# VMI 200 Series Charger
# Owner's Manual
# &
# Battery Handbook

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# Contents:



**Quick Reference for Tables and Illustrations:**

**Section 1**
**Introduction**

## Before You Begin

**Important !!** – For your protection, the information in this manual should be read thoroughly and understood before attempting to install or operate this equipment. Following the procedure as outlined in this manual will help to insure that the equipment is installed and functions properly and reduce the chance of personal injury. Remember, this charger and your batteries are capable of producing **HIGH CURRENT** and **POTENTIALLY LETHAL VOLTAGES**. **ALWAYS USE CAUTION WHEN WORKING WITH ELECTRICITY.**

## Handling

Equipment may be very heavy and awkward to balance. Always have sufficient manpower available as well as the proper handling equipment. Use care to prevent the equipment from accidentally being tipped over.

## Unpacking and Inspection

Carefully examine the packaging and contents for signs of damage. Promptly report any damage to your shipping carrier.
If at all possible, save the packaging material. Should the equipment ever need repair or servicing at the factory, adequate packaging will be needed. Quality Marine will not be responsible for any damage that occurs in shipping even if the damage occurs during shipment for warranty repairs.

## Name Plate & Initial Settings

The Name Plate is located on the front of the unit above the AC circuit breaker. It contains the part number, model number, serial number, and specifications for the unit. Be sure to include this information in all communication with Quality Marine.
All chargers are shipped from our factory fully checked and adjusted to the most practical settings for most applications. **DO NOT MAKE ANY ADJUSTMENTS UNTIL YOU HAVE REFERRED TO THIS MANUAL.** If you have any questions not answered by this manual, Please call technical support at: **800-463-5314.**

## Tools required

In addition to common hand tools you will need a power drill and bits, and a voltmeter. For *Case size 3* you will also need a terminal crimping tool to attach 3/8" ring lugs.

## Materials

1. You will need lead wire sufficient to connect both the AC line and the batteries. Refer to *Table 1 – 1* on page 2 for recommended sizes. Always use wire of recommended size or larger to reduce voltage drop in the leads.
2. You will need bolts to attach the unit to the bulkhead. *Case size 2* requires a minimum of 4, ¼" dia. or larger bolts. *Case size 3* requires a minimum of 4, 5/16" dia. or larger to support the unit. The case size may be determined by the last digit in the model number, either a "2" or a "3". (e.g. ***VMI*** 12302 would indicate a *Case size 2*.)
3. You will also need cable exit glands or grommets to protect the lead wire exits.

**NOTE** – WHEN LEAD WIRE EXCEEDS #4 AWG, IT WILL NOT FIT THE DEAD FRONT TERMINAL BLOCK. 3/8" STUD BINDING POSTS ARE AVAILABLE FROM QUALITY MARINE, LLC AS AN ACCESSORY ITEM.

**Section 1**
**Introduction**

| **Model** | **AC Line** | **DC Outputs to batteries** | | | | |
|---|---|---|---|---|---|---|
| **Distance** | **10'** | **11' – 20'** | **21' – 30'** | **31' – 40'** | **41' – 50'** | **Over 50'** |
| ***VMI*** 12102 | #14 AWG | #8 AWG | #4 AWG | #4 AWG | #2 AWG | #1 AWG |
| ***VMI*** 12202 | #14 AWG | #8 AWG | #4 AWG | #4 AWG | #2 AWG | #1 AWG |
| ***VMI*** 12302 | #12 AWG | #6 AWG | #4 AWG | #2 AWG | #1 AWG | #1/0 |
| ***VMI*** 12402 | #12 AWG | #6 AWG | #4 AWG | #2 AWG | #1 AWG | #1/0 |
| ***VMI*** 12603 | #10 AWG | #2 AWG | #1 AWG | #1/0 | #3/0 | #4/0 |
| ***VMI*** 12753 | #10 AWG | #2 AWG | #1 AWG | #1/0 | #3/0 | #4/0 |
| ***VMI*** 24102 | #14 AWG | #10 AWG | #8 AWG | #6 AWG | #4 AWG | #4 AWG |
| ***VMI*** 24252 | #12 AWG | #6 AWG | #4 AWG | #2 AWG | #1 AWG | #1/0 |
| ***VMI*** 24403 | #10 AWG | #4 AWG | #1 AWG | #1/0 | #3/0 | #4/0 |
| ***VMI*** 24603 | #8 AWG | #1/0 | #2/0 | #3/0 | #4/0 | 250 MCM |
| ***VMI*** 24753 | #6 AWG | #2/0 | #3/0 | #4/0 | 250 MCM | 350 MCM |
| ***VMI*** 32202 | #12 AWG | #6 AWG | #4 AWG | #2 AWG | #1/0 | #2/0 |
| ***VMI*** 32303 | #12 AWG | #4 AWG | #1 AWG | #1/0 | #3/0 | #4/0 |
| ***VMI*** 32503 | #8 AWG | #2 AWG | #2/0 | #3/0 | #4/0 | 250 MCM |
| | | | | | | |
| ***VMI*** 48102 | #12 AWG | #8 AWG | #6 AWG | #4 AWG | #2 AWG | #1/0 |
| ***VMI*** 48253 | #8 AWG | #6 AWG | #4 AWG | #1 AWG | #1/0 | #3/0 |
| ***VMI*** 48403 | #6 AWG | #2 AWG | #1/0 | #2/0 | #3/0 | 250 MCM |

**Table 1 – 1**
**Suggested Minimum Wire Size & Maximum Distance**

**Section 2**
**Overview**

**NOTE** – This section and procedure is intended as a summary. **IMPORTANT INFORMATION COULD BE MISSED BY FOLLOWING THIS PROCEDURE ALONE.**

1. Remove the charger from the packaging material and lay it on its side.
2. Remove the "EZ mount" mounting bracket from the back of the unit.
3. Mount the "EZ mount" mounting bracket in the desired location. Please refer to *Section 3, "Mounting"* for mounting considerations.
4. Be sure that the battery ends of your DC cables are disconnected. Attach the DC cables to the charger and then to the battery (s). Please refer to *Section 4, "Connecting DC, Batteries"* for proper DC connection and *Table 1 – 1* for recommended wire size. **WARNING – CONNECT THE DC CABLES DIRECTLY TO THE BATTERY OR BATTERY BUS. NEVER CONNECT THE CHARGER OUTPUT DIRECTLY TO THE EXTERNAL LOAD. DOING SO MAY RESULT IN DAMAGE TO THE EQUIPMENT BEING SUPPLIED OR EXCESSIVE ELECTRICAL NOISE.**
5. Be sure that the AC supply breaker is off and attach the AC leads to the charger. Please refer to *Section 5, "Connecting AC"* for proper configuration for the input voltage and *Table 1 – 1* for the recommended wire size.
6. Turn on the AC power.
7. Turn on the charger and verify that the power indicator is illuminated.
8. Verify the output voltage with a nominal load (approximately ½ the rated output of the charger). Please refer to *Section 6, "Operation & Initial Settings"* for voltage adjustment procedure.
9. Increase the load on the system until the battery voltage begins to drop. Verify that the charger output meter indicates 100 – 110% of the chargers rated output. Please refer to *Section 8, "Current Limiter & Over-Voltage Protection"* for information regarding the current limiter.

