

PHASE THREE™

THREE STAGE SMART CHARGER

INSTALLATION/OPERATION MANUAL

**Model:
PT-7**



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M-PT7
As of APR 2003

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I) GENERAL INFORMATION

Your Phase Three Series Battery Charger represents a new phase in charger design and performance, employing "smart" switching circuitry which puts batteries through the optimum three-step charge process, adapts for gel-cell or lead-acid batteries, is rated for continuous duty and is housed in a rugged stainless steel case.

Following is a brief listing of some of the more important features/options of your Phase Three Charger. Each is fully detailed later in this manual:

- * **Three step "smart" charging: bulk, absorption, float**
- * **Gel cell/lead-acid switch selects optimum charge/float voltages based on battery type**
- * **Dual output banks charge independently based on demand**
- * **"Universal" 115/230V a.c., 50-60 Hz input—can be used anywhere in the world**
- * **Charger Status indicator light—changes color according to output**
- * **Current limiting prevents damage from overload**
- * **Load activated cooling fan allows continuous operation at full-rated output**
- * **Use as a power supply without in-line battery; allows continued use of d.c. powered electronics (when a.c. is available) in the event that batteries must be taken off-line or removed.**
- * **"Float" selector switch protects batteries when charging under continuous load**
- * **Rugged stainless steel case with drip shield**
- * **Carries the CE mark.**
- * **Ignition protected per USCG CFR 183.410**

In addition, your Phase Three Charger carries a full two year warranty against defects in materials or workmanship from the date of purchase. Careful attention to these instructions should help you to enjoy years of trouble-free service.

II) IMPORTANT SAFETY INSTRUCTIONS

1. **SAVE THESE INSTRUCTIONS** — This manual contains important safety and operating instructions for the Phase Three Battery Charger.
2. Before using this battery charger, read all instructions and cautionary markings on (1) the battery charger (2) the battery, and (3) any product powered by the battery.

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3. **CAUTION** — To reduce the risk of injury, charge only 6 cell lead-acid rechargeable batteries (flooded, AGM, gel or sealed). Other types of batteries may burst, causing personal injury and damage.
4. Do not expose charger to rain or spray.
5. Use of an attachment not recommended or sold by NEWMAR may result in a risk of fire, electric shock or injury to persons.
6. To reduce the risk of damage to the electric plug and cord (if plugged into an a.c. outlet), pull by plug rather than cord when disconnecting the charger.
7. Make sure the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
8. An extension cord should not be used. Use of an improper cord could result in a risk of fire and electric shock.
9. Do not operate the charger with a damaged cord or plug; replace them immediately.
10. Do not operate the charger if it has received a sharp blow, been dropped, or otherwise damaged; take it to a qualified serviceman.
11. Do not disassemble the charger; take it to a qualified serviceman when service or repair is necessary. Incorrect reassembly may result in a risk of electric shock and fire.
12. To reduce the risk of electric shock, disconnect the charger from a.c. source before attempting any maintenance or cleaning.

WARNING—RISK OF EXPLOSIVE GASES

1. WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON, IT IS OF UTMOST IMPORTANCE THAT BEFORE INSTALLING AND USING YOUR CHARGER, YOU READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EXACTLY.
2. To reduce the risk of battery explosion, follow these instructions and those published by the battery manufacturer and by the manufacturer of any equipment you intend to use in the vicinity of the battery. Review all cautionary markings on these products.

PERSONAL PRECAUTIONS

1. Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
2. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.



3. Wear complete eye protection and clothing protection. Avoid touching your eyes while working near a battery.
4. If battery acid contacts skin or clothing, wash immediately with soap and water. If battery acid enters the eye, immediately flood the eye with running cold water for at least 10 minutes and get medical attention immediately.
5. NEVER smoke or allow a spark or flame in the vicinity of the battery or engine.
6. Be extra cautious to reduce the risk of dropping a metal tool onto the battery. It might spark or short-circuit the battery or other electrical part and cause an explosion.
7. Remove personal metal items such as rings, bracelets, necklaces and watches when working with a lead-acid battery. A lead-acid battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
8. Use the battery charger for charging gel-cell, AGM or flooded lead-acid batteries only. Do not use the charger for charging dry-cell batteries that are commonly used with home appliances. These batteries may burst and cause injury to persons and damage to property.
9. NEVER charge a frozen battery.

