

# OPERATING AND TECHNICAL MANUAL

HIGH FREQUENCY LINEAR POWER AMPLIFIERS

ALPHA 76A, 76PA, and 76CA



**ETO** EHRHORN TECHNOLOGICAL OPERATIONS, INC.

CANON CITY, COLORADO 81212

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0180 U.S.A.

## SECTION 2

### INSTALLATION

1. Unpacking: Carefully remove amplifier and transformer from cartons; **SAVE PACKING MATERIAL FOR RE-USE -- SHIPMENT OF YOUR ALPHA IN OTHER THAN FACTORY PACKING MAY RESULT IN DAMAGE NOT COVERED UNDER WARRANTY!**

Inspect closely for evidence of shipping damage; if found, notify delivering carrier and seller at once. Complete warranty registration form and mail it to ETO promptly.

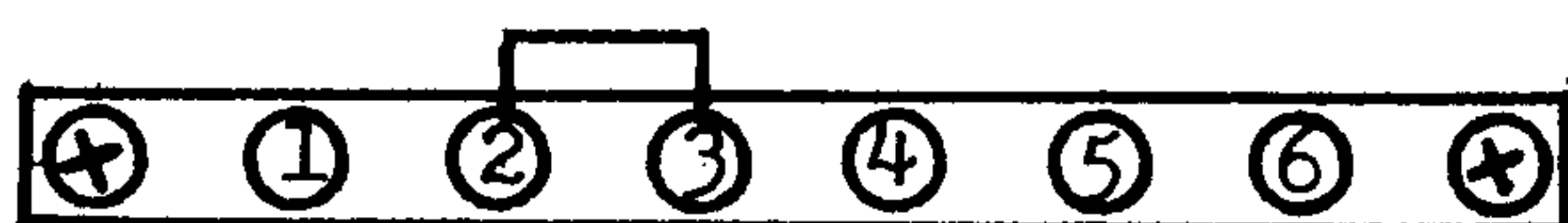
2. Transformer Installation: The cover of the amplifier is easily removed. Remove the three flat head Phillips screws from the front edge on top, the two pan head screws from the rear flange of the top cover, one flat head from the center of the top cover, and five pan head screws from each end of the cover -- then lift it carefully off, directly upward.

Orient the transformer so that both multi-pin, molded plugs on the transformer harness point toward the front of the amplifier; move the corresponding mating connectors in the amplifier itself temporarily out of the way. Carefully lower the transformer into position so that the 1/4-20 tapped holes in its base line up with the corresponding clearance holes in the amplifier base plate. Install the 1/4-20 bolts and washers provided, and tighten.

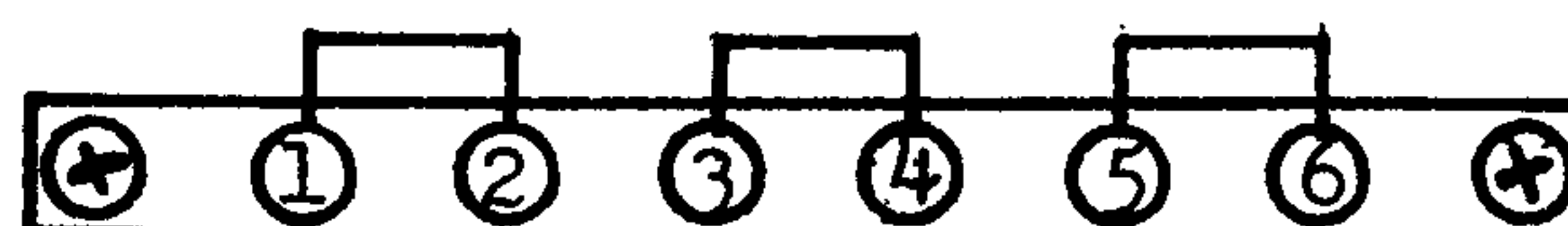
Check both pairs of connectors visually for proper mating orientation (avoid excessive harness bending or twisting, as it may cause damage to wires or connector pins) and mate them firmly, pushing until the integral latches engage.

3. Electrical Installation: The amplifier is normally shipped from the factory wired for 220-250V operation. If it is to be operated instead on 110-130V lines, change over the connections as described below before replacing the cabinet cover.

Changeover to 110-130V Operation - Locate the six-terminal barrier strip on the right side of the center chassis partition, above and to the left of the transformer. With short jumper wires between lugs #2 and #3 only, the amplifier is connected for 240V power supply. Substituting instead one jumper between terminals #1 and #2, another between #3 and #4, and a third between #5 and #6, re-connects for 120V power source. (See sketches below.)



CONNECTIONS FOR 240V



CONNECTIONS FOR 120V

Power Cable Connection - The green wire of the amplifier power cable is a chassis safety ground, and must always (and only) be connected to the safety ground of the a-c mains -- NEVER to one of the "hot" power wires. The black and white wires are interchangeable and connect to the two "hot" service conductors.