**Section 3**
**Mounting**

## Choosing a Location

The Quality Marine ***VMI*** Charger should be mounted upright in a cool dry location as close to the battery (s) as possible. Adequate airspace to permit cooling is a must. Allow at least 4" of free space on all sides to ensure proper ventilation. **NEVER** mount the charger in a confined, unventilated space. **DO NOT** mount the charger directly over the battery bank or expose it to salty spray. Both conditions can cause corrosion and reduce the service life of the unit. **MOUNTING THE UNIT OVER THE BATTERY COULD CAUSE AN EXPLOSION HAZARD SHOULD THE BATTERY VENT HYDROGEN GAS.**

**NOTE –** THEQUALITY MARINE ***VMI*** CHARGER ***DOES NOT*** REQUIRE A DRIP SHIELD TO MEET UL-1236 INSTALLATION REQUIREMENTS.

## Mounting Procedure

The Quality Marine ***VMI*** Charger is equipped with our exclusive "EZ mount" mounting bracket. This allows you to mount the bracket in the desired location and then hang the charger on the bracket for a "both hands free" installation of the finish hardware.

1. After removing the unit from the package, place it on its side (heavy side down) to allow for removal of the mounting bracket. Using a 7/16" socket or wrench, remove the ¼" – 20 flange nuts and washers from the top and bottom of the charger and save for reinstallation.
2. Remove the mounting bracket by moving it toward the bottom of the unit. Remove and discard the shipping pad located between the bracket and the backpan of the charger.
3. Mount the bracket to the wall or bulkhead in the desired location using hardware capable of supporting the weight of the unit. We recommend a minimum of 4, ¼" dia. bolts for *Case size 2*, and a minimum of 4, 5/16" dia. bolts for *Case size 3*. Use the pre-drilled holes to ensure proper weight distribution. (Case size may be determined by the last number in the model number of the unit. e.g. ***VMI*** 12302 would indicate a *Case size 2*.)
4. Carefully hang the charger on the mounting bracket making sure to lineup the studs on both the top and bottom of the unit. Reinstall the ¼" – 20 flange nuts and washers using a 7/16" socket or wrench.

**Section 4**
**Connecting DC, Batteries**

## Wire Selection

Select the appropriate size wire from *Table 1 – 1* on page 2. Use at least the recommended size or larger to ensure proper regulation and performance from the unit. Be sure to provide at least 6" per wire within the cabinet to allow for service loops. We recommend tinned, stranded wire in the following colors: Black for DC negative, Red for DC positive connections.

**WARNING – CONNECT THE DC CABLES DIRECTLY TO THE BATTERY OR BATTERY BUS. NEVER CONNECT THE CHARGER OUTPUT DIRECTLY TO THE EXTERNAL LOAD. DOING SO MAY RESULT IN DAMAGE TO THE EQUIPMENT BEING SUPPLIED OR EXCESSIVE ELECTRICAL NOISE.**

## Case Size 2

If you are installing a *Case size 3*, skip to the paragraph labeled *"Case Size 3"* (Case size may be determined by the last number in the model number of the unit. eg. ***VMI*** 12302 would indicate a *Case size 2*).

1. The *Case size 2* unit has 6 knock-outs on the bottom to allow for wiring (5, 7/8" & 1, 1-1/16"). Remove the desired knock-outs and install protective grommets or cable glands to protect the wire from abrasion. It is permissible to pass positive and negative DC wires through the same hole if desired. It is, however, not advised to pass DC leads through the same hole as AC leads as this will lead to increased electrical noise and could compromise the isolation between AC & DC.
2. The *Case size 2* units use an IEC (International Electrical Code) approved dead front terminal block for the AC & DC connections. The Quality Marine ***VMI*** Series Chargers are capable of charging up to 3 separate banks at one time. All of the banks must be of the same voltage and type. Determine the output jumper configuration that meets your needs for the number of banks connected to the charger. See *fig. 4 – 1*. Connect the positive cable (s) to the appropriate position (s), (P1, P2 & P3), on the terminal block and the negative cable to the position marked "NEG" on the terminal block. **NOTE** – The terminal block will accept up to #4 AWG wire. If the wire being used is larger than #4 AWG, you will need to use an external junction or 3/8" binding posts as close to the charger as possible. 3/8" binding posts are available from Quality Marine as an accessory. Connect the junction to the charger with #4 AWG wire. Keep the distance as short as possible (less than 18").

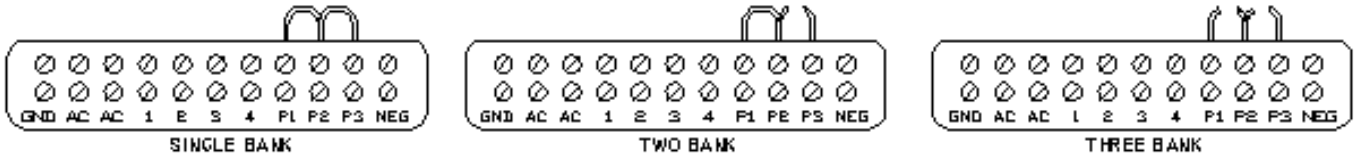


**fig. 4 – 1**
**Case Size 2 Output Jumper Configuration**

**NOTE** – WHEN USING THIS CHARGER IN A SINGLE BANK SYSTEM, TERMINAL POSITIONS P1, P2, & P3 MUST BE STRAPPED TOGETHER FOR PROPER OPERATION. THE TERMINALS ARE INSTALLED AND CONFIGURED FOR SINGLE BANK USE AT THE FACTORY.

**WARNING – DO NOT LEAVE THE OUTPUTS STRAPPED TOGETHER IF MORE THAN ONE BATTERY BANK IS CONNECTED. STRAPPING MORE THAN ONE BATTERY BANK TOGETHER MAY DAMAGE THE BATTERIES.**

To disconnect the jumpers, simply cut and remove a section of the jumper (see *fig. 4 – 1*). Do not loosen the terminal screws.

**NOTE** – WHEN USING TWO BANK OUTPUT, CONNECT THE HIGHER USAGE BANK TO POSITIONS P1 & P2 AND THE LOWER USAGE BANK TO POSITION P3.

