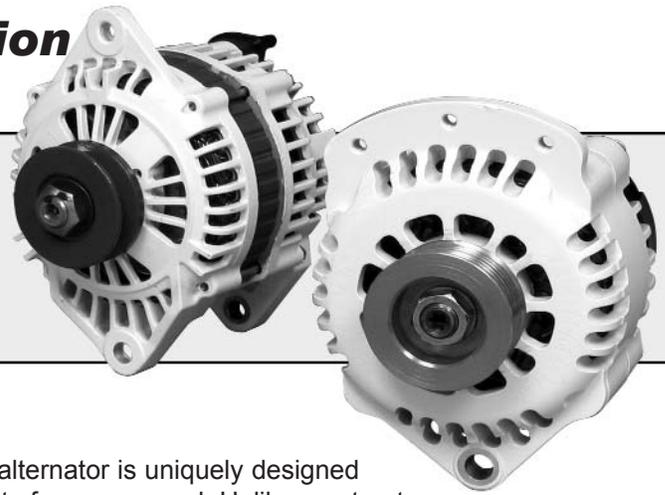


24 -Volt Alternator Installation & Operation Manual

BALMAR®
www.balmar.net



Introduction

Thank you for choosing a Balmar high-output alternator. This alternator is uniquely designed and 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 are built specifically to 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™ MC-624 multi-stage regulator, your new Balmar alternator can provide 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 MC-624 regulator will guide your alternator through a charging program that's tailored to provide your batteries with the best care possible. In addition, Balmar multi-stage regulators provide the ability to temperature sense at your alternator. Should an over-temperature condition occur with an alternator temperature sensor (MC-TS-A) installed, the regulator will reduce field output to 50 percent to allow the alternator to cool under lesser load, and the Dash Lamp circuit on the regulator will activate to provide power for a visual or audible alert, enabling the user to respond to the source of the over-temperature condition. Together, the Balmar high-output alternator and multi-stage regulator work to assure the best charge possible.

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.

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Basic Installation Alternator Mounting

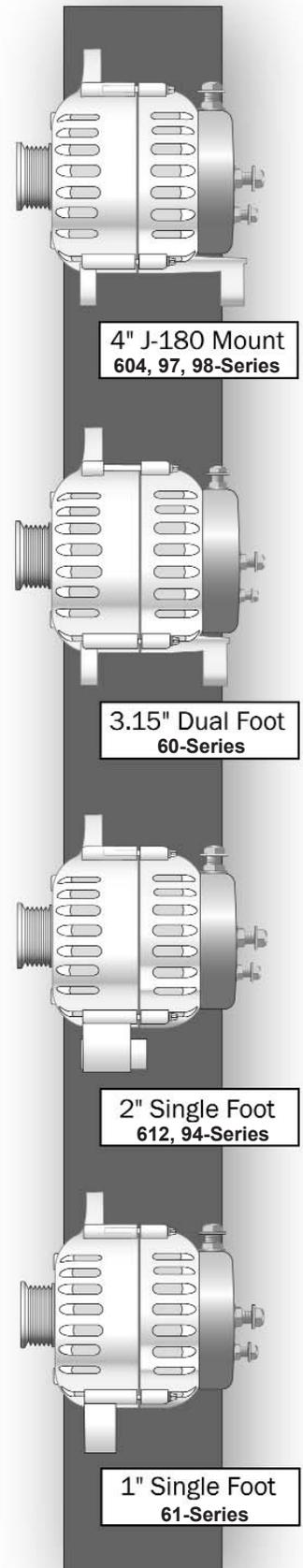
Due to the many domestic and international configurations of engine/alternator mounts, and factors such as year and location of engine manufacture and marinization, Balmar cannot guarantee a drop-in replacement in every engine application. Choose the model that most closely fits your application. Your 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 alternator represents each specific mounting style:

1. 60-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. 61-Series (1" Single Foot): Small Case. Replaces most domestic styles using a single 1" mounting foot (eg., Motorola, Prestolite).
3. 612-Series (2" Single Foot): Small Case. Replaces most domestic styles using a single 2" mounting foot (eg., Delco).
4. 94-Series (2" Single Foot) Series: Large case. See case dimensions on our website at www.balmar.net to determine if your engine can accommodate the large case alternator.
5. 97 & 98-Series (Dual Foot w/4" between feet) Series: Extra large case. See case dimensions at www.balmar.net to determine if your engine can accommodate an extra-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 remote Alternator Bracket #5276, to accommodate a larger alternator.