4. Physical Location: Your ALPHA must be located so that intake of cool air through the rear panel, and exhaust of warm air through the top cover perforations, is not impeded in any way. A minimum of 4 to 6 inches of clearance should be allowed behind and above the amplifier for air circulation. BE CAREFUL NOT TO BLOCK THE TOP-COVER EXHAUST OPENINGS with log books or equipment.
5. RF and Control Connections: Interconnection of the ALPHA for operation with any popular transceiver or exciter is extremely simple. Connect the rear panel jacks as follows:

RF INPUT - Use an appropriate plug and RG-58C/U or similar small 50 ohm coaxial cable to connect to transceiver or exciter "rf output" or "antenna" connector. KEEP CABLE AS SHORT AS POSSIBLE -- PREFERABLY NOT LONGER THAN 2-1/2 TO 3 FEET.

RF OUTPUT - Use a standard PL-259 ("UHF" type) plug and RG-8A/U or similar high power coaxial cable (50 ohm) to connect to antenna system.

RELAY - Use a standard "phono-type" patch cable to connect this jack to transceiver or exciter contacts which are "open" on receive and "shorted" on transmit ("N.O." = "normally open"). Nearly all transceivers provide such contacts via either phono-type jacks or other accessory connector on the rear panel or the power supply.

NOTE: When the amplifier is OFF, or in the RECEIVE condition with no short across its RELAY line, the RF OUTPUT connector is internally connected directly to the RF INPUT, providing normal "transceive-type" antenna input to the receiver.

ALC - For use with tube-type transceivers having negative-going ALC systems with external input jacks, simply patch this jack to the mating one on the transceiver or exciter, using a standard "phono-type" cable. Nearly all modern solid state (broadband) transceivers utilize positive-going internal ALC, with a detector at the rf output point. This internal system normally functions adequately to control SSB drive power to the amplifier; in fact, most such exciter/transceivers provide no external ALC input jack and it is entirely unnecessary to make any external ALC connection.

6. Blower: The cooling blower motor is mounted on a new "absorbent foam" cushion which dramatically reduces transmission of mechanical noise and vibration. Two 10-32 Phillips head screws secure the blower motor to the amplifier rear panel for safety during shipment, and must be removed for quietest operation. These two screws are identified with arrows in FIGURE 2 on page 11 of this manual. Remove both screws fully, and the rubber strips wedged between the rear panel and the blower motor bearing housing (between and slightly above the screws); save for future shipping. SERIOUS PHYSICAL DAMAGE TO THE AMPLIFIER AND BLOWER MAY RESULT IF THE SCREWS AND SHIM STRIPS ARE NOT PROPERLY RE-INSTALLED BEFORE SHIPPING THE AMPLIFIER!

### SECTION 3

#### OPERATION

##### 1. Control Functions:

- BAND - Selects tuning range of amplifier, indicating the nominal center of the band in MHz.
- TUNE - Controls the operating frequency. In general, higher frequency bands (14 & 21 MHz, etc.) tune toward the "0" end of the vernier dial scale, while lower frequency bands tend to tune toward the 50-100 end.
- LOAD - Controls amplifier plate loading ... the power input level at which best efficiency and linearity is achieved. Higher bands tend to load normally toward the 70-100 end of the vernier scale, while lower bands typically vary across most of the dial depending on exact frequency and the load impedance or VSWR. In general, higher dial numbers tend to result in heavier loading, but variations to this rule may occur, particularly on 160 meters.

##### PUSH BUTTONS -

- ON: Depressing momentarily applies a-c power to amplifier. Press also to restore power after overcurrent relay has tripped.
- OFF: Depress momentarily to remove a-c power from amplifier.
- HV: Multimeter monitors high voltage - 3000V d-c full scale.
- GRID: Multimeter monitors grid current - 150 mA full scale.
- FWD: Multimeter monitors forward RF power - 2000W full scale.
- REFL: Multimeter monitors reflected RF power - 200W full scale.
- CW: Selects lower plate voltage optimum for CW/FSK/SSTV and other types of emission, including SSB, up to 1 kW d-c plate input.
- SSB: Selects high plate voltage for up to 2+ kW PEP SSB plate input.
- OUT = STANDBY: When both the CW and SSB buttons are out (as evidenced by black color windows), the amplifier is placed in the STANDBY condition. Antenna changeover relay is disabled, permitting "straight-through" operation of the exciter/transceiver while the amplifier remains ready for immediate use if desired.
- ALC - Rear panel screwdriver adjustment sets the drive power level at which ALC voltage begins to increase (negatively) from zero -- the ALC "threshold" level. Use a small insulated screwdriver to avoid accidentally shorting the circuit.

