

INTERIM
INSTRUCTION MANUAL

A L P H A S E V E N T Y

HF LINEAR POWER AMPLIFIER
(Model PA70-V)

IMPORTANT !!

BEFORE APPLYING POWER IT IS ABSOLUTELY ESSENTIAL TO READ
AND OBSERVE CLOSELY ALL INSTALLATION AND OPERATING
INSTRUCTIONS IN THIS MANUAL.

THE ALPHA SEVENTY DIFFERS IN IMPORTANT RESPECTS FROM
OTHER AMPLIFIERS.

POSSIBLE SERIOUS DAMAGE TO THE EQUIPMENT WHICH MAY RESULT
FROM FAILURE TO COMPLY WITH ALL INSTALLATION AND OPERATING
INSTRUCTIONS HEREIN WILL NOT BE COVERED BY WARRANTY!

STANDARD WARRANTY

Ehrhorn Technological Operations, Inc. (ETO) warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use, and service discloses such defect, provided the unit is delivered by the owner to us or to our authorized radio dealer or wholesaler from whom purchased, intact, for our examination, with all transportation charges prepaid to our factory, within ninety days from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective. Should a malfunction be suspected, write in detail to our Service Department for suggestions concerning the operation, repair or return of your unit if it should prove necessary.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside our factory, nor in cases where the serial number thereof has been removed, defaced or changed, nor to units used with accessories not manufactured or recommended by us, nor to the high powered transmitting tubes.

The high powered transmitting tubes are warranted by their manufacturer and the warranty is administered by ETO.

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products.

ETO reserves the right to make any improvements to its products which it may deem desirable without obligating itself to install such improvements in its previously manufactured products.

NOTE: Do not under any circumstances return equipment to ETO without receiving explicit authorization for such return from us in advance. Shipment of ETO equipment in other than approved factory packing will void this warranty.

SECTION 1

DESCRIPTION AND SPECIFICATIONS

The ALPHA SEVENTY (Model PA70-V) is a high power linear amplifier incorporating major advances in design and construction. Completely self contained in a desk top cabinet, the ALPHA SEVENTY is rated for continuous single sideband operation at power levels to 3 KW PEP, continuous carrier operation (such as FSK) at levels to 1.25 KW, and continuous CW operation (50% duty cycle) at key-down inputs to 2.5 KW.

The ALPHA SEVENTY utilizes a rugged EIMAC 3CV1500A7 ceramic-metal tube in a grounded grid configuration. The unique vapor phase cooling system used with the 3CV1500A7 provides high continuous power capability, and exceptionally long tube life results from a much lower tube operating temperature than conventional air-cooled systems. Vapor cooling does not generate the annoying high level of acoustic noise which characterizes air-cooled systems.

Optimum plate circuit operating conditions are maintained throughout the amplifier's tuning range, and a large margin of safety and compact size are permitted, by the use of a vacuum variable plate tuning capacitor. A unique power transformer, utilizing a core of tape-wound Silectron steel, makes possible the high power capability of the ALPHA SEVENTY in an extremely compact desk top package. The rugged solid state bridge rectifier and 25 microfarad oil filled capacitor provide excellent filtering and dynamic regulation of plate voltage, thus insuring that the excellent linearity capabilities of the 3CV1500A7 tube are realized.

GENERAL SPECIFICATIONS

Frequency Coverage: 3 to 30 Mhz continuous in six ranges, with provision for later installation of low frequency extension kits.

Plate Power Input: "SSB" position - 3 KW PEP SSB voice continuous duty; 2.5 KW carrier (A-1, etc.) with 50% maximum duty cycle, repetitive continuous key-down periods not to exceed 15 seconds. "CW" position - 1.5 KW PEP or 1.25 KW carrier, any mode, continuous duty.

Drive Requirements: 50 watts nominal for one KW input; 100 watts nominal for 2.5 KW plate input.