PREPARING TO CHARGE

1. Be sure the area around the battery is well ventilated.
2. Clean battery terminals. Be careful to keep corrosion from coming in contact with eyes.
3. Add distilled water in each cell until battery acid reaches level specified by battery manufacturer. This helps purge excessive gas from cells. Do not overfill. For a battery without cell caps, carefully follow manufacturer's recharging instructions.
4. Study all battery manufacturer's specific precautions such as removing or not removing cell caps while charging and recommended rates of charge.

GROUNDING AND a.c. POWER CORD CONNECTION

1. The charger should be grounded to reduce the risk of electric shock.

(For marine applications only) EXTERNAL CONNECTIONS TO THE CHARGER SHALL COMPLY WITH UL RECOMMENDATIONS AND/OR UNITED STATES COAST GUARD ELECTRICAL REGULATIONS (33CFR183, SUB-PART I)

(For marine applications only) THE INSTALLATION AND PROTECTION OF VESSEL WIRING ASSOCIATED WITH BATTERY CHARGERS SHALL COMPLY WITH ABYC STANDARDS; E-8) AC ELECTRICAL SYSTEMS ON BOATS, E-9) DC ELECTRICAL SYSTEMS ON BOATS, AND A-20) BATTERY CHARGING DEVICES.

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III) INSTALLATION

A) Materials Provided

The PT-7 charger is provided completely assembled and ready for installation. The installer must provide mounting hardware, as well as d.c. output wiring and connectors. Proper sizes and gauges for the hardware, wire and connectors are noted in sections C and D following. A warranty registration/customer satisfaction card has been included in the packaging. Upon completion of the installation, please fill out this card and return it to the factory. You will be contacted promptly if you have any problems with or questions about your Phase Three charger.

B) Location

The charger should be mounted on a wall, bulkhead or other suitable mounting surface as close to the batteries to be charged as possible. Do not mount the charger directly over the batteries as battery fumes may cause excessive corrosion. The charger is ignition protected so it is acceptable to locate the unit in an area where ignition protected equipment is required. The area should be well ventilated and free from excessive moisture, exhaust manifolds and battery fumes.

Vertical mounting is preferred. However, horizontal mounting is acceptable where absolutely necessary. *Do not mount the charger where water, spray or condensation can occur, as this will shorten charger life.* It should not be located where there is a possibility of dust or debris being drawn into the unit through the fan. A minimum of 2" clearance around the charger is recommended for proper cooling.

If the charger is located in an extreme heat area, such as an unventilated engine room, and maximum operating temperature is exceeded, an automatic thermal protection circuit will shut the charger off. Although it will return to service automatically after cooling sufficiently, thermal cycling will shorten the life of the charger. If this condition occurs repeatedly, the charger should be relocated. For optimum performance and longer life the charger should not be located in an area of extreme high temperature.

C) Mounting

The charger may be mounted on either a metal or non-metal surface*.

**Per ABYC A-20: A d.c. chassis grounding conductor shall be connected from the case of the battery charger to the engine negative terminal or its bus, and must not be more than one size under that required for the d.c. current-carrying conductors, and not less than 16 AWG.*

Four # 10 screws (wood or machine screws, depending on mounting surface) with washers, are required to mount the charger.

IMPORTANT: Although the charger is constructed of materials and in a manner which makes it highly resistive to the corrosive effects of moisture in the environ-



ment, the charger is not waterproof. Do not mount the charger where there is a possibility of water entering the unit. Evidence of water entry into the charger will void the warranty.

D) d.c. Output Wiring

Note: Only qualified service personnel should access the output terminals of the charger.

The installer must provide output wires for attaching the charger to the battery. Use the table below to determine the correct gauge wire, based on the length of the wire run from the charger to the batteries.

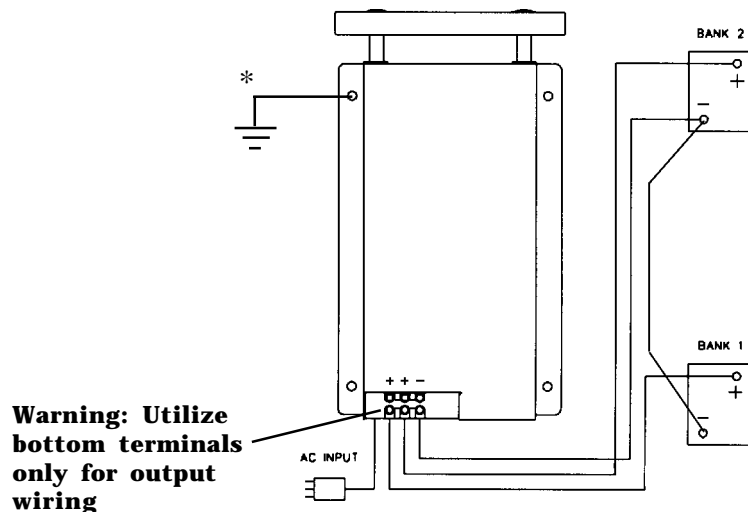
<u>Length of Wire from Charger to Batteries (in feet)</u>		
10'	15'	20'
<u>Minimum Wire Gauge AWG</u>		
#14	#12	#10