##### 2. Tune-Up Procedure:

- (a) GENERAL - The objective of tune-up is to adjust the amplifier to deliver maximum power output at the desired level of plate d-c power input, or at the available level of rf drive power, whichever is lower.

When the amplifier is adjusted for maximum attainable rf power output with a specific, fixed level of rf carrier drive power, it is automatically set up properly for the best combination of efficiency and linearity possible at that drive level.

If the drive power is increased beyond the tune-up level after final TUNE/LOAD adjustments, flattopping and undesirable distortion (on SSB) will



result, along with grid current greatly in excess of normal.

If drive power is reduced below the tune-up level without further adjustment of TUNE and LOAD controls, amplifier efficiency will be reduced. Both of these statements are applicable equally to any linear amplifier of the types used for high power amateur and similar service.

It is therefore essential that the amplifier be adjusted for maximum rf output at the drive and d-c input powers which are to be employed in normal operation, WITH ONE IMPORTANT EXCEPTION: if the plate voltage is changed without also changing the TUNE and LOAD adjustments, the resulting power input level which will yield optimum performance at the new plate voltage will vary in proportion to the square of the plate voltage. For example, if the ALPHA 76A is tuned up for maximum output with 1400 VDC plate voltage (typical LV) and with the drive level set so that the resultant maximum rf output is about 700 watts (equivalent to a d-c input of roughly 1000 watts), THEN when the plate voltage is increased to 2000 VDC the amplifier will inherently perform optimally when driven to about  $700 \times (2000/1400)^2 = 1400$  watts rf output, corresponding to approximately 2000 watts d-c plate input.

In general, the final operating adjustment after basic tune-up should be to set excitation (drive) from the exciter or transceiver so that the GRID current meter indication just reaches about 50 mAdc (1/3 scale) key-down or on SSB voice peaks.

- (b) INITIAL TUNE-UP - Place amplifier in STANDBY (both CW and SSB buttons out: if one is already depressed, partially depress the other and release, so that both pop out and show black).
- (1) Press HV button and watch MULTIMETER HV scale (0-3 KV).
  - (2) Press ON button and release. Panel meters should immediately illuminate amber or red and the MULTIMETER should swing promptly to indicate  $1.5 \text{ KV} \pm 100\text{V}$  (mid-scale). (If this does not occur, press OFF immediately and locate the problem.) The blower should start immediately and exhaust air should be detectable flowing from cover vents.
  - (3) When tube warm-up delay is completed in approximately 60 seconds, the meters will change to pale green or blue, indicating "ready" to transmit. Set controls to the preliminary points indicated in Table I below, depending on the desired operating frequency.

TABLE I -- PRELIMINARY SETTINGS FOR INITIAL TUNE-UP

<u>FREQ. MHZ</u>	<u>BAND</u>	<u>TUNE</u>	<u>LOAD</u>	<u>FREQ.</u>	<u>BAND</u>	<u>TUNE</u>	<u>LOAD</u>
1.8	1.8	84	30	7.1	7	50	45
2.0	1.8	75	25	14.15	14	20	70
3.6	3.5	53	38	21.20	21	10	82
3.9	3.5	42	48	28.70*	28*	08*	90*

(\* "E" suffix models only.)

- (4) Press CW button and switch the exciter to CW or TUNE; the ALPHA panel meters should turn amber, indicating "transmit".
- (5) VERY SLOWLY increase exciter carrier output until the amplifier PLATE CURRENT meter indicates half-scale -- about 0.5 ampere.

Press FWD and carefully adjust LOAD for maximum RF WATTS meter reading. Then adjust TUNE for maximum indication on the meter (FWD RF WATTS). Repeat the process of alternately peaking first LOAD, then TUNE, until no further increase in FWD RF WATTS can be achieved.

- (6) Note PLATE CURRENT meter indication; the desired reading for one kilowatt d-c input is approximately 0.7 ampere, since  $0.7 \text{ amp} \times 1400 \text{ volts} = 980 \text{ watts}$  input.
- (7) If the plate current in step (6) was less than 0.7 amp, increase exciter carrier output slightly and repeat the LOAD-TUNE adjustment process of steps (5) and (6) again. If the plate current in step (6) was greater than 0.7 amp, decrease exciter output slightly and repeat the process.
- (8) Continue the process outlined in step (7) until, after final LOAD-TUNE adjustments, the PLATE CURRENT meter indication is as desired.

The ALPHA is now correctly adjusted for operation at one kilowatt d-c input using the "CW" (low) plate voltage tap.

- (c) OPERATION AT 1 KW INPUT (KEY-DOWN OR PEP/SSB) - Tune up as in (b) above. Leave amplifier in CW mode. No further adjustment is required for CW-FSK-SSTV operation, except to check exciter rf output under operating conditions to insure that plate current is as desired. Also press GRID and check that grid current does not exceed about 50-75 mA (1/3 to 1/2 scale).