Linearity: Third order products more than 30 DB below each of two equal test tones at 2.5 KW PEP input.

Input and Output Impedance: Nominal 50 ohms resistive, SWR not to exceed 2:1. Note: Cathode input circuits are pretuned for amateur band operation, may be retuned if desired for operation

at other frequencies. A slide switch on the RF deck may be used to disconnect the input tuned circuits, permitting operation from 3-30 Mhz without adjustment of input tuning.

Primary Power Requirements: 115 or 230 volts, 60 hertz, 3 wire single phase a-c; approximately 15 amperes at maximum rated input with 230 volts primary source. Peak current requirement from a 115 volt source is approximately 30 amperes, and operation on 115 volts is not recommended unless an exceptionally well regulated source capable of supplying this current is available. A power cable no smaller than two conductors of #12 AWG plus ground wire should be used. ETO can supply such a cable on special order.

Size: Self-contained in a single desk-top cabinet 9½" high x 17" wide x 18" deep.

Weight: 70 lbs. (shipping weight 92 lbs.)

SECTION 2

INSTALLATION

1. Unpacking: Remove steel straps and open flaps on un-stapled end of outer carton. Remove inner carton from foam liner and set it on a flat surface with the side labeled "top" upward. Open the flaps on the marked end and very carefully work the amplifier out of the carton. Save all packing material for re-use, as any shipment of the amplifier in other than original factory packing will void the warranty. Inspect the amplifier for damage; notify the transportation company if damage is evident. Be sure to check packing material to insure that no accessory items are discarded. Complete and mail the warranty registration immediately.
2. Physical Placement: The ALPHA SEVENTY must be operated in a level horizontal position, so located as to allow free air circulation behind the rear panel. Under no circumstances should the back of the amplifier be placed less than six inches from any wall or other object, since reduction of air flow during operation can cause abnormal internal temperatures. Should such a situation accidentally occur, thermostatic protection is incorporated to switch the amplifier off until its temperature returns to normal, at which time power is automatically restored. In such an event, immediate action must be taken to assure free air flow or to eliminate any other possible cause of overheating.

Should the amplifier require positioning for internal access to the bottom, this may be accomplished without draining of coolant by placing it carefully on its side, power supply down. Placing the amplifier in any other position may result in leakage of coolant.

3. Filling with Coolant: The ALPHA SEVENTY MUST BE PROPERLY FILLED WITH COOLANT BEFORE ANY POWER IS APPLIED! It requires approximately one pint of coolant water, which must be either the "distilled" or "purified" type sold by nearly all drug stores and many food markets. DO NOT USE TAP WATER, RAIN WATER, OR CONDENSATE COLLECTED FROM A REFRIGERATOR OR AIR CONDITIONER! (Suitably pure water should show a resistance of approximately 100,000 to 500,000 ohms when two ohmmeter probes are placed in it one inch apart).

The amplifier top cover is held in place by a single Phillips head screw at the center of its rear lip; remove this screw and carefully slide the cover off. Remove any caps or plugs from the tops of the two copper vent tubes near the left rear corner of the RF section. Exercise caution to avoid dropping any foreign material into either vent, as to do so will contaminate the cooling system. The amplifier is drained of coolant water before shipment and the vent tubes are capped to prevent escape of residual moisture into the chassis area; if however moisture is

visible in the RF or power supply area it should be absorbed carefully with a small sponge before placing the amplifier in operation. (In the event that excessive water is present in the amplifier due to improper draining and/or shipment, refer to the "TROUBLE SHOOTING HINTS" section for the proper procedure to be followed.)

With the amplifier sitting level, remove the cap from the filler pipe at the left rear corner and slowly pour pure water into the top of the pipe. As the water in the internal reservoir approaches normal operating level, the level will also rise in the filler pipe. Add water until its level is even with the black line on the rear wall of the amplifier immediately in front of the filler pipe. This level varies slightly from unit to unit, but is typically between 1/8" and 1/4" below the top of the filler pipe. DO NOT OVER-FILL as this will result in ejection of water through the internal vent during operation. Reinstall the brass cap on the filler pipe.

