load on alternator terminal connections.
3. Inspect alternator and regulator for indications of saltwater or coolant intrusion. Evidence of liquid intrusion may take the form of staining on the alternator case, rust or corrosion on bare metal surfaces, or damage to alternator terminal connections. If evidence of intrusion is found, determine its source and correct the condition. Belt dust and other contaminants can be removed from the alternator case with a natural detergent spray (such as Simple Green®) and a clean cloth.

The following should be included as part of twice yearly scheduled maintenance:

1. Inspect alternator for bearing wear. Bearing wear can be determined by removing the drive belt from the alternator and by hand-spinning the alternator pulley. When spun, the pulley should rotate smoothly with no discernable rumble or grinding noise. Secondly, the pulley can be held securely from the front and wiggled from side to side. If the pulley shows indicators of substantial lateral movement, bearings may require replacement.
2. At the end of the boating season, the alternator may be treated with an anti-corrosive (such as Boeshield®) to protect it during storage. Re-application of dielectric grease or a protective spray on all terminal connections at the alternator and regulator will minimize the effects of corrosion during storage.
3. At the beginning of the boating season, disconnecting and re-connecting regulator wiring terminals and plug terminals at the alternator will help ensure optimal continuity. Any terminal pins and connectors with evidence of corrosion should be cleaned with an emery cloth and treated with an anti-corrosive coating prior to re-connection.

The following should take place at every 1000 hours of charging system operation:

1. Replace alternator brushed and bearings.

Contact Balmar Customer Service or Technical Support at 360-435-6100 to make arrangements for alternator service.