For SSB at power inputs to approximately 1 kW PEP, set mike gain (or the equivalent exciter rf output control) so that amplifier GRID current meter does not swing above about 30-50 mA (one-third scale) on speech peaks.

- (d) OPERATION ON SSB AT 2+ KW PEP INPUT (1 KW AVERAGE) - Tune up exactly as in (b) above. Remove excitation and press the SSB button.

Switch exciter to normal SSB and, while speaking normally into the mike, adjust mike gain until EITHER (1) amplifier PLATE CURRENT meter swings just reach approximately 0.45 amp (just under half scale) on highest speech peaks, OR (2) amplifier GRID current meter swings just reach 50 mA (one-third scale), whichever occurs first.

Maximum legal (U.S.) amateur power input of one kilowatt average corresponds to the condition described, assuming that plate voltage (HV) is approximately 2200 VDC on speech peaks (i.e.,  $0.45 \text{ amp} \times 2200 \text{ volts} = 990 \text{ watts}$  average input). A slight increase in loading will reduce grid current peaks, if necessary to achieve desired plate current without excessive grid current.



### 3. Operating Notes:

- (a) TUBES - The 8874 ceramic triodes are extremely rugged and normally operate with a large margin of safety. They will deliver outstanding service life IF not damaged by grossly excessive grid dissipation or airflow blockage (keep the intake and exhaust vent areas clear!) DO NOT ALLOW AVERAGE PLATE CURRENT PER TUBE TO EXCEED 0.35 AMPERE FOR MORE THAN 5-10 SECONDS, NOR EVER TO EXCEED 0.5 AMPERE. DO NOT ALLOW GRID CURRENT TO EVER EXCEED FULL SCALE (150 mA); normal operation requires only 50-60 mA for two tubes or 75-90 mA for three.
- (b) INTERLOCKS - The ALPHA 76A series is equipped with switches which shut off a-c power and short out the high voltage power supply when the cover is not securely fastened in place. THESE PROTECTIVE INTERLOCKS ARE PROVIDED TO PROTECT YOU AGAINST POTENTIALLY FATAL ELECTRIC SHOCK RESULTING FROM CONTACT WITH LETHAL OPERATING VOLTAGES INSIDE THE AMPLIFIER. THE AMPLIFIER SHOULD NEVER BE ENERGIZED WITH THE COVER REMOVED AND INTERLOCKS DEFEATED EXCEPT BY THOROUGHLY TRAINED AND KNOWLEDGABLE SERVICE PERSONNEL!
- (c) FUSES - Except in rare instances of component failure, the blowing of one or both primary line fuses indicates that the maximum safe average power input capability of the amplifier has been substantially exceeded. USE ONLY 10A CERAMIC FUSES, EXCEPT 15A for 76CA option, up to 20A for 120V operation. (Standard glass fuses of the same size are rated for circuits up to 32 V only, and may shatter or explode within the fuse holder.)  
  
The slo-blo fuse F3 located just behind the front panel prevents burn-out of the step-start resistors and HV rectifiers in the event of abnormal turn-on conditions or HV faults. DO NOT SUBSTITUTE a fuse of different type or rating.
- (d) PLATE OVERCURRENT RELAY - This relay functions primarily to de-energize the primary power circuit quickly in the event of a fault in the HV circuitry or grossly excessive drive conditions. The relay should not be relied on to prevent damage from either short- or long-term overdrive; that is the operator's responsibility. Should the overcurrent relay trip, removing all a-c power from the amplifier, it is essential to determine and correct the cause before re-applying power by pushing the ON button.
- (e) MAINTENANCE AND TROUBLESHOOTING - Most apparent failures and problems with ALPHA amplifiers result from operators' failure to read and thoroughly understand the contents of this manual, as well as basic linear amplifier principles -- rather than from actual equipment defects.

The amplifier interior, particularly the high voltage d-c areas of the power supply and rf compartment, should be cleaned frequently enough (with a soft brush and vacuum cleaner) to prevent visible accumulation of dust. If extremely dusty conditions prevail, it may be advisable to secure a thin plastic air filter, of the type used in window air conditioners, across the air-intake area.