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

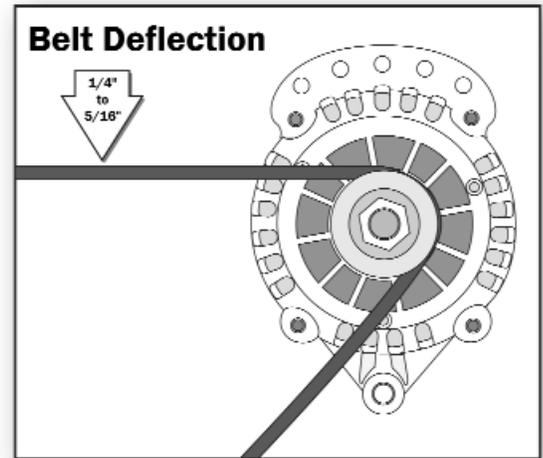
1. Disconnect the batteries and/or turn the switch to the "OFF" setting. Disconnect the wiring from the existing alternator.
2. Loosen the mounting & tensioning bolts and remove the existing alternator.
3. Once the alternator is disconnected from the engine, compare its mounting points to those on your 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.
7. 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.

Belt Tension Adjustment



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 black belt 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 system⁷. See additional information on Page 4.

Additional Installation Information

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 $CM = K \times I \times LE$ (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). In most cases, it may be much simpler to use the following chart as your guideline:

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					

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.

As well as belt quality, belt size can have a substantial impact on alternator performance. As a rule-of-thumb, we recommend a minimum 1/2" belt (measured across the back of the belt) for our 65-amp alternators. Any alternator larger than 65-amps will require dual 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 MC-624 (24-volt) multi-stage regulator, 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-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

Dayco - www.dayco.com

Goodyear - www.goodyear.com

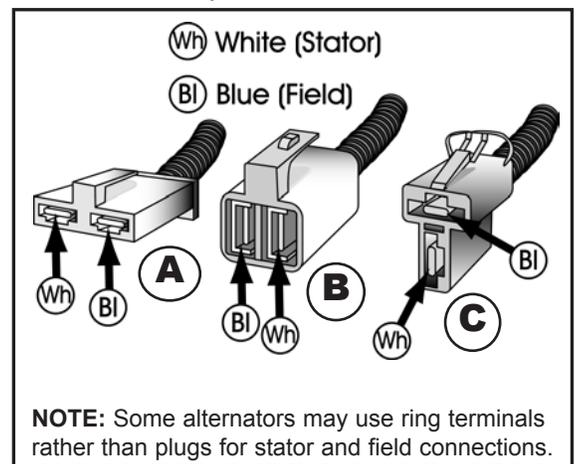
Fenner - www.fennerindustrial.com

Voltage Regulation

With the exception of our 6-Series alternators, which feature patented "Smart Ready"™ internal regulation, all Balmar high-output alternators require external regulation in order to operate. We recommend our multi-stage Max Charge regulator 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 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 97-Series and 98-Series alternators use ring terminal connectors.

Sample Terminal Connections



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 with internal fan styles can typically be run in either direction without difficulty. Model in the 97-Series and 98-Series feature bi-directional fans, so reverse rotation is acceptable. If using a 94-Series alternator, it may be necessary to replace the standard fan with an optional bi-directional fan to ensure proper cooling under load.

Older 90, 91, and 912-Series alternators may also require a reverse-rotation kit for counterclockwise 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 alternators 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 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.

Pulleys

Small case 6-Series alternators rated at 65 amps come standard with a single groove 2.5” 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. Most models can be equipped with multi-groove serpentine type pulleys, in needed.



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/accessories>, 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 a Max Charge MC-624 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 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.

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.

Tach Manufacturer Websites

Teleflex - www.teleflexmarine.com

VDO - www.vdo.com

Stewart Warner - www.stewartwarner.com

ISSPRO - www.isspro.com

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. 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. 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).