**Based on N.E.C. Minimum Wire Size Chart and ABYC 3% Voltage Drop Chart*

ENSURE THAT LEADS ARE PROPERLY FUSED AT THE BATTERY. (REFER TO ABYC RECOMMENDATIONS.)

Typical d.c. wiring configurations are illustrated in FIGURES 1 and 2.

FIGURE 1: Simple d.c. Wiring (Preferred Method)



Note: This diagram does not illustrate a complete system. Refer to ABYC Standards E-8) AC Electrical Systems on Boats, E-9) DC Electrical Systems on Boats and A-20) Battery Charging Devices

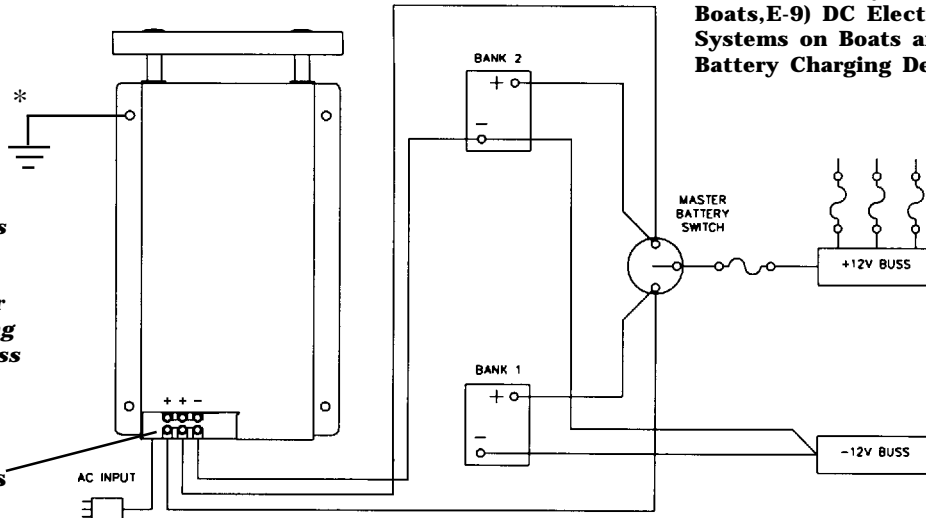
***Per ABYC A-20: A d.c. chassis grounding conductor shall be connected from the case of the battery charger to the engine negative terminal or its bus, and must not be more than one size under that required for the d.c. current-carrying conductors, and not less than 16 AWG.**

IMPORTANT: Install fuses at batteries per ABYC recommendations.

FIGURE 2: Wiring With Battery Switch

**Per ABYC A-20: A d.c. chassis grounding conductor shall be connected from the case of the battery charger to the engine negative terminal or its bus, and must not be more than one size under that required for the d.c. current-carrying conductors, and not less than 16 AWG.*

Warning: Utilize bottom terminals only for output wiring



Note: This diagram does not illustrate a complete system. Refer to ABYC Standards E-8) AC Electrical Systems on Boats, E-9) DC Electrical Systems on Boats and A-20) Battery Charging Devices

An Important Note about the DC Output Fuse: DC output wiring is protected by an externally mounted ATC blade-type output fuse. The fuseholder is located on the bottom of the unit. To remove the fuse for checking or replacing simply pinch the fuse between thumb and forefinger and pull firmly downward.

The current limiting circuit of the Phase Three charger should prevent the fuse from blowing under normal operating conditions. If the fuse blows, this may indicate a reverse polarity hook-up or an internal short. If the battery is connected to the charger backwards, the fuse should blow to prevent a dangerous short circuit, however damage to the internal components is possible, as well. If, after replacing this fuse, it blows again upon application of power, return the charger to an electronics service professional or to the factory for a thorough inspection.

Always replace the fuse with another of the same type and value: ATC 10 amp.