TABLE II -- TROUBLESHOOTING HINTS

<u>SYMPTOMS</u>	<u>POSSIBLE CAUSE/CURE</u>
1. Won't turn on; nothing happens when ON button is pushed.	a) External a-c wire, fuse, or breaker open or missing. b) Cover a-c interlock switch open. c) Fuse F1 or F2 blown or missing.
2. Relay closes (and blower may start) but no HV or meter illumination at turn-on.	a) Step-start relay K2 not closing; possible blown fuse F3, defective +28V supply (D107-D108 or C108), or HV fault.
3. Blower starts, HV normal, but meters do not switch to green and amplifier will not switch to transmit.	a) Defective reed relay K6. b) Defective Q101, Q102, or C109.
4. Grid meter "pins" at low drive.	a) R116 open or damaged.
5. Low grid current, excessive input VSWR (abnormal exciter loading), low rf output.	a) Bias zener D110 damaged or open. b) R116 damaged or open (grid current will indicate very high as in (4) above).
6. Plate current flows in receive or STBY conditions. See also (9).	a) 8874 tube leakage or short, cathode-to-grid or-heater. b) D106 damaged or defective.
7. Low drive and output power; cannot drive exciter to normal input or rf output levels.	a) ALC sensitivity control R209 set improperly; unplug ALC to check. See note at bottom of this page.
8. Flashover in RF compartment, usually between load capacitor plates.	a) Excessive load VSWR; mismatch or wrong antenna; defective rf cables or plugs. b) Insufficiently heavy loading and/or excessive rf drive power. c) Dirt or other contaminant in capacitor plates. d) If chronic, capacitor plates damaged by previous arcing.
9. Plate current flows in receive or STBY <u>and</u> cannot drive amplifier; abnormal exciter loading.	a) 8874 tube short, cathode-to-grid or cathode-to-heater.
10. Distorted SSB output signal; possible severe TVI.	a) Excessive rf drive power and/or inadequately-heavy loading adjustment. b) Flashover of variable capacitor on peaks. c) Antenna or feedline (or balun or trap) arcing on voice peaks. d) RF feedback from antenna into exciter, microphone or speech processor lines.

NOTE: If exciter manufacturer does not provide instructions for adjustment of ALC with an amplifier, set trimpot R209 for the desired amplifier plate current meter swings on voice peaks, and adjust exciter mike gain for the degree of ALC action desired for normal exciter operation.

## SECTION 4

### THEORY OF OPERATION

1. RF Amplifier Section: Tubes V1 and V2 (and V3 in models 76PA and 76CA) are parallel-connected in a grounded grid configuration. +28 volts of cathode bias is applied via R115 and L3 to cut off plate current during non-transmit periods; bias is reduced to an operating level of 5.1 volts when the antenna changeover relay is actuated.

RF excitation is applied to the tube cathodes via an input network, including a broadband toroidal ferrite input matching transformer, which is carefully designed to present to the exciter a nominal 50 ohm load. Changing this input network may result in excessive input VSWR.

The plate output circuit is a full pi-L network consisting of C18, L4-L5-L7, C19, and L6. The pi-L provides harmonic suppression substantially better than that of a simple pi network, as well as somewhat better efficiency in this application.

An rf directional wattmeter, consisting of L201 and associated components, senses forward and reflected power in the rf output line for display on the panel multimeter when selected by pushbuttons FWD and REFL, respectively.

Excitation rf voltage is detected and filtered by ALC rectifier C209-C210-D203 and associated components. The drive level at which negative-going ALC voltage is generated (i.e., the threshold ALC level) is set by rear-panel potentiometer R209, which appropriately back-biases D203.

Relay K4 switches the antenna straight through to the exciter when the amplifier is OFF or in STBY or receive conditions, permitting normal transceive operation. K4 switches the ALPHA 76A into the transmit configuration when an external short-circuit is placed across RELAY control jack, J3.

2. Power Supply: Transformer T1 is a 1.5 KVA continuous-service unit (2.4 KVA Hipersil<sup>R</sup>-core for 76CA only) which supplies all required a-c operating voltages for the amplifier.

High voltage d-c for the tube anodes is rectified by a full-wave bridge, D101-D104, and filtered by a 30 mfd., 2.7 KV capacitor consisting of C101-C106 in series. These computer-grade electrolytic capacitors are burned in and matched at the factory for both d-c leakage and capacitance, to insure uniform voltage distribution and long service life.

High voltage tap-change relay K3 selects high or low transformer voltage taps, as controlled by front panel CW/SSB pushbutton switches.

Cover interlock switch S5 prevents actuation of the main power relay, K1, unless the cover is secured in place. A safety crowbar switch places a low-resistance short across the HV supply (and discharges the filter capacitor bank) whenever the cover is opened. THIS IS A PERSONNEL-SAFETY FEATURE WHICH SHOULD NEVER BE DEFEATED EXCEPT TEMPORARILY BY HIGHLY QUALIFIED SERVICE PERSONNEL!



FWCT rectifier D107-D108 and filter capacitor C108 provide +28 V for bias and control circuits. A 25 VAC transformer winding is "bucking" connected to provide approximately 95 VAC for the blower motor, resulting in reduced noise but virtually the same cooling air delivery as at full voltage.

Dual primary windings on T1 permit connection for either 110-125 V or 220-250 V operation, as described in the Installation section of this manual. No wiring change is necessary for operation from either U.S.-standard 120-N-120 or from typical overseas 220-250 V without "central" neutral, two-wire systems. The third (green) power cable conductor is simply a chassis safety ground.