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

Switch

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

Advantages: Inexpensive. No substantial voltage drop.

Disadvantages: Require user interaction and heightened system understanding. Can be accidentally shut down, causing potential alternator damage. Does not allow for mixed battery technologies.

Voltage Sensing: Battery voltage sensed must always be that of battery being charged. Sense voltage at common side of battery switch or at alternator positive output.

Combiner

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.

Advantages: No user interface required. No substantial voltage drop. Available in 2 or 3-bank models.

Disadvantages: Moderately expensive. Does not allow for mixed battery technologies.

Voltage Sensing: Sense voltage at common side of combiner or at alternator positive output.

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 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.

Advantages: No user interface required. Reasonably priced. Available in 2 or 3-bank models.

Disadvantages: 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.

Voltage Sensing: 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 26 volts 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.

Advantages: 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.

Disadvantages: 30-amp maximum output may not support larger secondary banks (bowthrunder, windlass, etc.) without use of manual solenoid control. (See Digital Duo Charge on Page 8 for higher amperage option.)

Voltage Sensing: Alternator and regulator supply house bank only. Sense at house battery's positive post or at the positive output of the alternator.

Digital Duo Charge II

(Available Summer 2004)

Balmar's newest Digital Duo Charge II connects between the house and start (secondary) batteries -- keeping the two banks separate until the Duo Charge senses charging voltage (26V) at the house battery. Once voltage is reached, the Duo Charge II supplies up to 60 amps 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 -- so, both house and secondary batteries receive optimal charging current. Standard and deep cycle flooded, gel, Optima and AGM battery types are supported. Optional battery temperature sensing and solenoid drive control are included.

Advantages: No user interface required. Selectable programs ensure proper voltage control -- even with varied battery bank capacities and mixed battery constructions. Ensures optimal charging based specifically on the needs of each battery bank. Works with DC or shorepower charge sources. Simplifies charging control for alternator and regulator. Digital numeric (4 LED) display provides detailed operational data.

Disadvantages: Forces user to have fun and concentrate on boating, rather than worrying about charging system.

Voltage Sensing: Alternator and regulator supply house bank only. Sense at house battery's positive post or at the positive output of the alternator.

Two Alternators/Single Engine

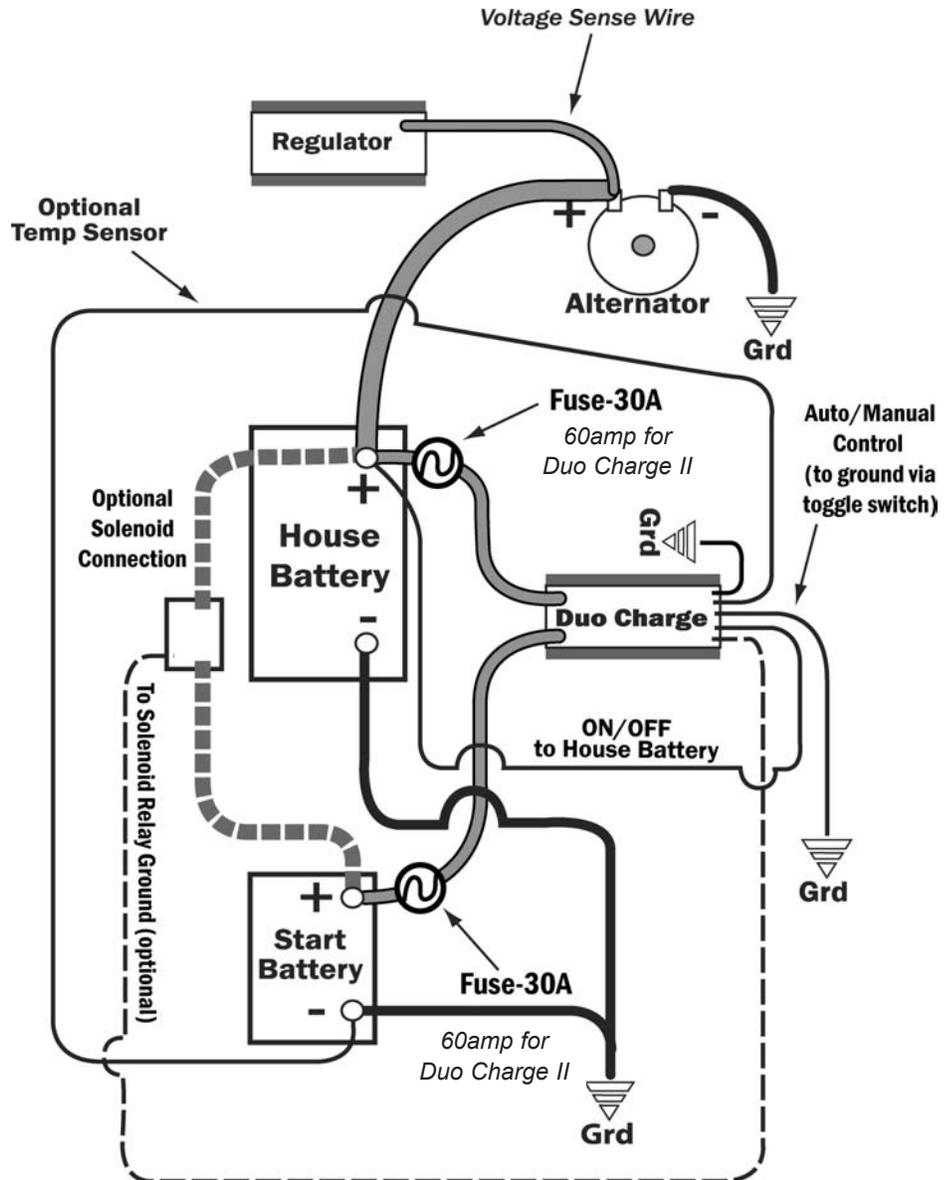
Should more charging power be required than is conveniently available from the engine's primary alternator, many boaters choose to install a second alternator. In these applications, alternators can be used separately as dedicated charge sources for the various battery banks, or the outputs from both 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.