E) a.c. Input Wiring/Voltage Selection

For the convenience of the installer an a.c. power cord has been factory installed. It is a three-conductor stranded type, 18 AWG. The cord is terminated with a plug suitable for standard USA outlets and uses standard USA color coding of conductors (see page following).

The PT-7 operates within a "universal" range of 82-132 or 176-264V a.c., 47-63 Hz input. Input voltage selection is made via a slide switch on the bottom of the charger. It is factory set for 115V. For 230V a.c. applications use a ball point pen or similar tool to slide the switch into the 230V position.



a.c. input for the charger must be routed through a fuse or circuit breaker on an a.c. distribution panel with proper safety/earth chassis ground in accordance with all applicable local codes and ordinances.

Color coding of the installed a.c. cord is as follows:

- Black.....a.c. Hot (fused)
- White.....a.c. Neutral
- Green.....a.c. Ground (safety, earth)

If the plug on the factory-installed cord is unsuitable for the available outlet it may be cut off and replaced. Pay careful attention to color coding of the wires as noted above. *Do not attempt to replace the entire cord by removing the charger cover. Evidence of entry into the charger will void the warranty.*

(In marine applications) All charger wiring should be installed in accordance with UL, U.S. Coast Guard and/or A.B.Y.C. regulations and recommendations, as well as all relevant local codes. See REFERENCE APPENDIX at the end of this manual for sources.

A note about the a.c. input fuse: The a.c. input of your charger is protected by an input fuse which is located inside the unit. Due to the current limiting characteristic of the charger, it is highly unlikely that this fuse will blow unless there is some other malfunction within the charger. This fuse is not user-replaceable. Contact the factory if you suspect a blown input fuse. (See Troubleshooting section.)

F) Setting the Gel-Cell — Flooded/AGM Switch

According to most battery manufacturers, the ideal charge regimen for gel-cell and flooded (wet) lead-acid or AGM (Absorbed Glass Mat) batteries differs somewhat.

The gelled electrolyte in a sealed battery may be lost or damaged by high voltage and, once lost, cannot be replaced as it can with a wet lead acid battery. Manufacturers of gel-cells usually recommend an ideal charge voltage which is slightly lower for a gel-cell than a lead-acid battery. (The charge regimen recommended for AGM batteries is typically similar to that of flooded lead-acid batteries.)

However, when the charger is in the float voltage mode over lengthier periods of time, gelled electrolyte in a sealed battery is not susceptible to evaporation, as is the non-immobilized electrolyte of a wet lead acid battery. This evaporation can be accelerated by the applied voltage. Consequently, the ideal float voltage is slightly higher for a gel-cell than a lead-acid or AGM battery.

The ideal charge/float regimen has been programmed into the Phase Three Charger for either sealed gel-cell or flooded lead-acid/AGM batteries. Simply make the proper selection for your battery type via the slide switch on the front of the charger, prior to turning the unit on.

Note: A wide variety of batteries are now available which do not conform to conventional



descriptions as "gel-cell" or "lead-acid". You are advised to consult the manufacturer of your particular battery as to proper charging regimen, and use the battery type selection switch setting which most closely conforms to the recommended voltages.

See the **SPECIFICATIONS** section for the actual preset charge and float voltages for each model.

IV) OPERATION

A) Three Stage Charge Regimen

The Phase Three Battery Charger utilizes the three stage charge regimen which is widely recommended by battery manufacturers for allowing the fastest possible recharge time without loss of batteries' electrolyte (gel or liquid) which may be caused by sustained charging at higher voltages.

This three stage regimen is initiated each time a.c. is first applied, when drained batteries are most likely to be encountered, and proceeds slowly or quickly through each stage depending on the battery's relative state of charge.

Note: The Charge Cycle Select switch on the front panel must be in the "Charge" position for the three stage cycle to occur. In the "Float" position, the charger will have a fixed output voltage which depends on the setting of the Battery Type Selector. (See Specifications section for output voltages. See also the warning about the switch setting at the end of this section.)

During the first two stages (referred to collectively as the "Charge" stage) the indicator light on the front panel will glow red. When charging is complete and the charger has switched to the "Float" stage, the indicator will glow green.

The charge regimen proceeds as follows:

1) Bulk Phase: When batteries are significantly discharged the charger responds initially by delivering a high amount of d.c. current, at or near the charger's maximum rated output, in order to rapidly replenish them. It is during this stage that charging current is maintained at a high level as battery voltage increases. Bulk charging continues until battery voltage reaches the "charge" voltage level (where batteries are at about 75-80% of capacity). At this point the charger switches to the second stage.