## Case Size 3

1. The *Case size 3* unit has 8 knock-outs on the bottom to allow for wiring (2, 7/8" & 6, 1-1/16"). Remove the desired knock-outs and install protective grommets or cable glands to protect the wire from abrasion. It is permissible to pass positive and negative DC wires through the same hole if desired. It is, however, not advised to pass DC leads through the same hole as AC leads as this will lead to increased electrical noise and could compromise the isolation between AC & DC.
2. The *Case size 3* units use an IEC (International Electrical Code) approved dead front terminal block for the AC connections and 3/8" binding posts for the DC connections. The Quality Marine ***VMI*** Series Chargers are capable of charging up to 3 separate banks at one time. All of the banks must be of the same voltage and type. Determine the output jumper configuration that meets your needs for the number of banks connected to the charger. See *fig. 4 – 2*. Connect the positive cable (s) to the appropriate position (s), (P1, P2 & P3), and the negative cable to the position marked "NEG".

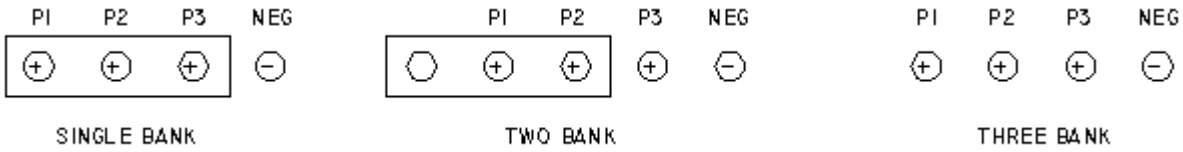


**fig. 4 – 2**
**Case Size 3 Output Jumper Configuration**

**NOTE –** WHEN USING THIS CHARGER IN A SINGLE BANK SYSTEM, TERMINAL POSITIONS P1, P2, & P3 MUST BE STRAPPED TOGETHER FOR PROPER OPERATION. THE TERMINALS ARE INSTALLED AND CONFIGURED FOR SINGLE BANK USE AT THE FACTORY.

**WARNING – DO NOT LEAVE THE OUTPUTS STRAPPED TOGETHER IF MORE THAN ONE BATTERY BANK IS CONNECTED. STRAPPING MORE THAN ONE BATTERY BANK TOGETHER MAY DAMAGE THE BATTERIES.**

For 3/8" binding posts, remove the fastening nuts and washers and move the jumper to the desired position or remove for three bank output (see *fig. 4 – 2*).

**NOTE** – WHEN USING TWO BANK OUTPUT, CONNECT THE HIGHER USAGE BANK TO POSITIONS P1 & P2 AND THE LOWER USAGE BANK TO POSITION P3.

**Section 5**
**Connecting AC**

All Quality Marine ***VMI*** Series Chargers are equipped with an isolation transformer with multiple input taps for use with 120V, 208V, & 220 – 240V, 50 – 60Hz.

## Wire Selection

Select the appropriate size wire from *Table 1 – 1* on page 2. Use at least the recommended size or larger to ensure proper regulation and performance from the unit. Be sure to provide at least 6" per wire within the cabinet to allow for service loops. We recommend tinned, stranded wire in the following colors: Black for AC "hot", White for AC neutral, and Green for chassis ground. The chassis ground lead should be at least #10 AWG for all models.

**WARNING – DO NOT PASS THE AC LEADS THROUGH THE SAME CASE OPENING AS THE DC LEADS. DOING SO MAY CAUSE EXCESSIVE ELECTRICAL NOISE AND COULD COMPROMISE THE ISOLATION BETWEEN AC & DC.**

1. Remove the desired knock-outs and install protective grommets or cable glands to protect the wire from abrasion.
2. The ***VMI*** Series Chargers use an IEC (International Electrical Code) approved dead front terminal block for the AC connections. The terminals are marked "GND, AC, AC, 1, 2, 3, 4". The GND position (Green wire) is the chassis ground. The first AC position (Black wire) is AC "hot". The second AC position (White wire) is AC "neutral". **WARNING – BE SURE THAT THE AC POWER TO YOUR CONNECTIONS IS OFF OR DISCONNECTED BEFORE PROCEEDING.** Strip approximately 5/8" of the insulation from each lead and insert it into the appropriate position of the terminal block and tighten the set screws to secure the connections.
3. The positions marked 1, 2, 3, & 4 are transformer taps that are used to configure the input voltage. Determine the input voltage of your supply and see *fig. 5 – 1* for proper input configuration. Loosen the set screws and remove and place the jumper from position 2 to position 3 and tighten the set screws for 208V, or 220 – 240V input. **For 208V input**, you will also need to disconnect the white transformer lead behind position 4 and connect it to the yellow lead also located behind the terminal block. These wires have a ¼" "fast–on" type connector for this purpose. **NOTE** – THE UNIT IS SET FOR 120V INPUT AT THE FACTORY UNLESS SPECIFIED OTHERWISE IN THE PURCHASE ORDER.

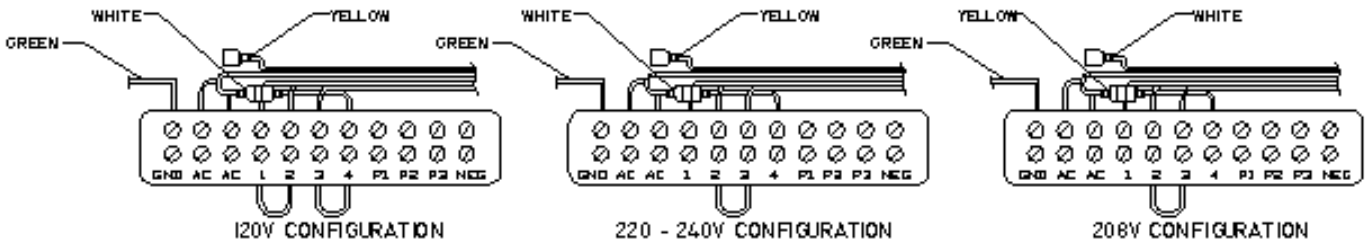


**fig. 5 – 1**
**AC Input Configuration**

**Section 6**
**Operation & Initial Settings**

## Operation

Connect the supply end of the AC leads and turn the source power on. Turn on the breaker at the charger and verify that the panel indicator is illuminated. Depending on the charge state of your batteries and the external load, the output meter should indicate somewhere between zero amps and the rated maximum of the charger. If there is no external load present and the battery (s) is fully charged the ammeter will indicate near zero. To verify proper operation of the charger, vary the load by turning on lights or equipment connected to the battery or bus and observe the increase of the ammeter reading.