4. Electrical Installation:

AC Power - The ALPHA SEVENTY requires a 110-125 or 220-250 volt, 60 hertz, three wire, single phase power source. Service wiring should be sufficiently heavy to avoid excessive voltage drop; a three wire 230 volt #10 or #12 service with 20 ampere fuses or circuit breakers is recommended. Install a suitable plug on the power cable. If 115 volt primary power must be used, the service wiring should be no smaller than #10, with fuses or circuit breakers no smaller than 30 amperes and the power cable supplied with the ALPHA SEVENTY should be replaced by a special 115 volt cable with #12 AWG copper conductors. A special power cable for this purpose is available from ETO on special order. Install a suitable plug on the power cable to be used, making certain that the green wire is connected to neutral in the case of a 230 volt service, or to the ground connection in the case of a 115 volt service.

RF OUT - Connect antenna or dummy load to the RF OUT receptacle using a standard PL-259 (UHF-type) plug. DO NOT OPERATE THE ALPHA SEVENTY AT ANY TIME WITHOUT A SUITABLE MATCHED LOAD, AS DOING SO MAY CAUSE SERIOUS DAMAGE WHICH WILL VOID THE WARRANTY.

RF IN - This receptacle must be connected through RG-58/U or equivalent coaxial cable to the output of the exciter or transceiver. A standard BNC plug is required. (ETO can supply an RG-58/U cable with a BNC plug on one end and BNC, UHF/PL-259, or phono-type plug on the other end, on special order). When the ALPHA SEVENTY is off or in standby condition (CW or SSB button pushed and relay circuit open) the load is fed through to the RF IN receptacle, permitting conventional interconnection and T/R operation with all popular transceiver and transmitter-receiver combinations.

RLY - Except in the break-in mode, an external circuit closure is required on transmit to activate the internal changeover relays. The open circuit voltage on this jack is approximately 70 VDC, and the short circuit current is approximately 60 MADC.

ALC - The ALPHA SEVENTY provides a source of control voltages for exciters and transceivers equipped with external ALC input connectors, which may be used to maintain transmitter input at a desired peak level. ALC threshold is adjustable by means of a screwdriver-adjust control located adjacent to the AUXILIARY connector on the rear of the ALPHA SEVENTY.

RCVR ANT - The output of the built-in electronic T/R switch is available at this jack to provide signal input to a receiver whenever the internal T/R relays are locked in the transmit position, such as in the BK-IN mode. With this arrangement, full CW break-in operation is possible near the transmitting frequency without the use of external keying relay connections.

AUXILIARY - This connector is provided for possible future addition of special accessory equipment and is not used in normal operation.

FREQ	LOAD CONTROL	TUNE CONTROL
(10 METERS) 28.6 MHZ	75	218
(15 METERS) 21.3 MHZ	64	199
(20 METERS) 14.2 MHZ	54	190
(40 METERS) 7.2 MHZ	53	179
(80 METERS) 3.8 MHZ	45	124
(160 METERS BAND A 1.9MHZ)	73	076
(160 METERS BAND B 1.8MHZ)	62	048

SECTION 3

OPERATION

1. Control Functions:

a. Mode Push-Button: The four buttons to the right of the PLATE CURRENT meter control power on-off and operational mode selection.

OFF: Fully depressing this button removes all a-c power. The button is illuminated red whenever any of the power interlocks are open, including the lid interlock switch, the tube anode over-temperature thermostat, or the plate over-current relay. Note: When all four buttons of this switch are in the "out" position (accomplished by partially depressing any one button momentarily) the OFF button remains illuminated and only the fan operates.