2) Absorption Phase: During this second stage of the charge cycle, battery voltage is maintained at the "charge" voltage level. Output current begins to taper off as the battery plates become saturated. Charge voltage is maintained until the current sensing circuit detects that output current has tapered to about 5-15 % of charger rating. At this point the batteries are at about 95 % of full charge and the Phase Three charger switches to the third and final stage of the charge cycle.

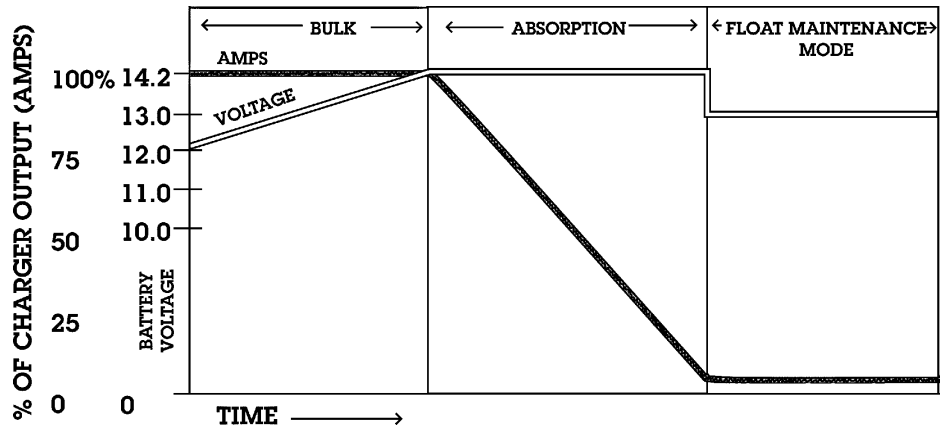
3) Float Phase: For extended battery life the Phase Three then automatically switches to a lower float voltage level. This float charge keeps batteries at peak condition without



overcharging. The charger may be left in this stage for lengthy periods of time without attention (though periodic checks of electrolyte level in flooded batteries is recommended). It is not necessary or recommended to shut the charger off when this stage is reached.

A typical three stage charging cycle is illustrated in FIGURE 3.

FIGURE 3: Typical Charger Output Graph (into battery without load)



A WARNING ABOUT THE CHARGE CYCLE SELECT SWITCH: Whenever a load of approximately 3 amps or more is applied, the charger will go into the elevated voltage "Charge" mode, as indicated by the glowing red indicator on the front panel. (See specifications for actual charge/float voltages.) Battery electrolyte may be damaged or lost by extended exposure to this higher voltage. If there is a d.c. load on the battery system of 3 amps or more for periods lasting 8 hours or more, it is **strongly recommended** that the Charge Cycle Select switch on the front panel be placed in the "Float" position.

B) Start Up

1) Before powering up your charger, check for tight electrical connections to each battery in your system. Switch off any d.c. loads on the batteries. Apply a.c. power. Observe the Charger Status indicator on the front panel. If it glows red and stays red for a while, it is an indication that the batteries are in a relatively low state of charge. The charger, sensing this, is supplying high current to the batteries. If the indicator glows red briefly, then switches to green it is an indication that the batteries are at or nearing full charge, and the charger has switched to the "Float" (maintenance) mode.

2) After the indicator has switched to green, apply a load to the charger by switching on some lights, a pump or some other d.c. appliance. Observe the indicator. As current is demanded from the battery system, the charger will automatically increase its output in response to the increased load demand and the charger will switch to the higher current (and higher voltage) "Charge" mode. As long as the load current exceeds approxi-

mately 3 amps, the charger will remain in the charge mode (unless the Charge Cycle Select switch is put into the "Float" position).

C) Constant Versus Occasional Use

In general, it is recommended that the charger be left connected continuously to the a.c. distribution system so that it will be in operation whenever a.c. is available. This will maintain batteries at peak voltage and will automatically compensate for the natural self-discharge of the battery system. When a load is applied to the battery system the charger's output will automatically increase to supply the current which would otherwise draw battery voltage down. **Repeatedly allowing batteries to become completely discharged before recharging will greatly shorten their life. Leaving the charger on continuously will prevent this.**

While the output regulation of the charger will minimize battery gassing and water loss, monthly checks of the electrolyte level (for wet lead acid batteries) are still strongly recommended. Some water loss is an inevitable aspect of the charging process, and maintaining the correct electrolyte level in your batteries is the most important thing you can do to assure their maximum performance and long life.