3. Control and Metering Circuits: ON/OFF pushbuttons S2 control self-latching main power relay K1. Resistors R1 and R2 limit the initial current inrush to about 12 amperes maximum, and are shorted by relay K2 when the HV filter capacitor approaches full charge (the delay is only a few milliseconds). Fuse F3 protects against burn-out of R1 and/or R2 in the event of mistakes or faults which prevent K2 from closing properly.

Time Delay: The 8874 tubes are protected against damaging cathode current flow during their mandatory (60 second nominal) heater warmup period by the time delay circuit located on CB-1. The gate of programmable unijunction transistor (PUT) Q101 is clamped at about +14 V by voltage divider R121-R122. At initial turn-on, C109 charges through R120 until the anode of Q101 becomes more positive than its gate. At that point Q101 turns on abruptly, triggering SCR Q102 which activates relay K6. Until K6 closes, the amplifier is locked in the STANDBY condition, since T/R relay K4 cannot be actuated. Once K6 closes, the green meter lamps light, indicating "ready."

After time delay K6 closes, an external short-circuit placed across J3 (the RELAY jack) closes T/R relay K4, provided that either the CW or the SSB pushbutton is depressed. If both CW and SSB buttons are "out," the T/R relay is locked out, leaving the amplifier in standby condition. Actuating K4 reduces the cathode bias applied via R115 to the +5.1 volts determined by zener diode D110. This operating bias level permits slight plate current flow under idling conditions in the SSB (high voltage) mode; the lower voltage applied for CW results in near-zero (cutoff) plate current in that mode.

Plate current is metered directly by M2. Grid current is measured across R116 in the grid return circuit, and high voltage is metered directly via precision multiplier resistors R107-R109.

Excessive plate current (as evidenced by abnormal voltage drop across R111) actuates overcurrent relay K7, which in turn trips out K1 just as if the OFF button had been pressed. Status-indicating meter lamps I1 through I4, which are controlled by Q103 and Q104, illuminate the meters amber when K6 is open (during the warm-up time delay interval) and when the external RELAY line is shorted so that the T/R relay is in the transmit condition. When the time delay relay is closed but the T/R relay is not actuated (amplifier in STANDBY and/or external RELAY line open), the green meter lamps illuminate, signifying "ready."