BK-IN: Sets up the amplifier for operation at power levels in the 1-1.5KW range; normally used for CW, FSK, or medium power SSB operation. T/R relays are locked in the transmit position, and a receiver antenna input is provided through the RCVR ANT jack.

✓ CW: Sets up amplifier as above for CW, FSK, or SSB operation at 1-1.5 KW with normal T/R relay operation (i.e., an external contact closure is required to activate relays.)

✓ SSB: Sets up amplifier operating conditions for SSB (or other mode) at peak input levels of 2-3 KW. T/R relay operation is normal, requiring an external contact closure on transmit.

b. METER Push-Buttons: These four buttons switch the multi-meter to read high voltage (HV-5000 VDC full scale), grid current (GRID-500 MADC full scale), forward RF power (FWD-5KW full scale, read on the red meter scale), and reflected RF power (REFL-500 watts full scale on the red scale). When all four buttons are out, the meter reads d-c leakage current (5 MA full scale), which is an indication of cooling water purity or contamination.

c. LOAD: This knob controls plate loading, which is minimum (corresponding to maximum capacitance) when set at or near zero dial reading, and maximum at the high-numbered end of the scale. Clockwise rotation increases loading.

d. TUNE: The counter dial controls the vacuum variable plate tuning capacitor. Maximum capacitance occurs at full counter-clockwise rotation, corresponding to a counter reading of approximately 0.

e. BAND: In any given bandswitch position, the approximate tuning range available is indicated on the skirt of the dial in Mhz. Thus the 20 meter amateur band - 14 Mhz - is covered in the 12 - 18 position.

f. COOLANT - LEV and LKG: Two warning lights are provided to indicate abnormal conditions in the cooling system. The LKG lamp will light only when contamination of the cooling water is excessive (1 Ma or more), indicating that the system should be drained promptly and refilled with fresh, purified or distilled water. This condition may be confirmed using the multimeter as described in (b) above.

The LEV lamp indicates low water level when illuminated steadily; it will also light (and flicker with modulation) when the water in the cooling system is extremely clean so that leakage is less than 200 microamperes, as when freshly filled. Only when this lamp remains on continuously and brightly after having been off for many hours of operating time is it a probable indication of low water level. In case of doubt, remove the cap on the filler pipe and insure that the water level is approximately even with the level line on the rear panel.

2. Tune-Up Procedure:

a. General:

The objective in "tuning up" the power amplifier is to adjust its plate output matching network so that, at the desired operating frequency, the impedance of the connected load is transformed to the proper value of load resistance for the plate of the tube. This plate load resistance is directly proportional to the ratio of plate d-c voltage divided by d-c plate current. Thus if an amplifier is adjusted for operation at 2000 volts and 500 milliamperes, it is also properly adjusted for operation at 4000 volts and 1000 milliamperes since the voltage/current ratio in each case is four. This principle is used to advantage in the ALPHA SEVENTY, where the availability of two different plate voltages permits the amplifier to be tuned up legally and safely at approximately 1 KW d-c plate input and then simply switched to high plate voltage and operated at 2 KW or greater power input without further adjustment.

When employing single sideband (or other form of amplitude modulation), care must be taken to insure that the amplifier is not driven beyond the peak power input for which it is adjusted. Several methods by which this may be accomplished are as follows:

(1) Use of a monitoring oscilloscope which is left in the line at all times is most effective in insuring amplifier operation at peak efficiency and with minimum distortion. Inexpensive oscilloscopes such as the Heath SB-610 or the Central Electronics MM-2 are quite satisfactory for this purpose, and their application is covered quite thoroughly in handbooks on SSB techniques, as well as in the oscilloscope instruction manuals.