D) Proper Load Sizing

The PT-7 is rated for continuous duty at 7 amps. While the charger cannot be damaged by overloads that exceed this continuous rating, excessive load demands may draw battery voltage down faster than the charger can resupply it. If battery voltage continues to drop and the output current is at maximum while the charger is in service, check to see that your average d.c. loads are not exceeding the charger's rated output.

E) Operation With Engine

It is perfectly acceptable to allow the charger to remain on when the engine is started and while it is running. The current limit feature of the Phase Three Charger will protect against any damage due to the high current demands of engine cranking. Output diodes will prevent any back-feed of current into the charger from the alternator while the engine runs.

As the alternator starts to charge the battery, the charger output will decrease. When the battery voltage exceeds the rated output voltage of the charger it will shut off and stay off as long as the batteries are in this high state of charge. If the battery voltage should drop below the charger's rated output voltage it will automatically return to service.

E) Operation as a d.c. Power Supply (stand-alone d.c. power source)

Most battery chargers are not suitable for powering electronic devices directly, without a battery attached to the output, as the high ripple and pulsing d.c. output (i.e., rectified a.c. output) can interfere with the operation of the device. However, the PT-7 employs a

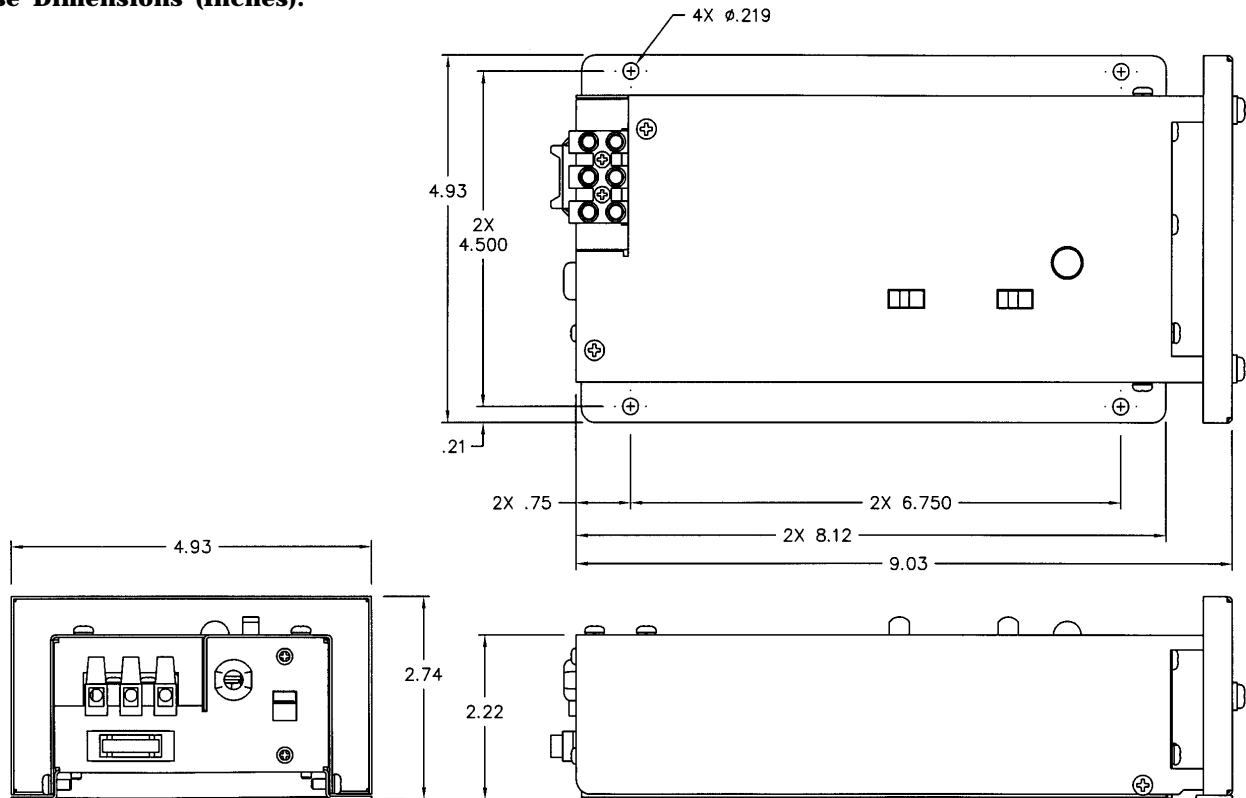
circuit that produces an extremely well-filtered d.c. output. Therefore it is able to power virtually any d.c. powered device (within the unit's rating) without the battery attached in-line (if, for instance, the battery must be removed for any purpose and a.c. is still available). All but the most sensitive d.c. powered electronic devices will function as normally as if powered by a battery. When using the PT-7 as a regulated power supply without battery in-line, place the Charger Cycle select switch in the "FLOAT" position for maximum regulation.