# SECTION 5 -- ILLUSTRATIONS

FIGURE 1 - Transformer Access & Location

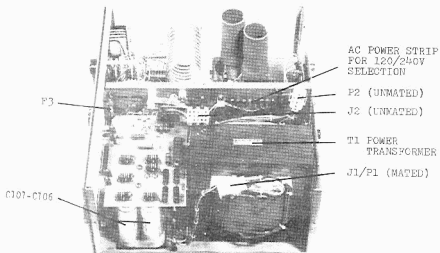


FIGURE 2 - Rear View

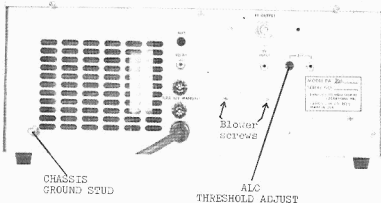
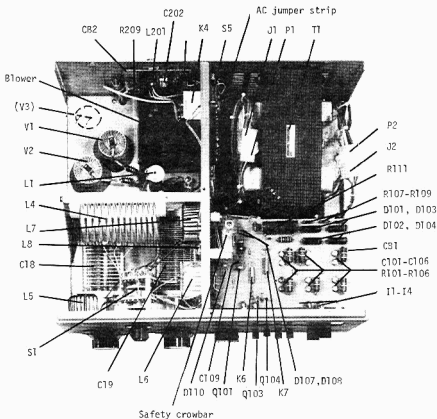
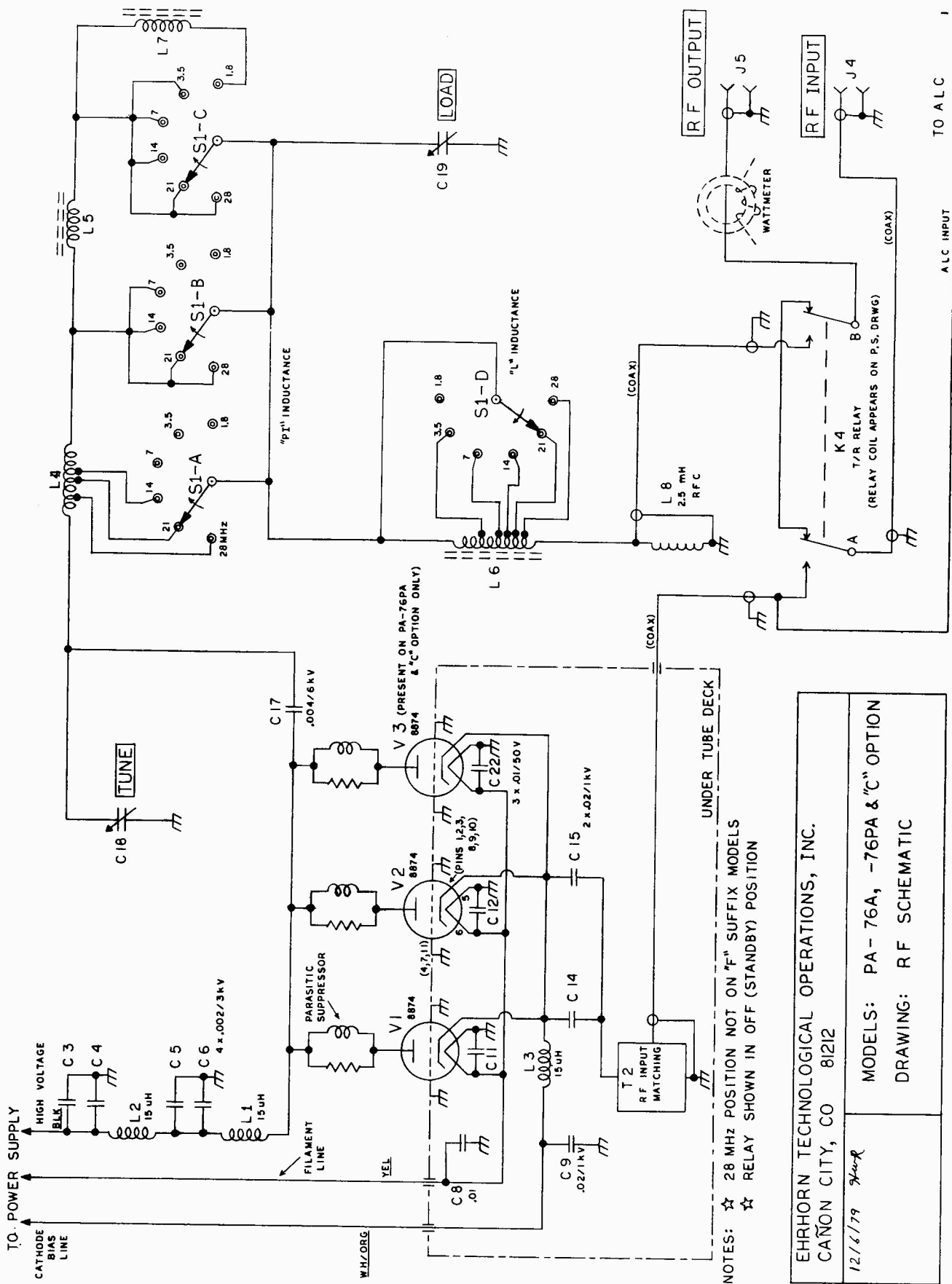