(2) Excitation power may be set at a fixed level and the linear amplifier tuned and loaded for maximum RF power output;

loading is then further increased until plate current is approximately 5% greater than the value at which maximum power output occurs. If plate power input under these conditions is greater (or less) than desired, excitation is reduced (or increased) slightly and the process repeated until a suitable result is achieved. It is necessary to insure that the peak excitation power under SSB conditions does not significantly exceed the excitation level at which tuning adjustments are made. This procedure is most useful in cases where the full output capability of the exciter may be employed without exceeding the ratings of the ALPHA SEVENTY, and where exciter ALC circuitry prevents its peak SSB output from significantly exceeding its "key-down" output.

(3) When a monitoring oscilloscope is not available, the simplest procedure in most cases is to follow the tune-up procedures described below and then to adjust the exciter SSB output so that "average" or "indicated" plate power input of 1 KW is not exceeded. This subject is discussed at more length in the following paragraphs.

b. Determining Power Input; PEP vs. "Average" Input:

The tuning and loading adjustment of a linear amplifier (as well as its basic design) establishes a maximum value of plate power input to which it may be driven on peaks of the ssb excitation signal without "flat-topping" and generating excessive distortion. This maximum plate power input level at which the amplifier will operate linearly is its so-called "peak envelope power" (PEP) capability under that set of conditions. Mechanical inertia prevents meters used to monitor transmitter operation from following instantaneous variations in current or voltage, and therefore the meters cannot be used to directly determine PEP input. "Average" or "d-c" power input is defined as the product of the plate voltmeter and ammeter indications at the peaks of their respective swings under SSB-voice operation. Instantaneous (PEP) input may actually range from two to three times the "average" input indicated by the meters. In most cases, however, the ratio of PEP to "average" power will not exceed 2.5, so that an amplifier tuned for proper linear operation at 2.5 KW peak power input may be driven to an indicated 1 KW input without danger of flat-topping or excessive distortion.

c. Initial Tune-Up:

- (1) Depress OFF and HV push buttons.
- (2) Set BAND, LOAD, and TUNE controls to the appropriate positions shown in the preliminary tuning chart supplied in this manual.
- (3) Insure that a suitable matched load for the frequency to be used is connected to the amplifier output.

(4) Leaving amplifier OFF, tune exciter for maximum output. (When the PA70-V is OFF, excitation is fed through the internal relays directly to the load; the maximum carrier power fed through the amplifier for long periods of time should not exceed 100 watts, in order to avoid possible damage to the input T/R relay.)

(5) Depress the FWD button and note multimeter deflection; depress REFL button and again note deflection. If the REFL meter deflection significantly exceeds the FWD value, antenna SWR is excessive and should be corrected before proceeding with tune-up of the ALPHA SEVENTY. Reduce exciter output to zero.

(6) Press HV and BK-IN buttons. Check that high voltage is approximately 2.5 KV, and that the depressed buttons are illuminated.

(7) Depress GRID button. Increase excitation until plate current is approximately 0.5 amperes. Quickly rotate TUNE crank for plate current dip.

(8) If no plate current dip is found near the indicated setting, depress FWD button and repeat, watching for maximum RF output reading. The plate current dip will coincide with maximum RF output.

(9) Depress GRID button; increase exciter output until grid current is approximately 225 ma (just under half scale on the multimeter).

(10) If plate current exceeds 0.45 amperes, reduce loading slightly (by counter-clockwise rotation of the LOAD dial) and quickly readjust TUNE for plate current dip.

(11) Readjust exciter output for 225 ma grid current and repeat until the plate current at the dip is approximately 0.45 amperes with 200 to 250 ma grid current. (If at any time the plate current is less than desired, loading should be increased slightly and the procedure repeated.)

(12) Depress HV to determine that plate voltage is approximately 2000 to 2300. Remove excitation.

d. CW Operation:

1 KW Input - When adjusted as described in the preceding paragraphs, the ALPHA SEVENTY is ready for CW or FSK operation at approximately 1 KW input. The loading adjustment and/or excitation level (indicated by grid current) may be varied slightly in order to achieve the exact d-c input desired.