## Output Voltage Adjustment

All Quality Marine ***VMI*** Series Chargers are fully tested and calibrated prior to shipment. The voltage settings are optimal for most applications. Please refer to your specific battery manufacturer for precise voltage settings and refer to *Appendix A*, *"Battery Handbook"* of this manual for more specific information regarding the methods of charging and maintaining your batteries. **NOTE** – CARE TAKEN AT THIS POINT MAY SAVE YOU TIME AND MONEY BY INCREASING THE SERVICE LIFE OF YOUR BATTERIES.

If adjustment to the voltage settings is required:

1. Open the front cover of the charger.
2. Turn the power on and add load to bring the charger to approximately ½ of the rated output current as indicated by the output meter.
3. The Control Circuit Board is located approximately in the center of the door. The Voltage Adjustment controls are located on the right-hand side of the Board on the edge nearest the top. See *fig. 6 – 1.* Set the desired mode (Float or Equalize) by pressing the Float / Equalize Select Button located on the front panel above the AC Breaker. The button will be illuminated in Equalize mode and off in Float mode. For more information regarding the Float / Equalize features see *Section 7, "Equalize Timer"* and *Appendix A, "Battery Handbook"*.
4. Adjust the corresponding control and observe the output voltage using a voltmeter attached to the DC Output as close to the battery (s) as possible. Rotating the control clockwise increases the output voltage and counterclockwise decreases the output voltage. The controls are multi-turn devices (approx. 15 turn).

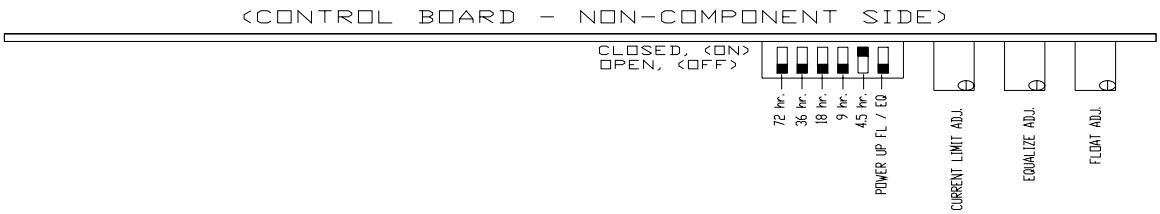


**fig. 6 – 1**
**Adjusting Float & Equalize Voltage**

**Section 7**
**Equalize Timer**

## Overview

The ***VMI*** Series Chargers have two independent voltage settings. One for Float voltage or maintenance charging, and one for Equalize voltage or recovery of dead or depleted batteries. This method uses only two steps to recover a depleted battery instead of the traditional three step process which uses a constant current mode for bulk charging. Constant current charging can cause excessive heat and venting which can dramatically reduce the service life of a battery so Quality Marine ***VMI*** Series Chargers use a safer "Equalize" mode or an elevated constant voltage mode controlled by a timer. When properly set up, recovery of a dead or depleted battery is nearly as fast as constant current charging but far safer. If you are not familiar with different charging methods, please refer to *Appendix A, "Battery Handbook"* in the back of this manual for a brief explanation of charging methods for various types of batteries. **NOTE** – SINCE THIS IS SUCH A CRITICAL STEP IN THE PROPER OPERATION OF THE CHARGER, PLEASE REFER TO YOUR BATTERY MANUFACTURER FOR SPECIFIC VOLTAGE SETTINGS OR CONTACT OUR **TECHNICAL SUPPORT AT 800-463-5314** IF YOU HAVE ANY QUESTIONS.

## Operation

The Float / Equalize function is controlled by a yellow pushbutton switch located on the front panel above the AC Circuit Breaker. The button is illuminated when the charger is in Equalize mode and off when in Float mode.

When in Float mode, pressing the button once will cause it to illuminate and places the charger in Equalize mode. The charger will remain in Equalize mode for the duration of the timer setting at which time it will automatically switch back to Float mode and extinguish the indicator lamp. Equalize mode may be cancelled at any time during the cycle by pressing the Float / Equalize button a second time.

The timer duration is adjustable from 4 ½ - 139 ½ hours in 4 ½ hour steps. The adjustment for timer duration is located inside the charger next to the voltage controls. *See Section 6, Operation and Initial Settings* and *fig. 7 –1.* The switch settings may be combined in any order to produce a combination of the values (they are additive).

The Equalize mode may be disabled by setting all switches to open (off).

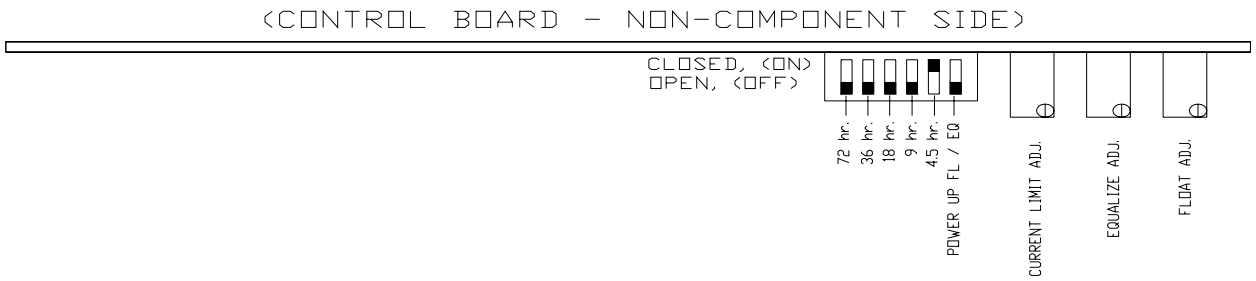


**fig. 7 – 1**
**Setting Equalize Timer Switches**
**(Factory Default Setting Shown)**

**Section 7**
**Equalize Timer**

## Auto Equalize

The last switch position labeled "Power up FL / EQ" (*fig. 7 – 1*) determines which mode the charger will be in when power is applied. For situations where the batteries are cycled, it is recommended that this feature be set to power up EQ. When power is restored to the charger, it will automatically switch to Equalize mode for the time duration set by the timer switches, after which, the charger will switch back to Float mode to safely finish the charge and maintain the batteries. Please refer to *Appendix A, "Battery Handbook"* and your battery manufacturer for proper time settings and to determine if the auto equalize feature is needed for your specific application. Auto Equalize is set when the "Power up FL /EQ" switch is in the closed or "on" position.

## Factory Default Setting

Because there are many different types of batteries and ways in which they are used, the factory setting is minimum time (4 ½ hours) and power up in Equalize mode. This setting is the safest for most applications but could result in long recharge cycles. For proper settings for your batteries, consult the battery manufacturer and/or *Appendix A, "Battery Handbook"*.