V) SPECIFICATIONS

Model: PT-7
Input VAC (50-60 Hz.): 82-132 or 164-264
Input Amps @ Full Load:
 @ 115 VAC 2
 @ 230 VAC 1
Output Voltage (Nominal VDC): 12
Output Amps (Continuous): 7
Output Banks: 2
Battery Capacity (Amp-Hours): 14-70
Weight (Lbs./Kg.): 3.2/1.5
Compliances: Ignition protected per USCG CFR 183.410, Carries the CE Mark
Temperature Rating: -10°C to +60°C; Derate linearly from 100% @ 50°C to 60% @ 60°C
Nominal Output Voltages at Gel/Flooded Switch Settings:

	Charge	Float
Setting @ 50 % load @ .5 amp load		
Flooded/AGM	14.0-14.2V d.c.	13.4V d.c.
Gel-Cell	13.8-14.0V d.c.	13.6V d.c.

Protection: Input/Output Fuses, Current Limiting, Thermal Protection, Forced Air Cooling, Drip Shield
Case Dimensions (Inches):



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VI) TROUBLESHOOTING

Note: The PT-7 charger incorporates a self-contained a.c. to d.c. conversion module which utilizes numerous automatic protection circuits. The a.c. input fuse which protects internal wiring is housed inside the charger with the module. Under most circumstances the fuse will fail only if the charger has an internal fault. Hence, it is not intended to be user-replaceable and any condition which has caused a blown a.c. fuse will likely require repair of other internal circuitry by a qualified technician. If an apparent charger fault cannot be corrected using any of the recommendations in this section, the charger should be returned to the factory or place of purchase for inspection and repair or replacement.

<u>PROBLEM</u>	<u>POSSIBLE CAUSE</u>	<u>SOLUTION</u>
A. Batteries not coming up to full charge	1. Extremely discharged batteries requiring long re-charge time 2. Charger limiting its output due to overload or over-temperature conditions	1. Turn off all d.c. loads and allow charger 24-48 hours to recharge batteries 2. Reduce d.c. load and/or determine cause of over-temperature condition (see section III-B, Location)
B. Charger continues to charge at 3 amps or more—does not taper back	1. d.c. load connected to batteries drawing current (not a problem condition) 2. Bad cell in one of the batteries to which the charger is connected	1. Turn off main battery switch to d.c. electrical panel or turn off all d.c. loads if you wish to confirm charger will output minimal amperage to fully charged batteries 2. Check for shorted cell in wet lead-acid batteries using a hydrometer. Refer to manufacturer for testing maintenance-free batteries
C. No charger output, even when all connections have been checked, a.c. is applied to the charger, and d.c. load is applied to the batteries	Blown input fuse or other internal defect	Return to servicing dealer for failure analysis or contact NEWMAR for Return Authorization Number



D. Reverse polarity connection has caused charger to have no output

d.c. output fuse and other internal components likely blown

Replace output fuse with like type and value. If still no output, return to servicing dealer for failure analysis or contact NEWMAR for Return Authorization Number

E. High voltage measured across charger output terminals

Batteries not connected to charger. It is normal to read 1/2 volt higher across any output bank when no batteries are connected.

Check for tight connection of charging leads to batteries

Factory Contact Information

If a problem with your charger persists after you have applied the above-outlined solutions, or if you have any questions about the installation and proper operation of your charger, please contact NEWMAR's Technical Services Manager:

Phone: 714-751-0488 — From the hours of 7:00 A.M. to 4:30 P.M. weekdays, P.S.T.

Fax: 714-957-1621 — Anytime

E-Mail: techservice@newmarpower.com — Anytime

We will be happy to consult with you to resolve any problem you may have. If it appears the charger must be returned to the factory for repair we will issue a Return Materials Authorization at that time.



VII) BATTERY CARE TIPS

Regular maintenance and proper care will assure you reliable service from the most depended upon and sometimes most neglected items, your batteries and battery charger. NEWMAR battery chargers are designed to keep your batteries fully charged but your batteries also need proper regular maintenance to provide a maximum life of service.