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.

Sample Duo Charge/Duo Charge II Wiring Diagram



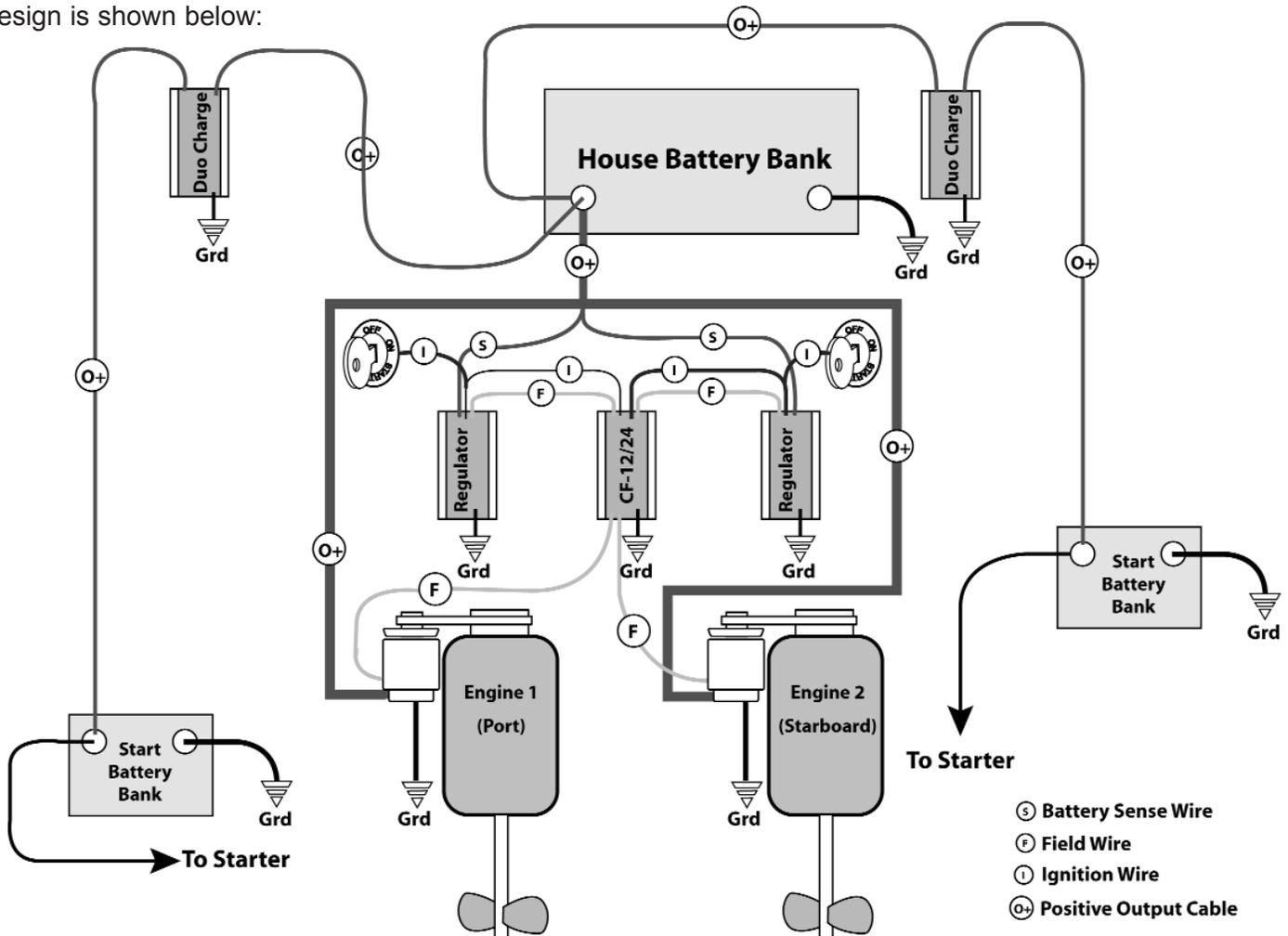
Twin Engine Issues

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.

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-624 regulators strongly recommended). 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 or other control device described on Page 8 or Page 9. A typical system wiring design is shown below:



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 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 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 multimeter 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.

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 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.

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.