High power CW - The ALPHA SEVENTY may be operated in the keyed CW (A1) mode at key-down inputs as high as 2.5 KW by following the above initial tune-up procedure and then simply depressing the SSB button and adjusting excitation for approximately 700 ma of plate current. Repetitive key-down periods should not exceed 15 seconds in this mode, and the overall duty cycle must be 50% or less. (If long periods of continuous operation at or near 50% duty cycle are anticipated, it is advisable to adjust plate loading for a plate current of approximately 600 ma with grid current of about 225 ma.)

The ALPHA SEVENTY may be operated on CW at a power input of approximately 1.5 KW in either the BK-IN or CW mode by adjusting for approximately 700-750 ma plate current with about 300 ma grid current.

Break-in - Full electronic break-in operation is possible in the amateur CW bands when the ALPHA SEVENTY is used with a suitable exciter or transceiver. When the BK-IN button is depressed, the internal electronic T/R switch provides antenna signal input to the receiver (whenever the key is open) via the RCVR ANT jack at the rear of the amplifier.

Because of the extremely fast-operating vacuum T/R relays used in the ALPHA SEVENTY, mechanical break-in is also possible in the CW or SSB modes. In this mode of operation, however, it is absolutely essential that the T/R relays be controlled from a keying source which allows them to close before RF excitation is applied to the amplifier and to stay closed until RF is removed. In the event that this mode of operation is desired, contact the ETO factory for information and suggestions.

Except that the internal T/R relays must be actuated by an external contact closure on the RLY line, amplifier operating conditions when the CW button is depressed are identical with those in the BK-IN mode.

e. SSB Operation:

Pushing the SSB button applies d-c plate voltage of approximately 3500 to 4000, suitable for plate power input of two to three KW; operation conditions are otherwise identical with those in the CW position. The ALPHA SEVENTY always operates in class AB2 and may be used for single sideband linear service regardless of whether the SSB, CW, or BK-IN button is pressed, provided that loading and excitation level are suitably adjusted.

(1) SSB operation at maximum legal amateur power input -

(a) Follow the instructions in c. above for initial tune-up at 1 KW input.

(b) Depress SSB button (amplifier is now set up for approximately 2.5 KW PEP input).

(c) Adjust single sideband output level from exciter so that the ALPHA SEVENTY plate current meter indicates 0.25 to 0.3 amperes on voice peaks, corresponding to approximately 1 KW "average" or "d-c" input. (If a monitoring oscilloscope is used, minor refinement of the TUNE and LOAD adjustments may be made during actual ssb operation to assure maximum peak power output without flat-topping. In the absence of an oscilloscope, however, the above procedure will result in nearly optimum operation).

(2) Maximum Power SSB Operation -

(a) Follow instructions in c. above for initial tune-up at 1 KW input, except make final adjustments for plate current of 0.6 amperes with grid current 200 ma.

(b) Depress SSB button.

(c) Adjust ssb excitation for peak meter indication of approximately 0.4 amperes plate current if the exciter has no ALC system or little ALC action; if the ssb exciter provides substantial speech clipping or compression, the ALPHA SEVENTY may be driven to indicated plate current peaks of 0.5 amperes, corresponding to "average" or "d-c" input of more than 1.5 KW and PEP input in excess of 3 KW. As is always the case, if it is desired to operate the amplifier near the maximum limits of its capability the use of a monitoring oscilloscope is extremely desirable.

(3) Medium Power SSB Operation -

Efficient operation at approximately 1000 to 1500 watts PEP input is possible with the CW button depressed by making initial tune-up adjustments in either of the following ways:

(a) Adjust excitation as necessary to maintain 275-300 ma grid current. Depress FWD button and adjust TUNE and LOAD for maximum RF power output; then increase loading until plate current is approximately 5% greater than that for maximum power output. Adjust ssb excitation to provide indicated plate current peaks of approximately 0.2 to 0.3 amperes, or 40% of the value noted under key-down conditions. Or,

(b) Adjust excitation as necessary to maintain 150 ma grid current and adjust TUNE and LOAD for 0.45 amperes plate current. Adjust ssb excitation level for approximately 0.2 to 0.3 amperes of indicated plate current as above.