**Section 8**
**Current Limiter & Over-Voltage Protection**

## Current Limiter

All Quality Marine ***VMI*** Series Chargers are equipped with a factory set and sealed current limit adjustment. When the output current reaches the maximum for the charger, the output voltage is reduced such that the current remains constant. This is also known as "fold back current limiting". Because of this feature, it is not necessary to turn the charger off when starting an engine or running a large intermittent load. The charger will safely supply its maximum output as long as the load is applied. **NOTE** – TAMPERING WITH THE SEALED CONTROL MAY VOID YOUR WARRANTY.

## Over Voltage Protection

The Quality Marine ***VMI*** Series Chargers produced after January 10, 2000 and bearing the marking "Rev. 4" on the control circuit board have a resettable over voltage protection device to protect the control board from accidental over voltage as well as surges in the supply voltage. If voltage higher than the AC configuration is applied, (See *Section 5, "Connecting AC"* ) the board will shut down and cause the charger output to go extremely low (5 – 10 VDC). If this occurs, you will need to turn off the AC power, wait for approximately 10 seconds, verify that the input voltage is correct and turn the AC power back on. If the problem persists, contact **TECHNICAL SUPPORT AT 800-463-5314.**

## Circuit Breakers & Fuses

All Quality Marine ***VMI*** Series Chargers are equipped with resettable circuit breakers on the AC input. They are located on the front panel and also serve as the "on/off" switch. The AC breakers are ignition protected and are of double pole design for safety. When in the "off" position, both input leads are broken to isolate the charger from the AC supply even when configured for 208 – 240V where both leads are "hot" with respect to ground. When tripped, the AC breaker may be reset by simply switching it back on. Repeated tripping indicates an AC supply problem. Verify that the input voltage and configuration are correct (see *Section 5 "Connecting AC"*). If the problem persists, contact **TECHNICAL SUPPORT AT 800-463-5314**.

All Quality Marine ***VMI*** Series Chargers with output voltage less than 48Vdc have resettable ignition protected circuit breakers. The DC breaker is located inside the charger in the lower right hand region. The DC breaker breaks only the positive (+) leg of the DC output. Consideration must be made when using this unit in a positive (+) ground system. Should the DC breaker trip, it may be reset by pressing the reset button located on the body of the breaker. A tripped DC breaker indicates an extreme overload or short in the DC system. Remove all load from the battery or DC bus before resetting the DC breaker. If the problem persists, contact **TECHNICAL SUPPORT AT 800-463-5314.**

All Quality Marine ***VMI*** Series Chargers with output voltage 48Vdc or greater use "one time" fuses in place of the DC breaker. **Always** replace the fuse with one of equal value and of the same type. **NOTE** – REPLACING THE DC FUSE WITH ONE OF GREATER VALUE WILL VOID YOUR WARRANTY.

**Section 9**
**Technical Specifications**

## Specifications

AC Input Voltage:
120V, 108 – 132V, 50 – 60 Hz.
208V, 187 – 228V, 50 – 60 Hz.
240V, 198 – 264V, 50 – 60 Hz.

Output Adjustment Range: (typical)
All 12V models : 12.0 – 17.9 Vdc
All 24V models : 24.0 – 36.6 Vdc
All 32/36V models: 32.0 – 46.8 Vdc
All 48 V models : 48.0 – 60.4 Vdc

Operating Temperature: 32 – 140 degrees F (0 – 60 degrees C)

Electrolysis Protection:
Quality Marine ***VMI*** Series Chargers are equipped with isolation type transformers to prevent shock and electrolysis. They will, however, not protect against electrolysis caused by other electrical sources.

Physical Size:
Case Size 2: H 10in.(254cm) x W 10in.(254cm) x D 10in.(254cm)
Case Size 3: H 18in.(457cm) x W 16in.(406cm) x D 10in.(254cm)

| **Model** | **Case Size** | **Nominal Output Voltage** (Vdc) | **Factory Float Voltage Setting** (Vdc) | **Factory Equalize Voltage Setting** (Vdc) | **Maximum Output Current** (Amps dc) | **Maximum Input Current*** (Amps rms) |
|---|---|---|---|---|---|---|
| ***VMI*** 12102 | 2 | 12 | 13.30 | 14.00 | 10.0 | 2.1 |
| ***VMI*** 12202 | 2 | 12 | 13.30 | 14.00 | 20.0 | 4.2 |
| ***VMI*** 12302 | 2 | 12 | 13.30 | 14.00 | 30.0 | 6.4 |
| ***VMI*** 12402 | 2 | 12 | 13.30 | 14.00 | 40.0 | 8.5 |
| ***VMI*** 12603 | 3 | 12 | 13.30 | 14.00 | 60.0 | 12.7 |
| ***VMI*** 12753 | 3 | 12 | 13.30 | 14.00 | 75.0 | 15.9 |
| ***VMI*** 24102 | 2 | 24 | 26.60 | 28.00 | 10.0 | 4.2 |
| ***VMI*** 24252 | 2 | 24 | 26.60 | 28.00 | 25.0 | 10.6 |
| ***VMI*** 24403 | 3 | 24 | 26.60 | 28.00 | 40.0 | 16.9 |
| ***VMI*** 24603 | 3 | 24 | 26.60 | 28.00 | 60.0 | 25.4 |
| ***VMI*** 24753 | 3 | 24 | 26.60 | 28.00 | 75.0 | 31.8 |
| ***VMI*** 32202 | 2 | 32 | 35.50 | 37.30 | 20.0 | 11.3 |
| ***VMI*** 32303 | 3 | 32 | 35.50 | 37.30 | 30.0 | 16.9 |
| ***VMI*** 32503 | 3 | 32 | 35.50 | 37.30 | 50.0 | 28.2 |
| ***VMI*** 36252 | 2 | 36 | 39.90 | 41.90 | 25.0 | 15.9 |
| ***VMI*** 48102 | 2 | 48 | 53.20 | 55.00 | 10.0 | 8.3 |
| ***VMI*** 48253 | 3 | 48 | 53.20 | 55.00 | 25.0 | 20.8 |
| ***VMI*** 48403 | 3 | 48 | 53.20 | 55.00 | 40.0 | 33.3 |

*Measured with 108Vac input @ 60Hz. with charger output at 110% maximum rated load.