FIGURE 3 - Top View Showing Major Component Locations

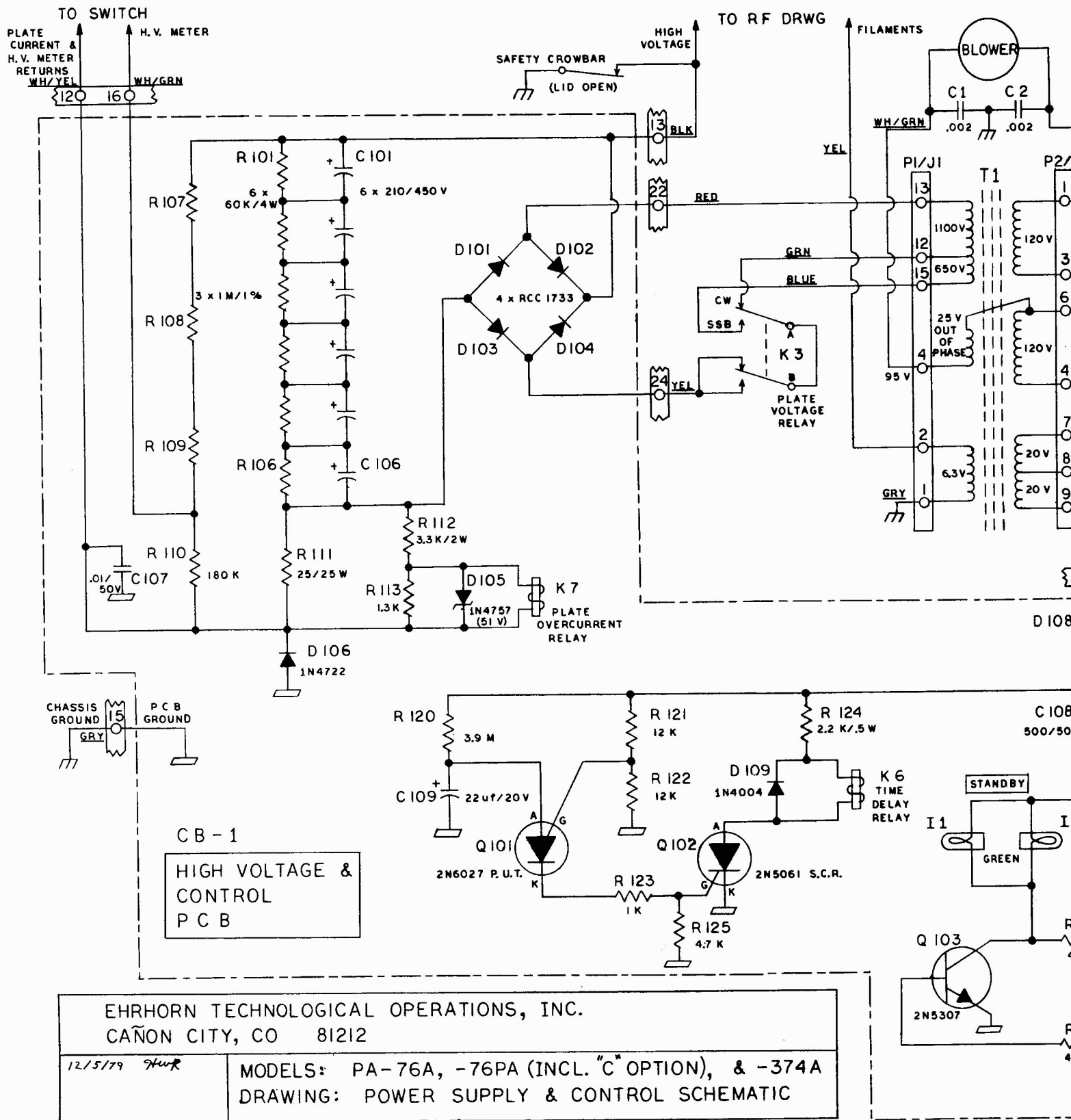














SECTION 6 -- STANDARD ELECTRICAL PARTS

<u>SYMBOL</u>	<u>DESCRIPTION</u>	<u>SYMBOL</u>	<u>DESCRIPTION</u>
B1	Howard #3-90-8507	L1-L3	15uhy/1A rf choke
C1, C2	.002uf/1KV disc ceramic	L8	1 to 2.5 mhy rf choke
C3-C6	.002uf/3KV disc ceramic	L202	1 mhy miniature rfc
C9,C14,C15	.02uf/1KV disc ceramic	Q101	2N6027 P.U.T.
C17	2 each .002uf/6KV disc	Q102	2N5061 S.C.R.
C101-C106	180uf/450V computer grade electrolytic	Q103	2N5307 Darlington NPN
C108	500uf/50V electrolytic	Q104	2N3904 NPN or equivalent
C109	15uf/20V tantalum	RESISTORS: All are 1/4 watt, 5% composition or film as shown on schematics unless otherwise specified below.	
C201	18pf/1KV disc ceramic		
C202	2-8pf air trimmer		
C203	300pf dipped silver mica		
C206	10uf/50V electrolytic	R1,R2	10 ohm/12W wirewound
C209	27pf dipped silver mica	R4	10K ohm/ 12W wirewound
C210	100pf dipped silver mica	R107-R109	1M/1% 3/4W precision
Capacitors not listed: .01uf/50V disc		R111	25 ohm/25W wirewound
D101-D104	3KV PIV/0.5A CCS (RCC 1733)	R205-R209	5K trimpot, linear taper
D105	1N4757 (51V/1W zener)	S1	Centralab JV9034 modified
D106	1N4722 or 1N5404	S2-S4	8 station special ass'y
D110	1N4733 (5.1V/1W zener)	S5	Microswitch V3L-4-D8 or equivalent
D201-D203	1N4148 or 1N914B	V1,V2,V3	Eimac type 8874
Diodes not listed: 1N4004 or equivalent		ALL COMPONENTS SUBJECT TO CHANGE WITHOUT NOTICE. COMPONENTS NOT LISTED ARE SPECIALS AVAILABLE THROUGH ETO. PLEASE SPECIFY MODEL AND SERIAL NUMBER OF AMPLIFIER, PLUS CIRCUIT SYMBOL OR DESCRIPTION AS ABOVE WHEN ORDERING REPLACEMENT PARTS.	
F1,F2	10A/250V, 3AB or ABC types (76CA only, 15A)		
F3	1-1/2A, slo-blo type MDL		
I1-I4	GE #85 push-in lamp		
K1	DPST/120VAC coil, Guardian 1390-2C-120A or equivalent	1279	
K2	DPST/24VDC coil, Guardian 1395-2C-24D or equivalent		
K3	KV relay, 24 VDC coil; P-B PRD11DY0-24 or equivalent		
K4	DPDT/10A, 24VDC coil; Magnecraft W88 or equivalent		
K6	5VDC coil, form A contacts		
K7	24VDC coil, SPST N.O.		