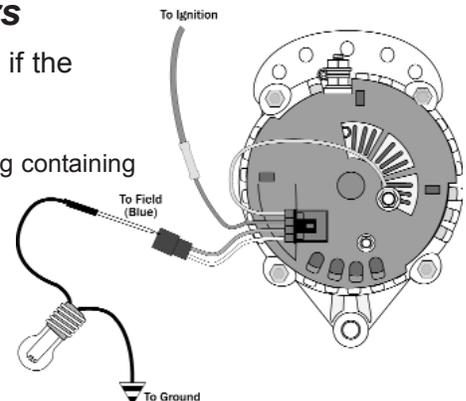
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Testing Smart Ready® Internally Regulated Alternators

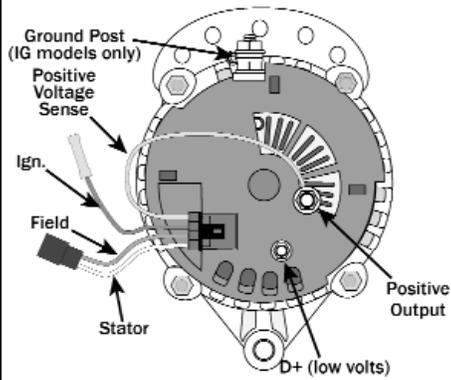
New 6-Series alternators require slightly different diagnosis to determine if the Smart Ready® internal regulator is functioning correctly.

To test the internal regulator:

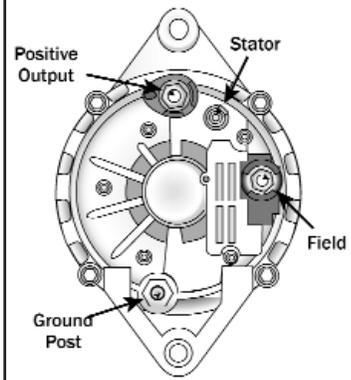
1. Disconnect the external regulator wiring harness from the alternator wiring plug containing the field and stator wires. Turn the ignition switch to the ON position.
2. Contact the positive probe of your test lamp on the FIELD terminal of the wiring plug. Connect the tester's negative probe to ground. 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 24V DC before placing probes at the field terminal and ground. If the regulator is working correctly, the meter will show approximately 3V DC.