NOTE: While procedure (a) is more precise than (b), it must be accomplished into a dummy load if amateur power input limitations are not to be exceeded. Procedure (b) provides near optimum adjustment without exceeding 1 KW d-c input.

f. Operation Under Other Conditions:

If it is desired to operate the ALPHA SEVENTY under conditions significantly different from those described above, it is recommended that the factory be contacted for suggestions and information. In any case, the following limitations must always be observed:

- (1) Continuous plate current must not exceed 0.6 amperes.
- (2) Peak plate current should not exceed 1 ampere, and the duty cycle at plate currents in excess of 0.6 amperes must not exceed the square of the ratio, (0.6 amperes/peak plate current). For example, in a keyed carrier mode with 0.7 ampere key-down plate current, the ratio (0.6/0.7) is 0.857, and the key-down duty cycle must not exceed the square of .857 or approximately 73%.
- (3) Continuous grid current should not exceed 300 madc. Brief excursions to 500 madc during tune-up are not harmful.
- (4) Plate loading must always be heavy enough to prevent tank circuit damage due to excessive operating "Q." In the BK-IN or CW modes, with 250 ma grid current the plate current should be no less than 0.4 amperes. With 250 ma grid current in SSB, the plate current should be 0.6 amperes or more.
- (5) D-c plate input power averaged over any period of thirty seconds should not ordinarily exceed 1250 watts under continuous operating conditions.

SECTION 4

MAINTENANCE AND TROUBLESHOOTING

1. Monitoring and Maintaining the Vapor Cooling System: The recirculating vapor phase cooling system used in the ALPHA SEVENTY provides high power capability, excellent reserve capacity and tube protection against temporary overloads, and an exceptionally low audible noise level. It is absolutely essential that cooling system operation be checked regularly and that the following maintenance functions be performed without fail:

a. Check d-c leakage current frequently. Because full d-c plate voltage is impressed across the column of water between the 3CV1500A7 tube anode and the grounded reservoir, water in the system must be kept very pure in order to prevent the flow of excess d-c leakage current through the water.

When all four of the meter push buttons are "out," which may be accomplished by partially depressing any one of them, the meter reads d-c leakage current directly on a 0 to 5 milliamperere scale. When the system is freshly filled with purified water, leakage normally will indicate no more than a few hundred microamperes. Coolant water is continually re-distilled as it circulates through the system, and therefore naturally maintains a very high degree of purity, any minor contamination remaining in the boiler. Normal leakage current is about 200 microamperes during extended operation; when the amplifier is first turned on, leakage may temporarily increase to as much as $1\frac{1}{2}$ milliamperes, but should decrease rapidly during operation at a few hundred watts plate input. Smaller temporary rises in leakage current can be expected at the beginning and end of transmission periods; these are of no concern unless they regularly exceed 500 - 600 microamperes.

b. If start-up leakage current increases to two milliamperes or more, or fluctuations approaching one milliamperere or more occur during operation, excessively contaminated cooling water is indicated and the system should be drained and refilled with fresh, purified water. A brass pipe plug is provided on the bottom of the filler "tee" at the left rear corner of the ALPHA SEVENTY; remove this plug and tilt the amplifier sharply first to one end and then the other to insure thorough draining. Replace the plug firmly and refill the system.

c. It is recommended that the cooling system be drained and refilled after approximately ten hours' transmitting time, and again after about twenty hours. Thereafter it should be drained and refilled approximately every six months, or when excessive d-c leakage is indicated as described above.

d. Although the LKG warning lamp will light to indicate that leakage current exceeds approximately 1.5 milliamperes, it is suggested that the meter switch be left in the leakage monitoring condition during normal operating periods.

e. Unless visible signs of discoloration are evident in the polypropylene plastic tube feeding coolant water to the 3CV1500A7 boiler jacket, the vapor cooling system should require no maintenance other than the occasional draining and flushing described above.