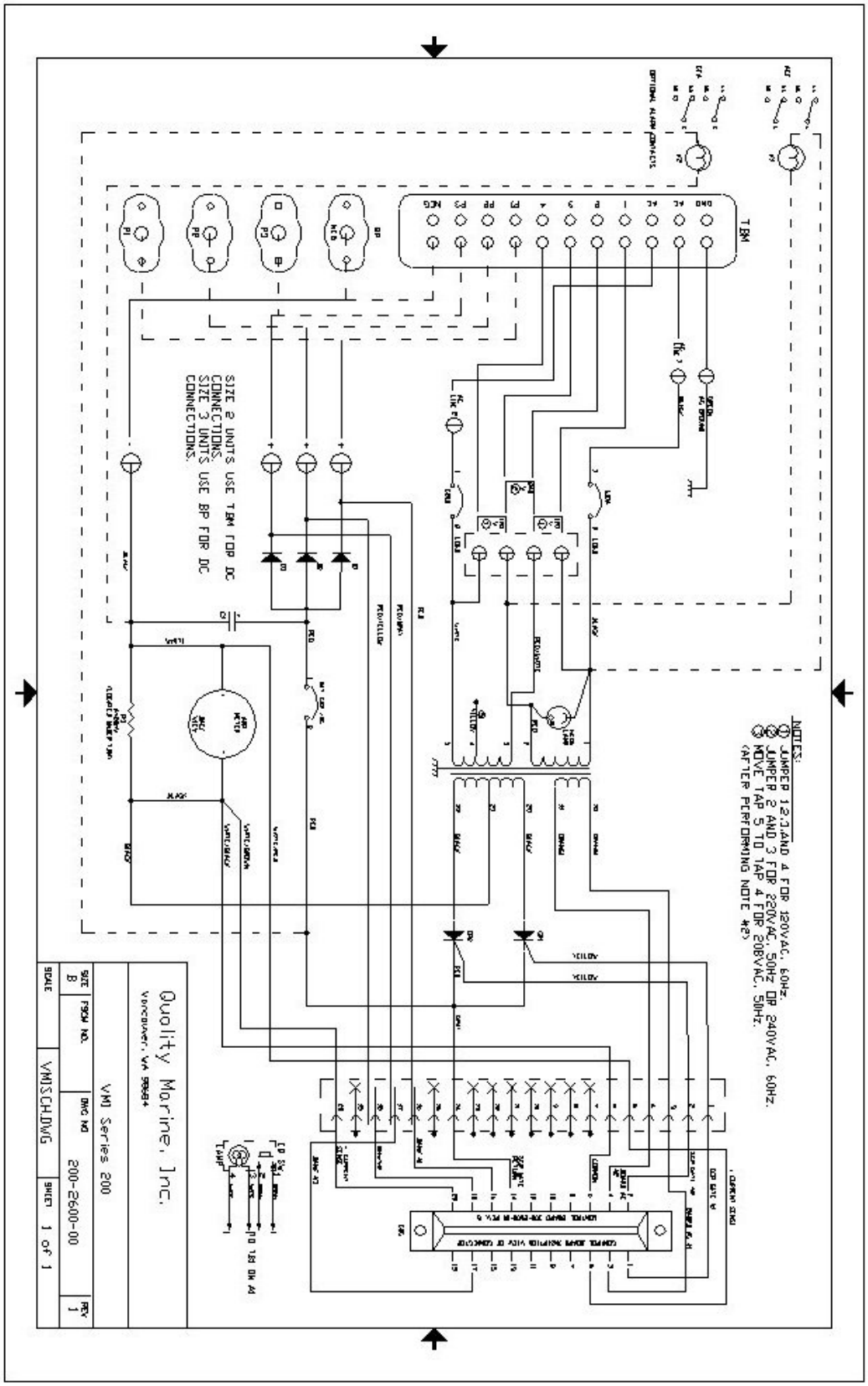


**fig. 9-1**
**System Schematic**

**Appendix A**

# *Battery Handbook*

By: RON SMITH

Information compiled from the Battery Charger Handbook and the Battery Handbook written by Alvin G. Graham, Chief Engineer, Ratelco Electronics Inc.

## Introduction

The purpose of this paper is to briefly acquaint the reader with the different kinds of batteries used in marine service and with the typical charging requirements of each. All noted voltages are shown to provide the reader "rules of thumb". Consult the manufacturer of your batteries for the specific charging and maintenance voltages. General information is offered on the effects of voltage on recharging rates, battery grid corrosion, and battery life in general. The reader will note the different objectives in battery charging, e.g. cell equalization, rapid charging, and forming new batteries, are accomplished at different charging voltages. Multi-bank charging and electromagnetic interference (EMI) are also briefly discussed. Specific information on the Quality Marine VM and ***VMI*** marine battery chargers is shown to inform the reader on that product's ability to meet all the objectives of marine battery charging**.**

## Summary of the Quality Marine VM and *VMI* Battery Charger

Three important design features make the Quality Marine VM battery charger the best value on the marine battery charger market today.

First, the Quality Marine charger's **constant voltage output** provides current necessary for meeting load requirements, while maintaining the battery at float voltage. Constant voltage charging prevents battery cycling and provides for years of extended battery life. This means hundreds of dollars worth of savings down the road.

Second, charge voltage is **manually adjustable** on all Quality Marine chargers. This allows the user to adjust the Quality Marine charger to meet any charging objective e.g. rapid charging, periodic cell equalization, forming new batteries, and maintaining any type of battery at its proper float voltage.

Third, Quality Marine chargers **tolerate extreme input variations**, in line voltage or generator frequency, and still do their job. Input variations are a fact of marine life and the ability to tolerate them means protection of the customer's investment in both charger and batteries.

In addition, the **quality** and care that goes into the manufacturing of Quality Marine chargers ensures that the Quality Marine customer will get decades of reliable performance for his initial investment dollars.

## Lead Acid Batteries

Two types of lead acid batteries are found in marine service, lead calcium and more commonly, lead antimony. In both, the plates are of (1) grid and (2) paste. The paste, the active material that holds the charge, is made up of lead dust, sulfuric acid, and possibly some kind of fiber to increase strength and reduce mud formation. The negative plates may have other substances to improve discharge performance or prevent capacity loss during repeat cycling. The density and porosity of the paste, along with the physical dimension of the plate, determine the capacity loss during repeat cycling.

The density and porosity of the paste, along with physical dimensions of the plate, determine the capacity and discharge rate of the plate. If high discharge rates are desired, as would be with starting batteries, the plate is made thin and the paste porous. More plates are used in the battery. These batteries are generally of the lead calcium design.

In deep cycle batteries, or when lots of cycle life is desired, plates are made thicker and the paste more dense. These batteries are generally of the lead antimony design.

## Selecting Recharge Voltage

When selecting recharge voltage, three things must be considered: (1) speed of recharge, (2) length of applied voltage, and (3) load. If a Quality Marine charger capable of supporting average loads is selected, battery management becomes easier. If not, understanding the following will allow the Quality Marine owner to properly use the voltage adjuster to accomplish all the objectives of battery charging.