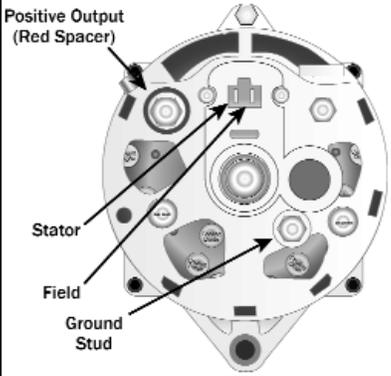
6-Series Alternators



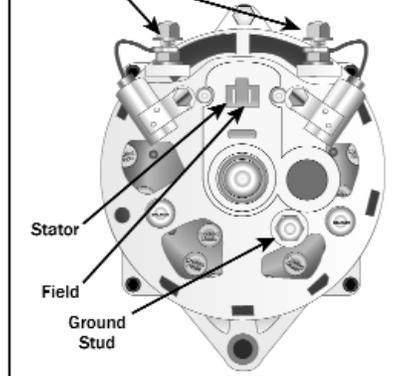
7-Series Alternators



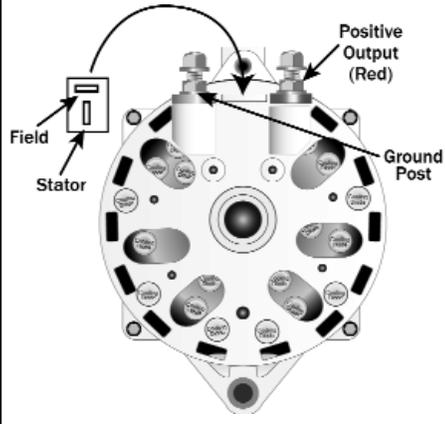
9-Series Alternators Single Output



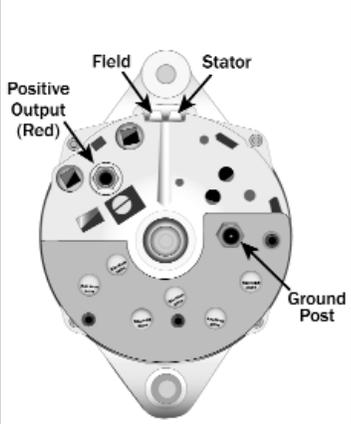
9-Series Alternators Dual Output



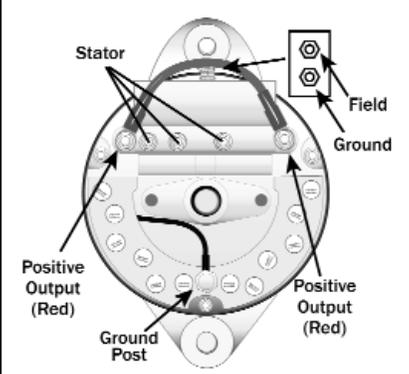
94-Series Alternators



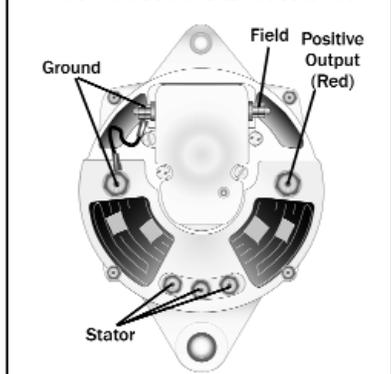
95-Series Alternators



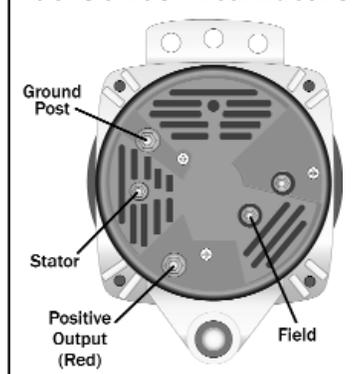
96-Series Alternators



97-Series Alternators



98-Series Alternators



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, 19009 61st 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

BALMAR 19009 61st Ave. NE, Arlington, WA 98223

Ph: (360) 435-6100, Fx: (360) 435-3210

E-mail: balmar@balmar.net, Web: www.balmar.net

Please note:

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