2. General Maintenance: The interior of the ALPHA SEVENTY should be inspected at regular intervals and any accumulated dust or dirt should be loosened with a soft brush and removed with a vacuum cleaner. Particular attention must be paid to preventing dust accumulation around high voltage areas, including the rectifier circuit board mounted on top of the filter capacitor. The intake fan, the perforated partition between the power supply and RF sections, and the steam condenser fins should be cleaned thoroughly to assure normal air flow. In most cases it will probably be adequate to perform this maintenance approximately each six months. Amplifiers subject to unusually dirty conditions should be cleaned more often as needed, and those used only in exceptionally clean, air conditioned locations may go longer between cleanings. While the cover of the ALPHA SEVENTY is removed for cleaning, it is good practice to visually check the RF section for any sign of water leakage from the cooling system, and to insure that the hose clamps securing the corrugated steam line are snug at both ends.

3. Troubleshooting Hints: The ALPHA SEVENTY differs significantly from most power amplifiers with respect to both mechanical and electrical design. The majority of difficulties experienced by users result from lack of familiarity with the equipment, and it is therefore strongly recommended that the operator study this entire manual thoroughly before installing or attempting to operate the equipment. The following chart lists the most common trouble symptoms and the usual causes of each:

<u>SYMPTOMS</u>	<u>PROBABLE CAUSE</u>
1. Amplifier completely inoperative; no push button illumination or high voltage.	a) Blown fuse F1 or F2. b) Improper wiring of power cable plug. c) Plugs P2, P3, P4, or P8 not properly connected inside amplifier.
2. None of the four right-hand push buttons depressed, <u>OFF</u> button illuminated red.	a) Desired button not pressed in firmly by operator. b) Overload relay actuated due to plate current in excess of one ampere; correct cause and reset by pressing desired button.

<p>3. <u>BK-IN</u>, <u>CW</u>, or <u>SSB</u> button depressed and illuminated, but <u>OFF</u> button also illuminated and no high voltage.</p>	<p>a) A-c power interlock switch not actuated by top cover.</p> <p>b) Over-temperature thermostat on 3CV1500A7 actuated due to excessive anode temperature. Check cooling system.</p>
<p>4. Depressed push buttons illuminated normally but no high voltage.</p>	<p>a) Blown fuse F2 or one side of 230 volt supply line open at fuse or breaker in primary distribution box.</p> <p>b) Defective power plug wiring.</p>
<p>5. No grid current and low plate current with exciter operating normally; lights and high voltage normal.</p>	<p>a) Blown grid fuse F3.</p> <p>b) Amplifier band switch improperly set.</p> <p>c) Transistors Q3, Q4, or Q5, or associated components, especially diodes D10, D11, D12, D17, D18 and D28, defective.</p>
<p>6. No grid or plate current with exciter operating normally.</p>	<p>a) No contact closure applied to <u>RLY</u> line in <u>CW</u> or <u>SSB</u>.</p> <p>b) Amplifier band switch improperly set.</p> <p>c) Input relay K4 damaged.</p>
<p>7. Plate current flows constantly even with exciter turned off.</p>	<p>a) Transistor Q5 shorted.</p> <p>b) Diode D3 shorted.</p>
<p>(Note: Check for possible high voltage arc or short to ground before operating amplifier, especially if grid fuse was also blown.)</p>	
<p>8. Overload relay actuates on "SSB" voice peaks.</p>	<p>a) Instantaneous plate current peaks exceed one ampere due to excessive RF drive. See Sec. 3, paragraphs 2.b through e.</p> <p>b) Incorrect tuning and loading, or possible defective antenna or dummy load arcing on peaks.</p>