Battery life is maximized when the battery is maintained at what is called float voltage. Simply put, it is a voltage above that point where a battery begins to accept a charge and below the point where it begins to gas. Above float voltage, several things begin to happen. First, the rate of recharge accelerates and battery cell voltages work toward equalization. Beyond that, most of what happens is detrimental to battery life. For example, in lead antimony batteries, float current doubles with every .05 volt per cell (vpc) that a battery is increased over float voltage (float current is that current which flows in a battery, due to losses in a fully charged cell, with a given potential on the plates). As float current accelerates, so does grid corrosion, preventing charge storage and reducing battery life. Moreover, when lead calcium batteries are maintained at overly high voltages, or repeatedly cycled, they can fail prematurely because associated heat and stress cause the plates to grow.

Battery gassing and water loss accelerate rapidly once float voltage is exceeded, gasses can accumulate and present an explosive situation. If plates become exposed due to severe water loss, they sulfate and capacity is permanently lost. Therefore, **the duration of time a battery is charged above float voltage must remain short, 24 to 72 hours.**

## Cell Equalization, Rapid Charging, and Forming Batteries

Charging a battery at a voltage higher than its float voltage should only be done for one of three reasons, either to equalize cell voltages, rapid charge, or form new batteries. Charging new batteries at an equalize voltage for 48 to 72 hours serves to establish a firm voltage and polarity imprint. **Always ventilate the compartment before equalizing.**

In cycle service, a number of things, such as impurities in the electrolyte or variations in electrolyte level across cells, can result in a situation where cells charge unequally. If allowed to continue, cell failure may occur, particularly in antimony batteries. This can be prevented by charging the battery at a higher voltage (every 2 months) for 8 to 24 hours. The same voltage settings used for cell equalization can be used for rapid charging. These voltage settings for different batteries are described below.

Rapid charging may be desired when a load period exceeds the chargers output and cell voltages drop below the "start to charge" voltages shown below. No charging takes place until the cell voltage is restored to that point. By elevating recharge voltage, the time it takes to restore a battery to 95% recharged state is dramatically reduced.

Recharging a battery at float voltage is a slow process. For example, a 30% discharged 100 amp-hour, 8 hr. rated battery, at a float setting of 2.15 vpc will take 55 hours to become 95% recharged. That same battery will become 95% recharged in 5 hours if the recharge voltage is raised to 2.25 vpc, and in 4 hours if raised to 2.33 vpc. If the Quality Marine charger is adjusted to a higher voltage to provide more rapid charging, little detrimental effect will occur if the charger is readjusted to float voltage in less than 72 hours. Check battery water before and after equalizing or rapid charging.

During periods of increased cycle activity, where average load often exceeds the charge output, the Quality Marine charger can be set to a compromise voltage to speed up recovery.

This "high float" (2.25 vpc) poses less risk to the battery than a rapid charge setting would if forgotten. When load seldom exceeds the chargers current rating, keep the charger at a proper float voltage. Then, only occasional inspection and equalization is necessary to produce long battery life.

## Measuring Specific Gravity or Voltage for Full Charge

The specific gravity (SG) reading of a fully charged battery cell depends upon the proportion of sulfuric acid to water in the electrolyte. The battery manufacturer can provide the precise electrolyte information. Once known, cell voltage can be determined by the formula below.

At 77 degrees F vpc = Specific Gravity (SG) +. 84

A battery with a SG of 1.250 would have a fully charged cell voltage of 2.09 V. Add .001 to SG for every 3 degrees over or subtract .001 for every 3 degrees under 77 degrees F.

Measuring the SG of a battery can be tricky. Accurate hydrometer (or voltmeter) reading can only be obtained after the battery has sat open cell (no current in or out) for several hours. Hydrometer readings must be taken before adding water as electrolyte mixing can take several weeks or even months. Also, hydrometer readings will vary across cells if water levels differ. Low level cells will read higher.

Before measuring new batteries for SG, form them first. Fully charge them at 2.35 vpc and then discharge them to 1.85 vpc. Recharge them at 2.35 vpc for three days. Replenish water and leave the batteries at 2.25 to 2.27 vpc for a few weeks. This process mixes the electrolyte and forms the new battery by leaving a firm voltage and polarity imprint. Accurate open cell SG readings can now be taken.

In a formed battery, after equalizing and mixing, if a .025 SG difference is showing between any 2 cells, replace the battery. **When using a hydrometer, use gloves and wear protective eye wear.**

## Float and Equalize Voltage Settings

Float voltages for batteries in marine service vary. The Quality Marine chargers adjust to accommodate any marine battery. Adjustment ranges and "rule of thumb" charge voltages are shown below. Float can also be established by monitoring battery water loss. Consult the manufacturer of your batteries for precise float and equalize settings.

Adjustment Range of Quality Marine VM & ***VMI*** Chargers

12 V units: 12 – 16 V, 24 V units: 24 – 30 V, 32 V units: 32 - 40V

Typical Lead Calcium Voltages/ Starting Batteries

| | |
|---|---|
| Starts to charge at | 2.1 vpc. (12.6 V) |
| Full charge | 2.15 vpc. (12.9 V charger off 24 hours) |
| Starts to gas at | 2.3 vpc. (13.8 V) |
| Float setting | 2.2 vpc. (13.5 V) |

Equalize at 2.35 vpc (14.1 V) every 3 to 4 months for 8 to 24 hours.

Note: Lead calcium batteries generally do not need equalizing if they are never let below 2.2 vpc (13.2 V).

Typical Lead Antimony Voltages /Deep Cycle Batteries

| | |
|---|---|
| Starts to charge at | 2.05 vpc. (12.3 V) |
| Full charge | 2. 1 vpc. (12.6 V charger off 24. hours) |
| Starts to gas at | 2.2 vpc. (13.2 V) |
| Float setting | 2.2 vpc. (13.2 V) |

**NOTE** – Lead antimony batteries should be equalized every 2 months at 2.33 to 2.35 vpc (14.0 V) for 8 to 24 hours.

## Gel Filled Batteries

Generally of lead calcium design, gel batteries offer the combined capability of lead calcium and lead antimony batteries e.g. cranking and cycle ability. Further benefits are found in their potential long life and the fact that they are sealed to prevent hydrogen gas emissions. However, to protect the life and enjoy the benefits of expensive gel batteries, careful charging procedures must be adhered to.

Because all lead calcium grids have a tendency to heat up and grow in deep cycle applications, or when over charged, particular attention must be paid to the ambient temperature of gel batteries. As temperature increases, the charge voltage must be reduced. Remember, engine rooms heat up. Establish compromise voltages and check alternators. Please note, recharge voltages of more than 2.4 vpc can destroy some gel batteries in 16 hours or less when hot.

**Typical Gel Battery Voltages**

| | | |
|---|---|---|
| Starts to charge at | | 2.12 vpc. (12.72 V) |
| Fully charged at | | 2.15 vpc. (12.9 V charger off 24 hours) |
| Sealed to prevent gas emission. | | |
| Float voltage | @ 70 degrees F | 2.3 vpc. (13.8 V) |
| | @ 86 degrees F | 2.25 vpc. (13.5 V) |
| | @ 100 degrees F | 2.22 vpc. (13.3 V) |

At 70 degrees F, equalize at 2.35 vpc every 3 to 4 months for 8 hours.