ALWAYS READ AND FOLLOW THE BATTERY MANUFACTURER'S INSTRUCTIONS

Battery Installation

Batteries must be securely mounted to prevent them from falling over when the vehicle or boat is in motion. A loose battery can do serious damage. Batteries should be mounted in a battery box to contain any acid spill. Batteries give off a certain amount of hydrogen gas when they are charging. When concentrated, this gas is highly explosive. Therefore make sure they are in an accessible place with adequate ventilation for any hydrogen gas discharge.

Cleaning Batteries

Dirt and electrolyte salts can build up on the top of your batteries. This accumulation conducts electricity stored in the battery and can cause the battery to discharge by itself. Therefore, at least twice a year, it is a good idea to disconnect the battery cables and scrub the battery with a baking soda solution. Rinse with fresh water and dry with a clean cloth.

You may wish to purchase a set of terminal post corrosion prevention rings. These are alkali-saturated felt rings that slip over the battery post to reduce corrosion. Do not apply grease to any part of the battery terminals, but you may use an occasional light spray of silicone lubricant.

Routine Checks and Maintenance

Batteries should periodically be "exercised" (slowly discharged and then recharged) to keep them in top condition. New batteries may need to be exercised before they will be capable of their full rating.

If your batteries are not the sealed type, distilled water should be added to them whenever needed. The electrolyte should cover the plates by about 1/2", allowing a small air space at the top. Do not fill the cells up to the filler cap as this could cause the battery to sputter out electrolyte when it is being charged. Only distilled water should be used never plain tap water. Tap water contains chemicals and elements that can alter the properties of the electrolyte, including specific gravity. Some chemicals may also create an insulating coating on the battery plates which will retard current flow.

The rate that water is lost by the battery is dependent on several factors; battery condition, ambient temperature, battery use, charge voltage, etc. It is normal for batteries



which are not maintenance-free to require topping off about once a month.

A battery's state of charge may be monitored by checking the specific gravity or by open circuit voltage. You may use the following table to evaluate the condition of your batteries:

Battery Condition Table

Specific Gravity Measured by Hydrometer	Open Circuit Voltage	State of Discharge @ 80° F
	12 Volt System	
1.265	12.6 or more	Fully Charged
1.225	12.4	25 % Discharged
1.190	12.2	50 % Discharged
1.155	12.0	75 % Discharged
1.120	11.7 or less	100 % Discharged

** Note: Wait at least 5 minutes after charging or discharging before checking specific gravity or open circuit voltage. The battery's voltage needs to stabilize in order to get an accurate reading.*

Troubleshooting Your Battery System

If your battery will not accept or hold a charge, one of the following conditions may exist:

1. **A BAD BATTERY.** You may have a battery with an open or shorted cell, a battery without any "life" left. Check by charging the battery until all cells have a specific gravity of 1.225 or greater at 80° F. If you are unable to obtain 1.225 in each cell, replace the battery.

2. **A BAD BATTERY CHARGER.** If the battery open circuit voltage is low and/or the hydrometer indicates your batteries are low, the battery charger should be providing current to the batteries. If it is not, check the input fuse and check to see that you have charging voltage on the output with no battery attached. *Note: You will not get an accurate voltage reading on the output of the charger with no batteries attached. This is checked merely to ensure that you do not have an open circuit on the output.*

The battery charger has a thermal power reduction circuit to protect the charger from overheating. If you suspect this is the case, refer to the INSTALLATION section for information about proper charger location.

3. **ELECTRICAL LEAKAGE.** You may have a previously unsuspected source of current drain from the battery. To check for a leakage of this sort, disconnect the battery ground cable and connect an ammeter between the negative battery post and ground. If



you have a reading over .1 amp, there is a source of current drain from the batteries which must be located and removed.

VIII) REFERENCE APPENDIX

* For more information about boat wiring to conform to U.S. Coast Guard regulations, write:

Superintendent of Documents
Government Printing Office
Washington, DC 20402

Request : 33 CFR 183 Subpart I

* For information about American Boat and Yacht Council recommendations for boat wiring, write to:

American Boat and Yacht Council
3069 Soloman's Island Road
Edgewater, MD 21037

Request: Standards and Recommended Practices for Small Craft.
AC systems: Section E8
DC systems: Section E9
A-20: Battery Charging Devices

* For additional installation instructions, refer to:
ANSI NFPA 302