## Charging Dead Batteries

Charge dead batteries at equalization voltage for 8 to 24 hours, then, re-set the charger to float voltage. Check the water level before and after charging. Do not overfill before charging as electrolyte will rise as charging begins. After a few hours, make sure that voltage is coming up on the battery and that it is indeed capable of taking a charge. Make sure the battery compartment is ventilated. **Never charge a frozen battery!**

## Multi-Bank Charging

Most Quality Marine chargers will charge up to 3 battery banks simultaneously. Remember, the charger can only be adjusted to one float voltage setting. The multi-bank outputs should not be used to charge banks where the batteries are of different design with different float requirements. Example: Gel or lead calcium starting batteries on one bank and lead antimony, deep cycle, house batteries on another.

Multi-bank charging is not recommended when one bank is used for heavy cycle service and the other not. No charger, using diode isolators to charge multi-banks, can totally eliminate some charging into a fully charged bank while charging a depleted one. Charging activity on the cycling bank will exercise the inactive banks and shorten their life. Load support to the primary service or house bank will be compromised by the fully charged banks. Avoid problems by asking your Quality Marine representative about paralleling banks.

## Battery Chargers and Noise

Battery chargers can generate noise in the form of electromagnetic interference (EMI), which is conducted throughout the ships wiring, or transmitted noise called radio frequency interference (RFI). Most noise will occur, or increase, at high end of the chargers output capability. When noise is being generated, it is disruptive to electronic equipment, e.g. radios, TVs, and stereos. To reduce EMI or RFI, observe the following guidelines.

1. Observe grounding instructions for the battery charger and all other equipment.
2. The battery bank itself is a good filter for noise. Never connect the charger to the panel or battery switch. Always connect the charger directly to the battery. The larger the battery bank, the less noise will be experienced. A good rule of thumb is to ensure the battery charger's maximum current output does not exceed 10% of the ampere hour rating of the battery bank. If a charger larger than 10% is needed to support the load, the capacity of the battery bank should be increased. Also, a bad cell, or bad battery in a bank, will result in more noise being passed across the bank.
3. Never bundle charging leads in with wire harnesses that lead to other areas of the boat or to the electronics. Make sure charging leads are adequately sized.
4. Consider the load requirement in amps, and provide a model of charger that does not have to work continuously at 100% to keep up.
5. Most wheel house electronics e.g. radars, sounders, etc. are, not, sensitive to charger noise. However, VHF, SSB, and stereo receivers are. The power leads of these types of equipment can be filtered. On large vessels, a common practice is to power radios with separate radio power supplies. In this case, switches can be provided to switch the radios back to the battery source in the event of an AC power failure.

## Electrolysis Protection

Quality Marine chargers are equipped with isolation transformers to protect against shock and AC electrolysis. Quality Marine chargers will not protect your boat from electrolysis caused by other devices.

## Customer Service

Quality Marine, LLC is proud of the products we provide to the marine market place and appreciate our customers. We will do our best to support you and resolve any problems or questions in an expedient manner.

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# Battery Charging, Things That Make a Difference

### - Keys to Long Battery Life -

**1. Voltage Regulation** – Quality Marine VM & ***VMI*** SCR battery chargers regulate to +/- 1% of the set float voltage across current output, even as line voltage varies +/- 10%, or frequency varies +/- 5%. At proper float voltage, Quality Marine's precise regulation minimizes battery water loss and grid corrosion, while maximizing battery life.

**2. Proper Setting of Float Voltage** – Quality Marine chargers are equipped with an adjustment for setting float voltage. They are delivered from testing at about 2.21 volts per cell (vpc) e.g. 13.3 volts on the 12 volt models. Consult the battery manufacturer on float voltage specifications, or see attached introduction to batteries and battery charging.

**3. Periodic Battery Cell Equalization** - The Quality Marine charger float voltage adjustment can be used to equalize batteries. This should ideally occur every 2 months. This adjustment can also be used when rapid charging is required. The ***VMI*** series charger has a built in Equalize timer in which a separate equalize voltage can be set independent of the float voltage setting. The equalize voltage will be maintained until the timer times out and the charger will return to the set float voltage.

**4. Sizing the Charger to Anticipated Load** – Quality Marine chargers are built to deliver 100% of their rated current to meet the load demand while maintaining the battery at a set float voltage. This ability prevents a battery discharge cycle and thereby increases battery life. Select a charger with a current rating at least 25% greater than the anticipated average load.

**5. Battery Maintenance** - Proper cable sizing, clean and tight connections, and battery water levels significantly add to battery life. Use distilled water.

**6. Multi-Bank Considerations** - No multi-bank charger can totally eliminate some charging into a fully charged bank when simultaneously connected to a cycling bank. A chargers output to a heavily used bank will be compromised when connected to a fully charged one. Do not apply multi-bank charging to batteries of different design, e.g. ni-cad, lead calcium or lead antimony deep cycle batteries.

**Appendix B**
**5-YEAR LIMITED WARRANTY POLICY**

Quality Marine, INC. warrants each ***VMI*** Battery Charger it manufactures, when properly applied and operated within specified conditions, against defects due to faulty materials or workmanship until 5 years after date of purchase on power transformers, and 12 months after date of purchase or 18 months after factory shipment which ever occurs first for all other electrical components. Quality Marine, INC shall provide all material and labor necessary at our factory to remedy a defective unit provided the buyer promptly notifies Quality Marine, INC of the defect, and the product is returned freight prepaid, to the factory. If Quality Marine, INC determines that a defect may be remedied by replacement of a defective part, replacement parts will be shipped via surface freight within 24 hours of Quality Marine's receipt of notice of defect. Equipment repaired under warranty shall be warranted for the unexpired portion of the warranty applying to the original date of sale.

Exception to this warranty is equipment that has been abused or operated outside the limits of its electrical or environmental specifications. When equipment failure or field tests suggest that the equipment may be defective, whether in or out of the warranty period, a full report of the difficulty should be telephoned to the customer support number listed below. The customer service department will issue a "RMA" number that must be referenced on any correspondence and discrepancy report accompanying the defective parts or equipment returned to the factory for repair.

Quality Marine, INC will not be liable for any associated costs or losses incurred by the user, installing contractor, or wholesaler as a direct or indirect result of defects or of the replacement of defective in-warranty material.

Any technical advice furnished by Quality Marine, INC before or after delivery in regard to use or application of Quality Marine's best judgment under the circumstances, but will not relieve the recipient from the terms of the warranty in case of negligent application of the equipment.

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